
MongoDB Documentation

Release 2.4.6

MongoDB Documentation Project

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See [About MongoDB Documentation](#) (page 1091) for more information about the MongoDB Documentation project, this Manual and additional editions of this text.

Install MongoDB

1.1 Installation Guides

MongoDB runs on most platforms and supports 32-bit and 64-bit architectures. MongoDB is available as a binary, or as a package. In production environments, use 64-bit MongoDB binaries. Choose your platform below:

1.1.1 Install MongoDB on Red Hat Enterprise, CentOS, or Fedora Linux

Synopsis

This tutorial outlines the basic installation process for deploying *MongoDB* on Red Hat Enterprise Linux, CentOS Linux, Fedora Linux and related systems. This procedure uses `.rpm` packages as the basis of the installation. MongoDB releases are available as `.rpm` packages for easy installation and management for users of CentOS, Fedora and Red Hat Enterprise Linux systems. While some of these distributions include their own MongoDB packages, the official packages are generally more up to date.

This tutorial includes: an overview of the available packages, instructions for configuring the package manager, the process install packages from the MongoDB downloads repository, and preliminary MongoDB configuration and operation.

See

Additional installation tutorials:

- <http://docs.mongodb.org/manual/tutorial/install-mongodb-on-debian-or-ubuntu-linux>
 - *Install MongoDB on Debian* (page 9)
 - *Install MongoDB on Ubuntu* (page 6)
 - *Install MongoDB on Linux* (page 11)
 - *Install MongoDB on OS X* (page 13)
 - *Install MongoDB on Windows* (page 16)
-

Package Options

The MongoDB downloads repository contains two packages:

- mongo-10gen-server

This package contains the `mongod` (page 925) and `mongos` (page 938) daemons from the latest **stable** release and associated configuration and init scripts. Additionally, you can use this package to *install daemons from a previous release* (page 4) of MongoDB.

- mongo-10gen

This package contains all MongoDB tools from the latest **stable** release. Additionally, you can use this package to *install tools from a previous release* (page 4) of MongoDB. Install this package on all production MongoDB hosts and optionally on other systems from which you may need to administer MongoDB systems.

Install MongoDB

Configure Package Management System (YUM)

Create a `/etc/yum.repos.d/mongodb.repo` file to hold the following configuration information for the MongoDB repository:

If you are running a 64-bit system, which is recommended, use the following configuration:

```
[mongodb]
name=MongoDB Repository
baseurl=http://downloads-distro.mongodb.org/repo/redhat/os/x86_64/
gpgcheck=0
enabled=1
```

If you are running a 32-bit system, which is not recommended for production deployments, use the following configuration:

```
[mongodb]
name=MongoDB Repository
baseurl=http://downloads-distro.mongodb.org/repo/redhat/os/i686/
gpgcheck=0
enabled=1
```

Install Packages

Issue the following command (as `root` or with `sudo`) to install the latest stable version of MongoDB and the associated tools:

```
yum install mongo-10gen mongo-10gen-server
```

When this command completes, you have successfully installed MongoDB!

Manage Installed Versions

You can use the `mongo-10gen` and `mongo-10gen-server` packages to install previous releases of MongoDB. To install a specific release, append the version number, as in the following example:

```
yum install mongo-10gen-2.2.3 mongo-10gen-server-2.2.3
```

This installs the `mongo-10gen` and `mongo-10gen-server` packages with the `2.2.3` release. You can specify any available version of MongoDB; however yum **will** upgrade the `mongo-10gen` and `mongo-10gen-server` packages when a newer version becomes available. Use the following *pinning* procedure to prevent unintended upgrades.

To pin a package, add the following line to your `/etc/yum.conf` file:

```
exclude=mongo-10gen,mongo-10gen-server
```

Configure MongoDB

These packages configure MongoDB using the `/etc/mongod.conf` file in conjunction with the *control script*. You can find the init script at `/etc/rc.d/init.d/mongod`.

This MongoDB instance will store its data files in the `/var/lib/mongo` and its log files in `/var/log/mongo`, and run using the `mongod` user account.

Note: If you change the user that runs the MongoDB process, you will need to modify the access control rights to the `/var/lib/mongo` and `/var/log/mongo` directories.

Control MongoDB

Warning: With the introduction of `systemd` in Fedora 15, the control scripts included in the packages available in the MongoDB downloads repository are not compatible with Fedora systems. A correction is forthcoming, see [SERVER-7285^a](#) for more information, and in the mean time use your own control scripts *or* install using the procedure outlined in [Install MongoDB on Linux](#) (page 11).

^a<https://jira.mongodb.org/browse/SERVER-7285>

Start MongoDB

Start the `mongod` (page 925) process by issuing the following command (as root, or with `sudo`):

```
service mongod start
```

You can verify that the `mongod` (page 925) process has started successfully by checking the contents of the log file at `/var/log/mongo/mongod.log`.

You may optionally, ensure that MongoDB will start following a system reboot, by issuing the following command (with root privileges:)

```
chkconfig mongod on
```

Stop MongoDB

Stop the `mongod` (page 925) process by issuing the following command (as root, or with `sudo`):

```
service mongod stop
```

Restart MongoDB

You can restart the `mongod` (page 925) process by issuing the following command (as root, or with `sudo`):

```
service mongod restart
```

Follow the state of this process by watching the output in the `/var/log/mongo/mongod.log` file to watch for errors or important messages from the server.

Control mongos

As of the current release, there are no *control scripts* for `mongos` (page 938). `mongos` (page 938) is only used in sharding deployments and typically do not run on the same systems where `mongod` (page 925) runs. You can use the `mongodb` script referenced above to derive your own `mongos` (page 938) control script.

SELinux Considerations

You must SELinux to allow MongoDB to start on Fedora systems. Administrators have two options:

- enable access to the relevant ports (e.g. 27017) for SELinux. See *Configuration Options* (page 239) for more information on MongoDB's default ports.
- disable SELinux entirely. This requires a system reboot and may have larger implications for your deployment.

Using MongoDB

Among the tools included in the `mongo-10gen` package, is the `mongo` (page 942) shell. You can connect to your MongoDB instance by issuing the following command at the system prompt:

```
mongo
```

This will connect to the database running on the localhost interface by default. At the `mongo` (page 942) prompt, issue the following two commands to insert a record in the “test” *collection* of the (default) “test” database and then retrieve that document.

```
db.test.save( { a: 1 } )
db.test.find()
```

See also:

`mongo` (page 942) and *mongo Shell Methods* (page 806)

1.1.2 Install MongoDB on Ubuntu

Synopsis

This tutorial outlines the basic installation process for installing *MongoDB* on Ubuntu Linux systems. This tutorial uses `.deb` packages as the basis of the installation. MongoDB releases are available as `.deb` packages for easy installation and management for users of Ubuntu. Although Ubuntu does include MongoDB packages, the official packages are generally more up to date.

This tutorial includes: an overview of the available packages, instructions for configuring the package manager, the process for installing packages from the MongoDB downloads repository, and preliminary MongoDB configuration and operation.

Note: If you use an older Ubuntu that does **not** use Upstart, (i.e. any version before 9.10 “Karmic”) please follow the instructions on the *Install MongoDB on Debian* (page 9) tutorial.

See

Additional installation tutorials:

- [Install MongoDB on Red Hat Enterprise, CentOS, or Fedora Linux](#) (page 3)
 - [Install MongoDB on Debian](#) (page 9)
 - [Install MongoDB on Linux](#) (page 11)
 - [Install MongoDB on OS X](#) (page 13)
 - [Install MongoDB on Windows](#) (page 16)
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Package Options

The MongoDB downloads repository provides the `mongodb-10gen` package, which contains the latest **stable** release. Additionally you can [install previous releases](#) (page 7) of MongoDB.

You cannot install this package concurrently with the `mongodb`, `mongodb-server`, or `mongodb-clients` packages provided by Ubuntu.

Install MongoDB

Configure Package Management System (APT)

The Ubuntu package management tool (i.e. `dpkg` and `apt`) ensure package consistency and authenticity by requiring that distributors sign packages with GPG keys. Issue the following command to import the [MongoDB public GPG Key](#)¹:

```
sudo apt-key adv --keyserver hkp://keyserver.ubuntu.com:80 --recv 7F0CEB10
```

Create a `/etc/apt/sources.list.d/mongodb.list` file using the following command.

```
echo 'deb http://downloads-distro.mongodb.org/repo/ubuntu-upstart dist 10gen' | sudo tee /etc/apt/sou
```

Now issue the following command to reload your repository:

```
sudo apt-get update
```

Install Packages

Issue the following command to install the latest stable version of MongoDB:

```
sudo apt-get install mongodb-10gen
```

When this command completes, you have successfully installed MongoDB! Continue for configuration and start-up suggestions.

Manage Installed Versions

You can use the `mongodb-10gen` package to install previous versions of MongoDB. To install a specific release, append the version number to the package name, as in the following example:

¹<http://docs.mongodb.org/10gen-gpg-key.asc>

```
apt-get install mongodb-10gen=2.2.3
```

This will install the 2.2.3 release of MongoDB. You can specify any available version of MongoDB; however apt-get **will** upgrade the `mongodb-10gen` package when a newer version becomes available. Use the following *pinning* procedure to prevent unintended upgrades.

To pin a package, issue the following command at the system prompt to *pin* the version of MongoDB at the currently installed version:

```
echo "mongodb-10gen hold" | sudo dpkg --set-selections
```

Configure MongoDB

These packages configure MongoDB using the `/etc/mongodb.conf` file in conjunction with the *control script*. You will find the control script is at `/etc/init.d/mongodb`.

This MongoDB instance will store its data files in the `/var/lib/mongodb` and its log files in `/var/log/mongodb`, and run using the `mongodb` user account.

Note: If you change the user that runs the MongoDB process, you will need to modify the access control rights to the `/var/lib/mongodb` and `/var/log/mongodb` directories.

Controlling MongoDB

Starting MongoDB

You can start the `mongod` (page 925) process by issuing the following command:

```
sudo service mongodb start
```

You can verify that `mongod` (page 925) has started successfully by checking the contents of the log file at `/var/log/mongodb/mongod.log`.

Stopping MongoDB

As needed, you may stop the `mongod` (page 925) process by issuing the following command:

```
sudo service mongodb stop
```

Restarting MongoDB

You may restart the `mongod` (page 925) process by issuing the following command:

```
sudo service mongodb restart
```

Controlling mongos

As of the current release, there are no *control scripts* for `mongos` (page 938). `mongos` (page 938) is only used in sharding deployments and typically do not run on the same systems where `mongod` (page 925) runs. You can use the `mongodb` script referenced above to derive your own `mongos` (page 938) control script.

Using MongoDB

Among the tools included with the MongoDB package, is the [mongo](#) (page 942) shell. You can connect to your MongoDB instance by issuing the following command at the system prompt:

```
mongo
```

This will connect to the database running on the localhost interface by default. At the [mongo](#) (page 942) prompt, issue the following two commands to insert a record in the “test” *collection* of the (default) “test” database.

```
db.test.save( { a: 1 } )
db.test.find()
```

See also:

[mongo](#) (page 942) and [mongo Shell Methods](#) (page 806)

1.1.3 Install MongoDB on Debian

Synopsis

This tutorial outlines the basic installation process for installing [MongoDB](#) on Debian systems, using .deb packages as the basis of the installation. MongoDB releases are available as .deb packages for easy installation and management for users of Debian. While some Debian distributions include their own MongoDB packages, the official packages are generally more up to date.

This tutorial includes: an overview of the available packages, instructions for configuring the package manager, the process for installing packages from the MongoDB downloads repository, and preliminary MongoDB configuration and operation.

Note: This tutorial applies to both Debian systems and versions of Ubuntu Linux prior to 9.10 “Karmic” which do not use Upstart. Other Ubuntu users will want to follow the [Install MongoDB on Ubuntu](#) (page 6) tutorial.

See

Additional installation tutorials:

- [Install MongoDB on Red Hat Enterprise, CentOS, or Fedora Linux](#) (page 3)
 - [Install MongoDB on Ubuntu](#) (page 6)
 - [Install MongoDB on Linux](#) (page 11)
 - [Install MongoDB on OS X](#) (page 13)
 - [Install MongoDB on Windows](#) (page 16)
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Package Options

The downloads repository provides the `mongodb-10gen` package, which contains the latest **stable** release. Additionally you can [install previous releases](#) (page 10) of MongoDB.

You cannot install this package concurrently with the `mongodb`, `mongodb-server`, or `mongodb-clients` packages that your release of Debian may include.

Install MongoDB

Configure Package Management System (APT)

The Debian package management tool (i.e. `dpkg` and `apt`) ensure package consistency and authenticity by requiring that distributors sign packages with GPG keys. Issue the following command to import the [MongoDB public GPG Key](#)²:

```
sudo apt-key adv --keyserver keyserver.ubuntu.com --recv 7F0CEB10
```

Create a `/etc/apt/sources.list.d/mongodb.list` file using the following command.

```
echo 'deb http://downloads-distro.mongodb.org/repo/debian-sysvinit dist 10gen' | sudo tee /etc/apt/so
```

Now issue the following command to reload your repository:

```
sudo apt-get update
```

Install Packages

Issue the following command to install the latest stable version of MongoDB:

```
sudo apt-get install mongodb-10gen
```

When this command completes, you have successfully installed MongoDB!

Manage Installed Versions

You can use the `mongodb-10gen` package to install previous versions of MongoDB. To install a specific release, append the version number to the package name, as in the following example:

```
apt-get install mongodb-10gen=2.2.3
```

This will install the 2.2.3 release of MongoDB. You can specify any available version of MongoDB; however `apt-get` **will** upgrade the `mongodb-10gen` package when a newer version becomes available. Use the following *pinning* procedure to prevent unintended upgrades.

To pin a package, issue the following command at the system prompt to *pin* the version of MongoDB at the currently installed version:

```
echo "mongodb-10gen hold" | sudo dpkg --set-selections
```

Configure MongoDB

These packages configure MongoDB using the `/etc/mongodb.conf` file in conjunction with the *control script*. You can find the control script at `/etc/init.d/mongodb`.

This MongoDB instance will store its data files in the `/var/lib/mongodb` and its log files in `/var/log/mongodb`, and run using the `mongodb` user account.

Note: If you change the user that runs the MongoDB process, you will need to modify the access control rights to the `/var/lib/mongodb` and `/var/log/mongodb` directories.

²<http://docs.mongodb.org/10gen-gpg-key.asc>

Controlling MongoDB

Starting MongoDB

Issue the following command to start `mongod` (page 925):

```
sudo /etc/init.d/mongodb start
```

You can verify that `mongod` (page 925) has started successfully by checking the contents of the log file at `/var/log/mongodb/mongod.log`.

Stopping MongoDB

Issue the following command to stop `mongod` (page 925):

```
sudo /etc/init.d/mongodb stop
```

Restarting MongoDB

Issue the following command to restart `mongod` (page 925):

```
sudo /etc/init.d/mongodb restart
```

Controlling `mongos`

As of the current release, there are no *control scripts* for `mongos` (page 938). `mongos` (page 938) is only used in sharding deployments and typically do not run on the same systems where `mongod` (page 925) runs. You can use the `mongodb` script referenced above to derive your own `mongos` (page 938) control script.

Using MongoDB

Among the tools included with the MongoDB package, is the `mongo` (page 942) shell. You can connect to your MongoDB instance by issuing the following command at the system prompt:

```
mongo
```

This will connect to the database running on the localhost interface by default. At the `mongo` (page 942) prompt, issue the following two commands to insert a record in the “test” *collection* of the (default) “test” database.

```
db.test.save( { a: 1 } )
db.test.find()
```

See also:

`mongo` (page 942) and *mongo Shell Methods* (page 806)

1.1.4 Install MongoDB on Linux

Synopsis

Compiled versions of *MongoDB* for use on Linux provide a simple option for users who cannot use packages. This tutorial outlines the basic installation of MongoDB using these compiled versions and an initial usage guide.

See

Additional installation tutorials:

- [Install MongoDB on Red Hat Enterprise, CentOS, or Fedora Linux](#) (page 3)
 - [Install MongoDB on Ubuntu](#) (page 6)
 - [Install MongoDB on Debian](#) (page 9)
 - [Install MongoDB on OS X](#) (page 13)
 - [Install MongoDB on Windows](#) (page 16)
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Download MongoDB

Note: You should place the MongoDB binaries in a central location on the file system that is easy to access and control. Consider `http://docs.mongodb.org/manual/pt or /usr/local/bin`.

In a terminal session, begin by downloading the latest release. In most cases you will want to download the 64-bit version of MongoDB.

```
curl http://downloads.mongodb.org/linux/mongodb-linux-x86_64-2.4.6.tgz > mongodb.tgz
```

If you need to run the 32-bit version, use the following command.

```
curl http://downloads.mongodb.org/linux/mongodb-linux-i686-2.4.6.tgz > mongodb.tgz
```

Once you've downloaded the release, issue the following command to extract the files from the archive:

```
tar -zxvf mongodb.tgz
```

Optional

You may use the following command to copy the extracted folder into a more generic location.

```
cp -R -n mongodb-linux-????-??-??/ mongodb
```

You can find the [mongod](#) (page 925) binary, and the binaries all of the associated MongoDB utilities, in the `bin/` directory within the extracted directory.

Using MongoDB

Before you start [mongod](#) (page 925) for the first time, you will need to create the data directory. By default, [mongod](#) (page 925) writes data to the `/data/db/` directory. To create this directory, use the following command:

```
mkdir -p /data/db
```

Note: Ensure that the system account that will run the [mongod](#) (page 925) process has read and write permissions to this directory. If [mongod](#) (page 925) runs under the `mongodb` user account, issue the following command to change the owner of this folder:

```
chown mongodb /data/db
```

If you use an alternate location for your data directory, ensure that this user can write to your chosen data path.

You can specify, and create, an alternate path using the `--dbpath` option to [mongod](#) (page 925) and the above command.

The official builds of MongoDB contain no *control scripts* or method to control the [mongod](#) (page 925) process. You may wish to create control scripts, modify your path, and/or create symbolic links to the MongoDB programs in your `/usr/local/bin` or `/usr/bin` directory for easier use.

For testing purposes, you can start a [mongod](#) (page 925) directly in the terminal without creating a control script:

```
mongod --config /etc/mongod.conf
```

Note: This command assumes that the [mongod](#) (page 925) binary is accessible via your system's search path. You may use modified form to invoke any [mongod](#) (page 925) binary. Furthermore, the command assumes that you have created a default configuration file located at `/etc/mongod.conf`. See [Run-time Database Configuration](#) (page 145) for more information on the format of configuration files.

You must [mongod](#) (page 925) with a user account that has read and write permissions to the `dbpath` (page 993).

Among the tools included with this MongoDB distribution, is the [mongo](#) (page 942) shell. You can use this shell to connect to your MongoDB instance by issuing the following command at the system prompt:

```
./bin/mongo
```

Note: The `./bin/mongo` command assumes that the [mongo](#) (page 942) binary is in the `bin/` sub-directory of the current directory. This is the directory into which you extracted the `.tgz` file.

This will connect to the database running on the localhost interface by default. At the [mongo](#) (page 942) prompt, issue the following two commands to insert a record in the “test” *collection* of the (default) “test” database and then retrieve that record:

```
db.test.save( { a: 1 } )
db.test.find()
```

See also:

[mongo](#) (page 942) and [mongo Shell Methods](#) (page 806)

1.1.5 Install MongoDB on OS X

Platform Support

MongoDB only supports OS X versions 10.6 (Snow Leopard) and later.

Changed in version 2.4.

Synopsis

This tutorial outlines the basic installation process for deploying [MongoDB](#) on Macintosh OS X systems. This tutorial provides two main methods of installing the MongoDB server (i.e. [mongod](#) (page 925)) and associated tools: first using the official MongoDB builds, and second using community package management tools.

See

Additional installation tutorials:

- [Install MongoDB on Red Hat Enterprise, CentOS, or Fedora Linux](#) (page 3)
 - [Install MongoDB on Ubuntu](#) (page 6)
 - [Install MongoDB on Debian](#) (page 9)
 - [Install MongoDB on Linux](#) (page 11)
 - [Install MongoDB on Windows](#) (page 16)
-

Install from Official Builds

Download MongoDB

In a terminal session, begin by downloading the latest release. Use the following command at the system prompt:

```
curl http://downloads.mongodb.org/osx/mongodb-osx-x86_64-2.4.6.tgz > mongodb.tgz
```

Note: The [mongod](#) (page 925) process will not run on older Macintosh computers with PowerPC (i.e. non-Intel) processors.

Once you've downloaded the release, issue the following command to extract the files from the archive:

```
tar -zxvf mongodb.tgz
```

Optional

You may use the following command to move the extracted folder into a more generic location.

```
mv -n mongodb-osx-[platform]-[version] / /path/to/new/location/
```

Replace [platform] with i386 or x86_64 depending on your system and the version you downloaded, and [version] with 2.4 or the version of MongoDB that you are installing.

You can find the [mongod](#) (page 925) binary, and the binaries all of the associated MongoDB utilities, in the bin/ directory within the archive.

Use MongoDB from Official Builds

Before you start [mongod](#) (page 925) for the first time, you will need to create the data directory. By default, [mongod](#) (page 925) writes data to the /data/db/ directory. To create this directory, and set the appropriate permissions use the following commands:

```
sudo mkdir -p /data/db  
sudo chown `id -u` /data/db
```

You can specify an alternate path for data files using the --dbpath option to [mongod](#) (page 925).

The official MongoDB builds contain no [control scripts](#) or method to control the [mongod](#) (page 925) process. You may wish to create control scripts, modify your path, and/or create symbolic links to the MongoDB programs in your /usr/local/bin directory for easier use.

For testing purposes, you can start a [mongod](#) (page 925) directly in the terminal without creating a control script:

```
mongod --config /etc/mongod.conf
```

Note: This command assumes that the [mongod](#) (page 925) binary is accessible via your system's search path. You may use modified form to invoke any [mongod](#) (page 925) binary. Furthermore, the command assumes that you have created a default configuration file located at `/etc/mongod.conf`.

See [Run-time Database Configuration](#) (page 145) for more information on the format of configuration files.

Among the tools included with this MongoDB distribution, is the [mongo](#) (page 942) shell. You can use this shell to connect to your MongoDB instance by issuing the following command at the system prompt from inside of the directory where you extracted [mongo](#) (page 942):

```
./bin/mongo
```

Note: The `./bin/mongo` command assumes that the [mongo](#) (page 942) binary is in the `bin/` sub-directory of the current directory. This is the directory into which you extracted the `.tgz` file.

This will connect to the database running on the localhost interface by default. At the [mongo](#) (page 942) prompt, issue the following two commands to insert a record in the “test” [collection](#) of the (default) “test” database and then retrieve that record:

```
db.test.save( { a: 1 } )
db.test.find()
```

See also:

[mongo](#) (page 942) and [mongo Shell Methods](#) (page 806)

Install with Package Management

Both community package management tools: [Homebrew](#)³ and [MacPorts](#)⁴ require some initial setup and configuration. This configuration is beyond the scope of this document. You only need to use one of these tools.

If you want to use package management, and do not already have a system installed, Homebrew is typically easier and simpler to use.

Homebrew

Homebrew installs binary packages based on published “formula.” Issue the following command at the system shell to update the `brew` package manager:

```
brew update
```

Use the following command to install the MongoDB package into your Homebrew system.

```
brew install mongodb
```

Later, if you need to upgrade MongoDB, you can issue the following sequence of commands to update the MongoDB installation on your system:

```
brew update
brew upgrade mongodb
```

³<http://mxcl.github.com/homebrew/>

⁴<http://www.macports.org/>

MacPorts

MacPorts distributes build scripts that allow you to easily build packages and their dependencies on your own system. The compilation process can take significant period of time depending on your system's capabilities and existing dependencies. Issue the following command in the system shell:

```
port install mongodb
```

Using MongoDB from Homebrew and MacPorts

The packages installed with Homebrew and MacPorts contain no *control scripts* or interaction with the system's process manager.

If you have configured Homebrew and MacPorts correctly, including setting your PATH, the MongoDB applications and utilities will be accessible from the system shell. Start the `mongod` (page 925) process in a terminal (for testing or development) or using a process management tool.

```
mongod
```

Then open the `mongo` (page 942) shell by issuing the following command at the system prompt:

```
mongo
```

This will connect to the database running on the localhost interface by default. At the `mongo` (page 942) prompt, issue the following two commands to insert a record in the “test” *collection* of the (default) “test” database and then retrieve that record.

```
> db.test.save( { a: 1 } )
> db.test.find()
```

See also:

`mongo` (page 942) and *mongo Shell Methods* (page 806)

1.1.6 Install MongoDB on Windows

Synopsis

This tutorial provides a method for installing and running the MongoDB server (i.e. `mongod.exe` (page 948)) on the Microsoft Windows platform through the *Command Prompt* and outlines the process for setting up MongoDB as a *Windows Service*.

Operating MongoDB with Windows is similar to MongoDB on other platforms. Most components share the same operational patterns.

Procedure

Important: If you are running any edition of Windows Server 2008 R2 or Windows 7, please install a hotfix to resolve an issue with memory mapped files on Windows⁵.

⁵<http://support.microsoft.com/kb/2731284>

Download MongoDB for Windows

Download the latest production release of MongoDB from the [MongoDB downloads page](#)⁶.

There are three builds of MongoDB for Windows:

- MongoDB for Windows Server 2008 R2 edition (i.e. 2008R2) only runs on Windows Server 2008 R2, Windows 7 64-bit, and newer versions of Windows. This build takes advantage of recent enhancements to the Windows Platform and cannot operate on older versions of Windows.
- MongoDB for Windows 64-bit runs on any 64-bit version of Windows newer than Windows XP, including Windows Server 2008 R2 and Windows 7 64-bit.
- MongoDB for Windows 32-bit runs on any 32-bit version of Windows newer than Windows XP. 32-bit versions of MongoDB are only intended for older systems and for use in testing and development systems.

Changed in version 2.2: MongoDB does not support Windows XP. Please use a more recent version of Windows to use more recent releases of MongoDB.

Note: Always download the correct version of MongoDB for your Windows system. The 64-bit versions of MongoDB will not work with 32-bit Windows.

32-bit versions of MongoDB are suitable only for testing and evaluation purposes and only support databases smaller than 2GB.

You can find the architecture of your version of Windows platform using the following command in the *Command Prompt*:

```
wmic os get osarchitecture
```

In Windows Explorer, find the MongoDB download file, typically in the default Downloads directory. Extract the archive to C:\ by right clicking on the archive and selecting *Extract All* and browsing to C:\.

Note: The folder name will be either:

```
C:\mongodb-win32-i386-[version]
```

Or:

```
C:\mongodb-win32-x86_64-[version]
```

In both examples, replace [version] with the version of MongoDB downloaded.

Set up the Environment

Start the *Command Prompt* by selecting the *Start Menu*, then *All Programs*, then *Accessories*, then right click *Command Prompt*, and select *Run as Administrator* from the popup menu. In the *Command Prompt*, issue the following commands:

```
cd \
move C:\mongodb-win32-* C:\mongodb
```

Note: MongoDB is self-contained and does not have any other system dependencies. You can run MongoDB from any folder you choose. You may install MongoDB in any directory (e.g. D:\test\mongodb)

⁶<http://www.mongodb.org/downloads>

MongoDB requires a *data folder* to store its files. The default location for the MongoDB data directory is C:\data\db. Create this folder using the *Command Prompt*. Issue the following command sequence:

```
md data  
md data\db
```

Note: You may specify an alternate path for \data\db with the dbpath (page 993) setting for mongod.exe (page 948), as in the following example:

```
C:\mongodb\bin\mongod.exe --dbpath d:\test\mongodb\data
```

If your path includes spaces, enclose the entire path in double quotations, for example:

```
C:\mongodb\bin\mongod.exe --dbpath "d:\test\mongo db data"
```

Start MongoDB

To start MongoDB, execute from the *Command Prompt*:

```
C:\mongodb\bin\mongod.exe
```

This will start the main MongoDB database process. The waiting for connections message in the console output indicates that the mongod.exe process is running successfully.

Note: Depending on the security level of your system, Windows will issue a *Security Alert* dialog box about blocking “some features” of C:\\mongodb\\bin\\mongod.exe from communicating on networks. All users should select Private Networks, such as my home or work network and click Allow access. For additional information on security and MongoDB, please read the *Security Concepts* (page 237) page.

Warning: Do not allow mongod.exe (page 948) to be accessible to public networks without running in “Secure Mode” (i.e. auth (page 993).) MongoDB is designed to be run in “trusted environments” and the database does not enable authentication or “Secure Mode” by default.

Connect to MongoDB using the mongo.exe (page 942) shell. Open another *Command Prompt* and issue the following command:

```
C:\mongodb\bin\mongo.exe
```

Note: Executing the command start C:\\mongodb\\bin\\mongo.exe will automatically start the mongo.exe shell in a separate *Command Prompt* window.

The mongo.exe (page 942) shell will connect to mongod.exe (page 948) running on the localhost interface and port 27017 by default. At the mongo.exe (page 942) prompt, issue the following two commands to insert a record in the test collection of the default test database and then retrieve that record:

```
db.test.save( { a: 1 } )  
db.test.find()
```

See also:

mongo (page 942) and mongo Shell Methods (page 806). If you want to develop applications using .NET, see the documentation of C# and MongoDB⁷ for more information.

⁷<http://docs.mongodb.org/ecosystem/drivers/csharp>

MongoDB as a Windows Service

New in version 2.0.

Setup MongoDB as a *Windows Service*, so that the database will start automatically following each reboot cycle.

Note: `mongod.exe` (page 948) added support for running as a Windows service in version 2.0, and `mongos.exe` (page 950) added support for running as a Windows Service in version 2.1.1.

Configure the System

You should specify two options when running MongoDB as a Windows Service: a path for the log output (i.e. `logpath` (page 992)) and a *configuration file* (page 990).

1. Create a specific directory for MongoDB log files:

```
md C:\mongodb\log
```

2. Create a configuration file for the `logpath` (page 992) option for MongoDB in the *Command Prompt* by issuing this command:

```
echo logpath=C:\mongodb\log\mongo.log > C:\mongodb\mongod.cfg
```

While these optional steps are optional, creating a specific location for log files and using the configuration file are good practice.

Note: Consider setting the `logappend` (page 992) option. If you do not, `mongod.exe` (page 948) will delete the contents of the existing log file when starting.

Changed in version 2.2: The default `logpath` (page 992) and `logappend` (page 992) behavior changed in the 2.2 release.

Install and Run the MongoDB Service

Run all of the following commands in *Command Prompt* with “Administrative Privileges.”

1. To install the MongoDB service:

```
C:\mongodb\bin\mongod.exe --config C:\mongodb\mongod.cfg --install
```

Modify the path to the `mongod.cfg` file as needed. For the `--install` option to succeed, you *must* specify a `logpath` (page 992) setting or the `--logpath` run-time option.

2. To run the MongoDB service:

```
net start MongoDB
```

Note: If you wish to use an alternate path for your `dbpath` (page 993) specify it in the config file (e.g. `C:\mongodb\mongod.cfg`) on that you specified in the `--install` operation. You may also specify `--dbpath` on the command line; however, always prefer the configuration file.

If the `dbpath` (page 993) directory does not exist, `mongod.exe` (page 948) will not be able to start. The default value for `dbpath` (page 993) is `\data\db`.

Stop or Remove the MongoDB Service

- To stop the MongoDB service:

```
net stop MongoDB
```

- To remove the MongoDB service:

```
C:\mongodb\bin\mongod.exe --remove
```

1.1.7 Install MongoDB Enterprise

New in version 2.2.

MongoDB Enterprise⁸ is available on four platforms and contains support for several features related to security and monitoring.

Required Packages

Changed in version 2.4.4: MongoDB Enterprise uses Cyrus SASL instead of GNU SASL. Earlier 2.4 Enterprise versions use GNU SASL (`libgsasl`) instead. For required packages for the earlier 2.4 versions, see [Earlier 2.4 Versions](#) (page 20).

To use MongoDB Enterprise, you must install several prerequisites. The names of the packages vary by distribution and are as follows:

- Debian or Ubuntu 12.04 require: `libssl0.9.8`, `snmp`, `snmpd`, `cyrus-sasl2-dbg`, `cyrus-sasl2-mit-dbg`, `libsasl2-2`, `libsasl2-dev`, `libsasl2-modules`, and `libsasl2-modules-gssapi-mit`. Issue a command such as the following to install these packages:

```
sudo apt-get install libssl0.9.8 snmp snmpd cyrus-sasl2-dbg cyrus-sasl2-mit-dbg libsasl2-2 libsasl2-dev libsasl2-modules-gssapi-mit
```

- CentOS and Red Hat Enterprise Linux 6.x and 5.x, as well as Amazon Linux AMI require: `net-snmp`, `net-snmp-libs`, `openssl`, `net-snmp-utils`, `cyrus-sasl`, `cyrus-sasl-lib`, `cyrus-sasl-devel`, and `cyrus-sasl-gssapi`. Issue a command such as the following to install these packages:

```
sudo yum install openssl net-snmp net-snmp-libs net-snmp-utils cyrus-sasl cyrus-sasl-lib cyrus-sasl-devel cyrus-sasl-gssapi
```

- SUSE Enterprise Linux requires `libopenssl10_9_8`, `libsntp15`, `slessp1-libsntp15`, `snmp-mibs`, `cyrus-sasl`, `cyrus-sasl-devel`, and `cyrus-sasl-gssapi`. Issue a command such as the following to install these packages:

```
sudo zypper install libopenssl10_9_8 libsntp15 slessp1-libsntp15 snmp-mibs cyrus-sasl cyrus-sasl-devel cyrus-sasl-gssapi
```

Earlier 2.4 Versions

Before version 2.4.4, the 2.4 versions of MongoDB Enterprise use `libgsasl`⁹. The required packages for the different distributions are as follows:

- Ubuntu 12.04 requires `libssl0.9.8`, `libgsasl`, `snmp`, and `snmpd`. Issue a command such as the following to install these packages:

⁸<http://www.mongodb.com/products/mongodb-enterprise>

⁹<http://www.gnu.org/software/gsasl/>

```
sudo apt-get install libssl0.9.8 libgsasl17 snmp snmpd
```

- Red Hat Enterprise Linux 6.x series and Amazon Linux AMI require `openssl`, `libgsasl17`, `net-snmp`, `net-snmp-libs`, and `net-snmp-utils`. To download `libgsasl` you must enable the EPEL repository by issuing the following sequence of commands to add and update the system repositories:

```
sudo rpm -ivh http://download.fedoraproject.org/pub/epel/6/x86_64/epel-release-6-8.noarch.rpm
```

```
sudo yum update -y
```

When you have installed and updated the EPEL repositories, issue the following to install these packages:

```
sudo yum install openssl net-snmp net-snmp-libs net-snmp-utils libgsasl
```

- SUSE Enterprise Linux requires `libopenssl0_9_8`, `libsntp15`, `slessp1-libsntp15`, and `snmp-mibs`. Issue a command such as the following to install these packages:

```
sudo zypper install libopenssl0_9_8 libsnmp15 slessp1-libsntp15 snmp-mibs
```

Note: Before 2.4.4, MongoDB Enterprise 2.4 for SUSE requires `libgsasl`¹⁰ which is not available in the default repositories for SUSE.

Install MongoDB Enterprise Binaries

When you have installed the required packages, and downloaded the Enterprise packages¹¹ you can install the packages using the same procedure as a standard *installation of MongoDB on Linux Systems* (page 11).

Note: `.deb` and `.rpm` packages for Enterprise releases are available for some platforms. You can use these to install MongoDB directly using the `dpkg` and `rpm` utilities.

Download and Extract Package

Use the sequence of commands below to download and extract MongoDB Enterprise packages appropriate for your distribution:

Ubuntu 12.04

```
curl http://downloads.10gen.com/linux/mongodb-linux-x86_64-subscription-ubuntu1204-2.4.6.tgz > mongo
tar -zvxf mongo
cp -R -n mongo/mongodb-linux-x86_64-subscription-ubuntu1204-2.4.6/ mongodb
```

Red Hat Enterprise Linux 6.x

```
curl http://downloads.10gen.com/linux/mongodb-linux-x86_64-subscription-rhel62-2.4.6.tgz > mongo
tar -zvxf mongo
cp -R -n mongo/mongodb-linux-x86_64-subscription-rhel62-2.4.6/ mongodb
```

Amazon Linux AMI

¹⁰<http://www.gnu.org/software/gsasl/>

¹¹<http://www.mongodb.com/products/mongodb-enterprise>

```
curl http://downloads.10gen.com/linux/mongodb-linux-x86_64-subscription-amzn64-2.4.6.tgz > mongodb.tgz  
tar -zxvf mongodb.tgz  
cp -R -n mongodb-linux-x86_64-subscription-amzn64-2.4.6/ mongodb
```

SUSE Enterprise Linux

```
curl http://downloads.10gen.com/linux/mongodb-linux-x86_64-subscription-suse11-2.4.6.tgz > mongodb.tgz  
tar -zxvf mongodb.tgz  
cp -R -n mongodb-linux-x86_64-subscription-suse11-2.4.6/ mongodb
```

Running and Using MongoDB

Note: The Enterprise packages currently include an example SNMP configuration file named `mongod.conf`. This file is not a MongoDB configuration file.

Before you start `mongod` (page 925) for the first time, you will need to create the data directory. By default, `mongod` (page 925) writes data to the `/data/db/` directory. To create this directory, use the following command:

```
mkdir -p /data/db
```

Note: Ensure that the system account that will run the `mongod` (page 925) process has read and write permissions to this directory. If `mongod` (page 925) runs under the `mongodb` user account, issue the following command to change the owner of this folder:

```
chown mongodb /data/db
```

If you use an alternate location for your data directory, ensure that this user can write to your chosen data path.

You can specify, and create, an alternate path using the `--dbpath` option to `mongod` (page 925) and the above command.

The official builds of MongoDB contain no *control scripts* or method to control the `mongod` (page 925) process. You may wish to create control scripts, modify your path, and/or create symbolic links to the MongoDB programs in your `/usr/local/bin` or `/usr/bin` directory for easier use.

For testing purposes, you can start a `mongod` (page 925) directly in the terminal without creating a control script:

```
mongod --config /etc/mongod.conf
```

Note: This command assumes that the `mongod` (page 925) binary is accessible via your system's search path. You may use modified form to invoke any `mongod` (page 925) binary. Furthermore, the command assumes that you have created a default configuration file located at `/etc/mongod.conf`. See *Run-time Database Configuration* (page 145) for more information on the format of configuration files.

You must `mongod` (page 925) with a user account that has read and write permissions to the `dbpath` (page 993).

Among the tools included with this MongoDB distribution, is the `mongo` (page 942) shell. You can use this shell to connect to your MongoDB instance by issuing the following command at the system prompt:

```
./bin/mongo
```

Note: The `./bin/mongo` command assumes that the `mongo` (page 942) binary is in the `bin/` sub-directory of the current directory. This is the directory into which you extracted the `.tgz` file.

This will connect to the database running on the localhost interface by default. At the `mongo` (page 942) prompt, issue the following two commands to insert a record in the “test” *collection* of the (default) “test” database and then retrieve that record:

```
db.test.save( { a: 1 } )
db.test.find()
```

See also:

`mongo` (page 942) and *mongo Shell Methods* (page 806)

Further Reading

As you begin to use MongoDB, consider the *Getting Started with MongoDB* (page 26) and *MongoDB Tutorials* (page 177) resources. To read about features only available in MongoDB Enterprise, consider: *Monitor MongoDB with SNMP* (page 171) and *Deploy MongoDB with Kerberos Authentication* (page 259).

1.2 Upgrade MongoDB

1.2.1 Upgrade to the Latest Revision of MongoDB

Rewards provide security patches, bug fixes, and new or changed features that do not contain any backward breaking changes. Always upgrade to the latest revision in your release series. The third number in the *MongoDB version number* (page 1090) indicates the revision.

Before Upgrading

- Ensure you have an up-to-date backup of your data set. See *Backup Strategies for MongoDB Systems* (page 136).
- Consult the following documents for any special considerations or compatibility issues specific to your MongoDB release:
 - The release notes, located at *Release Notes* (page 1029).
 - The documentation for your driver. See *MongoDB Drivers and Client Libraries* (page 95).
- If your installation includes *replica sets*, plan the upgrade during a predefined maintenance window.
- Before you upgrade a production environment, use the procedures in this document to upgrade a *staging* environment that reproduces your production environment, to ensure that your production configuration is compatible with all changes.

Upgrade Procedure

Important: Always backup all of your data before upgrading MongoDB.

Upgrade each `mongod` (page 925) and `mongos` (page 938) binary separately, using the procedure described here. When upgrading a binary, use the procedure *Upgrade a MongoDB Instance* (page 24).

Follow this upgrade procedure:

1. For deployments that use authentication, first upgrade all of your MongoDB *drivers* (page 95). To upgrade, see the documentation for your driver.

2. Upgrade sharded clusters, as described in [Upgrade Sharded Clusters](#) (page 24).
3. Upgrade any standalone instances. See [Upgrade a MongoDB Instance](#) (page 24).
4. Upgrade any replica sets that are not part of a sharded cluster, as described in [Upgrade Replica Sets](#) (page 25).

Upgrade a MongoDB Instance

To upgrade a `mongod` (page 925) or `mongos` (page 938) instance, use one of the following approaches:

- Upgrade the instance using the operating system’s package management tool and the official MongoDB packages. This is the preferred approach. See [Install MongoDB](#) (page 3).
- Upgrade the instance by replacing the existing binaries with new binaries. See [Replace the Existing Binaries](#) (page 24).

Replace the Existing Binaries

Important: Always backup all of your data before upgrading MongoDB.

This section describes how to upgrade MongoDB by replacing the existing binaries. The preferred approach to an upgrade is to use the operating system’s package management tool and the official MongoDB packages, as described in [Install MongoDB](#) (page 3).

To upgrade a `mongod` (page 925) or `mongos` (page 938) instance by replacing the existing binaries:

1. Download the binaries for the latest MongoDB revision from the [MongoDB Download Page](#)¹² and store the binaries in a temporary location. The binaries download as compressed files that uncompress to the directory structure used by the MongoDB installation.
2. Shutdown the instance.
3. Replace the existing MongoDB binaries with the downloaded binaries.
4. Restart the instance.

Upgrade Sharded Clusters

To upgrade a sharded cluster:

1. Disable the cluster’s balancer, as described in [Disable the Balancer](#) (page 552).
2. Upgrade each `mongos` (page 938) instance by following the instructions below in [Upgrade a MongoDB Instance](#) (page 24). You can upgrade the `mongos` (page 938) instances in any order.
3. Upgrade each `mongod` (page 925) *config server* (page 502) individually starting with the last config server listed in your `mongos --configdb` string and working backward. To keep the cluster online, make sure at least one config server is always running. For each config server upgrade, follow the instructions below in [Upgrade a MongoDB Instance](#) (page 24)

...example:: Given the following config string:

```
mongos --configdb cfg0.example.net:27019,cfg1.example.net:27019,cfg2.example.net:27019
```

You would upgrade the config servers in the following order:

(a) cfg2.example.net

¹²<http://downloads.mongodb.org/>

- (b) cfg1.example.net
 - (c) cfg0.example.net
4. Upgrade each shard.
 - If a shard is a replica set, upgrade the shard using the procedure below titled [Upgrade Replica Sets](#) (page 25).
 - If a shard is a standalone instance, upgrade the shard using the procedure below titled [Upgrade a MongoDB Instance](#) (page 24).
 5. Re-enable the balancer, as described in [Enable the Balancer](#) (page 553).

Upgrade Replica Sets

To upgrade a replica set, upgrade each member individually, starting with the *secondaries* and finishing with the *primary*. Plan the upgrade during a predefined maintenance window.

Upgrade Secondaries

Upgrade each secondary separately as follows:

1. Upgrade the secondary's `mongod` (page 925) binary by following the instructions below in [Upgrade a MongoDB Instance](#) (page 24).
2. After upgrading a secondary, wait for the secondary to recover to the SECONDARY state before upgrading the next instance. To check the member's state, issue `rs.status()` (page 898) in the `mongo` (page 942) shell.

The secondary may briefly go into STARTUP2 or RECOVERING. This is normal. Make sure to wait for the secondary to fully recover to SECONDARY before you continue the upgrade.

Upgrade the Primary

1. Step down the primary to initiate the normal [failover](#) (page 396) procedure. Using one of the following:
 - The `rs.stepDown()` (page 899) helper in the `mongo` (page 942) shell.
 - The `replSetStepDown` (page 730) database command.

During failover, the set cannot accept writes. Typically this takes 10-20 seconds. Plan the upgrade during a predefined maintenance window.

Note: Stepping down the primary is preferable to directly *shutting down* the primary. Stepping down expedites the failover procedure.

2. Once the primary has stepped down, call the `rs.status()` (page 898) method from the `mongo` (page 942) shell until you see that another member has assumed the PRIMARY state.
3. Shut down the original primary and upgrade its instance by following the instructions below in [Upgrade a MongoDB Instance](#) (page 24).

To upgrade to a new revision of a MongoDB major release, see [Upgrade to the Latest Revision of MongoDB](#) (page 23)

1.3 Release Notes

You should always install the latest, *stable* version of MongoDB. Stable versions have an even number for the second number in the *version number* (page 1090). The following release notes are for stable versions:

- Current Stable Release:
 - *Release Notes for MongoDB 2.4* (page 1029)
- Previous Stable Releases:
 - *Release Notes for MongoDB 2.2* (page 1050)
 - *Release Notes for MongoDB 2.0* (page 1059)
 - *Release Notes for MongoDB 1.8* (page 1065)

1.4 First Steps with MongoDB

After you have installed MongoDB, consider the following documents as you begin to learn about MongoDB:

1.4.1 Getting Started with MongoDB

This tutorial provides an introduction to basic database operations using the `mongo` (page 942) shell. `mongo` (page 942) is a part of the standard MongoDB distribution and provides a full JavaScript environment with a complete access to the JavaScript language and all standard functions as well as a full database interface for MongoDB. See the `mongo` JavaScript API¹³ documentation and the `mongo` (page 942) shell *JavaScript Method Reference* (page 806).

The tutorial assumes that you’re running MongoDB on a Linux or OS X operating system and that you have a running database server; MongoDB does support Windows and provides a Windows distribution with identical operation. For instructions on installing MongoDB and starting the database server, see the appropriate *installation* (page 3) document.

This tutorial addresses the following aspects of MongoDB use:

- Connect to a Database (page 27)
 - Connect to a `mongod` (page 925) (page 27)
 - Select a Database (page 27)
 - Display `mongo` Help (page 27)
- Create a Collection and Insert Documents (page 27)
- Insert Documents using a For Loops or JavaScript Function (page 28)
- Working with the Cursor (page 28)
 - Iterate over the Cursor with a Loop (page 29)
 - Use Array Operations with the Cursor (page 29)
 - Query for Specific Documents (page 30)
 - Return a Single Document from a Collection (page 30)
 - Limit the Number of Documents in the Result Set (page 30)
- Next Steps with MongoDB (page 31)

¹³<http://api.mongodb.org/js>

Connect to a Database

In this section, you connect to the database server, which runs as [mongod](#) (page 925), and begin using the [mongo](#) (page 942) shell to select a logical database within the database instance and access the help text in the [mongo](#) (page 942) shell.

Connect to a mongod

From a system prompt, start [mongo](#) (page 942) by issuing the [mongo](#) (page 942) command, as follows:

```
mongo
```

By default, [mongo](#) (page 942) looks for a database server listening on port 27017 on the `localhost` interface. To connect to a server on a different port or interface, use the `--port` and `--host` options.

Select a Database

After starting the [mongo](#) (page 942) shell your session will use the `test` database by default. At any time, issue the following operation at the [mongo](#) (page 942) to report the name of the current database:

```
db
```

1. From the [mongo](#) (page 942) shell, display the list of databases, with the following operation:

```
show dbs
```

2. Switch to a new database named `mydb`, with the following operation:

```
use mydb
```

3. Confirm that your session has the `mydb` database as context, by checking the value of the `db` object, which returns the name of the current database, as follows:

```
db
```

At this point, if you issue the `show dbs` operation again, it will not include the `mydb` database. MongoDB will not permanently create a database until you insert data into that database. The [Create a Collection and Insert Documents](#) (page 27) section describes the process for inserting data.

New in version 2.4: `show databases` also returns a list of databases.

Display mongo Help

At any point, you can access help for the [mongo](#) (page 942) shell using the following operation:

```
help
```

Furthermore, you can append the `.help()` method to some JavaScript methods, any cursor object, as well as the `db` and `db.collection` objects to return additional help information.

Create a Collection and Insert Documents

In this section, you insert documents into a new `collection` named `testData` within the new `database` named `mydb`.

MongoDB will create a collection implicitly upon its first use. You do not need to create a collection before inserting data. Furthermore, because MongoDB uses *dynamic schemas* (page 582), you also need not specify the structure of your documents before inserting them into the collection.

1. From the [mongo](#) (page 942) shell, confirm you are in the mydb database by issuing the following:

```
db
```

2. If [mongo](#) (page 942) does not return mydb for the previous operation, set the context to the mydb database, with the following operation:

```
use mydb
```

3. Create two documents named j and k by using the following sequence of JavaScript operations:

```
j = { name : "mongo" }  
k = { x : 3 }
```

4. Insert the j and k documents into the testData collection with the following sequence of operations:

```
db.testData.insert( j )  
db.testData.insert( k )
```

When you insert the first document, the [mongod](#) (page 925) will create both the mydb database and the testData collection.

5. Confirm that the testData collection exists. Issue the following operation:

```
show collections
```

The [mongo](#) (page 942) shell will return the list of the collections in the current (i.e. mydb) database. At this point, the only collection is testData. All [mongod](#) (page 925) databases also have a system.indexes (page 229) collection.

6. Confirm that the documents exist in the testData collection by issuing a query on the collection using the [find\(\)](#) (page 816) method:

```
db.testData.find()
```

This operation returns the following results. The [ObjectId](#) (page 103) values will be unique:

```
{ "_id" : ObjectId("4c2209f9f3924d31102bd84a"), "name" : "mongo" }  
{ "_id" : ObjectId("4c2209fef3924d31102bd84b"), "x" : 3 }
```

All MongoDB documents must have an _id field with a unique value. These operations do not explicitly specify a value for the _id field, so [mongo](#) (page 942) creates a unique [ObjectId](#) (page 103) value for the field before inserting it into the collection.

Insert Documents using a For Loops or JavaScript Function

To perform the remaining procedures in this tutorial, first add more documents to your database using one or both of the procedures described in [Generate Test Data](#) (page 31).

Working with the Cursor

When you query a [collection](#), MongoDB returns a “cursor” object that contains the results of the query. The [mongo](#) (page 942) shell then iterates over the cursor to display the results. Rather than returning all results at once, the shell iterates over the cursor 20 times to display the first 20 results and then waits for a request to iterate over the remaining results. In the shell, use enter it to iterate over the next set of results.

The procedures in this section show other ways to work with a cursor. For comprehensive documentation on cursors, see *Iterate the Returned Cursor* (page 820).

Iterate over the Cursor with a Loop

Before using this procedure, make sure to add at least 25 documents to a collection using one of the procedures in *Generate Test Data* (page 31). You can name your database and collections anything you choose, but this procedure will assume the database named `test` and a collection named `testData`.

1. In the MongoDB JavaScript shell, query the `testData` collection and assign the resulting cursor object to the `c` variable:

```
var c = db.testData.find()
```

2. Print the full result set by using a `while` loop to iterate over the `c` variable:

```
while ( c.hasNext() ) printjson( c.next() )
```

The `hasNext()` function returns true if the cursor has documents. The `next()` method returns the next document. The `printjson()` method renders the document in a JSON-like format.

The operation displays 20 documents. For example, if the documents have a single field named `x`, the operation displays the field as well as each document's `ObjectId`:

```
{ "_id" : ObjectId("51a7dc7b2cacf40b79990be6"), "x" : 1 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990be7"), "x" : 2 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990be8"), "x" : 3 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990be9"), "x" : 4 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bea"), "x" : 5 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990beb"), "x" : 6 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bec"), "x" : 7 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bed"), "x" : 8 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bee"), "x" : 9 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bef"), "x" : 10 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bf0"), "x" : 11 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bf1"), "x" : 12 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bf2"), "x" : 13 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bf3"), "x" : 14 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bf4"), "x" : 15 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bf5"), "x" : 16 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bf6"), "x" : 17 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bf7"), "x" : 18 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bf8"), "x" : 19 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bf9"), "x" : 20 }
```

Use Array Operations with the Cursor

The following procedure lets you manipulate a cursor object as if it were an array:

1. In the `mongo` (page 942) shell, query the `testData` collection and assign the resulting cursor object to the `c` variable:

```
var c = db.testData.find()
```

2. To find the document at the array index 4, use the following operation:

```
printjson( c [ 4 ] )
```

MongoDB returns the following:

```
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bea"), "x" : 5 }
```

When you access documents in a cursor using the array index notation, [mongo](#) (page 942) first calls the `cursor.toArray()` method and loads into RAM all documents returned by the cursor. The index is then applied to the resulting array. This operation iterates the cursor completely and exhausts the cursor.

For very large result sets, [mongo](#) (page 942) may run out of available memory.

For more information on the cursor, see [Iterate the Returned Cursor](#) (page 820).

Query for Specific Documents

MongoDB has a rich query system that allows you to select and filter the documents in a collection along specific fields and values. See [Query Documents](#) (page 68) and [Read Operations](#) (page 39) for a full account of queries in MongoDB.

In this procedure, you query for specific documents in the `testData` *collection* by passing a “query document” as a parameter to the [find\(\)](#) (page 816) method. A query document specifies the criteria the query must match to return a document.

In the [mongo](#) (page 942) shell, query for all documents where the `x` field has a value of 18 by passing the `{ x : 18 }` query document as a parameter to the [find\(\)](#) (page 816) method:

```
db.testData.find( { x : 18 } )
```

MongoDB returns one document that fits this criteria:

```
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bf7"), "x" : 18 }
```

Return a Single Document from a Collection

With the [findOne\(\)](#) (page 824) method you can return a single *document* from a MongoDB collection. The [findOne\(\)](#) (page 824) method takes the same parameters as [find\(\)](#) (page 816), but returns a document rather than a cursor.

To retrieve one document from the `testData` collection, issue the following command:

```
db.testData.findOne()
```

For more information on querying for documents, see the [Query Documents](#) (page 68) and [Read Operations](#) (page 39) documentation.

Limit the Number of Documents in the Result Set

To increase performance, you can constrain the size of the result by limiting the amount of data your application must receive over the network.

To specify the maximum number of documents in the result set, call the [limit\(\)](#) (page 867) method on a cursor, as in the following command:

```
db.testData.find().limit(3)
```

MongoDB will return the following result, with different *ObjectId* (page 103) values:

```
{ "_id" : ObjectId("51a7dc7b2cacf40b79990be6"), "x" : 1 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990be7"), "x" : 2 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990be8"), "x" : 3 }
```

Next Steps with MongoDB

For more information on manipulating the documents in a database as you continue to learn MongoDB, consider the following resources:

- [MongoDB CRUD Operations](#) (page 35)
- [SQL to MongoDB Mapping Chart](#) (page 98)
- [MongoDB Drivers and Client Libraries](#) (page 95)

1.4.2 Generate Test Data

This tutorial describes how to quickly generate test data as you need to test basic MongoDB operations.

Insert Multiple Documents Using a For Loop

You can add documents to a new or existing collection by using a JavaScript `for` loop run from the [mongo](#) (page 942) shell.

1. From the [mongo](#) (page 942) shell, insert new documents into the `testData` collection using the following `for` loop. If the `testData` collection does not exist, MongoDB creates the collection implicitly.

```
for (var i = 1; i <= 25; i++) db.testData.insert( { x : i } )
```

2. Use `find()` to query the collection:

```
db.testData.find()
```

The [mongo](#) (page 942) shell displays the first 20 documents in the collection. Your *ObjectId* (page 103) values will be different:

```
{ "_id" : ObjectId("51a7dc7b2cacf40b79990be6"), "x" : 1 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990be7"), "x" : 2 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990be8"), "x" : 3 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990be9"), "x" : 4 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bea"), "x" : 5 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990beb"), "x" : 6 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bec"), "x" : 7 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bed"), "x" : 8 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bee"), "x" : 9 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bef"), "x" : 10 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bf0"), "x" : 11 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bf1"), "x" : 12 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bf2"), "x" : 13 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bf3"), "x" : 14 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bf4"), "x" : 15 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bf5"), "x" : 16 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bf6"), "x" : 17 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bf7"), "x" : 18 }
```

```
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bf8"), "x" : 19 }
{ "_id" : ObjectId("51a7dc7b2cacf40b79990bf9"), "x" : 20 }
```

1. The `find()` (page 816) returns a cursor. To iterate the cursor and return more documents use the `it` operation in the `mongo` (page 942) shell. The `mongo` (page 942) shell will exhaust the cursor, and return the following documents:

```
{ "_id" : ObjectId("51a7dce92cacf40b79990bfc"), "x" : 21 }
{ "_id" : ObjectId("51a7dce92cacf40b79990bfd"), "x" : 22 }
{ "_id" : ObjectId("51a7dce92cacf40b79990bfe"), "x" : 23 }
{ "_id" : ObjectId("51a7dce92cacf40b79990bff"), "x" : 24 }
{ "_id" : ObjectId("51a7dce92cacf40b79990c00"), "x" : 25 }
```

Insert Multiple Documents with a `mongo` Shell Function

You can create a JavaScript function in your shell session to generate the above data. The `insertData()` JavaScript function, shown here, creates new data for use in testing or training by either creating a new collection or appending data to an existing collection:

```
function insertData(dbName, colName, num) {

    var col = db.getSiblingDB(dbName).getCollection(colName);

    for (i = 0; i < num; i++) {
        col.insert({x:i});
    }

    print(col.count());
}

}
```

The `insertData()` function takes three parameters: a database, a new or existing collection, and the number of documents to create. The function creates documents with an `x` field that is set to an incremented integer, as in the following example documents:

```
{ "_id" : ObjectId("51a4da9b292904caffcff6eb"), "x" : 0 }
{ "_id" : ObjectId("51a4da9b292904caffcff6ec"), "x" : 1 }
{ "_id" : ObjectId("51a4da9b292904caffcff6ed"), "x" : 2 }
```

Store the function in your `.mongorc.js` (page 946) file. The `mongo` (page 942) shell loads the function for you every time you start a session.

Example

Specify database name, collection name, and the number of documents to insert as arguments to `insertData()`.

```
insertData("test", "testData", 400)
```

This operation inserts 400 documents into the `testData` collection in the `test` database. If the collection and database do not exist, MongoDB creates them implicitly before inserting documents.

-
- [Getting Started with MongoDB](#) (page 26)
 - [Generate Test Data](#) (page 31)
 - [MongoDB CRUD Concepts](#) (page 37)
 - [Data Models](#) (page 117)

- *MongoDB Drivers and Client Libraries* (page 95)

MongoDB CRUD Operations

MongoDB provides rich semantics for reading and manipulating data. CRUD stands for *create*, *read*, *update*, and *delete*. These terms are the foundation for all interactions with the database.

[MongoDB CRUD Introduction](#) (page 35) An introduction to the MongoDB data model as well as queries and data manipulations.

[MongoDB CRUD Concepts](#) (page 37) The core documentation of query and data manipulation.

[MongoDB CRUD Tutorials](#) (page 66) Examples of basic query and data modification operations.

[MongoDB CRUD Reference](#) (page 91) Reference material for the query and data manipulation interfaces.

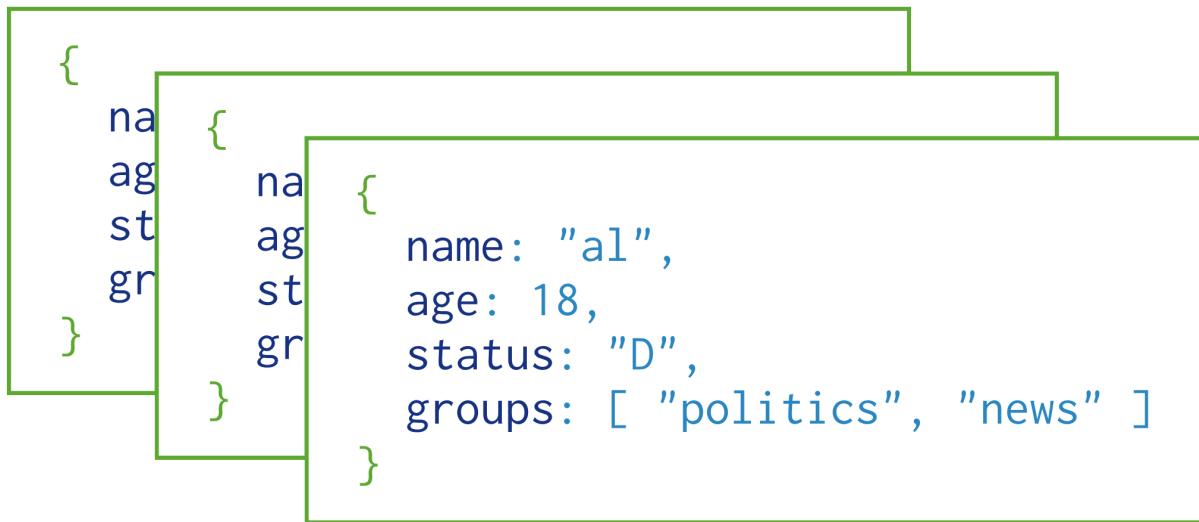
2.1 MongoDB CRUD Introduction

MongoDB stores data in the form of *documents*, which are JSON-like field and value pairs. Documents are analogous to structures in programming languages that associate keys with values, where keys may hold other pairs of keys and values (e.g. dictionaries, hashes, maps, and associative arrays). Formally, MongoDB documents are [BSON](#) documents, which is a binary representation of [JSON](#) with additional type information. For more information, see [Documents](#) (page 92).

```
{
  name: "sue",           ← field: value
  age: 26,               ← field: value
  status: "A",            ← field: value
  groups: [ "news", "sports" ] ← field: value
}
```

Figure 2.1: A MongoDB document.

MongoDB stores all documents in *collections*. A collection is a group of related documents that have a set of shared common indexes. Collections are analogous to a table in relational databases.



Collection

Figure 2.2: A collection of MongoDB documents.

2.1.1 Database Operations

Query

In MongoDB a query targets a specific collection of documents. Queries specify criteria, or conditions, that identify the documents that MongoDB returns to the clients. A query may include a *projection* that specifies the fields from the matching documents to return. You can optionally modify queries to impose limits, skips, and sort orders.

In the following diagram, the query process specifies a query criteria and a sort modifier:

Data Modification

Data modification refers to operations that create, update, or delete data. In MongoDB, these operations modify the data of a single *collection*. For the update and delete operations, you can specify the criteria to select the documents to update or remove.

In the following diagram, the insert operation adds a new document to the `users` collection.

2.1.2 Related Features

Indexes

To enhance the performance of common queries and updates, MongoDB has full support for secondary indexes. These indexes allow applications to store a *view* of a portion of the collection in an efficient data structure. Most indexes store an ordered representation of all values of a field or a group of fields. Indexes may also *enforce uniqueness* (page 334), store objects in a *geospatial representation* (page 326), and facilitate *text search* (page 332).

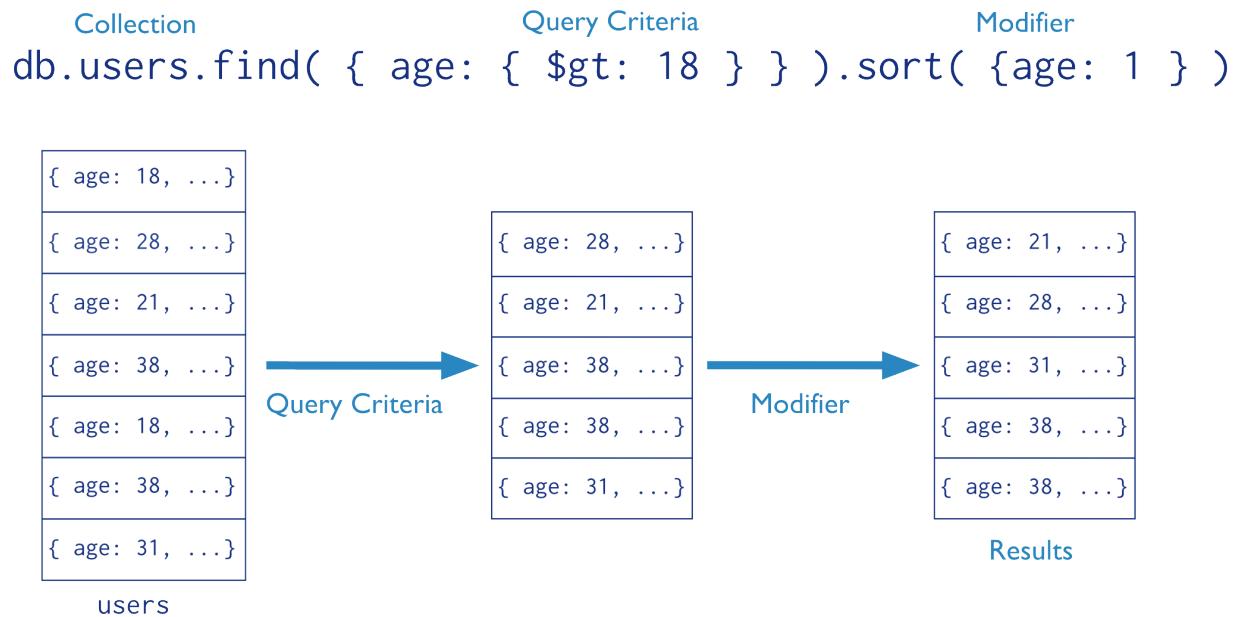


Figure 2.3: The stages of a MongoDB query with a query criteria and a sort modifier.

Read Preference

For replica sets and sharded clusters with replica set components, applications specify [read preferences](#) (page 405). A read preference determines how the client direct read operations to the set.

Write Concern

Applications can also control the behavior of write operations using [write concern](#) (page 55). Particularly useful for deployments with replica sets, the write concern semantics allow clients to specify the assurance that MongoDB provides when reporting on the success of a write operation.

Aggregation

In addition to the basic queries, MongoDB provides several data aggregation features. For example, MongoDB can return counts of the number of documents that match a query, or return the number of distinct values for a field, or process a collection of documents using a versatile stage-based data processing pipeline or map-reduce operations.

2.2 MongoDB CRUD Concepts

The [Read Operations](#) (page 39) and [Write Operations](#) (page 50) documents introduce the behavior and operations of read and write operations for MongoDB deployments.

Read Operations (page 39) Introduces all operations that select and return documents to clients, including the query specifications.

Cursors (page 43) Queries return iterable objects, called cursors, that hold the full result set of the query request.

Query Optimization (page 44) Analyze and improve query performance.

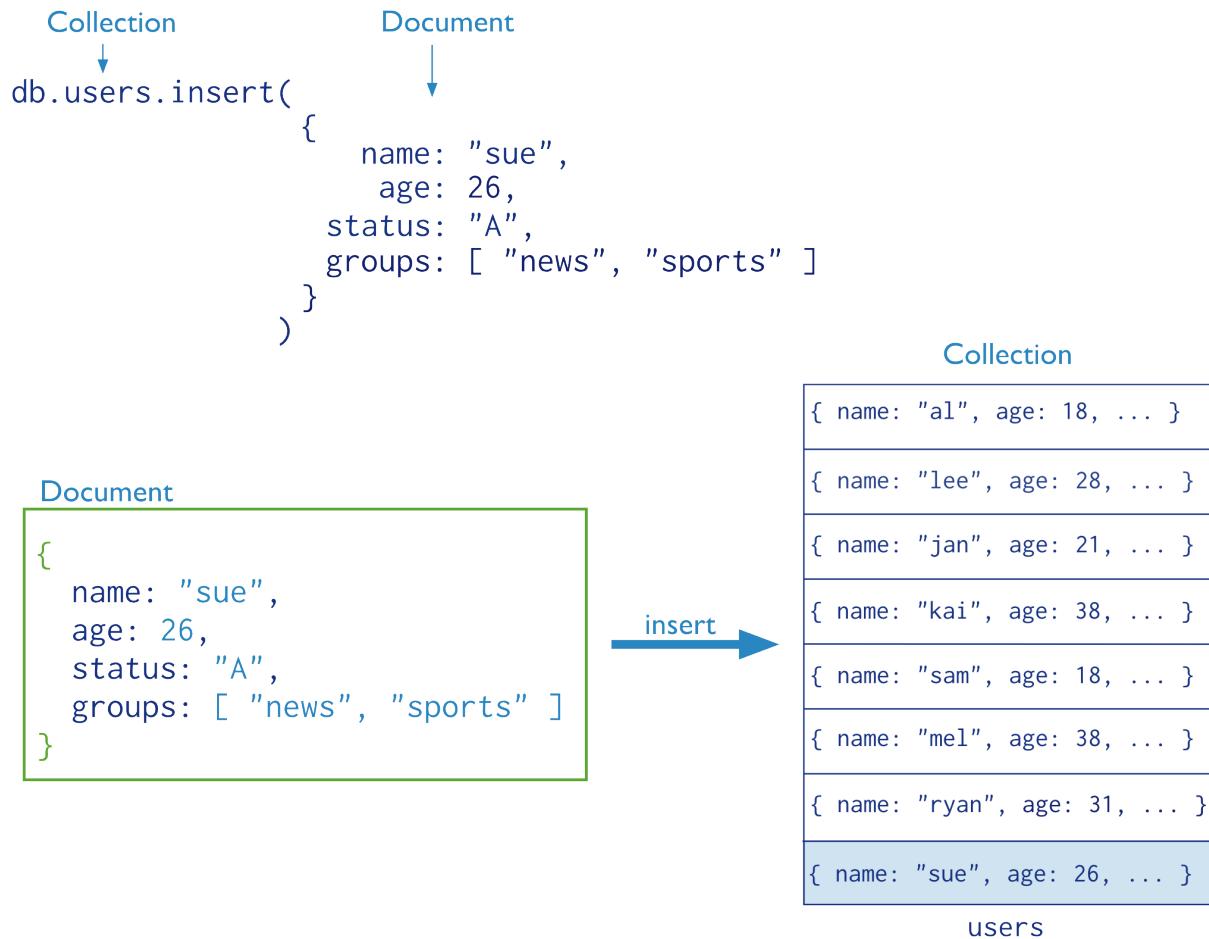


Figure 2.4: The stages of a MongoDB insert operation.

Distributed Queries (page 46) Describes how *sharded clusters* and *replica sets* affect the performance of read operations.

Write Operations (page 50) Introduces data create and modify operations, their behavior, and performances.

Write Concern (page 55) Describes the kind of guarantee MongoDB provides when reporting on the success of a write operation.

Distributed Write Operations (page 59) Describes how MongoDB directs write operations on *sharded clusters* and *replica sets* and the performance characteristics of these operations.

2.2.1 Read Operations

Read operations, or *queries*, retrieve data stored in the database. In MongoDB, queries select *documents* from a single *collection*.

Queries specify criteria, or conditions, that identify the documents that MongoDB returns to the clients. A query may include a *projection* that specifies the fields from the matching documents to return. The projection limits the amount of data that MongoDB returns to the client over the network.

Query Interface

For query operations, MongoDB provide a `db.collection.find()` (page 816) method. The method accepts both the query criteria and projections and returns a *cursor* (page 43) to the matching documents. You can optionally modify the query to impose limits, skips, and sort orders.

The following diagram highlights the components of a MongoDB query operation:

```
db.users.find(
  { age: { $gt: 18 } },
  { name: 1, address: 1 }
).limit(5)
```

← collection
← query criteria
← projection
← cursor modifier

Figure 2.5: The components of a MongoDB find operation.

The next diagram shows the same query in SQL:

```
SELECT _id, name, address ← projection
FROM   users            ← table
WHERE  age > 18          ← select criteria
LIMIT  5                ← cursor modifier
```

Figure 2.6: The components of a SQL SELECT statement.

Example

```
db.users.find( { age: { $gt: 18 } }, { name: 1, address: 1 } ).limit(5)
```

This query selects the documents in the `users` collection that match the condition `age` is greater than 18. To specify the greater than condition, query criteria uses the greater than (i.e. `$gt` (page 622)) [query selection operator](#) (page 621). The query returns at most 5 matching documents (or more precisely, a cursor to those documents). The matching documents will return with only the `_id`, `name` and `address` fields. See [Projections](#) (page 40) for details.

See

[SQL to MongoDB Mapping Chart](#) (page 98) for additional examples of MongoDB queries and the corresponding SQL statements.

Query Behavior

MongoDB queries exhibit the following behavior:

- All queries in MongoDB address a *single* collection.
- You can modify the query to impose [limits](#) (page 867), [skips](#) (page 871), and [sort orders](#) (page 872).
- The order of documents returned by a query is not defined and is not necessarily consistent unless you specify a [sort\(\)](#) (page 872).
- Operations that [modify existing documents](#) (page 75) (i.e. *updates*) use the same query syntax as queries to select documents to update.
- In [aggregation](#) (page 279) pipeline, the `$match` (page 666) pipeline stage provides access to MongoDB queries.

MongoDB provides a `db.collection.findOne()` (page 824) method as a special case of `find()` (page 816) that returns a single document.

Query Statements

Consider the following diagram of the query process that specifies a query criteria and a sort modifier:

In the diagram, the query selects documents from the `users` collection. Using a [query selection operator](#) (page 621) to define the conditions for matching documents, the query selects documents that have `age` greater than (i.e. `$gt` (page 622)) 18. Then the `sort()` (page 872) modifier sorts the results by `age` in ascending order.

For additional examples of queries, see [Query Documents](#) (page 68).

Projections

Queries in MongoDB return all fields in all matching documents by default. To limit the amount of data that MongoDB sends to applications, include a [projection](#) in the queries. By projecting results with a subset of fields, applications reduce their network overhead and processing requirements.

Projections, which are the the *second* argument to the `find()` (page 816) method, may either specify a list of fields to return *or* list fields to exclude in the result documents.

Important: Except for excluding the `_id` field in inclusive projections, you cannot mix exclusive and inclusive projections.

Consider the following diagram of the query process that specifies a query criteria and a projection:

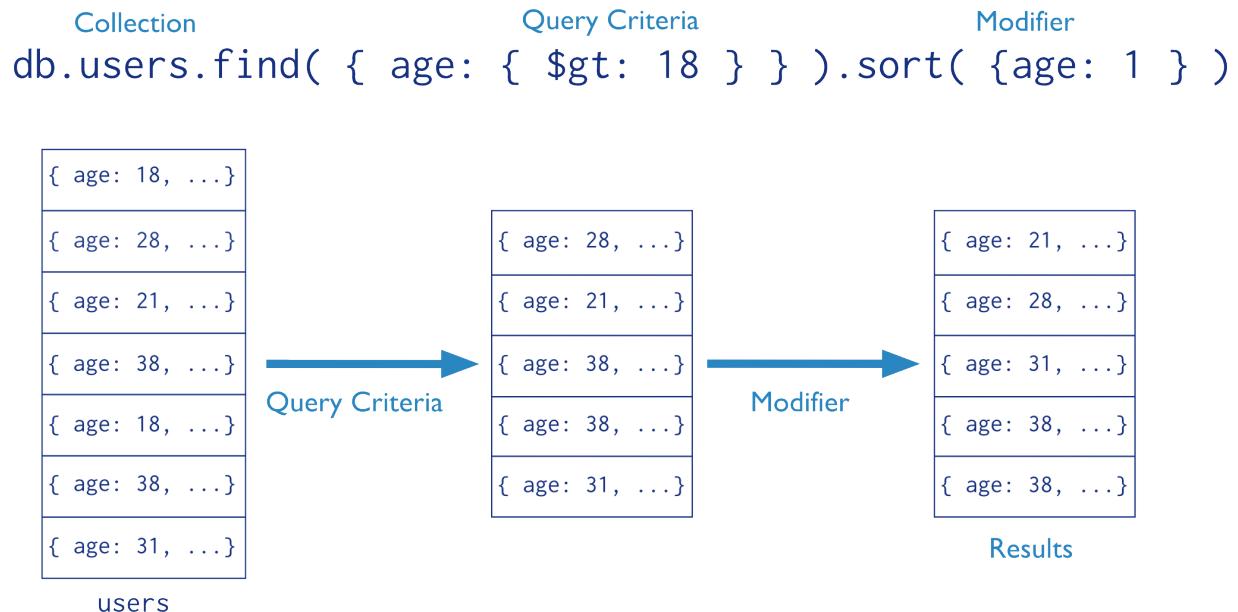


Figure 2.7: The stages of a MongoDB query with a query criteria and a sort modifier.

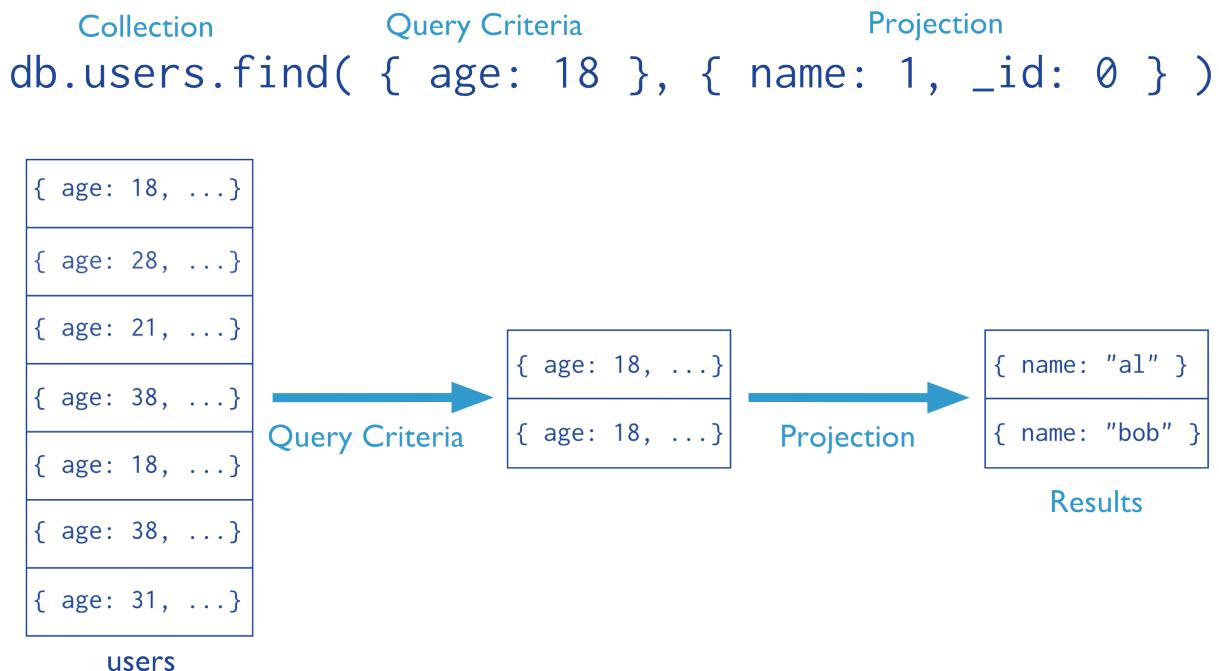


Figure 2.8: The stages of a MongoDB query with a query criteria and projection. MongoDB only transmits the projected data to the clients.

In the diagram, the query selects from the `users` collection. The criteria matches the documents that have `age` equal to 18. Then the projection specifies that only the `name` field should return in the matching documents.

Projection Examples

Exclude One Field From a Result Set

```
db.records.find( { "user_id": { $lt: 42} }, { history: 0} )
```

This query selects a number of documents in the `records` collection that match the query `{ "user_id": { $lt: 42} }`, but excludes the `history` field.

Return Two fields and the `_id` Field

```
db.records.find( { "user_id": { $lt: 42} }, { "name": 1, "email": 1} )
```

This query selects a number of documents in the `records` collection that match the query `{ "user_id": { $lt: 42} }`, but returns documents that have the `_id` field (implicitly included) as well as the `name` and `email` fields.

Return Two Fields and Exclude `_id`

```
db.records.find( { "user_id": { $lt: 42} }, { "_id": 0, "name": 1 , "email": 1 } )
```

This query selects a number of documents in the `records` collection that match the query `{ "user_id": { $lt: 42} }`, but only returns the `name` and `email` fields.

See

[Limit Fields to Return from a Query](#) (page 72) for more examples of queries with projection statements.

Projection Behavior

MongoDB projections have the following properties:

- In MongoDB, the `_id` field is always included in results unless explicitly excluded.
- For fields that contain arrays, MongoDB provides the following projection operators: `$elemMatch` (page 648), `$slice` (page 650), `$` (page 646).
- For related projection functionality in the [aggregation framework](#) (page 279) pipeline, use the `$project` (page 664) pipeline stage.

Related Concepts

The following documents further describe read operations:

[Cursors](#) (page 43) Queries return iterable objects, called cursors, that hold the full result set of the query request.

[Query Optimization](#) (page 44) Analyze and improve query performance.

[Query Plans](#) (page 45) MongoDB processes and executes using plans developed to return results as efficiently as possible.

[Distributed Queries](#) (page 46) Describes how `sharded clusters` and `replica sets` affect the performance of read operations.

Cursors

In the `mongo` (page 942) shell, the primary method for the read operation is the `db.collection.find()` (page 816) method. This method queries a collection and returns a *cursor* to the returning documents.

To access the documents, you need to iterate the cursor. However, in the `mongo` (page 942) shell, if the returned cursor is not assigned to a variable using the `var` keyword, then the cursor is automatically iterated up to 20 times¹ to print up to the first 20 documents in the results.

For example, in the `mongo` (page 942) shell, the following read operation queries the `inventory` collection for documents that have `type` equal to `'food'` and automatically print up to the first 20 matching documents:

```
db.inventory.find( { type: 'food' } );
```

To manually iterate the cursor to access the documents, see *Iterate a Cursor in the mongo Shell* (page 73).

Cursor Behaviors

Closure of Inactive Cursors By default, the server will automatically close the cursor after 10 minutes of inactivity or if client has exhausted the cursor. To override this behavior, you can specify the `noTimeout` wire protocol flag² in your query; however, you should either close the cursor manually or exhaust the cursor. In the `mongo` (page 942) shell, you can set the `noTimeout` flag:

```
var myCursor = db.inventory.find().addOption(DBQuery.Option.noTimeout);
```

See your `driver` (page 95) documentation for information on setting the `noTimeout` flag. For the `mongo` (page 942) shell, see `cursor.addOption()` (page 858) for a complete list of available cursor flags.

Cursor Isolation Because the cursor is not isolated during its lifetime, intervening write operations on a document may result in a cursor that returns a document more than once if that document has changed. To handle this situation, see the information on `snapshot mode` (page 592).

Cursor Batches The MongoDB server returns the query results in batches. Batch size will not exceed the `maximum BSON document size` (page 1015). For most queries, the *first* batch returns 101 documents or just enough documents to exceed 1 megabyte. Subsequent batch size is 4 megabytes. To override the default size of the batch, see `batchSize()` (page 859) and `limit()` (page 867).

For queries that include a sort operation *without* an index, the server must load all the documents in memory to perform the sort and will return all documents in the first batch.

As you iterate through the cursor and reach the end of the returned batch, if there are more results, `cursor.next()` (page 870) will perform a `getmore` operation (page 881) to retrieve the next batch. To see how many documents remain in the batch as you iterate the cursor, you can use the `objsLeftInBatch()` (page 871) method, as in the following example:

```
var myCursor = db.inventory.find();

var myFirstDocument = myCursor.hasNext() ? myCursor.next() : null;

myCursor.objsLeftInBatch();
```

¹ You can use the `DBQuery.shellBatchSize` to change the number of iteration from the default value 20. See *Executing Queries* (page 205) for more information.

²<http://docs.mongodb.org/meta-driver/latest/legacy/mongodb-wire-protocol>

Cursor Information You can use the command `cursorInfo` (page 769) to retrieve the following information on cursors:

- total number of open cursors
- size of the client cursors in current use
- number of timed out cursors since the last server restart

Consider the following example:

```
db.runCommand( { cursorInfo: 1 } )
```

The result from the command returns the following document:

```
{  
  "totalOpen" : <number>,  
  "clientCursors_size" : <number>,  
  "timedOut" : <number>,  
  "ok" : 1  
}
```

Query Optimization

Indexes improve the efficiency of read operations by reducing the amount of data that query operations need to process. This simplifies the work associated with fulfilling queries within MongoDB.

Create an Index to Support Read Operations If your application queries a collection on a particular field or fields, then an index on the queried field or fields can prevent the query from scanning the whole collection to find and return the query results. For more information about indexes, see the [complete documentation of indexes in MongoDB](#) (page 318).

Example

An application queries the `inventory` collection on the `type` field. The value of the `type` field is user-driven.

```
var typeValue = <someUserInput>;  
db.inventory.find( { type: typeValue } );
```

To improve the performance of this query, add an ascending, or a descending, index to the `inventory` collection on the `type` field.³ In the `mongo` (page 942) shell, you can create indexes using the `db.collection.ensureIndex()` (page 814) method:

```
db.inventory.ensureIndex( { type: 1 } )
```

This index can prevent the above query on `type` from scanning the whole collection to return the results.

To analyze the performance of the query with an index, see [Analyze Query Performance](#) (page 74).

In addition to optimizing read operations, indexes can support sort operations and allow for a more efficient storage utilization. See `db.collection.ensureIndex()` (page 814) and [Indexing Tutorials](#) (page 338) for more information about index creation.

³ For single-field indexes, the selection between ascending and descending order is immaterial. For compound indexes, the selection is important. See [indexing order](#) (page 323) for more details.

Query Selectivity Some query operations are not selective. These operations cannot use indexes effectively or cannot use indexes at all.

The inequality operators `$nin` (page 624) and `$ne` (page 624) are not very selective, as they often match a large portion of the index. As a result, in most cases, a `$nin` (page 624) or `$ne` (page 624) query with an index may perform no better than a `$nin` (page 624) or `$ne` (page 624) query that must scan all documents in a collection.

Queries that specify regular expressions, with inline JavaScript regular expressions or `$regex` (page 633) operator expressions, cannot use an index with one exception. Queries that specify regular expression *with anchors* at the beginning of a string *can* use an index.

Covering a Query An index *covers* (page 368) a query, a *covered query*, when:

- all the fields in the *query* (page 68) are part of that index, **and**
- all the fields returned in the documents that match the query are in the same index.

For these queries, MongoDB does not need to inspect documents outside of the index. This is often more efficient than inspecting entire documents.

Example

Given a collection `inventory` with the following index on the `type` and `item` fields:

```
{ type: 1, item: 1 }
```

This index will cover the following query on the `type` and `item` fields, which returns only the `item` field:

```
db.inventory.find( { type: "food", item:/^c/ },
    { item: 1, _id: 0 } )
```

However, the index will **not** cover the following query, which returns the `item` field **and** the `_id` field:

```
db.inventory.find( { type: "food", item:/^c/ },
    { item: 1 } )
```

See *Create Indexes that Support Covered Queries* (page 368) for more information on the behavior and use of covered queries.

Query Plans

The MongoDB query optimizer processes queries and chooses the most efficient query plan for a query given the available indexes. The query system then uses this query plan each time the query runs. The query optimizer occasionally reevaluates query plans as the content of the collection changes to ensure optimal query plans.

You can use the `explain()` (page 861) method to view statistics about the query plan for a given query. This information can help as you develop *indexing strategies* (page 367).

Query Optimization To create a new query plan, the query optimizer:

1. runs the query against several candidate indexes in parallel.
2. records the matches in a common results buffer or buffers.
 - If the candidate plans include only *ordered query plans*, there is a single common results buffer.
 - If the candidate plans include only *unordered query plans*, there is a single common results buffer.

- If the candidate plans include *both ordered query plans* and *unordered query plans*, there are two common results buffers, one for the ordered plans and the other for the unordered plans.

If an index returns a result already returned by another index, the optimizer skips the duplicate match. In the case of the two buffers, both buffers are de-duped.

3. stops the testing of candidate plans and selects an index when one of the following events occur:

- An *unordered query plan* has returned all the matching results; *or*
- An *ordered query plan* has returned all the matching results; *or*
- An *ordered query plan* has returned a threshold number of matching results:
 - Version 2.0: Threshold is the query batch size. The default batch size is 101.
 - Version 2.2: Threshold is 101.

The selected index becomes the index specified in the query plan; future iterations of this query or queries with the same query pattern will use this index. Query pattern refers to query select conditions that differ only in the values, as in the following two queries with the same query pattern:

```
db.inventory.find( { type: 'food' } )  
db.inventory.find( { type: 'utensil' } )
```

Query Plan Revision As collections change over time, the query optimizer deletes the query plan and re-evaluates after any of the following events:

- The collection receives 1,000 write operations.
- The [reIndex](#) (page 756) rebuilds the index.
- You add or drop an index.
- The [mongod](#) (page 925) process restarts.

Distributed Queries

Read Operations to Sharded Clusters *Sharded clusters* allow you to partition a data set among a cluster of [mongod](#) (page 925) instances in a way that is nearly transparent to the application. For an overview of sharded clusters, see the [Sharding](#) (page 493) section of this manual.

For a sharded cluster, applications issue operations to one of the [mongos](#) (page 938) instances associated with the cluster.

Read operations on sharded clusters are most efficient when directed to a specific shard. Queries to sharded collections should include the collection's [shard key](#) (page 506). When a query includes a shard key, the [mongos](#) (page 938) can use cluster metadata from the [config database](#) (page 502) to route the queries to shards.

If a query does not include the shard key, the [mongos](#) (page 938) must direct the query to *all* shards in the cluster. These *scatter gather* queries can be inefficient. On larger clusters, scatter gather queries are unfeasible for routine operations.

For more information on read operations in sharded clusters, see the [Sharded Cluster Query Routing](#) (page 510) and [Shard Keys](#) (page 506) sections.

Read Operations to Replica Sets *Replica sets* use [read preferences](#) to determine where and how to route read operations to members of the replica set. By default, MongoDB always reads data from a replica set's [primary](#). You can modify that behavior by changing the [read preference mode](#) (page 489).

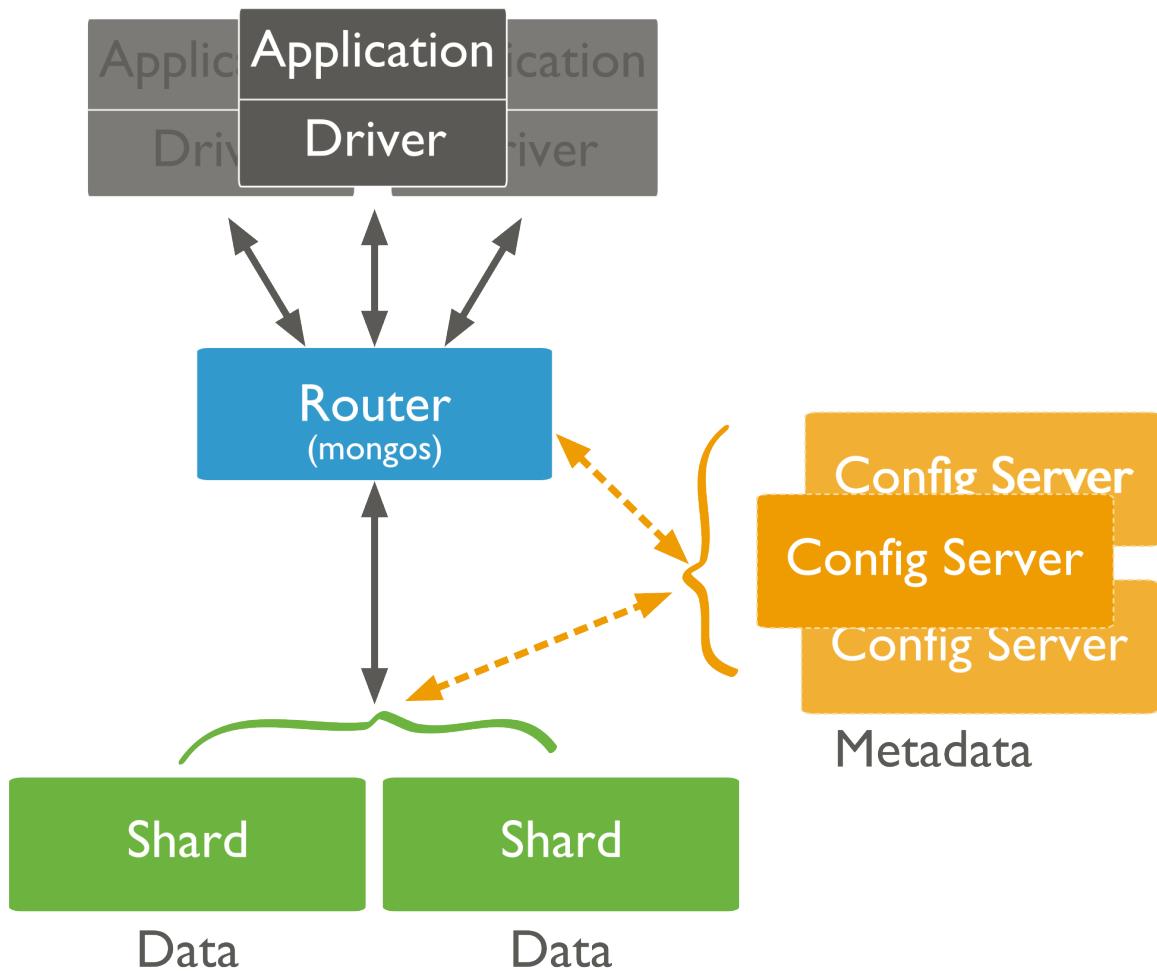


Figure 2.9: Diagram of a sharded cluster.

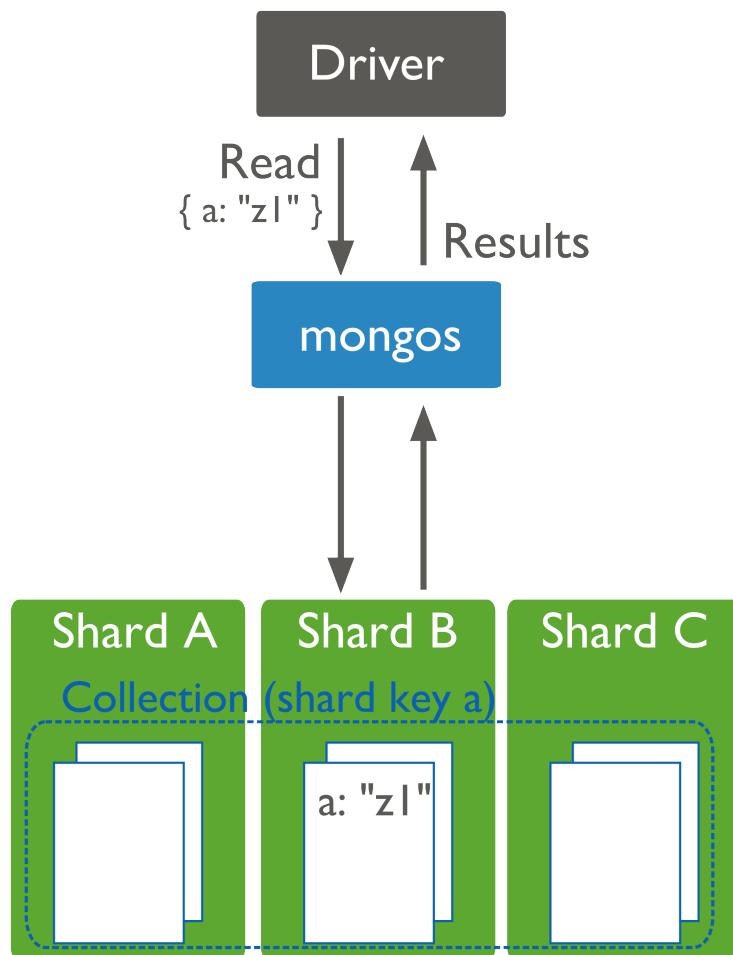


Figure 2.10: Read operations to a sharded cluster. Query criteria includes the shard key. The query router mongos can target the query to the appropriate shard or shards.

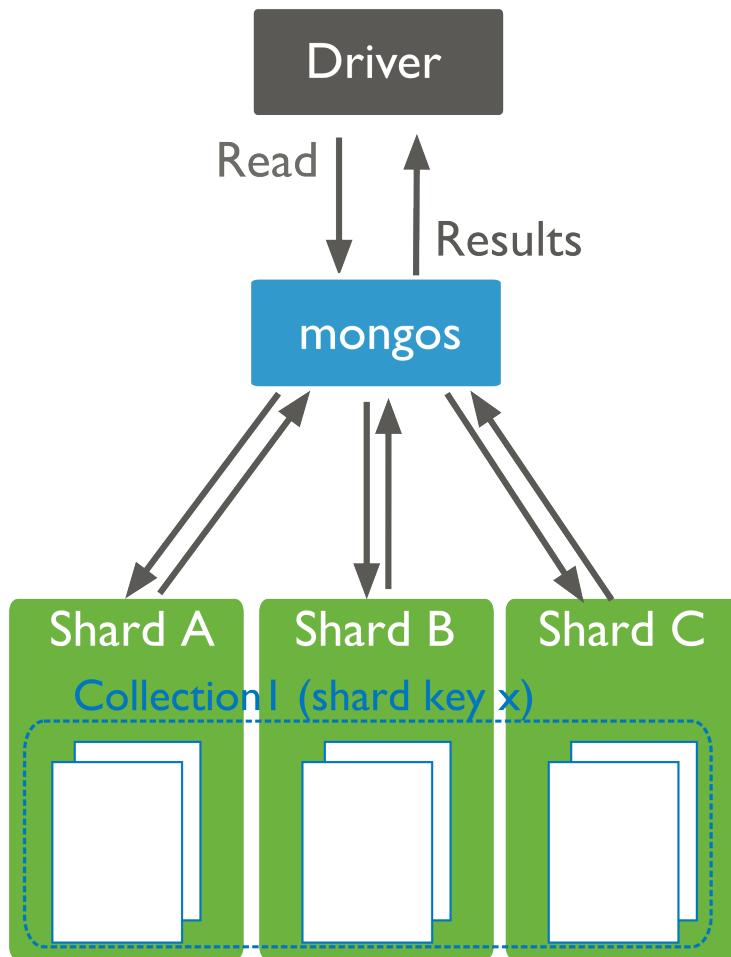


Figure 2.11: Read operations to a sharded cluster. Query criteria does not include the shard key. The query router mongos must broadcast query to all shards for the collection.

You can configure the [read preference mode](#) (page 489) on a per-connection or per-operation basis to allow reads from *secondaries* to:

- reduce latency in multi-data-center deployments,
- improve read throughput by distributing high read-volumes (relative to write volume),
- for backup operations, and/or
- to allow reads during [failover](#) (page 396) situations.

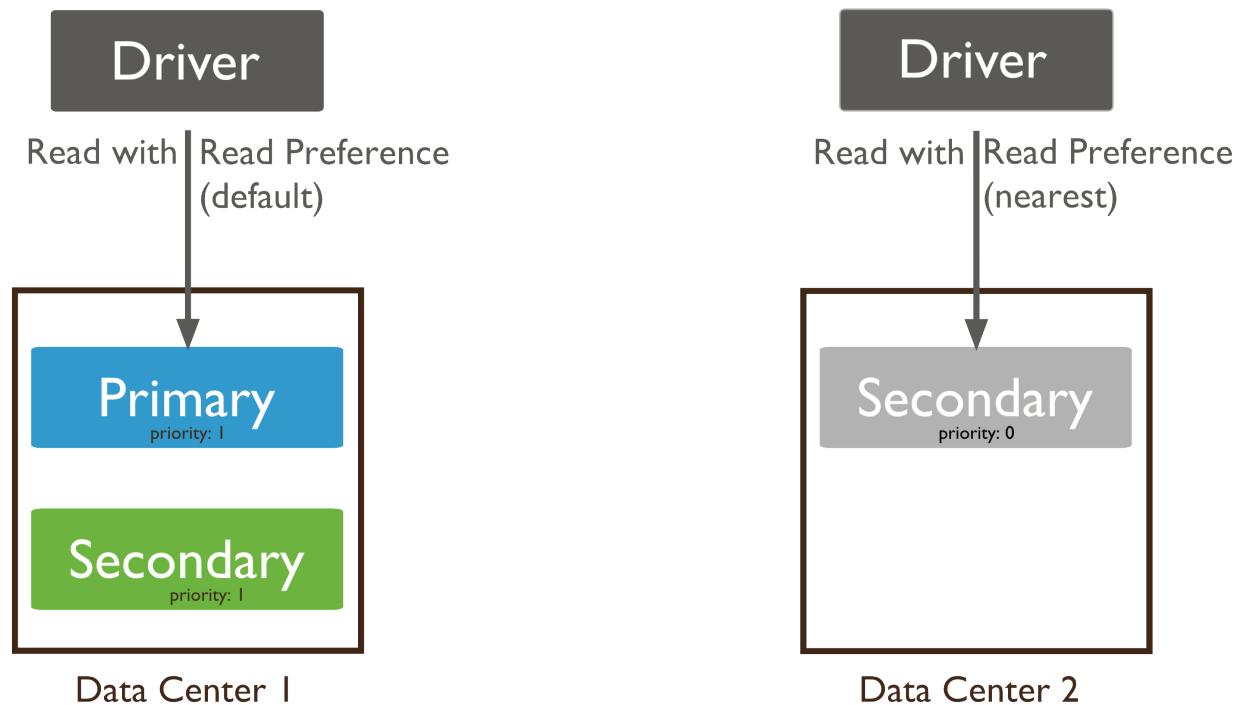


Figure 2.12: Read operations to a replica set. Default read preference routes the read to the primary. Read preference of nearest routes the read to the nearest member.

Read operations from secondary members of replica sets are not guaranteed to reflect the current state of the primary, and the state of secondaries will trail the primary by some amount of time. Often, applications don't rely on this kind of strict consistency, but application developers should always consider the needs of their application before setting read preference.

For more information on read preference or on the read preference modes, see [Read Preference](#) (page 405) and [Read Preference Modes](#) (page 489).

2.2.2 Write Operations

A write operation is any operation that creates or modifies data in the MongoDB instance. In MongoDB, write operations target a single *collection*. All write operations in MongoDB are atomic on the level of a single *document*.

There are three classes of write operations in MongoDB: insert, update, and remove. Insert operations add new data to a collection. Update operations modify an existing data, and remove operations delete data from a collection. No insert, update, or remove can affect more than one document atomically.

For the update and remove operations, you can specify criteria, or conditions, that identify the documents to update or remove. These operations use the same query syntax to specify the criteria as [read operations](#) (page 39).

After issuing these modification operations, MongoDB allows applications to determine the level of acknowledgment returned from the database. See [Write Concern](#) (page 55).

Create

Create operations add new *documents* to a collection. In MongoDB, the `db.collection.insert()` (page 832) method performs create operations.

The following diagram highlights the components of a MongoDB insert operation:

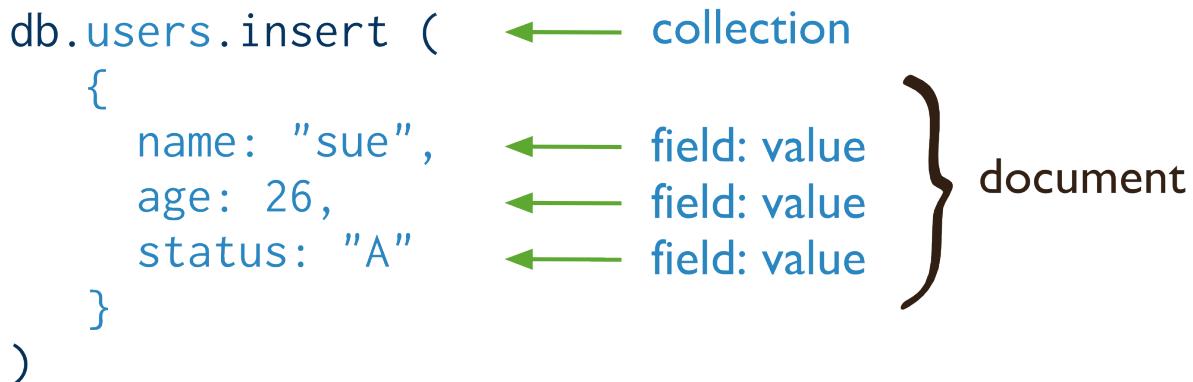


Figure 2.13: The components of a MongoDB insert operations.

The following diagram shows the same query in SQL:

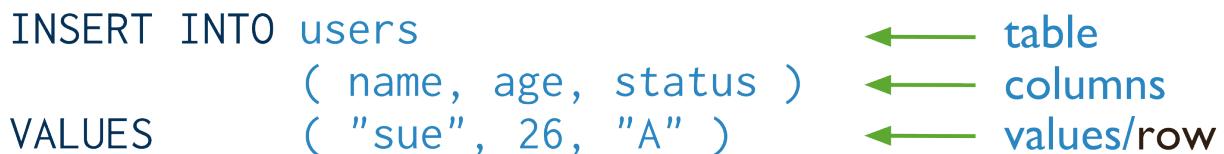


Figure 2.14: The components of a SQL INSERT statement.

Example

```
db.users.insert (
  {
    name: "sue",
    age: 26,
    status: "A"
  }
)
```

This operation inserts a new document into the `users` collection. The new document has four fields `name`, `age`, and `status`, and an `_id` field. MongoDB always adds the `_id` field to the new document if the field does not exist.

For more information, see `db.collection.insert()` (page 832) and [Insert Documents](#) (page 67).

An upsert is an operation that performs either an update of an existing document or an insert of a new document if the document to modify does not exist. With an upsert, applications do not need to make two separate calls to the database in order to decide between performing an update or an insert operation. Both the `db.collection.update()` (page 849) method and the `db.collection.save()` (page 846) method can perform an upsert. See `db.collection.update()` (page 849) and `db.collection.save()` (page 846) for details on performing an upsert with these methods.

See

SQL to MongoDB Mapping Chart (page 98) for additional examples of MongoDB write operations and the corresponding SQL statements.

Insert Behavior

If you add a new document *without* the `_id` field, the client library or the `mongod` (page 925) instance adds an `_id` field and populates the field with a unique *ObjectId*.

If you specify the `_id` field, the value must be unique within the collection. For operations with *write concern* (page 55), if you try to create a document with a duplicate `_id` value, `mongod` (page 925) returns a duplicate key exception.

Update

Update operations modify existing *documents* in a *collection*. In MongoDB, `db.collection.update()` (page 849) and the `db.collection.save()` (page 846) methods perform update operations. The `db.collection.update()` (page 849) method can accept a query criteria to determine which documents to update as well as an option to update multiple rows. The method can also accept options that affect its behavior such as the `multi` option to update multiple documents.

The following diagram highlights the components of a MongoDB update operation:

```
db.users.update(  
    { age: { $gt: 18 } },           ← collection  
    { $set: { status: "A" } },       ← update criteria  
    { multi: true }                ← update action  
)  
                                ← update option
```

Figure 2.15: The components of a MongoDB update operation.

The following diagram shows the same query in SQL:

Example

```
db.users.update(  
    { age: { $gt: 18 } },  
    { $set: { status: "A" } },  
    { multi: true }  
)
```

```
UPDATE users      ← table
SET   status = 'A' ← update action
WHERE age > 18    ← update criteria
```

Figure 2.16: The components of a SQL UPDATE statement.

This update operation on the `users` collection sets the `status` field to `A` for the documents that match the criteria of age greater than 18.

For more information, see `db.collection.update()` (page 849) and `db.collection.save()` (page 846), and *Modify Documents* (page 75) for examples.

Update Behavior

By default, the `db.collection.update()` (page 849) method updates a **single** document. However, with the `multi` option, `update()` (page 849) can update all documents in a collection that match a query.

The `db.collection.update()` (page 849) method either updates specific fields in the existing document or replaces the document. See `db.collection.update()` (page 849) for details.

When performing update operations that increase the document size beyond the allocated space for that document, the update operation relocates the document on disk and may reorder the document fields depending on the type of update.

The `db.collection.save()` (page 846) method replaces a document and can only update a single document. See `db.collection.save()` (page 846) and *Insert Documents* (page 67) for more information

Delete

Delete operations remove documents from a collection. In MongoDB, `db.collection.remove()` (page 844) method performs delete operations. The `db.collection.remove()` (page 844) method can accept a query criteria to determine which documents to remove.

The following diagram highlights the components of a MongoDB remove operation:

```
db.users.remove(
  { status: "D" }
)
```

Figure 2.17: The components of a MongoDB remove operation.

The following diagram shows the same query in SQL:

Example

DELETE FROM users ← table
WHERE status = 'D' ← delete criteria

Figure 2.18: The components of a SQL DELETE statement.

```
db.users.remove(  
    { status: "D" }  
)
```

This delete operation on the `users` collection removes all documents that match the criteria of `status` equal to D.

For more information, see `db.collection.remove()` (page 844) method and *Remove Documents* (page 76).

Remove Behavior

By default, `db.collection.remove()` (page 844) method removes all documents that match its query. However, the method can accept a flag to limit the delete operation to a single document.

Isolation of Write Operations

The modification of a single document is always atomic, even if the write operation modifies multiple sub-documents *within* that document. For write operations that modify multiple documents, the operation as a whole is not atomic, and other operations may interleave.

No other operations are atomic. You can, however, attempt to isolate a write operation that affects multiple documents using the *isolation operator* (page 663).

To isolate a sequence of write operations from other read and write operations, see *Perform Two Phase Commits* (page 77).

Related Concepts

The following documents further describe write operations:

[Write Concern](#) (page 55) Describes the kind of guarantee MongoDB provides when reporting on the success of a write operation.

[Distributed Write Operations](#) (page 59) Describes how MongoDB directs write operations on *sharded clusters* and *replica sets* and the performance characteristics of these operations.

[Write Operation Performance](#) (page 60) Introduces the performance constraints and factors for writing data to MongoDB deployments.

[Bulk Inserts in MongoDB](#) (page 64) Describe behaviors associated with inserting an array of documents.

[Record Padding](#) (page 65) When storing documents on disk, MongoDB reserves space to allow documents to grow efficiently during subsequent updates.

Write Concern

Write concern describes the guarantee that MongoDB provides when reporting on the success of a write operation. The strength of the write concerns determine the level of guarantee. When inserts, updates and deletes have a *weak* write concern, write operations return quickly. In some failure cases, write operations issued with weak write concerns may not persist. With *stronger* write concerns, clients wait after sending a write operation for MongoDB to confirm the write operations.

MongoDB provides different levels of write concern to better address the specific needs of applications. Clients may adjust write concern to ensure that the most important operations persist successfully to an entire MongoDB deployment. For other less critical operations, clients can adjust the write concern to ensure faster performance rather than ensure persistence to the entire deployment.

See also:

[Write Concern Reference](#) (page 96) for a reference of specific write concern configuration. Also consider [Write Operations](#) (page 50) for a general overview of write operations with MongoDB and [Write Concern for Replica Sets](#) (page 402) for considerations specific to replica sets.

Note: The [driver write concern](#) (page 1089) change created a new connection class in all of the MongoDB drivers. The new class, called `MongoClient` change the default write concern. See the [release notes](#) (page 1089) for this change and the release notes for your driver.

Write Concern Levels Clients issue write operations with some level of *write concern*. MongoDB has the following levels of conceptual write concern, listed from weakest to strongest:

Errors Ignored With an *errors ignored* write concern, MongoDB does not acknowledge write operations. With this level of write concern, the client cannot detect failed write operations. These errors include connection errors and `mongod` (page 925) exceptions such as duplicate key exceptions for [unique indexes](#) (page 334). Although the *errors ignored* write concern provides fast performance, this performance gain comes at the cost of significant risks for data persistence and durability.

To set *errors ignored* write concern, specify `w` values of `-1` to your driver.

Warning: Do not use *errors ignored* write concern in normal operation.

Unacknowledged With an *unacknowledged* write concern, MongoDB does not acknowledge the receipt of write operation. *Unacknowledged* is similar to *errors ignored*; however, drivers attempt receive and handle network errors when possible. The driver's ability to detect network errors depends on the system's networking configuration.

To set *unacknowledged* write concern, specify `w` values of `0` to your driver.

Before the releases outlined in [Default Write Concern Change](#) (page 1089), this was the default write concern.

Acknowledged With a receipt *acknowledged* write concern, the `mongod` (page 925) confirms the receipt of the write operation. *Acknowledged* write concern allows clients to catch network, duplicate key, and other errors.

To set *acknowledged* write concern, specify `w` values of `1` to your driver.

MongoDB uses *acknowledged* write concern by default, after the releases outlined in [Default Write Concern Change](#) (page 1089).

Internally, the default write concern calls `getLastError` (page 720) with no arguments. For replica sets, you can define the default write concern settings in the `getLastErrorDefaults` (page 483). When

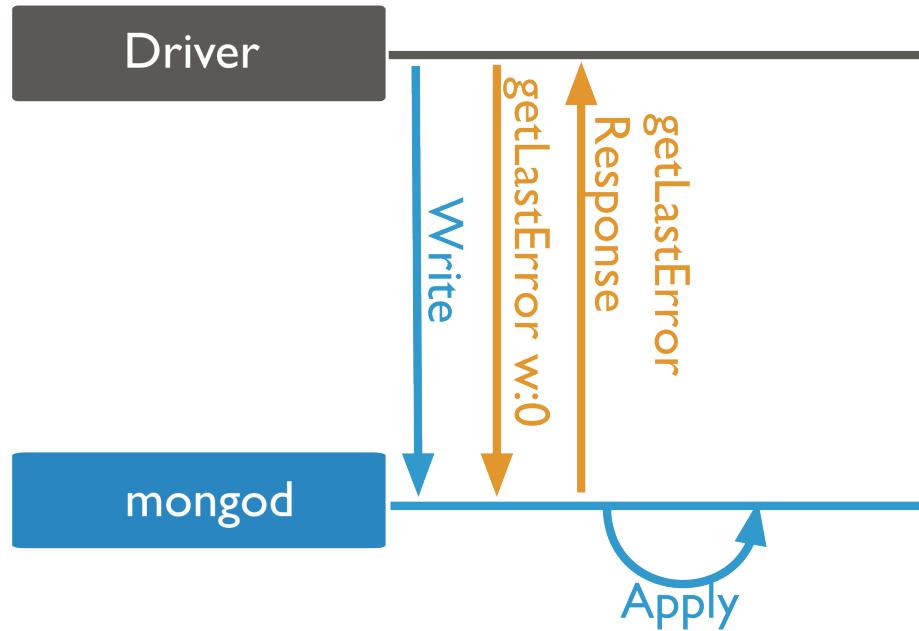


Figure 2.19: Write operation to a mongod instance with write concern of unacknowledged. The client does not wait for any acknowledgment.

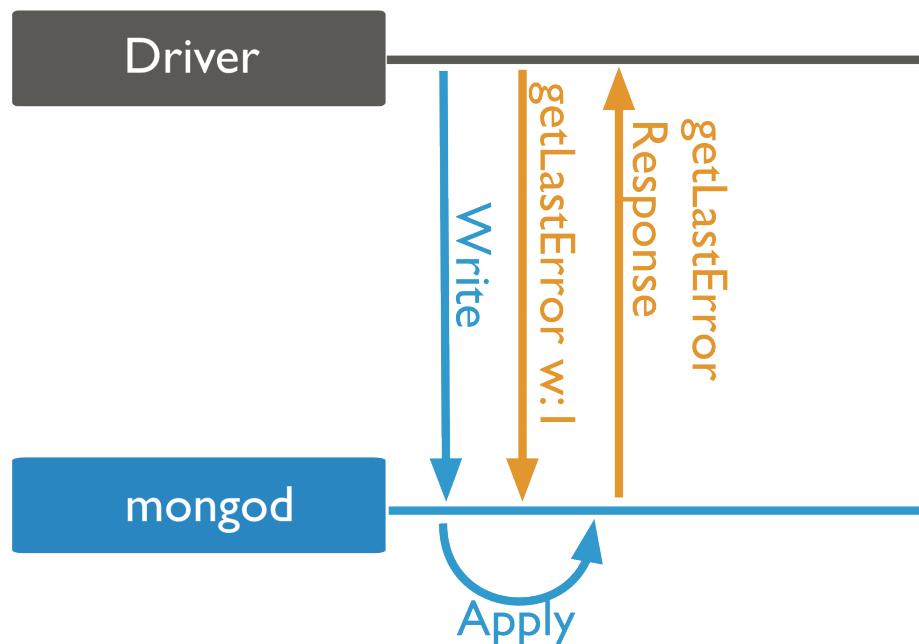


Figure 2.20: Write operation to a mongod instance with write concern of acknowledged. The client waits for acknowledgment of success or exception.

`getLastErrorDefaults` (page 483) does not define a default write concern setting, `getLastError` (page 720) defaults to basic receipt acknowledgment.

Jounaled With a *jounaled* write concern, the `mongod` (page 925) confirms the write operation only after committing to the *journal*. A confirmed journal commit ensures *durability*, which guarantees that a write operation will survive a `mongod` (page 925) shutdown. However, there is a window between journal commits when the write operation is not fully durable. See `journalCommitInterval` (page 995) for more information on this window.

To set *jounaled* write concern, specify `w` values of 1 and set the `journal` or `j` option to true to your driver.

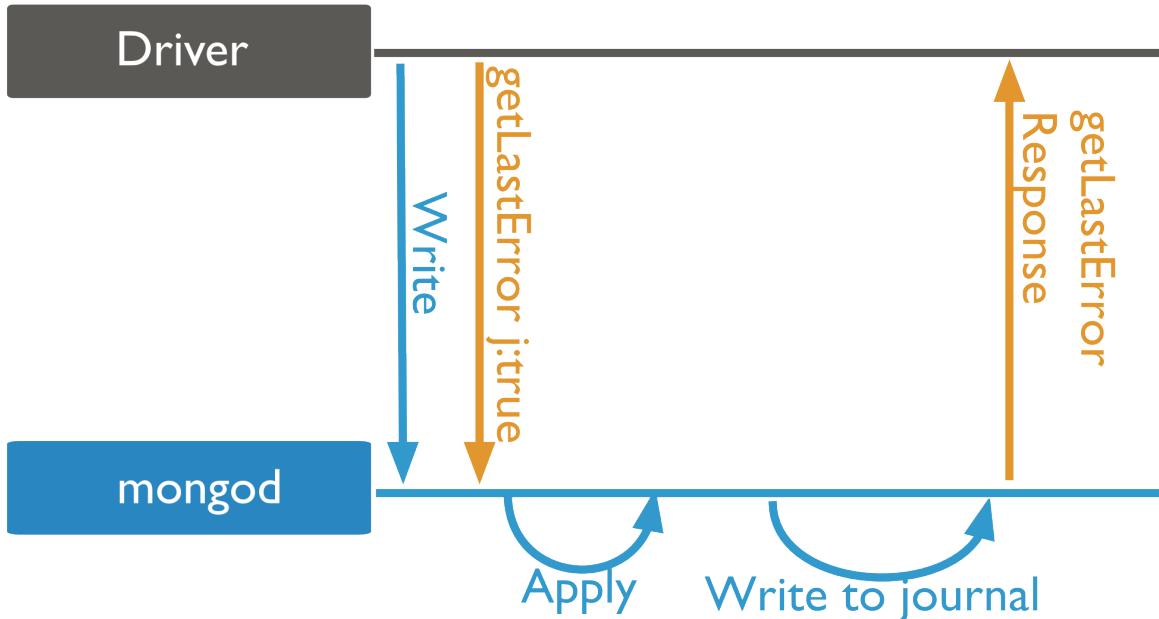


Figure 2.21: Write operation to a `mongod` instance with write concern of `jounaled`. The `mongod` sends acknowledgement after it commits the write operation to the journal.

Receipt *acknowledged* without *jounaled* provides the basis for write concern. Require *jounaled* as part of the write concern to provide this durability guarantee. The `mongod` (page 925) must have journaling enabled for the *jounaled* write concern to have effect.

Note: Requiring *jounaled* write concern in a replica set only requires a journal commit of the write operation to the *primary* of the set regardless of the level of *replica acknowledged* write concern.

Replica Acknowledged *Replica sets* add several considerations for write concern. Basic write concerns affect write operations on only one `mongod` (page 925) instance. The `w` argument to `getLastError` (page 720) provides *replica acknowledged* write concerns. With *replica acknowledged* you can guarantee that the write operation propagates to the members of a replica set. See `Write Concern Reference` (page 96) document for the values for `w` and `Write Concern for Replica Sets` (page 402) for more information.

To set *replica acknowledged* write concern, specify `w` values greater than 1 to your driver.

Note: Requiring *jounaled* write concern in a replica set only requires a journal commit of the write operation to the *primary* of the set regardless of the level of *replica acknowledged* write concern.

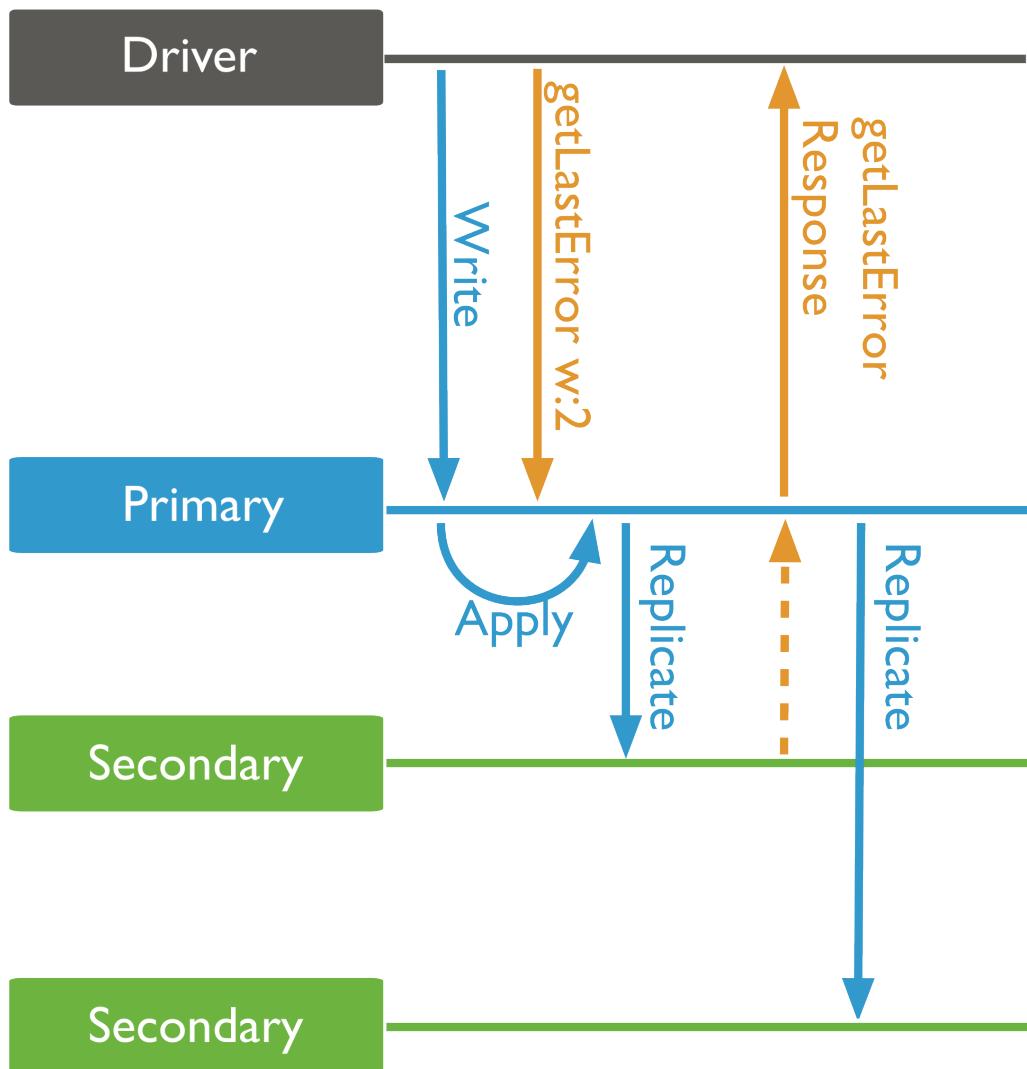


Figure 2.22: Write operation to a replica set with write concern level of `w:2` or write to the primary and at least one secondary.

Distributed Write Operations

Write Operations on Sharded Clusters For sharded collections in a *sharded cluster*, the `mongos` (page 938) directs write operations from applications to the shards that are responsible for the specific *portion* of the data set. The `mongos` (page 938) uses the cluster metadata from the *config database* (page 502) to route the write operation to the appropriate shards.

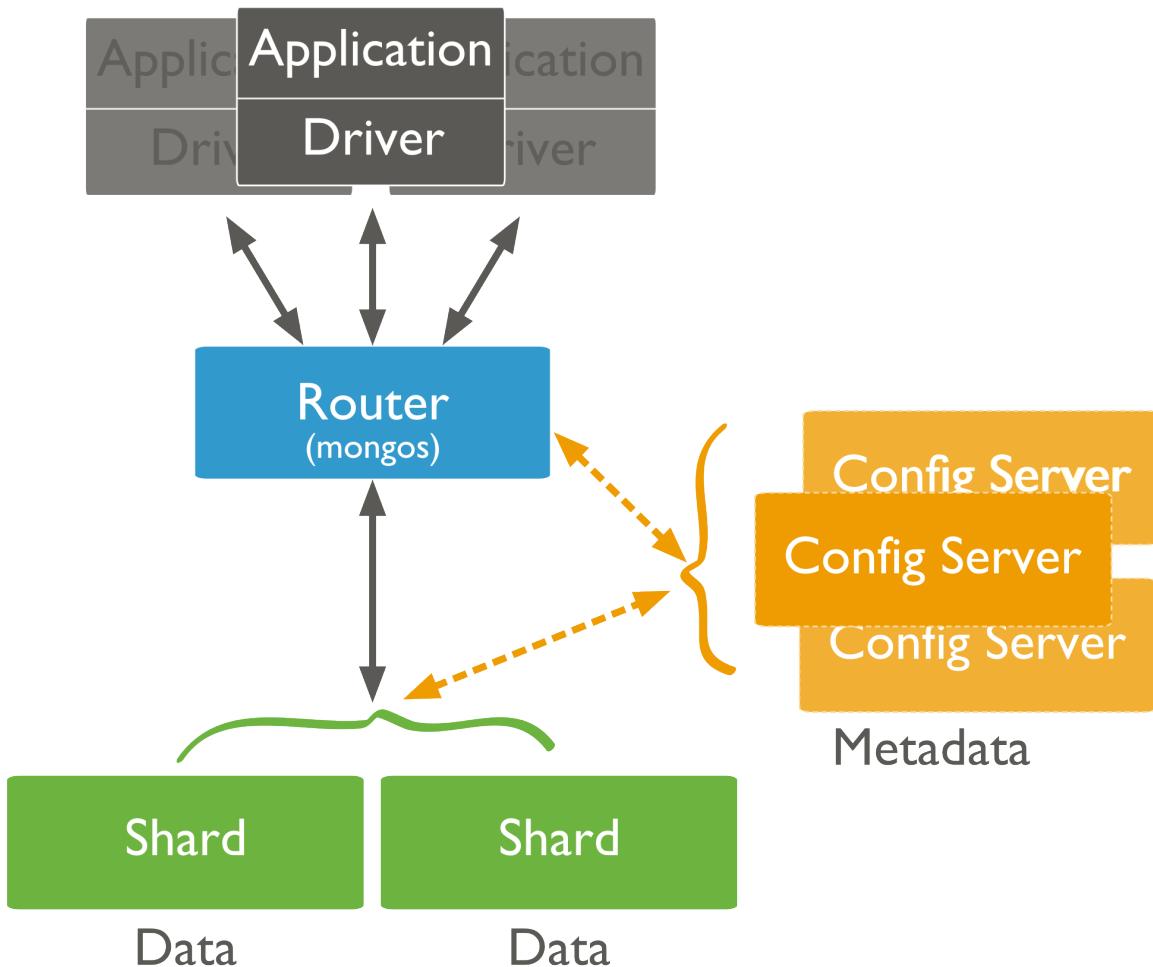


Figure 2.23: Diagram of a sharded cluster.

MongoDB partitions data in a sharded collection into *ranges* based on the values of the *shard key*. Then, MongoDB distributes these chunks to shards. The shard key determines the distribution of chunks to shards. This can affect the performance of write operations in the cluster.

Important: Update operations that affect a *single* document **must** include the *shard key* or the `_id` field. Updates that affect multiple documents are more efficient in some situations if they have the *shard key*, but can be broadcast to all shards.

If the value of the shard key increases or decreases with every insert, all insert operations target a single shard. As a result, the capacity of a single shard becomes the limit for the insert capacity of the sharded cluster.

For more information, see *Sharded Cluster Tutorials* (page 521) and *Bulk Inserts in MongoDB* (page 64).

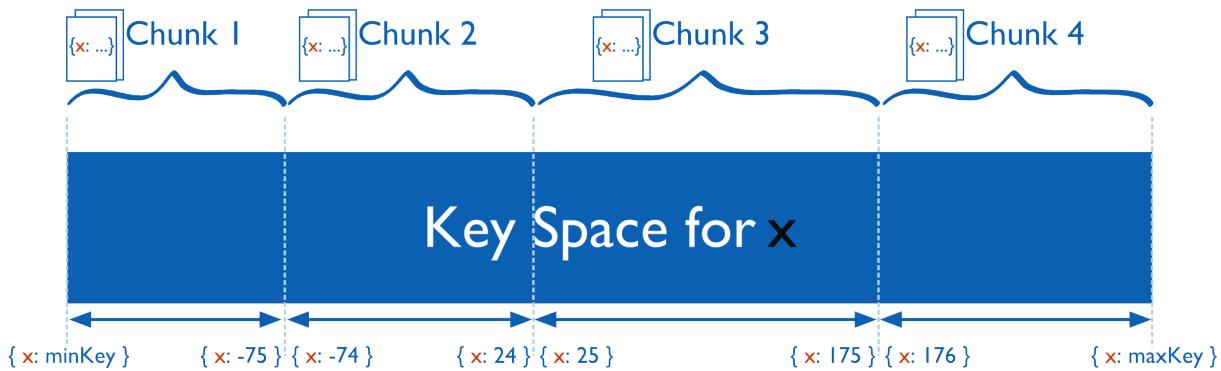


Figure 2.24: Diagram of the shard key value space segmented into smaller ranges or chunks.

Write Operations on Replica Sets In [replica sets](#), all write operations go to the set’s [primary](#), which applies the write operation then records the operations on the primary’s operation log or [oplog](#). The oplog is a reproducible sequence of operations to the data set. [Secondary](#) members of the set are continuously replicating the oplog and applying the operations to themselves in an asynchronous process.

Large volumes of write operations, particularly bulk operations, may create situations where the secondary members have difficulty applying the replicating operations from the primary at a sufficient rate: this can cause the secondary’s state to fall behind that of the primary. Secondaries that are significantly behind the primary present problems for normal operation of the replica set, particularly [failover](#) (page 396) in the form of [rollbacks](#) (page 401) as well as general [read consistency](#) (page 402).

To help avoid this issue, you can customize the [write concern](#) (page 55) to return confirmation of the write operation to another member⁴ of the replica set every 100 or 1,000 operations. This provides an opportunity for secondaries to catch up with the primary. Write concern can slow the overall progress of write operations but ensure that the secondaries can maintain a largely current state with respect to the primary.

For more information on replica sets and write operations, see [Replica Acknowledged](#) (page 57), [Oplog Size](#) (page 411), and [Change the Size of the Oplog](#) (page 446).

Write Operation Performance

- [Indexes](#) (page 60)
- [Document Growth](#) (page 63)
- [Storage Performance](#) (page 63)
 - [Hardware](#) (page 63)
 - [Journaling](#) (page 63)

Indexes After every insert, update, or delete operation, MongoDB must update *every* index associated with the collection in addition to the data itself. Therefore, every index on a collection adds some amount of overhead for the performance of write operations.⁵

⁴ Calling `getLastError` (page 720) intermittently with a `w` value of 2 or `majority` will slow the throughput of write traffic; however, this practice will allow the secondaries to remain current with the state of the primary.

⁵ For inserts and updates to un-indexed fields, the overhead for [sparse indexes](#) (page 335) is less than for non-sparse indexes. Also for non-sparse indexes, updates that do not change the record size have less indexing overhead.

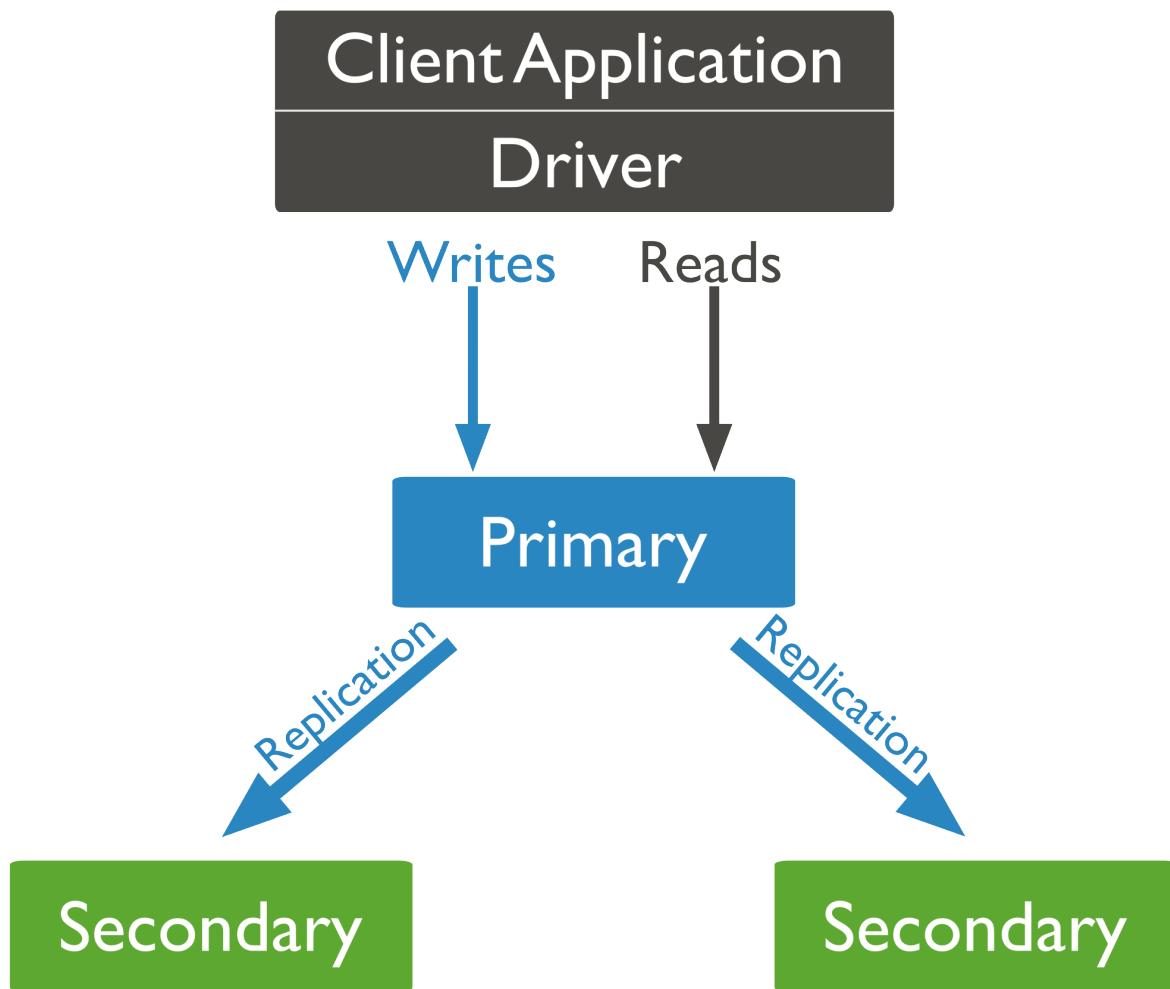


Figure 2.25: Diagram of default routing of reads and writes to the primary.

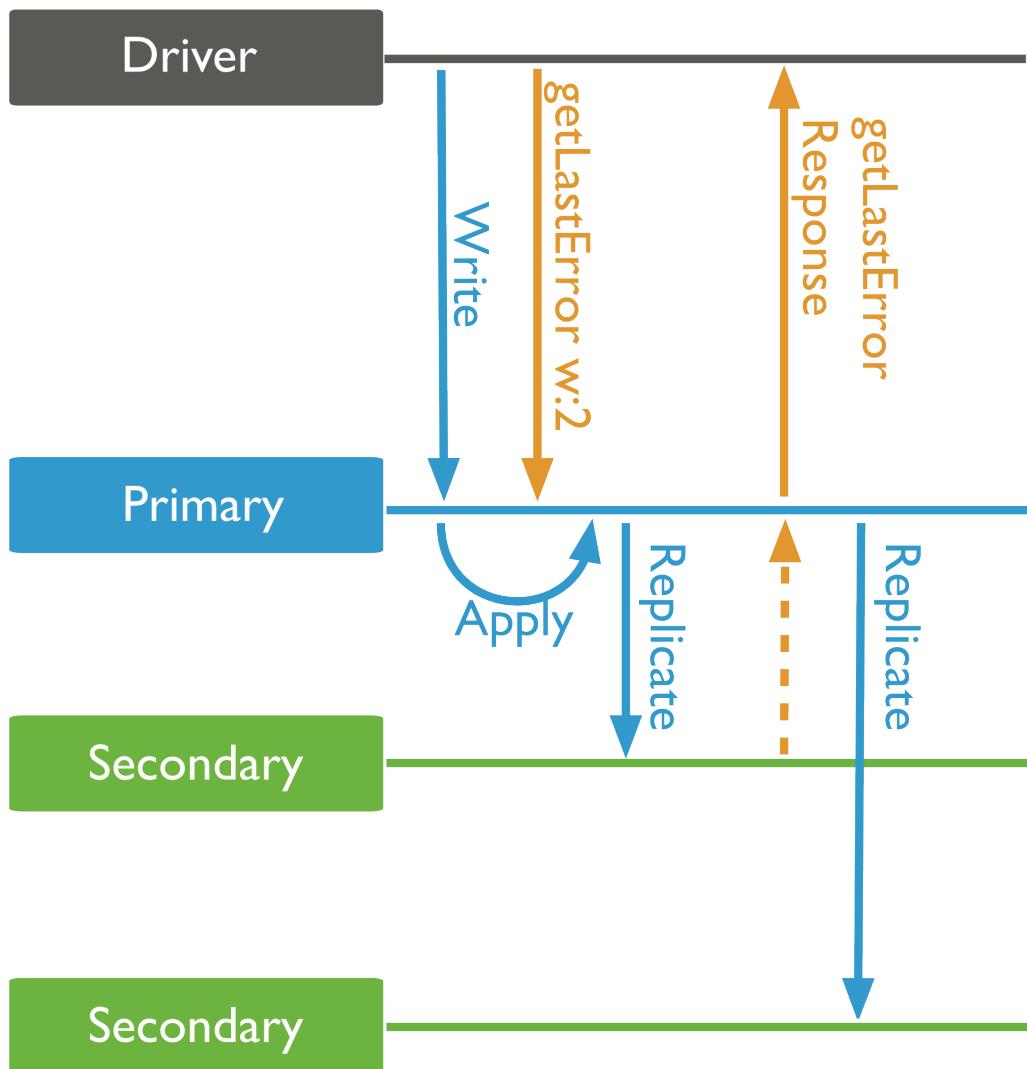


Figure 2.26: Write operation to a replica set with write concern level of `w:2` or write to the primary and at least one secondary.

In general, the performance gains that indexes provide for *read operations* are worth the insertion penalty. However, in order to optimize write performance when possible, be careful when creating new indexes and evaluate the existing indexes to ensure that your queries actually use these indexes.

For indexes and queries, see [Query Optimization](#) (page 44). For more information on indexes, see [Indexes](#) (page 313) and [Indexing Strategies](#) (page 367).

Document Growth If an update operation causes a document to exceed the currently allocated [record size](#), MongoDB relocates the document on disk with enough contiguous space to hold the document. These relocations take longer than in-place updates, particularly if the collection has indexes. If a collection has indexes, MongoDB must update all index entries. Thus, for a collection with many indexes, the move will impact the write throughput.

Some update operations, such as the [\\$inc](#) (page 651) operation, do not cause an increase in document size. For these update operations, MongoDB can apply the updates in-place. Other update operations, such as the [\\$push](#) (page 659) operation, change the size of the document.

In-place-updates are significantly more efficient than updates that cause document growth. When possible, use [data models](#) (page 117) that minimize the need for document growth.

See [Record Padding](#) (page 65) for more information.

Storage Performance

Hardware The capability of the storage system creates some important physical limits for the performance of MongoDB's write operations. Many unique factors related to the storage system of the drive affect write performance, including random access patterns, disk caches, disk readahead and RAID configurations.

Solid state drives (SSDs) can outperform spinning hard disks (HDDs) by 100 times or more for random workloads.

See

[Production Notes](#) (page 218) for recommendations regarding additional hardware and configuration options.

Journaling MongoDB uses *write ahead logging* to an on-disk [journal](#) to guarantee [write operation](#) (page 50) durability and to provide crash resiliency. Before applying a change to the data files, MongoDB writes the change operation to the journal.

While the durability assurance provided by the journal typically outweigh the performance costs of the additional write operations, consider the following interactions between the journal and performance:

- if the journal and the data file reside on the same block device, the data files and the journal may have to contend for a finite number of available write operations. Moving the journal to a separate device may increase the capacity for write operations.
- if applications specify [write concern](#) (page 55) that includes [journaled](#) (page 57), [mongod](#) (page 925) will decrease the duration between journal commits, which can increase the overall write load.
- the duration between journal commits is configurable using the [journalCommitInterval](#) (page 995) runtime option. Decreasing the period between journal commits will increase the number of write operations, which can limit MongoDB's capacity for write operations. Increasing the amount of time between commits may decrease the total number of write operations, but also increases the chance that the journal will not record a write operation in the event of a failure.

For additional information on journaling, see [Journaling Mechanics](#) (page 232).

Bulk Inserts in MongoDB

- Use the [insert \(\) Method](#) (page 64)
- Bulk Inserts on Sharded Clusters (page 64)
 - Pre-Split the Collection (page 64)
 - Insert to Multiple [mongos](#) (page 64)
 - Avoid Monotonic Throttling (page 64)

In some situations you may need to insert or ingest a large amount of data into a MongoDB database. These *bulk inserts* have some special considerations that are different from other write operations.

Use the `insert()` Method The [insert \(\)](#) (page 832) method, when passed an array of documents, performs a bulk insert, and inserts each document atomically. Bulk inserts can significantly increase performance by amortizing [write concern](#) (page 55) costs.

New in version 2.2: [insert \(\)](#) (page 832) in the [mongo](#) (page 942) shell gained support for bulk inserts in version 2.2.

In the [drivers](#) (page 95), you can configure write concern for batches rather than on a per-document level.

Drivers have a `ContinueOnError` option in their insert operation, so that the bulk operation will continue to insert remaining documents in a batch even if an insert fails.

Note: If multiple errors occur during a bulk insert, clients only receive the last error generated.

See also:

[Driver documentation](#) (page 95) for details on performing bulk inserts in your application. Also see [Import and Export MongoDB Data](#) (page 149).

Bulk Inserts on Sharded Clusters While `ContinueOnError` is optional on unsharded clusters, all bulk operations to a [sharded collection](#) run with `ContinueOnError`, which cannot be disabled.

Large bulk insert operations, including initial data inserts or routine data import, can affect [sharded cluster](#) performance. For bulk inserts, consider the following strategies:

Pre-Split the Collection If the sharded collection is empty, then the collection has only one initial [chunk](#), which resides on a single shard. MongoDB must then take time to receive data, create splits, and distribute the split chunks to the available shards. To avoid this performance cost, you can pre-split the collection, as described in [Split Chunks in a Sharded Cluster](#) (page 548).

Insert to Multiple [mongos](#) To parallelize import processes, send insert operations to more than one [mongos](#) (page 938) instance. Pre-split empty collections first as described in [Split Chunks in a Sharded Cluster](#) (page 548).

Avoid Monotonic Throttling If your shard key increases monotonically during an insert, then all inserted data goes to the last chunk in the collection, which will always end up on a single shard. Therefore, the insert capacity of the cluster will never exceed the insert capacity of that single shard.

If your insert volume is larger than what a single shard can process, and if you cannot avoid a monotonically increasing shard key, then consider the following modifications to your application:

- Reverse the binary bits of the shard key. This preserves the information and avoids correlating insertion order with increasing sequence of values.
- Swap the first and last 16-bit words to “shuffle” the inserts.

Example

The following example, in C++, swaps the leading and trailing 16-bit word of *BSON ObjectIds* generated so that they are no longer monotonically increasing.

```
using namespace mongo;
OID make_an_id() {
    OID x = OID::gen();
    const unsigned char *p = x.getData();
    swap( (unsigned short&) p[0], (unsigned short&) p[10] );
    return x;
}

void foo() {
    // create an object
    BSONObj o = BSON( "_id" << make_an_id() << "x" << 3 << "name" << "jane" );
    // now we may insert o into a sharded collection
}
```

See also:

[Shard Keys](#) (page 506) for information on choosing a sharded key. Also see [Shard Key Internals](#) (page 506) (in particular, [Choosing a Shard Key](#) (page 526)).

Record Padding

Update operations can increase the size of the document⁶. If a document outgrows its current allocated *record space*, MongoDB must allocate a new space and move the document to this new location.

To reduce the number of moves, MongoDB includes a small amount of extra space, or *padding*, when allocating the record space. This padding reduces the likelihood that a slight increase in document size will cause the document to exceed its allocated record size.

See also:

[Write Operation Performance](#) (page 60).

Padding Factor To minimize document movements and their impact, MongoDB employs padding. MongoDB adaptively adjusts the size of record allocations in a collection by adding a [paddingFactor](#) (page 764) so that the documents have room to grow. The [paddingFactor](#) (page 764) indicates the padding for new inserts and moves.

To check the current [paddingFactor](#) (page 764) on a collection, you can run the `db.collection.stats()` (page 848) operation in the `mongo` (page 942) shell, as in the following example:

```
db.myCollection.stats()
```

Since MongoDB writes each document at a different point in time, the padding for each document will not be the same. You can calculate the padding size by subtracting 1 from the [paddingFactor](#) (page 764), for example:

```
padding size = (paddingFactor - 1) * <document size>.
```

⁶ Documents in MongoDB can grow up to the full maximum [BSON document size](#) (page 1015).

For example, a `paddingFactor` (page 764) of `1.0` specifies no padding whereas a `paddingFactor` of `1.5` specifies a padding size of `0.5` or 50 percent (50%) of the document size.

Because the `paddingFactor` (page 764) is relative to the size of each document, you cannot calculate the exact amount of padding for a collection based on the average document size and padding factor.

If an update operation causes the document to *decrease* in size, for instance if you perform an `$unset` (page 655) or a `$pop` (page 657) update, the document remains in place and effectively has more padding. If the document remains this size, the space is not reclaimed until you perform a `compact` (page 752) or a `repairDatabase` (page 757) operation.

Operations That Remove Padding The following operations remove padding: `compact` (page 752), `repairDatabase` (page 757), and initial replica sync operations. However, with the `compact` (page 752) command, you can run the command with a `paddingFactor` or a `paddingBytes` parameter. See `compact` (page 752) command for details.

Padding is also removed if you use `mongoexport` (page 969) a collection. If you use `mongoimport` (page 965) into a new collection, `mongoimport` (page 965) will not add padding. If you use `mongoimport` (page 965) with an existing collection with padding, `mongoimport` (page 965) will not affect the existing padding.

When a database operation removes padding from a collection, subsequent updates to the collection that increase the record size will have reduced throughput until the collection's padding factor grows. However, the collection will require less storage.

Record Allocation Strategies New in version 2.2: `collMod` (page 755) and `usePowerOf2Sizes` (page 755).

To more efficiently reuse the space freed as a result of deletions or document relocations, you can specify that MongoDB allocates record sizes in powers of 2. To do so, use the `collMod` (page 755) command with the `usePowerOf2Sizes` (page 755) flag. See `collMod` (page 755) command for more details. As with all padding, power of 2 size allocations minimizes, but does not eliminate, document movements.

See also *Can I manually pad documents to prevent moves during updates?* (page 593)

2.3 MongoDB CRUD Tutorials

The following tutorials provide instructions for querying and modifying data. For a higher-level overview of these operations, see *MongoDB CRUD Operations* (page 35).

***Insert Documents* (page 67)** Insert new documents into a collection.

***Query Documents* (page 68)** Find documents in a collection using search criteria.

***Limit Fields to Return from a Query* (page 72)** Limit which fields are returned by a query.

***Iterate a Cursor in the mongo Shell* (page 73)** Access documents returned by a `find` (page 816) query by iterating the cursor, either manually or using the iterator index.

***Analyze Query Performance* (page 74)** Analyze the efficiency of queries and determine how a query uses available indexes.

***Modify Documents* (page 75)** Modify documents in a collection

***Remove Documents* (page 76)** Remove documents from a collection.

***Perform Two Phase Commits* (page 77)** Use two-phase commits when writing data to multiple documents.

***Create Tailable Cursor* (page 82)** Create tailable cursors for use in capped collections with high numbers of write operations for which an index would be too expensive.

Isolate Sequence of Operations (page 84) Use the <isolation> `isolated` operator to *isolate* a single write operation that affects multiple documents, preventing other operations from interrupting the sequence of write operations.

Create an Auto-Incrementing Sequence Field (page 86) Describes how to create an incrementing sequence number for the `_id` field using a Counters Collection or an Optimistic Loop.

Limit Number of Elements in an Array after an Update (page 89) Use `$push` with various modifiers to sort and maintain an array of fixed size after update

2.3.1 Insert Documents

In MongoDB, the `db.collection.insert()` (page 832) method adds new documents into a collection. In addition, both the `db.collection.update()` (page 849) method and the `db.collection.save()` (page 846) method can also add new documents through an operation called an *upsert*. An *upsert* is an operation that performs either an update of an existing document or an insert of a new document if the document to modify does not exist.

This tutorial provides examples of insert operations using each of the three methods in the `mongo` (page 942) shell.

Insert a Document with `insert()` Method

The following statement inserts a document with three fields into the collection `inventory`:

```
db.inventory.insert( { _id: 10, type: "misc", item: "card", qty: 15 } )
```

In the example, the document has a user-specified `_id` field value of 10. The value must be unique within the `inventory` collection.

For more examples, see `insert()` (page 832).

Insert a Document with `update()` Method

Call the `update()` (page 849) method with the `upsert` flag to create a new document if no document matches the update's query criteria.⁷

The following example creates a new document if no document in the `inventory` collection contains `{ type: "books", item : "journal" }`:

```
db.inventory.update(
    { type: "book", item : "journal" },
    { $set : { qty: 10 } },
    { upsert : true }
)
```

MongoDB adds the `_id` field and assigns as its value a unique ObjectId. The new document includes the `item` and `type` fields from the <query> criteria and the `qty` field from the <update> parameter.

```
{ "_id" : ObjectId("51e8636953dbe31d5f34a38a"), "item" : "journal", "qty" : 10, "type" : "book" }
```

For more examples, see `update()` (page 849).

⁷ Prior to version 2.2, in the `mongo` (page 942) shell, you would specify the `upsert` and the `multi` options in the `update()` (page 849) method as positional boolean options. See `update()` (page 849) for details.

Insert a Document with `save()` Method

To insert a document with the `save()` (page 846) method, pass the method a document that does not contain the `_id` field or a document that contains an `_id` field that does not exist in the collection.

The following example creates a new document in the `inventory` collection:

```
db.inventory.save( { type: "book", item: "notebook", qty: 40 } )
```

MongoDB adds the `_id` field and assigns as its value a unique ObjectId.

```
{ "_id" : ObjectId("51e866e48737f72b32ae4fbc"), "type" : "book", "item" : "notebook", "qty" : 40 }
```

For more examples, see `save()` (page 846).

2.3.2 Query Documents

In MongoDB, the `db.collection.find()` (page 816) method retrieves documents from a collection.⁸ The `db.collection.find()` (page 816) method returns a `cursor` (page 43) to the retrieved documents.

This tutorial provides examples of read operations using the `db.collection.find()` (page 816) method in the `mongo` (page 942) shell. In these examples, the retrieved documents contain all their fields. To restrict the fields to return in the retrieved documents, see *Limit Fields to Return from a Query* (page 72).

Select All Documents in a Collection

An empty query document (`{ }`) selects all documents in the collection:

```
db.inventory.find( {} )
```

Not specifying a query document to the `find()` (page 816) is equivalent to specifying an empty query document. Therefore the following operation is equivalent to the previous operation:

```
db.inventory.find()
```

Specify Equality Condition

To specify equality condition, use the query document `{ <field>: <value> }` to select all documents that contain the `<field>` with the specified `<value>`.

The following example retrieves from the `inventory` collection all documents where the `type` field has the value `snacks`:

```
db.inventory.find( { type: "snacks" } )
```

Specify Conditions Using Query Operators

A query document can use the `query operators` (page 621) to specify conditions in a MongoDB query.

The following example selects all documents in the `inventory` collection where the value of the `type` field is either '`food`' or '`snacks`':

⁸ The `db.collection.findOne()` (page 824) method also performs a read operation to return a single document. Internally, the `db.collection.findOne()` (page 824) method is the `db.collection.find()` (page 816) method with a limit of 1.

```
db.inventory.find( { type: { $in: [ 'food', 'snacks' ] } } )
```

Although you can express this query using the [\\$or](#) (page 625) operator, use the [\\$in](#) (page 623) operator rather than the [\\$or](#) (page 625) operator when performing equality checks on the same field.

Refer to the [Operators](#) (page 621) document for the complete list of query operators.

Specify AND Conditions

A compound query can specify conditions for more than one field in the collection’s documents. Implicitly, a logical AND conjunction connects the clauses of a compound query so that the query selects the documents in the collection that match all the conditions.

In the following example, the query document specifies an equality match on the field `food` **and** a less than ([\\$lt](#) (page 623)) comparison match on the field `price`:

```
db.inventory.find( { type: 'food', price: { $lt: 9.95 } } )
```

This query selects all documents where the `type` field has the value `' food'` **and** the value of the `price` field is less than `9.95`. See [comparison operators](#) (page 621) for other comparison operators.

Specify OR Conditions

Using the [\\$or](#) (page 625) operator, you can specify a compound query that joins each clause with a logical OR conjunction so that the query selects the documents in the collection that match at least one condition.

In the following example, the query document selects all documents in the collection where the field `qty` has a value greater than ([\\$gt](#) (page 622)) `100` **or** the value of the `price` field is less than ([\\$lt](#) (page 623)) `9.95`:

```
db.inventory.find(
  { $or: [
    { qty: { $gt: 100 } },
    { price: { $lt: 9.95 } }
  ]
})
```

Specify AND as well as OR Conditions

With additional clauses, you can specify precise conditions for matching documents.

In the following example, the compound query document selects all documents in the collection where the value of the `type` field is `' food'` **and** *either* the `qty` has a value greater than ([\\$gt](#) (page 622)) `100` *or* the value of the `price` field is less than ([\\$lt](#) (page 623)) `9.95`:

```
db.inventory.find( { type: 'food', $or: [ { qty: { $gt: 100 } },
                                         { price: { $lt: 9.95 } } ]
} )
```

Subdocuments

When the field holds an embedded document (i.e. subdocument), you can either specify the entire subdocument as the value of a field, or “reach into” the subdocument using [dot notation](#), to specify values for individual fields in the subdocument:

Exact Match on Subdocument

To specify an equality match on the whole subdocument, use the query document { <field>: <value> } where <value> is the subdocument to match. Equality matches on a subdocument require that the subdocument field match *exactly* the specified <value>, including the field order.

In the following example, the query matches all documents where the value of the field `producer` is a subdocument that contains *only* the field `company` with the value '`ABC123`' and the field `address` with the value '`123 Street`', in the exact order:

```
db.inventory.find(
  {
    producer: {
      company: 'ABC123',
      address: '123 Street'
    }
  }
)
```

Equality Match on Fields within Subdocument

Equality matches for specific fields within subdocuments select the documents in the collection when the field in the subdocument contains a field that matches the specified value.

In the following example, the query uses the *dot notation* to match all documents where the value of the field `producer` is a subdocument that contains a field `company` with the value '`ABC123`' and may contain other fields:

```
db.inventory.find( { 'producer.company': 'ABC123' } )
```

Arrays

When the field holds an array, you can query for an exact array match or for specific values in the array. If the array holds sub-documents, you can query for specific fields within the sub-documents using *dot notation*:

Exact Match on an Array

To specify equality match on an array, use the query document { <field>: <value> } where <value> is the array to match. Equality matches on the array require that the array field match *exactly* the specified <value>, including the element order.

In the following example, the query matches all documents where the value of the field `tags` is an array that holds exactly three elements, '`fruit`', '`food`', and '`citrus`', in this order:

```
db.inventory.find( { tags: [ 'fruit', 'food', 'citrus' ] } )
```

Match an Array Element

Equality matches can specify a single element in the array to match. These specifications match if the array contains at least *one* element with the specified value.

In the following example, the query matches all documents where the value of the field `tags` is an array that contains '`fruit`' as one of its elements:

```
db.inventory.find( { tags: 'fruit' } )
```

Match a Specific Element of an Array

Equality matches can specify equality matches for an element at a particular index or position of the array.

In the following example, the query uses the *dot notation* to match all documents where the value of the `tags` field is an array whose first element equals `'fruit'`:

```
db.inventory.find( { 'tags.0' : 'fruit' } )
```

Array of Subdocuments

Match a Field in the Subdocument Using the Array Index If you know the array index of the subdocument, you can specify the document using the subdocument's position.

The following example selects all documents where the `memos` contains an array whose first element (i.e. index is 0) is a subdocument with the field `by` with the value `'shipping'`:

```
db.inventory.find( { 'memos.0.by': 'shipping' } )
```

Match a Field Without Specifying Array Index If you do not know the index position of the subdocument, concatenate the name of the field that contains the array, with a dot (.) and the name of the field in the subdocument.

The following example selects all documents where the `memos` field contains an array that contains at least one subdocument with the field `by` with the value `'shipping'`:

```
db.inventory.find( { 'memos.by': 'shipping' } )
```

Match Multiple Fields To match by multiple fields in the subdocument, you can use either dot notation or the `$elemMatch` (page 645) operator:

The following example uses dot notation to query for documents where the value of the `memos` field is an array that has at least one subdocument that contains the field `memo` equal to `'on time'` and the field `by` equal to `'shipping'`:

```
db.inventory.find(
  {
    'memos.memo': 'on time',
    'memos.by': 'shipping'
  }
)
```

The following example uses `$elemMatch` (page 645) to query for documents where the value of the `memos` field is an array that has at least one subdocument that contains the field `memo` equal to `'on time'` and the field `by` equal to `'shipping'`:

```
db.inventory.find( {
  memos: {
    $elemMatch: {
      memo : 'on time',
      by: 'shipping'
    }
  }
})
```

2.3.3 Limit Fields to Return from a Query

The [projection](#) specification limits the fields to return for all matching documents. The projection takes the form of a [document](#) with a list of fields for inclusion or exclusion from the result set. You can either specify the fields to include (e.g. { field: 1 }) or specify the fields to exclude (e.g. { field: 0 }).

Important: The `_id` field is, by default, included in the result set. To exclude the `_id` field from the result set, you need to specify in the projection document the exclusion of the `_id` field (i.e. { `_id`: 0 }).

You cannot combine inclusion and exclusion semantics in a single projection with the *exception* of the `_id` field.

This tutorial offers various query examples that limit the fields to return for all matching documents. The examples in this tutorial use a collection `inventory` and use the [`db.collection.find\(\)`](#) (page 816) method in the [mongo](#) (page 942) shell. The [`db.collection.find\(\)`](#) (page 816) method returns a [cursor](#) (page 43) to the retrieved documents. For examples on query selection criteria, see [Query Documents](#) (page 68).

Return All Fields in Matching Documents

If you specify no projection, the [`find\(\)`](#) (page 816) method returns all fields of all documents that match the query.

```
db.inventory.find( { type: 'food' } )
```

This operation will return all documents in the `inventory` collection where the value of the `type` field is 'food'. The returned documents contain all its fields.

Return the Specified Fields and the `_id` Field Only

A projection can explicitly include several fields. In the following operation, [`find\(\)`](#) (page 816) method returns all documents that match the query. In the result set, only the `item` and `qty` fields and, by default, the `_id` field return in the matching documents.

```
db.inventory.find( { type: 'food' }, { item: 1, qty: 1 } )
```

Return Specified Fields Only

You can remove the `_id` field from the results by specifying its exclusion in the projection, as in the following example:

```
db.inventory.find( { type: 'food' }, { item: 1, qty: 1, _id: 0 } )
```

This operation returns all documents that match the query. In the result set, *only* the `item` and `qty` fields return in the matching documents.

Return All But the Excluded Field

To exclude a single field or group of fields you can use a projection in the following form:

```
db.inventory.find( { type: 'food' }, { type: 0 } )
```

This operation returns all documents where the value of the `type` field is `food`. In the result set, the `type` field does not return in the matching documents.

With the exception of the `_id` field you cannot combine inclusion and exclusion statements in projection documents.

Projection for Array Fields

The `$elemMatch` (page 648) and `$slice` (page 650) projection operators provide more control when projecting only a portion of an array.

2.3.4 Iterate a Cursor in the mongo Shell

The `db.collection.find()` (page 816) method returns a cursor. To access the documents, you need to iterate the cursor. However, in the `mongo` (page 942) shell, if the returned cursor is not assigned to a variable using the `var` keyword, then the cursor is automatically iterated up to 20 times to print up to the first 20 documents in the results. The following describes ways to manually iterate the cursor to access the documents or to use the iterator index.

Manually Iterate the Cursor

In the `mongo` (page 942) shell, when you assign the cursor returned from the `find()` (page 816) method to a variable using the `var` keyword, the cursor does not automatically iterate.

You can call the cursor variable in the shell to iterate up to 20 times ⁹ and print the matching documents, as in the following example:

```
var myCursor = db.inventory.find( { type: 'food' } );
myCursor
```

You can also use the cursor method `next()` (page 870) to access the documents, as in the following example:

```
var myCursor = db.inventory.find( { type: 'food' } );
var myDocument = myCursor.hasNext() ? myCursor.next() : null;

if (myDocument) {
    var myItem = myDocument.item;
    print(tojson(myItem));
}
```

As an alternative print operation, consider the `printjson()` helper method to replace `print(tojson())`:

```
if (myDocument) {
    var myItem = myDocument.item;
    printjson(myItem);
}
```

You can use the cursor method `forEach()` (page 866) to iterate the cursor and access the documents, as in the following example:

```
var myCursor = db.inventory.find( { type: 'food' } );
myCursor.forEach(printjson);
```

See [JavaScript cursor methods](#) (page 858) and your [driver](#) (page 95) documentation for more information on cursor methods.

⁹ You can use the `DBQuery.shellBatchSize` to change the number of iteration from the default value 20. See [Executing Queries](#) (page 205) for more information.

Iterator Index

In the `mongo` (page 942) shell, you can use the `toArray()` (page 874) method to iterate the cursor and return the documents in an array, as in the following:

```
var myCursor = db.inventory.find( { type: 'food' } );
var documentArray = myCursor.toArray();
var myDocument = documentArray[3];
```

The `toArray()` (page 874) method loads into RAM all documents returned by the cursor; the `toArray()` (page 874) method exhausts the cursor.

Additionally, some *drivers* (page 95) provide access to the documents by using an index on the cursor (i.e. `cursor[index]`). This is a shortcut for first calling the `toArray()` (page 874) method and then using an index on the resulting array.

Consider the following example:

```
var myCursor = db.inventory.find( { type: 'food' } );
var myDocument = myCursor[3];
```

The `myCursor[3]` is equivalent to the following example:

```
myCursor.toArray() [3];
```

2.3.5 Analyze Query Performance

The `explain()` (page 861) cursor method allows you to inspect the operation of the query system. This method is useful for analyzing the efficiency of queries, and for determining how the query uses the index. The `explain()` (page 861) method tests the query operation, and *not* the timing of query performance. Because `explain()` (page 861) attempts multiple query plans, it does not reflect an accurate timing of query performance.

Evaluate the Performance of a Query

To use the `explain()` (page 861) method, call the method on a cursor returned by `find()` (page 816).

Example

Evaluate a query on the `type` field on the collection `inventory` that has an index on the `type` field.

```
db.inventory.find( { type: 'food' } ).explain()
```

Consider the results:

```
{
  "cursor" : "BtreeCursor type_1",
  "isMultiKey" : false,
  "n" : 5,
  "nscannedObjects" : 5,
  "nscanned" : 5,
  "nscannedObjectsAllPlans" : 5,
  "nscannedAllPlans" : 5,
  "scanAndOrder" : false,
  "indexOnly" : false,
  "nYields" : 0,
  "nChunkSkips" : 0,
  "millis" : 0,
```

```
"indexBounds" : { "type" : [
    [ "food",
      "food" ]
  ] },
"server" : "mongodb0.example.net:27017" }
```

The `BtreeCursor` value of the `cursor` (page 863) field indicates that the query used an index.

This query returned 5 documents, as indicated by the `n` (page 864) field.

To return these 5 documents, the query scanned 5 documents from the index, as indicated by the `nscanned` (page 864) field, and then read 5 full documents from the collection, as indicated by the `nscannedObjects` (page 864) field.

Without the index, the query would have scanned the whole collection to return the 5 documents.

See *Explain Results* (page 861) method for full details on the output.

Compare Performance of Indexes

To manually compare the performance of a query using more than one index, you can use the `hint()` (page 866) and `explain()` (page 861) methods in conjunction.

Example

Evaluate a query using different indexes:

```
db.inventory.find( { type: 'food' } ).hint( { type: 1 } ).explain()
db.inventory.find( { type: 'food' } ).hint( { type: 1, name: 1 } ).explain()
```

These return the statistics regarding the execution of the query using the respective index.

Note: If you run `explain()` (page 861) without including `hint()` (page 866), the query optimizer reevaluates the query and runs against multiple indexes before returning the query statistics.

For more detail on the explain output, see *Explain Results* (page 861).

2.3.6 Modify Documents

In MongoDB, both `db.collection.update()` (page 849) and `db.collection.save()` (page 846) modify existing documents in a collection. `db.collection.update()` (page 849) provides additional control over the modification. For example, you can modify existing data or modify a group of documents that match a query with `db.collection.update()` (page 849). Alternately, `db.collection.save()` (page 846) replaces an existing document with the same `_id` field.

This document provides examples of the update operations using each of the two methods in the `mongo` (page 942) shell.

Modify Multiple Documents with `update()` Method

By default, the `update()` (page 849) method updates a single document that matches its selection criteria. Call the method with the `multi` option set to `true` to update multiple documents.¹⁰

¹⁰ This shows the syntax for MongoDB 2.2 and later. For syntax for versions prior to 2.2, see `update()` (page 849).

The following example finds all documents with `type` equal to "book" and modifies their `qty` field by -1. The example uses `$inc` (page 651), which is one of the `:ref:update operators <update-operators>` available.

```
db.inventory.update(
  { type : "book" },
  { $inc : { qty : -1 } },
  { multi: true }
)
```

For more examples, see `update()` (page 849).

Modify a Document with `save()` Method

The `save()` (page 846) method can replace an existing document. To replace a document with the `save()` (page 846) method, pass the method a document with an `_id` field that matches an existing document.

The following example completely replaces the document with the `_id` equal to 10 in the `inventory` collection:

```
db.inventory.save(
{
  _id: 10,
  type: "misc",
  item: "placard"
})
```

For further examples, see `save()` (page 846).

2.3.7 Remove Documents

In MongoDB, the `db.collection.remove()` (page 844) method removes documents from a collection. You can remove all documents, specify which documents to remove, and limit the operation to a single document.

This tutorial provides examples of remove operations using the `db.collection.remove()` (page 844) method in the `mongo` (page 942) shell.

Remove All Documents

If you do not specify a query, `remove()` (page 844) removes all documents from a collection, but does not remove the indexes.¹¹

The following example removes all documents from the `inventory` collection:

```
db.inventory.remove()
```

Remove Documents that Matches a Condition

To remove the documents that match a deletion criteria, call the `remove()` (page 844) method with the `<query>` parameter.

The following example removes all documents that have `type` equal to `food` from the `inventory` collection:

¹¹ To remove all documents from a collection, it may be more efficient to use the `drop()` (page 812) method to drop the entire collection, including the indexes, and then recreate the collection and rebuild the indexes.

```
db.inventory.remove( { type : "food" } )
```

Note: For large deletion operations, it may be more efficient to copy the documents that you want to keep to a new collection and then use [drop\(\)](#) (page 812) on the original collection.

Remove a Single Document that Matches a Condition

To remove a single document, call the [remove\(\)](#) (page 844) method with the `justOne` parameter set to `true` or `1`.

The following example removes one document that have `type` equal to `food` from the `inventory` collection:

```
db.inventory.remove( { type : "food" }, 1 )
```

2.3.8 Perform Two Phase Commits

Synopsis

This document provides a pattern for doing multi-document updates or “transactions” using a two-phase commit approach for writing data to multiple documents. Additionally, you can extend this process to provide a *rollback* (page 80) like functionality.

Background

Operations on a single *document* are always atomic with MongoDB databases; however, operations that involve multiple documents, which are often referred to as “transactions,” are not atomic. Since documents can be fairly complex and contain multiple “nested” documents, single-document atomicity provides necessary support for many practical use cases.

Thus, without precautions, success or failure of the database operation cannot be “all or nothing,” and without support for multi-document transactions it’s possible for an operation to succeed for some operations and fail with others. When executing a transaction composed of several sequential operations the following issues arise:

- Atomicity: if one operation fails, the previous operation within the transaction must “rollback” to the previous state (i.e. the “nothing,” in “all or nothing.”)
- Isolation: operations that run concurrently with the transaction operation set must “see” a consistent view of the data throughout the transaction process.
- Consistency: if a major failure (i.e. network, hardware) interrupts the transaction, the database must be able to recover a consistent state.

Despite the power of single-document atomic operations, there are cases that require multi-document transactions. For these situations, you can use a two-phase commit, to provide support for these kinds of multi-document updates.

Because documents can represent both pending data and states, you can use a two-phase commit to ensure that data is consistent, and that in the case of an error, the state that preceded the transaction is *recoverable* (page 80).

Note: Because only single-document operations are atomic with MongoDB, two-phase commits can only offer transaction-*like* semantics. It’s possible for applications to return intermediate data at intermediate points during the two-phase commit or rollback.

Pattern

Overview

The most common example of transaction is to transfer funds from account A to B in a reliable way, and this pattern uses this operation as an example. In a relational database system, this operation would encapsulate subtracting funds from the source (A) account and adding them to the destination (B) within a single atomic transaction. For MongoDB, you can use a two-phase commit in these situations to achieve a compatible response.

All of the examples in this document use the `mongo` (page 942) shell to interact with the database, and assume that you have two collections: First, a collection named `accounts` that will store data about accounts with one account per document, and a collection named `transactions` which will store the transactions themselves.

Begin by creating two accounts named A and B, with the following command:

```
db.accounts.save({name: "A", balance: 1000, pendingTransactions: []})
db.accounts.save({name: "B", balance: 1000, pendingTransactions: []})
```

To verify that these operations succeeded, use `find()` (page 816):

```
db.accounts.find()
```

`mongo` (page 942) will return two *documents* that resemble the following:

```
{ "_id" : ObjectId("4d7bc66cb8a04f512696151f"), "name" : "A", "balance" : 1000, "pendingTransactions": []}
{ "_id" : ObjectId("4d7bc67bb8a04f5126961520"), "name" : "B", "balance" : 1000, "pendingTransactions": []}
```

Transaction Description

Set Transaction State to Initial Create the `transaction` collection by inserting the following document. The transaction document holds the `source` and `destination`, which refer to the `name` fields of the `accounts` collection, as well as the `value` field that represents the amount of data change to the `balance` field. Finally, the `state` field reflects the current state of the transaction.

```
db.transactions.save({source: "A", destination: "B", value: 100, state: "initial"})
```

To verify that these operations succeeded, use `find()` (page 816):

```
db.transactions.find()
```

This will return a document similar to the following:

```
{ "_id" : ObjectId("4d7bc7a8b8a04f5126961522"), "source" : "A", "destination" : "B", "value" : 100, "state" : "initial"}
```

Switch Transaction State to Pending Before modifying either records in the `accounts` collection, set the transaction state to `pending` from `initial`.

Set the local variable `t` in your shell session, to the transaction document using `findOne()` (page 824):

```
t = db.transactions.findOne({state: "initial"})
```

After assigning this variable `t`, the shell will return the value of `t`, you will see the following output:

```
{
  "_id" : ObjectId("4d7bc7a8b8a04f5126961522"),
  "source" : "A",
  "destination" : "B",
  "value" : 100,
  "state" : "initial"
}
```

```

        "state" : "initial"
    }

```

Use `update()` (page 849) to change the value of `state` to `pending`:

```
db.transactions.update({_id: t._id}, {$set: {state: "pending"}})
db.transactions.find()
```

The `find()` (page 816) operation will return the contents of the `transactions` collection, which should resemble the following:

```
{ "_id" : ObjectId("4d7bc7a8b8a04f5126961522"), "source" : "A", "destination" : "B", "value" : 100, "state" : "initial" }
```

Apply Transaction to Both Accounts Continue by applying the transaction to both accounts. The `update()` (page 849) query will prevent you from applying the transaction *if* the transaction is *not* already pending. Use the following `update()` (page 849) operation:

```
db.accounts.update({name: t.source, pendingTransactions: {$ne: t._id}}, {$inc: {balance: -t.value}})
db.accounts.update({name: t.destination, pendingTransactions: {$ne: t._id}}, {$inc: {balance: t.value}})
db.accounts.find()
```

The `find()` (page 816) operation will return the contents of the `accounts` collection, which should now resemble the following:

```
{ "_id" : ObjectId("4d7bc97fb8a04f5126961523"), "balance" : 900, "name" : "A", "pendingTransactions" : 100 }
{ "_id" : ObjectId("4d7bc984b8a04f5126961524"), "balance" : 1100, "name" : "B", "pendingTransactions" : 100 }
```

Set Transaction State to Committed Use the following `update()` (page 849) operation to set the transaction's state to `committed`:

```
db.transactions.update({_id: t._id}, {$set: {state: "committed"}})
db.transactions.find()
```

The `find()` (page 816) operation will return the contents of the `transactions` collection, which should now resemble the following:

```
{ "_id" : ObjectId("4d7bc7a8b8a04f5126961522"), "destination" : "B", "source" : "A", "state" : "committed" }
```

Remove Pending Transaction Use the following `update()` (page 849) operation to set remove the pending transaction from the `documents` in the `accounts` collection:

```
db.accounts.update({name: t.source}, {$pull: {pendingTransactions: t._id}})
db.accounts.update({name: t.destination}, {$pull: {pendingTransactions: t._id}})
db.accounts.find()
```

The `find()` (page 816) operation will return the contents of the `accounts` collection, which should now resemble the following:

```
{ "_id" : ObjectId("4d7bc97fb8a04f5126961523"), "balance" : 900, "name" : "A", "pendingTransactions" : 0 }
{ "_id" : ObjectId("4d7bc984b8a04f5126961524"), "balance" : 1100, "name" : "B", "pendingTransactions" : 0 }
```

Set Transaction State to Done Complete the transaction by setting the `state` of the transaction `document` to `done`:

```
db.transactions.update({_id: t._id}, {$set: {state: "done"}})
db.transactions.find()
```

The `find()` (page 816) operation will return the contents of the `transactions` collection, which should now resemble the following:

```
{ "_id" : ObjectId("4d7bc7a8b8a04f5126961522"), "destination" : "B", "source" : "A", "state" : "done", "t" : { "source" : "A", "destination" : "B", "value" : 100 } }
```

Recovering from Failure Scenarios

The most important part of the transaction procedure is not, the prototypical example above, but rather the possibility for recovering from the various failure scenarios when transactions do not complete as intended. This section will provide an overview of possible failures and provide methods to recover from these kinds of events.

There are two classes of failures:

- all failures that occur after the first step (i.e. *setting the transaction set to initial* (page 78)) but before the third step (i.e. *applying the transaction to both accounts* (page 79).)

To recover, applications should get a list of transactions in the `pending` state and resume from the second step (i.e. *switching the transaction state to pending* (page 78).)

- all failures that occur after the third step (i.e. *applying the transaction to both accounts* (page 79)) but before the fifth step (i.e. *setting the transaction state to done* (page 79).)

To recover, application should get a list of transactions in the `committed` state and resume from the fourth step (i.e. *remove the pending transaction* (page 79).)

Thus, the application will always be able to resume the transaction and eventually arrive at a consistent state. Run the following recovery operations every time the application starts to catch any unfinished transactions. You may also wish run the recovery operation at regular intervals to ensure that your data remains consistent.

The time required to reach a consistent state depends, on how long the application needs to recover each transaction.

Rollback In some cases you may need to “rollback” or undo a transaction when the application needs to “cancel” the transaction, or because it can never recover as in cases where one of the accounts doesn’t exist, or stops existing during the transaction.

There are two possible rollback operations:

1. After you *apply the transaction* (page 79) (i.e. the third step,) you have fully committed the transaction and you should not roll back the transaction. Instead, create a new transaction and switch the values in the source and destination fields.
2. After you *create the transaction* (page 78) (i.e. the first step,) but before you *apply the transaction* (page 79) (i.e. the third step,) use the following process:

Set Transaction State to Canceling Begin by setting the transaction’s state to `canceling` using the following `update()` (page 849) operation:

```
db.transactions.update({ _id: t._id }, { $set: { state: "canceling" } })
```

Undo the Transaction Use the following sequence of operations to undo the transaction operation from both accounts:

```
db.accounts.update({ name: t.source, pendingTransactions: t._id }, { $inc: { balance: t.value }, $pull: { pendingTransactions: t._id } })
db.accounts.update({ name: t.destination, pendingTransactions: t._id }, { $inc: { balance: -t.value }, $pull: { pendingTransactions: t._id } })
db.accounts.find()
```

The `find()` (page 816) operation will return the contents of the `accounts` collection, which should resemble the following:

```
{ "_id" : ObjectId("4d7bc97fb8a04f5126961523"), "balance" : 1000, "name" : "A", "pendingTransactions" : 0}, { "_id" : ObjectId("4d7bc984b8a04f5126961524"), "balance" : 1000, "name" : "B", "pendingTransactions" : 0}
```

Set Transaction State to Canceled Finally, use the following `update()` (page 849) operation to set the transaction's state to `canceled`:

Step 3: set the transaction's state to “canceled”:

```
db.transactions.update({_id: t._id}, {$set: {state: "canceled"}})
```

Multiple Applications Transactions exist, in part, so that several applications can create and run operations concurrently without causing data inconsistency or conflicts. As a result, it is crucial that only one application can handle a given transaction at any point in time.

Consider the following example, with a single transaction (i.e. T1) and two applications (i.e. A1 and A2). If both applications begin processing the transaction which is still in the `initial` state (i.e. [step 1](#) (page 78)), then:

- A1 can apply the entire whole transaction before A2 starts.
- A2 will then apply T1 for the second time, because the transaction does not appear as pending in the `accounts` documents.

To handle multiple applications, create a marker in the transaction document itself to identify the application that is handling the transaction. Use `findAndModify()` (page 821) method to modify the transaction:

```
t = db.transactions.findAndModify({query: {state: "initial", application: {$exists: 0}},  
                                 update: {$set: {state: "pending", application: "A1"}},  
                                 new: true})
```

When you modify and reassign the local shell variable `t`, the `mongo` (page 942) shell will return the `t` object, which should resemble the following:

```
{  
  "_id" : ObjectId("4d7be8af2c10315c0847fc85"),  
  "application" : "A1",  
  "destination" : "B",  
  "source" : "A",  
  "state" : "pending",  
  "value" : 150  
}
```

Amend the transaction operations to ensure that only applications that match the identifier in the value of the `application` field before applying the transaction.

If the application A1 fails during transaction execution, you can use the [recovery procedures](#) (page 80), but applications should ensure that they “owns” the transaction before applying the transaction. For example to resume pending jobs, use a query that resembles the following:

```
db.transactions.find({application: "A1", state: "pending"})
```

This will (or may) return a document from the `transactions` document that resembles the following:

```
{ "_id" : ObjectId("4d7be8af2c10315c0847fc85"), "application" : "A1", "destination" : "B", "source" : "A", "state" : "pending", "value" : 150}
```

Using Two-Phase Commits in Production Applications

The example transaction above is intentionally simple. For example, it assumes that:

- it is always possible roll back operations an account.
- account balances can hold negative values.

Production implementations would likely be more complex. Typically accounts need to information about current balance, pending credits, pending debits. Then:

- when your application *switches the transaction state to pending* (page 78) (i.e. step 2) it would also make sure that the accounts has sufficient funds for the transaction. During this update operation, the application would also modify the values of the credits and debits as well as adding the transaction as pending.
- when your application *removes the pending transaction* (page 79) (i.e. step 4) the application would apply the transaction on balance, modify the credits and debits as well as removing the transaction from the pending field., all in one update.

Because all of the changes in the above two operations occur within a single `update()` (page 849) operation, these changes are all atomic.

Additionally, for most important transactions, ensure that:

- the database interface (i.e. client library or *driver*) has a reasonable *write concern* configured to ensure that operations return a response on the success or failure of a write operation.
- your `mongod` (page 925) instance has *journaling* enabled to ensure that your data is always in a recoverable state, in the event of an unclean `mongod` (page 925) shutdown.

2.3.9 Create Tailable Cursor

Overview

By default, MongoDB will automatically close a cursor when the client has exhausted all results in the cursor. However, for *capped collections* (page 156) you may use a *Tailable Cursor* that remains open after the client exhausts the results in the initial cursor. Tailable cursors are conceptually equivalent to the `tail` Unix command with the `-f` option (i.e. with “follow” mode.) After clients insert new additional documents into a capped collection, the tailable cursor will continue to retrieve documents.

Use tailable cursors on capped collections with high numbers of write operations for which an index would be too expensive. For instance, MongoDB *replication* (page 377) uses tailable cursors to tail the primary’s *oplog*.

Note: If your query is on an indexed field, do not use tailable cursors, but instead, use a regular cursor. Keep track of the last value of the indexed field returned by the query. To retrieve the newly added documents, query the collection again using the last value of the indexed field in the query criteria, as in the following example:

```
db.<collection>.find( { indexedField: { $gt: <lastvalue> } } )
```

Consider the following behaviors related to tailable cursors:

- Tailable cursors do not use indexes and return documents in *natural order*.
- Because tailable cursors do not use indexes, the initial scan for the query may be expensive; but, after initially exhausting the cursor, subsequent retrievals of the newly added documents are inexpensive.
- Tailable cursors may become *dead*, or invalid, if either:
 - the query returns no match.

- the cursor returns the document at the “end” of the collection and then the application deletes those documents.

A *dead* cursor has an id of 0.

See your [driver documentation](#) (page 95) for the driver-specific method to specify the tailable cursor. For more information on the details of specifying a tailable cursor, see [MongoDB wire protocol](#)¹² documentation.

C++ Example

The `tail` function uses a tailable cursor to output the results from a query to a capped collection:

- The function handles the case of the dead cursor by having the query be inside a loop.
- To periodically check for new data, the `cursor->more()` statement is also inside a loop.

```
#include "client/dbclient.h"

using namespace mongo;

/*
 * Example of a tailable cursor.
 * The function "tails" the capped collection (ns) and output elements as they are added.
 * The function also handles the possibility of a dead cursor by tracking the field 'insertDate'.
 * New documents are added with increasing values of 'insertDate'.
 */

void tail(DBClientBase& conn, const char *ns) {
    BSONElement lastValue = minKey.firstElement();

    Query query = Query().hint( BSON( "$natural" << 1 ) );

    while ( 1 ) {
        auto_ptr<DBClientCursor> c =
            conn.query(ns, query, 0, 0,
                       QueryOption_CursorTailable | QueryOption_AwaitData);

        while ( 1 ) {
            if ( !c->more() ) {

                if ( c->isDead() ) {
                    break;
                }

                continue;
            }

            BSONObj o = c->next();
            lastValue = o["insertDate"];
            cout << o.toString() << endl;
        }

        query = QUERY( "insertDate" << GT << lastValue ).hint( BSON( "$natural" << 1 ) );
    }
}
```

The `tail` function performs the following actions:

¹²<http://docs.mongodb.org/meta-driver/latest/legacy/mongodb-wire-protocol>

- Initialize the `lastValue` variable, which tracks the last accessed value. The function will use the `lastValue` if the cursor becomes *invalid* and `tail` needs to restart the query. Use `hint()` (page 866) to ensure that the query uses the `$natural` (page 693) order.

- In an outer `while (1)` loop,

- Query the capped collection and return a tailable cursor that blocks for several seconds waiting for new documents

```
auto_ptr<DBClientCursor> c =
    conn.query(ns, query, 0, 0,
               QueryOption_CursorTailable | QueryOption_AwaitData );
```

- * Specify the capped collection using `ns` as an argument to the function.
 - * Set the `QueryOption_CursorTailable` option to create a tailable cursor.
 - * Set the `QueryOption_AwaitData` option so that the returned cursor blocks for a few seconds to wait for data.
 - In an inner `while (1)` loop, read the documents from the cursor:
 - * If the cursor has no more documents and is not invalid, loop the inner `while` loop to recheck for more documents.
 - * If the cursor has no more documents and is dead, break the inner `while` loop.
 - * If the cursor has documents:
 - output the document,
 - update the `lastValue` value,
 - and loop the inner `while (1)` loop to recheck for more documents.
 - If the logic breaks out of the inner `while (1)` loop and the cursor is invalid:
 - * Use the `lastValue` value to create a new query condition that matches documents added after the `lastValue`. Explicitly ensure `$natural` order with the `hint()` method:

```
query = QUERY( "insertDate" << GT << lastValue ).hint( BSON( "$natural" << 1 ) );
```

- * Loop through the outer `while (1)` loop to re-query with the new query condition and repeat.

See also:

Detailed blog post on tailable cursor¹³

2.3.10 Isolate Sequence of Operations

Overview

Write operations are atomic on the level of a single document: no single write operation can atomically affect more than one document or more than one collection.

When a single write operation modifies multiple documents, the operation as a whole is not atomic, and other operations may interleave. The modification of a single document, or record, is always atomic, even if the write operation modifies multiple sub-document *within* the single record.

No other operations are atomic; however, you can *isolate* a single write operation that affects multiple documents using the `isolation operator` (page 663).

¹³<http://shtylman.com/post/the-tail-of-mongodb>

This document describes one method of updating documents *only* if the local copy of the document reflects the current state of the document in the database. In addition the following methods provide a way to manage isolated sequences of operations:

- the [findAndModify\(\)](#) (page 821) provides an isolated query and modify operation.
- [Perform Two Phase Commits](#) (page 77)
- Create a [unique index](#) (page 334), to ensure that a key doesn't exist when you insert it.

Update if Current

In this pattern, you will:

- query for a document,
- modify the fields in that document
- and update the fields of a document *only if* the fields have not changed in the collection since the query.

Consider the following example in JavaScript which attempts to update the `qty` field of a document in the `products` collection:

```

1  var myCollection = db.products;
2  var myDocument = myCollection.findOne( { sku: 'abc123' } );
3
4  if (myDocument) {
5
6      var oldQty = myDocument.qty;
7
8      if (myDocument.qty < 10) {
9          myDocument.qty *= 4;
10     } else if ( myDocument.qty < 20 ) {
11         myDocument.qty *= 3;
12     } else {
13         myDocument.qty *= 2;
14     }
15
16     myCollection.update(
17         {
18             _id: myDocument._id,
19             qty: oldQty
20         },
21         {
22             $set: { qty: myDocument.qty }
23         }
24     )
25
26     var err = db.getLastErrorObj();
27
28     if ( err && err.code ) {
29         print("unexpected error updating document: " + tojson( err ));
30     } else if ( err.n == 0 ) {
31         print("No update: no matching document for { _id: " + myDocument._id + ", qty: " + oldQty + " }")
32     }
33
34 }
```

Your application may require some modifications of this pattern, such as:

- Use the entire document as the query in lines 18 and 19, to generalize the operation and guarantee that the original document was not modified, rather than ensuring that a single field was not changed.
- Add a version variable to the document that applications increment upon each update operation to the documents. Use this version variable in the query expression. You must be able to ensure that *all* clients that connect to your database obey this constraint.
- Use `$set` (page 655) in the update expression to modify only your fields and prevent overriding other fields.
- Use one of the methods described in [Create an Auto-Incrementing Sequence Field](#) (page 86).

2.3.11 Create an Auto-Incrementing Sequence Field

Synopsis

MongoDB reserves the `_id` field in the top level of all documents as a primary key. `_id` must be unique, and always has an index with a [unique constraint](#) (page 334). However, except for the unique constraint you can use any value for the `_id` field in your collections. This tutorial describes two methods for creating an incrementing sequence number for the `_id` field using the following:

- [A Counters Collection](#) (page 86)
- [Optimistic Loop](#) (page 88)

Warning: Generally in MongoDB, you would not use an auto-increment pattern for the `_id` field, or any field, because it does not scale for databases with large numbers of documents. Typically the default value `ObjectId` is more ideal for the `_id`.

A Counters Collection

Use a separate `counters` collection to track the *last* number sequence used. The `_id` field contains the sequence name and the `seq` field contains the last value of the sequence.

1. Insert into the `counters` collection, the initial value for the `userid`:

```
db.counters.insert(  
  {  
    _id: "userid",  
    seq: 0  
  })
```

2. Create a `getNextSequence` function that accepts a name of the sequence. The function uses the `findAndModify()` (page 821) method to atomically increment the `seq` value and return this new value:

```
function getNextSequence(name) {  
  var ret = db.counters.findAndModify(  
    {  
      query: { _id: name },  
      update: { $inc: { seq: 1 } },  
      new: true  
    }  
  );  
  
  return ret.seq;  
}
```

3. Use this `getNextSequence()` function during `insert()` (page 832).

```
db.users.insert(
{
  _id: getNextSequence("userid"),
  name: "Sarah C."
}
)

db.users.insert(
{
  _id: getNextSequence("userid"),
  name: "Bob D."
}
)
```

You can verify the results with `find()` (page 816):

```
db.users.find()
```

The `_id` fields contain incrementing sequence values:

```
{
  _id : 1,
  name : "Sarah C."
}
{
  _id : 2,
  name : "Bob D."
}
```

Note: When `findAndModify()` (page 821) includes the `upsert: true` option **and** the query field(s) is not uniquely indexed, the method could insert a document multiple times in certain circumstances. For instance, if multiple clients each invoke the method with the same query condition and these methods complete the find phase before any of methods perform the modify phase, these methods could insert the same document.

In the `counters` collection example, the query field is the `_id` field, which always has a unique index. Consider that the `findAndModify()` (page 821) includes the `upsert: true` option, as in the following modified example:

```
function getNextSequence(name) {
  var ret = db.counters.findAndModify(
    {
      query: { _id: name },
      update: { $inc: { seq: 1 } },
      new: true,
      upsert: true
    }
  );

  return ret.seq;
}
```

If multiple clients were to invoke the `getNextSequence()` method with the same `name` parameter, then the methods would observe one of the following behaviors:

- Exactly one `findAndModify()` (page 821) would successfully insert a new document.
- Zero or more `findAndModify()` (page 821) methods would update the newly inserted document.
- Zero or more `findAndModify()` (page 821) methods would fail when they attempted to insert a duplicate.

If the method fails due to a unique index constraint violation, retry the method. Absent a delete of the document, the retry should not fail.

Optimistic Loop

In this pattern, an *Optimistic Loop* calculates the incremented `_id` value and attempts to insert a document with the calculated `_id` value. If the insert is successful, the loop ends. Otherwise, the loop will iterate through possible `_id` values until the insert is successful.

1. Create a function named `insertDocument` that performs the “insert if not present” loop. The function wraps the `insert()` (page 832) method and takes a `doc` and a `targetCollection` arguments.

```
function insertDocument(doc, targetCollection) {  
  
    while (1) {  
  
        var cursor = targetCollection.find( {}, { _id: 1 } ).sort( { _id: -1 } ).limit(1);  
  
        var seq = cursor.hasNext() ? cursor.next().id + 1 : 1;  
  
        doc._id = seq;  
  
        targetCollection.insert(doc);  
  
        var err = db.getLastErrorObj();  
  
        if( err && err.code ) {  
            if( err.code == 11000 /* dup key */ )  
                continue;  
            else  
                print( "unexpected error inserting data: " + tojson( err ) );  
        }  
  
        break;  
    }  
}
```

The `while (1)` loop performs the following actions:

- Queries the `targetCollection` for the document with the maximum `_id` value.
- Determines the next sequence value for `_id` by:
 - adding 1 to the returned `_id` value if the returned cursor points to a document.
 - otherwise: it sets the next sequence value to 1 if the returned cursor points to no document.
- For the `doc` to insert, set its `_id` field to the calculated sequence value `seq`.
- Insert the `doc` into the `targetCollection`.
- If the insert operation errors with duplicate key, repeat the loop. Otherwise, if the insert operation encounters some other error or if the operation succeeds, break out of the loop.

2. Use the `insertDocument()` function to perform an insert:

```
var myCollection = db.users2;  
  
insertDocument(  
{
```

```

        name: "Grace H."
    },
    myCollection
);

insertDocument (
{
    name: "Ted R."
},
myCollection
)

```

You can verify the results with `find()` (page 816):

```
db.users2.find()
```

The `_id` fields contain incrementing sequence values:

```
{
    _id: 1,
    name: "Grace H."
}
{
    _id : 2,
    "name" : "Ted R."
}
```

The `while` loop may iterate many times in collections with larger insert volumes.

2.3.12 Limit Number of Elements in an Array after an Update

New in version 2.4.

Synopsis

Consider an application where users may submit many scores (e.g. for a test), but the application only needs to track the top three test scores.

This pattern uses the `$push` (page 659) operator with the `$each` (page 660), `$sort` (page 661), and `$slice` (page 661) modifiers to sort and maintain an array of fixed size.

Important: The array elements must be documents in order to use the `$sort` (page 661) modifier.

Pattern

Consider the following document in the collection `students`:

```
{
    _id: 1,
    scores: [
        { attempt: 1, score: 10 },
        { attempt: 2, score: 8 }
    ]
}
```

The following update uses the [\\$push](#) (page 659) operator with:

- the [\\$each](#) (page 660) modifier to append to the array 2 new elements,
- the [\\$sort](#) (page 661) modifier to order the elements by ascending (1) score, and
- the [\\$slice](#) (page 661) modifier to keep the last 3 elements of the ordered array.

```
db.students.update(
    { _id: 1 },
    { $push: { scores: { $each : [
        { attempt: 3, score: 7 },
        { attempt: 4, score: 4 }
    ]},
        $sort: { score: 1 },
        $slice: -3
    }
}
```

Note: When using the [\\$sort](#) (page 661) modifier on the array element, access the field in the subdocument element directly instead of using the [dot notation](#) on the array field.

After the operation, the document contains the only the top 3 scores in the `scores` array:

```
{
  "_id" : 1,
  "scores" : [
    { "attempt" : 3, "score" : 7 },
    { "attempt" : 2, "score" : 8 },
    { "attempt" : 1, "score" : 10 }
  ]
}
```

See also:

- [\\$push](#) (page 659) operator,
- [\\$each](#) (page 660) modifier,
- [\\$sort](#) (page 661) modifier, and
- [\\$slice](#) (page 661) modifier.

2.4 MongoDB CRUD Reference

2.4.1 Query Cursor Methods

Name	Description
<code>cursor.count()</code> (page 860)	Returns a count of the documents in a cursor.
<code>cursor.explain()</code> (page 861)	Reports on the query execution plan, including index use, for a cursor.
<code>cursor_hint()</code> (page 866)	Forces MongoDB to use a specific index for a query.
<code>cursor.limit()</code> (page 867)	Constrains the size of a cursor's result set.
<code>cursor.next()</code> (page 870)	Returns the next document in a cursor.
<code>cursor.skip()</code> (page 871)	Returns a cursor that begins returning results only after passing or skipping a number of documents.
<code>cursor.sort()</code> (page 872)	Returns results ordered according to a sort specification.
<code>cursor.toArray()</code> (page 874)	Returns an array that contains all documents returned by the cursor.

2.4.2 Query and Data Manipulation Collection Methods

Name	Description
<code>db.collection.count()</code> (page 809)	Wraps <code>count</code> (page 695) to return a count of the number of documents in a collection or matching a query.
<code>db.collection.distinct()</code> (page 812)	Returns an array of documents that have distinct values for the specified field.
<code>db.collection.find()</code> (page 816)	Performs a query on a collection and returns a cursor object.
<code>db.collection.findOne()</code> (page 824)	Performs a query and returns a single document.
<code>db.collection.insert()</code> (page 832)	Creates a new document in a collection.
<code>db.collection.remove()</code> (page 844)	Deletes documents from a collection.
<code>db.collection.save()</code> (page 846)	Provides a wrapper around an <code>insert()</code> (page 832) and <code>update()</code> (page 849) to insert new documents.
<code>db.collection.update()</code> (page 849)	Modifies a document in a collection.

2.4.3 MongoDB CRUD Reference Documentation

Documents (page 92) MongoDB stores all data in documents, which are JSON-style data structures composed of field-and-value pairs.

MongoDB Drivers and Client Libraries (page 95) Applications access MongoDB using client libraries, or drivers, that provide idiomatic interfaces to MongoDB for many programming languages and development environments.

Write Concern Reference (page 96) Configuration options associated with the guarantee MongoDB provides when reporting on the success of a write operation.

SQL to MongoDB Mapping Chart (page 98) An overview of common database operations showing both the MongoDB operations and SQL statements.

ObjectId (page 103) A 12-byte BSON type that MongoDB uses as the default value for its documents' `_id` field if the `_id` field is not specified.

BSON Types (page 105) Outlines the unique `BSON` types used by MongoDB. See [BSONspec.org](http://bsonspec.org)¹⁴ for the complete BSON specification.

MongoDB Extended JSON (page 108) Describes the `JSON` super set used to express BSON documents in the `mongo` (page 942) shell and other MongoDB tools.

GridFS Reference (page 110) Convention for storing large files in a MongoDB Database.

The bios Example Collection (page 111) Sample data for experimenting with MongoDB. `insert()` (page 832), `update()` (page 849) and `find()` (page 816) pages use the data for some of their examples.

Documents

MongoDB stores all data in documents, which are JSON-style data structures composed of field-and-value pairs:

```
{ "item": "pencil", "qty": 500, "type": "no.2" }
```

Most user-accessible data structures in MongoDB are documents, including:

- All database records.
- *Query selectors* (page 39), which define what records to select for read, update, and delete operations.
- *Update definitions* (page 50), which define what fields to modify during an update.
- *Index specifications* (page 318), which define what fields to index.
- Data output by MongoDB for reporting and configuration, such as the output of the `serverStatus` (page 782) and the *replica set configuration document* (page 480).

Document Format

MongoDB stores documents on disk in the `BSON` serialization format. BSON is a binary representation of `JSON` documents, though contains more data types than does JSON. For the BSON spec, see bsonspec.org¹⁵. See also **BSON Types** (page 105).

The `mongo` (page 942) JavaScript shell and the *MongoDB language drivers* (page 95) translate between BSON and the language-specific document representation.

Document Structure

MongoDB documents are composed of field-and-value pairs and have the following structure:

```
{  
  field1: value1,  
  field2: value2,  
  field3: value3,
```

¹⁴<http://bsonspec.org/>

¹⁵<http://bsonspec.org/>

```

...
    fieldN: valueN
}

```

The value of a field can be any of the BSON *data types* (page 105), including other documents, arrays, and arrays of documents. The following document contains values of varying types:

```

var mydoc = {
    _id: ObjectId("5099803df3f4948bd2f98391"),
    name: { first: "Alan", last: "Turing" },
    birth: new Date('Jun 23, 1912'),
    death: new Date('Jun 07, 1954'),
    contribs: [ "Turing machine", "Turing test", "Turingery" ],
    views : NumberLong(1250000)
}

```

The above fields have the following data types:

- `_id` holds an *ObjectId*.
- `name` holds a *subdocument* that contains the fields `first` and `last`.
- `birth` and `death` hold values of the *Date* type.
- `contribs` holds an *array of strings*.
- `views` holds a value of the *NumberLong* type.

Field Names

Field names are strings. Field names cannot contain null characters, dots (.) or dollar signs (\$). See [Dollar Sign Operator Escaping](#) (page 589) for an alternate approach.

BSON documents may have more than one field with the same name. Most [MongoDB interfaces](#) (page 95), however, represent MongoDB with a structure (e.g. a hash table) that does not support duplicate field names. If you need to manipulate documents that have more than one field with the same name, see the [driver documentation](#) (page 95) for your driver.

Some documents created by internal MongoDB processes may have duplicate fields, but *no* MongoDB process will ever add duplicate fields to an existing user document.

Document Limitations

Documents have the following attributes:

- The maximum BSON document size is 16 megabytes.

The maximum document size helps ensure that a single document cannot use excessive amount of RAM or, during transmission, excessive amount of bandwidth. To store documents larger than the maximum size, MongoDB provides the GridFS API. See [mongofiles](#) (page 986) and the documentation for your [driver](#) (page 95) for more information about GridFS.

- [Documents](#) (page 92) have the following restrictions on field names:

- The field name `_id` is reserved for use as a primary key; its value must be unique in the collection, is immutable, and may be of any type other than an array.
- The field names **cannot** start with the \$ character.
- The field names **cannot** contain the . character.

- MongoDB does not make guarantees regarding the order of fields in a BSON document. Drivers and MongoDB will reorder the fields of a documents upon insertion and following updates.

Most programming languages represent BSON documents with some form of *mapping type*. Comparisons between mapping type objects typically, depend on order. As a result, the only way to ensure that two documents have the same set of field and value pairs is to compare each field and value individually.

The `_id` Field

The `_id` field has the following behavior and constraints:

- In documents, the `_id` field is always indexed for regular collections.
- The `_id` field may contain values of any *BSON data type* (page 105), other than an array.

Warning: To ensure functioning replication, do not store values that are of the BSON regular expression type in the `_id` field.

The following are common options for storing values for `_id`:

- Use an *ObjectId* (page 103).
- Use a natural unique identifier, if available. This saves space and avoids an additional index.
- Generate an auto-incrementing number. See *Create an Auto-Incrementing Sequence Field* (page 86).
- Generate a UUID in your application code. For a more efficient storage of the UUID values in the collection and in the `_id` index, store the UUID as a value of the BSON `BinData` type.

Index keys that are of the `BinData` type are more efficiently stored in the index if:

- the binary subtype value is in the range of 0-7 or 128-135, and
- the length of the byte array is: 0, 1, 2, 3, 4, 5, 6, 7, 8, 10, 12, 14, 16, 20, 24, or 32.
- Use your driver's BSON UUID facility to generate UUIDs. Be aware that driver implementations may implement UUID serialization and deserialization logic differently, which may not be fully compatible with other drivers. See your [driver documentation](#)¹⁶ for information concerning UUID interoperability.

Note: Most MongoDB driver clients will include the `_id` field and generate an `ObjectId` before sending the insert operation to MongoDB; however, if the client sends a document without an `_id` field, the `mongod` (page 925) will add the `_id` field and generate the `ObjectId`.

Dot Notation

MongoDB uses the *dot notation* to access the elements of an array and to access the fields of a subdocument.

To access an element of an array by the zero-based index position, concatenate the array name with the dot (.) and zero-based index position, and enclose in quotes:

```
'<array>.<index>'
```

To access a field of a subdocument with *dot-notation*, concatenate the subdocument name with the dot (.) and the field name, and enclose in quotes:

¹⁶<http://api.mongodb.org/>

'<subdocument>.<field>'

See also:

- *Subdocuments* (page 69) for dot notation examples with subdocuments.
- *Arrays* (page 70) for dot notation examples with arrays.

MongoDB Drivers and Client Libraries

An application communicates with MongoDB by way of a client library, called a [driver](#)¹⁷, that handles all interaction with the database in a language appropriate to the application.

Drivers

See the following pages for more information about the MongoDB drivers¹⁸:

- JavaScript ([Language Center](#)¹⁹, [docs](#)²⁰)
- Python ([Language Center](#)²¹, [docs](#)²²)
- Ruby ([Language Center](#)²³, [docs](#)²⁴)
- PHP ([Language Center](#)²⁵, [docs](#)²⁶)
- Perl ([Language Center](#)²⁷, [docs](#)²⁸)
- Java ([Language Center](#)²⁹, [docs](#)³⁰)
- Scala ([Language Center](#)³¹, [docs](#)³²)
- C# ([Language Center](#)³³, [docs](#)³⁴)
- C ([Language Center](#)³⁵, [docs](#)³⁶)
- C++ ([Language Center](#)³⁷, [docs](#)³⁸)
- Haskell ([Language Center](#)³⁹, [docs](#)⁴⁰)

¹⁷<http://docs.mongodb.org/ecosystem/drivers>

¹⁸<http://docs.mongodb.org/ecosystem/drivers>

¹⁹<http://docs.mongodb.org/ecosystem/drivers/javascript>

²⁰<http://api.mongodb.org/js/current>

²¹<http://docs.mongodb.org/ecosystem/drivers/python>

²²<http://api.mongodb.org/python/current>

²³<http://docs.mongodb.org/ecosystem/drivers/ruby>

²⁴<http://api.mongodb.org/ruby/current>

²⁵<http://docs.mongodb.org/ecosystem/drivers/php>

²⁶<http://php.net/mongo/>

²⁷<http://docs.mongodb.org/ecosystem/drivers/perl>

²⁸<http://api.mongodb.org/perl/current/>

²⁹<http://docs.mongodb.org/ecosystem/drivers/java>

³⁰<http://api.mongodb.org/java/current>

³¹<http://docs.mongodb.org/ecosystem/drivers/scala>

³²<http://api.mongodb.org/scala/casbah/current/>

³³<http://docs.mongodb.org/ecosystem/drivers/csharp>

³⁴<http://api.mongodb.org/csharp/current/>

³⁵<http://docs.mongodb.org/ecosystem/drivers/c/>

³⁶<http://api.mongodb.org/c/current/>

³⁷<http://docs.mongodb.org/ecosystem/drivers/cpp>

³⁸<http://api.mongodb.org/cplusplus/current/>

³⁹<http://hackage.haskell.org/package/mongoDB>

⁴⁰<http://api.mongodb.org/haskell/mongodb>

- Erlang (Language Center⁴¹, docs⁴²)

Driver Version Numbers

Driver version numbers use semantic versioning⁴³ or “**major.minor.patch**” versioning system. The first number is the major version, the second the minor version, and the third indicates a patch.

Example

Driver version numbers.

If your driver has a version number of `2.9.1`, `2` is the major version, `9` is minor, and `1` is the patch.

The numbering scheme for drivers differs from the scheme for the MongoDB server. For more information on server versioning, see [MongoDB Version Numbers](#) (page 1090).

Write Concern Reference

Overview

Write concern describes the guarantee that MongoDB provides when reporting on the success of a write operation. The strength of the write concerns determine the level of guarantee. When inserts, updates and deletes have a *weak* write concern, write operations return quickly. In some failure cases, write operations issued with weak write concerns may not persist. With *stronger* write concerns, clients wait after sending a write operation for MongoDB to confirm the write operations.

MongoDB provides different levels of write concern to better address the specific needs of applications. Clients may adjust write concern to ensure that the most important operations persist successfully to an entire MongoDB deployment. For other less critical operations, clients can adjust the write concern to ensure faster performance rather than ensure persistence to the entire deployment.

See also:

[Write Concern](#) (page 55) for an introduction to write concern in MongoDB.

Available Write Concern

To provide write concern, [drivers](#) (page 95) issue the `getLastError` (page 720) command after a write operation and receive a document with information about the last operation. This document’s `err` field contains either:

- `null`, which indicates the write operations have completed successfully, or
- a description of the last error encountered.

The definition of a “successful write” depends on the arguments specified to `getLastError` (page 720), or in replica sets, the configuration of `getLastErrorDefaults` (page 483). When deciding the level of write concern for your application, see the introduction to [Write Concern](#) (page 55).

The `getLastError` (page 720) command has the following options to configure write concern requirements:

⁴¹<http://docs.mongodb.org/ecosystem/drivers/erlang>

⁴²<http://api.mongodb.org/erlang/mongodb>

⁴³<http://semver.org/>

- `j` or “journal” option

This option confirms that the [mongod](#) (page 925) instance has written the data to the on-disk journal and ensures data is not lost if the [mongod](#) (page 925) instance shuts down unexpectedly. Set to `true` to enable, as shown in the following example:

```
db.runCommand( { getLastError: 1, j: "true" } )
```

If you set [journal](#) (page 995) to `true`, and the [mongod](#) (page 925) does not have journaling enabled, as with [nojournal](#) (page 996), then [getLastError](#) (page 720) will provide basic receipt acknowledgment, and will include a `jnote` field in its return document.

- `w` option

This option provides the ability to disable write concern entirely *as well as* specifies the write concern operations for [replica sets](#). See [Write Concern Considerations](#) (page 55) for an introduction to the fundamental concepts of write concern. By default, the `w` option is set to `1`, which provides basic receipt acknowledgment on a single [mongod](#) (page 925) instance or on the [primary](#) in a replica set.

The `w` option takes the following values:

- `-1`:

Disables all acknowledgment of write operations, and suppresses all errors, including network and socket errors.

- `0`:

Disables basic acknowledgment of write operations, but returns information about socket exceptions and networking errors to the application.

Note: If you disable basic write operation acknowledgment but require journal commit acknowledgment, the journal commit prevails, and the driver will require that [mongod](#) (page 925) will acknowledge the write operation.

- `1`:

Provides acknowledgment of write operations on a standalone [mongod](#) (page 925) or the [primary](#) in a replica set.

- *A number greater than 1*:

Guarantees that write operations have propagated successfully to the specified number of replica set members including the primary. If you set `w` to a number that is greater than the number of set members that hold data, MongoDB waits for the non-existent members to become available, which means MongoDB blocks indefinitely.

- *majority*:

Confirms that write operations have propagated to the majority of configured replica set: a majority of the set’s configured members must acknowledge the write operation before it succeeds. This ensures that write operation will *never* be subject to a rollback in the course of normal operation, and furthermore allows you to avoid hard coding assumptions about the size of your replica set into your application.

- *A tag set*:

By specifying a [tag set](#) (page 451) you can have fine-grained control over which replica set members must acknowledge a write operation to satisfy the required level of write concern.

[getLastError](#) (page 720) also supports a `timeout` setting which allows clients to specify a timeout for the write concern: if you don’t specify `timeout`, or if you give it a value of `0`, and the [mongod](#) (page 925) cannot fulfill the write concern the [getLastError](#) (page 720) will block, potentially forever.

For more information on write concern and replica sets, see [Write Concern for Replica Sets](#) (page 57) for more information.

In sharded clusters, `mongos` (page 938) instances will pass write concern on to the shard `mongod` (page 925) instances.

SQL to MongoDB Mapping Chart

In addition to the charts that follow, you might want to consider the [Frequently Asked Questions](#) (page 581) section for a selection of common questions about MongoDB.

Terminology and Concepts

The following table presents the various SQL terminology and concepts and the corresponding MongoDB terminology and concepts.

SQL Terms/Concepts	MongoDB Terms/Concepts
database	<code>database</code>
table	<code>collection</code>
row	<code>document</code> or <code> BSON</code> document
column	<code>field</code>
index	<code>index</code>
table joins	embedded documents and linking
primary key Specify any unique column or column combination as primary key.	<code>primary key</code> In MongoDB, the primary key is automatically set to the <code>_id</code> field.
aggregation (e.g. group by)	aggregation pipeline See the SQL to Aggregation Mapping Chart (page 309).

Executables

The following table presents the MySQL/Oracle executables and the corresponding MongoDB executables.

	MySQL/Oracle	MongoDB
Database Server	<code>mysqld/oracle</code>	<code>mongod</code> (page 925)
Database Client	<code>mysql/sqlplus</code>	<code>mongo</code> (page 942)

Examples

The following table presents the various SQL statements and the corresponding MongoDB statements. The examples in the table assume the following conditions:

- The SQL examples assume a table named `users`.
- The MongoDB examples assume a collection named `users` that contain documents of the following prototype:

```
{  
  _id: ObjectId("509a8fb2f3f4948bd2f983a0"),  
  user_id: "abc123",  
  age: 55,  
  status: 'A'  
}
```

Create and Alter The following table presents the various SQL statements related to table-level actions and the corresponding MongoDB statements.

SQL Schema Statements	MongoDB Schema Statements	Reference
<pre>CREATE TABLE users (id MEDIUMINT NOT NULL AUTO_INCREMENT, user_id Varchar(30), age Number, status char(1), PRIMARY KEY (id))</pre>	<p>Implicitly created on first <code>insert()</code> (page 832) operation. The primary key <code>_id</code> is automatically added if <code>_id</code> field is not specified.</p> <pre>db.users.insert(user_id: "abc123", age: 55, status: "A")</pre> <p>However, you can also explicitly create a collection:</p> <pre>db.createCollection("users")</pre>	See <code>insert()</code> (page 832) and <code>db.createCollection()</code> (page 878) for more information.
<pre>ALTER TABLE users ADD join_date DATETIME</pre>	<p>Collections do not describe or enforce the structure of its documents; i.e. there is no structural alteration at the collection level.</p> <p>However, at the document level, <code>update()</code> (page 849) operations can add fields to existing documents using the <code>\$set</code> (page 655) operator.</p> <pre>db.users.update({}, { \$set: { join_date: new Date() } }, { multi: true })</pre>	See the <i>Data Modeling Considerations for MongoDB Applications</i> (page 117), <code>update()</code> (page 849), and <code>\$set</code> (page 655) for more information on changing the structure of documents in a collection.
<pre>ALTER TABLE users DROP COLUMN join_date</pre>	<p>Collections do not describe or enforce the structure of its documents; i.e. there is no structural alteration at the collection level.</p> <p>However, at the document level, <code>update()</code> (page 849) operations can remove fields from documents using the <code>\$unset</code> (page 655) operator.</p> <pre>db.users.update({}, { \$unset: { join_date: "" } }, { multi: true })</pre>	See the <i>Data Modeling Considerations for MongoDB Applications</i> (page 117), <code>update()</code> (page 849), and <code>\$unset</code> (page 655) for more information on changing the structure of documents in a collection.
<pre>CREATE INDEX idx_user_id_as ON users(user_id)</pre>	<pre>db.users.ensureIndex({ user_id: 1 })</pre>	See <code>ensureIndex()</code> (page 814) and <code>indexes</code> (page 318) for more information.
<pre>CREATE INDEX idx_user_id_asc_age_desc ON users(user_id, age DESC)</pre>	<pre>db.users.ensureIndex({ user_id: 1, age: 1 })</pre>	See <code>ensureIndex()</code> (page 814) and <code>indexes</code> (page 318) for more information.
<pre>DROP TABLE users</pre>	<pre>db.users.drop()</pre>	See <code>drop()</code> (page 812) for more information.

Insert The following table presents the various SQL statements related to inserting records into tables and the corresponding MongoDB statements.

SQL INSERT Statements	MongoDB insert() Statements	Reference
<pre>INSERT INTO users(user_id, age, status) VALUES ("bcd001", 45, "A")</pre>	<pre>db.users.insert({ user_id: "bcd001", age: 45, status: "A" })</pre>	See insert() (page 832) for more information.

Select The following table presents the various SQL statements related to reading records from tables and the corresponding MongoDB statements.

SQL SELECT Statements	MongoDB find() Statements	Reference
<code>SELECT * FROM users</code>	<code>db.users.find()</code>	See find() (page 816) for more information.
<code>SELECT id, user_id, status FROM users</code>	<code>db.users.find({ }, { user_id: 1, status: })</code>	See find() (page 816) for more information.
<code>SELECT user_id, status FROM users</code>	<code>db.users.find({ }, { user_id: 1, status: 1, _id: 0 })</code>	See find() (page 816) for more information.
<code>SELECT * FROM users WHERE status = "A"</code>	<code>db.users.find({ status: "A" })</code>	See find() (page 816) for more information.
<code>SELECT user_id, status FROM users WHERE status = "A"</code>	<code>db.users.find({ status: "A" }, { user_id: 1, status: 1, _id: 0 })</code>	See find() (page 816) for more information.
<code>SELECT * FROM users WHERE status != "A"</code>	<code>db.users.find({ status: { \$ne: "A" }})</code>	See find() (page 816) and \$ne (page 624) for more information.
<code>SELECT * FROM users WHERE status = "A" AND age = 50</code>	<code>db.users.find({ status: "A", age: 50 })</code>	See find() (page 816) and \$and (page 626) for more information.
<code>SELECT * FROM users WHERE status = "A" OR age = 50</code>	<code>db.users.find({ \$or: [{ status: "A" }, { age: 50 }] })</code>	See find() (page 816) and \$or (page 625) for more information.
<code>SELECT * FROM users WHERE age > 25</code>	<code>db.users.find({ age: { \$gt: 25 } })</code>	See find() (page 816) and \$gt (page 622) for more information.
<code>SELECT * FROM users WHERE age < 25</code>	<code>db.users.find({ age: { \$lt: 25 } })</code>	See find() (page 816) and \$lt (page 623) for more information.
<code>SELECT * FROM users WHERE age > 25 AND age <= 50</code>	<code>db.users.find({ age: { \$gt: 25, \$lte: 50 } })</code>	See find() (page 816) , \$gt (page 622) , and \$lte (page 624) for more information.
102 <code>SELECT * FROM users WHERE user_id like "%bc%"</code>	<code>db.users.find({ user_id: /bc/ })</code>	Chapter 2. MongoDB CRUD Operations See find() (page 816) and \$regex (page 633) for more information.

Update Records The following table presents the various SQL statements related to updating existing records in tables and the corresponding MongoDB statements.

SQL Update Statements	MongoDB update() Statements	Reference
<code>UPDATE users SET status = "C" WHERE age > 25</code>	<code>db.users.update({ age: { \$gt: 25 } }, { \$set: { status: "C" } } { multi: true })</code>	See update() (page 849) , \$gt (page 622) , and \$set (page 655) for more information.
<code>UPDATE users SET age = age + 3 WHERE status = "A"</code>	<code>db.users.update({ status: "A" } , { \$inc: { age: 3 } } , { multi: true })</code>	See update() (page 849) , \$inc (page 651) , and \$set (page 655) for more information.

Delete Records The following table presents the various SQL statements related to deleting records from tables and the corresponding MongoDB statements.

SQL Delete Statements	MongoDB remove() Statements	Reference
<code>DELETE FROM users WHERE status = "D"</code>	<code>db.users.remove({ status: "D" })</code>	See remove () (page 844) for more information.
<code>DELETE FROM users</code>	<code>db.users.remove()</code>	See remove () (page 844) for more information.

ObjectId

Overview

ObjectId is a 12-byte [BSON](#) type, constructed using:

- a 4-byte value representing the seconds since the Unix epoch,
- a 3-byte machine identifier,
- a 2-byte process id, and
- a 3-byte counter, starting with a random value.

In MongoDB, documents stored in a collection require a unique `_id` field that acts as a [primary key](#). Because ObjectIds are small, most likely unique, and fast to generate, MongoDB uses ObjectIds as the default value for the `_id` field if the `_id` field is not specified. MongoDB clients should add an `_id` field with a unique ObjectId. However, if a client does not add an `_id` field, [mongod](#) (page 925) will add an `_id` field that holds an ObjectId.

Using ObjectIds for the `_id` field provides the following additional benefits:

- in the [mongo](#) (page 942) shell, you can access the creation time of the ObjectId, using the [getTimestamp \(\)](#) (page 916) method.
- sorting on an `_id` field that stores ObjectId values is roughly equivalent to sorting by creation time.

Important: The relationship between the order of ObjectId values and generation time is not strict within a single second. If multiple systems, or multiple processes or threads on a single system generate values, within a

single second; `ObjectId` values do not represent a strict insertion order. Clock skew between clients can also result in non-strict ordering even for values, because client drivers generate `ObjectId` values, *not* the `mongod` (page 925) process.

Also consider the [Documents](#) (page 92) section for related information on MongoDB's document orientation.

`ObjectId()`

The `mongo` (page 942) shell provides the `ObjectId()` wrapper class to generate a new `ObjectId`, and to provide the following helper attribute and methods:

- `str`
The hexadecimal string value of the `ObjectId()` object.
- [`getTimestamp\(\)` \(page 916\)](#)
Returns the timestamp portion of the `ObjectId()` object as a `Date`.
- [`toString\(\)` \(page 916\)](#)
Returns the string representation of the `ObjectId()` object. The returned string literal has the format “`ObjectId(...)`”.

Changed in version 2.2: In previous versions `toString()` (page 916) returns the value of the `ObjectId` as a hexadecimal string.
- [`valueOf\(\)` \(page 917\)](#)
Returns the value of the `ObjectId()` object as a hexadecimal string. The returned string is the `str` attribute.

Changed in version 2.2: In previous versions `valueOf()` (page 917) returns the `ObjectId()` object.

Examples

Consider the following uses `ObjectId()` class in the `mongo` (page 942) shell:

Generate a new `ObjectId` To generate a new `ObjectId`, use the `ObjectId()` constructor with no argument:

```
x = ObjectId()
```

In this example, the value of `x` would be:

```
ObjectId("507f1f77bcf86cd799439011")
```

To generate a new `ObjectId` using the `ObjectId()` constructor with a unique hexadecimal string:

```
y = ObjectId("507f191e810c19729de860ea")
```

In this example, the value of `y` would be:

```
ObjectId("507f191e810c19729de860ea")
```

- To return the timestamp of an `ObjectId()` object, use the `getTimestamp()` (page 916) method as follows:

Convert an ObjectId into a Timestamp To return the timestamp of an `ObjectId()` object, use the `getTimestamp()` (page 916) method as follows:

```
ObjectId("507f191e810c19729de860ea").getTimestamp()
```

This operation will return the following Date object:

```
ISODate("2012-10-17T20:46:22Z")
```

Convert ObjectIds into Strings Access the `str` attribute of an `ObjectId()` object, as follows:

```
ObjectId("507f191e810c19729de860ea").str
```

This operation will return the following hexadecimal string:

```
507f191e810c19729de860ea
```

To return the value of an `ObjectId()` object as a hexadecimal string, use the `valueOf()` (page 917) method as follows:

```
ObjectId("507f191e810c19729de860ea").valueOf()
```

This operation returns the following output:

```
507f191e810c19729de860ea
```

To return the string representation of an `ObjectId()` object, use the `toString()` (page 916) method as follows:

```
ObjectId("507f191e810c19729de860ea").toString()
```

This operation will return the following output:

```
ObjectId("507f191e810c19729de860ea")
```

BSON Types

- [ObjectId](#) (page 106)
- [String](#) (page 106)
- [Timestamps](#) (page 106)
- [Date](#) (page 107)

BSON is a binary serialization format used to store documents and make remote procedure calls in MongoDB. The BSON specification is located at bsonspec.org⁴⁴.

BSON supports the following data types as values in documents. Each data type has a corresponding number that can be used with the `$type` (page 630) operator to query documents by BSON type.

⁴⁴<http://bsonspec.org/>

Type	Number
Double	1
String	2
Object	3
Array	4
Binary data	5
Object id	7
Boolean	8
Date	9
Null	10
Regular Expression	11
JavaScript	13
Symbol	14
JavaScript (with scope)	15
32-bit integer	16
Timestamp	17
64-bit integer	18
Min key	255
Max key	127

To determine a field's type, see [Check Types in the mongo Shell](#) (page 201).

If you convert BSON to JSON, see [Data Type Fidelity](#) (page 150) for more information.

The next sections describe special considerations for particular BSON types.

ObjectId

ObjectIds are: small, likely unique, fast to generate, and ordered. These values consists of 12-bytes, where the first four bytes are a timestamp that reflect the ObjectId's creation. Refer to the [ObjectId](#) (page 103) documentation for more information.

String

BSON strings are UTF-8. In general, drivers for each programming language convert from the language's string format to UTF-8 when serializing and deserializing BSON. This makes it possible to store most international characters in BSON strings with ease.⁴⁵ In addition, MongoDB [\\$regex](#) (page 633) queries support UTF-8 in the regex string.

Timestamps

BSON has a special timestamp type for *internal* MongoDB use and is **not** associated with the regular [Date](#) (page 107) type. Timestamp values are a 64 bit value where:

- the first 32 bits are a `time_t` value (seconds since the Unix epoch)
- the second 32 bits are an incrementing `ordinal` for operations within a given second.

Within a single `mongod` (page 925) instance, timestamp values are always unique.

In replication, the `oplog` has a `ts` field. The values in this field reflect the operation time, which uses a BSON timestamp value.

⁴⁵ Given strings using UTF-8 character sets, using `sort()` (page 872) on strings will be reasonably correct. However, because internally `sort()` (page 872) uses the C++ `strcmp` api, the sort order may handle some characters incorrectly.

Note: The BSON Timestamp type is for *internal* MongoDB use. For most cases, in application development, you will want to use the BSON date type. See [Date](#) (page 107) for more information.

If you create a BSON Timestamp using the empty constructor (e.g. `new Timestamp()`), MongoDB will only generate a timestamp *if* you use the constructor in the first field of the document.⁴⁶ Otherwise, MongoDB will generate an empty timestamp value (i.e. `Timestamp(0, 0)`.)

Changed in version 2.1: `mongo` (page 942) shell displays the Timestamp value with the wrapper:

```
Timestamp(<time_t>, <ordinal>)
```

Prior to version 2.1, the `mongo` (page 942) shell display the Timestamp value as a document:

```
{ t : <time_t>, i : <ordinal> }
```

Date

BSON Date is a 64-bit integer that represents the number of milliseconds since the Unix epoch (Jan 1, 1970). The official BSON specification⁴⁷ refers to the BSON Date type as the *UTC datetime*.

Changed in version 2.0: BSON Date type is signed.⁴⁸ Negative values represent dates before 1970.

Example

Construct a Date using the `new Date()` constructor in the `mongo` (page 942) shell:

```
var mydate1 = new Date()
```

Example

Construct a Date using the `ISODATE()` constructor in the `mongo` (page 942) shell:

```
var mydate2 = ISODATE()
```

Example

Return the Date value as string:

```
mydate1.toString()
```

Example

Return the month portion of the Date value; months are zero-indexed, so that January is month 0:

```
mydate1.getMonth()
```

⁴⁶ If the first field in the document is `_id`, then you can generate a timestamp in the `second` field of a document.

⁴⁷<http://bsonspec.org/#/specification>

⁴⁸ Prior to version 2.0, Date values were incorrectly interpreted as *unsigned* integers, which affected sorts, range queries, and indexes on Date fields. Because indexes are not recreated when upgrading, please re-index if you created an index on Date values with an earlier version, and dates before 1970 are relevant to your application.

MongoDB Extended JSON

MongoDB [import and export utilities](#) (page 149) (i.e. `mongoimport` (page 965) and `mongoexport` (page 969)) and MongoDB REST Interfaces⁴⁹ render an approximation of MongoDB `BSON` documents in JSON format.

The REST interface supports three different modes for document output:

- *Strict* mode that produces output that conforms to the [JSON RFC specifications](#)⁵⁰.
- *JavaScript* mode that produces output that most JavaScript interpreters can process (via the `--jsonp` option)
- `mongo` (page 942) *Shell* mode produces output that the `mongo` (page 942) shell can process. This is “extended” JavaScript format.

MongoDB can process of these representations in REST input.

Special representations of `BSON` data in JSON format make it possible to render information that have no obvious corresponding JSON. In some cases MongoDB supports multiple equivalent representations of the same type information. Consider the following table:

⁴⁹<http://docs.mongodb.org/ecosystem/tools/http-interfaces>

⁵⁰<http://www.json.org>

BSON Data Type	Strict Mode	JavaScript Mode (via JSONP)	mongo Shell Mode	Notes
<code>data_binary</code>	{ " <code>\$binary</code> ": "<bindata>", " <code>\$type</code> ": "<t>" }	{ " <code>\$binary</code> ": "<bindata>", " <code>\$type</code> ": "<t>" }	BinData(<t>, <bindata>)	<bindata> is the base64 representation of a binary string. <t> is the hexadecimal representation of a single byte that indicates the data type.
<code>data_date</code>	{ " <code>\$date</code> ": <date> }	<code>new Date(<date>)</code>	<code>new Date(<date>)</code>	<date> is the JSON representation of a 64-bit signed integer for milliseconds since epoch UTC (unsigned before version 1.9.1).
<code>data_timestamp</code>	{ " <code>\$timestamp</code> ": { " <code>t</code> ": <t>, " <code>i</code> ": <i> } }	{ " <code>\$timestamp</code> ": { " <code>t</code> ": <t>, " <code>i</code> ": <i> } }	Timestamp(<t>, <i>)	<t> is the JSON representation of a 32-bit unsigned integer for seconds since epoch. <i> is a 32-bit unsigned integer for the increment.
<code>data_regex</code>	{ " <code>\$regex</code> ": "<sRegex>", " <code>\$options</code> ": "<sOptions>" }	/<jRegex>/<jOptions>	/<jRegex>/<jOptions>	<sRegex> is a string of valid JSON characters. <jRegex> is a string that may contain valid JSON characters and unescaped double quote ("") characters, but may not contain unescaped forward slash (http://docs.mongodb.org) characters. <sOptions> is a string containing the regex options represented by the letters of the alphabet. <jOptions> is a string that may contain only the characters 'g', 'i', 'm' and 's' (added in v1.9). Because the JavaScript and mongo Shell representations support a limited range of options, any non-conforming options will be dropped when converting to this representation. ¹⁰⁹
2.4. MongoDB CRUD Reference				
<code>data_oid</code>	{ " <code>\$oid</code> ": "<id>" }	{ " <code>\$oid</code> ": "<id>" }	ObjectId("<id>")	<id> is a 24-character hexadecimal string.

GridFS Reference

GridFS stores files in two collections:

- `chunks` stores the binary chunks. For details, see *The chunks Collection* (page 110).
- `files` stores the file's metadata. For details, see *The files Collection* (page 110).

GridFS places the collections in a common bucket by prefixing each with the bucket name. By default, GridFS uses two collections with names prefixed by `fs` bucket:

- `fs.files`
- `fs.chunks`

You can choose a different bucket name than `fs`, and create multiple buckets in a single database.

See also:

GridFS (page 154) for more information about GridFS.

The chunks Collection

Each document in the `chunks` collection represents a distinct chunk of a file as represented in the *GridFS* store. The following is a prototype document from the `chunks` collection.:

```
{  
  "_id" : <string>,  
  "files_id" : <string>,  
  "n" : <num>,  
  "data" : <binary>  
}
```

A document from the `chunks` collection contains the following fields:

`chunks._id`

The unique *ObjectID* of the chunk.

`chunks.files_id`

The `_id` of the “parent” document, as specified in the `files` collection.

`chunks.n`

The sequence number of the chunk. GridFS numbers all chunks, starting with 0.

`chunks.data`

The chunk's payload as a *BSON* binary type.

The `chunks` collection uses a *compound index* on `files_id` and `n`, as described in *GridFS Index* (page 155).

The files Collection

Each document in the `files` collection represents a file in the *GridFS* store. Consider the following prototype of a document in the `files` collection:

```
{  
  "_id" : <ObjectID>,  
  "length" : <num>,  
  "chunkSize" : <num>  
  "uploadDate" : <timestampl>  
  "md5" : <hash>
```

```

"filename" : <string>,
"contentType" : <string>,
"aliases" : <string array>,
"metadata" : <dataObject>,
}

```

Documents in the `files` collection contain some or all of the following fields. Applications may create additional arbitrary fields:

files._id

The unique ID for this document. The `_id` is of the data type you chose for the original document. The default type for MongoDB documents is [BSON ObjectID](#).

files.length

The size of the document in bytes.

files.chunkSize

The size of each chunk. GridFS divides the document into chunks of the size specified here. The default size is 256 kilobytes.

files.uploadDate

The date the document was first stored by GridFS. This value has the `Date` type.

files.md5

An MD5 hash returned from the `filemd5` API. This value has the `String` type.

files.filename

Optional. A human-readable name for the document.

files.contentType

Optional. A valid MIME type for the document.

files.aliases

Optional. An array of alias strings.

files.metadata

Optional. Any additional information you want to store.

The bios Example Collection

The `bios` collection provides example data for experimenting with MongoDB. Many of this guide's examples on [insert](#) (page 832), [update](#) (page 849) and [read](#) (page 816) operations create or query data from the `bios` collection.

The following documents comprise the `bios` collection. In the examples, the data might be different, as the examples themselves make changes to the data.

```

{
  "_id" : 1,
  "name" : {
    "first" : "John",
    "last" : "Backus"
  },
  "birth" : ISODate("1924-12-03T05:00:00Z"),
  "death" : ISODate("2007-03-17T04:00:00Z"),
  "contribs" : [
    "Fortran",
    "ALGOL",
    "Backus-Naur Form",
    "COBOL"
  ]
}

```

```
        "FP",
],
"awards" : [
{
    "award" : "W.W. McDowell Award",
    "year" : 1967,
    "by" : "IEEE Computer Society"
},
{
    "award" : "National Medal of Science",
    "year" : 1975,
    "by" : "National Science Foundation"
},
{
    "award" : "Turing Award",
    "year" : 1977,
    "by" : "ACM"
},
{
    "award" : "Draper Prize",
    "year" : 1993,
    "by" : "National Academy of Engineering"
}
]
}

{
    "_id" : ObjectId("51df07b094c6acd67e492f41"),
    "name" : {
        "first" : "John",
        "last" : "McCarthy"
    },
    "birth" : ISODate("1927-09-04T04:00:00Z"),
    "death" : ISODate("2011-12-24T05:00:00Z"),
    "contribs" : [
        "Lisp",
        "Artificial Intelligence",
        "ALGOL"
    ],
    "awards" : [
        {
            "award" : "Turing Award",
            "year" : 1971,
            "by" : "ACM"
        },
        {
            "award" : "Kyoto Prize",
            "year" : 1988,
            "by" : "Inamori Foundation"
        },
        {
            "award" : "National Medal of Science",
            "year" : 1990,
            "by" : "National Science Foundation"
        }
    ]
}
```

```
{
  "_id" : 3,
  "name" : {
    "first" : "Grace",
    "last" : "Hopper"
  },
  "title" : "Rear Admiral",
  "birth" : ISODate("1906-12-09T05:00:00Z"),
  "death" : ISODate("1992-01-01T05:00:00Z"),
  "contribs" : [
    "UNIVAC",
    "compiler",
    "FLOW-MATIC",
    "COBOL"
  ],
  "awards" : [
    {
      "award" : "Computer Sciences Man of the Year",
      "year" : 1969,
      "by" : "Data Processing Management Association"
    },
    {
      "award" : "Distinguished Fellow",
      "year" : 1973,
      "by" : "British Computer Society"
    },
    {
      "award" : "W. W. McDowell Award",
      "year" : 1976,
      "by" : "IEEE Computer Society"
    },
    {
      "award" : "National Medal of Technology",
      "year" : 1991,
      "by" : "United States"
    }
  ]
}

{
  "_id" : 4,
  "name" : {
    "first" : "Kristen",
    "last" : "Nygaard"
  },
  "birth" : ISODate("1926-08-27T04:00:00Z"),
  "death" : ISODate("2002-08-10T04:00:00Z"),
  "contribs" : [
    "OOP",
    "Simula"
  ],
  "awards" : [
    {
      "award" : "Rosing Prize",
      "year" : 1999,
      "by" : "Norwegian Data Association"
    },
    {
      "award" : "Nansen Medal"
    }
  ]
}
```

```
        "award" : "Turing Award",
        "year" : 2001,
        "by" : "ACM"
    },
    {
        "award" : "IEEE John von Neumann Medal",
        "year" : 2001,
        "by" : "IEEE"
    }
]
}

{
    "_id" : 5,
    "name" : {
        "first" : "Ole-Johan",
        "last" : "Dahl"
    },
    "birth" : ISODate("1931-10-12T04:00:00Z"),
    "death" : ISODate("2002-06-29T04:00:00Z"),
    "contribs" : [
        "OOP",
        "Simula"
    ],
    "awards" : [
        {
            "award" : "Rosing Prize",
            "year" : 1999,
            "by" : "Norwegian Data Association"
        },
        {
            "award" : "Turing Award",
            "year" : 2001,
            "by" : "ACM"
        },
        {
            "award" : "IEEE John von Neumann Medal",
            "year" : 2001,
            "by" : "IEEE"
        }
    ]
}

{
    "_id" : 6,
    "name" : {
        "first" : "Guido",
        "last" : "van Rossum"
    },
    "birth" : ISODate("1956-01-31T05:00:00Z"),
    "contribs" : [
        "Python"
    ],
    "awards" : [
        {
            "award" : "Award for the Advancement of Free Software",
            "year" : 2001,
            "by" : "Free Software Foundation"
        }
    ]
}
```

```

        },
        {
            "award" : "NLUUG Award",
            "year" : 2003,
            "by" : "NLUUG"
        }
    ]
}

{
    "_id" : ObjectId("51e062189c6ae665454e301d"),
    "name" : {
        "first" : "Dennis",
        "last" : "Ritchie"
    },
    "birth" : ISODate("1941-09-09T04:00:00Z"),
    "death" : ISODate("2011-10-12T04:00:00Z"),
    "contribs" : [
        "UNIX",
        "C"
    ],
    "awards" : [
        {
            "award" : "Turing Award",
            "year" : 1983,
            "by" : "ACM"
        },
        {
            "award" : "National Medal of Technology",
            "year" : 1998,
            "by" : "United States"
        },
        {
            "award" : "Japan Prize",
            "year" : 2011,
            "by" : "The Japan Prize Foundation"
        }
    ]
}

{
    "_id" : 8,
    "name" : {
        "first" : "Yukihiro",
        "aka" : "Matz",
        "last" : "Matsumoto"
    },
    "birth" : ISODate("1965-04-14T04:00:00Z"),
    "contribs" : [
        "Ruby"
    ],
    "awards" : [
        {
            "award" : "Award for the Advancement of Free Software",
            "year" : "2011",
            "by" : "Free Software Foundation"
        }
    ]
}

```

```
}

{
    "_id" : 9,
    "name" : {
        "first" : "James",
        "last" : "Gosling"
    },
    "birth" : ISODate("1955-05-19T04:00:00Z"),
    "contribs" : [
        "Java"
    ],
    "awards" : [
        {
            "award" : "The Economist Innovation Award",
            "year" : 2002,
            "by" : "The Economist"
        },
        {
            "award" : "Officer of the Order of Canada",
            "year" : 2007,
            "by" : "Canada"
        }
    ]
}

{
    "_id" : 10,
    "name" : {
        "first" : "Martin",
        "last" : "Odersky"
    },
    "contribs" : [
        "Scala"
    ],
}
```

Data Models

Data in MongoDB has a *flexible schema*. *Collections* do not enforce *document* structure. Although you may be able to use different structures for a single data set in MongoDB, different data models may have significant impacts on MongoDB and application performance. Consider *Data Modeling Considerations for MongoDB Applications* (page 117) for a conceptual overview of data modeling problems in MongoDB, and the *Data Modeling Patterns* (page 124) documents for examples of different approaches to data models.

See also:

MongoDB Use Case Studies¹ for overviews of application design, including data models, with MongoDB.

3.1 Background

3.1.1 Data Modeling Considerations for MongoDB Applications

Overview

Data in MongoDB has a *flexible schema*. *Collections* do not enforce *document* structure. This means that:

- documents in the same collection do not need to have the same set of fields or structure, and
- common fields in a collection's documents may hold different types of data.

Each document only needs to contain relevant fields to the entity or object that the document represents. In practice, *most* documents in a collection share a similar structure. Schema flexibility means that you can model your documents in MongoDB so that they can closely resemble and reflect application-level objects.

As in all data modeling, when developing data models (i.e. *schema designs*) for MongoDB, you must consider the inherent properties and requirements of the application objects and the relationships between application objects. MongoDB data models must also reflect:

- how data will grow and change over time, and
- the kinds of queries your application will perform.

These considerations and requirements force developers to make a number of multi-factored decisions when modeling data, including:

- normalization and de-normalization.

¹<http://docs.mongodb.org/ecosystem/use-cases>

These decisions reflect the degree to which the data model should store related pieces of data in a single document. Fully normalized data models describe relationships using [references](#) (page 121) between documents, while de-normalized models may store redundant information across related models.

- [indexing strategy](#) (page 338).
- representation of data in arrays in [BSON](#).

Although a number of data models may be functionally equivalent for a given application, different data models may have significant impacts on MongoDB and applications performance.

This document provides a high level overview of these data modeling decisions and factors. In addition, consider the [Data Modeling Patterns and Examples](#) (page 121) section which provides more concrete examples of all the discussed patterns.

Data Modeling Decisions

Data modeling decisions involve determining how to structure the documents to model the data effectively. The primary decision is whether to [embed](#) (page 118) or to [use references](#) (page 118).

Embedding

To de-normalize data, store two related pieces of data in a single [document](#).

Operations within a document are less expensive for the server than operations that involve multiple documents.

In general, use embedded data models when:

- you have “contains” relationships between entities. See [Model Embedded One-to-One Relationships Between Documents](#) (page 124).
- you have one-to-many relationships where the “many” objects always appear with or are viewed in the context of their parent documents. See [Model Embedded One-to-Many Relationships Between Documents](#) (page 125).

Embedding provides the following benefits:

- generally better performance for read operations.
- the ability to request and retrieve related data in a single database operation.

Embedding related data in documents, can lead to situations where documents grow after creation. Document growth can impact write performance and lead to data fragmentation. Furthermore, documents in MongoDB must be smaller than the [maximum BSON document size](#) (page 1015). For larger documents, consider using [GridFS](#) (page 154).

See also:

- [dot notation](#) for information on “reaching into” embedded sub-documents.
- [Arrays](#) (page 70) for more examples on accessing arrays.
- [Subdocuments](#) (page 69) for more examples on accessing subdocuments.

Referencing

To normalize data, store [references](#) (page 121) between two documents to indicate a relationship between the data represented in each document.

In general, use normalized data models:

- when embedding would result in duplication of data but would not provide sufficient read performance advantages to outweigh the implications of the duplication.
- to represent more complex many-to-many relationships.
- to model large hierarchical data sets. See *data-modeling-trees*.

Referencing provides more flexibility than embedding; however, to resolve the references, client-side applications must issue follow-up queries. In other words, using references requires more roundtrips to the server.

See [Model Referenced One-to-Many Relationships Between Documents](#) (page 126) for an example of referencing.

Atomicity

MongoDB only provides atomic operations on the level of a single document.² As a result needs for atomic operations influence decisions to use embedded or referenced relationships when modeling data for MongoDB.

Embed fields that need to be modified together atomically in the same document. See [Model Data for Atomic Operations](#) (page 128) for an example of atomic updates within a single document.

Operational Considerations

In addition to normalization and normalization concerns, a number of other operational factors help shape data modeling decisions in MongoDB. These factors include:

- data lifecycle management,
- number of collections and
- indexing requirements,
- sharding, and
- managing document growth.

These factors implications for database and application performance as well as future maintenance and development costs.

Data Lifecycle Management

Data modeling decisions should also take data lifecycle management into consideration.

The [Time to Live or TTL feature](#) (page 158) of collections expires documents after a period of time. Consider using the TTL feature if your application requires some data to persist in the database for a limited period of time.

Additionally, if your application only uses recently inserted documents consider [Capped Collections](#) (page 156). Capped collections provide *first-in-first-out* (FIFO) management of inserted documents and optimized to support operations that insert and read documents based on insertion order.

Large Number of Collections

In certain situations, you might choose to store information in several collections rather than in a single collection.

Consider a sample collection `logs` that stores log documents for various environment and applications. The `logs` collection contains documents of the following form:

² Document-level atomic operations include all operations within a single MongoDB document record: operations that affect multiple sub-documents within that single record are still atomic.

```
{ log: "dev", ts: ..., info: ... }
{ log: "debug", ts: ..., info: ... }
```

If the total number of documents is low you may group documents into collection by type. For logs, consider maintaining distinct log collections, such as `logs.dev` and `logs.debug`. The `logs.dev` collection would contain only the documents related to the dev environment.

Generally, having large number of collections has no significant performance penalty and results in very good performance. Distinct collections are very important for high-throughput batch processing.

When using models that have a large number of collections, consider the following behaviors:

- Each collection has a certain minimum overhead of a few kilobytes.
- Each index, including the index on `_id`, requires at least 8KB of data space.

A single `<database>.ns` file stores all meta-data for each `database`. Each index and collection has its own entry in the namespace file, MongoDB places [limits on the size of namespace files](#) (page 1016).

Because of [limits on namespaces](#) (page 1015), you may wish to know the current number of namespaces in order to determine how many additional namespaces the database can support, as in the following example:

```
db.system.namespaces.count()
```

The `<database>.ns` file defaults to 16 MB. To change the size of the `<database>.ns` file, pass a new size to `--nssize option <new size MB>` on server start.

The `--nssize` sets the size for *new* `<database>.ns` files. For existing databases, after starting up the server with `--nssize`, run the `db.repairDatabase()` (page 892) command from the `mongo` (page 942) shell.

Indexes

Create indexes to support common queries. Generally, indexes and index use in MongoDB correspond to indexes and index use in relational database: build indexes on fields that appear often in queries and for all operations that return sorted results. MongoDB automatically creates a unique index on the `_id` field.

As you create indexes, consider the following behaviors of indexes:

- Each index requires at least 8KB of data space.
- Adding an index has some negative performance impact for write operations. For collections with high write-to-read ratio, indexes are expensive as each insert must add keys to each index.
- Collections with high proportion of read operations to write operations often benefit from additional indexes. Indexes do not affect un-indexed read operations.

See [Indexing Tutorials](#) (page 338) for more information on determining indexes. Additionally, the MongoDB `database profiler` (page 167) may help identify inefficient queries.

Sharding

`Sharding` allows users to *partition* a `collection` within a database to distribute the collection's documents across a number of `mongod` (page 925) instances or `shards`.

The shard key determines how MongoDB distributes data among shards in a sharded collection. Selecting the proper `shard key` (page 506) has significant implications for performance.

See [Sharding Introduction](#) (page 493) and [Shard Keys](#) (page 506) for more information.

Document Growth

Certain updates to documents can increase the document size, such as pushing elements to an array and adding new fields. If the document size exceeds the allocated space for that document, MongoDB relocates the document on disk. This internal relocation can be both time and resource consuming.

Although MongoDB automatically provides padding to minimize the occurrence of relocations, you may still need to manually handle document growth. Refer to the [Pre-Aggregated Reports Use Case Study³](#) for an example of the *Pre-allocation* approach to handle document growth.

Data Modeling Patterns and Examples

The following documents provide overviews of various data modeling patterns and common schema design considerations:

- [Model Embedded One-to-One Relationships Between Documents](#) (page 124)
- [Model Embedded One-to-Many Relationships Between Documents](#) (page 125)
- [Model Referenced One-to-Many Relationships Between Documents](#) (page 126)
- [Model Data for Atomic Operations](#) (page 128)
- [Model Tree Structures with Parent References](#) (page 129)
- [Model Tree Structures with Child References](#) (page 129)
- [Model Tree Structures with Materialized Paths](#) (page 131)
- [Model Tree Structures with Nested Sets](#) (page 132)

For more information and examples of real-world data modeling, consider the following external resources:

- [Schema Design by Example⁴](#)
- [Walkthrough MongoDB Data Modeling⁵](#)
- [Document Design for MongoDB⁶](#)
- [Dynamic Schema Blog Post⁷](#)
- [MongoDB Data Modeling and Rails⁸](#)
- [Ruby Example of Materialized Paths⁹](#)
- [Sean Cribs Blog Post¹⁰](#) which was the source for much of the *data-modeling-trees* content.

3.1.2 Database References

MongoDB does not support joins. In MongoDB some data is *denormalized*, or stored with related data in *documents* to remove the need for joins. However, in some cases it makes sense to store related information in separate documents, typically in different collections or databases.

MongoDB applications use one of two methods for relating documents:

³<http://docs.mongodb.org/ecosystem/use-cases/pre-aggregated-reports>

⁴<http://www.mongodb.com/presentations/mongodb-melbourne-2012/schema-design-example>

⁵<http://architects.dzone.com/articles/walkthrough-mongodb-data>

⁶<http://oreilly.com/catalog/0636920018391>

⁷<http://dmerr.tumblr.com/post/6633338010/schemaless>

⁸<http://docs.mongodb.org/ecosystem/tutorial/model-data-for-ruby-on-rails/>

⁹<http://github.com/banker/newsmonger/blob/master/app/models/comment.rb>

¹⁰<http://seancribbs.com/tech/2009/09/28/modeling-a-tree-in-a-document-database>

1. *Manual references* (page 122) where you save the `_id` field of one document in another document as a reference. Then your application can run a second query to return the embedded data. These references are simple and sufficient for most use cases.
2. *DBRefs* (page 123) are references from one document to another using the value of the first document's `_id` field collection, and optional database name. To resolve DBRefs, your application must perform additional queries to return the referenced documents. Many *drivers* (page 95) have helper methods that form the query for the DBRef automatically. The drivers ¹¹ do not *automatically* resolve DBRefs into documents.

Use a DBRef when you need to embed documents from multiple collections in documents from one collection. DBRefs also provide a common format and type to represent these relationships among documents. The DBRef format provides common semantics for representing links between documents if your database must interact with multiple frameworks and tools.

Unless you have a compelling reason for using a DBRef, use manual references.

Manual References

Background

Manual references refers to the practice of including one *document's* `_id` field in another document. The application can then issue a second query to resolve the referenced fields as needed.

Process

Consider the following operation to insert two documents, using the `_id` field of the first document as a reference in the second document:

```
original_id = ObjectId()

db.places.insert({
    "_id": original_id,
    "name": "Broadway Center",
    "url": "bc.example.net"
})

db.people.insert({
    "name": "Erin",
    "places_id": original_id,
    "url": "bc.example.net/Erin"
})
```

Then, when a query returns the document from the `people` collection you can, if needed, make a second query for the document referenced by the `places_id` field in the `places` collection.

Use

For nearly every case where you want to store a relationship between two documents, use *manual references* (page 122). The references are simple to create and your application can resolve references as needed.

The only limitation of manual linking is that these references do not convey the database and collection name. If you have documents in a single collection that relate to documents in more than one collection, you may need to consider using *DBRefs* (page 123).

¹¹ Some community supported drivers may have alternate behavior and may resolve a DBRef into a document automatically.

DBRefs

Background

DBRefs are a convention for representing a *document*, rather than a specific reference “type.” They include the name of the collection, and in some cases the database, in addition to the value from the `_id` field.

Format

DBRefs have the following fields:

`$ref`

The `$ref` field holds the name of the collection where the referenced document resides.

`$id`

The `$id` field contains the value of the `_id` field in the referenced document.

`$db`

Optional.

Contains the name of the database where the referenced document resides.

Only some drivers support `$db` references.

Example

DBRef document would resemble the following:

```
{ "$ref" : <value>, "$id" : <value>, "$db" : <value> }
```

Consider a document from a collection that stored a DBRef in a `creator` field:

```
{
  "_id" : ObjectId("5126bbf64aed4daf9e2ab771"),
  // .. application fields
  "creator" : {
    "$ref" : "creators",
    "$id" : ObjectId("5126bc054aed4daf9e2ab772"),
    "$db" : "users"
  }
}
```

The DBRef in this example, points to a document in the `creators` collection of the `users` database that has `ObjectId("5126bc054aed4daf9e2ab772")` in its `_id` field.

Note: The order of fields in the DBRef matters, and you must use the above sequence when using a DBRef.

Support

C++ The C++ driver contains no support for DBRefs. You can transverse references manually.

C# The C# driver provides access to DBRef objects with the [MongoDBRef Class¹²](#) and supplies the [FetchDBRef Method¹³](#) for accessing these objects.

¹²<http://api.mongodb.org/csharp/current/html/46c356d3-ed06-a6f8-42fa-e0909ab64ce2.htm>

¹³<http://api.mongodb.org/csharp/current/html/1b0b8f48-ba98-1367-0a7d-6e01c8df436f.htm>

Java The `DBRef`¹⁴ class provides supports for DBRefs from Java.

JavaScript The `mongo` (page 942) shell's `JavaScript` (page 806) interface provides a `DBRef`.

Perl The Perl driver contains no support for DBRefs. You can transverse references manually or use the `MongoDBx::AutoDeref`¹⁵ CPAN module.

PHP The PHP driver does support DBRefs, including the optional `$db` reference, through `The MongoDBRef class`¹⁶.

Python The Python driver provides the `DBRef` class¹⁷, and the `dereference` method¹⁸ for interacting with DBRefs.

Ruby The Ruby Driver supports DBRefs using the `DBRef` class¹⁹ and the `deference` method²⁰.

Use

In most cases you should use the `manual reference` (page 122) method for connecting two or more related documents. However, if you need to reference documents from multiple collections, consider a `DBRef`.

3.2 Data Modeling Patterns

3.2.1 Model Embedded One-to-One Relationships Between Documents

Overview

Data in MongoDB has a *flexible schema*. `Collections` do not enforce `document` structure. Decisions that affect how you model data can affect application performance and database capacity. See `Data Modeling Considerations for MongoDB Applications` (page 117) for a full high level overview of data modeling in MongoDB.

This document describes a data model that uses `embedded` (page 118) documents to describe relationships between connected data.

Pattern

Consider the following example that maps patron and address relationships. The example illustrates the advantage of embedding over referencing if you need to view one data entity in context of the other. In this one-to-one relationship between `patron` and `address` data, the `address` belongs to the `patron`.

In the normalized data model, the `address` contains a reference to the parent.

```
{  
  _id: "joe",  
  name: "Joe Bookreader"  
}  
  
{  
  patron_id: "joe",  
  street: "123 Fake Street",  
  city: "Faketon",
```

¹⁴<http://api.mongodb.org/java/current/com/mongodb/DBRef.html>

¹⁵<http://search.cpan.org/dist/MongoDBx-AutoDeref/>

¹⁶<http://www.php.net/manual/en/class.mongodbref.php/>

¹⁷<http://api.mongodb.org/python/current/api/bson/dbref.html>

¹⁸<http://api.mongodb.org/python/current/api/pymongo/database.html#pymongo.database.Database.dereference>

¹⁹<http://api.mongodb.org/ruby/current/BSON/DBRef.html>

²⁰<http://api.mongodb.org/ruby/current/Mongo/DB.html#dereference>

```

    state: "MA"
    zip: 12345
}

```

If the `address` data is frequently retrieved with the `name` information, then with referencing, your application needs to issue multiple queries to resolve the reference. The better data model would be to embed the `address` data in the `patron` data, as in the following document:

```

{
  _id: "joe",
  name: "Joe Bookreader",
  address: {
    street: "123 Fake Street",
    city: "Faketown",
    state: "MA"
    zip: 12345
  }
}

```

With the embedded data model, your application can retrieve the complete patron information with one query.

3.2.2 Model Embedded One-to-Many Relationships Between Documents

Overview

Data in MongoDB has a *flexible schema*. [Collections](#) do not enforce [document](#) structure. Decisions that affect how you model data can affect application performance and database capacity. See [Data Modeling Considerations for MongoDB Applications](#) (page 117) for a full high level overview of data modeling in MongoDB.

This document describes a data model that uses [embedded](#) (page 118) documents to describe relationships between connected data.

Pattern

Consider the following example that maps `patron` and multiple `address` relationships. The example illustrates the advantage of embedding over referencing if you need to view many data entities in context of another. In this one-to-many relationship between `patron` and `address` data, the `patron` has multiple `address` entities.

In the normalized data model, the `address` contains a reference to the parent.

```

{
  _id: "joe",
  name: "Joe Bookreader"
}

{
  patron_id: "joe",
  street: "123 Fake Street",
  city: "Faketown",
  state: "MA",
  zip: 12345
}

{
  patron_id: "joe",
  street: "1 Some Other Street",

```

```
    city: "Boston",
    state: "MA",
    zip: 12345
}
```

If your application frequently retrieves the address data with the name information, then your application needs to issue multiple queries to resolve the references. A more optimal schema would be to embed the address data entities in the patron data, as in the following document:

```
{
  _id: "joe",
  name: "Joe Bookreader",
  addresses: [
    {
      street: "123 Fake Street",
      city: "Faketown",
      state: "MA",
      zip: 12345
    },
    {
      street: "1 Some Other Street",
      city: "Boston",
      state: "MA",
      zip: 12345
    }
  ]
}
```

With the embedded data model, your application can retrieve the complete patron information with one query.

3.2.3 Model Referenced One-to-Many Relationships Between Documents

Overview

Data in MongoDB has a *flexible schema*. [Collections](#) do not enforce [document](#) structure. Decisions that affect how you model data can affect application performance and database capacity. See [Data Modeling Considerations for MongoDB Applications](#) (page 117) for a full high level overview of data modeling in MongoDB.

This document describes a data model that uses [references](#) (page 118) between documents to describe relationships between connected data.

Pattern

Consider the following example that maps publisher and book relationships. The example illustrates the advantage of referencing over embedding to avoid repetition of the publisher information.

Embedding the publisher document inside the book document would lead to **repetition** of the publisher data, as the following documents show:

```
{
  title: "MongoDB: The Definitive Guide",
  author: [ "Kristina Chodorow", "Mike Dirolf" ],
  published_date: ISODate("2010-09-24"),
  pages: 216,
  language: "English",
  publisher: {
```

```

        name: "O'Reilly Media",
        founded: 1980,
        location: "CA"
    }
}

{
    title: "50 Tips and Tricks for MongoDB Developer",
    author: "Kristina Chodorow",
    published_date: ISODate("2011-05-06"),
    pages: 68,
    language: "English",
    publisher: {
        name: "O'Reilly Media",
        founded: 1980,
        location: "CA"
    }
}

```

To avoid repetition of the publisher data, use *references* and keep the publisher information in a separate collection from the book collection.

When using references, the growth of the relationships determine where to store the reference. If the number of books per publisher is small with limited growth, storing the book reference inside the publisher document may sometimes be useful. Otherwise, if the number of books per publisher is unbounded, this data model would lead to mutable, growing arrays, as in the following example:

```

{
    name: "O'Reilly Media",
    founded: 1980,
    location: "CA",
    books: [12346789, 234567890, ...]
}

{
    _id: 123456789,
    title: "MongoDB: The Definitive Guide",
    author: [ "Kristina Chodorow", "Mike Dirolf" ],
    published_date: ISODate("2010-09-24"),
    pages: 216,
    language: "English"
}

{
    _id: 234567890,
    title: "50 Tips and Tricks for MongoDB Developer",
    author: "Kristina Chodorow",
    published_date: ISODate("2011-05-06"),
    pages: 68,
    language: "English"
}

```

To avoid mutable, growing arrays, store the publisher reference inside the book document:

```
{
    _id: "oreilly",
    name: "O'Reilly Media",
    founded: 1980,
    location: "CA"
}
```

```
}

{
  _id: 123456789,
  title: "MongoDB: The Definitive Guide",
  author: [ "Kristina Chodorow", "Mike Dirolf" ],
  published_date: ISODate("2010-09-24"),
  pages: 216,
  language: "English",
  publisher_id: "oreilly"
}

{
  _id: 234567890,
  title: "50 Tips and Tricks for MongoDB Developer",
  author: "Kristina Chodorow",
  published_date: ISODate("2011-05-06"),
  pages: 68,
  language: "English",
  publisher_id: "oreilly"
}
```

3.2.4 Model Data for Atomic Operations

Pattern

Consider the following example that keeps a library book and its checkout information. The example illustrates how embedding fields related to an atomic update within the same document ensures that the fields are in sync.

Consider the following book document that stores the number of available copies for checkout and the current checkout information:

```
book = {
  _id: 123456789,
  title: "MongoDB: The Definitive Guide",
  author: [ "Kristina Chodorow", "Mike Dirolf" ],
  published_date: ISODate("2010-09-24"),
  pages: 216,
  language: "English",
  publisher_id: "oreilly",
  available: 3,
  checkout: [ { by: "joe", date: ISODate("2012-10-15") } ]
}
```

You can use the `db.collection.findAndModify()` (page 821) method to atomically determine if a book is available for checkout and update with the new checkout information. Embedding the `available` field and the `checkout` field within the same document ensures that the updates to these fields are in sync:

```
db.books.findAndModify ( {
  query: {
    _id: 123456789,
    available: { $gt: 0 }
  },
  update: {
    $inc: { available: -1 },
    $push: { checkout: { by: "abc", date: new Date() } }
  }
})
```

```

    }
}
)
```

3.2.5 Model Tree Structures with Parent References

Overview

Data in MongoDB has a *flexible schema*. [Collections](#) do not enforce [document](#) structure. Decisions that affect how you model data can affect application performance and database capacity. See [Data Modeling Considerations for MongoDB Applications](#) (page 117) for a full high level overview of data modeling in MongoDB.

This document describes a data model that describes a tree-like structure in MongoDB documents by storing [references](#) (page 118) to “parent” nodes in children nodes.

Pattern

The *Parent References* pattern stores each tree node in a document; in addition to the tree node, the document stores the id of the node’s parent.

Consider the following example that models a tree of categories using *Parent References*:

```
db.categories.insert( { _id: "MongoDB", parent: "Databases" } )
db.categories.insert( { _id: "Postgres", parent: "Databases" } )
db.categories.insert( { _id: "Databases", parent: "Programming" } )
db.categories.insert( { _id: "Languages", parent: "Programming" } )
db.categories.insert( { _id: "Programming", parent: "Books" } )
db.categories.insert( { _id: "Books", parent: null } )
```

- The query to retrieve the parent of a node is fast and straightforward:

```
db.categories.findOne( { _id: "MongoDB" } ).parent
```

- You can create an index on the field `parent` to enable fast search by the parent node:

```
db.categories.ensureIndex( { parent: 1 } )
```

- You can query by the `parent` field to find its immediate children nodes:

```
db.categories.find( { parent: "Databases" } )
```

The *Parent Links* pattern provides a simple solution to tree storage, but requires multiple queries to retrieve subtrees.

3.2.6 Model Tree Structures with Child References

Overview

Data in MongoDB has a *flexible schema*. [Collections](#) do not enforce [document](#) structure. Decisions that affect how you model data can affect application performance and database capacity. See [Data Modeling Considerations for MongoDB Applications](#) (page 117) for a full high level overview of data modeling in MongoDB.

This document describes a data model that describes a tree-like structure in MongoDB documents by storing [references](#) (page 118) in the parent-nodes to children nodes.

Pattern

The *Child References* pattern stores each tree node in a document; in addition to the tree node, document stores in an array the id(s) of the node's children.

Consider the following example that models a tree of categories using *Child References*:

```
db.categories.insert( { _id: "MongoDB", children: [] } )
db.categories.insert( { _id: "Postgres", children: [] } )
db.categories.insert( { _id: "Databases", children: [ "MongoDB", "Postgres" ] } )
db.categories.insert( { _id: "Languages", children: [] } )
db.categories.insert( { _id: "Programming", children: [ "Databases", "Languages" ] } )
db.categories.insert( { _id: "Books", children: [ "Programming" ] } )
```

- The query to retrieve the immediate children of a node is fast and straightforward:

```
db.categories.findOne( { _id: "Databases" } ).children
```

- You can create an index on the field `children` to enable fast search by the child nodes:

```
db.categories.ensureIndex( { children: 1 } )
```

- You can query for a node in the `children` field to find its parent node as well as its siblings:

```
db.categories.find( { children: "MongoDB" } )
```

The *Child References* pattern provides a suitable solution to tree storage as long as no operations on subtrees are necessary. This pattern may also provide a suitable solution for storing graphs where a node may have multiple parents.

3.2.7 Model Tree Structures with an Array of Ancestors

Overview

Data in MongoDB has a *flexible schema*. *Collections* do not enforce *document* structure. Decisions that affect how you model data can affect application performance and database capacity. See *Data Modeling Considerations for MongoDB Applications* (page 117) for a full high level overview of data modeling in MongoDB.

This document describes a data model that describes a tree-like structure in MongoDB documents using *references* (page 118) to parent nodes and an array that stores all ancestors.

Pattern

The *Array of Ancestors* pattern stores each tree node in a document; in addition to the tree node, document stores in an array the id(s) of the node's ancestors or path.

Consider the following example that models a tree of categories using *Array of Ancestors*:

```
db.categories.insert( { _id: "MongoDB", ancestors: [ "Books", "Programming", "Databases" ], parent: null }
db.categories.insert( { _id: "Postgres", ancestors: [ "Books", "Programming", "Databases" ], parent: null }
db.categories.insert( { _id: "Databases", ancestors: [ "Books", "Programming" ], parent: "Programming" }
db.categories.insert( { _id: "Languages", ancestors: [ "Books", "Programming" ], parent: "Programming" }
db.categories.insert( { _id: "Programming", ancestors: [ "Books" ], parent: "Books" } )
db.categories.insert( { _id: "Books", ancestors: [ ], parent: null } )
```

- The query to retrieve the ancestors or path of a node is fast and straightforward:

```
db.categories.findOne( { _id: "MongoDB" } ).ancestors
```

- You can create an index on the field `ancestors` to enable fast search by the ancestors nodes:

```
db.categories.ensureIndex( { ancestors: 1 } )
```

- You can query by the `ancestors` to find all its descendants:

```
db.categories.find( { ancestors: "Programming" } )
```

The *Array of Ancestors* pattern provides a fast and efficient solution to find the descendants and the ancestors of a node by creating an index on the elements of the `ancestors` field. This makes *Array of Ancestors* a good choice for working with subtrees.

The *Array of Ancestors* pattern is slightly slower than the *Materialized Paths* pattern but is more straightforward to use.

3.2.8 Model Tree Structures with Materialized Paths

Overview

Data in MongoDB has a *flexible schema*. *Collections* do not enforce *document* structure. Decisions that affect how you model data can affect application performance and database capacity. See *Data Modeling Considerations for MongoDB Applications* (page 117) for a full high level overview of data modeling in MongoDB.

This document describes a data model that describes a tree-like structure in MongoDB documents by storing full relationship paths between documents.

Pattern

The *Materialized Paths* pattern stores each tree node in a document; in addition to the tree node, document stores as a string the id(s) of the node's ancestors or path. Although the *Materialized Paths* pattern requires additional steps of working with strings and regular expressions, the pattern also provides more flexibility in working with the path, such as finding nodes by partial paths.

Consider the following example that models a tree of categories using *Materialized Paths*; the path string uses the comma , as a delimiter:

```
db.categories.insert( { _id: "Books", path: null } )
db.categories.insert( { _id: "Programming", path: ",Books," } )
db.categories.insert( { _id: "Databases", path: ",Books,Programming," } )
db.categories.insert( { _id: "Languages", path: ",Books,Programming," } )
db.categories.insert( { _id: "MongoDB", path: ",Books,Programming,Databases," } )
db.categories.insert( { _id: "Postgres", path: ",Books,Programming,Databases," } )
```

- You can query to retrieve the whole tree, sorting by the path:

```
db.categories.find().sort( { path: 1 } )
```

- You can use regular expressions on the `path` field to find the descendants of `Programming`:

```
db.categories.find( { path: /,Programming,/ } )
```

- You can also retrieve the descendants of `Books` where the `Books` is also at the topmost level of the hierarchy:

```
db.categories.find( { path: /^,Books,/ } )
```

- To create an index on the field `path` use the following invocation:

```
db.categories.ensureIndex( { path: 1 } )
```

This index may improve performance, depending on the query:

- For queries of the `Books` sub-tree (e.g. `http://docs.mongodb.org/manual^,Books,/`) an index on the `path` field improves the query performance significantly.
- For queries of the `Programming` sub-tree (e.g. `http://docs.mongodb.org/manual,Programming,/`), or similar queries of sub-trees, where the node might be in the middle of the indexed string, the query must inspect the entire index.

For these queries an index *may* provide some performance improvement *if* the index is significantly smaller than the entire collection.

3.2.9 Model Tree Structures with Nested Sets

Overview

Data in MongoDB has a *flexible schema*. [Collections](#) do not enforce [document](#) structure. Decisions that affect how you model data can affect application performance and database capacity. See [Data Modeling Considerations for MongoDB Applications](#) (page 117) for a full high level overview of data modeling in MongoDB.

This document describes a data model that describes a tree like structure that optimizes discovering subtrees at the expense of tree mutability.

Pattern

The *Nested Sets* pattern identifies each node in the tree as stops in a round-trip traversal of the tree. The application visits each node in the tree twice; first during the initial trip, and second during the return trip. The *Nested Sets* pattern stores each tree node in a document; in addition to the tree node, document stores the id of node's parent, the node's initial stop in the `left` field, and its return stop in the `right` field.

Consider the following example that models a tree of categories using *Nested Sets*:

```
db.categories.insert( { _id: "Books", parent: 0, left: 1, right: 12 } )
db.categories.insert( { _id: "Programming", parent: "Books", left: 2, right: 11 } )
db.categories.insert( { _id: "Languages", parent: "Programming", left: 3, right: 4 } )
db.categories.insert( { _id: "Databases", parent: "Programming", left: 5, right: 10 } )
db.categories.insert( { _id: "MongoDB", parent: "Databases", left: 6, right: 7 } )
db.categories.insert( { _id: "Postgres", parent: "Databases", left: 8, right: 9 } )
```

You can query to retrieve the descendants of a node:

```
var databaseCategory = db.v.findOne( { _id: "Databases" } );
db.categories.find( { left: { $gt: databaseCategory.left }, right: { $lt: databaseCategory.right } } )
```

The *Nested Sets* pattern provides a fast and efficient solution for finding subtrees but is inefficient for modifying the tree structure. As such, this pattern is best for static trees that do not change.

3.2.10 Model Data to Support Keyword Search

Note: Keyword search is *not* the same as text search or full text search, and does not provide stemming or other text-processing features. See the [Limitations of Keyword Indexes](#) (page 133) section for more information.

In 2.4, MongoDB provides a text search feature. See [Text Indexes](#) (page 332) for more information.

If your application needs to perform queries on the content of a field that holds text you can perform exact matches on the text or use `$regex` (page 633) to use regular expression pattern matches. However, for many operations on text, these methods do not satisfy application requirements.

This pattern describes one method for supporting keyword search using MongoDB to support application search functionality, that uses keywords stored in an array in the same document as the text field. Combined with a [multi-key index](#) (page 324), this pattern can support application's keyword search operations.

Pattern

To add structures to your document to support keyword-based queries, create an array field in your documents and add the keywords as strings in the array. You can then create a [multi-key index](#) (page 324) on the array and create queries that select values from the array.

Example

Given a collection of library volumes that you want to provide topic-based search. For each volume, you add the array `topics`, and you add as many keywords as needed for a given volume.

For the Moby-Dick volume you might have the following document:

```
{ title : "Moby-Dick" ,
  author : "Herman Melville" ,
  published : 1851 ,
  ISBN : 0451526996 ,
  topics : [ "whaling" , "allegory" , "revenge" , "American" ,
             "novel" , "nautical" , "voyage" , "Cape Cod" ]
}
```

You then create a multi-key index on the `topics` array:

```
db.volumes.ensureIndex( { topics: 1 } )
```

The multi-key index creates separate index entries for each keyword in the `topics` array. For example the index contains one entry for whaling and another for allegory.

You then query based on the keywords. For example:

```
db.volumes.findOne( { topics : "voyage" } , { title: 1 } )
```

Note: An array with a large number of elements, such as one with several hundreds or thousands of keywords will incur greater indexing costs on insertion.

Limitations of Keyword Indexes

MongoDB can support keyword searches using specific data models and [multi-key indexes](#) (page 324); however, these keyword indexes are not sufficient or comparable to full-text products in the following respects:

- *Stemming*. Keyword queries in MongoDB can not parse keywords for root or related words.
- *Synonyms*. Keyword-based search features must provide support for synonym or related queries in the application layer.
- *Ranking*. The keyword look ups described in this document do not provide a way to weight results.

- *Asynchronous Indexing.* MongoDB builds indexes synchronously, which means that the indexes used for keyword indexes are always current and can operate in real-time. However, asynchronous bulk indexes may be more efficient for some kinds of content and workloads.

Administration

The administration documentation addresses the ongoing operation and maintenance of MongoDB instances and deployments. This documentation includes both high level overviews of these concerns as well as tutorials that cover specific procedures and processes for operating MongoDB.

Administration Concepts ([page 135](#)) Core conceptual documentation of operational practices for managing MongoDB deployments and systems.

Backup Strategies for MongoDB Systems ([page 136](#)) Describes approaches and considerations for backing up a MongoDB database.

Data Center Awareness ([page 153](#)) Presents the MongoDB features that allow application developers and database administrators to configure their deployments to be more data center aware or allow operational and location-based separation.

Monitoring for MongoDB ([page 138](#)) An overview of monitoring tools, diagnostic strategies, and approaches to monitoring replica sets and sharded clusters.

Administration Tutorials ([page 163](#)) Tutorials that describe common administrative procedures and practices for operations for MongoDB instances and deployments.

Configuration, Maintenance, and Analysis ([page 163](#)) Describes routine management operations, including configuration and performance analysis.

Backup and Recovery ([page 181](#)) Outlines procedures for data backup and restoration with `mongod` ([page 925](#)) instances and deployments.

Administration Reference ([page 217](#)) Reference and documentation of internal mechanics of administrative features, systems and functions and operations.

See also:

The MongoDB Manual contains administrative documentation and tutorials though out several sections. See *Replica Set Tutorials* ([page 419](#)) and *Sharded Cluster Tutorials* ([page 521](#)) for additional tutorials and information.

4.1 Administration Concepts

The core administration documents address strategies and practices used in the operation of MongoDB systems and deployments.

Operational Strategies ([page 136](#)) Higher level documentation of key concepts for the operation and maintenance of MongoDB deployments, including backup, maintenance, and configuration.

Backup Strategies for MongoDB Systems ([page 136](#)) Describes approaches and considerations for backing up a MongoDB database.

Monitoring for MongoDB (page 138) An overview of monitoring tools, diagnostic strategies, and approaches to monitoring replica sets and sharded clusters.

Run-time Database Configuration (page 145) Outlines common MongoDB configurations and examples of best-practice configurations for common use cases.

Data Management (page 153) Core documentation that addresses issues in data management, organization, maintenance, and lifestyle management.

Data Center Awareness (page 153) Presents the MongoDB features that allow application developers and database administrators to configure their deployments to be more data center aware or allow operational and location-based separation.

Expire Data from Collections by Setting TTL (page 158) TTL collections make it possible to automatically remove data from a collection based on the value of a timestamp and are useful for managing data like machine generated event data that are only useful for a limited period of time.

Capped Collections (page 156) Capped collections provide a special type of size-constrained collections that preserve insertion order and can support high volume inserts.

GridFS (page 154) GridFS is a specification for storing documents that exceeds the *BSON*-document size limit of 16MB.

Optimization Strategies for MongoDB (page 160) Techniques for optimizing application performance with MongoDB.

4.1.1 Operational Strategies

These documents address higher level strategies for common administrative tasks and requirements with respect to MongoDB deployments.

Backup Strategies for MongoDB Systems (page 136) Describes approaches and considerations for backing up a MongoDB database.

Monitoring for MongoDB (page 138) An overview of monitoring tools, diagnostic strategies, and approaches to monitoring replica sets and sharded clusters.

Run-time Database Configuration (page 145) Outlines common MongoDB configurations and examples of best-practice configurations for common use cases.

Import and Export MongoDB Data (page 149) Provides an overview of `mongoimport` and `mongoexport`, the tools MongoDB includes for importing and exporting data.

Backup Strategies for MongoDB Systems

Backups are an important part of any operational disaster recovery plan. A good backup plan must be able to capture data in a consistent and usable state, and operators must be able to automate both the backup and the recovery operations. Also test all components of the backup system to ensure that you can recover backed up data as needed. If you cannot effectively restore your database from the backup, then your backups are useless.

Note: The [MongoDB Management Service](#)¹ supports backup and restoration for MongoDB deployments. See the [MMS Backup Documentation](#)² for more information.

¹https://mms.10gen.com/?pk_campaign=MongoDB-Org&pk_kwd=Backup-Docs

²<https://mms.mongodb.com/help/backup/>

Backup Considerations

As you develop a backup strategy for your MongoDB deployment consider the following factors:

- Geography. Ensure that you move some backups away from your primary database infrastructure.
- System errors. Ensure that your backups can survive situations where hardware failures or disk errors impact the integrity or availability of your backups.
- Production constraints. Backup operations themselves sometimes require substantial system resources. It is important to consider the time of the backup schedule relative to peak usage and maintenance windows.
- System capabilities. Some of the block-level snapshot tools require special support on the operating-system or infrastructure level.
- Database configuration. *Replication* and *sharding* can affect the process and impact of the backup implementation. See [Sharded Cluster Backup Considerations](#) (page 137) and [Replica Set Backup Considerations](#) (page 138).
- Actual requirements. You may be able to save time, effort, and space by including only crucial data in the most frequent backups and backing up less crucial data less frequently.

Warning: In order to use filesystem snapshots for backups, your [mongod](#) (page 925) instance must have [journal](#) (page 995) enabled, which is the default for 64 bit versions of MongoDB since 2.0. If the journal sits on a different filesystem than your data files then you must also disable writes while the snapshot completes.

Backup Approaches

There are two main methodologies for backing up MongoDB instances. Creating binary “dumps” of the database using [mongodump](#) (page 951) or creating filesystem level snapshots. Both methodologies have advantages and disadvantages:

- binary database dumps are comparatively small, because they don’t include index content or pre-allocated free space, and [record padding](#) (page 65). However, it’s impossible to capture a copy of a running system that reflects a single moment in time using a binary dump.
- filesystem snapshots, sometimes called block level backups, produce larger backup sizes, but complete quickly and can reflect a single moment in time on a running system. However, snapshot systems require filesystem and operating system support and tools.

The best option depends on the requirements of your deployment and disaster recovery needs. Typically, filesystem snapshots are because of their accuracy and simplicity; however, [mongodump](#) (page 951) is a viable option used often to generate backups of MongoDB systems.

In some cases, taking backups is difficult or impossible because of large data volumes, distributed architectures, and data transmission speeds. In these situations, increase the number of members in your replica set or sets.

Backup and Recovery Procedures

For tutorials on the backup approaches, see [Backup and Recovery](#) (page 181).

Backup Strategies for MongoDB Deployments

Sharded Cluster Backup Considerations

Important: To capture a point-in-time backup from a sharded cluster you **must** stop *all* writes to the cluster. On a running production system, you can only capture an *approximation* of point-in-time snapshot.

Sharded clusters complicate backup operations, as distributed systems. True point-in-time backups are only possible when stopping all write activity from the application. To create a precise moment-in-time snapshot of a cluster, stop all application write activity to the database, capture a backup, and allow only write operations to the database after the backup is complete.

However, you can capture a backup of a cluster that **approximates** a point-in-time backup by capturing a backup from a secondary member of the replica sets that provide the shards in the cluster at roughly the same moment. If you decide to use an approximate-point-in-time backup method, ensure that your application can operate using a copy of the data that does not reflect a single moment in time.

For backup procedures for sharded clusters, see [Backup and Restore Sharded Clusters](#) (page 188).

Replica Set Backup Considerations In most cases, backing up data stored in a *replica set* is similar to backing up data stored in a single instance. Options include:

- Create a file system snapshot of a single *secondary*, as described in [Backup and Restore with MongoDB Tools](#) (page 181). You may choose to maintain a dedicated *hidden member* for backup purposes.
- As an alternative you can create a backup with the `mongodump` (page 951) program and the `--oplog` option. To restore this backup use the `mongorestore` (page 956) program and the `--oplogReplay` option.

If you have a *sharded cluster* where each *shard* is itself a replica set, you can use one of these methods to create a backup of the entire cluster without disrupting the operation of the node. In these situations you should still turn off the balancer when you create backups.

For any cluster, using a non-primary node to create backups is particularly advantageous in that the backup operation does not affect the performance of the primary. Replication itself provides some measure of redundancy. Nevertheless, keeping point-in time backups of your cluster to provide for disaster recovery and as an additional layer of protection is crucial.

Monitoring for MongoDB

Monitoring is a critical component of all database administration. A firm grasp of MongoDB's reporting will allow you to assess the state of your database and maintain your deployment without crisis. Additionally, a sense of MongoDB's normal operational parameters will allow you to diagnose before they escalate to failures.

This document presents an overview of the available monitoring utilities and the reporting statistics available in MongoDB. It also introduces diagnostic strategies and suggestions for monitoring replica sets and sharded clusters.

Note: MongoDB Management Service (MMS)³ is a hosted monitoring service which collects and aggregates data to provide insight into the performance and operation of MongoDB deployments. See the [MMS documentation](#)⁴ for more information.

Monitoring Tools

There are two primary strategies for collecting data about the state of a running MongoDB instance:

- First, there is a set of utilities distributed with MongoDB that provides real-time reporting of database activities.
- Second, *database commands* (page 694) return statistics regarding the current database state with greater fidelity.

³<http://mms.mongodb.com>

⁴<http://mms.mongodb.com/help/>

Each strategy can help answer different questions and is useful in different contexts. The two methods are complementary.

This section provides an overview of these methods and the statistics they provide. It also offers examples of the kinds of questions that each method is best suited to help you address.

Utilities The MongoDB distribution includes a number of utilities that quickly return statistics about instances' performance and activity. Typically, these are most useful for diagnosing issues and assessing normal operation.

mongostat [mongostat](#) (page 974) captures and returns the counts of database operations by type (e.g. insert, query, update, delete, etc.). These counts report on the load distribution on the server.

Use [mongostat](#) (page 974) to understand the distribution of operation types and to inform capacity planning. See the [mongostat manual](#) (page 974) for details.

mongotop [mongotop](#) (page 979) tracks and reports the current read and write activity of a MongoDB instance, and reports these statistics on a per collection basis.

Use [mongotop](#) (page 979) to check if your database activity and use match your expectations. See the [mongotop manual](#) (page 979) for details.

REST Interface MongoDB provides a simple REST interface that can be useful for configuring monitoring and alert scripts, and for other administrative tasks.

To enable, configure [mongod](#) (page 925) to use [REST](#), either by starting [mongod](#) (page 925) with the `--rest` option, or by setting the `rest` (page 997) setting to `true` in a [configuration file](#) (page 990).

For more information on using the REST Interface see, the [Simple REST Interface⁵](#) documentation.

HTTP Console MongoDB provides a web interface that exposes diagnostic and monitoring information in a simple web page. The web interface is accessible at `localhost:<port>`, where the `<port>` number is **1000** more than the [mongod](#) (page 925) port .

For example, if a locally running [mongod](#) (page 925) is using the default port 27017, access the HTTP console at `http://localhost:28017`.

Commands MongoDB includes a number of commands that report on the state of the database.

These data may provide a finer level of granularity than the utilities discussed above. Consider using their output in scripts and programs to develop custom alerts, or to modify the behavior of your application in response to the activity of your instance. The `db.currentOp` (page 879) method is another useful tool for identifying the database instance's in-progress operations.

serverStatus The `serverStatus` (page 782) command, or `db.serverStatus()` (page 893) from the shell, returns a general overview of the status of the database, detailing disk usage, memory use, connection, journaling, and index access. The command returns quickly and does not impact MongoDB performance.

`serverStatus` (page 782) outputs an account of the state of a MongoDB instance. This command is rarely run directly. In most cases, the data is more meaningful when aggregated, as one would see with monitoring tools such as the [MMS Monitoring Service⁶](#). Nevertheless, all administrators should be familiar with the data provided by `serverStatus` (page 782).

⁵<http://docs.mongodb.org/ecosystem/tools/http-interfaces>

⁶<http://mms.mongodb.com>

dbStats The [dbStats](#) (page 767) command, or `db.stats()` (page 894) from the shell, returns a document that addresses storage use and data volumes. The [dbStats](#) (page 767) reflect the amount of storage used, the quantity of data contained in the database, and object, collection, and index counters.

Use this data to monitor the state and storage capacity of a specific database. This output also allows you to compare use between databases and to determine the average [document](#) size in a database.

collStats The [collStats](#) (page 763) provides statistics that resemble [dbStats](#) (page 767) on the collection level, including a count of the objects in the collection, the size of the collection, the amount of disk space used by the collection, and information about its indexes.

repSetGetStatus The [repSetGetStatus](#) (page 726) command (`rs.status()`) (page 898) from the shell) returns an overview of your replica set's status. The [repSetGetStatus](#) (page 726) document details the state and configuration of the replica set and statistics about its members.

Use this data to ensure that replication is properly configured, and to check the connections between the current host and the other members of the replica set.

Third Party Tools A number of third party monitoring tools have support for MongoDB, either directly, or through their own plugins.

Self Hosted Monitoring Tools These are monitoring tools that you must install, configure and maintain on your own servers. Most are open source.

Tool	Plugin	Description
Ganglia ⁷	mongodb-ganglia ⁸	Python script to report operations per second, memory usage, btree statistics, master/slave status and current connections.
Ganglia	gmond_python_modules ⁹	Parses output from the <code>serverStatus</code> (page 782) and repSetGetStatus (page 726) commands.
Motop ¹⁰	<i>None</i>	Realtime monitoring tool for MongoDB servers. Shows current operations ordered by durations every second.
mtop ¹¹	<i>None</i>	A top like tool.
Munin ¹²	mongo-munin ¹³	Retrieves server statistics.
Munin	mongomon ¹⁴	Retrieves collection statistics (sizes, index sizes, and each (configured) collection count for one DB).
Munin	munin-plugins Ubuntu PPA ¹⁵	Some additional munin plugins not in the main distribution.
Nagios ¹⁶	nagios-plugin-mongodb ¹⁷	A simple Nagios check script, written in Python.
Zabbix ¹⁸	mikoomi-mongodb ¹⁹	Monitors availability, resource utilization, health, performance and other important metrics.

⁷<http://sourceforge.net/apps/trac/ganglia/wiki>

⁸<https://github.com/quiiver/mongodb-ganglia>

⁹https://github.com/ganglia/gmond_python_modules

¹⁰<https://github.com/tart/motop>

¹¹<https://github.com/beaufour/mtop>

¹²<http://munin-monitoring.org/>

¹³<https://github.com/erh/mongo-munin>

¹⁴<https://github.com/pcdummy/mongomon>

¹⁵<https://launchpad.net/chris-lea/+archive/munin-plugins>

Also consider [dex²⁰](#), an index and query analyzing tool for MongoDB that compares MongoDB log files and indexes to make indexing recommendations.

As part of [MongoDB Enterprise²¹](#), you can run [MMS On-Prem²²](#), which offers the features of MMS in a package that runs within your infrastructure.

Hosted (SaaS) Monitoring Tools These are monitoring tools provided as a hosted service, usually through a paid subscription.

Name	Notes
MongoDB Management Service ²³	MMS²⁴ is a cloud-based suite of services for managing MongoDB deployments. MMS provides monitoring and backup functionality.
Scout ²⁵	Several plugins, including MongoDB Monitoring²⁶ , MongoDB Slow Queries²⁷ , and MongoDB Replica Set Monitoring²⁸ .
Server Density ²⁹	Dashboard for MongoDB ³⁰ , MongoDB specific alerts, replication failover timeline and iPhone, iPad and Android mobile apps.

Process Logging

During normal operation, [mongod](#) (page 925) and [mongos](#) (page 938) instances report a live account of all server activity and operations to either standard output or a log file. The following runtime settings control these options.

- [quiet](#) (page 998). Limits the amount of information written to the log or output.
- [verbose](#) (page 991). Increases the amount of information written to the log or output.

You can also specify this as v (as in -v). For higher levels of verbosity, set multiple v, as in vvvv = True.

You can also change the verbosity of a running [mongod](#) (page 925) or [mongos](#) (page 938) instance with the [setParameter](#) (page 756) command.

- [logpath](#) (page 992). Enables logging to a file, rather than the standard output. You must specify the full path to the log file when adjusting this setting.
- [logappend](#) (page 992). Adds information to a log file instead of overwriting the file.

Note: You can specify these configuration operations as the command line arguments to [mongod](#) (page 925) or [mongos](#) (page 937)

For example:

```
mongod -v --logpath /var/log/mongodb/server1.log --logappend
```

Starts a [mongod](#) (page 925) instance in [verbose](#) (page 991) mode, appending data to the log file at /var/log/mongodb/server1.log/.

²⁰<http://www.nagios.org/>

²¹<https://github.com/mzupan/nagios-plugin-mongodb>

²²<http://www.zabbix.com/>

²³<https://code.google.com/p/mikoomi/wiki/03>

²⁴<https://github.com/mongolab/dex>

²⁵<http://www.mongodb.com/products/mongodb-enterprise>

²⁶<http://mms.mongodb.com>

²⁷https://mms.mongodb.com/?pk_campaign=mongodb-org&pk_kwd=monitoring

²⁸https://mms.mongodb.com/?pk_campaign=mongodb-org&pk_kwd=monitoring

²⁹<http://scoutapp.com>

³⁰https://scoutapp.com/plugin_urls/391-mongodb-monitoring

²⁶http://scoutapp.com/plugin_urls/291-mongodb-slow-queries

²⁸http://scoutapp.com/plugin_urls/2251-mongodb-replica-set-monitoring

²⁹<http://www.serverdensity.com>

³⁰<http://www.serverdensity.com/mongodb-monitoring/>

The following *database commands* also affect logging:

- [getLog](#) (page 779). Displays recent messages from the [mongod](#) (page 925) process log.
- [logRotate](#) (page 760). Rotates the log files for [mongod](#) (page 925) processes only. See [Rotate Log Files](#) (page 173).

Diagnosing Performance Issues

Degraded performance in MongoDB is typically a function of the relationship between the quantity of data stored in the database, the amount of system RAM, the number of connections to the database, and the amount of time the database spends in a locked state.

In some cases performance issues may be transient and related to traffic load, data access patterns, or the availability of hardware on the host system for virtualized environments. Some users also experience performance limitations as a result of inadequate or inappropriate indexing strategies, or as a consequence of poor schema design patterns. In other situations, performance issues may indicate that the database may be operating at capacity and that it is time to add additional capacity to the database.

The following are some causes of degraded performance in MongoDB.

Locks MongoDB uses a locking system to ensure consistency. However, if certain operations are long-running, or a queue forms, performance will slow as requests and operations wait for the lock. Lock-related slowdowns can be intermittent. To see if the lock has been affecting your performance, look to the data in the [globalLock](#) (page 785) section of the [serverStatus](#) (page 782) output. If [globalLock.currentQueue.total](#) (page 786) is consistently high, then there is a chance that a large number of requests are waiting for a lock. This indicates a possible concurrency issue that may be affecting performance.

If [globalLock.totalTime](#) (page 785) is high relative to [uptime](#) (page 783), the database has existed in a lock state for a significant amount of time. If [globalLock.ratio](#) (page 786) is also high, MongoDB has likely been processing a large number of long running queries. Long queries are often the result of a number of factors: ineffective use of indexes, non-optimal schema design, poor query structure, system architecture issues, or insufficient RAM resulting in [page faults](#) (page 142) and disk reads.

Memory Usage MongoDB uses memory mapped files to store data. Given a data set of sufficient size, the MongoDB process will allocate all available memory on the system for its use. While this is part of the design, and affords MongoDB superior performance, the memory mapped files make it difficult to determine if the amount of RAM is sufficient for the data set.

The [memory usage statuses](#) (page 786) metrics of the [serverStatus](#) (page 782) output can provide insight into MongoDB's memory use. Check the resident memory use (i.e. [mem.resident](#) (page 787)): if this exceeds the amount of system memory *and* there is a significant amount of data on disk that isn't in RAM, you may have exceeded the capacity of your system.

You should also check the amount of mapped memory (i.e. [mem.mapped](#) (page 787).) If this value is greater than the amount of system memory, some operations will require disk access [page faults](#) to read data from virtual memory and negatively affect performance.

Page Faults A page fault occurs when MongoDB requires data not located in physical memory, and must read from virtual memory. To check for page faults, see the [extra_info.page_faults](#) (page 788) value in the [serverStatus](#) (page 782) output. This data is only available on Linux systems.

A single page fault completes quickly and is not problematic. However, in aggregate, large volumes of page faults typically indicate that MongoDB is reading too much data from disk. In many situations, MongoDB's read locks will

“yield” after a page fault to allow other processes to read and avoid blocking while waiting for the next page to read into memory. This approach improves concurrency, and also improves overall throughput in high volume systems.

Increasing the amount of RAM accessible to MongoDB may help reduce the number of page faults. If this is not possible, you may want to consider deploying a [sharded cluster](#) and/or adding [shards](#) to your deployment to distribute load among [mongod](#) (page 925) instances.

Number of Connections In some cases, the number of connections between the application layer (i.e. clients) and the database can overwhelm the ability of the server to handle requests. This can produce performance irregularities. The following fields in the [serverStatus](#) (page 782) document can provide insight:

- `globalLock.activeClients` (page 786) contains a counter of the total number of clients with active operations in progress or queued.
- `connections` (page 787) is a container for the following two fields:
 - `current` (page 787) the total number of current clients that connect to the database instance.
 - `available` (page 787) the total number of unused collections available for new clients.

Note: Unless constrained by system-wide limits MongoDB has a hard connection limit of 20,000 connections. You can modify system limits using the `ulimit` command, or by editing your system’s `/etc/sysctl` file.

If requests are high because there are numerous concurrent application requests, the database may have trouble keeping up with demand. If this is the case, then you will need to increase the capacity of your deployment. For read-heavy applications increase the size of your [replica set](#) and distribute read operations to [secondary](#) members. For write heavy applications, deploy [sharding](#) and add one or more [shards](#) to a [sharded cluster](#) to distribute load among [mongod](#) (page 925) instances.

Spikes in the number of connections can also be the result of application or driver errors. All of the officially supported MongoDB drivers implement connection pooling, which allows clients to use and reuse connections more efficiently. Extremely high numbers of connections, particularly without corresponding workload is often indicative of a driver or other configuration error.

Database Profiling MongoDB’s “Profiler” is a database profiling system that can help identify inefficient queries and operations.

The following profiling levels are available:

Level	Setting
0	Off. No profiling
1	On. Only includes “slow” operations
2	On. Includes all operations

Enable the profiler by setting the `profile` (page 770) value using the following command in the `mongo` (page 942) shell:

```
db.setProfilingLevel(1)
```

The `slowms` (page 997) setting defines what constitutes a “slow” operation. To set the threshold above which the profiler considers operations “slow” (and thus, included in the level 1 profiling data), you can configure `slowms` (page 997) at runtime as an argument to the `db.setProfilingLevel()` (page 894) operation.

See

The documentation of `db.setProfilingLevel()` (page 894) for more information about this command.

By default, `mongod` (page 925) records all “slow” queries to its `log` (page 992), as defined by `slowms` (page 997). Unlike log data, the data in `system.profile` does not persist between `mongod` (page 925) restarts.

Note: Because the database profiler can negatively impact performance, only enable profiling for strategic intervals and as minimally as possible on production systems.

You may enable profiling on a per-`mongod` (page 925) basis. This setting will not propagate across a *replica set* or *sharded cluster*.

You can view the output of the profiler in the `system.profile` collection of your database by issuing the `show profile` command in the `mongo` (page 942) shell, or with the following operation:

```
db.system.profile.find( { millis : { $gt : 100 } } )
```

This returns all operations that lasted longer than 100 milliseconds. Ensure that the value specified here (100, in this example) is above the `slowms` (page 997) threshold.

See also:

Optimization Strategies for MongoDB (page 160) addresses strategies that may improve the performance of your database queries and operations.

Replication and Monitoring

Beyond the basic monitoring requirements for any MongoDB instance, for replica sets, administrators must monitor *replication lag*. “Replication lag” refers to the amount of time that it takes to copy (i.e. replicate) a write operation on the *primary* to a *secondary*. Some small delay period may be acceptable, but two significant problems emerge as replication lag grows:

- First, operations that occurred during the period of lag are not replicated to one or more secondaries. If you’re using replication to ensure data persistence, exceptionally long delays may impact the integrity of your data set.
- Second, if the replication lag exceeds the length of the operation log (*oplog*) then MongoDB will have to perform an initial sync on the secondary, copying all data from the *primary* and rebuilding all indexes. This is uncommon under normal circumstances, but if you configure the oplog to be smaller than the default, the issue can arise.

Note: The size of the oplog is only configurable during the first run using the `--oplogSize` argument to the `mongod` (page 925) command, or preferably, the `oplogSize` (page 1000) in the MongoDB configuration file. If you do not specify this on the command line before running with the `--repSet` option, `mongod` (page 925) will create a default sized oplog.

By default, the oplog is 5 percent of total available disk space on 64-bit systems. For more information about changing the oplog size, see the *Change the Size of the Oplog* (page 446)

For causes of replication lag, see *Replication Lag* (page 463).

Replication issues are most often the result of network connectivity issues between members, or the result of a *primary* that does not have the resources to support application and replication traffic. To check the status of a replica, use the `repSetGetStatus` (page 726) or the following helper in the shell:

```
rs.status()
```

The `repSetGetStatus` (page 726) document provides a more in-depth overview view of this output. In general, watch the value of `optimeDate` (page 727), and pay particular attention to the time difference between the *primary* and the *secondary* members.

Sharding and Monitoring

In most cases, the components of [sharded clusters](#) benefit from the same monitoring and analysis as all other MongoDB instances. In addition, clusters require further monitoring to ensure that data is effectively distributed among nodes and that sharding operations are functioning appropriately.

See also:

See the [Sharding Concepts](#) (page 498) documentation for more information.

Config Servers The [config database](#) maintains a map identifying which documents are on which shards. The cluster updates this map as [chunks](#) move between shards. When a configuration server becomes inaccessible, certain sharding operations become unavailable, such as moving chunks and starting [mongos](#) (page 938) instances. However, clusters remain accessible from already-running [mongos](#) (page 938) instances.

Because inaccessible configuration servers can seriously impact the availability of a sharded cluster, you should monitor your configuration servers to ensure that the cluster remains well balanced and that [mongos](#) (page 938) instances can restart.

[MMS Monitoring](#)³¹ monitors config servers and can create notifications if a config server becomes inaccessible.

Balancing and Chunk Distribution The most effective [sharded cluster](#) deployments evenly balance [chunks](#) among the shards. To facilitate this, MongoDB has a background [balancer](#) process that distributes data to ensure that chunks are always optimally distributed among the [shards](#).

Issue the `db.printShardingStatus()` (page 892) or `sh.status()` (page 910) command to the [mongos](#) (page 938) by way of the [mongo](#) (page 942) shell. This returns an overview of the entire cluster including the database name, and a list of the chunks.

Stale Locks In nearly every case, all locks used by the balancer are automatically released when they become stale. However, because any long lasting lock can block future balancing, it's important to insure that all locks are legitimate. To check the lock status of the database, connect to a [mongos](#) (page 938) instance using the [mongo](#) (page 942) shell. Issue the following command sequence to switch to the `config` database and display all outstanding locks on the shard database:

```
use config
db.locks.find()
```

For active deployments, the above query can provide insights. The balancing process, which originates on a randomly selected [mongos](#) (page 938), takes a special “balancer” lock that prevents other balancing activity from transpiring. Use the following command, also to the `config` database, to check the status of the “balancer” lock.

```
db.locks.find( { _id : "balancer" } )
```

If this lock exists, make sure that the balancer process is actively using this lock.

Run-time Database Configuration

The [command line](#) (page 925) and [configuration file](#) (page 990) interfaces provide MongoDB administrators with a large number of options and settings for controlling the operation of the database system. This document provides an overview of common configurations and examples of best-practice configurations for common use cases.

While both interfaces provide access to the same collection of options and settings, this document primarily uses the configuration file interface. If you run MongoDB using a control script or installed from a package for your operating

³¹<http://mms.mongodb.com>

system, you likely already have a configuration file located at `/etc/mongodb.conf`. Confirm this by checking the contents of the `/etc/init.d/mongod` or `/etc/rc.d/mongod` script to insure that the *control scripts* start the `mongod` (page 925) with the appropriate configuration file (see below.)

To start a MongoDB instance using this configuration issue a command in the following form:

```
mongod --config /etc/mongodb.conf  
mongod -f /etc/mongodb.conf
```

Modify the values in the `/etc/mongodb.conf` file on your system to control the configuration of your database instance.

Configure the Database

Consider the following basic configuration:

```
fork = true  
bind_ip = 127.0.0.1  
port = 27017  
quiet = true  
dbpath = /srv/mongodb  
logpath = /var/log/mongodb/mongod.log  
logappend = true  
journal = true
```

For most standalone servers, this is a sufficient base configuration. It makes several assumptions, but consider the following explanation:

- `fork` (page 993) is `true`, which enables a *daemon* mode for `mongod` (page 925), which detaches (i.e. “forks”) the MongoDB from the current session and allows you to run the database as a conventional server.
- `bind_ip` (page 991) is `127.0.0.1`, which forces the server to only listen for requests on the localhost IP. Only bind to secure interfaces that the application-level systems can access with access control provided by system network filtering (i.e. “*firewall*”).
- `port` (page 991) is `27017`, which is the default MongoDB port for database instances. MongoDB can bind to any port. You can also filter access based on port using network filtering tools.

Note: UNIX-like systems require superuser privileges to attach processes to ports lower than 1024.

- `quiet` (page 998) is `true`. This disables all but the most critical entries in output/log file. In normal operation this is the preferable operation to avoid log noise. In diagnostic or testing situations, set this value to `false`. Use `setParameter` (page 756) to modify this setting during run time.
- `dbpath` (page 993) is `/srv/mongodb`, which specifies where MongoDB will store its data files. `/srv/mongodb` and `/var/lib/mongodb` are popular locations. The user account that `mongod` (page 925) runs under will need read and write access to this directory.
- `logpath` (page 992) is `/var/log/mongodb/mongod.log` which is where `mongod` (page 925) will write its output. If you do not set this value, `mongod` (page 925) writes all output to standard output (e.g. `stdout`.)
- `logappend` (page 992) is `true`, which ensures that `mongod` (page 925) does not overwrite an existing log file following the server start operation.
- `journal` (page 995) is `true`, which enables *journaling*. Journaling ensures single instance write-durability. 64-bit builds of `mongod` (page 925) enable journaling by default. Thus, this setting may be redundant.

Given the default configuration, some of these values may be redundant. However, in many situations explicitly stating the configuration increases overall system intelligibility.

Security Considerations

The following collection of configuration options are useful for limiting access to a `mongod` (page 925) instance. Consider the following:

```
bind_ip = 127.0.0.1,10.8.0.10,192.168.4.24
nounixsocket = true
auth = true
```

Consider the following explanation for these configuration decisions:

- “`bind_ip` (page 991)” has three values: `127.0.0.1`, the localhost interface; `10.8.0.10`, a private IP address typically used for local networks and VPN interfaces; and `192.168.4.24`, a private network interface typically used for local networks.

Because production MongoDB instances need to be accessible from multiple database servers, it is important to bind MongoDB to multiple interfaces that are accessible from your application servers. At the same time it’s important to limit these interfaces to interfaces controlled and protected at the network layer.

- “`nounixsocket` (page 993)” to `true` disables the UNIX Socket, which is otherwise enabled by default. This limits access on the local system. This is desirable when running MongoDB on systems with shared access, but in most situations has minimal impact.
- “`auth` (page 993)” is `true` enables the authentication system within MongoDB. If enabled you will need to log in by connecting over the `localhost` interface for the first time to create user credentials.

See also:

[Security Concepts](#) (page 237)

Replication and Sharding Configuration

Replication Configuration *Replica set* configuration is straightforward, and only requires that the `replicaSet` (page 1000) have a value that is consistent among all members of the set. Consider the following:

```
replicaSet = set0
```

Use descriptive names for sets. Once configured use the `mongo` (page 942) shell to add hosts to the replica set.

See also:

[Replica set reconfiguration](#) (page 483).

To enable authentication for the *replica set*, add the following option:

```
keyFile = /srv/mongodb/keyfile
```

New in version 1.8: for replica sets, and 1.9.1 for sharded replica sets.

Setting `keyFile` (page 993) enables authentication and specifies a key file for the replica set member use to when authenticating to each other. The content of the key file is arbitrary, but must be the same on all members of the *replica set* and `mongos` (page 938) instances that connect to the set. The keyfile must be less than one kilobyte in size and may only contain characters in the base64 set and the file must not have group or “world” permissions on UNIX systems.

See also:

The [Replica set Reconfiguration](#) (page 483) section for information regarding the process for changing replica set during operation.

Additionally, consider the [Replica Set Security](#) (page 238) section for information on configuring authentication with replica sets.

Finally, see the [Replication](#) (page 377) document for more information on replication in MongoDB and replica set configuration in general.

Sharding Configuration Sharding requires a number of [mongod](#) (page 925) instances with different configurations. The config servers store the cluster’s metadata, while the cluster distributes data among one or more shard servers.

Note: [Config servers](#) are not [replica sets](#).

To set up one or three “config server” instances as [normal](#) (page 146) [mongod](#) (page 925) instances, and then add the following configuration option:

```
configsvr = true  
  
bind_ip = 10.8.0.12  
port = 27001
```

This creates a config server running on the private IP address 10.8.0.12 on port 27001. Make sure that there are no port conflicts, and that your config server is accessible from all of your [mongos](#) (page 938) and [mongod](#) (page 925) instances.

To set up shards, configure two or more [mongod](#) (page 925) instance using your [base configuration](#) (page 146), adding the `shardsvr` (page 1001) setting:

```
shardsvr = true
```

Finally, to establish the cluster, configure at least one [mongos](#) (page 938) process with the following settings:

```
configdb = 10.8.0.12:27001  
chunkSize = 64
```

You can specify multiple `configdb` (page 1001) instances by specifying hostnames and ports in the form of a comma separated list. In general, avoid modifying the `chunkSize` (page 1002) from the default value of 64,³² and should ensure this setting is consistent among all [mongos](#) (page 938) instances.

See also:

The [Sharding](#) (page 493) section of the manual for more information on sharding and cluster configuration.

Run Multiple Database Instances on the Same System

In many cases running multiple instances of [mongod](#) (page 925) on a single system is not recommended. On some types of deployments³³ and for testing purposes you may need to run more than one [mongod](#) (page 925) on a single system.

In these cases, use a [base configuration](#) (page 146) for each instance, but consider the following configuration values:

```
dbpath = /srv/mongodb/db0/  
pidfilepath = /srv/mongodb/db0.pid
```

³² [Chunk](#) size is 64 megabytes by default, which provides the ideal balance between the most even distribution of data, for which smaller chunk sizes are best, and minimizing chunk migration, for which larger chunk sizes are optimal.

³³ Single-tenant systems with [SSD](#) or other high performance disks may provide acceptable performance levels for multiple [mongod](#) (page 925) instances. Additionally, you may find that multiple databases with small working sets may function acceptably on a single system.

The `dbpath` (page 993) value controls the location of the `mongod` (page 925) instance's data directory. Ensure that each database has a distinct and well labeled data directory. The `pidfilepath` (page 993) controls where `mongod` (page 925) process places its *process id* file. As this tracks the specific `mongod` (page 925) file, it is crucial that file be unique and well labeled to make it easy to start and stop these processes.

Create additional *control scripts* and/or adjust your existing MongoDB configuration and control script as needed to control these processes.

Diagnostic Configurations

The following configuration options control various `mongod` (page 925) behaviors for diagnostic purposes. The following settings have default values that tuned for general production purposes:

```
slowms = 50
profile = 3
verbose = true
diaglog = 3
objcheck = true
cpu = true
```

Use the *base configuration* (page 146) and add these options if you are experiencing some unknown issue or performance problem as needed:

- `slowms` (page 997) configures the threshold for the *database profiler* to consider a query “slow.” The default value is 100 milliseconds. Set a lower value if the database profiler does not return useful results. See *Optimization Strategies for MongoDB* (page 160) for more information on optimizing operations in MongoDB.
- `profile` (page 997) sets the *database profiler* level. The profiler is not active by default because of the possible impact on the profiler itself on performance. Unless this setting has a value, queries are not profiled.
- `verbose` (page 991) enables a verbose logging mode that modifies `mongod` (page 925) output and increases logging to include a greater number of events. Only use this option if you are experiencing an issue that is not reflected in the normal logging level. If you require additional verbosity, consider the following options:

```
v = true
vv = true
vvv = true
vvvv = true
vvvvv = true
```

Each additional level `v` adds additional verbosity to the logging. The `verbose` option is equal to `v = true`.

- `diaglog` (page 994) enables *diagnostic logging*. Level 3 logs all read and write options.
- `objcheck` (page 992) forces `mongod` (page 925) to validate all requests from clients upon receipt. Use this option to ensure that invalid requests are not causing errors, particularly when running a database with untrusted clients. This option may affect database performance.
- `cpu` (page 993) forces `mongod` (page 925) to report the percentage of the last interval spent in *write lock*. The interval is typically 4 seconds, and each output line in the log includes both the actual interval since the last report and the percentage of time spent in write lock.

Import and Export MongoDB Data

This document provides an overview of the import and export programs included in the MongoDB distribution. These tools are useful when you want to backup or export a portion of your data without capturing the state of the entire database, or for simple data ingestion cases. For more complex data migration tasks, you may want to write your own

import and export scripts using a client [driver](#) to interact with the database itself. For disaster recovery protection and routine database backup operation, use full [database instance backups](#) (page 136).

Warning: Because these tools primarily operate by interacting with a running [mongod](#) (page 925) instance, they can impact the performance of your running database.

Not only do these processes create traffic for a running database instance, they also force the database to read all data through memory. When MongoDB reads infrequently used data, it can supplant more frequently accessed data, causing a deterioration in performance for the database's regular workload.

[mongoimport](#) (page 965) and [mongoexport](#) (page 969) do not reliably preserve all rich [BSON](#) data types, because [BSON](#) is a superset of [JSON](#). Thus, [mongoimport](#) (page 965) and [mongoexport](#) (page 969) cannot represent [BSON](#) data accurately in [JSON](#). As a result data exported or imported with these tools may lose some measure of fidelity. See [MongoDB Extended JSON](#) (page 108) for more information about MongoDB Extended JSON.

See also:

See the [Backup Strategies for MongoDB Systems](#) (page 136) document for more information on backing up MongoDB instances. Additionally, consider the following references for commands addressed in this document:

- [mongoexport](#) (page 969)
- [mongorestore](#) (page 956)
- [mongodump](#) (page 951)

If you want to transform and process data once you've imported it in MongoDB consider the documents in the [Aggregation](#) (page 275) section, including:

- [Map-Reduce](#) (page 282) and
- [Aggregation Concepts](#) (page 279).

Data Type Fidelity

[JSON](#) does not have the following data types that exist in [BSON](#) documents: `data_binary`, `data_date`, `data_timestamp`, `data_regex`, `data_oid` and `data_ref`. As a result using any tool that decodes [BSON](#) documents into [JSON](#) will suffer some loss of fidelity.

If maintaining type fidelity is important, consider writing a data import and export system that does not force [BSON](#) documents into [JSON](#) form as part of the process. The following list of types contain examples for how MongoDB will represent how [BSON](#) documents render in [JSON](#).

- `data_binary`

```
{ "$binary" : "<bindata>", "$type" : "<t>" }
```

`<bindata>` is the base64 representation of a binary string. `<t>` is the hexadecimal representation of a single byte indicating the data type.

- `data_date`

```
Date( <date> )
```

`<date>` is the JSON representation of a 64-bit signed integer for milliseconds since epoch.

- `data_timestamp`

```
Timestamp( <t>, <i> )
```

`<t>` is the JSON representation of a 32-bit unsigned integer for milliseconds since epoch. `<i>` is a 32-bit unsigned integer for the increment.

- `data_regex`

`/<jRegex>/<jOptions>`

`<jRegex>` is a string that may contain valid JSON characters and unescaped double quote (i.e. `"`) characters, but may not contain unescaped forward slash (i.e. `http://docs.mongodb.org/manual`) characters. `<jOptions>` is a string that may contain only the characters `g`, `i`, `m`, and `s`.

- `data_oid`

`ObjectId("<id>")`

`<id>` is a 24 character hexadecimal string. These representations require that `data_oid` values have an associated field named `_id`.

- `data_ref`

`DBRef("<name>", "<id>")`

`<name>` is a string of valid JSON characters. `<id>` is a 24 character hexadecimal string.

See also:

[MongoDB Extended JSON](#) (page 108)

Data Import and Export and Backups Operations

For resilient and non-disruptive backups, use a file system or block-level disk snapshot function, such as the methods described in the [Backup Strategies for MongoDB Systems](#) (page 136) document. The tools and operations discussed provide functionality that's useful in the context of providing some kinds of backups.

By contrast, use import and export tools to backup a small subset of your data or to move data to or from a 3rd party system. These backups may capture a small crucial set of data or a frequently modified section of data, for extra insurance, or for ease of access. No matter how you decide to import or export your data, consider the following guidelines:

- Label files so that you can identify what point in time the export or backup reflects.
- Labeling should describe the contents of the backup, and reflect the subset of the data corpus, captured in the backup or export.
- Do not create or apply exports if the backup process itself will have an adverse effect on a production system.
- Make sure that they reflect a consistent data state. Export or backup processes can impact data integrity (i.e. type fidelity) and consistency if updates continue during the backup process.
- Test backups and exports by restoring and importing to ensure that the backups are useful.

Human Intelligible Import/Export Formats

This section describes a process to import/export your database, or a portion thereof, to a file in a [JSON](#) or [CSV](#) format.

See also:

The [mongoimport](#) (page 965) and [mongoexport](#) (page 969) documents contain complete documentation of these tools. If you have questions about the function and parameters of these tools not covered here, please refer to these documents.

If you want to simply copy a database or collection from one instance to another, consider using the [copydb](#) (page 745), [clone](#) (page 748), or [cloneCollection](#) (page 748) commands, which may be more suited to this task. The [mongo](#) (page 942) shell provides the [db.copyDatabase\(\)](#) (page 878) method.

These tools may also be useful for importing data into a MongoDB database from third party applications.

Collection Export with mongoexport With the [mongoexport](#) (page 969) utility you can create a backup file. In the most simple invocation, the command takes the following form:

```
mongoexport --collection collection --out collection.json
```

This will export all documents in the collection named `collection` into the file `collection.json`. Without the output specification (i.e. “`--out collection.json`”), [mongoexport](#) (page 969) writes output to standard output (i.e. “`stdout`.”) You can further narrow the results by supplying a query filter using the “`--query`” and limit results to a single database using the “`--db`” option. For instance:

```
mongoexport --db sales --collection contacts --query '{"field": 1}'
```

This command returns all documents in the `sales` database’s `contacts` collection, with a field named `field` with a value of 1. Enclose the query in single quotes (e.g. ‘) to ensure that it does not interact with your shell environment. The resulting documents will return on standard output.

By default, [mongoexport](#) (page 969) returns one *JSON document* per MongoDB document. Specify the “`--jsonArray`” argument to return the export as a single *JSON array*. Use the “`--csv`” file to return the result in CSV (comma separated values) format.

If your [mongod](#) (page 925) instance is not running, you can use the “`--dbpath`” option to specify the location to your MongoDB instance’s database files. See the following example:

```
mongoexport --db sales --collection contacts --dbpath /srv/MongoDB/
```

This reads the data files directly. This locks the data directory to prevent conflicting writes. The [mongod](#) (page 925) process must *not* be running or attached to these data files when you run [mongoexport](#) (page 969) in this configuration.

The “`--host`” and “`--port`” options allow you to specify a non-local host to connect to capture the export. Consider the following example:

```
mongoexport --host mongodb1.example.net --port 37017 --username user --password pass --collection contacts
```

On any [mongoexport](#) (page 969) command you may, as above specify username and password credentials as above.

Collection Import with mongoimport To restore a backup taken with [mongoexport](#) (page 969). Most of the arguments to [mongoexport](#) (page 969) also exist for [mongoimport](#) (page 965). Consider the following command:

```
mongoimport --collection collection --file collection.json
```

This imports the contents of the file `collection.json` into the collection named `collection`. If you do not specify a file with the “`--file`” option, [mongoimport](#) (page 965) accepts input over standard input (e.g. “`stdin`.”)

If you specify the “`--upsert`” option, all of [mongoimport](#) (page 965) operations will attempt to update existing documents in the database and insert other documents. This option will cause some performance impact depending on your configuration.

You can specify the database option `--db` to import these documents to a particular database. If your MongoDB instance is not running, use the “`--dbpath`” option to specify the location of your MongoDB instance’s database files. Consider using the “`--journal`” option to ensure that [mongoimport](#) (page 965) records its operations in the journal. The [mongod](#) process must *not* be running or attached to these data files when you run [mongoimport](#) (page 965) in this configuration.

Use the “`--ignoreBlanks`” option to ignore blank fields. For [CSV](#) and [TSV](#) imports, this option provides the desired functionality in most cases: it avoids inserting blank fields in MongoDB documents.

4.1.2 Data Management

These document introduce data management practices and strategies for MongoDB deployments, including strategies for managing multi-data center deployments, managing larger file stores, and data lifecycle tools.

[**Data Center Awareness**](#) (page 153) Presents the MongoDB features that allow application developers and database administrators to configure their deployments to be more data center aware or allow operational and location-based separation.

[**GridFS**](#) (page 154) GridFS is a specification for storing documents that exceeds the [BSON](#)-document size limit of 16MB.

[**Capped Collections**](#) (page 156) Capped collections provide a special type of size-constrained collections that preserve insertion order and can support high volume inserts.

[**Expire Data from Collections by Setting TTL**](#) (page 158) TTL collections make it possible to automatically remove data from a collection based on the value of a timestamp and are useful for managing data like machine generated event data that are only useful for a limited period of time.

Data Center Awareness

MongoDB provides a number of features that allow application developers and database administrators to customize the behavior of a [sharded cluster](#) or [replica set](#) deployment so that MongoDB may be *more* “data center aware,” or allow operational and location-based separation.

MongoDB also supports segregation based on functional parameters, to ensure that certain [mongod](#) (page 925) instances are only used for reporting workloads or that certain high-frequency portions of a sharded collection only exist on specific shards.

The following documents, *found either in this section or other sections of this manual*, provide information on customizing a deployment for operation- and location-based separation:

[**Operational Segregation in MongoDB Deployments**](#) (page 153) MongoDB lets you specify that certain application operations use certain [mongod](#) (page 925) instances.

[**Tag Aware Sharding**](#) (page 557) Tags associate specific ranges of [shard key](#) values with specific shards for use in managing deployment patterns.

[**Manage Shard Tags**](#) (page 536) Use tags to associate specific ranges of shard key values with specific shards.

Operational Segregation in MongoDB Deployments

Operational Overview MongoDB includes a number of features that allow database administrators and developers to segregate application operations to MongoDB deployments by functional or geographical groupings.

This capability provides “data center awareness,” which allows applications to target MongoDB deployments with consideration of the physical location of the [mongod](#) (page 925) instances. MongoDB supports segmentation of operations across different dimensions, which may include multiple data centers and geographical regions in multi-data center deployments, racks, networks, or power circuits in single data center deployments.

MongoDB also supports segregation of database operations based on functional or operational parameters, to ensure that certain [mongod](#) (page 925) instances are only used for reporting workloads or that certain high-frequency portions of a sharded collection only exist on specific shards.

Specifically, with MongoDB, you can:

- ensure write operations propagate to specific members of a replica set, or to specific members of replica sets.
- ensure that specific members of a replica set respond to queries.
- ensure that specific ranges of your *shard key* balance onto and reside on specific *shards*.
- combine the above features in a single distributed deployment, on a per-operation (for read and write operations) and collection (for chunk distribution in sharded clusters distribution) basis.

For full documentation of these features, see the following documentation in the MongoDB Manual:

- *Read Preferences* (page 405), which controls how drivers help applications target read operations to members of a replica set.
- *Write Concerns* (page 55), which controls how MongoDB ensures that write operations propagate to members of a replica set.
- *Replica Set Tags* (page 451), which control how applications create and interact with custom groupings of replica set members to create custom application-specific read preferences and write concerns.
- *Tag Aware Sharding* (page 557), which allows MongoDB administrators to define an application-specific balancing policy, to control how documents belonging to specific ranges of a shard key distribute to shards in the *sharded cluster*.

See also:

Before adding operational segregation features to your application and MongoDB deployment, become familiar with all documentation of *replication* (page 377), :and doc:*sharding* </sharding>.

Further Reading

- The *Write Concern* (page 55) and *Read Preference* (page 405) documents, which address capabilities related to data center awareness.
- *Deploy a Geographically Distributed Replica Set* (page 425).

GridFS

GridFS is a specification for storing and retrieving files that exceed the *BSON*-document *size limit* (page 1015) of 16MB.

Instead of storing a file in a single document, GridFS divides a file into parts, or chunks,³⁴ and stores each of those chunks as a separate document. By default GridFS limits chunk size to 256k. GridFS uses two collections to store files. One collection stores the file chunks, and the other stores file metadata.

When you query a GridFS store for a file, the driver or client will reassemble the chunks as needed. You can perform range queries on files stored through GridFS. You also can access information from arbitrary sections of files, which allows you to “skip” into the middle of a video or audio file.

GridFS is useful not only for storing files that exceed 16MB but also for storing any files for which you want access without having to load the entire file into memory. For more information on the indications of GridFS, see *When should I use GridFS?* (page 588).

Implement GridFS

To store and retrieve files using *GridFS*, use either of the following:

³⁴ The use of the term *chunks* in the context of GridFS is not related to the use of the term *chunks* in the context of sharding.

- A MongoDB driver. See the [drivers](#) (page 95) documentation for information on using GridFS with your driver.
- The [mongofiles](#) (page 986) command-line tool in the [mongo](#) (page 942) shell. See [mongofiles](#) (page 986).

GridFS Collections

GridFS stores files in two collections:

- `chunks` stores the binary chunks. For details, see [The chunks Collection](#) (page 110).
- `files` stores the file's metadata. For details, see [The files Collection](#) (page 110).

GridFS places the collections in a common bucket by prefixing each with the bucket name. By default, GridFS uses two collections with names prefixed by `fs` bucket:

- `fs.files`
- `fs.chunks`

You can choose a different bucket name than `fs`, and create multiple buckets in a single database.

Each document in the `chunks` collection represents a distinct chunk of a file as represented in the GridFS store. Each chunk is identified by its unique [`ObjectID`](#) stored in its `_id` field.

For descriptions of all fields in the `chunks` and `files` collections, see [GridFS Reference](#) (page 110).

GridFS Index

GridFS uses a *unique, compound* index on the `chunks` collection for the `files_id` and `n` fields. The `files_id` field contains the `_id` of the chunk's "parent" document. The `n` field contains the sequence number of the chunk. GridFS numbers all chunks, starting with 0. For descriptions of the documents and fields in the `chunks` collection, see [GridFS Reference](#) (page 110).

The GridFS index allows efficient retrieval of chunks using the `files_id` and `n` values, as shown in the following example:

```
cursor = db.fs.chunks.find({files_id: myFileID}).sort({n:1});
```

See the relevant [`driver`](#) (page 95) documentation for the specific behavior of your GridFS application. If your driver does not create this index, issue the following operation using the [mongo](#) (page 942) shell:

```
db.fs.chunks.ensureIndex( { files_id: 1, n: 1 }, { unique: true } );
```

Example Interface

The following is an example of the GridFS interface in Java. The example is for demonstration purposes only. For API specifics, see the relevant [`driver`](#) (page 95) documentation.

By default, the interface must support the default GridFS bucket, named `fs`, as in the following:

```
// returns default GridFS bucket (i.e. "fs" collection)
GridFS myFS = new GridFS(myDatabase);

// saves the file to "fs" GridFS bucket
myFS.createFile(new File("/tmp/largething.mpg"));
```

Optionally, interfaces may support other additional GridFS buckets as in the following example:

```
// returns GridFS bucket named "contracts"
GridFS myContracts = new GridFS(myDatabase, "contracts");

// retrieve GridFS object "smithco"
GridFSDBFile file = myContracts.findOne("smithco");

// saves the GridFS file to the file system
file.writeTo(new File("/tmp/smithco.pdf"));
```

Capped Collections

Capped collections are fixed-size collections that support high-throughput operations that insert, retrieve, and delete documents based on insertion order. Capped collections work in a way similar to circular buffers: once a collection fills its allocated space, it makes room for new documents by overwriting the oldest documents in the collection.

See [createCollection\(\)](#) (page 878) or [createCollection](#) for more information on creating capped collections.

Capped collections have the following behaviors:

- Capped collections guarantee preservation of the insertion order. As a result, queries do not need an index to return documents in insertion order. Without this indexing overhead, they can support higher insertion throughput.
- Capped collections guarantee that insertion order is identical to the order on disk (*natural order*) and do so by prohibiting updates that increase document size. Capped collections only allow updates that fit the original document size, which ensures a document does not change its location on disk.
- Capped collections automatically remove the oldest documents in the collection without requiring scripts or explicit remove operations.

For example, the *oplog.rs* collection that stores a log of the operations in a *replica set* uses a capped collection. Consider the following potential uses cases for capped collections:

- Store log information generated by high-volume systems. Inserting documents in a capped collection without an index is close to the speed of writing log information directly to a file system. Furthermore, the built-in *first-in-first-out* property maintains the order of events, while managing storage use.
- Cache small amounts of data in a capped collections. Since caches are read rather than write heavy, you would either need to ensure that this collection *always* remains in the working set (i.e. in RAM) *or* accept some write penalty for the required index or indexes.

Recommendations and Restrictions

- You *can* update documents in a collection after inserting them. *However*, these updates **cannot** cause the documents to grow. If the update operation causes the document to grow beyond their original size, the update operation will fail.

If you plan to update documents in a capped collection, create an index so that these update operations do not require a table scan.

- You cannot delete documents from a capped collection. To remove all records from a capped collection, use the ‘emptycapped’ command. To remove the collection entirely, use the [drop\(\)](#) (page 812) method.
- You cannot shard a capped collection.

- Capped collections created after 2.2 have an `_id` field and an index on the `_id` field by default. Capped collections created before 2.2 do not have an index on the `_id` field by default. If you are using capped collections with replication prior to 2.2, you should explicitly create an index on the `_id` field.

Warning: If you have a capped collection in a [replica set](#) outside of the `local` database, before 2.2, you should create a unique index on `_id`. Ensure uniqueness using the `unique: true` option to the [ensureIndex\(\)](#) (page 814) method or by using an [ObjectId](#) for the `_id` field. Alternately, you can use the `autoIndexId` option to [create](#) (page 747) when creating the capped collection, as in the [Query a Capped Collection](#) (page 157) procedure.

- Use natural ordering to retrieve the most recently inserted elements from the collection efficiently. This is (somewhat) analogous to tail on a log file.

Procedures

Create a Capped Collection You must create capped collections explicitly using the [createCollection\(\)](#) (page 878) method, which is a helper in the [mongo](#) (page 942) shell for the [create](#) (page 747) command. When creating a capped collection you must specify the maximum size of the collection in bytes, which MongoDB will pre-allocate for the collection. The size of the capped collection includes a small amount of space for internal overhead.

```
db.createCollection( "log", { capped: true, size: 100000 } )
```

Additionally, you may also specify a maximum number of documents for the collection using the `max` field as in the following document:

```
db.createCollection("log", { capped : true, size : 5242880, max : 5000 } )
```

Important: The `size` argument is *always* required, even when you specify `max` number of documents. MongoDB will remove older documents if a collection reaches the maximum size limit before it reaches the maximum document count.

See

[createCollection\(\)](#) (page 878) and [create](#) (page 747).

Query a Capped Collection If you perform a [find\(\)](#) (page 816) on a capped collection with no ordering specified, MongoDB guarantees that the ordering of results is the same as the insertion order.

To retrieve documents in reverse insertion order, issue [find\(\)](#) (page 816) along with the [sort\(\)](#) (page 872) method with the `$natural` (page 693) parameter set to `-1`, as shown in the following example:

```
db.cappedCollection.find().sort( { $natural: -1 } )
```

Check if a Collection is Capped Use the [isCapped\(\)](#) (page 837) method to determine if a collection is capped, as follows:

```
db.collection.isCapped()
```

Convert a Collection to Capped You can convert a non-capped collection to a capped collection with the [convertToCapped](#) (page 749) command:

```
db.runCommand({ "convertToCapped": "mycoll", size: 100000});
```

The `size` parameter specifies the size of the capped collection in bytes.

Changed in version 2.2: Before 2.2, capped collections did not have an index on `_id` unless you specified `autoIndexId` to the [create](#) (page 747), after 2.2 this became the default.

Automatically Remove Data After a Specified Period of Time For additional flexibility when expiring data, consider MongoDB's [TTL](#) indexes, as described in [Expire Data from Collections by Setting TTL](#) (page 158). These indexes allow you to expire and remove data from normal collections using a special type, based on the value of a date-typed field and a TTL value for the index.

[TTL Collections](#) (page 158) are not compatible with capped collections.

Tailable Cursor You can use a tailable cursor with capped collections. Similar to the Unix `tail -f` command, the tailable cursor “tails” the end of a capped collection. As new documents are inserted into the capped collection, you can use the tailable cursor to continue retrieving documents.

See [Create Tailable Cursor](#) (page 82) for information on creating a tailable cursor.

Expire Data from Collections by Setting TTL

- [Enable TTL for a Collection](#) (page 158)
 - [Expire after a Certain Number of Seconds](#) (page 159)
 - [Expire at a Certain Clock Time](#) (page 159)
- [Constraints](#) (page 160)

New in version 2.2.

This document provides an introduction to MongoDB's “*time to live*” or “[TTL](#)” collection feature. TTL collections make it possible to store data in MongoDB and have the [mongod](#) (page 925) automatically remove data after a specified number of seconds, or at a specific clock time.

Data expiration is useful for some classes of information, including machine generated event data, logs, and session information that only need to persist for a limited period of time.

A special index type supports the implementation of TTL collections. TTL relies on a background thread in [mongod](#) (page 925) that reads the date-typed values in the index and removes expired *documents* from the collection.

Enable TTL for a Collection

To enable TTL for a collection, use the [ensureIndex\(\)](#) (page 814) method to create a TTL index, as shown in the examples below. MongoDB begins removing expired documents as soon as the index finishes building.

Note: When the TTL thread is active, you will see a [delete](#) (page 50) operations in the output of [db.currentOp\(\)](#) (page 879) or in the data collected by the [database profiler](#) (page 167).

Note: When enabling TTL on *replica sets*, the TTL background thread runs *only* on *primary* members. *Secondary* members replicate deletion operations from the primary.

Warning: The TTL index does not guarantee that expired data will be deleted immediately. There may be a delay between the time a document expires and the time that MongoDB removes the document from the database. The background task that removes expired documents runs *every 60 seconds*. As a result, documents may remain in a collection *after* they expire but *before* the background task runs or completes. The duration of the removal operation depends on the workload of your [mongod](#) (page 925) instance. Therefore, expired data may exist for some time *beyond* the 60 second period between runs of the background task.

With the exception of the background thread, A TTL index supports queries in the same way normal indexes do. You can use TTL indexes to expire documents in one of two ways, either:

- remove documents a certain number of seconds after creation. The index will support queries for the creation time of the documents. Alternately,
- specify an explicit expiration time. The index will support queries for the expiration-time of the document.

Expire after a Certain Number of Seconds Begin by creating a TTL index and specify an `expireAfterSeconds` value of 3600. This sets the an expiration time of 1 hour after the time specified by the value of the indexed field. The following example, creates an index on the `log.events` collection's `status` field:

```
db.log.events.ensureIndex( { "status": 1 }, { expireAfterSeconds: 3600 } )
```

To expire documents a certain number of seconds after creation, give the date field a value corresponding to the insertion time of the documents. For example, given the index on the `log.events` collection with the `expireAfterSeconds` value of 0, and a current date of July 22, 2013: 13:00:00, consider the document in the following [insert\(\)](#) (page 832) operation:

```
db.log.events.insert( {
  "status": new Date('July 22, 2013: 13:00:00'),
  "logEvent": 2,
  "logMessage": "Success!",
} )
```

The `status` field *must* hold values of BSON date type or an array of BSON date-typed objects.

MongoDB will automatically delete documents from the `log.events` collection when at least one of the values of a document's `status` field is a time older than the number of seconds specified in `expireAfterSeconds`.

Expire at a Certain Clock Time Begin by creating a TTL index and specify an `expireAfterSeconds` value of 0. The following example, creates an index on the `log.events` collection's `status` field:

```
db.log.events.ensureIndex( { "status": 1 }, { expireAfterSeconds: 0 } )
```

To expire documents at a certain clock time, give the date field a value corresponding to the time a document should expire. For example, given the index on the `log.events` collection with the `expireAfterSeconds` value of 0, and a current date of July 22, 2013: 13:00:00, consider the document in the following [insert\(\)](#) (page 832) operation:

```
db.log.events.insert( {
  "status": new Date('July 22, 2013: 14:00:00'),
  "logEvent": 2,
  "logMessage": "Success!",
} )
```

The `status` field *must* hold values of BSON date type or an array of BSON date-typed objects.

MongoDB will automatically delete documents from the `log.events` collection when at least one of the values of a document's `status` field is a time older than the number of seconds specified in `expireAfterSeconds`.

Constraints

- The `_id` field does not support TTL indexes.
- You cannot create a TTL index on a field that already has an index.
- A document will not expire if the indexed field does not exist.
- A document will not expire if the indexed field is not a date *BSON type* or an array of date *BSON types*.
- The TTL index may not be compound (may not have multiple fields).
- If the TTL field holds an array, and there are multiple date-typed data in the index, the document will expire when the *lowest* (i.e. earliest) date matches the expiration threshold.
- You cannot create a TTL index on a capped collection, because MongoDB cannot remove documents from a capped collection.

Important: All collections with an index using the `expireAfterSeconds` option have `usePowerOf2Sizes` (page 755) enabled. Users cannot modify this setting. As a result of enabling `usePowerOf2Sizes` (page 755), MongoDB must allocate more disk space relative to data size. This approach helps mitigate the possibility of storage fragmentation caused by frequent delete operations and leads to more predictable storage use patterns.

4.1.3 Optimization Strategies for MongoDB

There are many factors that can affect database performance and responsiveness including index use, query structure, data models and application design, as well as operational factors such as architecture and system configuration.

This section describes techniques for optimizing application performance with MongoDB.

[**Evaluate Performance of Current Operations** \(page 160\)](#) MongoDB provides introspection tools that describe the query execution process, to allow users to test queries and build more efficient queries.

[**Use Capped Collections for Fast Writes and Reads** \(page 161\)](#) Outlines a use case for [*Capped Collections*](#) (page 156) to optimize certain data ingestion work flows.

[**Optimize Query Performance** \(page 161\)](#) Introduces the use of [*projections*](#) (page 40) to reduce the amount of data MongoDB must set to clients.

Evaluate Performance of Current Operations

The following sections describe techniques for evaluating operational performance.

Use the Database Profiler to Evaluate Operations Against the Database

MongoDB provides a database profiler that shows performance characteristics of each operation against the database. Use the profiler to locate any queries or write operations that are running slow. You can use this information, for example, to determine what indexes to create.

For more information, see [*Database Profiling*](#) (page 143).

Use db.currentOp() to Evaluate mongod Operations

The `db.currentOp()` (page 879) method reports on current operations running on a `mongod` (page 925) instance.

Use \$explain to Evaluate Query Performance

The `explain()` (page 861) method returns statistics on a query, and reports the index MongoDB selected to fulfill the query, as well as information about the internal operation of the query.

Example

To use `explain()` (page 861) on a query for documents matching the expression `{ a: 1 }`, in the collection named `records`, use an operation that resembles the following in the `mongo` (page 942) shell:

```
db.records.find( { a: 1 } ).explain()
```

Use Capped Collections for Fast Writes and Reads

Use Capped Collections for Fast Writes

Capped Collections (page 156) are circular, fixed-size collections that keep documents well-ordered, even without the use of an index. This means that capped collections can receive very high-speed writes and sequential reads.

These collections are particularly useful for keeping log files but are not limited to that purpose. Use capped collections where appropriate.

Use Natural Order for Fast Reads

To return documents in the order they exist on disk, return sorted operations using the `$natural` (page 693) operator. On a capped collection, this also returns the documents in the order in which they were written.

Natural order does not use indexes but can be fast for operations when you want to select the first or last items on disk.

See also:

`sort()` (page 872) and `limit()` (page 867).

Optimize Query Performance

Create Indexes to Support Queries

For commonly issued queries, create `indexes` (page 313). If a query searches multiple fields, create a `compound index` (page 322). Scanning an index is much faster than scanning a collection. The indexes structures are smaller than the documents reference, and store references in order.

Example

If you have a `posts` collection containing blog posts, and if you regularly issue a query that sorts on the `author_name` field, then you can optimize the query by creating an index on the `author_name` field:

```
db.posts.ensureIndex( { author_name : 1 } )
```

Indexes also improve efficiency on queries that routinely sort on a given field.

Example

If you regularly issue a query that sorts on the `timestamp` field, then you can optimize the query by creating an index on the `timestamp` field:

Creating this index:

```
db.posts.ensureIndex( { timestamp : 1 } )
```

Optimizes this query:

```
db.posts.find().sort( { timestamp : -1 } )
```

Because MongoDB can read indexes in both ascending and descending order, the direction of a single-key index does not matter.

Indexes support queries, update operations, and some phases of the *aggregation pipeline* (page 281).

Index keys that are of the `BinData` type are more efficiently stored in the index if:

- the binary subtype value is in the range of 0-7 or 128-135, and
- the length of the byte array is: 0, 1, 2, 3, 4, 5, 6, 7, 8, 10, 12, 14, 16, 20, 24, or 32.

Limit the Number of Query Results to Reduce Network Demand

MongoDB `cursors` return results in groups of multiple documents. If you know the number of results you want, you can reduce the demand on network resources by issuing the `limit()` (page 867) method.

This is typically used in conjunction with sort operations. For example, if you need only 10 results from your query to the `posts` collection, you would issue the following command:

```
db.posts.find().sort( { timestamp : -1 } ).limit(10)
```

For more information on limiting results, see `limit()` (page 867)

Use Projections to Return Only Necessary Data

When you need only a subset of fields from documents, you can achieve better performance by returning only the fields you need:

For example, if in your query to the `posts` collection, you need only the `timestamp`, `title`, `author`, and `abstract` fields, you would issue the following command:

```
db.posts.find( {}, { timestamp : 1 , title : 1 , author : 1 , abstract : 1 } ).sort( { timestamp : -1 } )
```

For more information on using projections, see *Limit Fields to Return from a Query* (page 72).

Use `$hint` to Select a Particular Index

In most cases the `query optimizer` (page 45) selects the optimal index for a specific operation; however, you can force MongoDB to use a specific index using the `hint()` (page 866) method. Use `hint()` (page 866) to support performance testing, or on some queries where you must select a field or field included in several indexes.

Use the Increment Operator to Perform Operations Server-Side

Use MongoDB's `$inc` (page 651) operator to increment or decrement values in documents. The operator increments the value of the field on the server side, as an alternative to selecting a document, making simple modifications in the client and then writing the entire document to the server. The `$inc` (page 651) operator can also help avoid race conditions, which would result when two application instances queried for a document, manually incremented a field, and saved the entire document back at the same time.

4.2 Administration Tutorials

The administration tutorials provide specific step-by-step instructions for performing common MongoDB setup, maintenance, and configuration operations.

Configuration, Maintenance, and Analysis (page 163) Describes routine management operations, including configuration and performance analysis.

Manage mongod Processes (page 165) Start, configure, and manage running `mongod` (page 925) process.

Rotate Log Files (page 173) Archive the current log files and start new ones.

Backup and Recovery (page 181) Outlines procedures for data backup and restoration with `mongod` (page 925) instances and deployments.

Backup and Restore with Filesystem Snapshots (page 184) An outline of procedures for creating MongoDB data set backups using system-level file snapshot tool, such as `LVM` or native storage appliance tools.

Backup and Restore Sharded Clusters (page 188) Detailed procedures and considerations for backing up sharded clusters and single shards.

Recover Data after an Unexpected Shutdown (page 195) Recover data from MongoDB data files that were not properly closed or are in an inconsistent state.

MongoDB Scripting (page 197) An introduction to the scripting capabilities of the `mongo` (page 942) shell and the scripting capabilities embedded in MongoDB instances.

MongoDB Tutorials (page 177) A complete list of tutorials in the MongoDB Manual that address MongoDB operation and use.

4.2.1 Configuration, Maintenance, and Analysis

The following tutorials describe routine management operations, including configuration and performance analysis:

Use Database Commands (page 164) The process for running database commands that provide basic database operations.

Manage mongod Processes (page 165) Start, configure, and manage running `mongod` (page 925) process.

Analyze Performance of Database Operations (page 167) Collect data that introspects the performance of query and update operations on a `mongod` (page 925) instance.

Monitor MongoDB with SNMP (page 171) The SNMP extension, available in MongoDB Enterprise, allows MongoDB to report data into SNMP traps.

Rotate Log Files (page 173) Archive the current log files and start new ones.

Manage Journaling (page 175) Describes the procedures for configuring and managing MongoDB's journaling system which allows MongoDB to provide crash resiliency and durability.

[Store a JavaScript Function on the Server \(page 177\)](#) Describes how to store JavaScript functions on a MongoDB server.

[MongoDB Tutorials \(page 177\)](#) A complete list of tutorials in the MongoDB Manual that address MongoDB operation and use.

Use Database Commands

The MongoDB command interface provides access to all *non CRUD* database operations. Fetching server stats, initializing a replica set, and running a map-reduce job are all accomplished with commands.

See [Database Commands \(page 694\)](#) for list of all commands sorted by function, and [Database Commands \(page 694\)](#) for a list of all commands sorted alphabetically.

Database Command Form

You specify a command first by constructing a standard [BSON](#) document whose first key is the name of the command. For example, specify the [isMaster](#) (page 732) command using the following [BSON](#) document:

```
{ isMaster: 1 }
```

Issue Commands

The [mongo](#) (page 942) shell provides a helper method for running commands called [db.runCommand\(\)](#) (page 893). The following operation in [mongo](#) (page 942) runs the above command:

```
db.runCommand( { isMaster: 1 } )
```

Many [drivers](#) (page 95) provide an equivalent for the [db.runCommand\(\)](#) (page 893) method. Internally, running commands with [db.runCommand\(\)](#) (page 893) is equivalent to a special query against the [\\$cmd](#) collection.

Many common commands have their own shell helpers or wrappers in the [mongo](#) (page 942) shell and drivers, such as the [db.isMaster\(\)](#) (page 890) method in the [mongo](#) (page 942) JavaScript shell.

admin Database Commands

You must run some commands on the [admin database](#). Normally, these operations resemble the followings:

```
use admin
db.runCommand( {buildInfo: 1} )
```

However, there's also a command helper that automatically runs the command in the context of the [admin](#) database:

```
db._adminCommand( {buildInfo: 1} )
```

Command Responses

All commands return, at minimum, a document with an `ok` field indicating whether the command has succeeded:

```
{ 'ok': 1 }
```

Failed commands return the `ok` field with a value of 0.

Manage mongod Processes

MongoDB runs as a standard program. You can start MongoDB from a command line by issuing the [mongod](#) (page 925) command and specifying options. For a list of options, see [mongod](#) (page 925). MongoDB can also run as a Windows service. For details, see [MongoDB as a Windows Service](#) (page 19). To install MongoDB, see [Install MongoDB](#) (page 3).

The following examples assume the directory containing the [mongod](#) (page 925) process is in your system paths. The [mongod](#) (page 925) process is the primary database process that runs on an individual server. [mongos](#) (page 938) provides a coherent MongoDB interface equivalent to a [mongod](#) (page 925) from the perspective of a client. The [mongo](#) (page 942) binary provides the administrative shell.

This document page discusses the [mongod](#) (page 925) process; however, some portions of this document may be applicable to [mongos](#) (page 938) instances.

See also:

[Run-time Database Configuration](#) (page 145), [mongod](#) (page 925), [mongos](#) (page 937), and [Configuration File Options](#) (page 990).

Start mongod

By default, MongoDB stores data in the `/data/db` directory. On Windows, MongoDB stores data in `C:\data\db`. On all platforms, MongoDB listens for connections from clients on port 27017.

To start MongoDB using all defaults, issue the following command at the system shell:

```
mongod
```

Specify a Data Directory If you want [mongod](#) (page 925) to store data files at a path *other than* `/data/db` you can specify a [dbpath](#) (page 993). The [dbpath](#) (page 993) must exist before you start [mongod](#) (page 925). If it does not exist, create the directory and the permissions so that [mongod](#) (page 925) can read and write data to this path. For more information on permissions, see the [security operations documentation](#) (page 236).

To specify a [dbpath](#) (page 993) for [mongod](#) (page 925) to use as a data directory, use the `--dbpath` option. The following invocation will start a [mongod](#) (page 925) instance and store data in the `/srv/mongodb` path

```
mongod --dbpath /srv/mongodb/
```

Specify a TCP Port Only a single process can listen for connections on a network interface at a time. If you run multiple [mongod](#) (page 925) processes on a single machine, or have other processes that must use this port, you must assign each a different port to listen on for client connections.

To specify a port to [mongod](#) (page 925), use the `--port` option on the command line. The following command starts [mongod](#) (page 925) listening on port 12345:

```
mongod --port 12345
```

Use the default port number when possible, to avoid confusion.

Start mongod as a Daemon To run a [mongod](#) (page 925) process as a daemon (i.e. [fork](#) (page 993),) *and* write its output to a log file, use the `--fork` and `--logpath` options. You must create the log directory; however, [mongod](#) (page 925) will create the log file if it does not exist.

The following command starts [mongod](#) (page 925) as a daemon and records log output to `/var/log/mongodb.log`.

```
mongod --fork --logpath /var/log/mongodb.log
```

Additional Configuration Options For an overview of common configurations and common configuration deployments, configurations for common use cases, see [Run-time Database Configuration](#) (page 145).

Stop mongod

To stop a [mongod](#) (page 925) instance not running as a daemon, press `Control+C`. MongoDB stops when all ongoing operations are complete and does a clean exit, flushing and closing all data files.

To stop a [mongod](#) (page 925) instance running in the background or foreground, issue the [db.shutdownServer\(\)](#) (page 894) helper in the [mongo](#) (page 942) shell. Use the following sequence:

1. To open the [mongo](#) (page 942) shell for a [mongod](#) (page 925) instance running on the default port of 27017, issue the following command:

```
mongo
```

2. To switch to the `admin` database and shutdown the [mongod](#) (page 925) instance, issue the following commands:

```
use admin
db.shutdownServer()
```

You may only use [db.shutdownServer\(\)](#) (page 894) when connected to the [mongod](#) (page 925) when authenticated to the `admin` database or on systems without authentication connected via the `localhost` interface.

Alternately, you can shut down the [mongod](#) (page 925) instance from a driver using the [shutdown](#) (page 759) command. For details, see the [drivers documentation](#) (page 95) for your driver.

mongod Shutdown and Replica Sets If the [mongod](#) (page 925) is the *primary* in a *replica set*, the shutdown process for these [mongod](#) (page 925) instances has the following steps:

1. Check how up-to-date the *secondaries* are.
2. If no secondary is within 10 seconds of the primary, [mongod](#) (page 925) will return a message that it will not shut down. You can pass the [shutdown](#) (page 759) command a `timeoutSecs` argument to wait for a secondary to catch up.
3. If there is a secondary within 10 seconds of the primary, the primary will step down and wait for the secondary to catch up.
4. After 60 seconds or once the secondary has caught up, the primary will shut down.

If there is no up-to-date secondary and you want the primary to shut down, issue the [shutdown](#) (page 759) command with the `force` argument, as in the following [mongo](#) (page 942) shell operation:

```
db.adminCommand({shutdown : 1, force : true})
```

To keep checking the secondaries for a specified number of seconds if none are immediately up-to-date, issue [shutdown](#) (page 759) with the `timeoutSecs` argument. MongoDB will keep checking the secondaries for the specified number of seconds if none are immediately up-to-date. If any of the secondaries catch up within the allotted time, the primary will shut down. If no secondaries catch up, it will not shut down.

The following command issues [shutdown](#) (page 759) with `timeoutSecs` set to 5:

```
db.adminCommand({shutdown : 1, timeoutSecs : 5})
```

Alternately you can use the `timeoutSecs` argument with the `db.shutdownServer()` (page 894) method:

```
db.shutdownServer({timeoutSecs : 5})
```

Sending a UNIX INT or TERM Signal

You can cleanly stop `mongod` (page 925) using a SIGINT or SIGTERM signal on UNIX-like systems. Either `^C` for a non-daemon `mongod` (page 925) instance, `kill -2 <pid>`, or `kill -15 <pid>` will cleanly terminate the `mongod` (page 925) instance.

Terminating a `mongod` (page 925) instance that is **not** running with `journaling` with `kill -9 <pid>` (i.e. SIGKILL) will probably cause data corruption.

To recover data in situations where `mongod` (page 925) instances have not terminated cleanly *without journaling* see [Recover Data after an Unexpected Shutdown](#) (page 195).

Analyze Performance of Database Operations

The database profiler collects fine grained data about MongoDB write operations, cursors, database commands on a running `mongod` (page 925) instance. You can enable profiling on a per-database or per-instance basis. The [profiling level](#) (page 167) is also configurable when enabling profiling.

The database profiler writes all the data it collects to the `system.profile` (page 229) collection, which is a *capped collection* (page 156). See [Database Profiler Output](#) (page 229) for overview of the data in the `system.profile` (page 229) documents created by the profiler.

This document outlines a number of key administration options for the database profiler. For additional related information, consider the following resources:

- [Database Profiler Output](#) (page 229)
- [Profile Command](#) (page 770)
- [db.currentOp\(\)](#) (page 879)

Profiling Levels

The following profiling levels are available:

- 0 - the profiler is off, does not collect any data.
- 1 - collects profiling data for slow operations only. By default slow operations are those slower than 100 milliseconds.
You can modify the threshold for “slow” operations with the `slowms` (page 997) runtime option or the `setParameter` (page 756) command. See the [Specify the Threshold for Slow Operations](#) (page 168) section for more information.
- 2 - collects profiling data for all database operations.

Enable Database Profiling and Set the Profiling Level

You can enable database profiling from the `mongo` (page 942) shell or through a driver using the `profile` (page 770) command. This section will describe how to do so from the `mongo` (page 942) shell. See your [driver documentation](#) (page 95) if you want to control the profiler from within your application.

When you enable profiling, you also set the [profiling level](#) (page 167). The profiler records data in the `system.profile` (page 229) collection. MongoDB creates the `system.profile` (page 229) collection in a database after you enable profiling for that database.

To enable profiling and set the profiling level, issue use the `db.setProfilingLevel()` (page 894) helper in the `mongo` (page 942) shell, passing the profiling level as a parameter. For example, to enable profiling for all database operations, consider the following operation in the `mongo` (page 942) shell:

```
db.setProfilingLevel(2)
```

The shell returns a document showing the *previous* level of profiling. The "ok" : 1 key-value pair indicates the operation succeeded:

```
{ "was" : 0, "slowms" : 100, "ok" : 1 }
```

To verify the new setting, see the [Check Profiling Level](#) (page 168) section.

Specify the Threshold for Slow Operations The threshold for slow operations applies to the entire `mongod` (page 925) instance. When you change the threshold, you change it for all databases on the instance.

Important: Changing the slow operation threshold for the database profiler also affects the profiling subsystem's slow operation threshold for the entire `mongod` (page 925) instance. Always set the threshold to the highest useful value.

By default the slow operation threshold is 100 milliseconds. Databases with a profiling level of 1 will log operations slower than 100 milliseconds.

To change the threshold, pass two parameters to the `db.setProfilingLevel()` (page 894) helper in the `mongo` (page 942) shell. The first parameter sets the profiling level for the current database, and the second sets the default slow operation threshold *for the entire mongod* (page 925) *instance*.

For example, the following command sets the profiling level for the current database to 0, which disables profiling, and sets the slow-operation threshold for the `mongod` (page 925) instance to 20 milliseconds. Any database on the instance with a profiling level of 1 will use this threshold:

```
db.setProfilingLevel(0,20)
```

Check Profiling Level To view the [profiling level](#) (page 167), issue the following from the `mongo` (page 942) shell:

```
db.getProfilingStatus()
```

The shell returns a document similar to the following:

```
{ "was" : 0, "slowms" : 100 }
```

The `was` field indicates the current level of profiling.

The `slowms` field indicates how long an operation must exist in milliseconds for an operation to pass the “slow” threshold. MongoDB will log operations that take longer than the threshold if the profiling level is 1. This document returns the profiling level in the `was` field. For an explanation of profiling levels, see [Profiling Levels](#) (page 167).

To return only the profiling level, use the `db.getProfilingLevel()` (page 887) helper in the `mongo` (page 942) as in the following:

```
db.getProfilingLevel()
```

Disable Profiling To disable profiling, use the following helper in the `mongo` (page 942) shell:

```
db.setProfilingLevel(0)
```

Enable Profiling for an Entire mongod Instance For development purposes in testing environments, you can enable database profiling for an entire `mongod` (page 925) instance. The profiling level applies to all databases provided by the `mongod` (page 925) instance.

To enable profiling for a `mongod` (page 925) instance, pass the following parameters to `mongod` (page 925) at startup or within the *configuration file* (page 990):

```
mongod --profile=1 --slowms=15
```

This sets the profiling level to 1, which collects profiling data for slow operations only, and defines slow operations as those that last longer than 15 milliseconds.

See also:

[profile](#) (page 997) and [slowms](#) (page 997).

Database Profiling and Sharding You *cannot* enable profiling on a `mongos` (page 938) instance. To enable profiling in a shard cluster, you must enable profiling for each `mongod` (page 925) instance in the cluster.

View Profiler Data

The database profiler logs information about database operations in the `system.profile` (page 229) collection.

To view profiling information, query the `system.profile` (page 229) collection. To view example queries, see [Profiler Overhead](#) (page 170).

For an explanation of the output data, see [Database Profiler Output](#) (page 229).

Example Profiler Data Queries This section displays example queries to the `system.profile` (page 229) collection. For an explanation of the query output, see [Database Profiler Output](#) (page 229).

To return the most recent 10 log entries in the `system.profile` (page 229) collection, run a query similar to the following:

```
db.system.profile.find().limit(10).sort( { ts : -1 } ).pretty()
```

To return all operations except command operations (`$cmd`), run a query similar to the following:

```
db.system.profile.find( { op: { $ne : 'command' } } ).pretty()
```

To return operations for a particular collection, run a query similar to the following. This example returns operations in the `mydb` database's `test` collection:

```
db.system.profile.find( { ns : 'mydb.test' } ).pretty()
```

To return operations slower than 5 milliseconds, run a query similar to the following:

```
db.system.profile.find( { millis : { $gt : 5 } } ).pretty()
```

To return information from a certain time range, run a query similar to the following:

```
db.system.profile.find(
    {
        ts : {
            $gt : new ISODate("2012-12-09T03:00:00Z") ,
            $lt : new ISODate("2012-12-09T03:40:00Z")
        }
    }
).pretty()
```

The following example looks at the time range, suppresses the `user` field from the output to make it easier to read, and sorts the results by how long each operation took to run:

```
db.system.profile.find(
    {
        ts : {
            $gt : new ISODate("2011-07-12T03:00:00Z") ,
            $lt : new ISODate("2011-07-12T03:40:00Z")
        }
    },
    { user : 0 }
).sort( { millis : -1 } )
```

Show the Five Most Recent Events On a database that has profiling enabled, the `show profile` helper in the `mongo` (page 942) shell displays the 5 most recent operations that took at least 1 millisecond to execute. Issue `show profile` from the `mongo` (page 942) shell, as follows:

```
show profile
```

Profiler Overhead

When enabled, profiling has a minor effect on performance. The `system.profile` (page 229) collection is a *capped collection* with a default size of 1 megabyte. A collection of this size can typically store several thousand profile documents, but some application may use more or less profiling data per operation.

To change the size of the `system.profile` (page 229) collection, you must:

1. Disable profiling.
2. Drop the `system.profile` (page 229) collection.
3. Create a new `system.profile` (page 229) collection.
4. Re-enable profiling.

For example, to create a new `system.profile` (page 229) collections that's 4000000 bytes, use the following sequence of operations in the `mongo` (page 942) shell:

```
db.setProfilingLevel(0)

db.system.profile.drop()

db.createCollection( "system.profile", { capped: true, size:4000000 } )

db.setProfilingLevel(1)
```

Monitor MongoDB with SNMP

New in version 2.2.

Enterprise Feature

This feature is only available in MongoDB Enterprise.

This document outlines the use and operation of MongoDB's SNMP extension, which is only available in MongoDB Enterprise³⁵.

Prerequisites

Install MongoDB Enterprise *MongoDB Enterprise*

Included Files The Enterprise packages contain the following files:

- MONGO-MIB.txt:
The MIB file that describes the data (i.e. schema) for MongoDB's SNMP output
- mongod.conf:
The SNMP configuration file for reading the SNMP output of MongoDB. The SNMP configures the community names, permissions, access controls, etc.

Required Packages To use SNMP, you must install several prerequisites. The names of the packages vary by distribution and are as follows:

- Ubuntu 11.04 requires libssl0.9.8, snmp-mibs-downloader, snmp, and snmpd. Issue a command such as the following to install these packages:

```
sudo apt-get install libssl0.9.8 snmp snmpd snmp-mibs-downloader
```

- Red Hat Enterprise Linux 6.x series and Amazon Linux AMI require libssl, net-snmp, net-snmp-libs, and net-snmp-utils. Issue a command such as the following to install these packages:

```
sudo yum install libssl net-snmp net-snmp-libs net-snmp-utils
```

- SUSE Enterprise Linux requires libopenssl0_9_8, libsnmp15, slessp1-libsnpmp15, and snmp-mibs. Issue a command such as the following to install these packages:

```
sudo zypper install libopenssl0_9_8 libsnmp15 slessp1-libsnpmp15 snmp-mibs
```

Configure SNMP

Install MIB Configuration Files Ensure that the MIB directory /usr/share/snmp/mibs exists. If not, issue the following command:

```
sudo mkdir -p /usr/share/snmp/mibs
```

Use the following command to create a symbolic link:

³⁵<http://www.mongodb.com/products/mongodb-enterprise>

```
sudo ln -s <path>MONGO-MIB.txt /usr/share/snmp/mibs/
```

Replace [/path/to/mongodb/distribution/] with the path to your MONGO-MIB.txt configuration file.

Copy the mongod.conf file into the /etc/snmp directory with the following command:

```
cp mongod.conf /etc/snmp/mongod.conf
```

Start Up You can control MongoDB Enterprise using default or custom control scripts, just as with any other **mongod**:

Use the following command to view all SNMP options available in your MongoDB:

```
mongod --help | grep snmp
```

The above command should return the following output:

Module snmp options:

```
--snmp-subagent      run snmp subagent  
--snmp-master       run snmp as master
```

Ensure that the following directories exist:

- /data/db/ (This is the path where MongoDB stores the data files.)
- /var/log/mongodb/ (This is the path where MongoDB writes the log output.)

If they do not, issue the following command:

```
mkdir -p /var/log/mongodb/ /data/db/
```

Start the **mongod** instance with the following command:

```
mongod --snmp-master --port 3001 --fork --dbpath /data/db/ --logpath /var/log/mongodb/1.log
```

Optionally, you can set these options in a *configuration file* (page 990).

To check if **mongod** is running with SNMP support, issue the following command:

```
ps -ef | grep 'mongod --snmp'
```

The command should return output that includes the following line. This indicates that the proper **mongod** instance is running:

```
systemuser 31415 10260 0 Jul13 pts/16 00:00:00 mongod --snmp-master --port 3001 # [...]
```

Test SNMP Check for the snmp agent process listening on port 1161 with the following command:

```
sudo lsof -i :1161
```

which return the following output:

COMMAND	PID	USER	FD	TYPE	DEVICE	SIZE/OFF	NODE	NAME
mongod	9238	sysadmin	10u	IPv4	96469	0t0	UDP	localhost:health-polling

Similarly, this command:

```
netstat -anp | grep 1161
```

should return the following output:

```
udp      0      0 127.0.0.1:1161      0.0.0.0:*      9238/<path>/mongod
```

Run snmpwalk Locally `snmpwalk` provides tools for retrieving and parsing the SNMP data according to the MIB. If you installed all of the required packages above, your system will have `snmpwalk`.

Issue the following command to collect data from `mongod` using SNMP:

```
snmpwalk -m MONGO-MIB -v 2c -c mongodb 127.0.0.1:1161 1.3.6.1.4.1.37601
```

You may also choose to specify the path to the MIB file:

```
snmpwalk -m /usr/share/snmp/mibs/MONGO-MIB -v 2c -c mongodb 127.0.0.1:1161 1.3.6.1.4.1.37601
```

Use this command *only* to ensure that you can retrieve and validate SNMP data from MongoDB.

Troubleshooting

Always check the logs for errors if something does not run as expected; see the log at `/var/log/mongodb/1.log`. The presence of the following line indicates that the `mongod` cannot read the `/etc/snmp/mongod.conf` file:

```
[SNMPAgent] warning: error starting SNMPAgent as master err:1
```

Rotate Log Files

- [Overview \(page 173\)](#)
- [Log Rotation With MongoDB \(page 173\)](#)
- [Syslog Log Rotation \(page 174\)](#)

Overview

Log rotation using MongoDB's standard approach archives the current log file and starts a new one. To do this, the `mongod` (page 925) or `mongos` (page 938) instance renames the current log file by appending a UTC (GMT) timestamp to the filename, in `ISODate` format. It then opens a new log file, closes the old log file, and sends all new log entries to the new log file.

MongoDB's standard approach to log rotation only rotates logs in response to the `logRotate` (page 760) command, or when the `mongod` (page 925) or `mongos` (page 938) process receives a `SIGUSR1` signal from the operating system.

Alternately, you may configure mongod to send log data to `syslog`. In this case, you can take advantage of alternate log rotation tools.

See also:

For information on logging, see the [Process Logging \(page 141\)](#) section.

Log Rotation With MongoDB

The following steps create and rotate a log file:

1. Start a `mongod` (page 925) with verbose logging, with appending enabled, and with the following log file:

```
mongod -v --logpath /var/log/mongodb/server1.log --logappend
```

2. In a separate terminal, list the matching files:

```
ls /var/log/mongodb/server1.log*
```

For results, you get:

```
server1.log
```

3. Rotate the log file using *one* of the following methods.

- From the [mongo](#) (page 942) shell, issue the [logRotate](#) (page 760) command from the `admin` database:

```
use admin
db.runCommand( { logRotate : 1 } )
```

This is the only available method to rotate log files on Windows systems.

- From the UNIX shell, rotate logs for a single process by issuing the following command:

```
kill -SIGUSR1 <mongod process id>
```

- From the UNIX shell, rotate logs for all [mongod](#) (page 925) processes on a machine by issuing the following command:

```
killall -SIGUSR1 mongod
```

4. List the matching files again:

```
ls /var/log/mongodb/server1.log*
```

For results you get something similar to the following. The timestamps will be different.

```
server1.log  server1.log.2011-11-24T23-30-00
```

The example results indicate a log rotation performed at exactly 11:30 pm on November 24th, 2011 UTC, which is the local time offset by the local time zone. The original log file is the one with the timestamp. The new log is `server1.log` file.

If you issue a second [logRotate](#) (page 760) command an hour later, then an additional file would appear when listing matching files, as in the following example:

```
server1.log  server1.log.2011-11-24T23-30-00  server1.log.2011-11-25T00-30-00
```

This operation does not modify the `server1.log.2011-11-24T23-30-00` file created earlier, while `server1.log.2011-11-25T00-30-00` is the previous `server1.log` file, renamed. `server1.log` is a new, empty file that receives all new log output.

Syslog Log Rotation

New in version 2.2.

To configure `mongod` to send log data to syslog rather than writing log data to a file, use the following procedure.

1. Start a [mongod](#) (page 925) with the [syslog](#) (page 992) option.
2. Store and rotate the log output using your system's default log rotation mechanism.

Important: You cannot use [syslog](#) (page 992) with [logpath](#) (page 992).

Manage Journaling

MongoDB uses *write ahead logging* to an on-disk *journal* to guarantee *write operation* (page 50) durability and to provide crash resiliency. Before applying a change to the data files, MongoDB writes the change operation to the journal. If MongoDB should terminate or encounter an error before it can write the changes from the journal to the data files, MongoDB can re-apply the write operation and maintain a consistent state.

Without a journal, if [mongod](#) (page 925) exits unexpectedly, you must assume your data is in an inconsistent state, and you must run either [repair](#) (page 195) or, preferably, [resync](#) (page 450) from a clean member of the replica set.

With journaling enabled, if [mongod](#) (page 925) stops unexpectedly, the program can recover everything written to the journal, and the data remains in a consistent state. By default, the greatest extent of lost writes, i.e., those not made to the journal, are those made in the last 100 milliseconds. See [journalCommitInterval](#) (page 995) for more information on the default.

With journaling, if you want a data set to reside entirely in RAM, you need enough RAM to hold the data set plus the “write working set.” The “write working set” is the amount of unique data you expect to see written between re-mappings of the private view. For information on views, see [Storage Views used in Journaling](#) (page 233).

Important: Changed in version 2.0: For 64-bit builds of [mongod](#) (page 925), journaling is enabled by default. For other platforms, see [journal](#) (page 995).

Procedures

Enable Journaling Changed in version 2.0: For 64-bit builds of [mongod](#) (page 925), journaling is enabled by default.

To enable journaling, start [mongod](#) (page 925) with the `--journal` command line option.

If no journal files exist, when [mongod](#) (page 925) starts, it must preallocate new journal files. During this operation, the [mongod](#) (page 925) is not listening for connections until preallocation completes: for some systems this may take a several minutes. During this period your applications and the [mongo](#) (page 942) shell are not available.

Disable Journaling

Warning: Do not disable journaling on production systems. If your [mongod](#) (page 925) instance stops without shutting down cleanly unexpectedly for any reason, (e.g. power failure) and you are not running with journaling, then you must recover from an unaffected *replica set* member or backup, as described in [repair](#) (page 195).

To disable journaling, start [mongod](#) (page 925) with the `--nojournal` command line option.

Get Commit Acknowledgment You can get commit acknowledgment with the [getLastError](#) (page 720) command and the `j` option. For details, see [Write Concern Reference](#) (page 96).

Avoid Preallocation Lag To avoid *preallocation lag* (page 232), you can preallocate files in the journal directory by copying them from another instance of [mongod](#) (page 925).

Preallocated files do not contain data. It is safe to later remove them. But if you restart [mongod](#) (page 925) with journaling, [mongod](#) (page 925) will create them again.

Example

The following sequence preallocates journal files for an instance of [mongod](#) (page 925) running on port 27017 with a database path of `/data/db`.

For demonstration purposes, the sequence starts by creating a set of journal files in the usual way.

1. Create a temporary directory into which to create a set of journal files:

```
mkdir ~/tmpDbpath
```

2. Create a set of journal files by starting a [mongod](#) (page 925) instance that uses the temporary directory:

```
mongod --port 10000 --dbpath ~/tmpDbpath --journal
```

3. When you see the following log output, indicating [mongod](#) (page 925) has the files, press CONTROL+C to stop the [mongod](#) (page 925) instance:

```
web admin interface listening on port 11000
```

4. Preallocate journal files for the new instance of [mongod](#) (page 925) by moving the journal files from the data directory of the existing instance to the data directory of the new instance:

```
mv ~/tmpDbpath/journal /data/db/
```

5. Start the new [mongod](#) (page 925) instance:

```
mongod --port 27017 --dbpath /data/db --journal
```

Monitor Journal Status Use the following commands and methods to monitor journal status:

- [serverStatus](#) (page 782)

The [serverStatus](#) (page 782) command returns database status information that is useful for assessing performance.

- [journalLatencyTest](#) (page 805)

Use [journalLatencyTest](#) (page 805) to measure how long it takes on your volume to write to the disk in an append-only fashion. You can run this command on an idle system to get a baseline sync time for journaling. You can also run this command on a busy system to see the sync time on a busy system, which may be higher if the journal directory is on the same volume as the data files.

The [journalLatencyTest](#) (page 805) command also provides a way to check if your disk drive is buffering writes in its local cache. If the number is very low (i.e., less than 2 milliseconds) and the drive is non-SSD, the drive is probably buffering writes. In that case, enable cache write-through for the device in your operating system, unless you have a disk controller card with battery backed RAM.

Change the Group Commit Interval Changed in version 2.0.

You can set the group commit interval using the `--journalCommitInterval` command line option. The allowed range is 2 to 300 milliseconds.

Lower values increase the durability of the journal at the expense of disk performance.

Recover Data After Unexpected Shutdown On a restart after a crash, MongoDB replays all journal files in the journal directory before the server becomes available. If MongoDB must replay journal files, [mongod](#) (page 925) notes these events in the log output.

There is no reason to run [repairDatabase](#) (page 757) in these situations.

Store a JavaScript Function on the Server

Note: We do **not** recommend using server-side stored functions if possible.

There is a special system collection named `system.js` that can store JavaScript functions for reuse.

To store a function, you can use the `db.collection.save()` (page 846), as in the following example:

```
db.system.js.save(
{
  _id : "myAddFunction",
  value : function (x, y){ return x + y; }
}
);
```

- The `_id` field holds the name of the function and is unique per database.
- The `value` field holds the function definition

Once you save a function in the `system.js` collection, you can use the function from any JavaScript context (e.g. `eval` (page 722) command or the `mongo` (page 942) shell method `db.eval()` (page 884), `$where` (page 634) operator, `mapReduce` (page 701) or `mongo` (page 942) shell method `db.collection.mapReduce()` (page 837)).

Consider the following example from the `mongo` (page 942) shell that first saves a function named `echoFunction` to the `system.js` collection and calls the function using `db.eval()` (page 884) method:

```
db.system.js.save(
  { _id: "echoFunction",
    value : function(x) { return x; }
  }
)

db.eval( "echoFunction( 'test' )" )
```

See <http://github.com/mongodb/mongo/tree/master/jstests/storefunc.js> for a full example.

New in version 2.1: In the `mongo` (page 942) shell, you can use `db.loadServerScripts()` (page 890) to load all the scripts saved in the `system.js` collection for the current database. Once loaded, you can invoke the functions directly in the shell, as in the following example:

```
db.loadServerScripts();

echoFunction(3);

myAddFunction(3, 5);
```

MongoDB Tutorials

This page lists the tutorials available as part of the *MongoDB Manual* (page 1). In addition to these documents, you can refer to the introductory *MongoDB Tutorial* (page 26). If there is a process or pattern that you would like to see included here, please open a [Jira Case](#)³⁶.

Getting Started

- [Install MongoDB on Linux](#) (page 11)

³⁶<https://jira.mongodb.org/browse/DOCS>

- [Install MongoDB on Red Hat Enterprise, CentOS, or Fedora Linux](#) (page 3)
- [Install MongoDB on Debian](#) (page 9)
- [Install MongoDB on Ubuntu](#) (page 6)
- [Install MongoDB on OS X](#) (page 13)
- [Install MongoDB on Windows](#) (page 16)
- [Getting Started with MongoDB](#) (page 26)
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- [Reconfigure a Replica Set with Unavailable Members](#) (page 455)
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- [Add Shards to a Cluster](#) (page 529)
- [Remove Shards from an Existing Sharded Cluster](#) (page 553)
- [Deploy Three Config Servers for Production Deployments](#) (page 539)
- [Migrate Config Servers with the Same Hostname](#) (page 540)
- [Migrate Config Servers with Different Hostnames](#) (page 540)
- [Replace a Config Server](#) (page 541)
- [Migrate a Sharded Cluster to Different Hardware](#) (page 542)
- [Backup Cluster Metadata](#) (page 545)
- [Backup a Small Sharded Cluster with mongodump](#) (page 188)
- [Backup a Sharded Cluster with Filesystem Snapshots](#) (page 189)
- [Backup a Sharded Cluster with Database Dumps](#) (page 190)
- [Restore a Single Shard](#) (page 192)
- [Restore a Sharded Cluster](#) (page 192)
- [Schedule Backup Window for Sharded Clusters](#) (page 191)
- [Manage Shard Tags](#) (page 536)

Basic Operations

- [Use Database Commands](#) (page 164)
- [Recover Data after an Unexpected Shutdown](#) (page 195)
- [Copy Databases Between Instances](#) (page 193)
- [Expire Data from Collections by Setting TTL](#) (page 158)
- [Analyze Performance of Database Operations](#) (page 167)
- [Rotate Log Files](#) (page 173)
- [Build Old Style Indexes](#) (page 345)
- [Manage mongod Processes](#) (page 165)
- [Backup and Restore with MongoDB Tools](#) (page 181)
- [Backup and Restore with Filesystem Snapshots](#) (page 184)

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- [Configure Linux iptables Firewall for MongoDB](#) (page 242)
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- [Model Embedded One-to-One Relationships Between Documents](#) (page 124)
- [Model Embedded One-to-Many Relationships Between Documents](#) (page 125)
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- [Model Data for Atomic Operations](#) (page 128)
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- [Model Tree Structures with Child References](#) (page 129)
- [Model Tree Structures with Materialized Paths](#) (page 131)

- *Model Tree Structures with Nested Sets* (page 132)

4.2.2 Backup and Recovery

The following tutorials describe backup and restoration for a `mongod` (page 925) instance:

Backup and Restore with MongoDB Tools (page 181) The procedure for writing the contents of a database to a BSON (i.e. binary) dump file for backing up MongoDB databases.

Backup and Restore with Filesystem Snapshots (page 184) An outline of procedures for creating MongoDB data set backups using system-level file snapshot tool, such as `LVM` or native storage appliance tools.

Backup and Restore Sharded Clusters (page 188) Detailed procedures and considerations for backing up sharded clusters and single shards.

Copy Databases Between Instances (page 193) Copy databases between `mongod` (page 925) instances or within a single `mongod` (page 925) instance or deployment.

Recover Data after an Unexpected Shutdown (page 195) Recover data from MongoDB data files that were not properly closed or are in an inconsistent state.

Backup and Restore with MongoDB Tools

This document describes the process for writing the entire contents of your MongoDB instance to a file in a binary format. If disk-level snapshots are not available, this approach provides the best option for full system database backups. If your system has disk level snapshot capabilities, consider the backup methods described in [Backup and Restore with Filesystem Snapshots](#) (page 184).

See also:

[Backup Strategies for MongoDB Systems](#) (page 136), `mongodump` (page 951), and `mongorestore` (page 956).

Backup a Database with `mongodump`

Important: `mongodump` (page 951) does *not* create output for the `local` database.

Basic `mongodump` Operations The `mongodump` (page 951) utility can back up data by either:

- connecting to a running `mongod` (page 925) or `mongos` (page 938) instance, or
- accessing data files without an active instance.

The utility can create a backup for an entire server, database or collection, or can use a query to backup just part of a collection.

When you run `mongodump` (page 951) without any arguments, the command connects to the MongoDB instance on the local system (e.g. `127.0.0.1` or `localhost`) on port `27017` and creates a database backup named `dump/` in the current directory.

To backup data from a `mongod` (page 925) or `mongos` (page 938) instance running on the same machine and on the default port of `27017` use the following command:

```
mongodump
```

Note: The format of data created by [mongodump](#) (page 951) tool from the 2.2 distribution or later is different and incompatible with earlier versions of [mongod](#) (page 925).

To limit the amount of data included in the database dump, you can specify `--db` and `--collection` as options to the [mongodump](#) (page 951) command. For example:

```
mongodump --dbpath /data/db/ --out /data/backup/  
mongodump --host mongodb.example.net --port 27017
```

[mongodump](#) (page 951) will write *BSON* files that hold a copy of data accessible via the [mongod](#) (page 925) listening on port 27017 of the `mongodb.example.net` host.

```
mongodump --collection collection --db test
```

This command creates a dump of the collection named `collection` from the database `test` in a `dump/` subdirectory of the current working directory.

Point in Time Operation Using Oplogs Use the `--oplog` option with [mongodump](#) (page 951) to collect the *oplog* entries to build a point-in-time snapshot of a database within a replica set. With `--oplog`, [mongodump](#) (page 951) copies all the data from the source database as well as all of the *oplog* entries from the beginning of the backup procedure to until the backup procedure completes. This backup procedure, in conjunction with [mongorestore](#) `--oplogReplay`, allows you to restore a backup that reflects a consistent and specific moment in time.

Create Backups Without a Running mongod Instance If your MongoDB instance is not running, you can use the `--dbpath` option to specify the location to your MongoDB instance's database files. [mongodump](#) (page 951) reads from the data files directly with this operation. This locks the data directory to prevent conflicting writes. The [mongod](#) (page 925) process must *not* be running or attached to these data files when you run [mongodump](#) (page 951) in this configuration. Consider the following example:

Example

Backup a MongoDB Instance Without a Running mongod

Given a MongoDB instance that contains the `customers`, `products`, and `suppliers` databases, the following [mongodump](#) (page 951) operation backs up the databases using the `--dbpath` option, which specifies the location of the database files on the host:

```
mongodump --dbpath /data -o dataout
```

The `--out` option allows you to specify the directory where [mongodump](#) (page 951) will save the backup. [mongodump](#) (page 951) creates a separate backup directory for each of the backed up databases: `dataout/customers`, `dataout/products`, and `dataout/suppliers`.

Create Backups from Non-Local mongod Instances The `--host` and `--port` options for [mongodump](#) (page 951) allow you to connect to and backup from a remote host. Consider the following example:

```
mongodump --host mongodb1.example.net --port 3017 --username user --password pass --out /opt/backup/r
```

On any [mongodump](#) (page 951) command you may, as above, specify username and password credentials to specify database authentication.

Restore a Database with mongorestore

The [mongorestore](#) (page 956) utility restores a binary backup created by [mongodump](#) (page 951). By default, [mongorestore](#) (page 956) looks for a database backup in the `dump/` directory.

The [mongorestore](#) (page 956) utility can restore data either by:

- connecting to a running [mongod](#) (page 925) or [mongos](#) (page 938) directly, or
- writing to a set of MongoDB data files without use of a running [mongod](#) (page 925).

[mongorestore](#) (page 956) can restore either an entire database backup or a subset of the backup.

To use [mongorestore](#) (page 956) to connect to an active [mongod](#) (page 925) or [mongos](#) (page 938), use a command with the following prototype form:

```
mongorestore --port <port number> <path to the backup>
```

To use [mongorestore](#) (page 956) to write to data files without using a running [mongod](#) (page 925), use a command with the following prototype form:

```
mongorestore --dbpath <database path> <path to the backup>
```

Consider the following example:

```
mongorestore dump-2012-10-25/
```

Here, [mongorestore](#) (page 956) imports the database backup in the `dump-2012-10-25` directory to the [mongod](#) (page 925) instance running on the localhost interface.

Restore Point in Time Oplog Backup If you created your database dump using the `--oplog` option to ensure a point-in-time snapshot, call [mongorestore](#) (page 956) with the `--oplogReplay` option, as in the following example:

```
mongorestore --oplogReplay
```

You may also consider using the `mongorestore --objcheck` option to check the integrity of objects while inserting them into the database, or you may consider the `mongorestore --drop` option to drop each collection from the database before restoring from backups.

Restore a Subset of data from a Binary Database Dump [mongorestore](#) (page 956) also includes the ability to filter to all input before inserting it into the new database. Consider the following example:

```
mongorestore --filter '{"field": 1}'
```

Here, [mongorestore](#) (page 956) only adds documents to the database from the dump located in the `dump/` folder if the documents have a field name `field` that holds a value of 1. Enclose the filter in single quotes (e.g. `'`) to prevent the filter from interacting with your shell environment.

Restore Without a Running mongod [mongorestore](#) (page 956) can write data to MongoDB data files without needing to connect to a [mongod](#) (page 925) directly.

Example

Restore a Database Without a Running mongod

Given a set of backed up databases in the `dataout` directory:

- `dataout/customers`,

- dataout/products, and
- dataout/suppliers

The following [mongorestore](#) (page 956) command restores the products database. The command uses the --dbpath option to specify which database to restore:

```
mongorestore --host localhost --port 27107 --dbpath /dataout/products --journal
```

The [mongorestore](#) (page 956) imports the database backup in the /dataout/products directory to the [mongod](#) (page 925) instance that runs on the localhost interface. The [mongorestore](#) (page 956) operation imports the backup even if the [mongod](#) (page 925) is not running.

The --journal option ensures that [mongorestore](#) (page 956) records all operation in the durability [journal](#). The journal prevents data file corruption if anything (e.g. power failure, disk failure, etc.) interrupts the restore operation.

See also:

[mongodump](#) (page 951) and [mongorestore](#) (page 956).

Restore Backups to Non-Local mongod Instances By default, [mongorestore](#) (page 956) connects to a MongoDB instance running on the localhost interface (e.g. 127.0.0.1) and on the default port (27017). If you want to restore to a different host or port, use the --host and --port options.

Consider the following example:

```
mongorestore --host mongodb1.example.net --port 3017 --username user --password pass /opt/backup/mong
```

As above, you may specify username and password connections if your [mongod](#) (page 925) requires authentication.

Backup and Restore with Filesystem Snapshots

This document describes a procedure for creating backups of MongoDB systems using system-level tools, such as [LVM](#) or storage appliance, as well as the corresponding restoration strategies.

These filesystem snapshots, or “block-level” backup methods use system level tools to create copies of the device that holds MongoDB’s data files. These methods complete quickly and work reliably, but require more system configuration outside of MongoDB.

See also:

[Backup Strategies for MongoDB Systems](#) (page 136) and [Backup and Restore with MongoDB Tools](#) (page 181).

Snapshots Overview

Snapshots work by creating pointers between the live data and a special snapshot volume. These pointers are theoretically equivalent to “hard links.” As the working data diverges from the snapshot, the snapshot process uses a copy-on-write strategy. As a result the snapshot only stores modified data.

After making the snapshot, you mount the snapshot image on your file system and copy data from the snapshot. The resulting backup contains a full copy of all data.

Snapshots have the following limitations:

- The database must be in a consistent or recoverable state when the snapshot takes place. This means that all writes accepted by the database need to be fully written to disk: either to the [journal](#) or to data files.

If all writes are not on disk when the backup occurs, the backup will not reflect these changes. If writes are *in progress* when the backup occurs, the data files will reflect an inconsistent state. With [journaling](#) all data-file

states resulting from in-progress writes are recoverable; without journaling you must flush all pending writes to disk before running the backup operation and must ensure that no writes occur during the entire backup procedure.

If you do use journaling, the journal **must** reside on the same volume as the data.

- Snapshots create an image of an entire disk image. Unless you need to back up your entire system, consider isolating your MongoDB data files, journal (if applicable), and configuration on one logical disk that doesn't contain any other data.

Alternately, store all MongoDB data files on a dedicated device so that you can make backups without duplicating extraneous data.

- Ensure that you copy data from snapshots and onto other systems to ensure that data is safe from site failures.
- Although different snapshots methods provide different capability, the LVM method outlined below does not provide any capacity for capturing incremental backups.

Snapshots With Journaling If your [mongod](#) (page 925) instance has journaling enabled, then you can use any kind of file system or volume/block level snapshot tool to create backups.

If you manage your own infrastructure on a Linux-based system, configure your system with [LVM](#) to provide your disk packages and provide snapshot capability. You can also use LVM-based setups *within* a cloud/virtualized environment.

Note: Running [LVM](#) provides additional flexibility and enables the possibility of using snapshots to back up MongoDB.

Snapshots with Amazon EBS in a RAID 10 Configuration If your deployment depends on Amazon's Elastic Block Storage (EBS) with RAID configured within your instance, it is impossible to get a consistent state across all disks using the platform's snapshot tool. As an alternative, you can do one of the following:

- Flush all writes to disk and create a write lock to ensure consistent state during the backup process.
If you choose this option see [Create Backups on Instances that do not have Journaling Enabled](#) (page 187).
- Configure [LVM](#) to run and hold your MongoDB data files on top of the RAID within your system.
If you choose this option, perform the LVM backup operation described in [Create a Snapshot](#) (page 185).

Backup and Restore Using LVM on a Linux System

This section provides an overview of a simple backup process using [LVM](#) on a Linux system. While the tools, commands, and paths may be (slightly) different on your system the following steps provide a high level overview of the backup operation.

Note: Only use the following procedure as a guideline for a backup system and infrastructure. Production backup systems must consider a number of application specific requirements and factors unique to specific environments.

Create a Snapshot To create a snapshot with [LVM](#), issue a command as root in the following format:

```
lvcreate --size 100M --snapshot --name mdb-snap01 /dev/vg0/mongodb
```

This command creates an [LVM](#) snapshot (with the `--snapshot` option) named `mdb-snap01` of the `mongodb` volume in the `vg0` volume group.

This example creates a snapshot named `mdb-snap01` located at `http://docs.mongodb.org/manualdev/vg0/mdb-snap01`. The location and paths to your systems volume groups and devices may vary slightly depending on your operating system's [LVM](#) configuration.

The snapshot has a cap of at 100 megabytes, because of the parameter `--size 100M`. This size does not reflect the total amount of the data on the disk, but rather the quantity of differences between the current state of `http://docs.mongodb.org/manualdev/vg0/mongodb` and the creation of the snapshot (i.e. `http://docs.mongodb.org/manualdev/vg0/mdb-snap01`.)

Warning: Ensure that you create snapshots with enough space to account for data growth, particularly for the period of time that it takes to copy data out of the system or to a temporary image.
If your snapshot runs out of space, the snapshot image becomes unusable. Discard this logical volume and create another.

The snapshot will exist when the command returns. You can restore directly from the snapshot at any time or by creating a new logical volume and restoring from this snapshot to the alternate image.

While snapshots are great for creating high quality backups very quickly, they are not ideal as a format for storing backup data. Snapshots typically depend and reside on the same storage infrastructure as the original disk images. Therefore, it's crucial that you archive these snapshots and store them elsewhere.

Archive a Snapshot After creating a snapshot, mount the snapshot and move the data to separate storage. Your system might try to compress the backup images as you move the offline. The following procedure fully archives the data from the snapshot:

```
umount /dev/vg0/mdb-snap01
dd if=/dev/vg0/mdb-snap01 | gzip > mdb-snap01.gz
```

The above command sequence does the following:

- Ensures that the `http://docs.mongodb.org/manualdev/vg0/mdb-snap01` device is not mounted.
- Performs a block level copy of the entire snapshot image using the `dd` command and compresses the result in a gzipped file in the current working directory.

Warning: This command will create a large `gz` file in your current working directory. Make sure that you run this command in a file system that has enough free space.

Restore a Snapshot To restore a snapshot created with the above method, issue the following sequence of commands:

```
lvcreate --size 1G --name mdb-new vg0
gzip -d -c mdb-snap01.gz | dd of=/dev/vg0/mdb-new
mount /dev/vg0/mdb-new /srv/mongodb
```

The above sequence does the following:

- Creates a new logical volume named `mdb-new`, in the `http://docs.mongodb.org/manualdev/vg0` volume group. The path to the new device will be `http://docs.mongodb.org/manualdev/vg0/mdb-new`.

Warning: This volume will have a maximum size of 1 gigabyte. The original file system must have had a total size of 1 gigabyte or smaller, or else the restoration will fail.
Change `1G` to your desired volume size.

- Uncompresses and unarchives the `mdb-snap01.gz` into the `mdb-new` disk image.

- Mounts the `mdb-new` disk image to the `/srv/mongodb` directory. Modify the mount point to correspond to your MongoDB data file location, or other location as needed.

Note: The restored snapshot will have a stale `mongod.lock` file. If you do not remove this file from the snapshot, and MongoDB may assume that the stale lock file indicates an unclean shutdown. If you’re running with `journal` (page 995) enabled, and you *do not* use `db.fsyncLock()` (page 885), you do not need to remove the `mongod.lock` file. If you use `db.fsyncLock()` (page 885) you will need to remove the lock.

Restore Directly from a Snapshot To restore a backup without writing to a compressed `gz` file, use the following sequence of commands:

```
umount /dev/vg0/mdb-snap01
lvcreate --size 1G --name mdb-new vg0
dd if=/dev/vg0/mdb-snap01 of=/dev/vg0/mdb-new
mount /dev/vg0/mdb-new /srv/mongodb
```

Remote Backup Storage You can implement off-system backups using the *combined process* (page 187) and SSH. This sequence is identical to procedures explained above, except that it archives and compresses the backup on a remote system using SSH.

Consider the following procedure:

```
umount /dev/vg0/mdb-snap01
dd if=/dev/vg0/mdb-snap01 | ssh username@example.com gzip > /opt/backup/mdb-snap01.gz
lvcreate --size 1G --name mdb-new vg0
ssh username@example.com gzip -d -c /opt/backup/mdb-snap01.gz | dd of=/dev/vg0/mdb-new
mount /dev/vg0/mdb-new /srv/mongodb
```

Create Backups on Instances that do not have Journaling Enabled

If your `mongod` (page 925) instance does not run with journaling enabled, or if your journal is on a separate volume, obtaining a functional backup of a consistent state is more complicated. As described in this section, you must flush all writes to disk and lock the database to prevent writes during the backup process. If you have a `replica set` configuration, then for your backup use a `secondary` which is not receiving reads (i.e. `hidden member`).

1. To flush writes to disk and to “lock” the database (to prevent further writes), issue the `db.fsyncLock()` (page 885) method in the `mongo` (page 942) shell:

```
db.fsyncLock();
```

2. Perform the backup operation described in *Create a Snapshot* (page 185).

3. To unlock the database after the snapshot has completed, use the following command in the `mongo` (page 942) shell:

```
db.fsyncUnlock();
```

Note: Changed in version 2.0: MongoDB 2.0 added `db.fsyncLock()` (page 885) and `db.fsyncUnlock()` (page 886) helpers to the `mongo` (page 942) shell. Prior to this version, use the `fsync` (page 751) command with the `lock` option, as follows:

```
db.runCommand( { fsync: 1, lock: true } );
db.runCommand( { fsync: 1, lock: false } );
```

Note: The database cannot be locked with `db.fsyncLock()` (page 885) while profiling is enabled. You must disable profiling before locking the database with `db.fsyncLock()` (page 885). Disable profiling using `db.setProfilingLevel()` (page 894) as follows in the `mongo` (page 942) shell:

```
db.setProfilingLevel(0)
```

Warning: Changed in version 2.2: When used in combination with `fsync` (page 751) or `db.fsyncLock()` (page 885), `mongod` (page 925) may block some reads, including those from `mongodump` (page 951), when queued write operation waits behind the `fsync` (page 751) lock.

Backup and Restore Sharded Clusters

The following tutorials describe backup and restoration for sharded clusters:

Backup a Small Sharded Cluster with mongodump (page 188) If your *sharded cluster* holds a small data set, you can use `mongodump` (page 951) to capture the entire backup in a reasonable amount of time.

Backup a Sharded Cluster with Filesystem Snapshots (page 189) Use file system snapshots back up each component in the sharded cluster individually. The procedure involves stopping the cluster balancer. If your system configuration allows file system backups, this might be more efficient than using MongoDB tools.

Backup a Sharded Cluster with Database Dumps (page 190) Create backups using `mongodump` (page 951) to back up each component in the cluster individually.

Schedule Backup Window for Sharded Clusters (page 191) Limit the operation of the cluster balancer to provide a window for regular backup operations.

Restore a Single Shard (page 192) An outline of the procedure and consideration for restoring a single shard from a backup.

Restore a Sharded Cluster (page 192) An outline of the procedure and consideration for restoring an *entire* sharded cluster from backup.

Backup a Small Sharded Cluster with mongodump

Overview If your *sharded cluster* holds a small data set, you can connect to a `mongos` (page 938) using `mongodump` (page 951). You can create backups of your MongoDB cluster, if your backup infrastructure can capture the entire backup in a reasonable amount of time and if you have a storage system that can hold the complete MongoDB data set.

Read *Sharded Cluster Backup Considerations* (page 137) for a high-level overview of important considerations as well as a list of alternate backup tutorials.

Important: By default `mongodump` (page 951) issue its queries to the non-primary nodes.

Procedure

Capture Data

Note: If you use `mongodump` (page 951) without specifying a database or collection, `mongodump` (page 951) will capture collection data *and* the cluster meta-data from the `config servers` (page 502).

You cannot use the `--oplog` option for `mongodump` (page 951) when capturing data from `mongos` (page 938). This option is only available when running directly against a `replica set` member.

You can perform a backup of a `sharded cluster` by connecting `mongodump` (page 951) to a `mongos` (page 938). Use the following operation at your system's prompt:

```
mongodump --host mongos3.example.net --port 27017
```

`mongodump` (page 951) will write `BSON` files that hold a copy of data stored in the `sharded cluster` accessible via the `mongos` (page 938) listening on port 27017 of the `mongos3.example.net` host.

Restore Data Backups created with `mongodump` (page 951) do not reflect the chunks or the distribution of data in the sharded collection or collections. Like all `mongodump` (page 951) output, these backups contain separate directories for each database and `BSON` files for each collection in that database.

You can restore `mongodump` (page 951) output to any MongoDB instance, including a standalone, a `replica set`, or a new `sharded cluster`. When restoring data to sharded cluster, you must deploy and configure sharding before restoring data from the backup. See *Deploy a Sharded Cluster* (page 522) for more information.

Backup a Sharded Cluster with Filesystem Snapshots

Overview This document describes a procedure for taking a backup of all components of a sharded cluster. This procedure uses file system snapshots to capture a copy of the `mongod` (page 925) instance. An alternate procedure that uses `mongodump` (page 951) to create binary database dumps when file-system snapshots are not available. See *Backup a Sharded Cluster with Database Dumps* (page 190) for the alternate procedure.

See *Sharded Cluster Backup Considerations* (page 137) for a full higher level overview backing up a sharded cluster as well as links to other tutorials that provide alternate procedures.

Important: To capture a point-in-time backup from a sharded cluster you **must** stop *all* writes to the cluster. On a running production system, you can only capture an *approximation* of point-in-time snapshot.

Procedure In this procedure, you will stop the cluster balancer and take a backup up of the `config database`, and then take backups of each shard in the cluster using a file-system snapshot tool. If you need an exact moment-in-time snapshot of the system, you will need to stop all application writes before taking the filesystem snapshots; otherwise the snapshot will only approximate a moment in time.

For approximate point-in-time snapshots, you can improve the quality of the backup while minimizing impact on the cluster by taking the backup from a secondary member of the replica set that provides each shard.

1. Disable the `balancer` process that equalizes the distribution of data among the `shards`. To disable the balancer, use the `sh.stopBalancer()` (page 912) method in the `mongo` (page 942) shell, and see the *Disable the Balancer* (page 552) procedure.

Warning: It is essential that you stop the balancer before creating backups. If the balancer remains active, your resulting backups could have duplicate data or miss some data, as `chunks` may migrate while recording backups.

2. Lock one member of each replica set in each shard so that your backups reflect the state of your database at the nearest possible approximation of a single moment in time. Lock these `mongod` (page 925) instances in as short of an interval as possible.

To lock or freeze a sharded cluster, you must:

- use the `db.fsyncLock()` (page 885) method in the `mongo` (page 942) shell connected to a single secondary member of the replica set that provides shard `mongod` (page 925) instance.
 - Shutdown one of the `config servers` (page 502), to prevent all metadata changes during the backup process.
3. Use `mongodump` (page 951) to backup one of the `config servers` (page 502). This backs up the cluster's metadata. You only need to back up one config server, as they all hold the same data.
- Issue this command against one of the config `mongod` (page 925) instances or via the `mongos` (page 938):
- ```
mongodump --db config
```
4. Back up the replica set members of the shards that you locked. You may back up the shards in parallel. For each shard, create a snapshot. Use the procedures in *Backup and Restore with Filesystem Snapshots* (page 184).
5. Unlock all locked replica set members of each shard using the `db.fsyncUnlock()` (page 886) method in the `mongo` (page 942) shell.
6. Re-enable the balancer with the `sh.setBalancerState()` (page 908) method.

Use the following command sequence when connected to the `mongos` (page 938) with the `mongo` (page 942) shell:

```
use config
sh.setBalancerState(true)
```

## Backup a Sharded Cluster with Database Dumps

**Overview** This document describes a procedure for taking a backup of all components of a sharded cluster. This procedure uses `mongodump` (page 951) to create dumps of the `mongod` (page 925) instance. An alternate procedure uses file system snapshots to capture the backup data, and may be more efficient in some situations if your system configuration allows file system backups. See *Backup a Sharded Cluster with Filesystem Snapshots* (page 189).

See *Sharded Cluster Backup Considerations* (page 137) for a full higher level overview of backing up a sharded cluster as well as links to other tutorials that provide alternate procedures.

---

**Important:** To capture a point-in-time backup from a sharded cluster you **must** stop *all* writes to the cluster. On a running production system, you can only capture an *approximation* of point-in-time snapshot.

---

**Procedure** In this procedure, you will stop the cluster balancer and take a backup up of the `config database`, and then take backups of each shard in the cluster using `mongodump` (page 951) to capture the backup data. If you need an exact moment-in-time snapshot of the system, you will need to stop all application writes before taking the filesystem snapshots; otherwise the snapshot will only approximate a moment of time.

For approximate point-in-time snapshots, you can improve the quality of the backup while minimizing impact on the cluster by taking the backup from a secondary member of the replica set that provides each shard.

1. Disable the `balancer` process that equalizes the distribution of data among the `shards`. To disable the balancer, use the `sh.stopBalancer()` (page 912) method in the `mongo` (page 942) shell, and see the *Disable the Balancer* (page 552) procedure.

**Warning:** It is essential that you stop the balancer before creating backups. If the balancer remains active, your resulting backups could have duplicate data or miss some data, as `chunks` migrate while recording backups.

2. Lock one member of each replica set in each shard so that your backups reflect the state of your database at the nearest possible approximation of a single moment in time. Lock these `mongod` (page 925) instances in as short of an interval as possible.

To lock or freeze a sharded cluster, you must:

- Shutdown one member of each replica set.

Ensure that the `oplog` has sufficient capacity to allow these secondaries to catch up to the state of the primaries after finishing the backup procedure. See *Oplog Size* (page 411) for more information.

- Shutdown one of the `config servers` (page 502), to prevent all metadata changes during the backup process.

3. Use `mongodump` (page 951) to backup one of the `config servers` (page 502). This backs up the cluster's metadata. You only need to back up one config server, as they all hold the same data.

Issue this command against one of the config `mongod` (page 925) instances or via the `mongos` (page 938):

```
mongodump --journal --db config
```

4. Back up the replica set members of the shards that shut down using `mongodump` (page 951) and specifying the `--dbpath` option. You may back up the shards in parallel. Consider the following invocation:

```
mongodump --journal --dbpath /data/db/ --out /data/backup/
```

You must run this command on the system where the `mongod` (page 925) ran. This operation will use journaling and create a dump of the entire `mongod` (page 925) instance with data files stored in `/data/db/`. `mongodump` (page 951) will write the output of this dump to the `/data/backup/` directory.

5. Restart all stopped replica set members of each shard as normal and allow them to catch up with the state of the primary.
6. Re-enable the balancer with the `sh.setBalancerState()` (page 908) method.

Use the following command sequence when connected to the `mongos` (page 938) with the `mongo` (page 942) shell:

```
use config
sh.setBalancerState(true)
```

## Schedule Backup Window for Sharded Clusters

**Overview** In a *sharded cluster*, the balancer process is responsible for distributing sharded data around the cluster, so that each `shard` has roughly the same amount of data.

However, when creating backups from a sharded cluster it is important that you disable the balancer while taking backups to ensure that no chunk migrations affect the content of the backup captured by the backup procedure. Using the procedure outlined in the section *Disable the Balancer* (page 552) you can manually stop the balancer process temporarily. As an alternative you can use this procedure to define a balancing window so that the balancer is always disabled during your automated backup operation.

**Procedure** If you have an automated backup schedule, you can disable all balancing operations for a period of time. For instance, consider the following command:

```
use config
db.settings.update({ _id : "balancer" }, { $set : { activeWindow : { start : "6:00", stop : "23:00" } } }
```

This operation configures the balancer to run between 6:00am and 11:00pm, server time. Schedule your backup operation to run *and complete* outside of this time. Ensure that the backup can complete outside the window when

the balancer is running *and* that the balancer can effectively balance the collection among the shards in the window allotted to each.

### Restore a Single Shard

**Overview** Restoring a single shard from backup with other unaffected shards requires a number of special considerations and practices. This document outlines the additional tasks you must perform when restoring a single shard.

Consider the following resources on backups in general as well as backup and restoration of sharded clusters specifically:

- [Sharded Cluster Backup Considerations](#) (page 137)
- [Restore a Sharded Cluster](#) (page 192)
- [Backup Strategies for MongoDB Systems](#) (page 136)

**Procedure** Always restore *sharded clusters* as a whole. When you restore a single shard, keep in mind that the [balancer](#) process might have moved *chunks* to or from this shard since the last backup. If that's the case, you must manually move those chunks, as described in this procedure.

1. Restore the shard as you would any other [mongod](#) (page 925) instance. See [Backup Strategies for MongoDB Systems](#) (page 136) for overviews of these procedures.
2. For all chunks that migrate away from this shard, you do not need to do anything at this time. You do not need to delete these documents from the shard because the chunks are automatically filtered out from queries by [mongos](#) (page 938). You can remove these documents from the shard, if you like, at your leisure.
3. For chunks that migrate to this shard after the most recent backup, you must manually recover the chunks using backups of other shards, or some other source. To determine what chunks have moved, view the [changelog](#) collection in the [Config Database](#) (page 564).

### Restore a Sharded Cluster

**Overview** The procedure outlined in this document addresses how to restore an entire sharded cluster. For information on related backup procedures consider the following tutorials which describe backup procedures in greater detail:

- [Backup a Sharded Cluster with Filesystem Snapshots](#) (page 189)
- [Backup a Sharded Cluster with Database Dumps](#) (page 190)

The exact procedure used to restore a database depends on the method used to capture the backup. See the [Backup Strategies for MongoDB Systems](#) (page 136) document for an overview of backups with MongoDB, as well as [Sharded Cluster Backup Considerations](#) (page 137) which provides an overview of the high level concepts important for backing up sharded clusters.

### Procedure

1. Stop all [mongod](#) (page 925) and [mongos](#) (page 938) processes.
2. If shard hostnames have changed, you must manually update the [shards](#) collection in the [Config Database](#) (page 564) to use the new hostnames. Do the following:
  - (a) Start the three [config servers](#) (page 502) by issuing commands similar to the following, using values appropriate to your configuration:

```
mongod --configsvr --dbpath /data/configdb --port 27019
```

- (b) Restore the *Config Database* (page 564) on each config server.
  - (c) Start one `mongos` (page 938) instance.
  - (d) Update the *Config Database* (page 564) collection named `shards` to reflect the new hostnames.
3. Restore the following:
- Data files for each server in each *shard*. Because replica sets provide each production shard, restore all the members of the replica set or use the other standard approaches for restoring a replica set from backup. See the *Restore a Snapshot* (page 186) and *Restore a Database with mongorestore* (page 183) sections for details on these procedures.
  - Data files for each *config server* (page 502), if you have not already done so in the previous step.
4. Restart all the `mongos` (page 938) instances.
5. Restart all the `mongod` (page 925) instances.
6. Connect to a `mongos` (page 938) instance from a `mongo` (page 942) shell and use the `db.printShardingStatus()` (page 892) method to ensure that the cluster is operational, as follows:

```
db.printShardingStatus()
show collections
```

## Copy Databases Between Instances

### Synopsis

MongoDB provides the `copydb` (page 745) and `clone` (page 748) *database commands* to support migrations of entire logical databases between `mongod` (page 925) instances. With these commands you can copy data between instances with a simple interface without the need for an intermediate stage. The `db.cloneDatabase()` (page 877) and `db.copyDatabase()` (page 878) provide helpers for these operations in the `mongo` (page 942) shell. These migration helpers run the commands on the **destination** server and *pull* data from the **source** server..

Data migrations that require an intermediate stage or that involve more than one database instance are beyond the scope of this tutorial. `copydb` (page 745) and `clone` (page 748) are more ideal for use cases that resemble the following use cases:

- data migrations,
- data warehousing, and
- seeding test environments.

Also consider the *Backup Strategies for MongoDB Systems* (page 136) and *Import and Export MongoDB Data* (page 149) documentation for more related information.

---

**Note:** `copydb` (page 745) and `clone` (page 748) do not produce point-in-time snapshots of the source database. Write traffic to the source or destination database during the copy process will result divergent data sets.

---

### Considerations

- You must run `copydb` (page 745) or `clone` (page 748) on the destination server.

- You cannot use `copydb` (page 745) or `clone` (page 748) with databases that have a sharded collection in a *sharded cluster*, or any database via a `mongos` (page 938).
- You *can* use `copydb` (page 745) or `clone` (page 748) with databases that do not have sharded collections in a *cluster* when you're connected directly to the `mongod` (page 925) instance.
- You can run `copydb` (page 745) or `clone` (page 748) commands on a *secondary* member of a replica set, with properly configured *read preference*.
- Each destination `mongod` (page 925) instance must have enough free disk space on the destination server for the database you are copying. Use the `db.stats()` (page 894) operation to check the size of the database on the source `mongod` (page 925) instance. For more information, see `db.stats()` (page 894).

### Processes

**Copy and Rename a Database** To copy a database from one MongoDB instance to another and rename the database in the process, use the `copydb` (page 745) command, or the `db.copyDatabase()` (page 878) helper in the `mongo` (page 942) shell.

Use the following procedure to copy the database named `test` on server `db0.example.net` to the server named `db1.example.net` and rename it to `records` in the process:

- Verify that the database, `test` exists on the source `mongod` (page 925) instance running on the `db0.example.net` host.
- Connect to the destination server, running on the `db1.example.net` host, using the `mongo` (page 942) shell.
- Model your operation on the following command:

```
db.copyDatabase("test", "records", "db0.example.net")
```

**Rename a Database** You can also use `copydb` (page 745) or the `db.copyDatabase()` (page 878) helper to:

- rename a database within a single MongoDB instance or
- create a duplicate database for testing purposes.

Use the following procedure to rename the `test` database `records` on a single `mongod` (page 925) instance:

- Connect to the `mongod` (page 925) using the `mongo` (page 942) shell.
- Model your operation on the following command:

```
db.copyDatabase("test", "records")
```

**Copy a Database with Authentication** To copy a database from a source MongoDB instance that has authentication enabled, you can specify authentication credentials to the `copydb` (page 745) command or the `db.copyDatabase()` (page 878) helper in the `mongo` (page 942) shell.

In the following operation, you will copy the `test` database from the `mongod` (page 925) running on `db0.example.net` to the `records` database on the local instance (e.g. `db1.example.net`). Because the `mongod` (page 925) instance running on `db0.example.net` requires authentication for all connections, you will need to pass `db.copyDatabase()` (page 878) authentication credentials, as in the following procedure:

- Connect to the destination `mongod` (page 925) instance running on the `db1.example.net` host using the `mongo` (page 942) shell.
- Issue the following command:

---

```
db.copyDatabase("test", "records", db0.example.net, "<username>", "<password>")
```

Replace <username> and <password> with your authentication credentials.

**Clone a Database** The [clone](#) (page 748) command copies a database between [mongod](#) (page 925) instances like [copydb](#) (page 745); however, [clone](#) (page 748) preserves the database name from the source instance on the destination [mongod](#) (page 925).

For many operations, [clone](#) (page 748) is functionally equivalent to [copydb](#) (page 745), but it has a more simple syntax and a more narrow use. The [mongo](#) (page 942) shell provides the [db.cloneDatabase\(\)](#) (page 877) helper as a wrapper around [clone](#) (page 748).

You can use the following procedure to clone a database from the [mongod](#) (page 925) instance running on `db0.example.net` to the [mongod](#) (page 925) running on `db1.example.net`:

- Connect to the destination [mongod](#) (page 925) instance running on the `db1.example.net` host using the [mongo](#) (page 942) shell.
- Issue the following command to specify the name of the database you want to copy:

```
use records
```

- Use the following operation to initiate the [clone](#) (page 748) operation:

```
db.cloneDatabase("db0.example.net")
```

## Recover Data after an Unexpected Shutdown

If MongoDB does not shutdown cleanly <sup>37</sup> the on-disk representation of the data files will likely reflect an inconsistent state which could lead to data corruption. <sup>38</sup>

To prevent data inconsistency and corruption, always shut down the database cleanly and use the [durability journaling](#) (page 995). MongoDB writes data to the journal, by default, every 100 milliseconds, such that MongoDB can always recover to a consistent state even in the case of an unclean shutdown due to power loss or other system failure.

If you are *not* running as part of a [replica set](#) and do *not* have journaling enabled, use the following procedure to recover data that may be in an inconsistent state. If you are running as part of a replica set, you should *always* restore from a backup or restart the [mongod](#) (page 925) instance with an empty [dbpath](#) (page 993) and allow MongoDB to perform an initial sync to restore the data.

### See also:

The [Administration](#) (page 135) documents, including [Replica Set Syncing](#) (page 410), and the documentation on the [repair](#) (page 997), [repairpath](#) (page 997), and [journal](#) (page 995) settings.

## Process

**Indications** When you are aware of a [mongod](#) (page 925) instance running without journaling that stops unexpectedly **and** you're not running with replication, you should always run the repair operation before starting MongoDB again. If you're using replication, then restore from a backup and allow replication to perform an initial [sync](#) (page 410) to restore data.

---

<sup>37</sup> To ensure a clean shut down, use the [db.shutdownServer\(\)](#) (page 894) from the [mongo](#) (page 942) shell, your control script, the [mongod --shutdown](#) option on Linux systems, “Control-C” when running [mongod](#) (page 925) in interactive mode, or `kill $(pidof mongod)` or `kill -2 $(pidof mongod)`.

<sup>38</sup> You can also use the [db.collection.validate\(\)](#) (page 856) method to test the integrity of a single collection. However, this process is time consuming, and without journaling you can safely assume that the data is in an invalid state and you should either run the repair operation or resync from an intact member of the replica set.

If the `mongod.lock` file in the data directory specified by `dbpath` (page 993), `/data/db` by default, is *not* a zero-byte file, then `mongod` (page 925) will refuse to start, and you will find a message that contains the following line in your MongoDB log our output:

Unclean shutdown detected.

This indicates that you need to run `mongod` (page 925) with the `--repair` option. If you run repair when the `mongod.lock` file exists in your `dbpath` (page 993), or the optional `--repairpath`, you will see a message that contains the following line:

```
old lock file: /data/db/mongod.lock. probably means unclean shutdown
```

If you see this message, as a last resort you may remove the lockfile **and** run the repair operation before starting the database normally, as in the following procedure:

### Overview

**Warning:** Recovering a member of a replica set.

Do not use this procedure to recover a member of a *replica set*. Instead you should either restore from a *backup* (page 136) or perform an initial sync using data from an intact member of the set, as described in *Resync a Member of a Replica Set* (page 450).

There are two processes to repair data files that result from an unexpected shutdown:

1. Use the `--repair` option in conjunction with the `--repairpath` option. `mongod` (page 925) will read the existing data files, and write the existing data to new data files. This does not modify or alter the existing data files.

You do not need to remove the `mongod.lock` file before using this procedure.

2. Use the `--repair` option. `mongod` (page 925) will read the existing data files, write the existing data to new files and replace the existing, possibly corrupt, files with new files.

You must remove the `mongod.lock` file before using this procedure.

---

**Note:** `--repair` functionality is also available in the shell with the `db.repairDatabase()` (page 892) helper for the `repairDatabase` (page 757) command.

---

**Procedures** To repair your data files using the `--repairpath` option to preserve the original data files unmodified:

1. Start `mongod` (page 925) using `--repair` to read the existing data files.

```
mongod --dbpath /data/db --repair --repairpath /data/db0
```

When this completes, the new repaired data files will be in the `/data/db0` directory.

2. Start `mongod` (page 925) using the following invocation to point the `dbpath` (page 993) at `/data/db0`:

```
mongod --dbpath /data/db0
```

Once you confirm that the data files are operational you may delete or archive the data files in the `/data/db` directory.

To repair your data files without preserving the original files, do not use the `--repairpath` option, as in the following procedure:

1. Remove the stale lock file:

```
rm /data/db/mongod.lock
```

Replace `/data/db` with your [dbpath](#) (page 993) where your MongoDB instance's data files reside.

**Warning:** After you remove the `mongod.lock` file you *must* run the `--repair` process before using your database.

2. Start [mongod](#) (page 925) using `--repair` to read the existing data files.

```
mongod --dbpath /data/db --repair
```

When this completes, the repaired data files will replace the original data files in the `/data/db` directory.

3. Start [mongod](#) (page 925) using the following invocation to point the [dbpath](#) (page 993) at `/data/db`:

```
mongod --dbpath /data/db
```

#### `mongod.lock`

In normal operation, you should **never** remove the `mongod.lock` file and start [mongod](#) (page 925). Instead consider the one of the above methods to recover the database and remove the lock files. In dire situations you can remove the lockfile, and start the database using the possibly corrupt files, and attempt to recover data from the database; however, it's impossible to predict the state of the database in these situations.

If you are not running with journaling, and your database shuts down unexpectedly for *any* reason, you should always proceed *as if* your database is in an inconsistent and likely corrupt state. If at all possible restore from [backup](#) (page 136) or, if running as a [replica set](#), restore by performing an initial sync using data from an intact member of the set, as described in [Resync a Member of a Replica Set](#) (page 450).

### 4.2.3 MongoDB Scripting

The [mongo](#) (page 942) shell is an interactive JavaScript shell for MongoDB, and is part of all [MongoDB distributions](#)<sup>39</sup>. This section provides an introduction to the shell, and outlines key functions, operations, and use of the [mongo](#) (page 942) shell. Also consider [FAQ: The mongo Shell](#) (page 594) and the [shell method](#) (page 806) and other relevant [reference material](#) (page 621).

---

**Note:** Most examples in the [MongoDB Manual](#) (page 1) use the [mongo](#) (page 942) shell; however, many [drivers](#) (page 95) provide similar interfaces to MongoDB.

---

[Server-side JavaScript](#) (page 198) Details MongoDB's support for executing JavaScript code for server-side operations.

[Data Types in the mongo Shell](#) (page 199) Describes the super-set of JSON available for use in the [mongo](#) (page 942) shell.

[Write Scripts for the mongo Shell](#) (page 202) An introduction to the [mongo](#) (page 942) shell for writing scripts to manipulate data and administer MongoDB.

[Getting Started with the mongo Shell](#) (page 204) Introduces the use and operation of the MongoDB shell.

[Access the mongo Shell Help Information](#) (page 208) Describes the available methods for accessing online help for the operation of the [mongo](#) (page 942) interactive shell.

[mongo Shell Quick Reference](#) (page 210) A high level reference to the use and operation of the [mongo](#) (page 942) shell.

---

<sup>39</sup><http://www.mongodb.org/downloads>

## Server-side JavaScript

Changed in version 2.4: The V8 JavaScript engine, which became the default in 2.4, allows multiple JavaScript operations to execute at the same time. Prior to 2.4, MongoDB operations that required the JavaScript interpreter had to acquire a lock, and a single `mongod` (page 925) could only run a single JavaScript operation at a time.

### Overview

MongoDB supports the execution of JavaScript code for the following server-side operations:

- `mapReduce` (page 701) and the corresponding `mongo` (page 942) shell method `db.collection.mapReduce()` (page 837). See *Map-Reduce* (page 282) for more information.
- `eval` (page 722) command, and the corresponding `mongo` (page 942) shell method `db.eval()` (page 884)
- `$where` (page 634) operator
- *Running .js files via a mongo shell Instance on the Server* (page 198)

---

### JavaScript in MongoDB

Although the above operations use JavaScript, most interactions with MongoDB do not use JavaScript but use an *idiomatic driver* (page 95) in the language of the interacting application.

---

#### See also:

*Store a JavaScript Function on the Server* (page 177)

You can disable all server-side execution of JavaScript, by passing the `--noscripting` option on the command line or setting `noscripting` (page 996) in a configuration file.

### Running .js files via a mongo shell Instance on the Server

You can run a JavaScript (.js) file using a `mongo` (page 942) shell instance on the server. This is a good technique for performing batch administrative work. When you run `mongo` (page 942) shell on the server, connecting via the localhost interface, the connection is fast with low latency.

The *command helpers* (page 210) provided in the `mongo` (page 942) shell are not available in JavaScript files because they are not valid JavaScript. The following table maps the most common `mongo` (page 942) shell helpers to their JavaScript equivalents.

| Shell Helpers            | JavaScript Equivalents                                                                 |
|--------------------------|----------------------------------------------------------------------------------------|
| show dbs, show databases | db.adminCommand('listDatabases')                                                       |
| use <db>                 | db = db.getSiblingDB('<db>')                                                           |
| show collections         | db.getCollectionNames()                                                                |
| show users               | db.system.users.find()                                                                 |
| show log <logname>       | db.adminCommand( { 'getLog' : '<logname>' } )                                          |
| show logs                | db.adminCommand( { 'getLog' : '*' } )                                                  |
| it                       | <pre>cursor = db.collection.find() if ( cursor.hasNext() ){     cursor.next(); }</pre> |

## Concurrency

Refer to the individual method or operator documentation for any concurrency information. See also the [concurrency table](#) (page 597).

## Data Types in the mongo Shell

MongoDB [BSON](#) provide support for additional data types than [JSON](#). [Drivers](#) (page 95) provide native support for these data types in host languages and the [mongo](#) (page 942) shell also provides several helper classes to support the use of these data types in the [mongo](#) (page 942) JavaScript shell. See [MongoDB Extended JSON](#) (page 108) for additional information.

### Types

**Date** The [mongo](#) (page 942) shell provides various options to return the date, either as a string or as an object:

- `Date()` method which returns the current date as a string.
- `Date()` constructor which returns an `ISODate` object when used with the `new` operator.
- `ISODate()` constructor which returns an `ISODate` object when used with `or` without the `new` operator.

Consider the following examples:

- To return the date as a string, use the `Date()` method, as in the following example:

```
var myDateString = Date();
```

- To print the value of the variable, type the variable name in the shell, as in the following:

```
myDateString
```

The result is the value of `myDateString`:

```
Wed Dec 19 2012 01:03:25 GMT-0500 (EST)
```

- To verify the type, use the `typeof` operator, as in the following:

```
typeof myDateString
```

The operation returns `string`.

- To get the date as an `ISODate` object, instantiate a new instance using the `Date()` constructor with the `new` operator, as in the following example:

```
var myDateObject = new Date();
```

- To print the value of the variable, type the variable name in the shell, as in the following:

```
myDateObject
```

The result is the value of `myDateObject`:

```
ISODate("2012-12-19T06:01:17.171Z")
```

- To verify the type, use the `typeof` operator, as in the following:

```
typeof myDateObject
```

The operation returns `object`.

- To get the date as an `ISODate` object, instantiate a new instance using the `ISODate()` constructor *without* the `new` operator, as in the following example:

```
var myDateObject2 = ISODate();
```

You can use the `new` operator with the `ISODate()` constructor as well.

- To print the value of the variable, type the variable name in the shell, as in the following:

```
myDateObject2
```

The result is the value of `myDateObject2`:

```
ISODate("2012-12-19T06:15:33.035Z")
```

- To verify the type, use the `typeof` operator, as in the following:

```
typeof myDateObject2
```

The operation returns `object`.

**ObjectId** The [mongo](#) (page 942) shell provides the `ObjectId()` wrapper class around `ObjectId` data types. To generate a new `ObjectId`, use the following operation in the [mongo](#) (page 942) shell:

```
new ObjectId
```

---

## See

[ObjectId](#) (page 103) for full documentation of `ObjectIds` in MongoDB.

---

**NumberLong** By default, the [mongo](#) (page 942) shell treats all numbers as floating-point values. The [mongo](#) (page 942) shell provides the `NumberLong()` class to handle 64-bit integers.

The `NumberLong()` constructor accepts the long as a string:

```
NumberLong("2090845886852")
```

The following examples use the `NumberLong()` class to write to the collection:

```
db.collection.insert({ _id: 10, calc: NumberLong("2090845886852") })
db.collection.update({ _id: 10 },
 { $set: { calc: NumberLong("2555555000000") } })
db.collection.update({ _id: 10 },
 { $inc: { calc: NumberLong(5) } })
```

Retrieve the document to verify:

```
db.collection.findOne({ _id: 10 })
```

In the returned document, the `calc` field contains a `NumberLong` object:

```
{ "_id" : 10, "calc" : NumberLong("2555555000005") }
```

If you use the `$inc` (page 651) to increment the value of a field that contains a `NumberLong` object by a `float`, the data type changes to a floating point value, as in the following example:

1. Use `$inc` (page 651) to increment the `calc` field by 5, which the [mongo](#) (page 942) shell treats as a float:

```
db.collection.update({ _id: 10 },
 { $inc: { calc: 5 } })
```

2. Retrieve the updated document:

```
db.collection.findOne({ _id: 10 })
```

In the updated document, the `calc` field contains a floating point value:

```
{ "_id" : 10, "calc" : 2555555000010 }
```

**NumberInt** By default, the [mongo](#) (page 942) shell treats all numbers as floating-point values. The [mongo](#) (page 942) shell provides the `NumberInt()` constructor to explicitly specify 32-bit integers.

## Check Types in the `mongo` Shell

To determine the type of fields, the [mongo](#) (page 942) shell provides the following operators:

- `instanceof` returns a boolean to test if a value has a specific type.
- `typeof` returns the type of a field.

---

### Example

Consider the following operations using `instanceof` and `typeof`:

- The following operation tests whether the `_id` field is of type `ObjectID`:

```
mydoc._id instanceof ObjectID
```

The operation returns `true`.

- The following operation returns the type of the `_id` field:

```
typeof mydoc._id
```

In this case `typeof` will return the more generic `object` type rather than `ObjectID` type.

---

### Write Scripts for the `mongo` Shell

You can write scripts for the `mongo` (page 942) shell in JavaScript that manipulate data in MongoDB or perform administrative operation. For more information about the `mongo` (page 942) shell see [MongoDB Scripting](#) (page 197), and see the [Running .js files via a mongo shell Instance on the Server](#) (page 198) section for more information about using these `mongo` (page 942) script.

This tutorial provides an introduction to writing JavaScript that uses the `mongo` (page 942) shell to access MongoDB.

#### Opening New Connections

From the `mongo` (page 942) shell or from a JavaScript file, you can instantiate database connections using the `Mongo()` (page 919) constructor:

```
new Mongo()
new Mongo(<host>)
new Mongo(<host:port>)
```

Consider the following example that instantiates a new connection to the MongoDB instance running on localhost on the default port and sets the global `db` variable to `myDatabase` using the `getDB()` (page 917) method:

```
conn = new Mongo();
db = conn.getDB("myDatabase");
```

Additionally, you can use the `connect()` method to connect to the MongoDB instance. The following example connects to the MongoDB instance that is running on `localhost` with the non-default port `27020` and set the global `db` variable:

```
db = connect("localhost:27020/myDatabase");
```

#### Differences Between Interactive and Scripted `mongo`

When writing scripts for the `mongo` (page 942) shell, consider the following:

- To set the `db` global variable, use the `getDB()` (page 917) method or the `connect()` method. You can assign the database reference to a variable other than `db`.
- Inside the script, call `db.getLastError()` (page 886) explicitly to wait for the result of *write operations* (page 50).
- You **cannot** use any shell helper (e.g. `use <dbname>`, `show dbs`, etc.) inside the JavaScript file because they are not valid JavaScript.

The following table maps the most common `mongo` (page 942) shell helpers to their JavaScript equivalents.

| Shell Helpers            | JavaScript Equivalents                                                                 |
|--------------------------|----------------------------------------------------------------------------------------|
| show dbs, show databases | db.adminCommand('listDatabases')                                                       |
| use <db>                 | db = db.getSiblingDB('<db>')                                                           |
| show collections         | db.getCollectionNames()                                                                |
| show users               | db.system.users.find()                                                                 |
| show log <logname>       | db.adminCommand( { 'getLog' : '<logname>' } )                                          |
| show logs                | db.adminCommand( { 'getLog' : '*' } )                                                  |
| it                       | <pre>cursor = db.collection.find() if ( cursor.hasNext() ){     cursor.next(); }</pre> |

- In interactive mode, `mongo` (page 942) prints the results of operations including the content of all cursors. In scripts, either use the JavaScript `print()` function or the `mongo` (page 942) specific `printjson()` function which returns formatted JSON.

### Example

To print all items in a result cursor in `mongo` (page 942) shell scripts, use the following idiom:

```
cursor = db.collection.find();
while (cursor.hasNext()) {
 printjson(cursor.next());
}
```

---

### Scripting

From the system prompt, use `mongo` (page 942) to evaluate JavaScript.

**--eval option** Use the `--eval` option to `mongo` (page 942) to pass the shell a JavaScript fragment, as in the following:

```
mongo test --eval "printjson(db.getCollectionNames())"
```

This returns the output of `db.getCollectionNames()` (page 886) using the `mongo` (page 942) shell connected to the `mongod` (page 925) or `mongos` (page 938) instance running on port 27017 on the `localhost` interface.

**Execute a JavaScript file** You can specify a `.js` file to the `mongo` (page 942) shell, and `mongo` (page 942) will execute the JavaScript directly. Consider the following example:

```
mongo localhost:27017/test myjsfile.js
```

This operation executes the `myjsfile.js` script in a `mongo` (page 942) shell that connects to the `test` database on the `mongod` (page 925) instance accessible via the `localhost` interface on port 27017.

Alternately, you can specify the `mongodb` connection parameters inside of the javascript file using the `Mongo()` constructor. See [Opening New Connections](#) (page 202) for more information.

You can execute a `.js` file from within the `mongo` (page 942) shell, using the `load()` function, as in the following:

```
load("myjstest.js")
```

This function loads and executes the `myjstest.js` file.

The `load()` method accepts relative and absolute paths. If the current working directory of the `mongo` (page 942) shell is `/data/db`, and the `myjstest.js` resides in the `/data/db/scripts` directory, then the following calls within the `mongo` (page 942) shell would be equivalent:

```
load("scripts/myjstest.js")
load("/data/db/scripts/myjstest.js")
```

---

**Note:** There is no search path for the `load()` function. If the desired script is not in the current working directory or the full specified path, `mongo` (page 942) will not be able to access the file.

---

## Getting Started with the `mongo` Shell

This document provides a basic introduction to using the `mongo` (page 942) shell. See [Install MongoDB](#) (page 3) for instructions on installing MongoDB for your system.

### Start the `mongo` Shell

To start the `mongo` (page 942) shell and connect to your [MongoDB](#) (page 925) instance running on **localhost** with **default port**:

1. Go to your <mongodb installation dir>:

```
cd <mongodb installation dir>
```

2. Type `./bin/mongo` to start `mongo` (page 942):

```
./bin/mongo
```

If you have added the <mongodb installation dir>/bin to the PATH environment variable, you can just type `mongo` instead of `./bin/mongo`.

3. To display the database you are using, type `db`:

```
db
```

The operation should return `test`, which is the default database. To switch databases, issue the `use <db>` helper, as in the following example:

```
use <database>
```

To list the available databases, use the helper `show dbs`. See also [How can I access different databases temporarily?](#) (page 594) to access a different database from the current database without switching your current database context (i.e. `db ..`)

To start the `mongo` (page 942) shell with other options, see [examples of starting up mongo](#) (page 947) and [mongo reference](#) (page 942) which provides details on the available options.

---

**Note:** When starting, `mongo` (page 942) checks the user's `HOME` (page 946) directory for a JavaScript file named `.mongorc.js` (page 946). If found, `mongo` (page 942) interprets the content of `.mongorc.js` before displaying the prompt for the first time. If you use the shell to evaluate a JavaScript file or expression, either by using the `--eval` option on the command line or by specifying *a .js file to mongo* (page 945), `mongo` (page 942) will read the `.mongorc.js` file *after* the JavaScript has finished processing.

---

## Executing Queries

From the `mongo` (page 942) shell, you can use the *shell methods* (page 806) to run queries, as in the following example:

```
db.<collection>.find()
```

- The `db` refers to the current database.
- The `<collection>` is the name of the collection to query. See *Collection Help* (page 209) to list the available collections.

If the `mongo` (page 942) shell does not accept the name of the collection, for instance if the name contains a space, hyphen, or starts with a number, you can use an alternate syntax to refer to the collection, as in the following:

```
db["3test"].find()
```

```
db.getCollection("3test").find()
```

- The `find()` (page 816) method is the JavaScript method to retrieve documents from `<collection>`. The `find()` (page 816) method returns a `cursor` to the results; however, in the `mongo` (page 942) shell, if the returned cursor is not assigned to a variable using the `var` keyword, then the cursor is automatically iterated up to 20 times to print up to the first 20 documents that match the query. The `mongo` (page 942) shell will prompt Type it to iterate another 20 times.

You can set the `DBQuery.shellBatchSize` attribute to change the number of iteration from the default value 20, as in the following example which sets it to 10:

```
DBQuery.shellBatchSize = 10;
```

For more information and examples on cursor handling in the `mongo` (page 942) shell, see *Cursors* (page 43).

See also *Cursor Help* (page 209) for list of cursor help in the `mongo` (page 942) shell.

For more documentation of basic MongoDB operations in the `mongo` (page 942) shell, see:

- *Getting Started with MongoDB* (page 26)
- *mongo Shell Quick Reference* (page 210)
- *Read Operations* (page 39)
- *Write Operations* (page 50)
- *Indexing Tutorials* (page 338)
- *Read Operations* (page 39)
- *Write Operations* (page 50)

### Print

The `mongo` (page 942) shell automatically prints the results of the `find()` (page 816) method if the returned cursor is not assigned to a variable using the `var` keyword. To format the result, you can add the `.pretty()` to the operation, as in the following:

```
db.<collection>.find().pretty()
```

In addition, you can use the following explicit print methods in the `mongo` (page 942) shell:

- `print()` to print without formatting
- `print(tojson(<obj>))` to print with `JSON` formatting and equivalent to `printjson()`
- `printjson()` to print with `JSON` formatting and equivalent to `print(tojson(<obj>))`

### Evaluate a JavaScript File

You can execute a `.js` file from within the `mongo` (page 942) shell, using the `load()` function, as in the following:

```
load("myjstest.js")
```

This function loads and executes the `myjstest.js` file.

The `load()` method accepts relative and absolute paths. If the current working directory of the `mongo` (page 942) shell is `/data/db`, and the `myjstest.js` resides in the `/data/db/scripts` directory, then the following calls within the `mongo` (page 942) shell would be equivalent:

```
load("scripts/myjstest.js")
load("/data/db/scripts/myjstest.js")
```

---

**Note:** There is no search path for the `load()` function. If the desired script is not in the current working directory or the full specified path, `mongo` (page 942) will not be able to access the file.

---

### Use a Custom Prompt

You may modify the content of the prompt by creating the variable `prompt` in the shell. The `prompt` variable can hold strings as well as any arbitrary JavaScript. If `prompt` holds a function that returns a string, `mongo` (page 942) can display dynamic information in each prompt. Consider the following examples:

---

#### Example

Create a prompt with the number of operations issued in the current session, define the following variables:

```
cmdCount = 1;
prompt = function() {
 return (cmdCount++) + "> ";
```

The prompt would then resemble the following:

```
1> db.collection.find()
2> show collections
3>
```

---

#### Example

---

To create a [mongo](#) (page 942) shell prompt in the form of <database>@<hostname>\$ define the following variables:

```
host = db.serverStatus().host;

prompt = function() {
 return db+"@"+host+"$ ";
}
```

The prompt would then resemble the following:

```
<database>@<hostname>$ use records
switched to db records
records@<hostname>$
```

---

### Example

To create a [mongo](#) (page 942) shell prompt that contains the system up time *and* the number of documents in the current database, define the following prompt variable:

```
prompt = function() {
 return "Uptime:"+db.serverStatus().uptime+" Documents:"+db.stats().objects+" > ";
}
```

The prompt would then resemble the following:

```
Uptime:5897 Documents:6 > db.people.save({name : "James"});
Uptime:5948 Documents:7 >
```

---

### Use an External Editor in the [mongo](#) Shell

New in version 2.2.

In the [mongo](#) (page 942) shell you can use the `edit` operation to edit a function or variable in an external editor. The `edit` operation uses the value of your environments `EDITOR` variable.

At your system prompt you can define the `EDITOR` variable and start [mongo](#) (page 942) with the following two operations:

```
export EDITOR=vim
mongo
```

Then, consider the following example shell session:

```
MongoDB shell version: 2.2.0
> function f() {}
> edit f
> f
function f() {
 print("this really works");
}
> f()
>this really works
> o = {}
{
}
> edit o
> o
```

```
{ "soDoes" : "this" }
>
```

**Note:** As [mongo](#) (page 942) shell interprets code edited in an external editor, it may modify code in functions, depending on the JavaScript compiler. For [mongo](#) (page 942) may convert `1+1` to `2` or remove comments. The actual changes affect only the appearance of the code and will vary based on the version of JavaScript used but will not affect the semantics of the code.

---

### Exit the Shell

To exit the shell, type `quit()` or use the `<Ctrl-c>` shortcut.

### Access the mongo Shell Help Information

In addition to the documentation in the [MongoDB Manual](#) (page 1), the [mongo](#) (page 942) shell provides some additional information in its “online” help system. This document provides an overview of accessing this help information.

#### See also:

- [mongo Manual Page](#) (page 942)
- [MongoDB Scripting](#) (page 197), and
- [mongo Shell Quick Reference](#) (page 210).

### Command Line Help

To see the list of options and help for starting the [mongo](#) (page 942) shell, use the `--help` option from the command line:

```
mongo --help
```

### Shell Help

To see the list of help, in the [mongo](#) (page 942) shell, type `help`:

```
help
```

### Database Help

- To see the list of databases on the server, use the `show dbs` command:

```
show dbs
```

New in version 2.4: `show databases` is now an alias for `show dbs`

- To see the list of help for methods you can use on the `db` object, call the `db.help()` (page 889) method:

```
db.help()
```

- To see the implementation of a method in the shell, type the `db.<method name>` without the parenthesis `(())`, as in the following example which will return the implementation of the method `db.addUser()` (page 875):

```
db.addUser
```

## Collection Help

- To see the list of collections in the current database, use the `show collections` command:

```
show collections
```

- To see the help for methods available on the collection objects (e.g. `db.<collection>`), use the `db.<collection>.help()` method:

```
db.collection.help()
```

`<collection>` can be the name of a collection that exists, although you may specify a collection that doesn't exist.

- To see the collection method implementation, type the `db.<collection>.<method>` name without the parenthesis `(())`, as in the following example which will return the implementation of the `save()` (page 846) method:

```
db.collection.save
```

## Cursor Help

When you perform *read operations* (page 39) with the `find()` (page 816) method in the `mongo` (page 942) shell, you can use various cursor methods to modify the `find()` (page 816) behavior and various JavaScript methods to handle the cursor returned from the `find()` (page 816) method.

- To list the available modifier and cursor handling methods, use the `db.collection.find().help()` command:

```
db.collection.find().help()
```

`<collection>` can be the name of a collection that exists, although you may specify a collection that doesn't exist.

- To see the implementation of the cursor method, type the `db.<collection>.find().<method>` name without the parenthesis `(())`, as in the following example which will return the implementation of the `toArray()` method:

```
db.collection.find().toArray
```

Some useful methods for handling cursors are:

- `hasNext()` (page 866) which checks whether the cursor has more documents to return.
- `next()` (page 870) which returns the next document and advances the cursor position forward by one.
- `forEach(<function>)` (page 866) which iterates the whole cursor and applies the `<function>` to each document returned by the cursor. The `<function>` expects a single argument which corresponds to the document from each iteration.

For examples on iterating a cursor and retrieving the documents from the cursor, see *cursor handling* (page 43). See also *Cursor* (page 858) for all available cursor methods.

## Type Help

To get a list of the wrapper classes available in the [mongo](#) (page 942) shell, such as `BinData()`, type `help misc` in the [mongo](#) (page 942) shell:

```
help misc
```

## [mongo Shell Quick Reference](#)

### [mongo Shell Command History](#)

You can retrieve previous commands issued in the [mongo](#) (page 942) shell with the up and down arrow keys. Command history is stored in `~/ .dbshell` file. See [.dbshell](#) (page 946) for more information.

### [Command Line Options](#)

The [mongo](#) (page 942) executable can be started with numerous options. See [mongo executable](#) (page 942) page for details on all available options.

The following table displays some common options for [mongo](#) (page 942):

| Op-tion               | Description                                                                                                                                                                                                                                              |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>--help</code>   | Show command line options                                                                                                                                                                                                                                |
| <code>--no db</code>  | Start <a href="#">mongo</a> (page 942) shell without connecting to a database.<br>To connect later, see <a href="#">Opening New Connections</a> (page 202).                                                                                              |
| <code>--she ll</code> | Used in conjunction with a JavaScript file (i.e. <code>&lt;file.js&gt;</code> (page 945)) to continue in the <a href="#">mongo</a> (page 942) shell after running the JavaScript file.<br>See <a href="#">JavaScript file</a> (page 203) for an example. |

### [Command Helpers](#)

The [mongo](#) (page 942) shell provides various help. The following table displays some common help methods and commands:

| Help Methods and Commands | Description                                                                                                                                                        |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| help                      | Show help.                                                                                                                                                         |
| db.help()                 | Show help for database methods.                                                                                                                                    |
| db.<collection>           | Show help on collection methods. The <collection> can be the name of an existing collection or a non-existing collection.                                          |
| show dbs                  | Print a list of all databases on the server.                                                                                                                       |
| use <db>                  | Switch current database to <db>. The <a href="#">mongo</a> (page 942) shell variable db is set to the current database.                                            |
| show collections          | Print a list of all collections for current database                                                                                                               |
| show users                | Print a list of users for current database.                                                                                                                        |
| show profile              | Print the five most recent operations that took 1 millisecond or more. See documentation on the <a href="#">database profiler</a> (page 167) for more information. |
| show databases            | New in version 2.4: Print a list of all available databases.                                                                                                       |
| load()                    | Execute a JavaScript file. See <a href="#">Getting Started with the mongo Shell</a> (page 204) for more information.                                               |

## Basic Shell JavaScript Operations

The [mongo](#) (page 942) shell provides numerous [mongo Shell Methods](#) (page 806) methods for database operations.

In the [mongo](#) (page 942) shell, db is the variable that references the current database. The variable is automatically set to the default database test or is set when you use the use <db> to switch current database.

The following table displays some common JavaScript operations:

| JavaScript Database Operations            | Description                                                                                                                                                                                                                                                                                                          |
|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>db.auth()</code> (page 876)         | If running in secure mode, authenticate the user.                                                                                                                                                                                                                                                                    |
| <code>coll = db.&lt;collection&gt;</code> | Set a specific collection in the current database to a variable <code>coll</code> , as in the following example:<br><code>coll = db.myCollection;</code><br>You can perform operations on the <code>myCollection</code> using the variable, as in the following example:<br><code>coll.find();</code>                |
| <code>find()</code> (page 816)            | Find all documents in the collection and returns a cursor.<br>See the <code>db.collection.find()</code> (page 816) and <i>Query Documents</i> (page 68) for more information and examples.<br>See <i>Cursors</i> (page 43) for additional information on cursor handling in the <code>mongo</code> (page 942) shell. |
| <code>insert()</code> (page 832)          | Insert a new document into the collection.                                                                                                                                                                                                                                                                           |
| <code>update()</code> (page 849)          | Update an existing document in the collection.<br>See <i>Write Operations</i> (page 50) for more information.                                                                                                                                                                                                        |
| <code>save()</code> (page 846)            | Insert either a new document or update an existing document in the collection.<br>See <i>Write Operations</i> (page 50) for more information.                                                                                                                                                                        |
| <code>remove()</code> (page 844)          | Delete documents from the collection.<br>See <i>Write Operations</i> (page 50) for more information.                                                                                                                                                                                                                 |
| <code>drop()</code> (page 812)            | Drops or removes completely the collection.                                                                                                                                                                                                                                                                          |
| <code>ensureIndex()</code> (page 814)     | Create a new index on the collection if the index does not exist; otherwise, the operation has no effect.                                                                                                                                                                                                            |
| <code>db.getSiblingDB()</code> (page 888) | Return a reference to another database using this same connection without explicitly switching the current database. This allows for cross database queries. See <i>How can I access different databases temporarily?</i> (page 594) for more information.                                                           |

For more information on performing operations in the shell, see:

- *MongoDB CRUD Concepts* (page 37)
- *Read Operations* (page 39)
- *Write Operations* (page 50)
- *mongo Shell Methods* (page 806)

## Keyboard Shortcuts

Changed in version 2.2.

The `mongo` (page 942) shell provides most keyboard shortcuts similar to those found in the `bash` shell or in Emacs. For some functions `mongo` (page 942) provides multiple key bindings, to accommodate several familiar paradigms.

The following table enumerates the keystrokes supported by the `mongo` (page 942) shell:

| Keystroke              | Function          |
|------------------------|-------------------|
| Up-arrow               | previous-history  |
| Down-arrow             | next-history      |
| Home                   | beginning-of-line |
| Continued on next page |                   |

**Table 4.1 – continued from previous page**

| <b>Keystroke</b>        | <b>Function</b>                      |
|-------------------------|--------------------------------------|
| End                     | end-of-line                          |
| Tab                     | autocomplete                         |
| Left-arrow              | backward-character                   |
| Right-arrow             | forward-character                    |
| Ctrl-left-arrow         | backward-word                        |
| Ctrl-right-arrow        | forward-word                         |
| Meta-left-arrow         | backward-word                        |
| Meta-right-arrow        | forward-word                         |
| Ctrl-A                  | beginning-of-line                    |
| Ctrl-B                  | backward-char                        |
| Ctrl-C                  | exit-shell                           |
| Ctrl-D                  | delete-char (or exit shell)          |
| Ctrl-E                  | end-of-line                          |
| Ctrl-F                  | forward-char                         |
| Ctrl-G                  | abort                                |
| Ctrl-J                  | accept-line                          |
| Ctrl-K                  | kill-line                            |
| Ctrl-L                  | clear-screen                         |
| Ctrl-M                  | accept-line                          |
| Ctrl-N                  | next-history                         |
| Ctrl-P                  | previous-history                     |
| Ctrl-R                  | reverse-search-history               |
| Ctrl-S                  | forward-search-history               |
| Ctrl-T                  | transpose-chars                      |
| Ctrl-U                  | unix-line-discard                    |
| Ctrl-W                  | unix-word-rubout                     |
| Ctrl-Y                  | yank                                 |
| Ctrl-Z                  | Suspend (job control works in linux) |
| Ctrl-H (i.e. Backspace) | backward-delete-char                 |
| Ctrl-I (i.e. Tab)       | complete                             |
| Meta-B                  | backward-word                        |
| Meta-C                  | capitalize-word                      |
| Meta-D                  | kill-word                            |
| Meta-F                  | forward-word                         |
| Meta-L                  | downcase-word                        |
| Meta-U                  | upcase-word                          |
| Meta-Y                  | yank-pop                             |
| Meta-[Backspace]        | backward-kill-word                   |
| Meta-<                  | beginning-of-history                 |
| Meta->                  | end-of-history                       |

## Queries

In the `mongo` (page 942) shell, perform read operations using the `find()` (page 816) and `findOne()` (page 824) methods.

The `find()` (page 816) method returns a cursor object which the `mongo` (page 942) shell iterates to print documents on screen. By default, `mongo` (page 942) prints the first 20. The `mongo` (page 942) shell will prompt the user to “Type it” to continue iterating the next 20 results.

The following table provides some common read operations in the [mongo](#) (page 942) shell:

| Read Operations                                                                        | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>db.collection.find(&lt;query&gt;)</code> (page 816)                              | <p>Find the documents matching the <code>&lt;query&gt;</code> criteria in the collection. If the <code>&lt;query&gt;</code> criteria is not specified or is empty (i.e <code>{ } </code>), the read operation selects all documents in the collection.</p> <p>The following example selects the documents in the <code>users</code> collection with the <code>name</code> field equal to "Joe":</p> <pre>coll = db.users; coll.find( { name: "Joe" } );</pre> <p>For more information on specifying the <code>&lt;query&gt;</code> criteria, see <a href="#">Query Documents</a> (page 68).</p>                         |
| <code>db.collection.find( &lt;query&gt;, &lt;projection&gt; )</code> (page 816)        | <p>Find documents matching the <code>&lt;query&gt;</code> criteria and return just specific fields in the <code>&lt;projection&gt;</code>.</p> <p>The following example selects all documents from the collection but returns only the <code>name</code> field and the <code>_id</code> field. The <code>_id</code> is always returned unless explicitly specified to not return.</p> <pre>coll = db.users; coll.find( { },           { name: true }         );</pre> <p>For more information on specifying the <code>&lt;projection&gt;</code>, see <a href="#">Limit Fields to Return from a Query</a> (page 72).</p> |
| <code>db.collection.find().sort( &lt;sort order&gt; )</code> (page 872)                | <p>Return results in the specified <code>&lt;sort order&gt;</code>.</p> <p>The following example selects all documents from the collection and returns the results sorted by the <code>name</code> field in ascending order (1). Use -1 for descending order:</p> <pre>coll = db.users; coll.find().sort( { name: 1 } );</pre>                                                                                                                                                                                                                                                                                          |
| <code>db.collection.find( &lt;query&gt; ).sort( &lt;sort order&gt; )</code> (page 872) | Return the documents matching the <code>&lt;query&gt;</code> criteria in the specified <code>&lt;sort order&gt;</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <code>db.collection.find( ... ).limit( &lt;n&gt; )</code> (page 867)                   | Limit result to <code>&lt;n&gt;</code> rows. Highly recommended if you need only a certain number of rows for best performance.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <code>db.collection.find( ... ).skip( &lt;n&gt; )</code> (page 871)                    | Skip <code>&lt;n&gt;</code> results.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <code>count()</code> (page 809)                                                        | Returns total number of documents in the collection.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <code>db.collection.find( &lt;query&gt; ).count()</code> (page 860)                    | <p>Returns the total number of documents that match the query.</p> <p>The <code>count()</code> (page 860) ignores <code>limit()</code> (page 867) and <code>skip()</code> (page 871). For example, if 100 records match but the limit is 10, <code>count()</code> (page 860) will return 100. This will be faster than iterating yourself, but still take time.</p>                                                                                                                                                                                                                                                     |
| <code>db.collection.findOne( &lt;query&gt; )</code> (page 824)                         | <p>Find and return a single document. Returns null if not found.</p> <p>The following example selects a single document in the <code>users</code> collection with the <code>name</code> field matches to "Joe":</p> <pre>coll = db.users; coll.findOne( { name: "Joe" } );</pre> <p>Internally, the <code>findOne()</code> (page 824) method is the <code>find()</code> (page 816) method with a <code>limit(1)</code> (page 867).</p>                                                                                                                                                                                  |
| <b>4.2. Administration Tutorials</b>                                                   | <b>215</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

See [Query Documents](#) (page 68) and [Read Operations](#) (page 39) documentation for more information and examples. See [Operators](#) (page 621) to specify other query operators.

### Error Checking Methods

The `mongo` (page 942) shell provides numerous [administrative database methods](#) (page 806), including error checking methods. These methods are:

| Error Checking Methods                       | Description                                         |
|----------------------------------------------|-----------------------------------------------------|
| <code>db.getLastError()</code> (page 886)    | Returns error message from the last operation.      |
| <code>db.getLastErrorObj()</code> (page 886) | Returns the error document from the last operation. |

### Administrative Command Helpers

The following table lists some common methods to support database administration:

| JavaScript Database Administration Methods                                               | Description                                                                                                                                                                                                              |
|------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>db.cloneDatabase(&lt;host&gt;)</code> (page 877)                                   | Clone the current database from the <code>&lt;host&gt;</code> specified. The <code>&lt;host&gt;</code> database instance must be in noauth mode.                                                                         |
| <code>db.copyDatabase(&lt;from&gt;, &lt;to&gt;, &lt;host&gt;)</code> (page 878)          | Copy the <code>&lt;from&gt;</code> database from the <code>&lt;host&gt;</code> to the <code>&lt;to&gt;</code> database on the current server.<br>The <code>&lt;host&gt;</code> database instance must be in noauth mode. |
| <code>db.fromColl.renameCollection(&lt;collection&gt;, &lt;toColl&gt;)</code> (page 846) | Rename <code>&lt;collection&gt;</code> from <code>fromColl</code> to <code>&lt;toColl&gt;</code> .                                                                                                                       |
| <code>db.repairDatabase()</code> (page 892)                                              | Repair and compact the current database. This operation can be very slow on large databases.                                                                                                                             |
| <code>db.addUser(&lt;user&gt;, &lt;pwd&gt;)</code> (page 875)                            | Add user to current database.                                                                                                                                                                                            |
| <code>db.getCollectionNames()</code> (page 886)                                          | Get the list of all collections in the current database.                                                                                                                                                                 |
| <code>db.dropDatabase()</code> (page 884)                                                | Drops the current database.                                                                                                                                                                                              |

See also [administrative database methods](#) (page 806) for a full list of methods.

### Opening Additional Connections

You can create new connections within the `mongo` (page 942) shell.

The following table displays the methods to create the connections:

| JavaScript Connection Create Methods                                      | Description                                                                                                                                   |
|---------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| <code>db = connect("=&lt;host&gt;&lt;:port&gt;/&lt;dbname&gt;")</code>    | Open a new database connection.                                                                                                               |
| <code>conn = new Mongo()</code><br><code>db = conn.getDB("dbname")</code> | Open a connection to a new server using <code>new Mongo()</code> .<br>Use <code>getDB()</code> method of the connection to select a database. |

See also [Opening New Connections](#) (page 202) for more information on the opening new connections from the `mongo` (page 942) shell.

## Miscellaneous

The following table displays some miscellaneous methods:

| Method                                         | Description                                   |
|------------------------------------------------|-----------------------------------------------|
| <code>Object.bsonsize(&lt;document&gt;)</code> | Prints the <i> BSON</i> size of an <document> |

See the [MongoDB JavaScript API Documentation](#)<sup>40</sup> for a full list of JavaScript methods.

## Additional Resources

Consider the following reference material that addresses the `mongo` (page 942) shell and its interface:

- [mongo](#) (page 942)
- [mongo Shell Methods](#) (page 806)
- [Operators](#) (page 621)
- [Database Commands](#) (page 694)
- [Aggregation Reference](#) (page 306)

Additionally, the MongoDB source code repository includes a `jstests` directory<sup>41</sup> which contains numerous `mongo` (page 942) shell scripts.

### See also:

The MongoDB Manual contains administrative documentation and tutorials though out several sections. See [Replica Set Tutorials](#) (page 419) and [Sharded Cluster Tutorials](#) (page 521) for additional tutorials and information.

## 4.3 Administration Reference

***Production Notes* (page 218)** A collection of notes that describe best practices and considerations for the operations of MongoDB instances and deployments.

***Design Notes* (page 223)** A collection of notes related to the architecture, design, and administration of MongoDB-based applications.

***UNIX ulimit Settings* (page 225)** Describes user resources limits (i.e. `ulimit`) and introduces the considerations and optimal configurations for systems that run MongoDB deployments.

***System Collections* (page 228)** Introduces the internal collections that MongoDB uses to track per-database metadata, including indexes, collections, and authentication credentials.

***Database Profiler Output* (page 229)** Describes the data collected by MongoDB's operation profiler, which introspects operations and reports data for analysis on performance and behavior.

***Journaling Mechanics* (page 232)** Describes the internal operation of MongoDB's journaling facility and outlines how the journal allows MongoDB to provide provides durability and crash resiliency.

<sup>40</sup><http://api.mongodb.org/js/index.html>

<sup>41</sup><https://github.com/mongodb/mongo/tree/master/jstests/>

### 4.3.1 Production Notes

This page details system configurations that affect MongoDB, especially in production.

---

**Note:** MongoDB Management Service (MMS)<sup>42</sup> is a hosted monitoring service which collects and aggregates diagnostic data to provide insight into the performance and operation of MongoDB deployments. See the [MMS Website](#)<sup>43</sup> and the [MMS documentation](#)<sup>44</sup> for more information.

---

#### Packages

##### MongoDB

Be sure you have the latest stable release. All releases are available on the [Downloads](#)<sup>45</sup> page. This is a good place to verify what is current, even if you then choose to install via a package manager.

Always use 64-bit builds for production. The 32-bit build MongoDB offers for test and development environments is not suitable for production deployments as it can store no more than 2GB of data. See the [32-bit limitations](#) (page 584) for more information.

32-bit builds exist to support use on development machines.

#### Operating Systems

MongoDB distributions are currently available for Mac OS X, Linux, Windows Server 2008 R2 64bit, Windows 7 (32 bit and 64 bit), Windows Vista, and Solaris platforms.

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**Note:** MongoDB uses the [GNU C Library](#)<sup>46</sup> (glibc) if available on a system. MongoDB requires version at least glibc-2.12-1.2.el6 to avoid a known bug with earlier versions. For best results use at least version 2.13.

---

#### Concurrency

In earlier versions of MongoDB, all write operations contended for a single readers-writer lock on the MongoDB instance. As of version 2.2, each database has a readers-writer lock that allows concurrent reads access to a database, but gives exclusive access to a single write operation per database. See the [Concurrency](#) (page 596) page for more information.

#### Write Concern

*Write concern* describes the guarantee that MongoDB provides when reporting on the success of a write operation. The strength of the write concerns determine the level of guarantee. When inserts, updates and deletes have a *weak* write concern, write operations return quickly. In some failure cases, write operations issued with weak write concerns may not persist. With *stronger* write concerns, clients wait after sending a write operation for MongoDB to confirm the write operations.

MongoDB provides different levels of write concern to better address the specific needs of applications. Clients may adjust write concern to ensure that the most important operations persist successfully to an entire MongoDB

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<sup>42</sup><http://mms.mongodb.com>

<sup>43</sup><http://mms.mongodb.com/>

<sup>44</sup><http://mms.mongodb.com/help/>

<sup>45</sup><http://www.mongodb.org/downloads>

<sup>46</sup><http://www.gnu.org/software/libc/>

deployment. For other less critical operations, clients can adjust the write concern to ensure faster performance rather than ensure persistence to the entire deployment.

See [Write Concern](#) (page 55) for more information about choosing an appropriate write concern level for your deployment.

## Journaling

MongoDB uses *write ahead logging* to an on-disk *journal* to guarantee that MongoDB is able to quickly recover the *write operations* (page 50) following a crash or other serious failure.

In order to ensure that [mongod](#) (page 925) will be able to recover and remain in a consistent state following a crash, you should leave journaling enabled. See [Journaling](#) (page 232) for more information.

## Connection Pool

To avoid overloading the connection resources of a single [mongod](#) (page 925) or [mongos](#) (page 938) instance, ensure that clients maintain reasonable connection pool sizes.

The [connPoolStats](#) (page 765) database command returns information regarding the number of open connections to the current database for [mongos](#) (page 938) instances and [mongod](#) (page 925) instances in sharded clusters.

## Hardware Requirements and Limitations

MongoDB is designed specifically with commodity hardware in mind and has few hardware requirements or limitations. MongoDB's core components run on little-endian hardware, primarily x86/x86\_64 processors. Client libraries (i.e. drivers) can run on big or little endian systems.

The hardware for the most effective MongoDB deployments have the following properties:

- As with all software, more RAM and a faster CPU clock speed are important for performance.
- In general, databases are not CPU bound. As such, increasing the number of cores can help, but does not provide significant marginal return.
- MongoDB has good results and a good price-performance ratio with SATA SSD (Solid State Disk).
- Use SSD if available and economical. Spinning disks can be performant, but SSDs' capacity for random I/O operations works well with the update model of [mongod](#) (page 925).
- Commodity (SATA) spinning drives are often a good option, as the increase to random I/O for more expensive drives is not that dramatic (only on the order of 2x). Using SSDs or increasing RAM may be more effective in increasing I/O throughput.
- Remote file storage can create performance problems in MongoDB. See [Remote Filesystems](#) (page 220) for more information about storage and MongoDB.

## MongoDB on NUMA Hardware

---

**Important:** The discussion of NUMA in this section only applies to Linux, and therefore does not affect deployments where [mongod](#) (page 925) instances run other UNIX-like systems or on Windows.

---

Running MongoDB on a system with Non-Uniform Access Memory (NUMA) can cause a number of operational problems, including slow performance for periods of time or high system process usage.

When running MongoDB on NUMA hardware, you should disable NUMA for MongoDB and instead set an interleave memory policy.

---

**Note:** MongoDB version 2.0 and greater checks these settings on start up when deployed on a Linux-based system, and prints a warning if the system is NUMA-based.

---

To disable NUMA for MongoDB and set an interleave memory policy, use the `numactl` command and start `mongod` (page 925) in the following manner:

```
numactl --interleave=all /usr/bin/local/mongod
```

Then, disable `zone reclaim` in the `proc` settings using the following command:

```
echo 0 > /proc/sys/vm/zone_reclaim_mode
```

To fully disable NUMA, you must perform both operations. For more information, see the Documentation for `/proc/sys/vm/*`<sup>47</sup>.

See the [The MySQL “swap insanity” problem and the effects of NUMA](#)<sup>48</sup> post, which describes the effects of NUMA on databases. This blog post addresses the impact of NUMA for MySQL, but the issues for MongoDB are similar. The post introduces NUMA and its goals, and illustrates how these goals are not compatible with production databases.

## Disk and Storage Systems

### Swap

Assign swap space for your systems. Allocating swap space can avoid issues with memory contention and can prevent the OOM Killer on Linux systems from killing `mongod` (page 925).

The method `mongod` (page 925) uses to map memory files to memory ensures that the operating system will never store MongoDB data in swap space.

### RAID

Most MongoDB deployments should use disks backed by RAID-10.

RAID-5 and RAID-6 do not typically provide sufficient performance to support a MongoDB deployment.

Avoid RAID-0 with MongoDB deployments. While RAID-0 provides good write performance, it also provides limited availability and can lead to reduced performance on read operations, particularly when using Amazon’s EBS volumes.

### Remote Filesystems

The Network File System protocol (NFS) is not recommended for use with MongoDB as some versions perform poorly.

Performance problems arise when both the data files and the journal files are hosted on NFS. You may experience better performance if you place the journal on local or `iscsi` volumes. If you must use NFS, add the following NFS options to your `/etc/fstab` file: `bg`, `nolock`, and `noatime`.

Many MongoDB deployments work successfully with Amazon’s *Elastic Block Store* (EBS) volumes. There are certain intrinsic performance characteristics with EBS volumes that users should consider.

---

<sup>47</sup><http://www.kernel.org/doc/Documentation/sysctl/vm.txt>

<sup>48</sup><http://jcole.us/blog/archives/2010/09/28/mysql-swap-insanity-and-the-numa-architecture/>

## MongoDB on Linux

**Important:** The following discussion only applies to Linux, and therefore does not affect deployments where [mongod](#) (page 925) instances run other UNIX-like systems or on Windows.

### Kernel and File Systems

When running MongoDB in production on Linux, it is recommended that you use Linux kernel version 2.6.36 or later.

MongoDB preallocates its database files before using them and often creates large files. As such, you should use the Ext4 and XFS file systems:

- In general, if you use the Ext4 file system, use at least version 2.6.23 of the Linux Kernel.
- In general, if you use the XFS file system, use at least version 2.6.25 of the Linux Kernel.
- Some Linux distributions require different versions of the kernel to support using ext4 and/or xfs:

| Linux Distribution               | Filesystem | Kernel Version             |
|----------------------------------|------------|----------------------------|
| CentOS 5.5                       | ext4, xfs  | 2.6.18-194.el5             |
| CentOS 5.6                       | ext4, xfs  | 2.6.18-238.el5             |
| CentOS 5.8                       | ext4, xfs  | 2.6.18-308.8.2.el5         |
| CentOS 6.1                       | ext4, xfs  | 2.6.32-131.0.15.el6.x86_64 |
| RHEL 5.6                         | ext4       | 2.6.18-238                 |
| RHEL 6.0                         | xfs        | 2.6.32-71                  |
| Ubuntu 10.04.4 LTS               | ext4, xfs  | 2.6.32-38-server           |
| Amazon Linux AMI release 2012.03 | ext4       | 3.2.12-3.2.4.amzn1.x86_64  |

**Important:** MongoDB requires a filesystem that supports `fsync()` on *directories*. For example, HGFS and Virtual Box's shared folders do *not* support this operation.

### Recommended Configuration

- Turn off `atime` for the storage volume containing the *database files*.
- Set the file descriptor limit, `-n`, and the user process limit (`ulimit`), `-u`, above 20,000, according to the suggestions in the [UNIX ulimit Settings](#) (page 225). A low `ulimit` will affect MongoDB when under heavy use and can produce errors and lead to failed connections to MongoDB processes and loss of service.
- Do not use hugepages virtual memory pages as MongoDB performs better with normal virtual memory pages.
- Disable NUMA in your BIOS. If that is not possible see [MongoDB on NUMA Hardware](#) (page 219).
- Ensure that readahead settings for the block devices that store the database files are appropriate. For random access use patterns, set low readahead values. A readahead of 32 (16kb) often works well.
- Use the Network Time Protocol (NTP) to synchronize time among your hosts. This is especially important in sharded clusters.

### Networking

Always run MongoDB in a *trusted environment*, with network rules that prevent access from *all* unknown machines, systems, and networks. As with any sensitive system dependent on network access, your MongoDB deployment should only be accessible to specific systems that require access, such as application servers, monitoring services, and other MongoDB components.

---

**Note:** By default, `auth` (page 993) is not enabled and `mongod` (page 925) assumes a trusted environment. You can enable `security/auth` (page 237) mode if you need it.

---

See documents in the [Security](#) (page 235) section for additional information, specifically:

- [Configuration Options](#) (page 239)
- [Firewalls](#) (page 240)
- [Configure Linux iptables Firewall for MongoDB](#) (page 242)
- [Configure Windows netsh Firewall for MongoDB](#) (page 246)

For Windows users, consider the [Windows Server Technet Article on TCP Configuration](#)<sup>49</sup> when deploying MongoDB on Windows.

## MongoDB on Virtual Environments

The section describes considerations when running MongoDB in some of the more common virtual environments.

### EC2

MongoDB is compatible with EC2 and requires no configuration changes specific to the environment.

You may alternately choose to obtain a set of Amazon Machine Images (AMI) that bundle together MongoDB and Amazon's Provisioned IOPS storage volumes. Provisioned IOPS can greatly increase MongoDB's performance and ease of use. For more information, see [this blog post](#)<sup>50</sup>.

### VMWare

MongoDB is compatible with VMWare. As some users have run into issues with VMWare's memory overcommit feature, disabling the feature is recommended.

It is possible to clone a virtual machine running MongoDB. You might use this function to spin up a new virtual host to add as a member of a replica set. If you clone a VM with journaling enabled, the clone snapshot will be consistent. If not using journaling, first stop `mongod` (page 925), then clone the VM, and finally, restart `mongod` (page 925).

### OpenVZ

Some users have had issues when running MongoDB on some older version of OpenVZ due to its handling of virtual memory, as with VMWare.

This issue seems to have been resolved in the more recent versions of OpenVZ.

## Performance Monitoring

### iostat

On Linux, use the `iostat` command to check if disk I/O is a bottleneck for your database. Specify a number of seconds when running `iostat` to avoid displaying stats covering the time since server boot.

---

<sup>49</sup><http://technet.microsoft.com/en-us/library/dd349797.aspx>

<sup>50</sup><http://www.mongodb.com/blog/post/provisioned-iops-aws-marketplace-significantly-boosts-mongodb-performance-ease-use>

For example, the following command will display extended statistics and the time for each displayed report, with traffic in MB/s, at one second intervals:

```
iostat -xmt 1
```

Key fields from iostat:

- **%util**: this is the most useful field for a quick check, it indicates what percent of the time the device/drive is in use.
- **avgrq-sz**: average request size. Smaller number for this value reflect more random IO operations.

## bwm-ng

[bwm-ng](#)<sup>51</sup> is a command-line tool for monitoring network use. If you suspect a network-based bottleneck, you may use bwm-ng to begin your diagnostic process.

## Separate Components onto Different Storage Devices

For improved performance, consider separating your database’s data, journal, and logs onto different storage devices, based on your application’s access and write pattern.

---

**Note:** This will affect your ability to create snapshot-style backups of your data, since the files will be on different devices and volumes.

---

## Backups

To make backups of your MongoDB database, please refer to [Backup Strategies for MongoDB Systems](#) (page 136).

### 4.3.2 Design Notes

This page details features of MongoDB that may be important to bear in mind when designing your applications.

#### Schema Considerations

##### Dynamic Schema

Data in MongoDB has a *dynamic schema*. [Collections](#) do not enforce [document](#) structure. This facilitates iterative development and polymorphism. Nevertheless, collections often hold documents with highly homogeneous structures. See [Data Modeling Considerations for MongoDB Applications](#) (page 117) for more information.

Some operational considerations include:

- the exact set of collections to be used;
- the indexes to be used: with the exception of the `_id` index, all indexes must be created explicitly;
- shard key declarations: choosing a good shard key is very important as the shard key cannot be changed once set.

Avoid importing unmodified data directly from a relational database. In general, you will want to “roll up” certain data into richer documents that take advantage of MongoDB’s support for sub-documents and nested arrays.

---

<sup>51</sup><http://www.gropp.org/?id=projects&sub=bwm-ng>

## Case Sensitive Strings

MongoDB strings are case sensitive. So a search for "joe" will not find "Joe".

Consider:

- storing data in a normalized case format, or
- using regular expressions ending with `http://docs.mongodb.org/manual/i`, and/or
- using `$toLower` (page 685) or `$toUpper` (page 685) in the *aggregation framework* (page 279).

## Type Sensitive Fields

MongoDB data is stored in the  `BSON52` format, a binary encoded serialization of JSON-like documents. BSON encodes additional type information. See `bsonspec.org53` for more information.

Consider the following document which has a field `x` with the *string* value "123":

```
{ x : "123" }
```

Then the following query which looks for a *number* value 123 will **not** return that document:

```
db.mycollection.find({ x : 123 })
```

## General Considerations

### By Default, Updates Affect one Document

To update multiple documents that meet your query criteria, set the `update multi` option to `true` or `1`. See: *Update Multiple Documents* (page 53).

Prior to MongoDB 2.2, you would specify the `upsert` and `multi` options in the `update` method as positional boolean options. See: the `update` method reference documentation.

### BSON Document Size Limit

The `BSON Document Size` (page 1015) limit is currently set at 16MB per document. If you require larger documents, use `GridFS` (page 154).

### No Fully Generalized Transactions

MongoDB does not have *fully generalized transactions* (page 84). Creating rich documents that closely resemble and reflect your application-level objects to (words).

## Replica Set Considerations

### Use an Odd Number of Replica Set Members

*Replica sets* (page 377) perform consensus elections. To ensure that elections will proceed successfully, either use an odd number of members, typically three, or else use an `arbiter` to ensure an odd number of votes.

---

<sup>52</sup><http://docs.mongodb.org/meta-driver/latest/legacy/bson/>

<sup>53</sup><http://bsonspec.org/#/specification>

## Keep Replica Set Members Up-to-Date

MongoDB replica sets support [automatic failover](#) (page 396). It is important for your secondaries to be up-to-date. There are various strategies for assessing consistency:

1. Use monitoring tools to alert you to lag events. See [Monitoring for MongoDB](#) (page 138) for a detailed discussion of MongoDB's monitoring options.
2. Specify appropriate write concern.
3. If your application requires *manual* fail over, you can configure your secondaries as [priority 0](#) (page 386). Priority 0 secondaries require manual action for a failover. This may be practical for a small replica set, but large deployments should fail over automatically.

**See also:**

[replica set rollbacks](#) (page 401).

## Sharding Considerations

- Pick your shard keys carefully. You cannot choose a new shard key for a collection that is already sharded.
- Shard key values are immutable.
- When enabling sharding on an *existing collection*, MongoDB imposes a maximum size on those collections to ensure that it is possible to create chunks. For a detailed explanation of this limit, see: <sharding-existing-collection-data-size>.

To shard large amounts of data, create a new empty sharded collection, and ingest the data from the source collection using an application level import operation.

- Unique indexes are not enforced across shards except for the shard key itself. See [Enforce Unique Keys for Sharded Collections](#) (page 558).
- Consider [pre-splitting](#) (page 521) a sharded collection before a massive bulk import.

### 4.3.3 UNIX ulimit Settings

Most UNIX-like operating systems, including Linux and OS X, provide ways to limit and control the usage of system resources such as threads, files, and network connections on a per-process and per-user basis. These “ulimits” prevent single users from using too many system resources. Sometimes, these limits have low default values that can cause a number of issues in the course of normal MongoDB operation.

---

**Note:** Red Hat Enterprise Linux and CentOS 6 place a max process limitation of 1024 which overrides ulimit settings. Edit the soft nproc and hard nproc values in the /etc/security/limits.d/90-nproc.conf file to increase the process limit.

---

## Resource Utilization

[mongod](#) (page 925) and [mongos](#) (page 938) each use threads and file descriptors to track connections and manage internal operations. This section outlines the general resource utilization patterns for MongoDB. Use these figures in combination with the actual information about your deployment and its use to determine ideal ulimit settings.

Generally, all [mongod](#) (page 925) and [mongos](#) (page 938) instances:

- track each incoming connection with a file descriptor *and* a thread.

- track each internal thread or *pthread* as a system process.

### **mongod**

- 1 file descriptor for each data file in use by the [mongod](#) (page 925) instance.
- 1 file descriptor for each journal file used by the [mongod](#) (page 925) instance when [journal](#) (page 995) is true.
- In replica sets, each [mongod](#) (page 925) maintains a connection to all other members of the set.

[mongod](#) (page 925) uses background threads for a number of internal processes, including [TTL collections](#) (page 158), replication, and replica set health checks, which may require a small number of additional resources.

### **mongos**

In addition to the threads and file descriptors for client connections, [mongos](#) (page 938) must maintain connects to all config servers and all shards, which includes all members of all replica sets.

For [mongos](#) (page 938), consider the following behaviors:

- [mongos](#) (page 938) instances maintain a connection pool to each shard so that the [mongos](#) (page 938) can reuse connections and quickly fulfill requests without needing to create new connections.
- You can limit the number of incoming connections using the [maxConns](#) (page 992) run-time option.

By restricting the number of incoming connections you can prevent a cascade effect where the [mongos](#) (page 938) creates too many connections on the [mongod](#) (page 925) instances.

---

**Note:** You cannot set [maxConns](#) (page 992) to a value higher than 20000.

---

## Review and Set Resource Limits

### **ulimit**

---

**Note:** Both the “hard” and the “soft” [ulimit](#) affect MongoDB’s performance. The “hard” [ulimit](#) refers to the maximum number of processes that a user can have active at any time. This is the ceiling: no non-root process can increase the “hard” [ulimit](#). In contrast, the “soft” [ulimit](#) is the limit that is actually enforced for a session or process, but any process can increase it up to “hard” [ulimit](#) maximum.

A low “soft” [ulimit](#) can cause `can't create new thread, closing connection` errors if the number of connections grows too high. For this reason, it is extremely important to set *both* [ulimit](#) values to the recommended values.

---

You can use the [ulimit](#) command at the system prompt to check system limits, as in the following example:

```
$ ulimit -a
-t: cpu time (seconds) unlimited
-f: file size (blocks) unlimited
-d: data seg size (kbytes) unlimited
-s: stack size (kbytes) 8192
-c: core file size (blocks) 0
-m: resident set size (kbytes) unlimited
-u: processes 192276
-n: file descriptors 21000
```

```
-l: locked-in-memory size (kb) 40000
-v: address space (kb) unlimited
-x: file locks unlimited
-i: pending signals 192276
-q: bytes in POSIX msg queues 819200
-e: max nice 30
-r: max rt priority 65
-N 15: unlimited
```

`ulimit` refers to the per-user limitations for various resources. Therefore, if your `mongod` (page 925) instance executes as a user that is also running multiple processes, or multiple `mongod` (page 925) processes, you might see contention for these resources. Also, be aware that the `processes` value (i.e. `-u`) refers to the combined number of distinct processes and sub-process threads.

You can change `ulimit` settings by issuing a command in the following form:

```
ulimit -n <value>
```

For many distributions of Linux you can change values by substituting the `-n` option for any possible value in the output of `ulimit -a`. On OS X, use the `launchctl limit` command. See your operating system documentation for the precise procedure for changing system limits on running systems.

---

**Note:** After changing the `ulimit` settings, you *must* restart the process to take advantage of the modified settings. You can use the `http://docs.mongodb.org/manualproc` file system to see the current limitations on a running process.

Depending on your system's configuration, and default settings, any change to system limits made using `ulimit` may revert following system a system restart. Check your distribution and operating system documentation for more information.

---

## /proc File System

---

**Note:** This section applies only to Linux operating systems.

The `http://docs.mongodb.org/manualproc` file-system stores the per-process limits in the file system object located at `/proc/<pid>/limits`, where `<pid>` is the process's **PID** or process identifier. You can use the following bash function to return the content of the `limits` object for a process or processes with a given name:

```
return-limits() {
 for process in $@; do
 process_pids=`ps -C $process -o pid --no-headers | cut -d " " -f 2`

 if [-z $@]; then
 echo "[no $process running]"
 else
 for pid in $process_pids; do
 echo "[${process} #${pid} -- limits]"
 cat /proc/${pid}/limits
 done
 fi
 done
}
```

You can copy and paste this function into a current shell session or load it as part of a script. Call the function with one the following invocations:

```
return-limits mongod
return-limits mongos
return-limits mongod mongos
```

The output of the first command may resemble the following:

```
[mongod #6809 -- limits]
Limit Soft Limit Hard Limit Units
Max cpu time unlimited unlimited seconds
Max file size unlimited unlimited bytes
Max data size unlimited unlimited bytes
Max stack size 8720000 unlimited bytes
Max core file size 0 unlimited bytes
Max resident set unlimited unlimited bytes
Max processes 192276 192276 processes
Max open files 1024 4096 files
Max locked memory 40960000 40960000 bytes
Max address space unlimited unlimited bytes
Max file locks unlimited unlimited locks
Max pending signals 192276 192276 signals
Max msgqueue size 819200 819200 bytes
Max nice priority 30 30 us
Max realtime priority 65 65 us
Max realtime timeout unlimited unlimited us
```

## Recommended Settings

Every deployment may have unique requirements and settings; however, the following thresholds and settings are particularly important for [mongod](#) (page 925) and [mongos](#) (page 938) deployments:

- `-f` (file size): unlimited
- `-t` (cpu time): unlimited
- `-v` (virtual memory): unlimited<sup>54</sup>
- `-n` (open files): 64000
- `-m` (memory size): unlimited<sup>1</sup>
- `-u` (processes/threads): 32000

Always remember to restart your [mongod](#) (page 925) and [mongos](#) (page 938) instances after changing the `ulimit` settings to make sure that the settings change takes effect.

### 4.3.4 System Collections

#### Synopsis

MongoDB stores system information in collections that use the `<database>.system.* namespace`, which MongoDB reserves for internal use. Do not create collections that begin with `system`.

MongoDB also stores some additional instance-local metadata in the [local database](#) (page 485), specifically for replication purposes.

---

<sup>54</sup> If you limit virtual or resident memory size on a system running MongoDB the operating system will refuse to honor additional allocation requests.

## Collections

System collections include these collections stored directly in the database:

### <database>.system.namespaces

The <database>.system.namespaces (page 229) collection contains information about all of the database's collections. Additional namespace metadata exists in the database.ns files and is opaque to database users.

### <database>.system.indexes

The <database>.system.indexes (page 229) collection lists all the indexes in the database. Add and remove data from this collection via the `ensureIndex()` (page 814) and `dropIndex()` (page 812)

### <database>.system.profile

The <database>.system.profile (page 229) collection stores database profiling information. For information on profiling, see *Database Profiling* (page 143).

### <database>.system.users

The <database>.system.users (page 270) collection stores credentials for users who have access to the database. For more information on this collection, see *Add a User to a Database* (page 257) and <database>.system.users (page 270).

### <database>.system.js

The <database>.system.js (page 229) collection holds special JavaScript code for use in *server side JavaScript* (page 198). See *Store a JavaScript Function on the Server* (page 177) for more information.

## 4.3.5 Database Profiler Output

The database profiler captures data information about read and write operations, cursor operations, and database commands. To configure the database profile and set the thresholds for capturing profile data, see the *Analyze Performance of Database Operations* (page 167) section.

The database profiler writes data in the `system.profile` (page 229) collection, which is a *capped collection*. To view the profiler's output, use normal MongoDB queries on the `system.profile` (page 229) collection.

---

**Note:** Because the database profiler writes data to the `system.profile` (page 229) collection in a database, the profiler will profile some write activity, even for databases that are otherwise read-only.

---

## Example `system.profile` Document

The documents in the `system.profile` (page 229) collection have the following form. This example document reflects an update operation:

```
{
 "ts" : ISODate("2012-12-10T19:31:28.977Z"),
 "op" : "update",
 "ns" : "social.users",
 "query" : {
 "name" : "jane"
 },
 "updateobj" : {
 "$set" : {
 "likes" : [
 "basketball",
 "trekking"
]
 }
 }
}
```

```
 }
 },
 "nscanned" : 8,
 "moved" : true,
 "nmoved" : 1,
 "nupdated" : 1,
 "keyUpdates" : 0,
 "numYield" : 0,
 "lockStats" : {
 "timeLockedMicros" : {
 "r" : NumberLong(0),
 "w" : NumberLong(258)
 },
 "timeAcquiringMicros" : {
 "r" : NumberLong(0),
 "w" : NumberLong(7)
 }
 },
 "millis" : 0,
 "client" : "127.0.0.1",
 "user" : ""
}
```

## Output Reference

For any single operation, the documents created by the database profiler will include a subset of the following fields. The precise selection of fields in these documents depends on the type of operation.

### system.profile.ts

The timestamp of the operation.

### system.profile.op

The type of operation. The possible values are:

- insert
- query
- update
- remove
- getmore
- command

### system.profile.ns

The *namespace* the operation targets. Namespaces in MongoDB take the form of the *database*, followed by a dot (.), followed by the name of the *collection*.

### system.profile.query

The *query document* (page 68) used.

### system.profile.command

The command operation.

### system.profile.updateobj

The <update> document passed in during an *update* (page 50) operation.

### system.profile.cursorid

The ID of the cursor accessed by a getmore operation.

**system.profile.ntoreturn**

Changed in version 2.2: In 2.0, MongoDB includes this field for query and command operations. In 2.2, this information MongoDB also includes this field for getmore operations.

The number of documents the operation specified to return. For example, the [profile](#) (page 770) command would return one document (a results document) so the [ntoreturn](#) (page 230) value would be 1. The [limit \(5\)](#) (page 867) command would return five documents so the [ntoreturn](#) (page 230) value would be 5.

If the [ntoreturn](#) (page 230) value is 0, the command did not specify a number of documents to return, as would be the case with a simple [find\(\)](#) (page 816) command with no limit specified.

**system.profile.ntoskip**

New in version 2.2.

The number of documents the [skip\(\)](#) (page 871) method specified to skip.

**system.profile.nscanned**

The number of documents that MongoDB scans in the [index](#) (page 313) in order to carry out the operation.

In general, if [nscanned](#) (page 231) is much higher than [nreturned](#) (page 232), the database is scanning many objects to find the target objects. Consider creating an index to improve this.

**system.profile.moved**

If [moved](#) (page 231) has a value of `true` indicates that the update operation moved one or more documents to a new location on disk. These operations take more time than in-place updates, and typically occur when documents grow as a result of document growth.

**system.profile.nmoved**

New in version 2.2.

The number of documents moved on disk by the operation.

**system.profile.nupdated**

New in version 2.2.

The number of documents updated by the operation.

**system.profile.keyUpdates**

New in version 2.2.

The number of [index](#) (page 313) keys the update changed in the operation. Changing an index key carries a small performance cost because the database must remove the old key and inserts a new key into the B-tree index.

**system.profile.numYield**

New in version 2.2.

The number of times the operation yielded to allow other operations to complete. Typically, operations yield when they need access to data that MongoDB has not yet fully read into memory. This allows other operations that have data in memory to complete while MongoDB reads in data for the yielding operation. For more information, see [the FAQ on when operations yield](#) (page 597).

**system.profile.lockStats**

New in version 2.2.

The time in microseconds the operation spent acquiring and holding locks. This field reports data for the following lock types:

- R - global read lock
- W - global write lock
- r - database-specific read lock

- `w` - database-specific write lock

`system.profile.lockStats.timeLockedMicros`

The time in microseconds the operation held a specific lock. For operations that require more than one lock, like those that lock the `local` database to update the `oplog`, then this value may be longer than the total length of the operation (i.e. `millis` (page 232).)

`system.profile.lockStats.timeAcquiringMicros`

The time in microseconds the operation spent waiting to acquire a specific lock.

`system.profile.nreturned`

The number of documents returned by the operation.

`system.profile.responseLength`

The length in bytes of the operation's result document. A large `responseLength` (page 232) can affect performance. To limit the size of the result document for a query operation, you can use any of the following:

- [Projections](#) (page 72)
- [The `limit\(\)` method](#) (page 867)
- [The `batchSize\(\)` method](#) (page 859)

`system.profile.millis`

The time in milliseconds for the server to perform the operation. This time does not include network time nor time to acquire the lock.

`system.profile.client`

The IP address or hostname of the client connection where the operation originates.

For some operations, such as `db.eval()` (page 884), the client is `0.0.0.0:0` instead of an actual client.

`system.profile.user`

The authenticated user who ran the operation.

### 4.3.6 Journaling Mechanics

When running with journaling, MongoDB stores and applies [write operations](#) (page 50) in memory and in the journal before the changes are in the data files. This document discusses the implementation and mechanics of Journaling in MongoDB systems, see [Manage Journaling](#) (page 175) for information on configuring, tuning and managing journaling.

#### Journal Files

With journaling enabled, MongoDB creates a journal directory within the directory defined by `dbpath` (page 993), which is `/data/db` by default. The journal directory holds journal files, which contain write-ahead redo logs. The directory also holds a last-sequence-number file. A clean shutdown removes all the files in the journal directory.

Journal files are append-only files and have file names prefixed with `j._`. When a journal file holds 1 gigabyte of data, MongoDB creates a new journal file. Once MongoDB applies all the write operations in the journal files, it deletes these files. Unless you write *many* bytes of data per-second, the journal directory should contain only two or three journal files.

To limit the size of each journal file to 128 megabytes, use the `smallfiles` (page 998) run time option when starting `mongod` (page 925).

To speed the frequent sequential writes that occur to the current journal file, you can ensure that the journal directory is on a different system.

**Important:** If you place the journal on a different filesystem from your data files you *cannot* use a filesystem snapshot to capture consistent backups of a `dbpath` (page 993) directory.

---

**Note:** Depending on your file system, you might experience a preallocation lag the first time you start a `mongod` (page 925) instance with journaling enabled.

MongoDB may preallocate journal files if the `mongod` (page 925) process determines that it is more efficient to preallocate journal files than create new journal files as needed. The amount of time required to pre-allocate lag might last several minutes, during which you will not be able to connect to the database. This is a one-time preallocation and does not occur with future invocations.

---

To avoid preallocation lag, see [Avoid Preallocation Lag](#) (page 175).

## Storage Views used in Journaling

Journaling adds three storage views to MongoDB.

The `shared` view stores modified data for upload to the MongoDB data files. The `shared` view is the only view with direct access to the MongoDB data files. When running with journaling, `mongod` (page 925) asks the operating system to map your existing on-disk data files to the `shared` view memory view. The operating system maps the files but does not load them. MongoDB later loads data files to `shared` view as needed.

The `private` view stores data for use in [read operations](#) (page 39). MongoDB maps `private` view to the `shared` view and is the first place MongoDB applies new [write operations](#) (page 50).

The journal is an on-disk view that stores new write operations after MongoDB applies the operation to the `private` cache but before applying them to the data files. The journal provides durability. If the `mongod` (page 925) instance were to crash without having applied the writes to the data files, the journal could replay the writes to the `shared` view for eventual upload to the data files.

## How Journaling Records Write Operations

MongoDB copies the write operations to the journal in batches called group commits. See [journalCommitInterval](#) (page 995) for more information on the default commit interval. These “group commits” help minimize the performance impact of journaling.

Journaling stores raw operations that allow MongoDB to reconstruct the following:

- document insertion/updates
- index modifications
- changes to the namespace files

As [write operations](#) (page 50) occur, MongoDB writes the data to the `private` view in RAM and then copies the write operations in batches to the journal. The journal stores the operations on disk to ensure durability. MongoDB adds the operations as entries on the journal’s forward pointer. Each entry describes which bytes the write operation changed in the data files.

MongoDB next applies the journal’s write operations to the `shared` view. At this point, the `shared` view becomes inconsistent with the data files.

At default intervals of 60 seconds, MongoDB asks the operating system to flush the `shared` view to disk. This brings the data files up-to-date with the latest write operations.

When MongoDB flushes write operations to the data files, MongoDB removes the write operations from the journal’s behind pointer. The behind pointer is always far back from the advanced pointer.

As part of journaling, MongoDB routinely asks the operating system to remap the `shared view` to the `private view`, for consistency.

---

**Note:** The interaction between the `shared view` and the on-disk data files is similar to how MongoDB works *without* journaling, which is that MongoDB asks the operating system to flush in-memory changes back to the data files every 60 seconds.

---

---

## Security

---

This section outlines basic security and risk management strategies and access control. The included tutorials outline specific tasks for configuring firewalls, authentication, and system privileges.

***Security Introduction*** ([page 235](#)) A high-level introduction to security and MongoDB deployments.

***Security Concepts*** ([page 237](#)) The core documentation of security.

***Access Control*** ([page 237](#)) Control access to MongoDB instances using authentication and authorization.

***Network Exposure and Security*** ([page 239](#)) Discusses potential security risks related to the network and strategies for decreasing possible network-based attack vectors for MongoDB.

***Security and MongoDB API Interfaces*** ([page 241](#)) Discusses potential risks related to MongoDB's JavaScript, HTTP and REST interfaces, including strategies to control those risks.

***Security Tutorials*** ([page 242](#)) Tutorials for enabling and configuring security features for MongoDB.

***Create a Vulnerability Report*** ([page 263](#)) Report a vulnerability in MongoDB.

***Network Security Tutorials*** ([page 242](#)) Ensure that the underlying network configuration supports a secure operating environment for MongoDB deployments, and appropriately limits access to MongoDB deployments.

***Access Control Tutorials*** ([page 254](#)) MongoDB's access control system provides role-based access control for limiting access to MongoDB deployments. These tutorials describe procedures relevant for the operation and maintenance of this access control system.

***Security Reference*** ([page 264](#)) Reference for security related functions.

## 5.1 Security Introduction

As with all software running in a networked environment, administrators of MongoDB must consider security and risk exposures for a MongoDB deployment. There are no magic solutions for risk mitigation, and maintaining a secure MongoDB deployment is an ongoing process.

### 5.1.1 Defense in Depth

The documents in this section takes a *Defense in Depth* approach to securing MongoDB deployments and addresses a number of different methods for managing risk and reducing risk exposure.

The intent of a *Defense In Depth* approach is to ensure there are no exploitable points of failure in your deployment that could allow an intruder or un-trusted party to access the data stored in the MongoDB database. The easiest and

most effective way to reduce the risk of exploitation is to run MongoDB in a trusted environment, limit access, follow a system of least privilege, and follow best development and deployment practices.

### 5.1.2 Trusted Environments

The most effective way to reduce risk for MongoDB deployments is to run your entire MongoDB deployment, including all MongoDB components (i.e. [mongod](#) (page 925), [mongos](#) (page 938) and application instances) in a *trusted environment*. Trusted environments use the following strategies to control access:

- Use network filter (e.g. firewall) rules that block all connections from unknown systems to MongoDB components.
- Bind [mongod](#) (page 925) and [mongos](#) (page 938) instances to specific IP addresses to limit accessibility.
- Limit MongoDB programs to non-public local networks, and virtual private networks.

### 5.1.3 Operational Practices to Reduce Risk

You may further reduce risk by [controlling access](#) (page 237) to the database by employing authentication and authorization. Require [authentication](#) (page 237) for access to MongoDB instances and require strong, complex, single purpose authentication credentials. This should be part of your internal security policy. Employ [authorization](#) (page 238) and deploy a model of least privilege, where all users have *only* the amount of access they need to accomplish required tasks and no more. See [Access Control](#) (page 237) for more information.

Follow the best application development and deployment practices, which includes: validating all inputs, managing sessions, and application-level access control.

Always run the [mongod](#) (page 925) or [mongos](#) (page 938) process as a *unique* user with the minimum required permissions and access. Never run a MongoDB program as a `root` or administrative users. The system users that run the MongoDB processes should have robust authentication credentials that prevent unauthorized or casual access.

To further limit the environment, you can run the [mongod](#) (page 925) or [mongos](#) (page 938) process in a `chroot` environment. Both user-based access restrictions and `chroot` configuration follow recommended conventions for administering all daemon processes on Unix-like systems.

### 5.1.4 Data Encryption

To support audit requirements, you may need to encrypt data stored in MongoDB. For best results, you can encrypt this data in the application layer by encrypting the content of fields that hold secure data.

Additionally, MongoDB<sup>1</sup> has a partnership<sup>2</sup> with Gazzang<sup>3</sup> to encrypt and secure sensitive data within MongoDB. The solution encrypts data in real time and Gazzang provides advanced key management that ensures only authorized processes can access this data. The Gazzang software ensures that the cryptographic keys remain safe and ensures compliance with standards including HIPAA, PCI-DSS, and FERPA.

For more information, refer to the following resources: Datasheet<sup>4</sup> and Webinar<sup>5</sup>.

---

<sup>1</sup><http://mongodb.com>

<sup>2</sup><https://www.mongodb.com/partners/technology/gazzang>

<sup>3</sup><http://www.gazzang.com/>

<sup>4</sup><http://www.gazzang.com/images/datasheet-zNcrypt-for-MongoDB.pdf>

<sup>5</sup><http://gazzang.com/resources/videos/partner-videos/item/209-gazzang-zncrypt-on-mongodb>

### 5.1.5 Additional Security Strategies

MongoDB provides various strategies to reduce network risk, such as configuring MongoDB or configuring firewalls for MongoDB. See [Network Exposure and Security](#) (page 239) for more information.

In addition, consider the strategies listed in [Security and MongoDB API Interfaces](#) (page 241) to reduce interface-related risks for the `mongo` (page 942) shell, HTTP status interface and the REST API.

MongoDB Enterprise supports authentication using Kerberos. See [Deploy MongoDB with Kerberos Authentication](#) (page 259).

### 5.1.6 Vulnerability Notification

MongoDB takes security very seriously. If you discover a vulnerability in MongoDB, or would like to know more about our vulnerability reporting and response process, see the [Create a Vulnerability Report](#) (page 263) document.

## 5.2 Security Concepts

These documents introduce and address concepts and strategies related to security practices in MongoDB deployments.

[Access Control](#) (page 237) Control access to MongoDB instances using authentication and authorization.

[Inter-Process Authentication](#) (page 238) Components of a MongoDB sharded cluster or replica set deployment must be able to authenticate to each other to perform routine internal operations.

[Network Exposure and Security](#) (page 239) Discusses potential security risks related to the network and strategies for decreasing possible network-based attack vectors for MongoDB.

[Security and MongoDB API Interfaces](#) (page 241) Discusses potential risks related to MongoDB's JavaScript, HTTP and REST interfaces, including strategies to control those risks.

### 5.2.1 Access Control

MongoDB provides support for authentication and authorization on a per-database level. Users exist in the context of a single logical database.

#### Authentication

MongoDB provisions authentication, or verification of the user identity, on a per-database level. Authentication disables anonymous access to the database. For basic authentication, MongoDB stores the user credentials in a database's `system.users` (page 270) collection.

Authentication is **disabled** by default. To enable authentication for a given `mongod` (page 925) or `mongos` (page 938) instance, use the `auth` (page 993) and `keyFile` (page 993) configuration settings. For details, see [Enable Authentication](#) (page 255).

For MongoDB Enterprise installations, authentication using a Kerberos service is available. See [Deploy MongoDB with Kerberos Authentication](#) (page 259).

---

**Important:** You can authenticate as only one user for a given database. If you authenticate to a database as one user and later authenticate on the same database as a different user, the second authentication invalidates the first. You can, however, log into a *different* database as a different user and not invalidate your authentication on other databases.

---

## Authorization

MongoDB provisions authorization, or access to databases and operations, on a per-database level. MongoDB uses a role-based approach to authorization, storing each user's roles in a [privilege document](#) (page 265) in a database's `system.users` (page 270) collection. For more information on privilege documents and available user roles, see `system.users` [Privilege Documents](#) (page 270) and [User Privilege Roles in MongoDB](#) (page 265).

---

**Important:** The `admin` database provides roles that are *unavailable* in other databases, including a role that effectively makes a user a MongoDB system superuser. See [Database Administration Roles](#) (page 266) and [Administrative Roles](#) (page 267).

---

To assign roles to users, you must be a user with administrative role in the database. As such, you must first create an administrative user. For details, see [Create a User Administrator](#) (page 255) and [Add a User to a Database](#) (page 257).

### `system.users` Collection

A database's `system.users` (page 270) collection stores information for authentication and authorization to that database. Specifically, the collection stores user credentials for authentication and user privilege information for authorization. MongoDB requires authorization to access the `system.users` (page 270) collection in order to prevent privilege escalation attacks. To access the collection, you must have either `userAdmin` (page 267) or `userAdminAnyDatabase` (page 269) role.

Changed in version 2.4: The schema of `system.users` (page 270) changed to accommodate a more sophisticated authorization using user privilege model, as defined in [privilege documents](#) (page 265).

## 5.2.2 Inter-Process Authentication

In most cases, `replica set` and `sharded cluster` administrators do not have to keep additional considerations in mind beyond the normal security precautions that all MongoDB administrators must take. However, ensure that:

- Your network configuration will allow every member of the replica set to contact every other member of the replica set.
- If you use MongoDB's authentication system to limit access to your infrastructure, ensure that you configure a `keyFile` (page 993) on all members to permit authentication.

For most instances, the most effective ways to control access and to secure the connection between members of a `replica set` depend on network-level access control. Use your environment's firewall and network routing to ensure that traffic *only* from clients and other replica set members can reach your `mongod` (page 925) instances. If needed, use virtual private networks (VPNs) to ensure secure connections over wide area networks (WANs.)

### Enable Authentication in Replica Sets and Sharded Clusters

New in version 1.8: Added support authentication in replica set deployments.

Changed in version 1.9.1: Added support authentication in sharded replica set deployments.

MongoDB provides an authentication mechanism for `mongod` (page 925) and `mongos` (page 938) instances connecting to replica sets. These instances enable authentication but specify a shared key file that serves as a shared password.

To enable authentication, add the following option to your configuration file:

```
keyFile = /srv/mongodb/keyfile
```

---

**Note:** You may chose to set these run-time configuration options using the `--keyFile` (or `mongos --keyFile`) options on the command line.

Setting `keyFile` (page 993) enables authentication and specifies a key file for the replica set members to use when authenticating to each other. The content of the key file is arbitrary but must be the same on all members of the replica set and on all `mongos` (page 938) instances that connect to the set.

The key file must be less one kilobyte in size and may only contain characters in the base64 set. The key file must not have group or “world” permissions on UNIX systems. See [Generate a Key File](#) (page 258) for instructions on generating a key file.

### 5.2.3 Network Exposure and Security

By default, MongoDB programs (i.e. `mongos` (page 938) and `mongod` (page 925)) will bind to all available network interfaces (i.e. IP addresses) on a system.

This page outlines various runtime options that allow you to limit access to MongoDB programs.

#### Configuration Options

You can limit the network exposure with the following `mongod` (page 925) and `mongos` (page 938) configuration options: `nohttpinterface` (page 996), `rest` (page 997), `bind_ip` (page 991), and `port` (page 991). You can use a [configuration file](#) (page 990) to specify these settings.

##### `nohttpinterface`

The `nohttpinterface` (page 996) setting for `mongod` (page 925) and `mongos` (page 938) instances disables the “home” status page, which would run on port 28017 by default. The status interface is read-only by default. You may also specify this option on the command line as `mongod --nohttpinterface` or `mongos --nohttpinterface`.

Authentication does not control or affect access to this interface.

---

**Important:** Disable this option for production deployments. If you *do* leave this interface enabled, you should only allow trusted clients to access this port. See [Firewalls](#) (page 240).

##### `rest`

The `rest` (page 997) setting for `mongod` (page 925) enables a fully interactive administrative [REST](#) interface, which is *disabled by default*. The status interface, which is enabled by default, is read-only. This configuration makes that interface fully interactive. The REST interface does not support any authentication and you should always restrict access to this interface to only allow trusted clients to connect to this port.

You may also enable this interface on the command line as `mongod --rest`.

---

**Important:** Disable this option for production deployments. If *do* you leave this interface enabled, you should only allow trusted clients to access this port.

### **bind\_ip**

The [bind\\_ip](#) (page 991) setting for [mongod](#) (page 925) and [mongos](#) (page 938) instances limits the network interfaces on which MongoDB programs will listen for incoming connections. You can also specify a number of interfaces by passing [bind\\_ip](#) (page 991) a comma separated list of IP addresses. You can use the `mongod --bind_ip` and `mongos --bind_ip` option on the command line at run time to limit the network accessibility of a MongoDB program.

---

**Important:** Make sure that your [mongod](#) (page 925) and [mongos](#) (page 938) instances are only accessible on trusted networks. If your system has more than one network interface, bind MongoDB programs to the private or internal network interface.

---

### **port**

The [port](#) (page 991) setting for [mongod](#) (page 925) and [mongos](#) (page 938) instances changes the main port on which the [mongod](#) (page 925) or [mongos](#) (page 938) instance listens for connections. The default port is 27017. Changing the port does not meaningfully reduce risk or limit exposure. You may also specify this option on the command line as `mongod --port` or `mongos --port`. Setting [port](#) (page 991) also indirectly sets the port for the HTTP status interface, which is always available on the port numbered 1000 greater than the primary [mongod](#) (page 925) port.

Only allow trusted clients to connect to the port for the [mongod](#) (page 925) and [mongos](#) (page 938) instances. See [Firewalls](#) (page 240).

See also [Security Considerations](#) (page 147) and [Default MongoDB Port](#) (page 272).

## **Firewalls**

Firewalls allow administrators to filter and control access to a system by providing granular control over what network communications. For administrators of MongoDB, the following capabilities are important: limiting incoming traffic on a specific port to specific systems, and limiting incoming traffic from untrusted hosts.

On Linux systems, the `iptables` interface provides access to the underlying `netfilter` firewall. On Windows systems, `netsh` command line interface provides access to the underlying Windows Firewall. For additional information about firewall configuration, see [Configure Linux iptables Firewall for MongoDB](#) (page 242) and [Configure Windows netsh Firewall for MongoDB](#) (page 246).

For best results and to minimize overall exposure, ensure that *only* traffic from trusted sources can reach [mongod](#) (page 925) and [mongos](#) (page 938) instances and that the [mongod](#) (page 925) and [mongos](#) (page 938) instances can only connect to trusted outputs.

### **See also:**

For MongoDB deployments on Amazon's web services, see the [Amazon EC2<sup>6</sup>](#) page, which addresses Amazon's Security Groups and other EC2-specific security features.

## **Virtual Private Networks**

Virtual private networks, or VPNs, make it possible to link two networks over an encrypted and limited-access trusted network. Typically MongoDB users who use VPNs use SSL rather than IPSEC VPNs for performance issues.

Depending on configuration and implementation, VPNs provide for certificate validation and a choice of encryption protocols, which requires a rigorous level of authentication and identification of all clients. Furthermore, because

---

<sup>6</sup><http://docs.mongodb.org/ecosystem/platforms/amazon-ec2>

VPNs provide a secure tunnel, by using a VPN connection to control access to your MongoDB instance, you can prevent tampering and “man-in-the-middle” attacks.

## 5.2.4 Security and MongoDB API Interfaces

The following section contains strategies to limit risks related to MongoDB’s available interfaces including JavaScript, HTTP, and REST interfaces.

### JavaScript and the Security of the `mongo` Shell

The following JavaScript evaluation behaviors of the `mongo` (page 942) shell represents risk exposures.

#### JavaScript Expression or JavaScript File

The `mongo` (page 942) program can evaluate JavaScript expressions using the command line `--eval` option. Also, the `mongo` (page 942) program can evaluate a JavaScript file (`.js`) passed directly to it (e.g. `mongo someFile.js`).

Because the `mongo` (page 942) program evaluates the JavaScript without validating the input, this behavior presents a vulnerability.

#### `.mongorc.js` File

If a `.mongorc.js` file exists<sup>7</sup>, the `mongo` (page 942) shell will evaluate a `.mongorc.js` file before starting. You can disable this behavior by passing the `mongo --norc` option.

### HTTP Status Interface

The HTTP status interface provides a web-based interface that includes a variety of operational data, logs, and status reports regarding the `mongod` (page 925) or `mongos` (page 938) instance. The HTTP interface is always available on the port numbered 1000 greater than the primary `mongod` (page 925) port. By default, the HTTP interface port is 28017, but is indirectly set using the `port` (page 991) option which allows you to configure the primary `mongod` (page 925) port.

Without the `rest` (page 997) setting, this interface is entirely read-only, and limited in scope; nevertheless, this interface may represent an exposure. To disable the HTTP interface, set the `nohttpinterface` (page 996) run time option or the `--nohttpinterface` command line option. See also *Configuration Options* (page 239).

### REST API

The REST API to MongoDB provides additional information and write access on top of the HTTP Status interface. While the REST API does not provide any support for insert, update, or remove operations, it does provide administrative access, and its accessibility represents a vulnerability in a secure environment. The REST interface is *disabled* by default, and is not recommended for production use.

If you must use the REST API, please control and limit access to the REST API. The REST API does not include any support for authentication, even when running with `auth` (page 993) enabled.

See the following documents for instructions on restricting access to the REST API interface:

<sup>7</sup> On Linux and Unix systems, `mongo` (page 942) reads the `.mongorc.js` file from `$HOME/.mongorc.js` (i.e. `~/.mongorc.js`). On Windows, `mongo.exe` reads the `.mongorc.js` file from `%HOME%.mongorc.js` or `%HOMEDRIVE%%HOMEPATH%.mongorc.js`.

- [Configure Linux iptables Firewall for MongoDB \(page 242\)](#)
- [Configure Windows netsh Firewall for MongoDB \(page 246\)](#)

## 5.3 Security Tutorials

The following tutorials provide instructions for enabling and using the security features available in MongoDB.

[Network Security Tutorials \(page 242\)](#) Ensure that the underlying network configuration supports a secure operating environment for MongoDB deployments, and appropriately limits access to MongoDB deployments.

[Configure Linux iptables Firewall for MongoDB \(page 242\)](#) Basic firewall configuration patterns and examples for `iptables` on Linux systems.

[Configure Windows netsh Firewall for MongoDB \(page 246\)](#) Basic firewall configuration patterns and examples for `netsh` on Windows systems.

[Connect to MongoDB with SSL \(page 249\)](#) SSL allows MongoDB clients to support encrypted connections to `mongod` (page 925) instances.

[Access Control Tutorials \(page 254\)](#) MongoDB's access control system provides role-based access control for limiting access to MongoDB deployments. These tutorials describe procedures relevant for the operation and maintenance of this access control system.

[Enable Authentication \(page 255\)](#) Describes the process for enabling authentication for MongoDB deployments.

[Create a User Administrator \(page 255\)](#) Create users with special permissions to create, modify, and remove other users, as well as administer authentication credentials (e.g. passwords).

[Add a User to a Database \(page 257\)](#) Create non-administrator users using MongoDB's role-based authentication system.

[Deploy MongoDB with Kerberos Authentication \(page 259\)](#) Describes the process, for MongoDB Enterprise, used to enable and implement a Kerberos-based authentication system for MongoDB deployments.

[Create a Vulnerability Report \(page 263\)](#) Report a vulnerability in MongoDB.

### 5.3.1 Network Security Tutorials

The following tutorials provide information on handling network security for MongoDB.

[Configure Linux iptables Firewall for MongoDB \(page 242\)](#) Basic firewall configuration patterns and examples for `iptables` on Linux systems.

[Configure Windows netsh Firewall for MongoDB \(page 246\)](#) Basic firewall configuration patterns and examples for `netsh` on Windows systems.

[Connect to MongoDB with SSL \(page 249\)](#) SSL allows MongoDB clients to support encrypted connections to `mongod` (page 925) instances.

#### Configure Linux iptables Firewall for MongoDB

On contemporary Linux systems, the `iptables` program provides methods for managing the Linux Kernel's netfilter or network packet filtering capabilities. These firewall rules make it possible for administrators to control what hosts can connect to the system, and limit risk exposure by limiting the hosts that can connect to a system.

This document outlines basic firewall configurations for `iptables` firewalls on Linux. Use these approaches as a starting point for your larger networking organization. For a detailed overview of security practices and risk management for MongoDB, see [Security Concepts](#) (page 237).

### See also:

For MongoDB deployments on Amazon's web services, see the [Amazon EC2<sup>8</sup>](#) page, which addresses Amazon's Security Groups and other EC2-specific security features.

## Overview

Rules in `iptables` configurations fall into chains, which describe the process for filtering and processing specific streams of traffic. Chains have an order, and packets must pass through earlier rules in a chain to reach later rules. This document addresses only the following two chains:

**INPUT** Controls all incoming traffic.

**OUTPUT** Controls all outgoing traffic.

Given the [default ports](#) (page 239) of all MongoDB processes, you must configure networking rules that permit *only* required communication between your application and the appropriate `mongod` (page 925) and `mongos` (page 938) instances.

Be aware that, by default, the default policy of `iptables` is to allow all connections and traffic unless explicitly disabled. The configuration changes outlined in this document will create rules that explicitly allow traffic from specific addresses and on specific ports, using a default policy that drops all traffic that is not explicitly allowed. When you have properly configured your `iptables` rules to allow only the traffic that you want to permit, you can [Change Default Policy to DROP](#) (page 245).

## Patterns

This section contains a number of patterns and examples for configuring `iptables` for use with MongoDB deployments. If you have configured different ports using the `port` (page 991) configuration setting, you will need to modify the rules accordingly.

**Traffic to and from `mongod` Instances** This pattern is applicable to all `mongod` (page 925) instances running as standalone instances or as part of a *replica set*.

The goal of this pattern is to explicitly allow traffic to the `mongod` (page 925) instance from the application server. In the following examples, replace `<ip-address>` with the IP address of the application server:

```
iptables -A INPUT -s <ip-address> -p tcp --destination-port 27017 -m state --state NEW,ESTABLISHED -j ACCEPT
iptables -A OUTPUT -d <ip-address> -p tcp --source-port 27017 -m state --state ESTABLISHED -j ACCEPT
```

The first rule allows all incoming traffic from `<ip-address>` on port 27017, which allows the application server to connect to the `mongod` (page 925) instance. The second rule, allows outgoing traffic from the `mongod` (page 925) to reach the application server.

---

### Optional

If you have only one application server, you can replace `<ip-address>` with either the IP address itself, such as: `198.51.100.55`. You can also express this using CIDR notation as `198.51.100.55/32`. If you want to permit a larger block of possible IP addresses you can allow traffic from a <http://docs.mongodb.org/manual/2.4/> using one of the following specifications for the `<ip-address>`, as follows:

---

<sup>8</sup><http://docs.mongodb.org/ecosystem/platforms/amazon-ec2>

10.10.10.10/24  
10.10.10.10/255.255.255.0

---

**Traffic to and from mongos Instances** [mongos](#) (page 938) instances provide query routing for [sharded clusters](#). Clients connect to [mongos](#) (page 938) instances, which behave from the client's perspective as [mongod](#) (page 925) instances. In turn, the [mongos](#) (page 938) connects to all [mongod](#) (page 925) instances that are components of the sharded cluster.

Use the same `iptables` command to allow traffic to and from these instances as you would from the [mongod](#) (page 925) instances that are members of the replica set. Take the configuration outlined in the [Traffic to and from mongod Instances](#) (page 243) section as an example.

**Traffic to and from a MongoDB Config Server** Config servers, host the [config database](#) that stores metadata for sharded clusters. Each production cluster has three config servers, initiated using the `mongod --configsvr` option.<sup>9</sup> Config servers listen for connections on port 27019. As a result, add the following `iptables` rules to the config server to allow incoming and outgoing connection on port 27019, for connection to the other config servers.

```
iptables -A INPUT -s <ip-address> -p tcp --destination-port 27019 -m state --state NEW,ESTABLISHED -j ACCEPT
iptables -A OUTPUT -d <ip-address> -p tcp --source-port 27019 -m state --state ESTABLISHED -j ACCEPT
```

Replace `<ip-address>` with the address or address space of *all* the [mongod](#) (page 925) that provide config servers.

Additionally, config servers need to allow incoming connections from all of the [mongos](#) (page 938) instances in the cluster *and* all [mongod](#) (page 925) instances in the cluster. Add rules that resemble the following:

```
iptables -A INPUT -s <ip-address> -p tcp --destination-port 27019 -m state --state NEW,ESTABLISHED -j ACCEPT
iptables -A OUTPUT -d <ip-address> -p tcp --source-port 27019 -m state --state ESTABLISHED -j ACCEPT
```

Replace `<ip-address>` with the address of the [mongos](#) (page 938) instances and the shard [mongod](#) (page 925) instances.

**Traffic to and from a MongoDB Shard Server** For shard servers, running as `mongod --shardsvr`<sup>10</sup> Because the default port number when running with [shardsvr](#) (page 1001) is 27018, you must configure the following `iptables` rules to allow traffic to and from each shard:

```
iptables -A INPUT -s <ip-address> -p tcp --destination-port 27018 -m state --state NEW,ESTABLISHED -j ACCEPT
iptables -A OUTPUT -d <ip-address> -p tcp --source-port 27018 -m state --state ESTABLISHED -j ACCEPT
```

Replace the `<ip-address>` specification with the IP address of all [mongod](#) (page 925). This allows you to permit incoming and outgoing traffic between all shards including constituent replica set members, to:

- all [mongod](#) (page 925) instances in the shard's replica sets.
- all [mongod](#) (page 925) instances in other shards.<sup>11</sup>

Furthermore, shards need to be able make outgoing connections to:

- all [mongos](#) (page 938) instances.
- all [mongod](#) (page 925) instances in the config servers.

Create a rule that resembles the following, and replace the `<ip-address>` with the address of the config servers and the [mongos](#) (page 938) instances:

<sup>9</sup> You can also run a config server by setting the `configsvr` (page 1001) option in a configuration file.

<sup>10</sup> You can also specify the shard server option using the `shardsvr` (page 1001) setting in the configuration file. Shard members are also often conventional replica sets using the default port.

<sup>11</sup> All shards in a cluster need to be able to communicate with all other shards to facilitate [chunk](#) and balancing operations.

```
iptables -A OUTPUT -d <ip-address> -p tcp --source-port 27018 -m state --state ESTABLISHED -j ACCEPT
```

## Provide Access For Monitoring Systems

1. The [mongostat](#) (page 974) diagnostic tool, when running with the `--discover` needs to be able to reach all components of a cluster, including the config servers, the shard servers, and the [mongos](#) (page 938) instances.
2. If your monitoring system needs access the HTTP interface, insert the following rule to the chain:

```
iptables -A INPUT -s <ip-address> -p tcp --destination-port 28017 -m state --state NEW,ESTABLISHED -j ACCEPT
```

Replace `<ip-address>` with the address of the instance that needs access to the HTTP or REST interface. For *all* deployments, you should restrict access to this port to *only* the monitoring instance.

---

### Optional

For shard server [mongod](#) (page 925) instances running with [shardsvr](#) (page 1001), the rule would resemble the following:

```
iptables -A INPUT -s <ip-address> -p tcp --destination-port 28018 -m state --state NEW,ESTABLISHED -j ACCEPT
```

For config server [mongod](#) (page 925) instances running with [configsvr](#) (page 1001), the rule would resemble the following:

```
iptables -A INPUT -s <ip-address> -p tcp --destination-port 28019 -m state --state NEW,ESTABLISHED -j ACCEPT
```

---

## Change Default Policy to DROP

The default policy for `iptables` chains is to allow all traffic. After completing all `iptables` configuration changes, you *must* change the default policy to `DROP` so that all traffic that isn't explicitly allowed as above will not be able to reach components of the MongoDB deployment. Issue the following commands to change this policy:

```
iptables -P INPUT DROP
```

```
iptables -P OUTPUT DROP
```

## Manage and Maintain `iptables` Configuration

This section contains a number of basic operations for managing and using `iptables`. There are various front end tools that automate some aspects of `iptables` configuration, but at the core all `iptables` front ends provide the same basic functionality:

**Make all `iptables` Rules Persistent** By default all `iptables` rules are only stored in memory. When your system restarts, your firewall rules will revert to their defaults. When you have tested a rule set and have guaranteed that it effectively controls traffic you can use the following operations to you should make the rule set persistent.

On Red Hat Enterprise Linux, Fedora Linux, and related distributions you can issue the following command:

```
service iptables save
```

On Debian, Ubuntu, and related distributions, you can use the following command to dump the `iptables` rules to the `/etc/iptables.conf` file:

```
iptables-save > /etc/iptables.conf
```

Run the following operation to restore the network rules:

```
iptables-restore < /etc/iptables.conf
```

Place this command in your `rc.local` file, or in the `/etc/network/if-up.d/iptables` file with other similar operations.q

**List all iptables Rules** To list all of currently applied `iptables` rules, use the following operation at the system shell.

```
iptables --L
```

**Flush all iptables Rules** If you make a configuration mistake when entering `iptables` rules or simply need to revert to the default rule set, you can use the following operation at the system shell to flush all rules:

```
iptables --F
```

If you've already made your `iptables` rules persistent, you will need to repeat the appropriate procedure in the [Make all iptables Rules Persistent](#) (page 245) section.

### Configure Windows netsh Firewall for MongoDB

On Windows Server systems, the `netsh` program provides methods for managing the *Windows Firewall*. These firewall rules make it possible for administrators to control what hosts can connect to the system, and limit risk exposure by limiting the hosts that can connect to a system.

This document outlines basic *Windows Firewall* configurations. Use these approaches as a starting point for your larger networking organization. For a detailed over view of security practices and risk management for MongoDB, see [Security Concepts](#) (page 237).

#### See also:

[Windows Firewall](#)<sup>12</sup> documentation from Microsoft.

### Overview

*Windows Firewall* processes rules in an ordered determined by rule type, and parsed in the following order:

1. Windows Service Hardening
2. Connection security rules
3. Authenticated Bypass Rules
4. Block Rules
5. Allow Rules
6. Default Rules

---

<sup>12</sup><http://technet.microsoft.com/en-us/network/bb545423.aspx>

By default, the policy in *Windows Firewall* allows all outbound connections and blocks all incoming connections.

Given the [default ports](#) (page 239) of all MongoDB processes, you must configure networking rules that permit *only* required communication between your application and the appropriate [mongod.exe](#) (page 948) and [mongos.exe](#) (page 950) instances.

The configuration changes outlined in this document will create rules which explicitly allow traffic from specific addresses and on specific ports, using a default policy that drops all traffic that is not explicitly allowed.

You can configure the *Windows Firewall* with using the `netsh` command line tool or through a windows application. On Windows Server 2008 this application is *Windows Firewall With Advanced Security* in *Administrative Tools*. On previous versions of Windows Server, access the *Windows Firewall* application in the *System and Security* control panel.

The procedures in this document use the `netsh` command line tool.

## Patterns

This section contains a number of patterns and examples for configuring *Windows Firewall* for use with MongoDB deployments. If you have configured different ports using the [port](#) (page 991) configuration setting, you will need to modify the rules accordingly.

**Traffic to and from mongod.exe Instances** This pattern is applicable to all [mongod.exe](#) (page 948) instances running as standalone instances or as part of a [replica set](#). The goal of this pattern is to explicitly allow traffic to the [mongod.exe](#) (page 948) instance from the application server.

```
netsh advfirewall firewall add rule name="Open mongod port 27017" dir=in action=allow protocol=TCP localport=27017
```

This rule allows all incoming traffic to port 27017, which allows the application server to connect to the [mongod.exe](#) (page 948) instance.

*Windows Firewall* also allows enabling network access for an entire application rather than to a specific port, as in the following example:

```
netsh advfirewall firewall add rule name="Allowing mongod" dir=in action=allow program=" C:\mongodb\bin\mongod.exe"
```

You can allow all access for a [mongos.exe](#) (page 950) server, with the following invocation:

```
netsh advfirewall firewall add rule name="Allowing mongos" dir=in action=allow program=" C:\mongodb\bin\mongos.exe"
```

**Traffic to and from mongos.exe Instances** [mongos.exe](#) (page 950) instances provide query routing for [sharded clusters](#). Clients connect to [mongos.exe](#) (page 950) instances, which behave from the client's perspective as [mongod.exe](#) (page 948) instances. In turn, the [mongos.exe](#) (page 950) connects to all [mongod.exe](#) (page 948) instances that are components of the sharded cluster.

Use the same *Windows Firewall* command to allow traffic to and from these instances as you would from the [mongod.exe](#) (page 948) instances that are members of the replica set.

```
netsh advfirewall firewall add rule name="Open mongod shard port 27018" dir=in action=allow protocol=TCP localport=27018
```

**Traffic to and from a MongoDB Config Server** Configuration servers, host the [config database](#) that stores metadata for sharded clusters. Each production cluster has three configuration servers, initiated using the `mongod --configsvr` option.<sup>13</sup> Configuration servers listen for connections on port 27019. As a result, add the following *Windows Firewall* rules to the config server to allow incoming and outgoing connection on port 27019, for connection to the other config servers.

<sup>13</sup> You can also run a config server by setting the `configsvr` (page 1001) option in a configuration file.

```
netsh advfirewall firewall add rule name="Open mongod config svr port 27019" dir=in action=allow protocol=tcp port=27019
```

Additionally, config servers need to allow incoming connections from all of the [mongos.exe](#) (page 950) instances in the cluster *and* all [mongod.exe](#) (page 948) instances in the cluster. Add rules that resemble the following:

```
netsh advfirewall firewall add rule name="Open mongod config svr inbound" dir=in action=allow protocol=tcp port=27018
```

Replace <ip-address> with the addresses of the [mongos.exe](#) (page 950) instances and the shard [mongod.exe](#) (page 948) instances.

**Traffic to and from a MongoDB Shard Server** For shard servers, running as `mongod --shardsvr`<sup>14</sup> Because the default port number when running with `shardsvr` (page 1001) is 27018, you must configure the following *Windows Firewall* rules to allow traffic to and from each shard:

```
netsh advfirewall firewall add rule name="Open mongod shardsvr inbound" dir=in action=allow protocol=tcp port=27018
netsh advfirewall firewall add rule name="Open mongod shardsvr outbound" dir=out action=allow protocol=tcp port=27018
```

Replace the <ip-address> specification with the IP address of all [mongod.exe](#) (page 948) instances. This allows you to permit incoming and outgoing traffic between all shards including constituent replica set members to:

- all [mongod.exe](#) (page 948) instances in the shard's replica sets.
- all [mongod.exe](#) (page 948) instances in other shards.<sup>15</sup>

Furthermore, shards need to be able make outgoing connections to:

- all [mongos.exe](#) (page 950) instances.
- all [mongod.exe](#) (page 948) instances in the config servers.

Create a rule that resembles the following, and replace the <ip-address> with the address of the config servers and the [mongos.exe](#) (page 950) instances:

```
netsh advfirewall firewall add rule name="Open mongod config svr outbound" dir=out action=allow protocol=tcp port=27018
```

### Provide Access For Monitoring Systems

1. The [mongostat](#) (page 974) diagnostic tool, when running with the `--discover` needs to be able to reach all components of a cluster, including the config servers, the shard servers, and the [mongos.exe](#) (page 950) instances.
2. If your monitoring system needs access the HTTP interface, insert the following rule to the chain:

```
netsh advfirewall firewall add rule name="Open mongod HTTP monitoring inbound" dir=in action=allow protocol=tcp port=28018
```

Replace <ip-address> with the address of the instance that needs access to the HTTP or REST interface. For *all* deployments, you should restrict access to this port to *only* the monitoring instance.

---

### Optional

For shard server [mongod.exe](#) (page 948) instances running with `shardsvr` (page 1001), the rule would resemble the following:

```
netsh advfirewall firewall add rule name="Open mongos HTTP monitoring inbound" dir=in action=allow protocol=tcp port=28018
```

<sup>14</sup> You can also specify the shard server option using the `shardsvr` (page 1001) setting in the configuration file. Shard members are also often conventional replica sets using the default port.

<sup>15</sup> All shards in a cluster need to be able to communicate with all other shards to facilitate [chunk](#) and balancing operations.

For config server `mongod.exe` (page 948) instances running with `configsvr` (page 1001), the rule would resemble the following:

```
netsh advfirewall firewall add rule name="Open mongod configsvr HTTP monitoring inbound" dir=in
```

---

## Manage and Maintain *Windows Firewall* Configurations

This section contains a number of basic operations for managing and using `netsh`. While you can use the GUI front ends to manage the *Windows Firewall*, all core functionality is accessible from `netsh`.

**Delete all Windows Firewall Rules** To delete the firewall rule allowing `mongod.exe` (page 948) traffic:

```
netsh advfirewall firewall delete rule name="Open mongod port 27017" protocol=tcp localport=27017
netsh advfirewall firewall delete rule name="Open mongod shard port 27018" protocol=tcp localport=27018
```

**List All Windows Firewall Rules** To return a list of all *Windows Firewall* rules:

```
netsh advfirewall firewall show rule name=all
```

**Reset Windows Firewall** To reset the *Windows Firewall* rules:

```
netsh advfirewall reset
```

**Backup and Restore Windows Firewall Rules** To simplify administration of larger collection of systems, you can export or import firewall systems from different servers) rules very easily on Windows:

Export all firewall rules with the following command:

```
netsh advfirewall export "C:\temp\MongoDBfw.wfw"
```

Replace "`C:\temp\MongoDBfw.wfw`" with a path of your choosing. You can use a command in the following form to import a file created using this operation:

```
netsh advfirewall import "C:\temp\MongoDBfw.wfw"
```

## Connect to MongoDB with SSL

This document outlines the use and operation of MongoDB's SSL support. SSL allows MongoDB clients to support encrypted connections to `mongod` (page 925) instances.

---

**Note:** The default distribution of MongoDB<sup>16</sup> does **not** contain support for SSL. To use SSL, you must either build MongoDB locally passing the “`--ssl`” option to `scons` or use MongoDB Enterprise<sup>17</sup>.

---

These instructions outline the process for getting started with SSL and assume that you have already installed a build of MongoDB that includes SSL support and that your client driver supports SSL.

---

<sup>16</sup><http://www.mongodb.org/downloads>

<sup>17</sup><http://www.mongodb.com/products/mongodb-enterprise>

## Configure mongod and mongos for SSL

**Combine SSL Certificate and Key File** Before you can use SSL, you must have a .pem file that contains the public key certificate and private key. MongoDB can use any valid SSL certificate. To generate a self-signed certificate and private key, use a command that resembles the following:

```
cd /etc/ssl/
openssl req -new -x509 -days 365 -nodes -out mongodb-cert.crt -keyout mongodb-cert.key
```

This operation generates a new, self-signed certificate with no passphrase that is valid for 365 days. Once you have the certificate, concatenate the certificate and private key to a .pem file, as in the following example:

```
cat mongodb-cert.key mongodb-cert.crt > mongodb.pem
```

**Set Up mongod and mongos with SSL Certificate and Key** To use SSL in your MongoDB deployment, include the following run-time options with [mongod](#) (page 925) and [mongos](#) (page 938):

- [sslOnNormalPorts](#) (page 1003)
- [sslPEMKeyFile](#) (page 1003) with the .pem file that contains the SSL certificate and key.

Consider the following syntax for [mongod](#) (page 925):

```
mongod --sslOnNormalPorts --sslPEMKeyFile <pem>
```

For example, given an SSL certificate located at /etc/ssl/mongodb.pem, configure [mongod](#) (page 925) to use SSL encryption for all connections with the following command:

```
mongod --sslOnNormalPorts --sslPEMKeyFile /etc/ssl/mongodb.pem
```

---

### Note:

- Specify <pem> with the full path name to the certificate.
- If the private key portion of the <pem> is encrypted, specify the encryption password with the [sslPEMKeyPassword](#) (page 1003) option.
- You may also specify these options in the [configuration file](#) (page 990), as in the following example:

```
sslOnNormalPorts = true
sslPEMKeyFile = /etc/ssl/mongodb.pem
```

---

To connect, to [mongod](#) (page 925) and [mongos](#) (page 938) instances using SSL, the [mongo](#) (page 942) shell and MongoDB tools must include the --ssl option. See [SSL Configuration for Clients](#) (page 252) for more information on connecting to [mongod](#) (page 925) and [mongos](#) (page 938) running with SSL.

**Set Up mongod and mongos with Certificate Validation** To set up [mongod](#) (page 925) or [mongos](#) (page 938) for SSL encryption using an SSL certificate signed by a certificate authority, include the following run-time options during startup:

- [sslOnNormalPorts](#) (page 1003)
- [sslPEMKeyFile](#) (page 1003) with the name of the .pem file that contains the signed SSL certificate and key.
- [sslCAFile](#) (page 1004) with the name of the .pem file that contains the root certificate chain from the Certificate Authority.

Consider the following syntax for [mongod](#) (page 925):

---

```
mongod --sslOnNormalPorts --sslPEMKeyFile <pem> --sslCAFile <ca>
```

For example, given a signed SSL certificate located at /etc/ssl/mongodb.pem and the certificate authority file at /etc/ssl/ca.pem, you can configure `mongod` (page 925) for SSL encryption as follows:

```
mongod --sslOnNormalPorts --sslPEMKeyFile /etc/ssl/mongodb.pem --sslCAFile /etc/ssl/ca.pem
```

---

**Note:**

- Specify the <pem> file and the <ca> file with either the full path name or the relative path name.
- If the <pem> is encrypted, specify the encryption password with the `sslPEMKeyPassword` (page 1003) option.
- You may also specify these options in the *configuration file* (page 990), as in the following example:

```
sslOnNormalPorts = true
sslPEMKeyFile = /etc/ssl/mongodb.pem
sslCAFile = /etc/ssl/ca.pem
```

---

To connect, to `mongod` (page 925) and `mongos` (page 938) instances using SSL, the `mongo` (page 942) tools must include the both the `--ssl` and `--sslPEMKeyFile` option. See *SSL Configuration for Clients* (page 252) for more information on connecting to `mongod` (page 925) and `mongos` (page 938) running with SSL.

**Block Revoked Certificates for Clients** To prevent clients with revoked certificates from connecting, include the `sslCRLFile` (page 1004) to specify a .pem file that contains revoked certificates.

For example, the following `mongod` (page 925) with SSL configuration includes the `sslCRLFile` (page 1004) setting:

```
mongod --sslOnNormalPorts --sslCRLFile /etc/ssl/ca-crl.pem --sslPEMKeyFile /etc/ssl/mongodb.pem --ssl...
```

Clients with revoked certificates in the /etc/ssl/ca-crl.pem will not be able to connect to this `mongod` (page 925) instance.

**Validate Only if a Client Presents a Certificate** In most cases it is important to ensure that clients present valid certificates. However, if you have clients that cannot present a client certificate, or are transitioning to using a certificate authority you may only want to validate certificates from clients that present a certificate.

If you want to bypass validation for clients that don't present certificates, include the `sslWeakCertificateValidation` (page 1004) run-time option with `mongod` (page 925) and `mongos` (page 938). If the client does not present a certificate, no validation occurs. These connections, though not validated, are still encrypted using SSL.

For example, consider the following `mongod` (page 925) with an SSL configuration that includes the `sslWeakCertificateValidation` (page 1004) setting:

```
mongod --sslOnNormalPorts --sslWeakCertificateValidation --sslPEMKeyFile /etc/ssl/mongodb.pem --ssl...
```

Then, clients can connect either with the option `--ssl` and **no** certificate or with the option `--ssl` and a **valid** certificate. See *SSL Configuration for Clients* (page 252) for more information on SSL connections for clients.

---

**Note:** If the client presents a certificate, the certificate must be a valid certificate.

All connections, including those that have not presented certificates are encrypted using SSL.

**Run in FIPS Mode** If your [mongod](#) (page 925) or [mongos](#) (page 938) is running on a system with an OpenSSL library configured with the FIPS 140-2 module, you can run [mongod](#) (page 925) or [mongos](#) (page 938) in FIPS mode, with the [sslFIPSMode](#) (page 1004) setting.

## SSL Configuration for Clients

Clients must have support for SSL to work with a [mongod](#) (page 925) or a [mongos](#) (page 938) instance that has SSL support enabled. The current versions of the Python, Java, Ruby, Node.js, .NET, and C++ drivers have support for SSL, with full support coming in future releases of other drivers.

**mongo SSL Configuration** For SSL connections, you must use the [mongo](#) (page 942) shell built with SSL support or distributed with MongoDB Enterprise. To support SSL, [mongo](#) (page 942) has the following settings:

- `--ssl`
- `--sslPEMKeyFile` (page 1003) with the name of the `.pem` file that contains the SSL certificate and key.
- `--sslCAFile` (page 1004) with the name of the `.pem` file that contains the certificate from the Certificate Authority.
- `--sslPEMKeyPassword` (page 1003) option if the client certificate-key file is encrypted.

**Connect to MongoDB Instance with SSL Encryption** To connect to a [mongod](#) (page 925) or [mongos](#) (page 938) instance that requires *only a SSL encryption mode* (page 250), start [mongo](#) (page 942) shell with `--ssl`, as in the following:

```
mongo --ssl
```

**Connect to MongoDB Instance that Requires Client Certificates** To connect to a [mongod](#) (page 925) or [mongos](#) (page 938) that requires *CA-signed client certificates* (page 250), start the [mongo](#) (page 942) shell with `--ssl` and the `--sslPEMKeyFile` (page 1003) option to specify the signed certificate-key file, as in the following:

```
mongo --ssl --sslPEMKeyFile /etc/ssl/client.pem
```

**Connect to MongoDB Instance that Validates when Presented with a Certificate** To connect to a [mongod](#) (page 925) or [mongos](#) (page 938) instance that *only requires valid certificates when the client presents a certificate* (page 251), start [mongo](#) (page 942) shell either with the `--ssl ssl` and `no` certificate or with the `--ssl ssl` and a `valid` signed certificate.

For example, if [mongod](#) (page 925) is running with weak certificate validation, both of the following [mongo](#) (page 942) shell clients can connect to that [mongod](#) (page 925):

```
mongo --ssl
mongo --ssl --sslPEMKeyFile /etc/ssl/client.pem
```

---

**Important:** If the client presents a certificate, the certificate must be valid.

---

**MMS Monitoring Agent** The Monitoring agent will also have to connect via SSL in order to gather its stats. Because the agent already utilizes SSL for its communications to the MMS servers, this is just a matter of enabling SSL support in MMS itself on a per host basis.

Use the “Edit” host button (i.e. the pencil) on the Hosts page in the MMS console to enable SSL.

Please see the MMS documentation<sup>18</sup> for more information about MMS configuration.

**PyMongo** Add the “ssl=True” parameter to a PyMongo `MongoClient`<sup>19</sup> to create a MongoDB connection to an SSL MongoDB instance:

```
from pymongo import MongoClient
c = MongoClient(host="mongodb.example.net", port=27017, ssl=True)
```

To connect to a replica set, use the following operation:

```
from pymongo import MongoReplicaSetClient
c = MongoReplicaSetClient("mongodb.example.net:27017",
 replicaSet="mysetname", ssl=True)
```

PyMongo also supports an “ssl=true” option for the MongoDB URI:

```
mongodb://mongodb.example.net:27017/?ssl=true
```

**Java** Consider the following example “SSLApp.java” class file:

```
import com.mongodb.*;
import javax.net.ssl.SSLSocketFactory;

public class SSLApp {

 public static void main(String args[]) throws Exception {

 MongoClientOptions o = new MongoClientOptions.Builder()
 .socketFactory(SSLocketFactory.getDefault())
 .build();

 MongoClient m = new MongoClient("localhost", o);

 DB db = m.getDB("test");
 DBCollection c = db.getCollection("foo");

 System.out.println(c.findOne());
 }
}
```

**Ruby** The recent versions of the Ruby driver have support for connections to SSL servers. Install the latest version of the driver with the following command:

```
gem install mongo
```

Then connect to a standalone instance, using the following form:

```
require 'rubygems'
require 'mongo'

connection = MongoClient.new('localhost', 27017, :ssl => true)
```

Replace `connection` with the following if you’re connecting to a replica set:

---

<sup>18</sup><http://mms.mongodb.com/help>

<sup>19</sup>[http://api.mongodb.org/python/current/api/pymongo/mongo\\_client.html#pymongo.mongo\\_client.MongoClient](http://api.mongodb.org/python/current/api/pymongo/mongo_client.html#pymongo.mongo_client.MongoClient)

```
connection = MongoReplicaSetClient.new(['localhost:27017'],
 ['localhost:27018'],
 :ssl => true)
```

Here, `mongod` (page 925) instance run on “localhost:27017” and “localhost:27018”.

**Node.JS (`node-mongodb-native`)** In the `node-mongodb-native`<sup>20</sup> driver, use the following invocation to connect to a `mongod` (page 925) or `mongos` (page 938) instance via SSL:

```
var db1 = new Db(MONGODB, new Server("127.0.0.1", 27017,
 { auto_reconnect: false, poolSize:4, ssl:ssl }));
```

To connect to a replica set via SSL, use the following form:

```
var replSet = new ReplSetServers([
 new Server(RS.host, RS.ports[1], { auto_reconnect: true }),
 new Server(RS.host, RS.ports[0], { auto_reconnect: true }),
],
{rs_name:RS.name, ssl:ssl}
);
```

**.NET** As of release 1.6, the .NET driver supports SSL connections with `mongod` (page 925) and `mongos` (page 938) instances. To connect using SSL, you must add an option to the connection string, specifying `ssl=true` as follows:

```
var connectionString = "mongodb://localhost/?ssl=true";
var server = MongoServer.Create(connectionString);
```

The .NET driver will validate the certificate against the local trusted certificate store, in addition to providing encryption of the server. This behavior may produce issues during testing if the server uses a self-signed certificate. If you encounter this issue, add the `sslverifycertificate=false` option to the connection string to prevent the .NET driver from validating the certificate, as follows:

```
var connectionString = "mongodb://localhost/?ssl=true&sslverifycertificate=false";
var server = MongoServer.Create(connectionString);
```

### 5.3.2 Access Control Tutorials

The following tutorials provide instructions on how to enable authentication and limit access for users with privilege roles.

[Enable Authentication \(page 255\)](#) Describes the process for enabling authentication for MongoDB deployments.

[Create a User Administrator \(page 255\)](#) Create users with special permissions to to create, modify, and remove other users, as well as administer authentication credentials (e.g. passwords).

[Add a User to a Database \(page 257\)](#) Create non-administrator users using MongoDB’s role-based authentication system.

[Change a User’s Password \(page 258\)](#) Only user administrators can edit credentials. This tutorial describes the process for editing an existing user’s password.

[Generate a Key File \(page 258\)](#) Use key file to allow the components of MongoDB sharded cluster or replica set to mutually authenticate.

[Deploy MongoDB with Kerberos Authentication \(page 259\)](#) Describes the process, for MongoDB Enterprise, used to enable and implement a Kerberos-based authentication system for MongoDB deployments.

---

<sup>20</sup><https://github.com/mongodb/node-mongodb-native>

## Enable Authentication

Enable authentication using the [auth](#) (page 993) or [keyFile](#) (page 993) settings. Use [auth](#) (page 993) for standalone instances, and [keyFile](#) (page 993) with [replica sets](#) and [sharded clusters](#). [keyFile](#) (page 993) implies [auth](#) (page 993) and allows members of a MongoDB deployment to authenticate internally.

Authentication requires at least one administrator user in the `admin` database. You can create the user before enabling authentication or after enabling authentication.

### See also:

[Deploy MongoDB with Kerberos Authentication](#) (page 259).

## Procedures

You can enable authentication using either of the following procedures, depending

### Create the Administrator Credentials and then Enable Authentication

1. Start the `mongod` (page 925) or `mongos` (page 938) instance *without* the [auth](#) (page 993) or [keyFile](#) (page 993) setting.
2. Create the administrator user as described in [Create a User Administrator](#) (page 255).
3. Re-start the `mongod` (page 925) or `mongos` (page 938) instance with the [auth](#) (page 993) or [keyFile](#) (page 993) setting.

### Enable Authentication and then Create Administrator

1. Start the `mongod` (page 925) or `mongos` (page 938) instance with the [auth](#) (page 993) or [keyFile](#) (page 993) setting.
2. Connect to the instance on the same system so that you can authenticate using the [localhost exception](#) (page 256).
3. Create the administrator user as described in [Create a User Administrator](#) (page 255).

## Query Authenticated Users

If you have the [userAdmin](#) (page 267) or [userAdminAnyDatabase](#) (page 269) role on a database, you can query authenticated users in that database with the following operation:

```
db.system.users.find()
```

## Create a User Administrator

In a MongoDB deployment, users with either the [userAdmin](#) (page 267) or [userAdminAnyDatabase](#) (page 269) roles are *effective* administrative “superusers”. Users with either of these roles can create and modify any other users and can assign them any privileges. The user also can grant *itself* any privileges. In production deployments, this user should have *no other roles* and should only administer users and privileges.

This should be the first user created for a MongoDB deployment. This user can then create all other users in the system.

---

**Important:** The [userAdminAnyDatabase](#) (page 269) user can grant itself and any other user full access to the entire MongoDB instance. The credentials to log in as this user should be carefully controlled.

Users with the [userAdmin](#) (page 267) and [userAdminAnyDatabase](#) (page 269) privileges are not the same as the UNIX root superuser in that this role confers **no additional access** beyond user administration. These users cannot perform administrative operations or read or write data without first conferring themselves with additional permissions.

---

**Note:** The [userAdmin](#) (page 267) is a database specific privilege, and *only* grants a user the ability to administer users on a single database. However, for the admin database, [userAdmin](#) (page 267) allows a user the ability to gain [userAdminAnyDatabase](#) (page 269), and so for the admin database **only** these roles are effectively the same.

---

### Create a User Administrator

1. Connect to the [mongod](#) (page 925) or [mongos](#) (page 938) by either:
  - Authenticating as an existing user with the [userAdmin](#) (page 267) or [userAdminAnyDatabase](#) (page 269) role.
  - Authenticating using the [localhost exception](#) (page 256). When creating the first user in a deployment, you must authenticate using the [localhost exception](#) (page 256).
2. Switch to the admin database:

```
db = db.getSiblingDB('admin')
```

3. Add the user with either the [userAdmin](#) (page 267) role or [userAdminAnyDatabase](#) (page 269) role, and only that role, by issuing a command similar to the following, where <username> is the username and <password> is the password:

```
db.addUser({ user: "<username>",
 pwd: "<password>",
 roles: ["userAdminAnyDatabase"] })
```

To authenticate as this user, you must authenticate against the admin database.

### Authenticate with Full Administrative Access via Localhost

If there are no users for the admin database, you can connect with full administrative access via the localhost interface. This bypass exists to support bootstrapping new deployments. This approach is useful, for example, if you want to run [mongod](#) (page 925) or [mongos](#) (page 938) with authentication before creating your first user.

To authenticate via localhost, connect to the [mongod](#) (page 925) or [mongos](#) (page 938) from a client running on the same system. Your connection will have full administrative access.

To disable the localhost bypass, set the [enableLocalhostAuthBypass](#) (page 1005) parameter using [setParameter](#) (page 999) during startup:

```
mongod --setParameter enableLocalhostAuthBypass=0
```

---

**Note:** For versions of MongoDB 2.2 prior to 2.2.4, if [mongos](#) (page 938) is running with [keyFile](#) (page 993), then all users connecting over the localhost interface must authenticate, even if there aren't any users in the admin database. Connections on localhost are not correctly granted full access on sharded systems that run those versions.

MongoDB 2.2.4 resolves this issue.

---

**Note:** In version 2.2, you cannot add the first user to a sharded cluster using the localhost connection. If you are

---

running a 2.2 sharded cluster and want to enable authentication, you must deploy the cluster and add the first user to the `admin` database before restarting the cluster to run with `keyFile` (page 993).

---

## Add a User to a Database

To add a user to a database you must authenticate to that database as a user with the `userAdmin` (page 267) or `userAdminAnyDatabase` (page 269) role. If you have not first created a user with one of those roles, do so as described in *Create a User Administrator* (page 255).

When adding a user to multiple databases, you must define the user *for each database*. See *Password Hashing Insecurity* (page 273) for important security information.

To add a user, pass the `db.addUser()` (page 875) method a well formed *privilege document* (page 265) that contains the user's credentials and privileges. The `db.addUser()` (page 875) method adds the document to the database's `system.users` (page 270) collection.

**Changed in version 2.4:** In previous versions of MongoDB, you could change an existing user's password by calling `db.addUser()` (page 875) again with the user's username and their updated password. Anything specified in the `addUser()` method would override the existing information for that user. In newer versions of MongoDB, this will result in a duplicate key error.

To change a user's password in version 2.4 or newer, see *Change a User's Password* (page 258).

For the structure of a privilege document, see `system.users` (page 270). For descriptions of user roles, see *User Privilege Roles in MongoDB* (page 265).

---

### Example

The following creates a user named `Alice` in the `products` database and gives her `readWrite` and `dbAdmin` privileges.

```
use products
db.addUser({ user: "Alice",
 pwd: "Moon1234",
 roles: ["readWrite", "dbAdmin"]
 })
```

---

### Example

The following creates a user named `Bob` in the `admin` database. The *privilege document* (page 270) uses Bob's credentials from the `products` database and assigns him `userAdmin` privileges.

```
use admin
db.addUser({ user: "Bob",
 userSource: "products",
 roles: ["userAdmin"]
 })
```

---

### Example

The following creates a user named `Carlos` in the `admin` database and gives him `readWrite` access to the `config` database, which lets him change certain settings for sharded clusters, such as to disable the balancer.

```
db = db.getSiblingDB('admin')
db.addUser({ user: "Carlos",
 pwd: "Moon1234",
 roles: ["clusterAdmin"],
 })
```

```
 otherDBRoles: { config: ["readWrite"]
} })
```

Only the `admin` database supports the `otherDBRoles` (page 271) field.

---

## Change a User's Password

New in version 2.4.

To change a user's password, you must have the `userAdmin` (page 267) role on the database that contains the definition of the user whose password you wish to change.

To update the password, pass the user's username and the new desired password to the `db.changeUserPassword()` (page 877) method.

---

### Example

The following operation changes the reporting user's password to SOhSS3TbYhxusooLiW8ypJPxmt1oOfL:

```
db = db.getSiblingDB('records')
db.changeUserPassword("reporting", "SOhSS3TbYhxusooLiW8ypJPxmt1oOfL")
```

---

**Note:** In previous versions of MongoDB, you could change an existing user's password by calling `db.addUser()` (page 875) again with the user's username and their updated password. Anything specified in the `addUser()` method would override the existing information for that user. In newer versions of MongoDB, this will result in a duplicate key error.

For more about changing a user's password prior to version 2.4, see: [Add a User to a Database](#) (page 257).

---

## Generate a Key File

This section describes how to generate a key file to store authentication information. After generating a key file, specify the key file using the `keyFile` (page 993) option when starting a `mongod` (page 925) or `mongos` (page 938) instance.

A key file must be less than one kilobyte in size and may only contain characters in the base64 set. The key file must not have group or world permissions on UNIX systems. Key file permissions are not checked on Windows systems.

### Generate a Key File

Use the following `openssl` command at the system shell to generate pseudo-random content for a key file:

```
openssl rand -base64 741
```

---

**Note:** Key file permissions are not checked on Windows systems.

---

### Key File Properties

Be aware that MongoDB strips whitespace characters (e.g. `x0d`, `x09`, and `x20`,) for cross-platform convenience. As a result, the following operations produce identical keys:

```
echo -e "my secret key" > key1
echo -e "my secret key\n" > key2
echo -e "my secret key" > key3
echo -e "my\r\nsecret\r\nkey\r\n" > key4
```

## Deploy MongoDB with Kerberos Authentication

New in version 2.4.

MongoDB Enterprise supports authentication using a Kerberos service. Kerberos is an industry standard authentication protocol for large client/server system. With Kerberos MongoDB and application ecosystems can take advantage of existing authentication infrastructure and processes.

Setting up and configuring a Kerberos deployment is beyond the scope of this document. In order to use MongoDB with Kerberos, you must have a properly configured Kerberos deployment and the ability to generate a valid *keytab* file for each [mongod](#) (page 925) instance in your MongoDB deployment.

---

**Note:** The following assumes that you have a valid Kerberos keytab file for your realm accessible on your system. The examples below assume that the keytab file is valid and is located at <http://docs.mongodb.org/manual/appendix/mongod-keytab/> and is *only* accessible to the user that runs the [mongod](#) (page 925) process.

---

### Process Overview

To run MongoDB with Kerberos support, you must:

- Configure a Kerberos service principal for each [mongod](#) (page 925) and [mongos](#) (page 938) instance in your MongoDB deployment.
- Generate and distribute keytab files for each MongoDB component (i.e. [mongod](#) (page 925) and [mongos](#) (page 938)) in your deployment. Ensure that you *only* transmit keytab files over secure channels.
- Optional. Start the [mongod](#) (page 925) instance *without* [auth](#) (page 993) and create users inside of MongoDB that you can use to bootstrap your deployment.
- Start [mongod](#) (page 925) and [mongos](#) (page 938) with the KRB5\_KTNAME environment variable as well as a number of required run time options.
- If you did not create Kerberos user accounts, you can use the [localhost exception](#) (page 256) to create users at this point until you create the first user on the [admin](#) database.
- Authenticate clients, including the [mongo](#) (page 942) shell using Kerberos.

### Operations

**Create Users and Privilege Documents** For every user that you want to be able to authenticate using Kerberos, you must create corresponding privilege documents in the [system.users](#) (page 270) collection to provision access to users. Consider the following document:

```
{
 user: "application/reporting@EXAMPLE.NET",
 roles: ["read"],
 userSource: "$external"
}
```

This grants the Kerberos user principal `application/reporting@EXAMPLE.NET` read only access to a database. The `userSource` (page 271) `$external` reference allows `mongod` (page 925) to consult an external source (i.e. Kerberos) to authenticate this user.

In the `mongo` (page 942) shell you can pass the `db.addUser()` (page 875) a user privilege document to provision access to users, as in the following operation:

```
db = db.getSiblingDB("records")
db.addUser({
 "user": "application/reporting@EXAMPLE.NET",
 "roles": ["read"],
 "userSource": "$external"
})
```

These operations grants the Kerberos user `application/reporting@EXAMPLE.NET` access to the `records` database.

To remove access to a user, use the `remove()` (page 844) method, as in the following example:

```
db.system.users.remove({ user: "application/reporting@EXAMPLE.NET" })
```

To modify a user document, use `update` (page 50) operations on documents in the `system.users` (page 270) collection.

### See also:

`system.users Privilege Documents` (page 270) and `User Privilege Roles in MongoDB` (page 265).

**Start `mongod` with Kerberos Support** Once you have provisioned privileges to users in the `mongod` (page 925), and obtained a valid keytab file, you must start `mongod` (page 925) using a command in the following form:

```
env KRB5_KTNAME=<path to keytab file> <mongod invocation>
```

For successful operation with `mongod` (page 925) use the following run time options in addition to your normal default configuration options:

- `--setParameter` with the `authenticationMechanisms=GSSAPI` argument to enable support for Kerberos.
- `--auth` to enable authentication.
- `--keyFile` to allow components of a single MongoDB deployment to communicate with each other, if needed to support replica set and sharded cluster operations. `keyFile` (page 993) implies `auth` (page 993).

For example, consider the following invocation:

```
env KRB5_KTNAME=/opt/mongodb/mongod.keytab \
 /opt/mongodb/bin/mongod --dbpath /opt/mongodb/data \
 --fork --logpath /opt/mongodb/log/mongod.log \
 --auth --setParameter authenticationMechanisms=GSSAPI
```

You can also specify these options using the configuration file. As in the following:

```
/opt/mongodb/mongod.conf, Example configuration file.

fork = true
auth = true

dbpath = /opt/mongodb/data
logpath = /opt/mongodb/log/mongod.log
setParameter = authenticationMechanisms=GSSAPI
```

To use this configuration file, start `mongod` (page 925) as in the following:

```
env KRB5_KTNAME=/opt/mongodb/mongod.keytab \
 /opt/mongodb/bin/mongod --config /opt/mongodb/mongod.conf
```

To start a `mongos` (page 938) instance using Kerberos, you must create a Kerberos service principal and deploy a keytab file for this instance, and then start the `mongos` (page 938) with the following invocation:

```
env KRB5_KTNAME=/opt/mongodb/mongos.keytab \
 /opt/mongodb/bin/mongos
 --configdb shard0.example.net,shard1.example.net,shard2.example.net \
 --setParameter authenticationMechanisms=GSSAPI \
 --keyFile /opt/mongodb/mongos.keyfile
```

If you encounter problems when trying to start `mongod` (page 925) or `mongos` (page 938), please see the *troubleshooting section* (page 262) for more information.

---

**Important:** Before users can authenticate to MongoDB using Kerberos you must [create users](#) (page 259) and grant them privileges within MongoDB. If you have not created users when you start MongoDB with Kerberos you can use the [localhost authentication exception](#) (page 256) to add users. See the [Create Users and Privilege Documents](#) (page 259) section and the [User Privilege Roles in MongoDB](#) (page 265) document for more information.

---

**Authenticate mongo Shell with Kerberos** To connect to a `mongod` (page 925) instance using the `mongo` (page 942) shell you must begin by using the `kinit` program to initialize and authenticate a Kerberos session. Then, start a `mongo` (page 942) instance, and use the `db.auth()` (page 876) method, to authenticate against the special `$external` database, as in the following operation:

```
use $external
db.auth({ mechanism: "GSSAPI", user: "application/reporting@EXAMPLE.NET" })
```

Alternately, you can authenticate using command line options to `mongo` (page 942), as in the following equivalent example:

```
mongo --authenticationMechanism=GSSAPI
 --authenticationDatabase='$external' \
 --username application/reporting@EXAMPLE.NET
```

These operations authenticate the Kerberos principal name `application/reporting@EXAMPLE.NET` to the connected `mongod` (page 925), and will automatically acquire all available privileges as needed.

**Use MongoDB Drivers to Authenticate with Kerberos** At the time of release, the C++, Java, C#, and Python drivers all provide support for Kerberos authentication to MongoDB. Consider the following tutorials for more information:

- [Java<sup>21</sup>](#)
- [C#<sup>22</sup>](#)
- [C++<sup>23</sup>](#)
- [Python<sup>24</sup>](#)

<sup>21</sup><http://docs.mongodb.org/ecosystem/tutorial/authenticate-with-java-driver/>

<sup>22</sup><http://docs.mongodb.org/ecosystem/tutorial/authenticate-with-csharp-driver/>

<sup>23</sup><http://docs.mongodb.org/ecosystem/tutorial/authenticate-with-cpp-driver/>

<sup>24</sup><http://api.mongodb.org/python/current/examples/authentication.html>

**Kerberos and the HTTP Console** MongoDB does not support kerberizing the [HTTP Console](#)<sup>25</sup>.

## Troubleshooting

**Kerberos Configuration Checklist** If you’re having trouble getting [mongod](#) (page 925) to start with Kerberos, there are a number of Kerberos-specific issues that can prevent successful authentication. As you begin troubleshooting your Kerberos deployment, ensure that:

- The [mongod](#) (page 925) is from MongoDB Enterprise.
- You are not using the [HTTP Console](#)<sup>26</sup>. MongoDB Enterprise does not support Kerberos authentication over the HTTP Console interface.
- You have a valid keytab file specified in the environment running the [mongod](#) (page 925). For the [mongod](#) (page 925) instance running on the db0.example.net host, the service principal should be `mongodb/db0.example.net`.
- DNS allows the [mongod](#) (page 925) to resolve the components of the Kerberos infrastructure. You should have both A and PTR records (i.e. forward and reverse DNS) for the system that runs the [mongod](#) (page 925) instance.
- The canonical system hostname of the system that runs the [mongod](#) (page 925) instance is the resolvable fully qualified domain for this host. Test system hostname resolution with the `hostname -f` command at the system prompt.
- Both the Kerberos *KDC* and the system running [mongod](#) (page 925) instance must be able to resolve each other using DNS <sup>27</sup>
- The time systems of the systems running the [mongod](#) (page 925) instances and the Kerberos infrastructure are synchronized. Time differences greater than 5 minutes will prevent successful authentication.

If you still encounter problems with Kerberos, you can start both [mongod](#) (page 925) and [mongo](#) (page 942) (or another client) with the environment variable `KRB5_TRACE` set to different files to produce more verbose logging of the Kerberos process to help further troubleshooting, as in the following example:

```
env KRB5_KTNAME=/opt/mongodb/mongod.keytab \
KRB5_TRACE=/opt/mongodb/log/mongodb-kerberos.log \
/opt/mongodb/bin/mongod --dbpath /opt/mongodb/data \
--fork --logpath /opt/mongodb/log/mongod.log \
--auth --setParameter authenticationMechanisms=GSSAPI
```

**Common Error Messages** In some situations, MongoDB will return error messages from the GSSAPI interface if there is a problem with the Kerberos service.

`GSSAPI error in client while negotiating security context.`

This error occurs on the client and reflects insufficient credentials or a malicious attempt to authenticate.

If you receive this error ensure that you’re using the correct credentials and the correct fully qualified domain name when connecting to the host.

`GSSAPI error acquiring credentials.`

This error only occurs when attempting to start the [mongod](#) (page 925) or [mongos](#) (page 938) and reflects improper configuration of system hostname or a missing or incorrectly configured keytab file. If

<sup>25</sup><http://docs.mongodb.org/ecosystem/tools/http-interface/#http-console>

<sup>26</sup><http://docs.mongodb.org/ecosystem/tools/http-interface/#http-console>

<sup>27</sup> By default, Kerberos attempts to resolve hosts using the content of the `/etc/krb5.conf` before using DNS to resolve hosts.

you encounter this problem, consider all the items in the [Kerberos Configuration Checklist](#) (page 262), in particular:

- examine the keytab file, with the following command:

```
klist -k <keytab>
```

Replace `<keytab>` with the path to your keytab file.

- check the configured hostname for your system, with the following command:

```
hostname -f
```

Ensure that this name matches the name in the keytab file, or use the `saslHostName` (page 1007) to pass MongoDB the correct hostname.

**Enable the Traditional MongoDB Authentication Mechanism** For testing and development purposes you can enable both the Kerberos (i.e. GSSAPI) authentication mechanism in combination with the traditional MongoDB challenge/response authentication mechanism (i.e. MONGODB-CR), using the following `setParameter` (page 999) run-time option:

```
mongod --setParameter authenticationMechanisms=GSSAPI,MONGODB-CR
```

**Warning:** All `keyFile` (page 993) *internal* authentication between members of a *replica set* or *sharded cluster* still uses the MONGODB-CR authentication mechanism, even if MONGODB-CR is not enabled. All client authentication will still use Kerberos.

### 5.3.3 Create a Vulnerability Report

If you believe you have discovered a vulnerability in MongoDB or have experienced a security incident related to MongoDB, please report the issue it can be avoided in the future.

To report an issue, use either [jira.mongodb.org<sup>28</sup>](https://jira.mongodb.org) (preferred) or email. MongoDB, Inc responds to vulnerability notifications within 48 hours.

#### Information to Provide

All vulnerability reports should contain as much information as possible so MongoDB's developers can move quickly to resolve the issue. In particular, please include the following:

- The name of the product.
- *Common Vulnerability* information, if applicable, including:
  - CVSS (Common Vulnerability Scoring System) Score.
  - CVE (Common Vulnerability and Exposures) Identifier.
- Contact information, including an email address and/or phone number, if applicable.

<sup>28</sup><https://jira.mongodb.org>

## Create the Report in Jira

[jira.mongodb.org](https://jira.mongodb.org)<sup>29</sup> is the preferred method of communication regarding MongoDB.

Submit a ticket in the [Core Server Security](https://jira.mongodb.org/browse/SECURITY/)<sup>30</sup> project at: <https://jira.mongodb.org/browse/SECURITY/>. The ticket number will become the reference identification for the issue for the lifetime of the issue. You can use this identifier for tracking purposes.

## Send the Report via Email

While Jira is the preferred reporting method, you may also report vulnerabilities via email to [security@mongodb.com](mailto:security@mongodb.com)<sup>31</sup>.

You may encrypt email using MongoDB's public key at <http://docs.mongodb.org/10gen-gpg-key.asc>.

MongoDB, Inc. responds to vulnerability reports sent via email with a response email that contains a reference number for a Jira ticket posted to the [SECURITY](https://jira.mongodb.org/browse/SECURITY)<sup>32</sup> project.

## Evaluation of a Vulnerability Report

MongoDB, Inc. validates all submitted vulnerabilities and uses Jira to track all communications regarding a vulnerability, including requests for clarification or additional information. If needed, MongoDB representatives set up a conference call to exchange information regarding the vulnerability.

## Disclosure

MongoDB, Inc. requests that you do *not* publicly disclose any information regarding the vulnerability or exploit the issue until it has had the opportunity to analyze the vulnerability, to respond to the notification, and to notify key users, customers, and partners.

The amount of time required to validate a reported vulnerability depends on the complexity and severity of the issue. MongoDB, Inc. takes all required vulnerabilities very seriously and will always ensure that there is a clear and open channel of communication with the reporter.

After validating an issue, MongoDB, Inc. coordinates public disclosure of the issue with the reporter in a mutually agreed timeframe and format. If required or requested, the reporter of a vulnerability will receive credit in the published security bulletin.

## 5.4 Security Reference

### 5.4.1 Security Methods in the mongo Shell

| Name                                               | Description                                                                              |
|----------------------------------------------------|------------------------------------------------------------------------------------------|
| <a href="#">db.addUser()</a> (page 875)            | Adds a user to a database, and allows administrators to configure the user's privileges. |
| <a href="#">db.auth()</a> (page 876)               | Authenticates a user to a database.                                                      |
| <a href="#">db.changeUserPassword()</a> (page 877) | Changes an existing user's password.                                                     |

<sup>29</sup><https://jira.mongodb.org>

<sup>30</sup><https://jira.mongodb.org/browse/SECURITY>

<sup>31</sup>[security@mongodb.com](mailto:security@mongodb.com)

<sup>32</sup><https://jira.mongodb.org/browse/SECURITY>

## 5.4.2 Security Reference Documentation

[User Privilege Roles in MongoDB \(page 265\)](#) Reference on user privilege roles and corresponding access.

[system.users Privilege Documents \(page 270\)](#) Reference on documents used to store user credentials and privilege roles.

[Default MongoDB Port \(page 272\)](#) List of default ports used by MongoDB.

### User Privilege Roles in MongoDB

New in version 2.4: In version 2.4, MongoDB adds support for the following user roles:

#### Roles

Changed in version 2.4.

Roles in MongoDB provide users with a set of specific privileges, on specific logical databases. Users may have multiple roles and may have different roles on different logical database. Roles only grant privileges and never limit access: if a user has `read` (page 265) *and* `readWriteAnyDatabase` (page 269) permissions on the `records` database, that user will be able to write data to the `records` database.

---

**Note:** By default, MongoDB 2.4 is backwards-compatible with the MongoDB 2.2 access control roles. You can explicitly disable this backwards-compatibility by setting the `supportCompatibilityForPrivilegeDocuments` (page 1007) option to 0 during startup, as in the following command-line invocation of MongoDB:

```
mongod --setParameter supportCompatibilityForPrivilegeDocuments=0
```

In general, you should set this option if your deployment does not need to support legacy user documents. Typically legacy user documents are only useful during the upgrade process and while you migrate applications to the updated privilege document form.

---

See [privilege documents](#) (page 270) and [Delegated Credentials for MongoDB Authentication](#) (page 272) for more information about permissions and authentication in MongoDB.

#### Database User Roles

##### `read`

Provides users with the ability to read data from any collection within a specific logical database. This includes `find()` (page 816) and the following *database commands*:

- [aggregate](#) (page 694)
- [checkShardingIndex](#) (page 736)
- [cloneCollectionAsCapped](#) (page 749)
- [collStats](#) (page 763)
- [count](#) (page 695)
- [dataSize](#) (page 769)
- [dbHash](#) (page 761)
- [dbStats](#) (page 767)
- [distinct](#) (page 696)

- [filemd5](#) (page 750)
- [geoNear](#) (page 708)
- [geoSearch](#) (page 709)
- [geoWalk](#) (page 710)
- [group](#) (page 697)
- [mapReduce](#) (page 701) (inline output only.)
- [text](#) (page 715) (beta feature.)

#### **readWrite**

Provides users with the ability to read from or write to any collection within a specific logical database. Users with [readWrite](#) (page 266) have access to all of the operations available to [read](#) (page 265) users, as well as the following basic write operations: [insert\(\)](#) (page 832), [remove\(\)](#) (page 844), and [update\(\)](#) (page 849).

Additionally, users with the [readWrite](#) (page 266) have access to the following *database commands*:

- [cloneCollection](#) (page 748) (as the target database.)
- [convertToCapped](#) (page 749)
- [create](#) (page 747) (and to create collections implicitly.)
- [drop\(\)](#) (page 812)
- [dropIndexes](#) (page 750)
- [emptycapped](#) (page 803)
- [ensureIndex\(\)](#) (page 814)
- [findAndModify](#) (page 710)
- [mapReduce](#) (page 701) (output to a collection.)
- [renameCollection](#) (page 744) (within the same database.)

## Database Administration Roles

### **dbAdmin**

Provides the ability to perform the following set of administrative operations within the scope of this logical database.

- [clean](#) (page 752)
- [collMod](#) (page 755)
- [collStats](#) (page 763)
- [compact](#) (page 752)
- [convertToCapped](#) (page 749)
- [create](#) (page 747)
- [db.createCollection\(\)](#) (page 878)
- [dbStats](#) (page 767)
- [drop\(\)](#) (page 812)
- [dropIndexes](#) (page 750)
- [ensureIndex\(\)](#) (page 814)

- `indexStats` (page 774)
- `profile` (page 770)
- `reIndex` (page 756)
- `renameCollection` (page 744) (within a single database.)
- `validate` (page 771)

Furthermore, only `dbAdmin` (page 266) has the ability to read the `system.profile` (page 229) collection.

#### **userAdmin**

Allows users to read and write data to the `system.users` (page 270) collection of any database. Users with this role will be able to modify permissions for existing users and create new users. `userAdmin` (page 267) does not restrict the permissions that a user can grant, and a `userAdmin` (page 267) user can grant privileges to themselves or other users in excess of the `userAdmin` (page 267) users' current privileges.

---

**Important:** `userAdmin` (page 267) is effectively the `superuser` role for a specific database. Users with `userAdmin` (page 267) can grant themselves all privileges. However, `userAdmin` (page 267) does not explicitly authorize a user for any privileges beyond user administration.

---

**Note:** The `userAdmin` (page 267) is a database specific privilege, and *only* grants a user the ability to administer users on a single database. However, for the `admin` database, `userAdmin` (page 267) allows a user the ability to gain `userAdminAnyDatabase` (page 269), and so for the `admin` database **only** these roles are effectively the same.

---

## Administrative Roles

#### **clusterAdmin**

`clusterAdmin` (page 267) grants access to several administration operations that affect or present information about the whole system, rather than just a single database. These privileges include but are not limited to `replica set` and `sharded cluster` administrative functions.

`clusterAdmin` (page 267) is only applicable on the `admin` database, and does not confer any access to the `local` or `config` databases.

Specifically, users with the `clusterAdmin` (page 267) role have access to the following operations:

- `addShard` (page 736)
- `closeAllDatabases` (page 749)
- `connPoolStats` (page 765)
- `connPoolSync` (page 752)
- `_cpuProfilerStart`
- `_cpuProfilerStop`
- `cursorInfo` (page 769)
- `diagLogging` (page 769)
- `dropDatabase` (page 746)
- `enableSharding` (page 736)
- `flushRouterConfig` (page 735)
- `fsync` (page 751)

- `db.fsyncUnlock()` (page 886)
- `getCmdLineOpts` (page 769)
- `getLog` (page 779)
- `getParameter` (page 757)
- `getShardMap` (page 737)
- `getShardVersion` (page 737)
- `hostInfo` (page 780)
- `db.currentOp()` (page 879)
- `db.killOp()` (page 890)
- `listDatabases` (page 761)
- `listShards` (page 737)
- `logRotate` (page 760)
- `moveChunk` (page 742)
- `movePrimary` (page 743)
- `netstat` (page 770)
- `removeShard` (page 737)
- `repairDatabase` (page 757)
- `replSetFreeze` (page 726)
- `replSetGetStatus` (page 726)
- `replSetInitiate` (page 728)
- `replSetMaintenance` (page 729)
- `replSetReconfig` (page 729)
- `replSetStepDown` (page 730)
- `replSetSyncFrom` (page 730)
- `resync` (page 731)
- `serverStatus` (page 782)
- `setParameter` (page 756)
- `setShardVersion` (page 737)
- `shardCollection` (page 738)
- `shardingState` (page 738)
- `shutdown` (page 759)
- `splitChunk` (page 741)
- `splitVector` (page 742)
- `split` (page 739)
- `top` (page 774)
- `touch` (page 759)

- [unsetSharding](#) (page 739)

For some cluster administration operations, MongoDB requires read and write access to the `local` or `config` databases. You must specify this access separately from [clusterAdmin](#) (page 267). See the [Combined Access](#) (page 269) section for more information.

## Any Database Roles

---

**Note:** You must specify the following “any” database roles on the `admin` databases. These roles apply to all databases in a `mongod` (page 925) instance and are roughly equivalent to their single-database equivalents.

If you add any of these roles to a [user privilege document](#) (page 270) outside of the `admin` database, the privilege will have no effect. However, only the specification of the roles must occur in the `admin` database, with [delegated authentication credentials](#) (page 272), users can gain these privileges by authenticating to another database.

---

### `readAnyDatabase`

[readAnyDatabase](#) (page 269) provides users with the same read-only permissions as [read](#) (page 265), except it applies to *all* logical databases in the MongoDB environment.

### `readWriteAnyDatabase`

[readWriteAnyDatabase](#) (page 269) provides users with the same read and write permissions as [readWrite](#) (page 266), except it applies to *all* logical databases in the MongoDB environment.

### `userAdminAnyDatabase`

[userAdminAnyDatabase](#) (page 269) provides users with the same access to user administration operations as [userAdmin](#) (page 267), except it applies to *all* logical databases in the MongoDB environment.

---

**Important:** Because users with [userAdminAnyDatabase](#) (page 269) and [userAdmin](#) (page 267) have the ability to create and modify permissions in addition to their own level of access, this role is *effectively* the MongoDB system superuser. However, [userAdminAnyDatabase](#) (page 269) and [userAdmin](#) (page 267) do not explicitly authorize a user for any privileges beyond user administration.

---

### `dbAdminAnyDatabase`

[dbAdminAnyDatabase](#) (page 269) provides users with the same access to database administration operations as [dbAdmin](#) (page 266), except it applies to *all* logical databases in the MongoDB environment.

## Combined Access

Some operations are only available to users that have multiple roles. Consider the following:

`sh.status()` (page 910) Requires [clusterAdmin](#) (page 267) and [read](#) (page 265) access to the `config` (page 565) database.

`applyOps` (page 732), `eval` (page 722)<sup>33</sup> Requires [readWriteAnyDatabase](#) (page 269), [userAdminAnyDatabase](#) (page 269), [dbAdminAnyDatabase](#) (page 269) and [clusterAdmin](#) (page 267) (on the `admin` database.)

Some operations related to cluster administration are not available to users who *only* have the [clusterAdmin](#) (page 267) role:

`rs.conf()` (page 896) Requires [read](#) (page 265) on the `local` database.

`sh.addShard()` (page 903) Requires [readWrite](#) (page 266) on the `config` database.

## system.users Privilege Documents

Changed in version 2.4.

### Overview

The documents in the <database>.system.users (page 270) collection store credentials and user privilege information used by the authentication system to provision access to users in the MongoDB system. See [User Privilege Roles in MongoDB](#) (page 265) for more information about access roles, and [Security](#) (page 235) for an overview of security in MongoDB.

### Data Model

<database>.system.users

Changed in version 2.4.

Documents in the <database>.system.users (page 270) collection stores credentials and *user roles* (page 265) for users who have access to the database. Consider the following prototypes of user privilege documents:

```
{
 user: "<username>",
 pwd: "<hash>",
 roles: []
}

{
 user: "<username>",
 userSource: "<database>",
 roles: []
}
```

---

**Note:** The `pwd` (page 270) and `userSource` (page 271) fields are mutually exclusive. A single document cannot contain both.

---

The following privilege document with the `otherDBRoles` (page 271) field is only supported on the `admin` database:

```
{
 user: "<username>",
 userSource: "<database>",
 otherDBRoles: {
 <database0> : [],
 <database1> : []
 },
 roles: []
}
```

Consider the content of the following *fields* in the system.users (page 270) documents:

<database>.system.users.user

`user` (page 270) is a string that identifies each user. Users exist in the context of a single logical database; however, users from one database may obtain access in another database by way of the `otherDBRoles` (page 271) field on the `admin` database, the `userSource` (page 271) field, or the [Any Database Roles](#) (page 269).

**<database>.system.users.pwd**

`pwd` (page 270) holds a *hashed* shared secret used to authenticate the `user` (page 270). `pwd` (page 270) field is mutually exclusive with the `userSource` (page 271) field.

**<database>.system.users.roles**

`roles` (page 271) holds an array of user roles. The available roles are:

- `read` (page 265)
- `readWrite` (page 266)
- `dbAdmin` (page 266)
- `userAdmin` (page 267)
- `clusterAdmin` (page 267)
- `readAnyDatabase` (page 269)
- `readWriteAnyDatabase` (page 269)
- `userAdminAnyDatabase` (page 269)
- `dbAdminAnyDatabase` (page 269)

See [Roles](#) (page 265) for full documentation of all available user roles.

**<database>.system.users.userSource**

A string that holds the name of the database that contains the credentials for the user. If `userSource` (page 271) is `$external`, then MongoDB will use an external resource, such as Kerberos, for authentication credentials.

---

**Note:** In the current release, the only external authentication source is Kerberos, which is only available in MongoDB Enterprise.

---

Use `userSource` (page 271) to ensure that a single user's authentication credentials are only stored in a single location in a `mongod` (page 925) instance's data.

A `userSource` (page 271) and `user` (page 270) pair identifies a unique user in a MongoDB system.

**admin.system.users.otherDBRoles**

A document that holds one or more fields with a name that is the name of a database in the MongoDB instance with a value that holds a list of roles this user has on other databases. Consider the following example:

```
{
 user: "admin",
 userSource: "$external",
 roles: ["clusterAdmin"],
 otherDBRoles:
 {
 config: ["read"],
 records: ["dbadmin"]
 }
}
```

This user has the following privileges:

- `clusterAdmin` (page 267) on the `admin` database,
- `read` (page 265) on the `config` (page 565) database, and
- `dbAdmin` (page 266) on the `records` database.

## Delegated Credentials for MongoDB Authentication

New in version 2.4.

With a new document format in the `system.users` (page 270) collection, MongoDB now supports the ability to delegate authentication credentials to other sources and databases. The `userSource` (page 271) field in these documents forces MongoDB to use another source for credentials.

Consider the following document in a `system.users` (page 270) collection in a database named `accounts`:

```
{
 user: "application0",
 pwd: "YvuolxMtaycghk2GMrzmImkG4073jzAw2AliMRul",
 roles: []
}
```

Then for *every* database that the `application0` user requires access, add documents to the `system.users` (page 270) collection that resemble the following:

```
{
 user: "application0",
 roles: ['readWrite'],
 userSource: "accounts"
}
```

To gain privileges to databases where the `application0` has access, you must first authenticate to the `accounts` database.

## Disable Legacy Privilege Documents

By default MongoDB 2.4 includes support for both new, role-based privilege documents style as well 2.2 and earlier privilege documents. MongoDB assumes any privilege document without a `roles` (page 271) field is a 2.2 or earlier document.

To ensure that `mongod` (page 925) instances will only provide access to users defined with the new role-based privilege documents, use the following `setParameter` (page 999) run-time option:

```
mongod --setParameter supportCompatibilityForPrivilegeDocuments=0
```

## Default MongoDB Port

The following table lists the default ports used by MongoDB:

| Default Port | Description                                                                                                                                                                           |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 27017        | The default port for <code>mongod</code> (page 925) and <code>mongos</code> (page 938) instances. You can change this port with <code>port</code> (page 991) or <code>--port</code> . |
| 27018        | The default port when running with <code>--shardsvr</code> runtime operation or <code>shardsvr</code> (page 1001) setting.                                                            |
| 27019        | The default port when running with <code>--configsvr</code> runtime operation or <code>configsvr</code> (page 1001) setting.                                                          |
| 28017        | The default port for the web status page. The web status page is always accessible at a port number that is 1000 greater than the port determined by <code>port</code> (page 991).    |

### 5.4.3 Security Release Notes Alerts

*Security Release Notes* (page 273) Security vulnerability for password.

#### Security Release Notes

##### Access to `system.users` Collection

Changed in version 2.4.

In 2.4, only users with the `userAdmin` role have access to the `system.users` collection.

In version 2.2 and earlier, the read-write users of a database all have access to the `system.users` collection, which contains the user names and user password hashes.<sup>34</sup>

##### Password Hashing Insecurity

If a user has the same password for multiple databases, the hash will be the same. A malicious user could exploit this to gain access on a second database using a different user's credentials.

As a result, always use unique username and password combinations for each database.

Thanks to Will Urbanski, from Dell SecureWorks, for identifying this issue.

---

<sup>34</sup> Read-only users do not have access to the `system.users` collection.



---

## Aggregation

---

Aggregations operations process data records and return computed results. Aggregation operations group values from multiple documents together, and can perform a variety of operations on the grouped data to return a single result. MongoDB provides three ways to perform aggregation: the [aggregation pipeline](#) (page 279), the [map-reduce function](#) (page 282), and [single purpose aggregation methods and commands](#) (page 283).

**Aggregation Introduction** (page 275) A high-level introduction to aggregation.

**Aggregation Concepts** (page 279) Introduces the use and operation of the data aggregation modalities available in MongoDB.

**Aggregation Pipeline** (page 279) The aggregation pipeline is a framework for performing aggregation tasks, modeled on the concept of data processing pipelines. Using this framework, MongoDB passes the documents of a single collection through a pipeline. The pipeline transforms the documents into aggregated results, and is accessed through the [aggregate](#) (page 694) database command.

**Map-Reduce** (page 282) Map-reduce is a generic multi-phase data aggregation modality for processing quantities of data. MongoDB provides map-reduce with the [mapReduce](#) (page 701) database command.

**Single Purpose Aggregation Operations** (page 283) MongoDB provides a collection of specific data aggregation operations to support a number of common data aggregation functions. These operations include returning counts of documents, distinct values of a field, and simple grouping operations.

**Aggregation Mechanics** (page 286) Details internal optimization operations, limits, support for sharded collections, and concurrency concerns.

**Aggregation Examples** (page 290) Examples and tutorials for data aggregation operations in MongoDB.

**Aggregation Reference** (page 306) References for all aggregation operations material for all data aggregation methods in MongoDB.

## 6.1 Aggregation Introduction

Aggregations are operations that process data records and return computed results. MongoDB provides a rich set of aggregation operations that examine and perform calculations on the data sets. Running data aggregation on the [mongod](#) (page 925) instance simplifies application code and limits resource requirements.

Like queries, aggregation operations in MongoDB use [collections](#) of documents as an input and return results in the form of one or more documents.

## 6.1.1 Aggregation Modalities

### Aggregation Pipelines

MongoDB 2.2 introduced a new [aggregation framework](#) (page 279), modeled on the concept of data processing pipelines. Documents enter a multi-stage pipeline that transforms the documents into an aggregated result.

The most basic pipeline stages provide *filters* that operate like queries and *document transformations* that modify the form of the output document.

Other pipeline operations provide tools for grouping and sorting documents by specific field or fields as well as tools for aggregating the contents of arrays, including arrays of documents. In addition, pipeline stages can use [operators](#) (page 673) for tasks such as calculating the average or concatenating a string.

The pipeline provides efficient data aggregation using native operations within MongoDB, and is the preferred method for data aggregation in MongoDB.

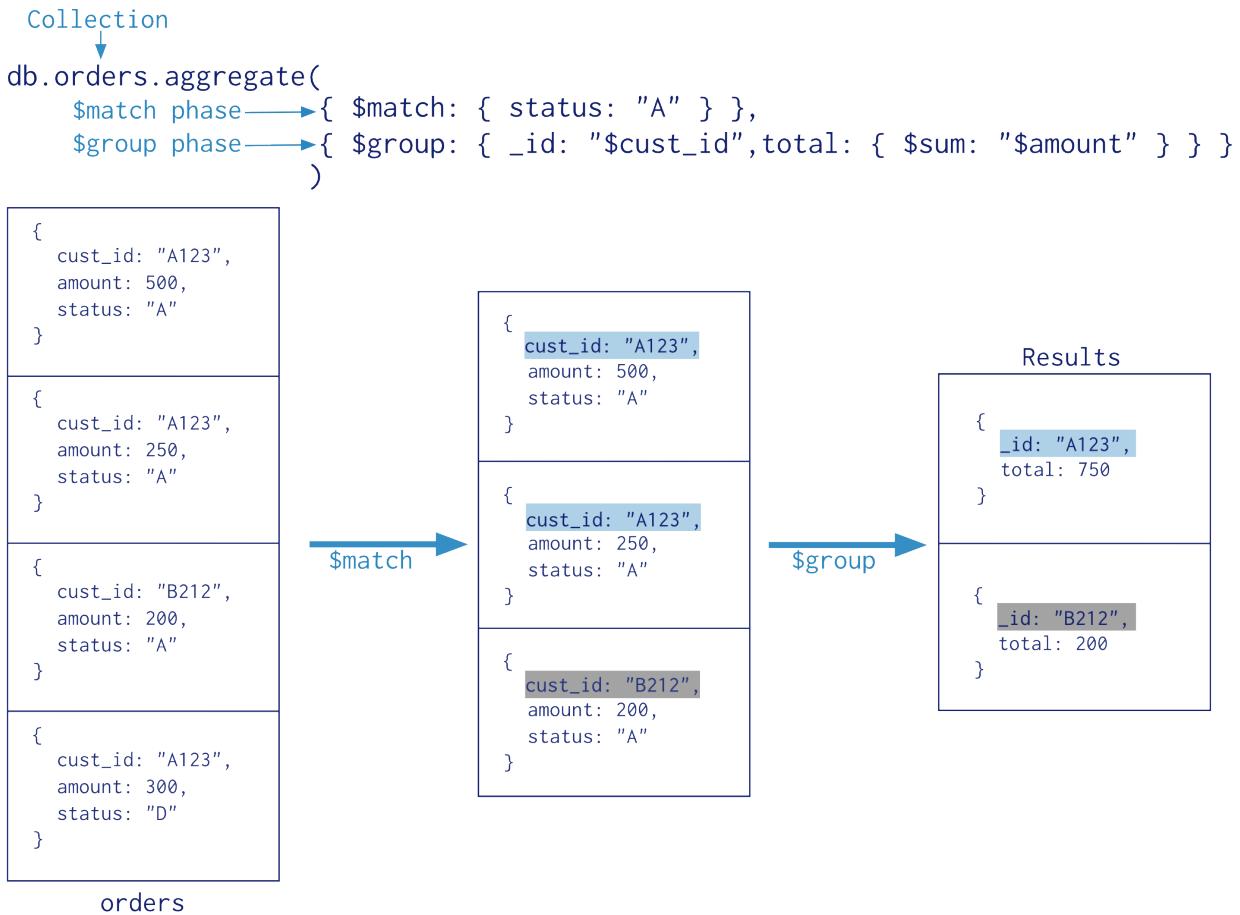


Figure 6.1: Diagram of the annotated aggregation pipeline operation. The aggregation pipeline has two phases: `$match` (page 666) and `$group` (page 669).

### Map-Reduce

MongoDB also provides [map-reduce](#) (page 282) operations to perform aggregation. In general, map-reduce operations have two phases: a *map* stage that processes each document and *emits* one or more objects for each input document,

and *reduce* phase that combines the output of the map operation. Optionally, map-reduce can have a *finalize* stage to make final modifications to the result. Like other aggregation operations, map-reduce can specify a query condition to select the input documents as well as sort and limit the results.

Map-reduce uses custom JavaScript functions to perform the map and reduce operations, as well as the optional *finalize* operation. While the custom JavaScript provide great flexibility compared to the aggregation pipeline, in general, map-reduce is less efficient and more complex than the aggregation pipeline.

Additionally, map-reduce operations can have output sets that exceed the 16 megabyte output limitation of the aggregation pipeline.

### Tip

Starting in MongoDB 2.4, certain `mongo` (page 942) shell functions and properties are inaccessible in map-reduce operations. MongoDB 2.4 also provides support for multiple JavaScript operations to run at the same time. Before MongoDB 2.4, JavaScript code executed in a single thread, raising concurrency issues for map-reduce.

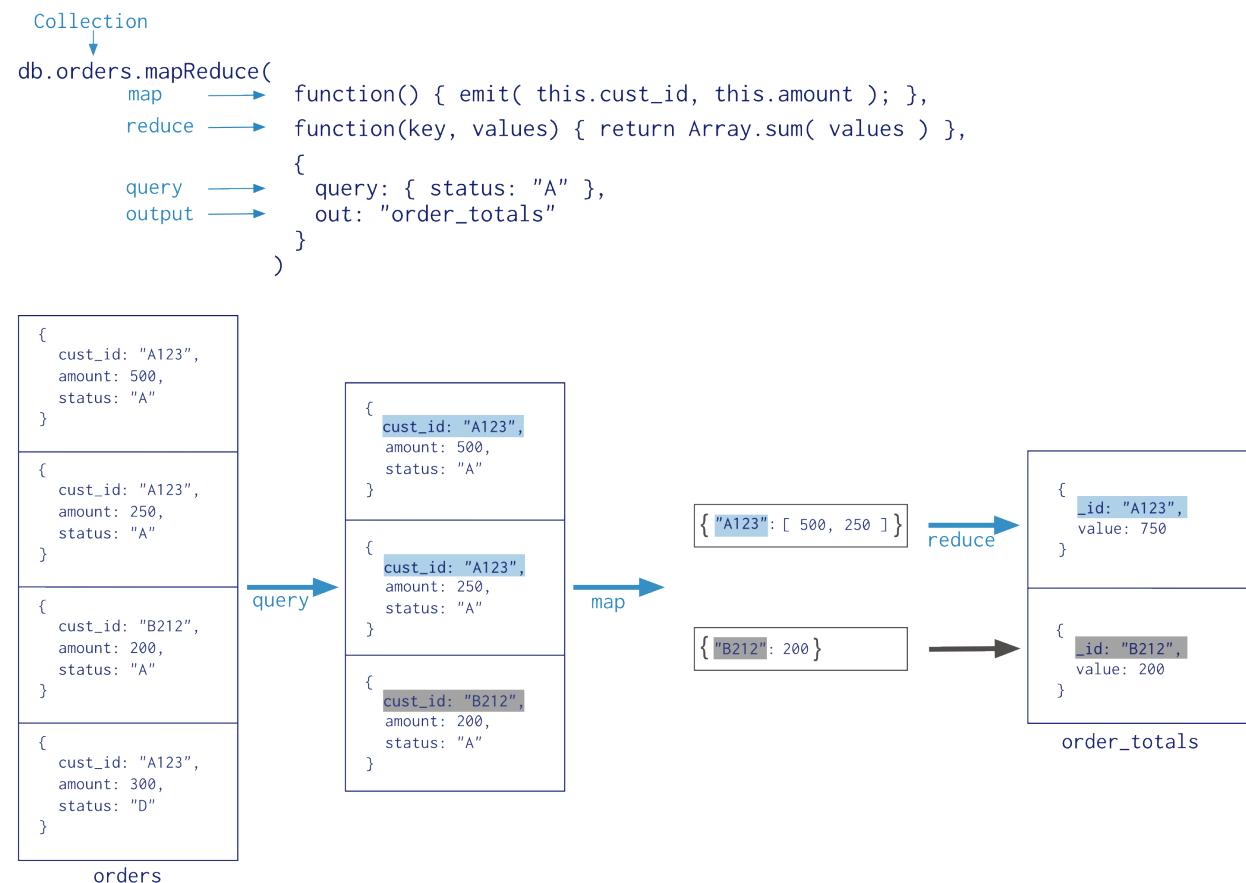


Figure 6.2: Diagram of the annotated map-reduce operation.

## Single Purpose Aggregation Operations

For a number of common *single purpose aggregation operations* (page 283), MongoDB provides special purpose database commands. These common aggregation operations are: returning a count of matching documents, returning the distinct values for a field, and grouping data based on the values of a field. All of these operations aggregate

documents from a single collection. While these operations provide simple access to common aggregation processes, they lack the flexibility and capabilities of the aggregation pipeline and map-reduce.

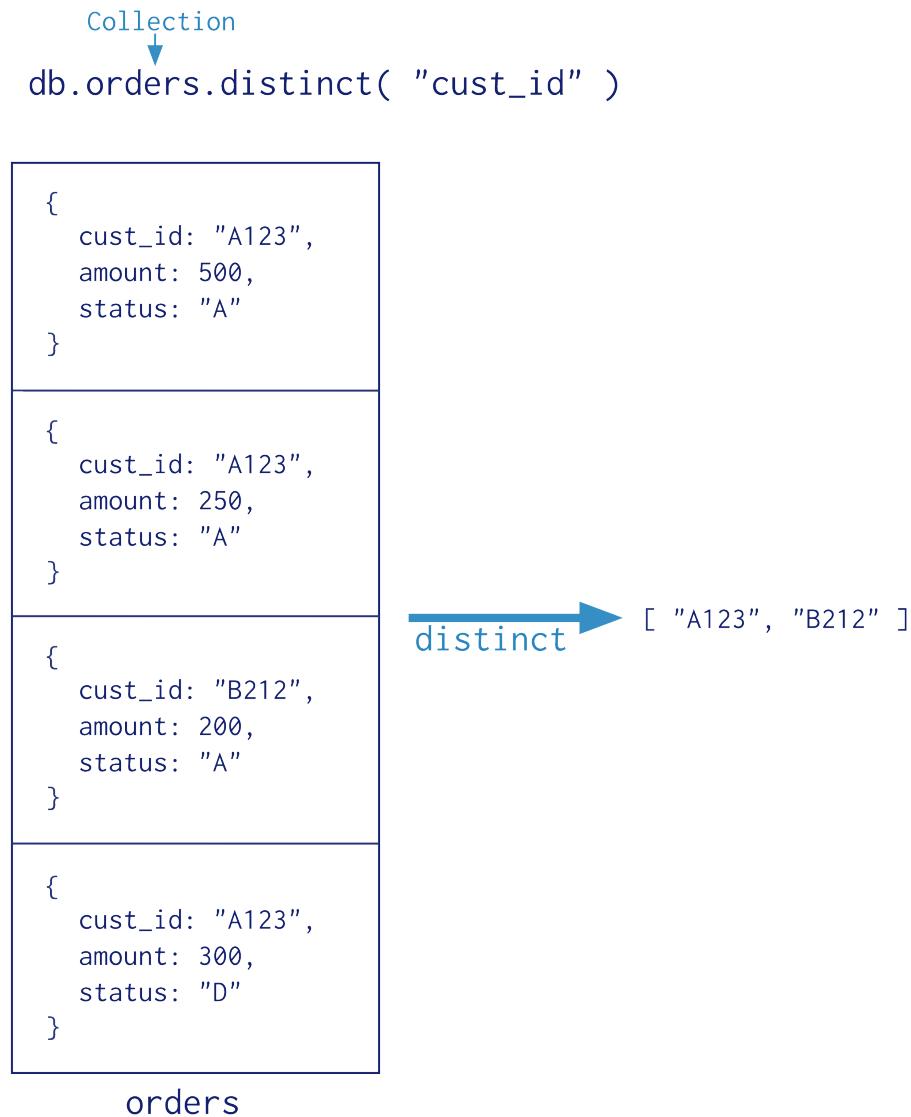


Figure 6.3: Diagram of the annotated distinct operation.

### 6.1.2 Additional Features and Behaviors

Both the aggregation pipeline and map-reduce can operate on a [sharded collection](#) (page 493). Map-reduce operations can also output to a sharded collection. See [Aggregation Pipeline and Sharded Collections](#) (page 288) and [Map-Reduce and Sharded Collections](#) (page 289) for details.

The aggregation pipeline can use indexes to improve its performance during some of its stages. In addition, the aggregation pipeline has an internal optimization phase. See [Pipeline Operators and Indexes](#) (page 281) and [Aggregation Pipeline Optimization](#) (page 286) for details.

For a feature comparison of the aggregation pipeline, map-reduce, and the special group functionality, see [Aggregation](#)

*Commands Comparison* (page 306).

## 6.2 Aggregation Concepts

MongoDB provides the three approaches to aggregation, each with its own strengths and purposes for a given situation. This section describes these approaches and also describes behaviors and limitations specific to each approach. See also the [chart](#) (page 306) that compares the approaches.

**Aggregation Pipeline** (page 279) The aggregation pipeline is a framework for performing aggregation tasks, modeled on the concept of data processing pipelines. Using this framework, MongoDB passes the documents of a single collection through a pipeline. The pipeline transforms the documents into aggregated results, and is accessed through the [aggregate](#) (page 694) database command.

**Map-Reduce** (page 282) Map-reduce is a generic multi-phase data aggregation modality for processing quantities of data. MongoDB provides map-reduce with the [mapReduce](#) (page 701) database command.

**Single Purpose Aggregation Operations** (page 283) MongoDB provides a collection of specific data aggregation operations to support a number of common data aggregation functions. These operations include returning counts of documents, distinct values of a field, and simple grouping operations.

**Aggregation Mechanics** (page 286) Details internal optimization operations, limits, support for sharded collections, and concurrency concerns.

### 6.2.1 Aggregation Pipeline

New in version 2.2.

The aggregation pipeline is a framework for data aggregation modeled on the concept of data processing pipelines. Documents enter a multi-stage pipeline that transforms the documents into an aggregated results.

The aggregation pipeline provides an alternative to [map-reduce](#) and may be the preferred solution for many aggregation tasks where the complexity of map-reduce may be unwarranted.

Aggregation pipeline have some limitations on value types and result size. See [Aggregation Pipeline Limits](#) (page 288) for details on limits and restrictions on the aggregation pipeline.

#### Pipeline

Conceptually, documents from a collection travel through an aggregation pipeline, which transforms these objects as they pass through. For those familiar with UNIX-like shells (e.g. bash,) the concept is analogous to the pipe (i.e. `|`).

The MongoDB aggregation pipeline starts with the documents of a collection and streams the documents from one [pipeline operator](#) (page 664) to the next to process the documents. Each operator in the pipeline transforms the documents as they pass through the pipeline. Pipeline operators do not need to produce one output document for every input document. Operators may generate new documents or filter out documents. Pipeline operators can be repeated in the pipeline.

---

**Important:** The result of aggregation pipeline is a [document](#) and is subject to the  [BSON Document size](#) (page 1015) limit, which is currently 16 megabytes.

See [Pipeline Operators](#) (page 664) for the list of pipeline operators that define the stages.

For example usage of the aggregation pipeline, consider [Aggregation with User Preference Data](#) (page 294) and [Aggregation with the Zip Code Data Set](#) (page 290), as well as the [aggregate](#) (page 694) command and the `db.collection.aggregate()` (page 808) method reference pages.

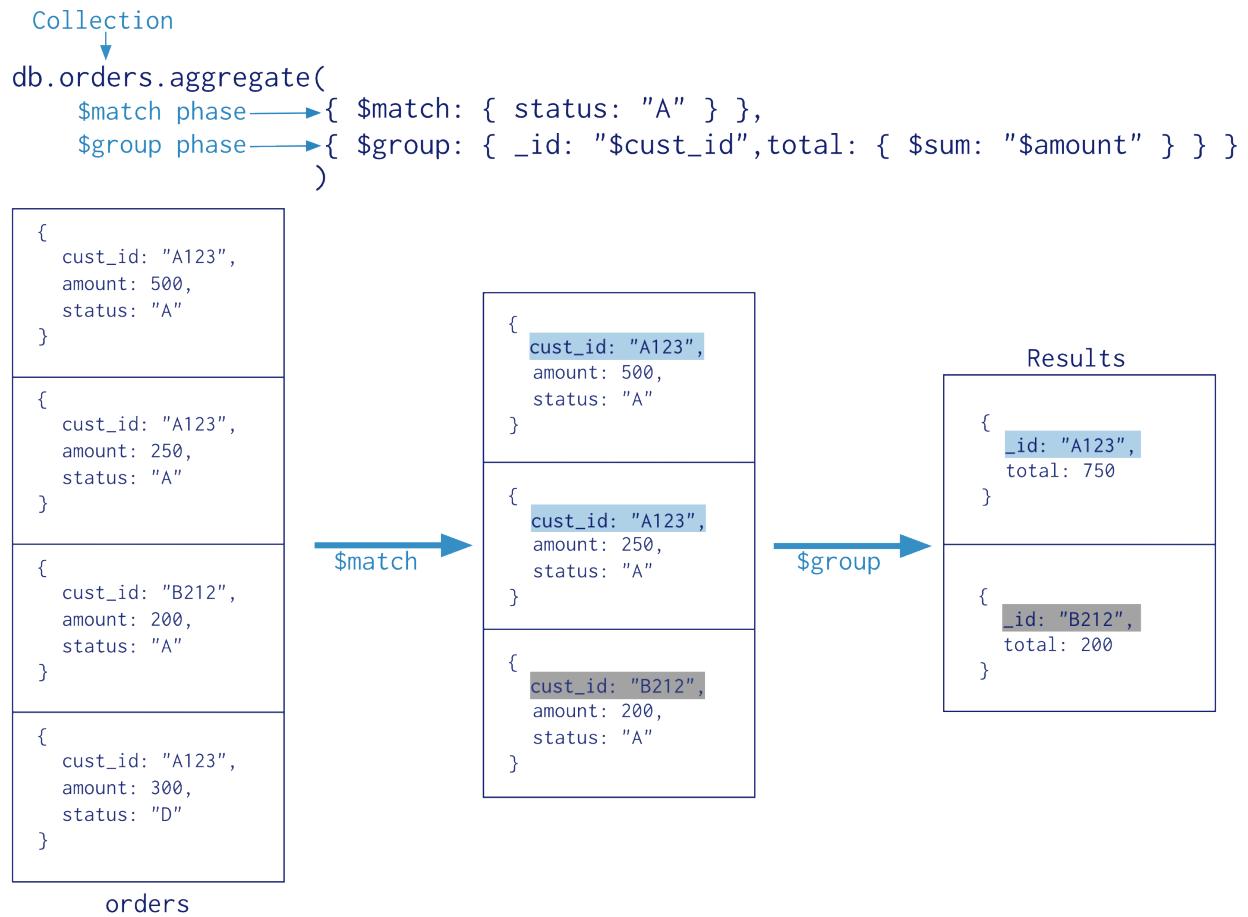


Figure 6.4: Diagram of the annotated aggregation pipeline operation. The aggregation pipeline has two phases: `$match` (page 666) and `$group` (page 669).

## Pipeline Expressions

Each pipeline operator takes a pipeline expression as its operand. Pipeline expressions specify the transformation to apply to the input documents. Expressions have a [document](#) structure and can contain fields, values, and [operators](#) (page 673).

Pipeline expressions can only operate on the current document in the pipeline and cannot refer to data from other documents: expression operations provide in-memory transformation of documents.

Generally, expressions are stateless and are only evaluated when seen by the aggregation process with one exception: [accumulator](#) expressions. The accumulator expressions, used with the [\\$group](#) (page 669) pipeline operator, maintain their state (e.g. totals, maximums, minimums, and related data) as documents progress through the pipeline.

For the expression operators, see [Expression Operators](#) (page 673).

## Aggregation Pipeline Behavior

In MongoDB, the [aggregate](#) (page 694) command operates on a single collection, logically passing the *entire* collection into the aggregation pipeline. To optimize the operation, wherever possible, use the following strategies to avoid scanning the entire collection.

## Pipeline Operators and Indexes

The [\\$match](#) (page 666), [\\$sort](#) (page 670), [\\$limit](#) (page 667), and [\\$skip](#) (page 668) pipeline operators can take advantage of an index when they occur at the **beginning** of the pipeline **before** any of the following aggregation operators: [\\$project](#) (page 664), [\\$unwind](#) (page 668), and [\\$group](#) (page 669).

New in version 2.4: The [\\$geoNear](#) (page 671) pipeline operator takes advantage of a geospatial index. When using [\\$geoNear](#) (page 671), the [\\$geoNear](#) (page 671) pipeline operation must appear as the first stage in an aggregation pipeline.

For unsharded collections, when the aggregation pipeline only needs to access the indexed fields to fulfill its operations, an index can [cover](#) (page 45) the pipeline.

---

### Example

Consider the following index on the `orders` collection:

```
{ status: 1, amount: 1, cust_id: 1 }
```

This index can cover the following aggregation pipeline operation because MongoDB does not need to inspect the data outside of the index to fulfill the operation:

```
db.orders.aggregate([
 { $match: { status: "A" } },
 { $group: { _id: "$cust_id", total: { $sum: "$amount" } } },
 { $sort: { total: -1 } }
])
```

---

## Early Filtering

If your aggregation operation requires only a subset of the data in a collection, use the [\\$match](#) (page 666), [\\$limit](#) (page 667), and [\\$skip](#) (page 668) stages to restrict the documents that enter at the beginning of the pipeline. When placed at the beginning of a pipeline, [\\$match](#) (page 666) operations use suitable indexes to scan only the matching documents in a collection.

Placing a `$match` (page 666) pipeline stage followed by a `$sort` (page 670) stage at the start of the pipeline is logically equivalent to a single query with a sort and can use an index. When possible, place `$match` (page 666) operators at the beginning of the pipeline.

## Additional Features

The aggregation pipeline has an internal optimization phase that provides improved performance for certain sequences of operators. For details, see [Pipeline Sequence Optimization](#) (page 286).

The aggregation pipeline supports operations on sharded collections. See [Aggregation Pipeline and Sharded Collections](#) (page 288).

### 6.2.2 Map-Reduce

Map-reduce is a data processing paradigm for condensing large volumes of data into useful *aggregated* results. For map-reduce operations, MongoDB provides the `mapReduce` (page 701) database command.

Consider the following map-reduce operation:

```
Collection
↓
db.orders.mapReduce(
 map → function() { emit(this.cust_id, this.amount); },
 reduce → function(key, values) { return Array.sum(values) },
 {
 query → query: { status: "A" },
 output → out: "order_totals"
 }
)
```

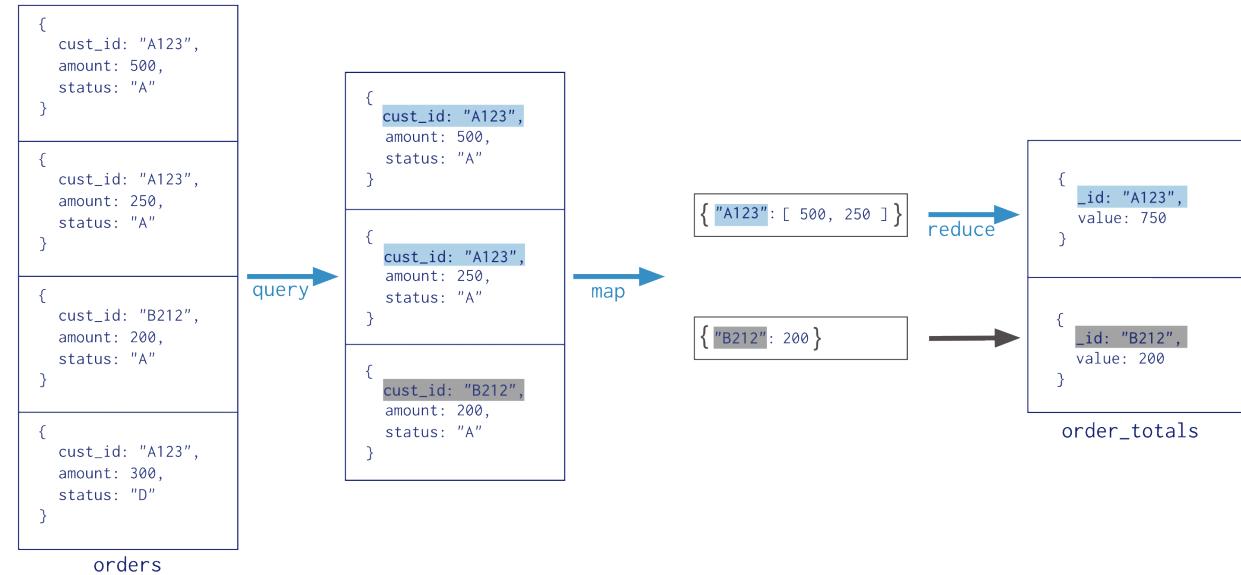


Figure 6.5: Diagram of the annotated map-reduce operation.

In this map-reduce operation, MongoDB applies the *map* phase to each input document (i.e. the documents in the collection that match the query condition). The map function emits key-value pairs. For those keys that have multiple values, MongoDB applies the *reduce* phase, which collects and condenses the aggregated data. MongoDB then stores

the results in a collection. Optionally, the output of the reduce function may pass through a *finalize* function to further condense or process the results of the aggregation.

All map-reduce functions in MongoDB are JavaScript and run within the `mongod` (page 925) process. Map-reduce operations take the documents of a single *collection* as the *input* and can perform any arbitrary sorting and limiting before beginning the map stage. `mapReduce` (page 701) can return the results of a map-reduce operation as a document, or may write the results to collections. The input and the output collections may be sharded.

---

**Note:** For most aggregation operations, the *Aggregation Pipeline* (page 279) provides better performance and more coherent interface. However, map-reduce operations provide some flexibility that is not presently available in the aggregation pipeline.

---

## Map-Reduce JavaScript Functions

In MongoDB, map-reduce operations use custom JavaScript functions to *map*, or associate, values to a key. If a key has multiple values mapped to it, the operation *reduces* the values for the key to a single object.

The use of custom JavaScript functions provide flexibility to map-reduce operations. For instance, when processing a document, the map function can create more than one key and value mapping or no mapping. Map-reduce operations can also use a custom JavaScript function to make final modifications to the results at the end of the map and reduce operation, such as perform additional calculations.

## Map-Reduce Behavior

In MongoDB, the map-reduce operation can write results to a collection or return the results inline. If you write map-reduce output to a collection, you can perform subsequent map-reduce operations on the same input collection that merge replace, merge, or reduce new results with previous results. See `mapReduce` (page 701) and *Perform Incremental Map-Reduce* (page 300) for details and examples.

When returning the results of a map reduce operation *inline*, the result documents must be within the `BSON Document Size` (page 1015) limit, which is currently 16 megabytes. For additional information on limits and restrictions on map-reduce operations, see the `mapReduce` (page 701) reference page.

MongoDB supports map-reduce operations on *sharded collections* (page 493). Map-reduce operations can also output the results to a sharded collection. See *Map-Reduce and Sharded Collections* (page 289).

### 6.2.3 Single Purpose Aggregation Operations

Aggregation refers to a broad class of data manipulation operations that compute a result based on an input *and* a specific procedure. MongoDB provides a number of aggregation operations that perform specific aggregation operations on a set of data.

Although limited in scope, particularly compared to the *aggregation pipeline* (page 279) and *map-reduce* (page 282), these operations provide straightforward semantics for common data processing options.

#### Count

MongoDB can return a count of the number of documents that match a query. The `count` (page 695) command as well as the `count()` (page 809) and `cursor.count()` (page 860) methods provide access to counts in the `mongo` (page 942) shell.

---

#### Example

Given a collection named `records` with *only* the following documents:

```
{ a: 1, b: 0 }
{ a: 1, b: 1 }
{ a: 1, b: 4 }
{ a: 2, b: 2 }
```

The following operation would count all documents in the collection and return the number 4:

```
db.records.count()
```

The following operation will count only the documents where the value of the field `a` is 1 and return 3:

```
db.records.count({ a: 1 })
```

---

## Distinct

The `distinct` operation takes a number of documents that match a query and returns all of the unique values for a field in the matching documents. The [distinct](#) (page 696) command and [db.collection.distinct\(\)](#) (page 812) method provide this operation in the [mongo](#) (page 942) shell. Consider the following examples of a distinct operation:

---

### Example

Given a collection named `records` with *only* the following documents:

```
{ a: 1, b: 0 }
{ a: 1, b: 1 }
{ a: 1, b: 1 }
{ a: 1, b: 4 }
{ a: 2, b: 2 }
{ a: 2, b: 2 }
```

Consider the following [db.collection.distinct\(\)](#) (page 812) operation which returns the distinct values of the field `b`:

```
db.records.distinct("b")
```

The results of this operation would resemble:

```
[0, 1, 4, 2]
```

---

## Group

The `group` operation takes a number of documents that match a query, and then collects groups of documents based on the value of a field or fields. It returns an array of documents with computed results for each group of documents.

Access the grouping functionality via the [group](#) (page 697) command or the [db.collection.group\(\)](#) (page 828) method in the [mongo](#) (page 942) shell.

**Warning:** [group](#) (page 697) does not support data in sharded collections. In addition, the results of the [group](#) (page 697) operation must be no larger than 16 megabytes.

Consider the following group operation:

---

### Example

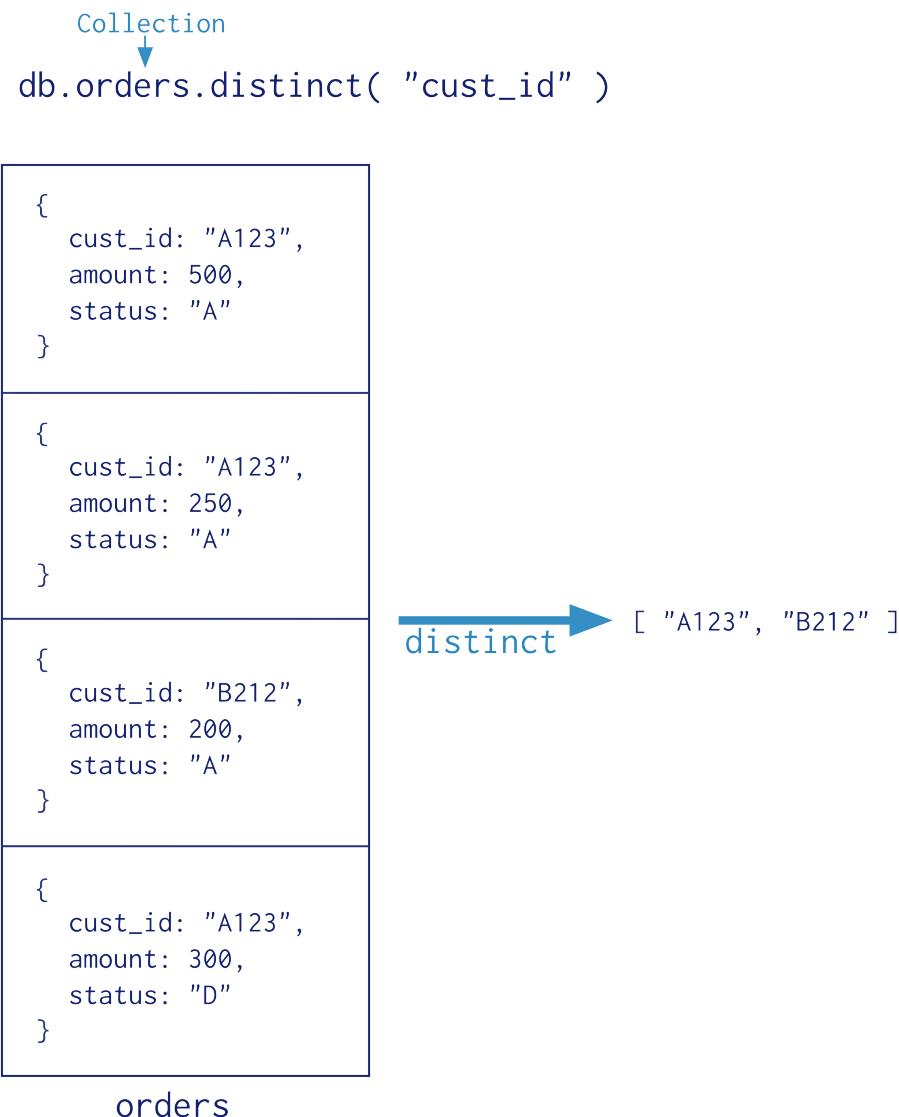


Figure 6.6: Diagram of the annotated distinct operation.

Given a collection named `records` with the following documents:

```
{ a: 1, count: 4 }
{ a: 1, count: 2 }
{ a: 1, count: 4 }
{ a: 2, count: 3 }
{ a: 2, count: 1 }
{ a: 1, count: 5 }
{ a: 4, count: 4 }
```

Consider the following `group` (page 697) operation which groups documents by the field `a`, where `a` is less than 3, and sums the field `count` for each group:

```
db.records.group({
 key: { a: 1 },
 cond: { a: { $lt: 3 } },
 reduce: function(cur, result) { result.count += cur.count },
 initial: { count: 0 }
})
```

The results of this group operation would resemble the following:

```
[
 { a: 1, count: 15 },
 { a: 2, count: 4 }
]
```

---

#### See also:

The `$group` (page 669) for related functionality in the *aggregation pipeline* (page 279).

## 6.2.4 Aggregation Mechanics

This section describes behaviors and limitations for the various aggregation modalities.

[Aggregation Pipeline Optimization \(page 286\)](#) Details the internal optimization of certain pipeline sequence.

[Aggregation Pipeline Limits \(page 288\)](#) Presents limitations on aggregation pipeline operations.

[Aggregation Pipeline and Sharded Collections \(page 288\)](#) Mechanics of aggregation pipeline operations on sharded collections.

[Map-Reduce and Sharded Collections \(page 289\)](#) Mechanics of map-reduce operation with sharded collections.

[Map Reduce Concurrency \(page 290\)](#) Details the locks taken during map-reduce operations.

### Aggregation Pipeline Optimization

Changed in version 2.4.

Aggregation pipeline operations have an optimization phase which attempts to rearrange the pipeline for improved performance.

### Pipeline Sequence Optimization

**\$sort + \$skip + \$limit Sequence Optimization** When you have a sequence with [\\$sort](#) (page 670) followed by a [\\$skip](#) (page 668) followed by a [\\$limit](#) (page 667), an optimization occurs that moves the [\\$limit](#) (page 667) operator before the [\\$skip](#) (page 668) operator. For example, if the pipeline consists of the following stages:

```
{ $sort: { age : -1 } },
{ $skip: 10 },
{ $limit: 5 }
```

During the optimization phase, the optimizer transforms the sequence to the following:

```
{ $sort: { age : -1 } },
{ $limit: 15 }
{ $skip: 10 }
```

---

**Note:** The [\\$limit](#) (page 667) value has increased to the sum of the initial value and the [\\$skip](#) (page 668) value.

---

The optimized sequence now has [\\$sort](#) (page 670) immediately preceding the [\\$limit](#) (page 667). See [\\$sort](#) (page 670) for information on the behavior of the [\\$sort](#) (page 670) operation when it immediately precedes [\\$limit](#) (page 667).

**\$limit + \$skip + \$limit + \$skip Sequence Optimization** When you have a continuous sequence of a [\\$limit](#) (page 667) pipeline stage followed by a [\\$skip](#) (page 668) pipeline stage, the optimization phase attempts to arrange the pipeline stages to combine the limits and skips. For example, if the pipeline consists of the following stages:

```
{ $limit: 100 },
{ $skip: 5 },
{ $limit: 10 },
{ $skip: 2 }
```

During the intermediate step, the optimizer reverses the position of the [\\$skip](#) (page 668) followed by a [\\$limit](#) (page 667) to [\\$limit](#) (page 667) followed by the [\\$skip](#) (page 668).

```
{ $limit: 100 },
{ $limit: 15 },
{ $skip: 5 },
{ $skip: 2 }
```

The [\\$limit](#) (page 667) value has increased to the sum of the initial value and the [\\$skip](#) (page 668) value. Then, for the final [\\$limit](#) (page 667) value, the optimizer selects the minimum between the adjacent [\\$limit](#) (page 667) values. For the final [\\$skip](#) (page 668) value, the optimizer adds the adjacent [\\$skip](#) (page 668) values, to transform the sequence to the following:

```
{ $limit: 15 },
{ $skip: 7 }
```

## Projection Optimization

If the aggregation pipeline contains a [\\$project](#) (page 664) stage that specifies the fields to **include**, then MongoDB applies the projection to the head of the pipeline. This reduces the amount of data passing through the pipeline from the start. In the following example, the [\\$project](#) (page 664) stage specifies that the results of this stage return only the `_id` and the `amount` fields. The optimization phase applies the projection to the head of the pipeline such that only the `_id` and the `amount` fields return in the resulting documents from the [\\$match](#) (page 666) stage as well.

```
db.orders.aggregate(
 { $match: { status: "A" } },
 { $project: { amount: 1 } }
)
```

### Aggregation Pipeline Limits

Aggregation operations with the [aggregate](#) (page 694) command have the following limitations.

#### Type Restrictions

The [aggregation pipeline](#) (page 279) cannot operate on values of the following types: Symbol, MinKey, MaxKey, DBRef, Code, CodeWScope.

Changed in version 2.4: Removed restriction on Binary type data. In MongoDB 2.2, the pipeline could not operate on Binary type data.

#### Result Size Restrictions

Output from the pipeline cannot exceed the [BSON Document Size](#) (page 1015) limit, which is currently 16 megabytes. If the result set exceeds this limit, the [aggregate](#) (page 694) command produces an error.

#### Memory Restrictions

If any single aggregation operation consumes more than 10 percent or more of system RAM, the operation will produce an error.

Cumulative operators, such as [\\$sort](#) (page 670) and [\\$group](#) (page 669), require access to the entire input set before they can produce any output. These operators log a *warning* if the cumulative operator consumes 5% or more of the physical memory on the host. Like any aggregation operation, these operators produce an error if they consume 10% or more of the physical memory on the host. See the [\\$sort](#) (page 670) and [\\$group](#) (page 669) reference pages for details on their specific memory requirements and use.

### Aggregation Pipeline and Sharded Collections

The aggregation pipeline supports operations on [sharded](#) collections. This section describes behaviors specific to the [aggregation pipeline](#) (page 279) and sharded collections.

---

**Note:** Changed in version 2.2: Some [aggregation pipeline](#) (page 694) operations will cause [mongos](#) (page 938) instances to require more CPU resources than in previous versions. This modified performance profile may dictate alternate architectural decisions if you use the [aggregation pipeline](#) (page 279) extensively in a sharded environment.

---

When operating on a sharded collection, the aggregation pipeline is split into two parts. First, the aggregation pipeline pushes all of the operators up to the first [\\$group](#) (page 669) or [\\$sort](#) (page 670) operation to each shard<sup>1</sup>. Then, a second pipeline runs on the [mongos](#) (page 938). This pipeline consists of the first [\\$group](#) (page 669) or [\\$sort](#) (page 670) and any remaining pipeline operators, and runs on the results received from the shards.

---

<sup>1</sup> If an early [\\$match](#) (page 666) can exclude shards through the use of the shard key in the predicate, then these operators are only pushed to the relevant shards.

The `$group` (page 669) operator brings in any “sub-totals” from the shards and combines them: in some cases these may be structures. For example, the `$avg` (page 676) expression maintains a total and count for each shard; `mongos` (page 938) combines these values and then divides.

## Map-Reduce and Sharded Collections

Map-reduce supports operations on sharded collections, both as an input and as an output. This section describes the behaviors of `mapReduce` (page 701) specific to sharded collections.

### Sharded Collection as Input

When using sharded collection as the input for a map-reduce operation, `mongos` (page 938) will automatically dispatch the map-reduce job to each shard in parallel. There is no special option required. `mongos` (page 938) will wait for jobs on all shards to finish.

### Sharded Collection as Output

Changed in version 2.2.

If the `out` field for `mapReduce` (page 701) has the `sharded` value, MongoDB shards the output collection using the `_id` field as the shard key.

To output to a sharded collection:

- If the output collection does not exist, MongoDB creates and shards the collection on the `_id` field.
- For a new or an empty sharded collection, MongoDB uses the results of the first stage of the map-reduce operation to create the initial `chunks` distributed among the shards.
- `mongos` (page 938) dispatches, in parallel, a map-reduce post-processing job to every shard that owns a chunk. During the post-processing, each shard will pull the results for its own chunks from the other shards, run the final reduce/finalize, and write locally to the output collection.

---

#### Note:

- During later map-reduce jobs, MongoDB splits chunks as needed.
  - Balancing of chunks for the output collection is automatically prevented during post-processing to avoid concurrency issues.
- 

In MongoDB 2.0:

- `mongos` (page 938) retrieves the results from each shard, performs a merge sort to order the results, and proceeds to the reduce/finalize phase as needed. `mongos` (page 938) then writes the result to the output collection in sharded mode.
- This model requires only a small amount of memory, even for large data sets.
- Shard chunks are not automatically split during insertion. This requires manual intervention until the chunks are granular and balanced.

---

**Important:** For best results, only use the sharded output options for `mapReduce` (page 701) in version 2.2 or later.

---

## Map Reduce Concurrency

The map-reduce operation is composed of many tasks, including reads from the input collection, executions of the `map` function, executions of the `reduce` function, writes to a temporary collection during processing, and writes to the output collection.

During the operation, map-reduce takes the following locks:

- The read phase takes a read lock. It yields every 100 documents.
- The insert into the temporary collection takes a write lock for a single write.
- If the output collection does not exist, the creation of the output collection takes a write lock.
- If the output collection exists, then the output actions (i.e. `merge`, `replace`, `reduce`) take a write lock.

Changed in version 2.4: The V8 JavaScript engine, which became the default in 2.4, allows multiple JavaScript operations to execute at the same time. Prior to 2.4, JavaScript code (i.e. `map`, `reduce`, `finalize` functions) executed in a single thread.

---

**Note:** The final write lock during post-processing makes the results appear atomically. However, output actions `merge` and `reduce` may take minutes to process. For the `merge` and `reduce`, the `nonAtomic` flag is available. See the `db.collection.mapReduce()` (page 837) reference for more information.

---

## 6.3 Aggregation Examples

This document provides the practical examples that display the capabilities of `aggregation` (page 279).

**Aggregation with the Zip Code Data Set (page 290)** Use the aggregation pipeline to group values and to calculate aggregated sums and averages for a collection of United States zip codes.

**Aggregation with User Preference Data (page 294)** Use the pipeline to sort, normalize, and sum data on a collection of user data.

**Map-Reduce Examples (page 298)** Define map-reduce operations that select ranges, group data, and calculate sums and averages.

**Perform Incremental Map-Reduce (page 300)** Run a map-reduce operations over one collection and output results to another collection.

**Troubleshoot the Map Function (page 302)** Steps to troubleshoot the `map` function.

**Troubleshoot the Reduce Function (page 303)** Steps to troubleshoot the `reduce` function.

### 6.3.1 Aggregation with the Zip Code Data Set

The examples in this document use the `zipcode` collection. This collection is available at: `media.mongodb.org/zips.json`<sup>2</sup>. Use `mongoimport` (page 965) to load this data set into your `mongod` (page 925) instance.

#### Data Model

Each document in the `zipcode` collection has the following form:

---

<sup>2</sup><http://media.mongodb.org/zips.json>

```
{
 "_id": "10280",
 "city": "NEW YORK",
 "state": "NY",
 "pop": 5574,
 "loc": [
 -74.016323,
 40.710537
]
}
```

The `_id` field holds the zip code as a string.

The `city` field holds the city.

The `state` field holds the two letter state abbreviation.

The `pop` field holds the population.

The `loc` field holds the location as a latitude longitude pair.

All of the following examples use the `aggregate()` (page 808) helper in the `mongo` (page 942) shell. `aggregate()` (page 808) provides a wrapper around the `aggregate` (page 694) database command. See the documentation for your `driver` (page 95) for a more idiomatic interface for data aggregation operations.

## Return States with Populations above 10 Million

To return all states with a population greater than 10 million, use the following aggregation operation:

```
db.zipcodes.aggregate({ $group :
 { _id : "$state",
 totalPop : { $sum : "$pop" } } },
 { $match : {totalPop : { $gte : 10*1000*1000 } } })
```

Aggregations operations using the `aggregate()` (page 808) helper process all documents in the `zipcodes` collection. `aggregate()` (page 808) connects a number of `pipeline` (page 279) operators, which define the aggregation process.

In this example, the pipeline passes all documents in the `zipcodes` collection through the following steps:

- the `$group` (page 669) operator collects all documents and creates documents for each state.

These new per-state documents have one field in addition the `_id` field: `totalPop` which is a generated field using the `$sum` (page 678) operation to calculate the total value of all `pop` fields in the source documents.

After the `$group` (page 669) operation the documents in the pipeline resemble the following:

```
{
 "_id" : "AK",
 "totalPop" : 550043
}
```

- the `$match` (page 666) operation filters these documents so that the only documents that remain are those where the value of `totalPop` is greater than or equal to 10 million.

The `$match` (page 666) operation does not alter the documents, which have the same format as the documents output by `$group` (page 669).

The equivalent `SQL` for this operation is:

```
SELECT state, SUM(pop) AS totalPop
 FROM zipcodes
 GROUP BY state
 HAVING totalPop >= (10*1000*1000)
```

## Return Average City Population by State

To return the average populations for cities in each state, use the following aggregation operation:

```
db.zipcodes.aggregate({ $group :
 { _id : { state : "$state", city : "$city" },
 pop : { $sum : "$pop" } },
 { $group :
 { _id : "$_id.state",
 avgCityPop : { $avg : "$pop" } } })
```

Aggregations operations using the `aggregate()` (page 808) helper process all documents in the `zipcodes` collection. `aggregate()` (page 808) connects a number of `pipeline` (page 279) operators that define the aggregation process.

In this example, the pipeline passes all documents in the `zipcodes` collection through the following steps:

- the `$group` (page 669) operator collects all documents and creates new documents for every combination of the `city` and `state` fields in the source document.

After this stage in the pipeline, the documents resemble the following:

```
{
 "_id" : {
 "state" : "CO",
 "city" : "EDGEWATER"
 },
 "pop" : 13154
}
```

- the second `$group` (page 669) operator collects documents by the `state` field and use the `$avg` (page 676) expression to compute a value for the `avgCityPop` field.

The final output of this aggregation operation is:

```
{
 "_id" : "MN",
 "avgCityPop" : 5335
},
```

## Return Largest and Smallest Cities by State

To return the smallest and largest cities by population for each state, use the following aggregation operation:

```
db.zipcodes.aggregate({ $group:
 { _id: { state: "$state", city: "$city" },
 pop: { $sum: "$pop" } },
 { $sort: { pop: 1 } },
 { $group:
 { _id : "$_id.state",
 biggestCity: { $last: "$_id.city" },
 biggestPop: { $last: "$pop" },
```

```

smallestCity: { $first: "$_id.city" },
smallestPop: { $first: "$pop" } } },
// the following $project is optional, and
// modifies the output format.

{ $project:
 { _id: 0,
 state: "$_id",
 biggestCity: { name: "$biggestCity", pop: "$biggestPop" },
 smallestCity: { name: "$smallestCity", pop: "$smallestPop" } } })

```

Aggregation operations using the `aggregate()` (page 808) helper process all documents in the `zipcodes` collection. `aggregate()` (page 808) combines a number of `pipeline` (page 279) operators that define the aggregation process.

All documents from the `zipcodes` collection pass into the pipeline, which consists of the following steps:

- the `$group` (page 669) operator collects all documents and creates new documents for every combination of the `city` and `state` fields in the source documents.

By specifying the value of `_id` as a sub-document that contains both fields, the operation preserves the `state` field for use later in the pipeline. The documents produced by this stage of the pipeline have a second field, `pop`, which uses the `$sum` (page 678) operator to provide the total of the `pop` fields in the source document.

At this stage in the pipeline, the documents resemble the following:

```
{
 "_id" : {
 "state" : "CO",
 "city" : "EDGEWATER"
 },
 "pop" : 13154
}
```

- `$sort` (page 670) operator orders the documents in the pipeline based on the value of the `pop` field from largest to smallest. This operation does not alter the documents.
- the second `$group` (page 669) operator collects the documents in the pipeline by the `state` field, which is a field inside the nested `_id` document.

Within each per-state document this `$group` (page 669) operator specifies four fields: Using the `$last` (page 675) expression, the `$group` (page 669) operator creates the `biggestCity` and `biggestPop` fields that store the city with the largest population and that population. Using the `$first` (page 675) expression, the `$group` (page 669) operator creates the `smallestCity` and `smallestPop` fields that store the city with the smallest population and that population.

The documents, at this stage in the pipeline resemble the following:

```
{
 "_id" : "WA",
 "biggestCity" : "SEATTLE",
 "biggestPop" : 520096,
 "smallestCity" : "BENGE",
 "smallestPop" : 2
}
```

- The final operation is `$project` (page 664), which renames the `_id` field to `state` and moves the `biggestCity`, `biggestPop`, `smallestCity`, and `smallestPop` into `biggestCity` and `smallestCity` sub-documents.

The output of this aggregation operation is:

```
{
 "state" : "RI",
 "biggestCity" : {
 "name" : "CRANSTON",
 "pop" : 176404
 },
 "smallestCity" : {
 "name" : "CLAYVILLE",
 "pop" : 45
 }
}
```

### 6.3.2 Aggregation with User Preference Data

#### Data Model

Consider a hypothetical sports club with a database that contains a `user` collection that tracks the user's join dates, sport preferences, and stores these data in documents that resemble the following:

```
{
 _id : "jane",
 joined : ISODate("2011-03-02"),
 likes : ["golf", "racquetball"]
}
{
 _id : "joe",
 joined : ISODate("2012-07-02"),
 likes : ["tennis", "golf", "swimming"]
}
```

#### Normalize and Sort Documents

The following operation returns user names in upper case and in alphabetical order. The aggregation includes user names for all documents in the `users` collection. You might do this to normalize user names for processing.

```
db.users.aggregate(
 [
 { $project : { name:$toUpperCase:"$_id" } , _id:0 } ,
 { $sort : { name : 1 } }
]
)
```

All documents from the `users` collection pass through the pipeline, which consists of the following operations:

- The `$project` (page 664) operator:
  - creates a new field called `name`.
  - converts the value of the `_id` to upper case, with the `$toUpperCase` (page 685) operator. Then the `$project` (page 664) creates a new field, named `name` to hold this value.
  - suppresses the `id` field. `$project` (page 664) will pass the `_id` field by default, unless explicitly suppressed.
- The `$sort` (page 670) operator orders the results by the `name` field.

The results of the aggregation would resemble the following:

```
{
 "name" : "JANE"
},
{
 "name" : "JILL"
},
{
 "name" : "JOE"
}
```

## Return Usernames Ordered by Join Month

The following aggregation operation returns user names sorted by the month they joined. This kind of aggregation could help generate membership renewal notices.

```
db.users.aggregate(
 [
 { $project : { month_joined : {
 $month : "$joined"
 },
 name : "$_id",
 _id : 0
 },
 { $sort : { month_joined : 1 } }
]
)
```

The pipeline passes all documents in the `users` collection through the following operations:

- The `$project` (page 664) operator:
  - Creates two new fields: `month_joined` and `name`.
  - Suppresses the `_id` from the results. The `aggregate()` (page 808) method includes the `_id`, unless explicitly suppressed.
- The `$month` (page 686) operator converts the values of the `joined` field to integer representations of the month. Then the `$project` (page 664) operator assigns those values to the `month_joined` field.
- The `$sort` (page 670) operator sorts the results by the `month_joined` field.

The operation returns results that resemble the following:

```
{
 "month_joined" : 1,
 "name" : "ruth"
},
{
 "month_joined" : 1,
 "name" : "harold"
},
{
 "month_joined" : 1,
 "name" : "kate"
}
{
 "month_joined" : 2,
```

```
 "name" : "jill"
 }
```

## Return Total Number of Joins per Month

The following operation shows how many people joined each month of the year. You might use this aggregated data for recruiting and marketing strategies.

```
db.users.aggregate(
 [
 { $project : { month_joined : { $month : "$joined" } } },
 { $group : { _id : {month_joined:"$month_joined"} , number : { $sum : 1 } } },
 { $sort : { "_id.month_joined" : 1 } }
]
)
```

The pipeline passes all documents in the `users` collection through the following operations:

- The `$project` (page 664) operator creates a new field called `month_joined`.
- The `$month` (page 686) operator converts the values of the `joined` field to integer representations of the month. Then the `$project` (page 664) operator assigns the values to the `month_joined` field.
- The `$group` (page 669) operator collects all documents with a given `month_joined` value and counts how many documents there are for that value. Specifically, for each unique value, `$group` (page 669) creates a new “per-month” document with two fields:
  - `_id`, which contains a nested document with the `month_joined` field and its value.
  - `number`, which is a generated field. The `$sum` (page 678) operator increments this field by 1 for every document containing the given `month_joined` value.
- The `$sort` (page 670) operator sorts the documents created by `$group` (page 669) according to the contents of the `month_joined` field.

The result of this aggregation operation would resemble the following:

```
{
 "_id" : {
 "month_joined" : 1
 },
 "number" : 3
},
{
 "_id" : {
 "month_joined" : 2
 },
 "number" : 9
},
{
 "_id" : {
 "month_joined" : 3
 },
 "number" : 5
}
```

## Return the Five Most Common “Likes”

The following aggregation collects top five most “liked” activities in the data set. This type of analysis could help inform planning and future development.

```
db.users.aggregate(
 [
 { $unwind : "$likes" },
 { $group : { _id : "$likes" , number : { $sum : 1 } } },
 { $sort : { number : -1 } },
 { $limit : 5 }
]
)
```

The pipeline begins with all documents in the `users` collection, and passes these documents through the following operations:

- The `$unwind` (page 668) operator separates each value in the `likes` array, and creates a new version of the source document for every element in the array.

---

### Example

Given the following document from the `users` collection:

```
{
 _id : "jane",
 joined : ISODate("2011-03-02"),
 likes : ["golf", "racquetball"]
}
```

The `$unwind` (page 668) operator would create the following documents:

```
{
 _id : "jane",
 joined : ISODate("2011-03-02"),
 likes : "golf"
}
{
 _id : "jane",
 joined : ISODate("2011-03-02"),
 likes : "racquetball"
}
```

---

- The `$group` (page 669) operator collects all documents the same value for the `likes` field and counts each grouping. With this information, `$group` (page 669) creates a new document with two fields:
  - `_id`, which contains the `likes` value.
  - `number`, which is a generated field. The `$sum` (page 678) operator increments this field by 1 for every document containing the given `likes` value.
- The `$sort` (page 670) operator sorts these documents by the `number` field in reverse order.
- The `$limit` (page 667) operator only includes the first 5 result documents.

The results of aggregation would resemble the following:

```
{
 "_id" : "golf",
 "number" : 33
},
```

```
{
 "_id" : "racquetball",
 "number" : 31
},
{
 "_id" : "swimming",
 "number" : 24
},
{
 "_id" : "handball",
 "number" : 19
},
{
 "_id" : "tennis",
 "number" : 18
}
```

### 6.3.3 Map-Reduce Examples

In the `mongo` (page 942) shell, the `db.collection.mapReduce()` (page 837) method is a wrapper around the `mapReduce` (page 701) command. The following examples use the `db.collection.mapReduce()` (page 837) method:

Consider the following map-reduce operations on a collection `orders` that contains documents of the following prototype:

```
{
 _id: ObjectId("50a8240b927d5d8b5891743c"),
 cust_id: "abc123",
 ord_date: new Date("Oct 04, 2012"),
 status: 'A',
 price: 25,
 items: [{ sku: "mmm", qty: 5, price: 2.5 },
 { sku: "nnn", qty: 5, price: 2.5 }]
}
```

#### Return the Total Price Per Customer

Perform the map-reduce operation on the `orders` collection to group by the `cust_id`, and calculate the sum of the `price` for each `cust_id`:

1. Define the map function to process each input document:

- In the function, `this` refers to the document that the map-reduce operation is processing.
- The function maps the `price` to the `cust_id` for each document and emits the `cust_id` and `price` pair.

```
var mapFunction1 = function() {
 emit(this.cust_id, this.price);
};
```

2. Define the corresponding reduce function with two arguments `keyCustId` and `valuesPrices`:

- The `valuesPrices` is an array whose elements are the `price` values emitted by the map function and grouped by `keyCustId`.

- The function reduces the `valuesPrice` array to the sum of its elements.

```
var reduceFunction1 = function(keyCustId, valuesPrices) {
 return Array.sum(valuesPrices);
};
```

3. Perform the map-reduce on all documents in the `orders` collection using the `mapFunction1` map function and the `reduceFunction1` reduce function.

```
db.orders.mapReduce(
 mapFunction1,
 reduceFunction1,
 { out: "map_reduce_example" }
)
```

This operation outputs the results to a collection named `map_reduce_example`. If the `map_reduce_example` collection already exists, the operation will replace the contents with the results of this map-reduce operation:

### Calculate Order and Total Quantity with Average Quantity Per Item

In this example, you will perform a map-reduce operation on the `orders` collection for all documents that have an `ord_date` value greater than 01/01/2012. The operation groups by the `item.sku` field, and calculates the number of orders and the total quantity ordered for each `sku`. The operation concludes by calculating the average quantity per order for each `sku` value:

1. Define the map function to process each input document:

- In the function, `this` refers to the document that the map-reduce operation is processing.
- For each item, the function associates the `sku` with a new object value that contains the `count` of 1 and the `item.qty` for the order and emits the `sku` and `value` pair.

```
var mapFunction2 = function() {
 for (var idx = 0; idx < this.items.length; idx++) {
 var key = this.items[idx].sku;
 var value = {
 count: 1,
 qty: this.items[idx].qty
 };
 emit(key, value);
 }
};
```

2. Define the corresponding reduce function with two arguments `keySKU` and `countObjVals`:

- `countObjVals` is an array whose elements are the objects mapped to the grouped `keySKU` values passed by map function to the reducer function.
- The function reduces the `countObjVals` array to a single object `reducedValue` that contains the `count` and the `qty` fields.
- In `reducedVal`, the `count` field contains the sum of the `count` fields from the individual array elements, and the `qty` field contains the sum of the `qty` fields from the individual array elements.

```
var reduceFunction2 = function(keySKU, countObjVals) {
 reducedVal = { count: 0, qty: 0 };

 for (var idx = 0; idx < countObjVals.length; idx++) {
 reducedVal.count += countObjVals[idx].count;
```

```
 reducedVal.qty += countObjVals[idx].qty;
 }

 return reducedVal;
};
```

3. Define a finalize function with two arguments key and reducedVal. The function modifies the reducedVal object to add a computed field named avg and returns the modified object:

```
var finalizeFunction2 = function (key, reducedVal) {

 reducedVal.avg = reducedVal.qty/reducedVal.count;

 return reducedVal;

};
```

4. Perform the map-reduce operation on the orders collection using the mapFunction2, reduceFunction2, and finalizeFunction2 functions.

```
db.orders.mapReduce(mapFunction2,
 reduceFunction2,
 {
 out: { merge: "map_reduce_example" },
 query: { ord_date:
 { $gt: new Date('01/01/2012') }
 },
 finalize: finalizeFunction2
 }
)
```

This operation uses the query field to select only those documents with ord\_date greater than new Date(01/01/2012). Then it output the results to a collection map\_reduce\_example. If the map\_reduce\_example collection already exists, the operation will merge the existing contents with the results of this map-reduce operation.

### 6.3.4 Perform Incremental Map-Reduce

Map-reduce operations can handle complex aggregation tasks. To perform map-reduce operations, MongoDB provides the [mapReduce](#) (page 701) command and, in the [mongo](#) (page 942) shell, the [db.collection.mapReduce\(\)](#) (page 837) wrapper method.

If the map-reduce data set is constantly growing, you may want to perform an incremental map-reduce rather than performing the map-reduce operation over the entire data set each time.

To perform incremental map-reduce:

1. Run a map-reduce job over the current collection and output the result to a separate collection.
2. When you have more data to process, run subsequent map-reduce job with:
  - the `query` parameter that specifies conditions that match *only* the new documents.
  - the `out` parameter that specifies the `reduce` action to merge the new results into the existing output collection.

Consider the following example where you schedule a map-reduce operation on a sessions collection to run at the end of each day.

## Data Setup

The sessions collection contains documents that log users' sessions each day, for example:

```
db.sessions.save({ userid: "a", ts: ISODate('2011-11-03 14:17:00'), length: 95 });
db.sessions.save({ userid: "b", ts: ISODate('2011-11-03 14:23:00'), length: 110 });
db.sessions.save({ userid: "c", ts: ISODate('2011-11-03 15:02:00'), length: 120 });
db.sessions.save({ userid: "d", ts: ISODate('2011-11-03 16:45:00'), length: 45 });

db.sessions.save({ userid: "a", ts: ISODate('2011-11-04 11:05:00'), length: 105 });
db.sessions.save({ userid: "b", ts: ISODate('2011-11-04 13:14:00'), length: 120 });
db.sessions.save({ userid: "c", ts: ISODate('2011-11-04 17:00:00'), length: 130 });
db.sessions.save({ userid: "d", ts: ISODate('2011-11-04 15:37:00'), length: 65 });
```

## Initial Map-Reduce of Current Collection

Run the first map-reduce operation as follows:

1. Define the map function that maps the `userid` to an object that contains the fields `userid`, `total_time`, `count`, and `avg_time`:

```
var mapFunction = function() {
 var key = this.userid;
 var value = {
 userid: this.userid,
 total_time: this.length,
 count: 1,
 avg_time: 0
 };

 emit(key, value);
};
```

2. Define the corresponding reduce function with two arguments `key` and `values` to calculate the total time and the count. The `key` corresponds to the `userid`, and the `values` is an array whose elements corresponds to the individual objects mapped to the `userid` in the `mapFunction`.

```
var reduceFunction = function(key, values) {

 var reducedObject = {
 userid: key,
 total_time: 0,
 count: 0,
 avg_time: 0
 };

 values.forEach(function(value) {
 reducedObject.total_time += value.total_time;
 reducedObject.count += value.count;
 });
 return reducedObject;
};
```

3. Define the finalize function with two arguments `key` and `reducedValue`. The function modifies the `reducedValue` document to add another field `average` and returns the modified document.

```
var finalizeFunction = function (key, reducedValue) {
 if (reducedValue.count > 0)
 reducedValue.avg_time = reducedValue.total_time / reducedValue.count;

 return reducedValue;
};
```

4. Perform map-reduce on the sessions collection using the mapFunction, the reduceFunction, and the finalizeFunction functions. Output the results to a collection session\_stat. If the session\_stat collection already exists, the operation will replace the contents:

```
db.sessions.mapReduce(mapFunction,
 reduceFunction,
 {
 out: { reduce: "session_stat" },
 finalize: finalizeFunction
 }
)
```

## Subsequent Incremental Map-Reduce

Later, as the sessions collection grows, you can run additional map-reduce operations. For example, add new documents to the sessions collection:

```
db.sessions.save({ userid: "a", ts: ISODate('2011-11-05 14:17:00'), length: 100 });
db.sessions.save({ userid: "b", ts: ISODate('2011-11-05 14:23:00'), length: 115 });
db.sessions.save({ userid: "c", ts: ISODate('2011-11-05 15:02:00'), length: 125 });
db.sessions.save({ userid: "d", ts: ISODate('2011-11-05 16:45:00'), length: 55 });
```

At the end of the day, perform incremental map-reduce on the sessions collection, but use the query field to select only the new documents. Output the results to the collection session\_stat, but reduce the contents with the results of the incremental map-reduce:

```
db.sessions.mapReduce(mapFunction,
 reduceFunction,
 {
 query: { ts: { $gt: ISODate('2011-11-05 00:00:00') } },
 out: { reduce: "session_stat" },
 finalize: finalizeFunction
 }
);
```

### 6.3.5 Troubleshoot the Map Function

The map function is a JavaScript function that associates or “maps” a value with a key and emits the key and value pair during a [map-reduce](#) (page 282) operation.

To verify the key and value pairs emitted by the map function, write your own emit function.

Consider a collection orders that contains documents of the following prototype:

```
{
 _id: ObjectId("50a8240b927d5d8b5891743c"),
 cust_id: "abc123",
 ord_date: new Date("Oct 04, 2012"),
```

```

 status: 'A',
 price: 250,
 items: [{ sku: "mmm", qty: 5, price: 2.5 },
 { sku: "nnn", qty: 5, price: 2.5 }]
}

```

1. Define the `map` function that maps the `price` to the `cust_id` for each document and emits the `cust_id` and `price` pair:

```
var map = function() {
 emit(this.cust_id, this.price);
};
```

2. Define the `emit` function to print the key and value:

```
var emit = function(key, value) {
 print("emit");
 print("key: " + key + " value: " + toJson(value));
}
```

3. Invoke the `map` function with a single document from the `orders` collection:

```
var myDoc = db.orders.findOne({ _id: ObjectId("50a8240b927d5d8b5891743c") });
map.apply(myDoc);
```

4. Verify the key and value pair is as you expected.

```
emit
key: abc123 value:250
```

5. Invoke the `map` function with multiple documents from the `orders` collection:

```
var myCursor = db.orders.find({ cust_id: "abc123" });

while (myCursor.hasNext()) {
 var doc = myCursor.next();
 print ("document _id= " + toJson(doc._id));
 map.apply(doc);
 print();
}
```

6. Verify the key and value pairs are as you expected.

#### See also:

The `map` function must meet various requirements. For a list of all the requirements for the `map` function, see [mapReduce](#) (page 701), or the `mongo` (page 942) shell helper method `db.collection.mapReduce()` (page 837).

### 6.3.6 Troubleshoot the Reduce Function

The `reduce` function is a JavaScript function that “reduces” to a single object all the values associated with a particular key during a [map-reduce](#) (page 282) operation. The `reduce` function must meet various requirements. This tutorial helps verify that the `reduce` function meets the following criteria:

- The `reduce` function must return an object whose `type` must be **identical** to the type of the `value` emitted by the `map` function.
- The order of the elements in the `valuesArray` should not affect the output of the `reduce` function.

- The `reduce` function must be *idempotent*.

For a list of all the requirements for the `reduce` function, see [mapReduce](#) (page 701), or the `mongo` (page 942) shell helper method `db.collection.mapReduce()` (page 837).

## Confirm Output Type

You can test that the `reduce` function returns a value that is the same type as the value emitted from the `map` function.

1. Define a `reduceFunction1` function that takes the arguments `keyCustId` and `valuesPrices`. `valuesPrices` is an array of integers:

```
var reduceFunction1 = function(keyCustId, valuesPrices) {
 return Array.sum(valuesPrices);
};
```

2. Define a sample array of integers:

```
var myTestValues = [5, 5, 10];
```

3. Invoke the `reduceFunction1` with `myTestValues`:

```
reduceFunction1('myKey', myTestValues);
```

4. Verify the `reduceFunction1` returned an integer:

20

5. Define a `reduceFunction2` function that takes the arguments `keySKU` and `valuesCountObjects`. `valuesCountObjects` is an array of documents that contain two fields `count` and `qty`:

```
var reduceFunction2 = function(keySKU, valuesCountObjects) {
 reducedValue = { count: 0, qty: 0 };

 for (var idx = 0; idx < valuesCountObjects.length; idx++) {
 reducedValue.count += valuesCountObjects[idx].count;
 reducedValue.qty += valuesCountObjects[idx].qty;
 }

 return reducedValue;
};
```

6. Define a sample array of documents:

```
var myTestObjects = [
 { count: 1, qty: 5 },
 { count: 2, qty: 10 },
 { count: 3, qty: 15 }
];
```

7. Invoke the `reduceFunction2` with `myTestObjects`:

```
reduceFunction2('myKey', myTestObjects);
```

8. Verify the `reduceFunction2` returned a document with exactly the `count` and the `qty` field:

```
{ "count" : 6, "qty" : 30 }
```

## Ensure Insensitivity to the Order of Mapped Values

The `reduce` function takes a key and a `values` array as its argument. You can test that the result of the `reduce` function does not depend on the order of the elements in the `values` array.

1. Define a sample `values1` array and a sample `values2` array that only differ in the order of the array elements:

```
var values1 = [
 { count: 1, qty: 5 },
 { count: 2, qty: 10 },
 { count: 3, qty: 15 }
];

var values2 = [
 { count: 3, qty: 15 },
 { count: 1, qty: 5 },
 { count: 2, qty: 10 }
];
```

2. Define a `reduceFunction2` function that takes the arguments `keySKU` and `valuesCountObjects`. `valuesCountObjects` is an array of documents that contain two fields `count` and `qty`:

```
var reduceFunction2 = function(keySKU, valuesCountObjects) {
 reducedValue = { count: 0, qty: 0 };

 for (var idx = 0; idx < valuesCountObjects.length; idx++) {
 reducedValue.count += valuesCountObjects[idx].count;
 reducedValue.qty += valuesCountObjects[idx].qty;
 }

 return reducedValue;
};
```

3. Invoke the `reduceFunction2` first with `values1` and then with `values2`:

```
reduceFunction2('myKey', values1);
reduceFunction2('myKey', values2);
```

4. Verify the `reduceFunction2` returned the same result:

```
{ "count" : 6, "qty" : 30 }
```

## Ensure Reduce Function Idempotence

Because the map-reduce operation may call a `reduce` multiple times for the same key, and won't call a `reduce` for single instances of a key in the working set, the `reduce` function must return a value of the same type as the value emitted from the `map` function. You can test that the `reduce` function process “reduced” values without affecting the *final* value.

1. Define a `reduceFunction2` function that takes the arguments `keySKU` and `valuesCountObjects`. `valuesCountObjects` is an array of documents that contain two fields `count` and `qty`:

```
var reduceFunction2 = function(keySKU, valuesCountObjects) {
 reducedValue = { count: 0, qty: 0 };

 for (var idx = 0; idx < valuesCountObjects.length; idx++) {
 reducedValue.count += valuesCountObjects[idx].count;
 reducedValue.qty += valuesCountObjects[idx].qty;
 }

}
```

```
 return reducedValue;
 };
}
```

2. Define a sample key:

```
var myKey = 'myKey';
```

3. Define a sample valuesIdempotent array that contains an element that is a call to the reduceFunction2 function:

```
var valuesIdempotent = [
 { count: 1, qty: 5 },
 { count: 2, qty: 10 },
 reduceFunction2(myKey, [{ count: 3, qty: 15 }])
];
```

4. Define a sample values1 array that combines the values passed to reduceFunction2:

```
var values1 = [
 { count: 1, qty: 5 },
 { count: 2, qty: 10 },
 { count: 3, qty: 15 }
];
```

5. Invoke the reduceFunction2 first with myKey and valuesIdempotent and then with myKey and values1:

```
reduceFunction2(myKey, valuesIdempotent);
reduceFunction2(myKey, values1);
```

6. Verify the reduceFunction2 returned the same result:

```
{ "count" : 6, "qty" : 30 }
```

## 6.4 Aggregation Reference

[Aggregation Commands Comparison \(page 306\)](#) A comparison of `group` (page 697), `mapReduce` (page 701) and `aggregate` (page 694) that explores the strengths and limitations of each aggregation modality.

[Aggregation Framework Operators \(page 308\)](#) Aggregation pipeline operations have a collection of operators available to define and manipulate documents in pipeline stages.

[SQL to Aggregation Mapping Chart \(page 309\)](#) An overview common aggregation operations in SQL and MongoDB using the aggregation pipeline and operators in MongoDB and common SQL statements.

[Aggregation Interfaces \(page 312\)](#) The data aggregation interfaces document the invocation format and output for MongoDB's aggregation commands and methods.

### 6.4.1 Aggregation Commands Comparison

The following table provides a brief overview of the features of the MongoDB aggregation commands.

|                         | <a href="#">aggregate (page 694)</a>                                                                                                                                                                                                                                                                                                                                                                                                                             | <a href="#">mapReduce (page 701)</a>                                                                                                                                                                                                                                        | <a href="#">group (page 697)</a>                                                                                                                                                                                                                                                                                              |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Description</b>      | New in version 2.2.<br>Designed with specific goals of improving performance and usability for aggregation tasks. Uses a “pipeline” approach where objects are transformed as they pass through a series of pipeline operators such as <code>\$group</code> (page 669), <code>\$match</code> (page 666), and <code>\$sort</code> (page 670).<br>See <a href="#">Aggregation Reference</a> (page 306) for more information on the pipeline operators.             | Implements the Map-Reduce aggregation for processing large data sets.                                                                                                                                                                                                       | Provides grouping functionality. Is slower than the <a href="#">aggregate</a> (page 694) command and has less functionality than the <a href="#">mapReduce</a> (page 701) command.                                                                                                                                            |
| <b>Key Features</b>     | Pipeline operators can be repeated as needed. Pipeline operators need not produce one output document for every input document. Can also generate new documents or filter out documents.                                                                                                                                                                                                                                                                         | In addition to grouping operations, can perform complex aggregation tasks as well as perform incremental aggregation on continuously growing datasets.<br>See <a href="#">Map-Reduce Examples</a> (page 298) and <a href="#">Perform Incremental Map-Reduce</a> (page 300). | Can either group by existing fields or with a custom <code>keyf</code> JavaScript function, can group by calculated fields.<br>See <a href="#">group</a> (page 697) for information and example using the <code>keyf</code> function.                                                                                         |
| <b>Flexibility</b>      | Limited to the operators and expressions supported by the aggregation pipeline. However, can add computed fields, create new virtual sub-objects, and extract sub-fields into the top-level of results by using the <code>\$project</code> (page 664) pipeline operator. See <a href="#">\$project</a> (page 664) for more information as well as <a href="#">Aggregation Reference</a> (page 306) for more information on all the available pipeline operators. | Custom map, reduce and finalize JavaScript functions offer flexibility to aggregation logic.<br>See <a href="#">mapReduce</a> (page 701) for details and restrictions on the functions.                                                                                     | Custom reduce and finalize JavaScript functions offer flexibility to grouping logic. See <a href="#">group</a> (page 697) for details and restrictions on these functions.                                                                                                                                                    |
| <b>Output Results</b>   | Returns results inline. The result is subject to the <a href="#">BSON Document size</a> (page 1015) limit.                                                                                                                                                                                                                                                                                                                                                       | Returns results in various options (inline, new collection, merge, replace, reduce). See <a href="#">mapReduce</a> (page 701) for details on the output options. Changed in version 2.2: Provides much better support for sharded map-reduce output than previous versions. | Returns results inline as an array of grouped items. The result set must fit within the <a href="#">maximum BSON document size limit</a> (page 1015). Changed in version 2.2: The returned array can contain at most 20,000 elements; i.e. at most 20,000 unique groupings. Previous versions had a limit of 10,000 elements. |
| <b>Sharding</b>         | Supports non-sharded and sharded input collections.                                                                                                                                                                                                                                                                                                                                                                                                              | Supports non-sharded and sharded input collections.                                                                                                                                                                                                                         | Does <b>not</b> support sharded collection.                                                                                                                                                                                                                                                                                   |
| <b>Notes</b>            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Prior to 2.4, JavaScript code executed in a single thread.                                                                                                                                                                                                                  | Prior to 2.4, JavaScript code executed in a single thread.                                                                                                                                                                                                                                                                    |
| <b>More Information</b> | See <a href="#">Aggregation Concepts</a> (page 279) and <a href="#">Aggregation Reference</a> (page 694).                                                                                                                                                                                                                                                                                                                                                        | See <a href="#">Map-Reduce</a> (page 282) and <a href="#">mapReduce</a> (page 701).                                                                                                                                                                                         | See <a href="#">group</a> (page 697).                                                                                                                                                                                                                                                                                         |

## 6.4.2 Aggregation Framework Operators

New in version 2.2.

### Pipeline Operators

**Warning:** The pipeline cannot operate on values of the following types: Binary, Symbol, MinKey, MaxKey, DBRef, Code, and CodeWScope.

Pipeline operators appear in an array. Documents pass through the operators in a sequence.

| Name                                     | Description                                                                                                                                                             |
|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <a href="#">\$project<br/>(page 664)</a> | Reshapes a document stream. <a href="#">\$project</a> (page 664) can rename, add, or remove fields as well as create computed values and sub-documents.                 |
| <a href="#">\$match<br/>(page 666)</a>   | Filters the document stream, and only allows matching documents to pass into the next pipeline stage. <a href="#">\$match</a> (page 666) uses standard MongoDB queries. |
| <a href="#">\$limit<br/>(page 667)</a>   | Restricts the number of documents in an aggregation pipeline.                                                                                                           |
| <a href="#">\$skip<br/>(page 668)</a>    | Skips over a specified number of documents from the pipeline and returns the rest.                                                                                      |
| <a href="#">\$unwind<br/>(page 668)</a>  | Takes an array of documents and returns them as a stream of documents.                                                                                                  |
| <a href="#">\$group<br/>(page 669)</a>   | Groups documents together for the purpose of calculating aggregate values based on a collection of documents.                                                           |
| <a href="#">\$sort<br/>(page 670)</a>    | Takes all input documents and returns them in a stream of sorted documents.                                                                                             |
| <a href="#">\$geoNear<br/>(page 671)</a> | Returns an ordered stream of documents based on proximity to a geospatial point.                                                                                        |

### Expression Operators

Expression operators calculate values within the [Pipeline Operators](#) (page 664).

#### \$group Operators

#### Boolean Operators

These operators accept Booleans as arguments and return Booleans as results.

The operators convert non-Booleans to Boolean values according to the BSON standards. Here, null, undefined, and 0 values become false, while non-zero numeric values, and all other types, such as strings, dates, objects become true.

#### Comparison Operators

These operators perform comparisons between two values and return a Boolean, in most cases reflecting the result of the comparison.

All comparison operators take an array with a pair of values. You may compare numbers, strings, and dates. Except for [\\$cmp](#) (page 680), all comparison operators return a Boolean value. [\\$cmp](#) (page 680) returns an integer.

## Arithmetic Operators

Arithmetic operators support only numbers.

## String Operators

String operators manipulate strings within projection expressions.

## Date Operators

Date operators take a “Date” typed value as a single argument and return a number.

## Conditional Expressions

### 6.4.3 SQL to Aggregation Mapping Chart

The [aggregation pipeline](#) (page 279) allows MongoDB to provide native aggregation capabilities that corresponds to many common data aggregation operations in SQL. If you’re new to MongoDB you might want to consider the [Frequently Asked Questions](#) (page 581) section for a selection of common questions.

The following table provides an overview of common SQL aggregation terms, functions, and concepts and the corresponding MongoDB [aggregation operators](#) (page 664):

| SQL Terms, Functions, and Concepts | MongoDB Aggregation Operators                                                                                                                                                        |
|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| WHERE                              | <a href="#">\$match</a> (page 666)                                                                                                                                                   |
| GROUP BY                           | <a href="#">\$group</a> (page 669)                                                                                                                                                   |
| HAVING                             | <a href="#">\$match</a> (page 666)                                                                                                                                                   |
| SELECT                             | <a href="#">\$project</a> (page 664)                                                                                                                                                 |
| ORDER BY                           | <a href="#">\$sort</a> (page 670)                                                                                                                                                    |
| LIMIT                              | <a href="#">\$limit</a> (page 667)                                                                                                                                                   |
| SUM()                              | <a href="#">\$sum</a> (page 678)                                                                                                                                                     |
| COUNT()                            | <a href="#">\$sum</a> (page 678)                                                                                                                                                     |
| join                               | No direct corresponding operator; however, the <a href="#">\$unwind</a> (page 668) operator allows for somewhat similar functionality, but with fields embedded within the document. |

## Examples

The following table presents a quick reference of SQL aggregation statements and the corresponding MongoDB statements. The examples in the table assume the following conditions:

- The SQL examples assume *two* tables, `orders` and `order_lineitem` that join by the `order_lineitem.order_id` and the `orders.id` columns.
- The MongoDB examples assume *one* collection `orders` that contain documents of the following prototype:

```
{
 cust_id: "abc123",
 ord_date: ISODate("2012-11-02T17:04:11.102Z"),
 status: 'A',
 price: 50,
```

```
 items: [{ sku: "xxx", qty: 25, price: 1 },
 { sku: "yyy", qty: 25, price: 1 }]
}
```

- The MongoDB statements prefix the names of the fields from the *documents* in the collection `orders` with a `$` character when they appear as operands to the aggregation operations.

| SQL Example                                                                                                                         | MongoDB Example                                                                                                                                                                                                         | Description                                                                                                        |
|-------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| <pre>SELECT COUNT(*) AS count FROM orders</pre>                                                                                     | <pre>db.orders.aggregate( [   { \$group: { _id: null,               count: { \$sum: 1 } } } ] )</pre>                                                                                                                   | Count all records from orders                                                                                      |
| <pre>SELECT SUM(price) AS total FROM orders</pre>                                                                                   | <pre>db.orders.aggregate( [   { \$group: { _id: null,               total: { \$sum: "\$price" } } } ] )</pre>                                                                                                           | Sum the price field from orders                                                                                    |
| <pre>SELECT cust_id,        SUM(price) AS total FROM orders GROUP BY cust_id</pre>                                                  | <pre>db.orders.aggregate( [   { \$group: { _id: "\$cust_id",               total: { \$sum: "\$price" } } } ] )</pre>                                                                                                    | For each unique cust_id, sum the price field.                                                                      |
| <pre>SELECT cust_id,        SUM(price) AS total FROM orders GROUP BY cust_id ORDER BY total</pre>                                   | <pre>db.orders.aggregate( [   { \$group: { _id: "\$cust_id",               total: { \$sum: "\$price" } },     { \$sort: { total: 1 } } ] )</pre>                                                                        | For each unique cust_id, sum the price field, results sorted by sum.                                               |
| <pre>SELECT cust_id,        ord_date,        SUM(price) AS total FROM orders GROUP BY cust_id, ord_date</pre>                       | <pre>db.orders.aggregate( [   { \$group: { _id: { cust_id: "\$cust_id",                      ord_date: "\$ord_date" },               total: { \$sum: "\$price" } } } ] )</pre>                                          | For each unique cust_id, ord_date grouping, sum the price field.                                                   |
| <pre>SELECT cust_id, count(*) FROM orders GROUP BY cust_id HAVING count(*) &gt; 1</pre>                                             | <pre>db.orders.aggregate( [   { \$group: { _id: "\$cust_id",               count: { \$sum: 1 } } },   { \$match: { count: { \$gt: 1 } } } ] )</pre>                                                                     | For cust_id with multiple records, return the cust_id and the corresponding record count.                          |
| <pre>SELECT cust_id,        ord_date,        SUM(price) AS total FROM orders GROUP BY cust_id, ord_date HAVING total &gt; 250</pre> | <pre>db.orders.aggregate( [   { \$group: { _id: { cust_id: "\$cust_id",                      ord_date: "\$ord_date" },               total: { \$sum: "\$price" } },     { \$match: { total: { \$gt: 250 } } } ] )</pre> | For each unique cust_id, ord_date grouping, sum the price field and return only where the sum is greater than 250. |
| <pre>SELECT cust_id,        SUM(price) AS total FROM orders WHERE status = 'A' GROUP BY cust_id</pre>                               | <pre>db.orders.aggregate( [   { \$match: { status: 'A' } },   { \$group: { _id: "\$cust_id",               total: { \$sum: "\$price" } } } ] )</pre>                                                                    | For each unique cust_id with status A, sum the price field.                                                        |
| <pre>SELECT cust_id,        SUM(price) AS total FROM orders WHERE status = 'A' GROUP BY cust_id HAVING total &gt; 250</pre>         | <pre>db.orders.aggregate( [   { \$match: { status: 'A' } },   { \$group: { _id: "\$cust_id",               total: { \$sum: "\$price" } },     { \$match: { total: { \$gt: 250 } } } ] )</pre>                           | For each unique cust_id with status A, sum the price field and return only where the sum is greater than 250.      |
| <b>6.4 Aggregation Reference</b>                                                                                                    |                                                                                                                                                                                                                         | 311                                                                                                                |
| <pre>SELECT cust_id</pre>                                                                                                           | <pre>db.orders.aggregate( [</pre>                                                                                                                                                                                       | For each unique cust_id, sum the                                                                                   |

## 6.4.4 Aggregation Interfaces

### Aggregation Commands

| Name                              | Description                                                                                 |
|-----------------------------------|---------------------------------------------------------------------------------------------|
| <code>aggregate</code> (page 694) | Performs <i>aggregation tasks</i> (page 279) such as group using the aggregation framework. |
| <code>count</code> (page 695)     | Counts the number of documents in a collection.                                             |
| <code>distinct</code> (page 696)  | Displays the distinct values found for a specified key in a collection.                     |
| <code>group</code> (page 697)     | Groups documents in a collection by the specified key and performs simple aggregation.      |
| <code>mapReduce</code> (page 701) | Performs <i>map-reduce</i> (page 282) aggregation for large data sets.                      |

### Aggregation Methods

| Name                                              | Description                                                                            |
|---------------------------------------------------|----------------------------------------------------------------------------------------|
| <code>db.collection.aggregate()</code> (page 808) | Provides access to the <i>aggregation pipeline</i> (page 279).                         |
| <code>db.collection.group()</code> (page 828)     | Groups documents in a collection by the specified key and performs simple aggregation. |
| <code>db.collection.mapReduce()</code> (page 837) | Performs <i>map-reduce</i> (page 282) aggregation for large data sets.                 |

---

## Indexes

---

Indexes provide high performance read operations for frequently used queries.

This section introduces indexes in MongoDB, describes the types and configuration options for indexes, and describes special types of indexing MongoDB supports. The section also provides tutorials detailing procedures and operational concerns, and providing information on how applications may use indexes.

***Index Introduction*** (page 313) An introduction to indexes in MongoDB.

***Index Concepts*** (page 318) The core documentation of indexes in MongoDB, including geospatial and text indexes.

***Index Types*** (page 319) MongoDB provides different types of indexes for different purposes and different types of content.

***Index Properties*** (page 333) The properties you can specify when building indexes.

***Index Creation*** (page 335) The options available when creating indexes.

***Indexing Tutorials*** (page 338) Examples of operations involving indexes, including index creation and querying indexes.

***Indexing Reference*** (page 374) Reference material for indexes in MongoDB.

## 7.1 Index Introduction

Indexes support the efficient resolution of queries in MongoDB. Without indexes, MongoDB must scan every document in a collection to select those documents that match the query statement. These *collection scans* are inefficient and require the `mongod` (page 925) to process a large volume of data for each operation.

Indexes are special data structures<sup>1</sup> that store a small portion of the collection’s data set in an easy to traverse form. The index stores the value of a specific field or set of fields, ordered by the value of the field.

Fundamentally, indexes in MongoDB are similar to indexes in other database systems. MongoDB defines indexes at the *collection* level and supports indexes on any field or sub-field of the documents in a MongoDB collection.

If an appropriate index exists for a query, MongoDB can use the index to limit the number of documents it must inspect. In some cases, MongoDB can use the data from the index to determine which documents match a query. The following diagram illustrates a query that selects documents using an index.

Consider the documentation of the *query optimizer* (page 45) for more information on the relationship between queries and indexes.

---

### Tip

<sup>1</sup> MongoDB indexes use a B-tree data structure.

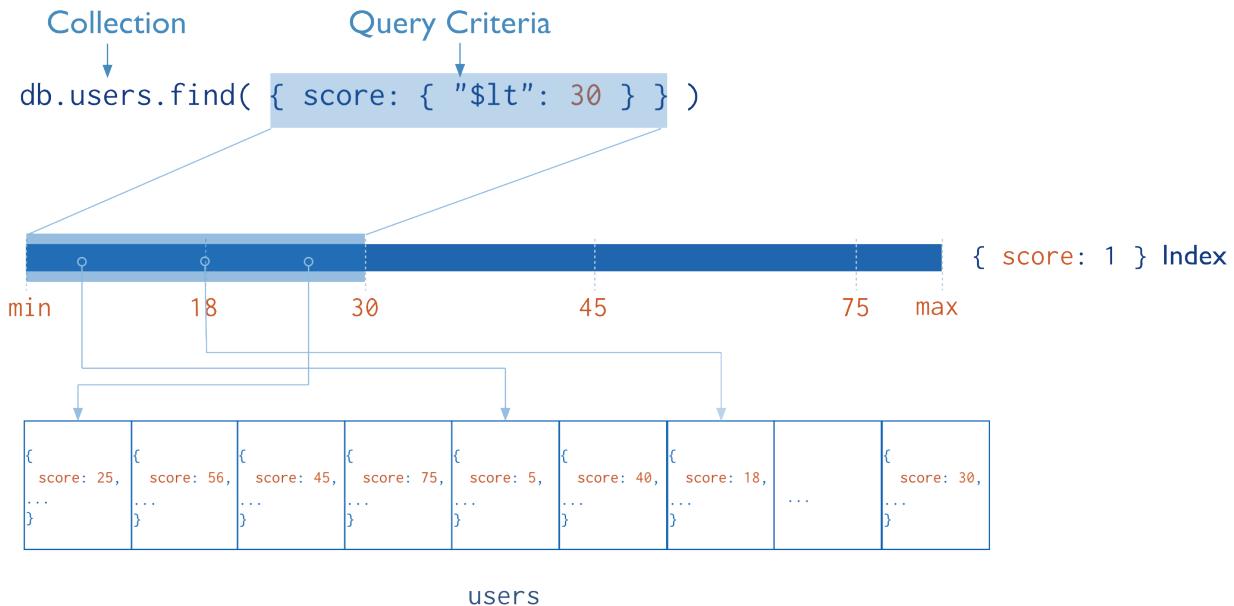


Figure 7.1: Diagram of a query selecting documents using an index. MongoDB narrows the query by scanning the range of documents with values of `score` less than 30.

Create indexes to support common and user-facing queries. Having these indexes will ensure that MongoDB only scans the smallest possible number of documents.

Indexes can also optimize the performance of other operations in specific situations:

### Sorted Results

MongoDB can use indexes to return documents sorted by the index key directly from the index without requiring an additional sort phase.

### Covered Results

When the query criteria and the [projection](#) of a query include *only* the indexed fields, MongoDB will return results directly from the index *without* scanning any documents or bringing documents into memory. These covered queries can be *very* efficient. Indexes can also cover [aggregation pipeline operations](#) (page 279).

## 7.1.1 Index Types

MongoDB provides a number of different index types to support specific types of data and queries.

### Default `_id`

All MongoDB collections have an index on the `_id` field that exists by default. If applications do not specify a value for `_id` the driver or the `mongod` (page 925) will create an `_id` field with an [ObjectID](#) value.

The `_id` index is *unique*, and prevents clients from inserting two documents with the same value for the `_id` field.

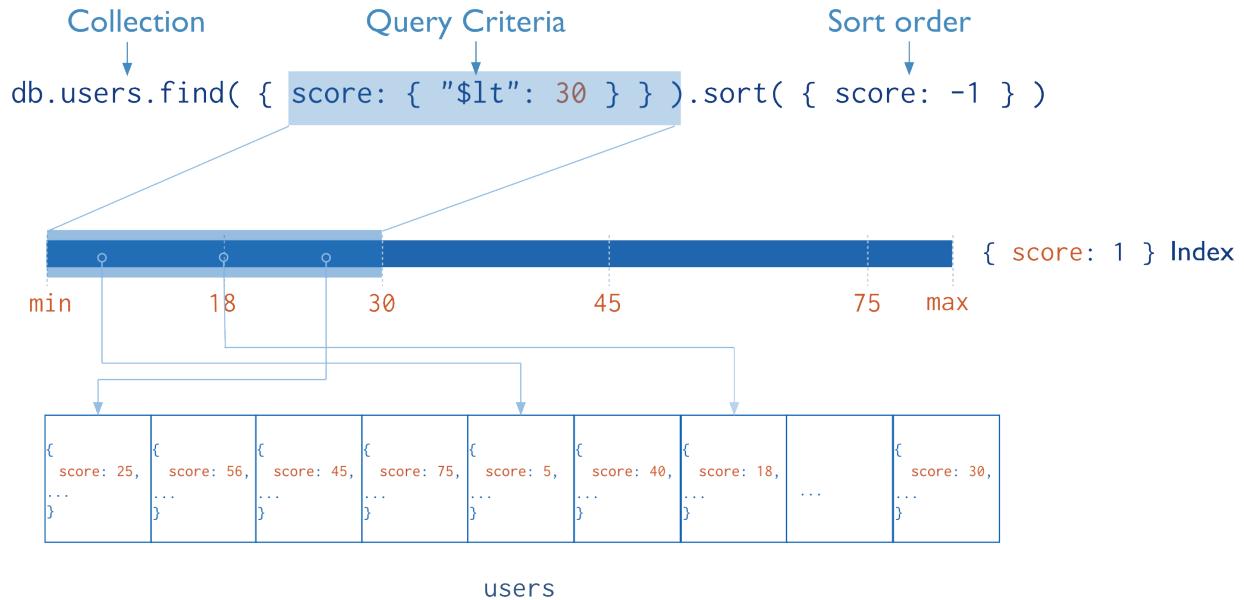


Figure 7.2: Diagram of a query that uses an index to select and return sorted results. The index stores `score` values in ascending order. MongoDB can traverse the index in either ascending or descending order to return sorted results.

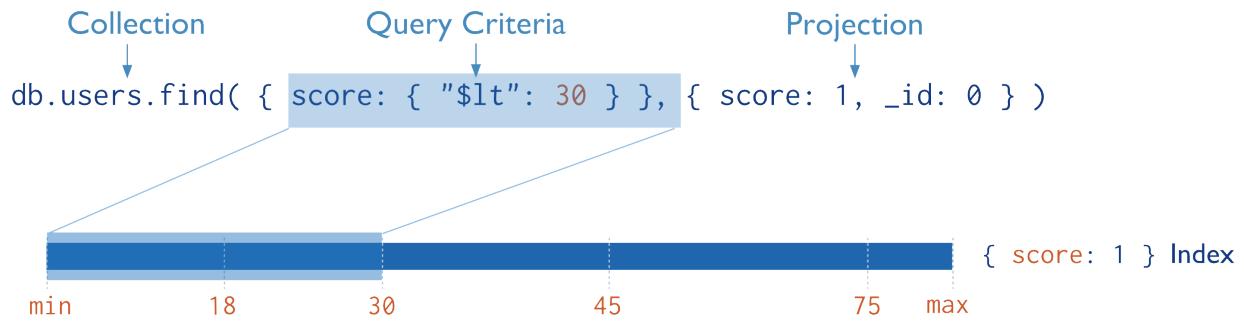


Figure 7.3: Diagram of a query that uses only the index to match the query criteria and return the results. MongoDB does not need to inspect data outside of the index to fulfill the query.

## Single Field

In addition to the MongoDB-defined `_id` index, MongoDB supports user-defined indexes on a *single field of a document* (page 320). Consider the following illustration of a single-field index:

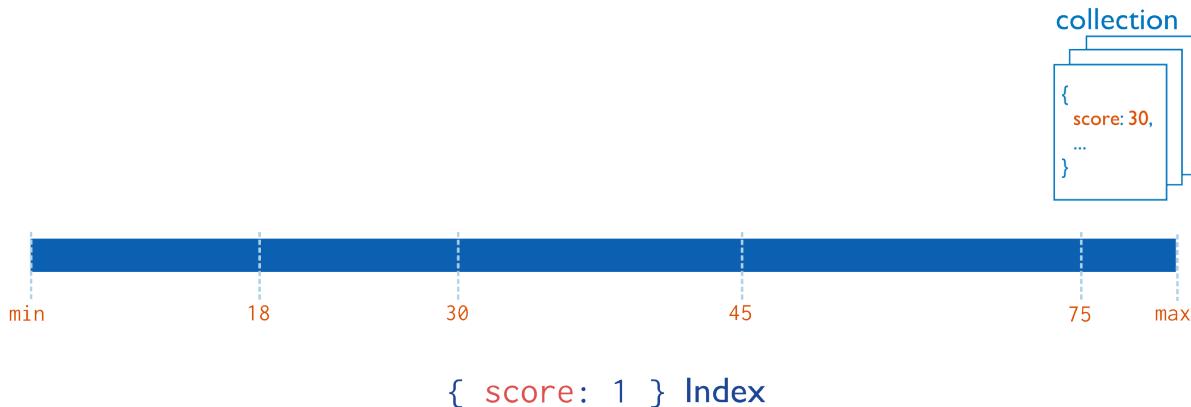


Figure 7.4: Diagram of an index on the `score` field (ascending).

## Compound Index

MongoDB also supports user-defined indexes on multiple fields. These *compound indexes* (page 322) behave like single-field indexes; however, the query can select documents based on additional fields. The order of fields listed in a compound index has significance. For instance, if a compound index consists of `{ userid: 1, score: -1 }`, the index sorts first by `userid` and then, within each `userid` value, sort by `score`. Consider the following illustration of this compound index:

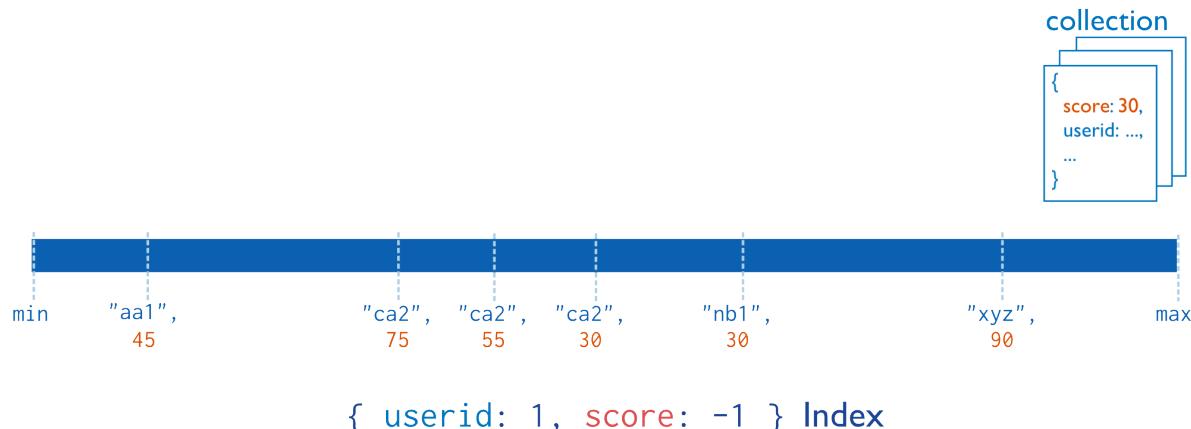


Figure 7.5: Diagram of a compound index on the `userid` field (ascending) and the `score` field (descending). The index sorts first by the `userid` field and then by the `score` field.

## Multikey Index

MongoDB uses [multikey indexes](#) (page 324) to index the content stored in arrays. If you index a field that holds an array value, MongoDB creates separate index entries for *every* element of the array. These [multikey indexes](#) (page 324) allow queries to select documents that contain arrays by matching on element or elements of the arrays. MongoDB automatically determines whether to create a multikey index if the indexed field contains an array value; you do not need to explicitly specify the multikey type.

Consider the following illustration of a multikey index:

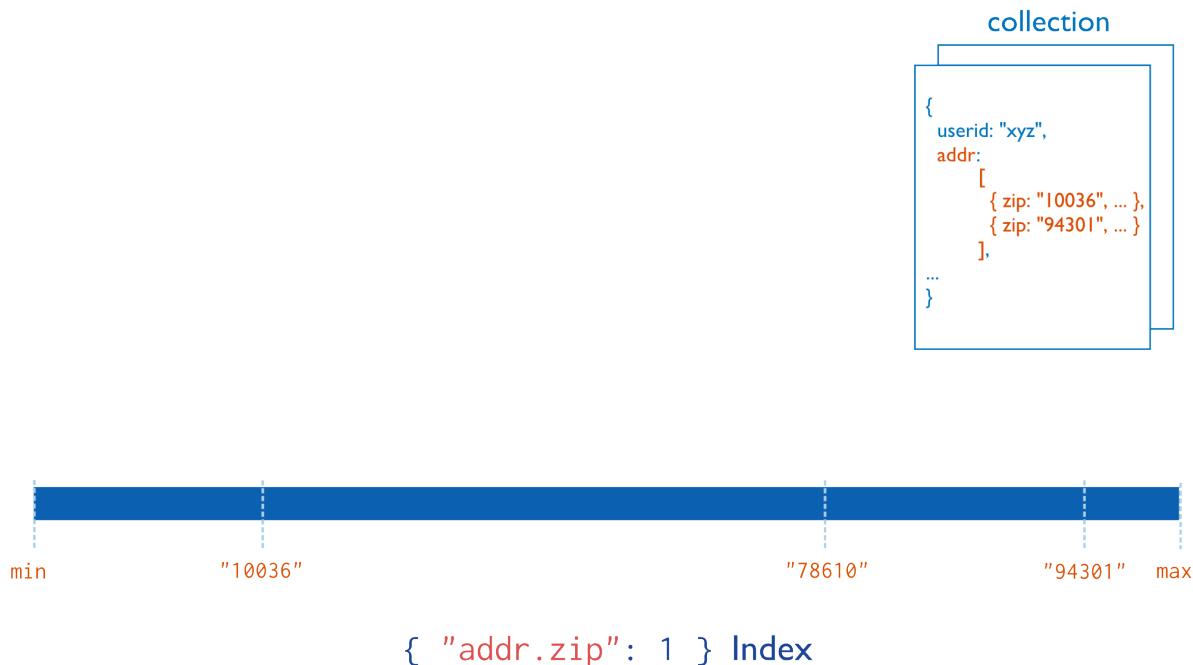


Figure 7.6: Diagram of a multikey index on the `addr.zip` field. The `addr` field contains an array of address documents. The address documents contain the `zip` field.

## Geospatial Index

To support efficient queries of geospatial coordinate data, MongoDB provides two special indexes: [2d indexes](#) (page 330) that uses planar geometry when returning results and [2sphere indexes](#) (page 328) that use spherical geometry to return results.

See [2d Index Internals](#) (page 330) for a high level introduction to geospatial indexes.

## Text Indexes

MongoDB provides a *beta* `text` index type that supports searching for string content in a collection. These text indexes do not store language-specific *stop* words (e.g. “the”, “a”, “or”) and *stem* the words in a collection to only store root words.

See [Text Indexes](#) (page 332) for more information on text indexes and search.

## Hashed Indexes

To support [hash based sharding](#) (page 506), MongoDB provides a [hashed index](#) (page 333) type, which indexes the hash of the value of a field. These indexes have a more random distribution of values along their range, but *only* support equality matches and cannot support range-based queries.

### 7.1.2 Index Properties

#### Unique Indexes

The [unique](#) (page 334) property for an index causes MongoDB to reject duplicate values for the indexed field. To create a [unique index](#) (page 334) on a field that already has duplicate values, see [Drop Duplicates](#) (page 337) for index creation options. Other than the unique constraint, unique indexes are functionally interchangeable with other MongoDB indexes.

#### Sparse Indexes

The [sparse](#) (page 335) property of an index ensures that the index only contain entries for documents that have the indexed field. The index skips documents that *do not* have the indexed field.

You can combine the sparse index option with the unique index option to reject documents that have duplicate values for a field but ignore documents that do not have the indexed key.

## 7.2 Index Concepts

These documents describe and provide examples of the types, configuration options, and behavior of indexes in MongoDB. For an over view of indexing, see [Index Introduction](#) (page 313). For operational instructions, see [Indexing Tutorials](#) (page 338). The [Indexing Reference](#) (page 374) documents the commands and operations specific to index construction, maintenance, and querying in MongoDB, including index types and creation options.

**[Index Types](#) (page 319)** MongoDB provides different types of indexes for different purposes and different types of content.

**[Single Field Indexes](#) (page 320)** A single field index only includes data from a single field of the documents in a collection. MongoDB supports single field indexes on fields at the top level of a document *and* on fields in sub-documents.

**[Compound Indexes](#) (page 322)** A compound index includes more than one field of the documents in a collection.

**[Multikey Indexes](#) (page 324)** A multikey index references an array and records a match if a query includes any value in the array.

**[Geospatial Indexes and Queries](#) (page 326)** Geospatial indexes support location-based searches on data that is stored as either GeoJSON objects or legacy coordinate pairs.

**[Text Indexes](#) (page 332)** Text indexes supports search of string content in documents.

**[Hashed Index](#) (page 333)** Hashed indexes maintain entries with hashes of the values of the indexed field.

**[Index Properties](#) (page 333)** The properties you can specify when building indexes.

**[TTL Indexes](#) (page 334)** The TTL index is used for TTL collections, which expire data after a period of time.

**[Unique Indexes](#) (page 334)** A unique index causes MongoDB to reject all documents that contain a duplicate value for the indexed field.

[Sparse Indexes](#) (page 335) A sparse index does not index documents that do not have the indexed field.

[Index Creation](#) (page 335) The options available when creating indexes.

## 7.2.1 Index Types

MongoDB provides a number of different index types. You can create indexes on any field or embedded field within a document or sub-document. You can create [single field indexes](#) (page 320) or [compound indexes](#) (page 322). MongoDB also supports indexes of arrays, called [multi-key indexes](#) (page 324), as well as supports [indexes on geospatial data](#) (page 326). For a list of the supported index types, see [Index Type Documentation](#) (page 319).

In general, you should create indexes that support your common and user-facing queries. Having these indexes will ensure that MongoDB scans the smallest possible number of documents.

In the [mongo](#) (page 942) shell, you can create an index by calling the `ensureIndex()` (page 814) method. For more detailed instructions about building indexes, see the [Indexing Tutorials](#) (page 338) page.

### Behavior of Index Types

All indexes in MongoDB are [B-tree](#) indexes, which can efficiently support equality matches and range queries. The index stores items internally in order sorted by the value of the index field. The ordering of index entries supports efficient range-based operations and allows MongoDB to return sorted results using the order of documents in the index.

### Ordering of Indexes

MongoDB indexes may be ascending, (i.e. 1) or descending (i.e. -1) in their ordering. Nevertheless, MongoDB may also traverse the index in either directions. As a result, for single-field indexes, ascending and descending indexes are interchangeable. This is not the case for compound indexes: in compound indexes, the direction of the sort order can have a greater impact on the results.

See [Sort Order](#) (page 323) for more information on the impact of index order on results in compound indexes.

### Redundant Indexes

A single query can only use *one* index, except for queries that use the `$or` (page 625) operator that can use a different index for each clause.

#### See also:

[Index Limitations](#) (page 1016).

### Index Type Documentation

[Single Field Indexes](#) (page 320) A single field index only includes data from a single field of the documents in a collection. MongoDB supports single field indexes on fields at the top level of a document *and* on fields in sub-documents.

[Compound Indexes](#) (page 322) A compound index includes more than one field of the documents in a collection.

[Multikey Indexes](#) (page 324) A multikey index references an array and records a match if a query includes any value in the array.

**Geospatial Indexes and Queries** (page 326) Geospatial indexes support location-based searches on data that is stored as either GeoJSON objects or legacy coordinate pairs.

**Text Indexes** (page 332) Text indexes supports search of string content in documents.

**Hashed Index** (page 333) Hashed indexes maintain entries with hashes of the values of the indexed field.

### Single Field Indexes

MongoDB provides complete support for indexes on any field in a *collection* of *documents*. By default, all collections have an index on the [\\_id field](#) (page 321), and applications and users may add additional indexes to support important queries and operations.

MongoDB supports indexes that contain either a single field *or* multiple fields depending on the operations that index supports. This document describes indexes that contain a single field. Consider the following illustration of a single field index.

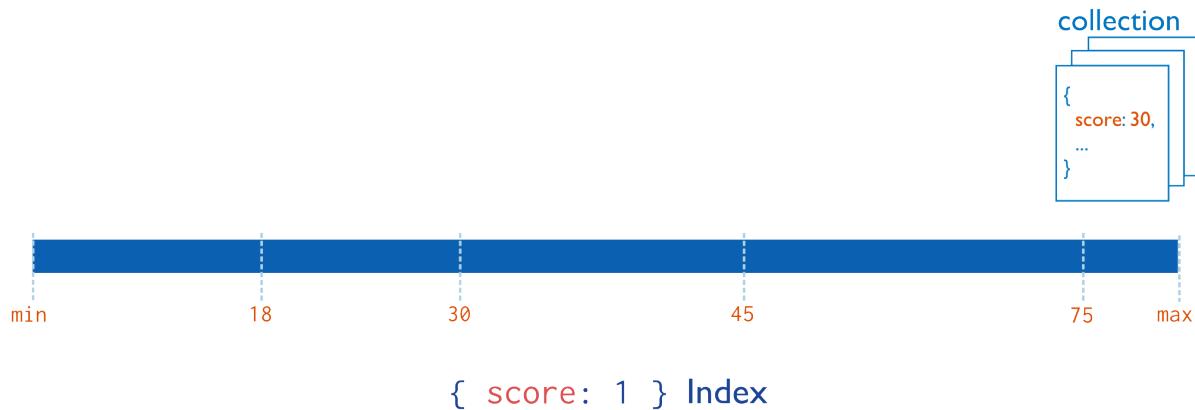


Figure 7.7: Diagram of an index on the `score` field (ascending).

#### See also:

[Compound Indexes](#) (page 322) for information about indexes that include multiple fields, and [Index Introduction](#) (page 313) for a higher level introduction to indexing in MongoDB.

**Example** Given the following document in the `friends` collection:

```
{ "_id" : ObjectId(...),
 "name" : "Alice"
 "age" : 27
}
```

The following command creates an index on the `name` field:

```
db.friends.ensureIndex({ "name" : 1 })
```

### Cases

**\_id Field Index** For all collections, MongoDB creates the default `_id` index, which is a *unique index* (page 334) on the `_id` field. MongoDB creates this index by default on all collections. You cannot delete the index on `_id`.

You can think of the `_id` field as the *primary key* for the collection. Every document *must* have a unique `_id` field. You may store any unique value in the `_id` field. The default value of `_id` is an *ObjectId* on every `insert()` (page 832) operation. An *ObjectId* is a 12-byte unique identifiers suitable for use as the value of an `_id` field.

---

**Note:** In *sharded clusters*, if you do *not* use the `_id` field as the *shard key*, then your application **must** ensure the uniqueness of the values in the `_id` field to prevent errors. This is most-often done by using a standard auto-generated *ObjectId*.

Before version 2.2, *capped collections* did not have an `_id` field. In version 2.2 and newer, capped collection do have an `_id` field, except those in the `local` database. See *Capped Collections Recommandations and Restrictions* (page 156) for more information.

---

**Indexes on Embedded Fields** You can create indexes on fields embedded in sub-documents, just as you can index top-level fields in documents. Indexes on embedded fields differ from *indexes on sub-documents* (page 321), which include the full content up to the maximum *Index Size* (page ??) of the sub-document in the index. Instead, indexes on embedded fields allow you to use a “dot notation,” to introspect into sub-documents.

Consider a collection named `people` that holds documents that resemble the following example document:

```
{ "_id": ObjectId(...),
 "name": "John Doe",
 "address": {
 "street": "Main",
 "zipcode": 53511,
 "state": "WI"
 }
}
```

You can create an index on the `address.zipcode` field, using the following specification:

```
db.people.ensureIndex({ "address.zipcode": 1 })
```

**Indexes on Subdocuments** You can also create indexes on subdocuments.

For example, the `factories` collection contains documents that contain a `metro` field, such as:

```
{
 _id: ObjectId("523cba3c73a8049bcd6007"),
 metro: {
 city: "New York",
 state: "NY"
 },
 name: "Giant Factory"
}
```

The `metro` field is a subdocument, containing the embedded fields `city` and `state`. The following creates an index on the `metro` field as a whole:

```
db.factories.ensureIndex({ metro: 1 })
```

The following query can use the index on the `metro` field:

```
db.factories.find({ metro: { city: "New York", state: "NY" } })
```

This query returns the above document. When performing equality matches on subdocuments, field order matters and the subdocuments must match exactly. For example, the following query does not match the above document:

```
db.factories.find({ metro: { state: "NY", city: "New York" } })
```

See [Query Subdocuments](#) (page 818) for more information regarding querying on subdocuments.

The index on the `metro` field can also support the following query:

```
db.factories.find({ metro: { $gte : { city: "New York" } } })
```

This query returns the above document because `{ city: "New York", state: "NY" }` is greater than `{ city: "New York" }`. The order of comparison is in ascending key order in the order that the keys occur in the [BSON](#) document.

## Compound Indexes

MongoDB supports *compound indexes*, where a single index structure holds references to multiple fields<sup>2</sup> within a collection's documents. The following diagram illustrates an example of a compound index on two fields:

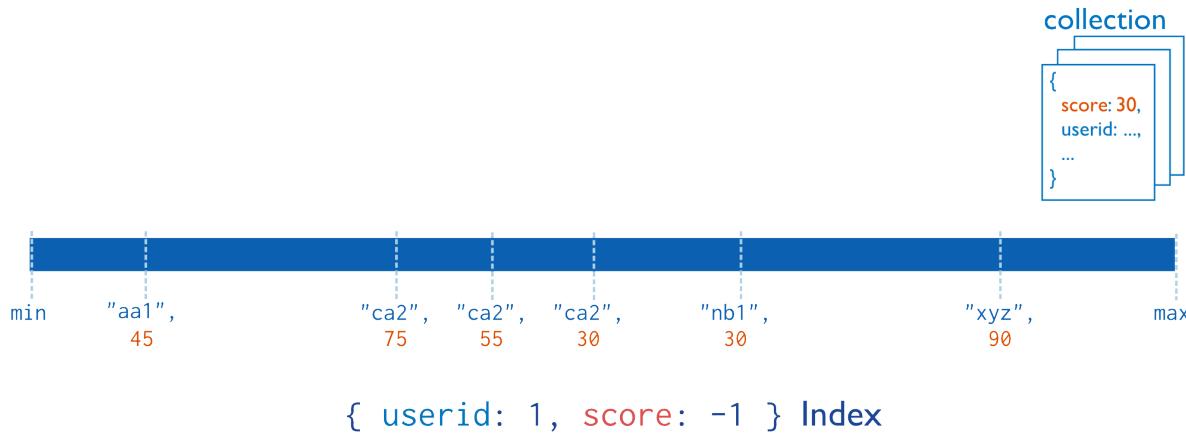


Figure 7.8: Diagram of a compound index on the `userid` field (ascending) and the `score` field (descending). The index sorts first by the `userid` field and then by the `score` field.

Compound indexes can support queries that match on multiple fields.

### Example

Consider a collection named `products` that holds documents that resemble the following document:

```
{
 "_id": ObjectId(...),
 "item": "Banana",
 "category": ["food", "produce", "grocery"],
 "location": "4th Street Store",
 "stock": 4,
 "type": cases,
 "arrival": Date(...)
}
```

<sup>2</sup> MongoDB imposes a limit of 31 fields for any compound index (page 1016).

If applications query on the `item` field as well as query on both the `item` field and the `stock` field, you can specify a single compound index to support both of these queries:

```
db.products.ensureIndex({ "item": 1, "stock": 1 })
```

---

**Important:** You may not create compound indexes that have hashed index fields. You will receive an error if you attempt to create a compound index that includes [a hashed index](#) (page 333).

The order of the fields in a compound index is very important. In the previous example, the index will contain references to documents sorted first by the values of the `item` field and, within each value of the `item` field, sorted by values of the `stock` field. See [Sort Order](#) (page 323) for more information.

In addition to supporting queries that match on all the index fields, compound indexes can support queries that match on the prefix of the index fields. For details, see [Prefixes](#) (page 323).

**Sort Order** Indexes store references to fields in either ascending (1) or descending (-1) sort order. For single-field indexes, the sort order of keys doesn't matter because MongoDB can traverse the index in either direction. However, for [compound indexes](#) (page 322), sort order can matter in determining whether the index can support a sort operation.

Consider a collection `events` that contains documents with the fields `username` and `date`. Applications can issue queries that return results sorted first by ascending `username` values and then by descending (i.e. more recent to last) `date` values, such as:

```
db.events.find().sort({ username: 1, date: -1 })
```

or queries that return results sorted first by descending `username` values and then by ascending `date` values, such as:

```
db.events.find().sort({ username: -1, date: 1 })
```

The following index can support both these sort operations:

```
db.events.ensureIndex({ "username" : 1, "date" : -1 })
```

However, the above index cannot support sorting by ascending `username` values and then by ascending `date` values, such as the following:

```
db.events.find().sort({ username: 1, date: 1 })
```

**Prefixes** Compound indexes support queries on any prefix of the index fields. Index prefixes are the beginning subset of indexed fields. For example, given the index `{ a: 1, b: 1, c: 1 }`, both `{ a: 1 }` and `{ a: 1, b: 1 }` are prefixes of the index.

If you have a collection that has a compound index on `{ a: 1, b: 1 }`, as well as an index that consists of the prefix of that index, i.e. `{ a: 1 }`, assuming none of the index has a sparse or unique constraints, then you can drop the `{ a: 1 }` index. MongoDB will be able to use the compound index in all of situations that it would have used the `{ a: 1 }` index.

---

## Example

Given the following index:

```
{ "item": 1, "location": 1, "stock": 1 }
```

MongoDB **can** use this index to support queries that include:

- the `item` field, and

- the `item` field *and* the `location` field, and
- the `item` field *and* the `location` field *and* the `stock` field.

MongoDB **cannot** use this index to support queries that include:

- only the `location` field,
- only the `stock` field,
- only the `location` *and* `stock` fields, and
- only the `item` *and* `stock` fields.

## Multikey Indexes

To index a field that holds an array value, MongoDB adds index items for each item in the array. These *multikey* indexes allow MongoDB return documents from queries using the value of an array. MongoDB automatically determines whether to create a multikey index if the indexed field contains an array value; you do not need to explicitly specify the multikey type.

Consider the following illustration of a multikey index:

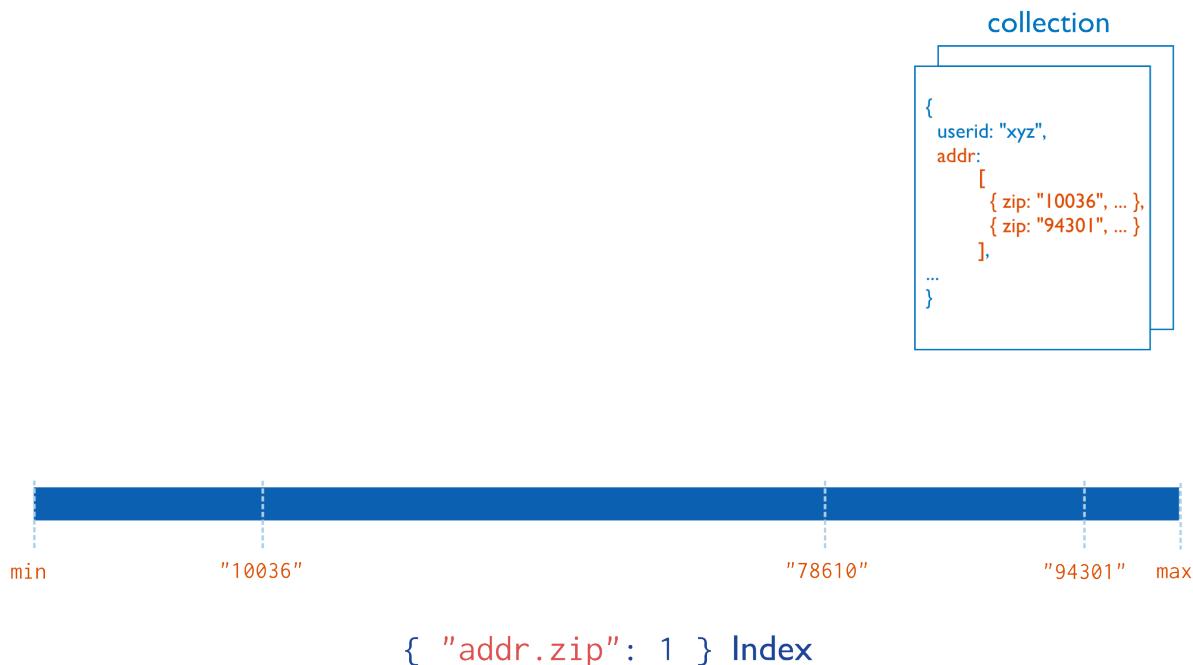


Figure 7.9: Diagram of a multikey index on the `addr.zip` field. The `addr` field contains an array of address documents. The address documents contain the `zip` field.

Multikey indexes support all operations of other MongoDB indexes; however, applications may use multikey indexes to select documents based on ranges of values for the value of an array. Multikey indexes support arrays that hold both values (e.g. strings, numbers) *and* nested documents.

## Limitations

**Interactions between Compound and Multikey Indexes** While you can create multikey *compound indexes* (page 322), at most one field in a compound index may hold an array. For example, given an index on { a: 1, b: [1] }, the following documents are permissible:

```
{a: [1, 2], b: 1}
{a: 1, b: [1, 2]}
```

However, the following document is impermissible, and MongoDB cannot insert such a document into a collection with the {a: 1, b: [1]} index:

```
{a: [1, 2], b: [1, 2]}
```

If you attempt to insert a such a document, MongoDB will reject the insertion, and produce an error that says `cannot index parallel arrays`. MongoDB does not index parallel arrays because they require the index to include each value in the Cartesian product of the compound keys, which could quickly result in incredibly large and difficult to maintain indexes.

## Shard Keys

---

**Important:** The index of a shard key **cannot** be a multi-key index.

---

**Hashed Indexes** hashed indexes are not compatible with multi-key indexes.

To compute the hash for a hashed index, MongoDB collapses sub-documents and computes the hash for the entire value. For fields that hold arrays or sub-documents, you cannot use the index to support queries that introspect the sub-document.

## Examples

**Index Basic Arrays** Given the following document:

```
{
 "_id" : ObjectId("..."),
 "name" : "Warm Weather",
 "author" : "Steve",
 "tags" : ["weather", "hot", "record", "april"]
}
```

Then an index on the tags field, { tags: 1 }, would be a multikey index and would include these four separate entries for that document:

- "weather",
- "hot",
- "record", and
- "april".

Queries could use the multikey index to return queries for any of the above values.

**Index Arrays with Nested Documents** You can use multikey indexes to index fields within objects embedded in arrays, as in the following example:

Consider a feedback collection with documents in the following form:

```
{
 "_id": ObjectId(...)
 "title": "Grocery Quality"
 "comments": [
 { author_id: ObjectId(...)
 date: Date(...)
 text: "Please expand the cheddar selection." },
 { author_id: ObjectId(...)
 date: Date(...)
 text: "Please expand the mustard selection." },
 { author_id: ObjectId(...)
 date: Date(...)
 text: "Please expand the olive selection." }
]
}
```

An index on the `comments.text` field would be a multikey index and would add items to the index for all of the sub-documents in the array.

With an index, such as `{ comments.text: 1 }`, consider the following query:

```
db.feedback.find({ "comments.text": "Please expand the olive selection." })
```

This would select the document, that contains the following document in the `comments.text` array:

```
{ author_id: ObjectId(...)
 date: Date(...)
 text: "Please expand the olive selection." }
```

## Geospatial Indexes and Queries

MongoDB offers a number of indexes and query mechanisms to handle geospatial information. This section introduces MongoDB's geospatial features.

**Surfaces** Before storing your location data and writing queries, you must decide the type of surface to use to perform calculations. The type you choose affects how you store data, what type of index to build, and the syntax of your queries.

MongoDB offers two surface types:

- **Spherical**

To calculate geometry over an Earth-like sphere, store your location data on a spherical surface and use [2dsphere](#) (page 328) index.

Store your location data as GeoJSON objects with this coordinate-axis order: **longitude, latitude**. The coordinate reference system for GeoJSON uses the [WGS84](#) datum.

- **Flat**

To calculate distances on a Euclidean plane, store your location data as legacy coordinate pairs and use a [2d](#) (page 330) index.

**Location Data** If you choose spherical surface calculations, you store location data as

- [GeoJSON](#) objects (preferred).

Queries on GeoJSON objects always calculate on a sphere. The default coordinate reference system for GeoJSON uses the [WGS84](#) datum.

New in version 2.4: The storage and querying of GeoJSON objects is new in version 2.4. Prior to version 2.4, all geospatial data was stored as coordinate pairs.

MongoDB supports the following GeoJSON objects:

- Point
- LineString
- Polygon

- *Legacy coordinate pairs*

MongoDB supports spherical surface calculations on legacy coordinate pairs by converting the data to the GeoJSON Point type.

If you choose flat surface calculations, you can store data only as *legacy coordinate pairs*.

**Query Operations** MongoDB’s geospatial query operators let you query for:

- **Inclusion.** MongoDB can query for locations contained entirely within a specified polygon. Inclusion queries use the [\\$geoWithin](#) (page 635) operator.
- **Intersection.** MongoDB can query for locations that intersect with a specified geometry. These queries apply only to data on a spherical surface. These queries use the [\\$geoIntersects](#) (page 637) operator.
- **Proximity.** MongoDB can query for the points nearest to another point. Proximity queries use the [\\$near](#) (page 637) operator. The [\\$near](#) (page 637) operator requires a `2d` or `2dsphere` index.

**Geospatial Indexes** MongoDB provides the following geospatial index types to support the geospatial queries:

- [2dsphere](#) (page 328), which supports:
  - Calculations on a sphere
  - Both GeoJSON objects and legacy coordinate pairs
  - A compound index with scalar index fields (i.e. ascending or descending) as a prefix or suffix of the `2dsphere` index field

New in version 2.4: `2dsphere` indexes are not available before version 2.4.

- [2d](#) (page 330), which supports:
  - Calculations using flat geometry
  - Legacy coordinate pairs (i.e., geospatial points on a flat coordinate system)
  - A compound index with only one additional field, as a suffix of the `2d` index field

**Geospatial Indexes and Sharding** You *cannot* use a geospatial index as the [shard key](#) index.

You can create and maintain a geospatial index on a sharded collection if using different fields as the shard key.

Queries using [\\$near](#) (page 637) are not supported for sharded collections. Use [geoNear](#) (page 708) instead. You also can query for geospatial data using [\\$geoWithin](#) (page 635).

**Additional Resources** The following pages provide complete documentation for geospatial indexes and queries:

**2dsphere Indexes (page 328)** A 2dsphere index supports queries that calculate geometries on an earth-like sphere. The index supports data stored as both GeoJSON objects and as legacy coordinate pairs.

**2d Indexes (page 330)** The 2d index supports data stored as legacy coordinate pairs and is intended for use in MongoDB 2.2 and earlier.

**Haystack Indexes (page 330)** A haystack index is a special index optimized to return results over small areas. For queries that use spherical geometry, a 2dsphere index is a better option than a haystack index.

**2d Index Internals (page 330)** Provides a more in-depth explanation of the internals of geospatial indexes. This material is not necessary for normal operations but may be useful for troubleshooting and for further understanding.

### 2dsphere Indexes New in version 2.4.

A 2dsphere index supports queries that calculate geometries on an earth-like sphere. The index supports data stored as both [GeoJSON](#) objects and as legacy coordinate pairs. The index supports legacy coordinate pairs by converting the data to the GeoJSON Point type.

The 2dsphere index supports all MongoDB geospatial queries: queries for inclusion, intersection and proximity.

A [compound](#) (page 322) 2dsphere index can reference multiple location and non-location fields within a collection's documents. You can arrange the fields in any order.

The default datum for an earth-like sphere in MongoDB 2.4 is [WGS84](#). Coordinate-axis order is **longitude, latitude**.

---

**Important:** MongoDB allows *only one* geospatial index per collection. You can create either a 2dsphere or a 2d (page 330) per collection.

---

**Important:** You cannot use a 2dsphere index as a shard key when sharding a collection. However, you can create and maintain a geospatial index on a sharded collection by using a different field as the shard key.

---

### Store GeoJSON Objects New in version 2.4.

MongoDB supports the following GeoJSON objects:

- [Point](#)
- [LineString](#)
- [Polygon](#)

In order to index GeoJSON data, you must store the data in a location field that you name. The location field contains a subdocument with a `type` field specifying the GeoJSON object type and a `coordinates` field specifying the object's coordinates. Always store coordinates `longitude, latitude` order.

Use the following syntax:

```
{ <location field> : { type : "<GeoJSON type>" ,
 coordinates : <coordinates>
} }
```

The following example stores a GeoJSON Point:

```
{ loc : { type : "Point" ,
 coordinates : [40, 5]
} }
```

The following example stores a GeoJSON LineString:

```
{ loc : { type : "LineString" ,
 coordinates : [[40 , 5] , [41 , 6]]
 } }
```

*Polygons* consist of an array of GeoJSON LinearRing coordinate arrays. These LinearRings are closed LineStrings. Closed LineStrings have at least four coordinate pairs and specify the same position as the first and last coordinates.

The following example stores a GeoJSON Polygon with an exterior ring and no interior rings (or holes). Note the first and last coordinate pair with the [ 0 , 0 ] coordinate:

```
{ loc :
 { type : "Polygon" ,
 coordinates : [[[0 , 0] , [3 , 6] , [6 , 1] , [0 , 0]]]
 } }
```

For Polygons with multiple rings:

- The first described ring must be the exterior ring.
- The exterior ring cannot self-intersect.
- Any interior ring must be entirely contained by the outer ring.
- Interior rings cannot intersect or overlap each other. Interior rings can share an edge.

The following document represents a polygon with an interior ring as GeoJSON:

```
{ loc :
 { type : "Polygon" ,
 coordinates : [[[0 , 0] , [3 , 6] , [6 , 1] , [0 , 0]],
 [[2 , 2] , [3 , 3] , [4 , 2] , [2 , 2]]]
 } }
```

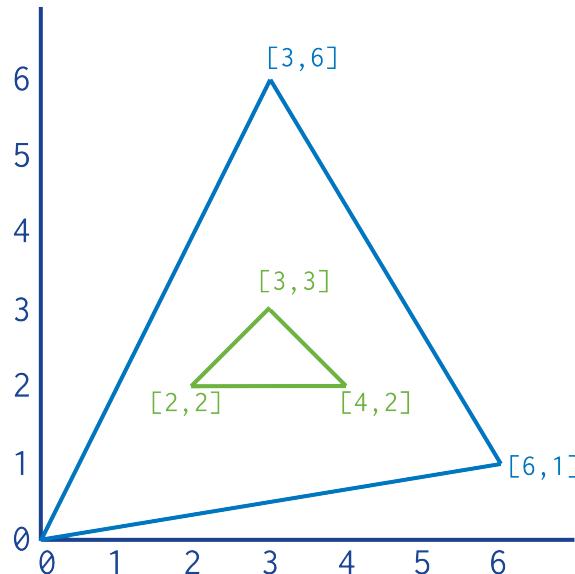


Figure 7.10: Diagram of a Polygon with internal ring.

## 2d Indexes

---

**Important:** MongoDB allows *only one* geospatial index per collection. You can create either a `2d` or a `2dsphere` (page 328) per collection.

---

Use a `2d` index for data stored as points on a two-dimensional plane. The `2d` index is intended for legacy coordinate pairs used in MongoDB 2.2 and earlier.

Use a `2d` index if:

- your database has legacy location data from MongoDB 2.2 or earlier, *and*
- you do not intend to store any location data as `GeoJSON` objects.

Do not use a `2d` index if your location data includes `GeoJSON` objects. To index on both legacy coordinate pairs *and* `GeoJSON` objects, use a `2dsphere` (page 328) index.

The `2d` index supports calculations on a flat, Euclidean plane. The `2d` index also supports *distance-only* calculations on a sphere, but for *geometric* calculations (e.g. `$geoWithin` (page 635)) on a sphere, store data as `GeoJSON` objects and use the `2dsphere` index type.

A `2d` index can reference two fields. The first must be the location field. A `2d` compound index constructs queries that select first on the location field, and then filters those results by the additional criteria. A compound `2d` index can cover queries.

---

**Note:** You cannot use a `2d` index as a shard key when sharding a collection. However, you can create and maintain a geospatial index on a sharded collection by using a different field as the shard key.

---

**Store Points on a 2D Plane** To store location data as legacy coordinate pairs, use either an array (preferred):

```
loc : [<longitude> , <latitude>]
```

Or an embedded document:

```
loc : { lng : <longitude> , lat : <latitude> }
```

Arrays are preferred as certain languages do not guarantee associative map ordering.

Whether as an array or document, if you use longitude and latitude, store coordinates in this order: **longitude, latitude**.

**Haystack Indexes** A haystack index is a special index that is optimized to return results over small areas. Haystack indexes improve performance on queries that use flat geometry.

For queries that use spherical geometry, a **2dsphere index is a better option** than a haystack index. `2dsphere indexes` (page 328) allow field reordering; haystack indexes require the first field to be the location field. Also, haystack indexes are only usable via commands and so always return all results at once.

Haystack indexes create “buckets” of documents from the same geographic area in order to improve performance for queries limited to that area. Each bucket in a haystack index contains all the documents within a specified proximity to a given longitude and latitude.

To create a geohaystacks index, see [Create a Haystack Index](#) (page 354). For information and example on querying a haystack index, see [Query a Haystack Index](#) (page 355).

**2d Index Internals** This document provides a more in-depth explanation of the internals of MongoDB’s `2d` geospatial indexes. This material is not necessary for normal operations or application development but may be useful for troubleshooting and for further understanding.

**Calculation of Geohash Values for 2d Indexes** When you create a geospatial index on *legacy coordinate pairs*, MongoDB computes *geohash* values for the coordinate pairs within the specified *location range* (page 352) and then indexes the geohash values.

To calculate a geohash value, recursively divide a two-dimensional map into quadrants. Then assign each quadrant a two-bit value. For example, a two-bit representation of four quadrants would be:

```
01 11
00 10
```

These two-bit values (00, 01, 10, and 11) represent each of the quadrants and all points within each quadrant. For a geohash with two bits of resolution, all points in the bottom left quadrant would have a geohash of 00. The top left quadrant would have the geohash of 01. The bottom right and top right would have a geohash of 10 and 11, respectively.

To provide additional precision, continue dividing each quadrant into sub-quadrants. Each sub-quadrant would have the geohash value of the containing quadrant concatenated with the value of the sub-quadrant. The geohash for the upper-right quadrant is 11, and the geohash for the sub-quadrants would be (clockwise from the top left): 1101, 1111, 1110, and 1100, respectively.

### **Multi-location Documents for 2d Indexes** New in version 2.0: Support for multiple locations in a document.

While 2d geospatial indexes do not support more than one set of coordinates in a document, you can use a *multi-key index* (page 324) to index multiple coordinate pairs in a single document. In the simplest example you may have a field (e.g. `locs`) that holds an array of coordinates, as in the following example:

```
{ _id : ObjectId(...),
 locs : [[55.5 , 42.3] ,
 [-74 , 44.74] ,
 { lng : 55.5 , lat : 42.3 }]
}
```

The values of the array may be either arrays, as in `[ 55.5 , 42.3 ]`, or embedded documents, as in `{ lng : 55.5 , lat : 42.3 }`.

You could then create a geospatial index on the `locs` field, as in the following:

```
db.places.ensureIndex({ "locs": "2d" })
```

You may also model the location data as a field inside of a sub-document. In this case, the document would contain a field (e.g. `addresses`) that holds an array of documents where each document has a field (e.g. `loc`) that holds location coordinates. For example:

```
{ _id : ObjectId(...),
 name : "...",
 addresses : [{
 context : "home" ,
 loc : [55.5 , 42.3]
 } ,
 {
 context : "home",
 loc : [-74 , 44.74]
 }
]
```

You could then create the geospatial index on the `addresses.loc` field as in the following example:

```
db.records.ensureIndex({ "addresses.loc": "2d" })
```

For documents with multiple coordinate values, queries may return the same document multiple times if more than one indexed coordinate pair satisfies the query constraints. Use the `uniqueDocs` parameter to [geoNear](#) (page 708) or the `$uniqueDocs` (page 643) operator with `$geoWithin` (page 635).

To include the location field with the distance field in multi-location document queries, specify `includeLocs: true` in the [geoNear](#) (page 708) command.

**See also:**

[Geospatial Query Compatibility](#) (page 643)

## Text Indexes

New in version 2.4.

MongoDB provides `text` indexes to support text search of string content in documents of a collection. `text` indexes are case-insensitive and can include any field whose value is a string or an array of string elements. You can only access the `text` index with the [text](#) (page 715) command.

---

**Important:**

- Before you can create a text index or [run the text command](#) (page 333), you need to manually enable the text search. See [Enable Text Search](#) (page 358) for information on how to enable the text search feature.
  - A collection can have at most **one** `text` index.
- 

**Create Text Index** To create a `text` index, use the [db.collection.ensureIndex\(\)](#) (page 814) method. To index a field that contains a string or an array of string elements, include the field and specify the string literal "`text`" in the index document, as in the following example:

```
db.reviews.ensureIndex({ comments: "text" })
```

For examples of creating `text` indexes on multiple fields, see [Create a text Index](#) (page 358).

`text` indexes drop language-specific stop words (e.g. in English, “the,” “an,” “a,” “and,” etc.) and uses simple language-specific suffix stemming. See [Text Search Languages](#) (page 719) for the supported languages and [Specify a Language for Text Index](#) (page 362) for details on specifying languages with `text` indexes.

`text` indexes can cover a text search. If an index covers a text search, MongoDB does not need to inspect data outside of the index to fulfill the search. For details, see [Create text Index to Cover Queries](#) (page 366).

**Storage Requirements and Performance Costs** `text` indexes have the following storage requirements and performance costs:

- `text` indexes change the space allocation method for all future record allocations in a collection to [usePowerOf2Sizes](#) (page 755).
- `text` indexes can be large. They contain one index entry for each unique post-stemmed word in each indexed field for each document inserted.
- Building a `text` index is very similar to building a large multi-key index and will take longer than building a simple ordered (scalar) index on the same data.
- When building a large `text` index on an existing collection, ensure that you have a sufficiently high limit on open file descriptors. See the [recommended settings](#) (page 225).

- text indexes will impact insertion throughput because MongoDB must add an index entry for each unique post-stemmed word in each indexed field of each new source document.
- Additionally, text indexes do not store phrases or information about the proximity of words in the documents. As a result, phrase queries will run much more effectively when the entire collection fits in RAM.

**Text Search** Text search supports the search of string content in documents of a collection. MongoDB provides the [text](#) (page 715) command to perform the text search. The [text](#) (page 715) command accesses the text index.

The text search process:

- tokenizes and stems the search term(s) during both the index creation and the text command execution.
- assigns a score to each document that contains the search term in the indexed fields. The score determines the relevance of a document to a given search query.

By default, the [text](#) (page 715) command returns at most the top 100 matching documents as determined by the scores. The command can search for words and phrases. The command matches on the complete stemmed words. For example, if a document field contains the word `blueberry`, a search on the term `blue` will not match the document. However, a search on either `blueberry` or `blueberries` will match.

For information and examples on various text search patterns, see [Search String Content for Text](#) (page 359).

## Hashed Index

New in version 2.4.

Hashed indexes maintain entries with hashes of the values of the indexed field. The hashing function collapses sub-documents and computes the hash for the entire value but does not support multi-key (i.e. arrays) indexes.

Hashed indexes support [sharding](#) (page 493) a collection using a [hashed shard key](#) (page 506). Using a hashed shard key to shard a collection ensures a more even distribution of data. See [Shard a Collection Using a Hashed Shard Key](#) (page 528) for more details.

MongoDB can use the hashed index to support equality queries, but hashed indexes do not support range queries.

You may not create compound indexes that have hashed index fields or specify a unique constraint on a hashed index; however, you can create both a hashed index and an ascending/descending (i.e. non-hashed) index on the same field: MongoDB will use the scalar index for range queries.

**Warning:** MongoDB hashed indexes truncate floating point numbers to 64-bit integers before hashing. For example, a hashed index would store the same value for a field that held a value of `2.3`, `2.2`, and `2.9`. To prevent collisions, do not use a hashed index for floating point numbers that cannot be consistently converted to 64-bit integers (and then back to floating point). MongoDB hashed indexes do not support floating point values larger than  $2^{53}$ .

Create a hashed index using an operation that resembles the following:

```
db.active.ensureIndex({ a: "hashed" })
```

This operation creates a hashed index for the `active` collection on the `a` field.

### 7.2.2 Index Properties

In addition to the numerous [index types](#) (page 319) MongoDB supports, indexes can also have various properties. The following documents detail the index properties that can you can select when building an index.

**TTL Indexes** (page 334) The TTL index is used for TTL collections, which expire data after a period of time.

[Unique Indexes](#) (page 334) A unique index causes MongoDB to reject all documents that contain a duplicate value for the indexed field.

[Sparse Indexes](#) (page 335) A sparse index does not index documents that do not have the indexed field.

## TTL Indexes

TTL indexes are special indexes that MongoDB can use to automatically remove documents from a collection after a certain amount of time. This is ideal for some types of information like machine generated event data, logs, and session information that only need to persist in a database for a limited amount of time.

These indexes have the following limitations:

- [Compound indexes](#) (page 322) are *not* supported.
- The indexed field **must** be a date *type*.
- If the field holds an array, and there are multiple date-typed data in the index, the document will expire when the *lowest* (i.e. earliest) matches the expiration threshold.

**Warning:** The TTL index does not guarantee that expired data will be deleted immediately. There may be a delay between the time a document expires and the time that MongoDB removes the document from the database.

The background task that removes expired documents runs *every 60 seconds*. As a result, documents may remain in a collection *after* they expire but *before* the background task runs or completes.

The duration of the removal operation depends on the workload of your [mongod](#) (page 925) instance. Therefore, expired data may exist for some time *beyond* the 60 second period between runs of the background task.

In all other respects, TTL indexes are normal indexes, and if appropriate, MongoDB can use these indexes to fulfill arbitrary queries.

---

### See

[Expire Data from Collections by Setting TTL](#) (page 158)

---

## Unique Indexes

A unique index causes MongoDB to reject all documents that contain a duplicate value for the indexed field. To create a unique index on the `user_id` field of the `members` collection, use the following operation in the `mongo` (page 942) shell:

```
db.addresses.ensureIndex({ "user_id": 1 }, { unique: true })
```

By default, `unique` is `false` on MongoDB indexes.

If you use the `unique` constraint on a [compound index](#) (page 322), then MongoDB will enforce uniqueness on the *combination* of values rather than the individual value for any or all values of the key.

If a document does not have a value for the indexed field in a unique index, the index will store a null value for this document. Because of the unique constraint, MongoDB will only permit one document that lacks the indexed field. If there is more than one document without a value for the indexed field or is missing the indexed field, the index build will fail with a duplicate key error.

You can combine the unique constraint with the [sparse index](#) (page 335) to filter these null values from the unique index and avoid the error.

You may not specify a unique constraint on a [hashed index](#) (page 333).

## Sparse Indexes

Sparse indexes only contain entries for documents that have the indexed field, even if the index field contains a null value. The index skips over any document that is missing the indexed field. The index is “sparse” because it does not include all documents of a collection. By contrast, non-sparse indexes contain all documents in a collection, storing null values for those documents that do not contain the indexed field.

The following example in the `mongo` (page 942) shell creates a sparse index on the `xmpp_id` field of the `members` collection:

```
db.addresses.ensureIndex({ "xmpp_id": 1 }, { sparse: true })
```

By default, `sparse` is `false` on MongoDB indexes.

**Warning:** Using these indexes will sometimes result in incomplete results when filtering or sorting results, because sparse indexes are not complete for all documents in a collection.

---

### Example

Sparse index on a collection can results in incomplete results.

Consider a collection `score` that contains the following documents:

```
{ "_id" : ObjectId("523b6e32fb408eea0eec2647"), "userid" : "newbie" }
{ "_id" : ObjectId("523b6e61fb408eea0eec2648"), "userid" : "abby", "score" : 82 }
{ "_id" : ObjectId("523b6e6ffb408eea0eec2649"), "userid" : "nina", "score" : 90 }
```

The collection has a sparse index on the field `score`:

```
db.scores.ensureIndex({ score: 1 } , { sparse: true })
```

Then, the following query to return all documents in the `scores` collection sorted by the `score` field results in incomplete results:

```
db.scores.find().sort({ score: -1 })
```

Because the document for the `userid` “`newbie`” does not contain the `score` field, the query, which uses the sparse index, will return incomplete results that omit that document:

```
{ "_id" : ObjectId("523b6e6ffb408eea0eec2649"), "userid" : "nina", "score" : 90 }
{ "_id" : ObjectId("523b6e61fb408eea0eec2648"), "userid" : "abby", "score" : 82 }
```

---

**Note:** Do not confuse sparse indexes in MongoDB with [block-level](#)<sup>3</sup> indexes in other databases. Think of them as dense indexes with a specific filter.

You can combine the sparse index option with the [`unique indexes`](#) (page 334) option so that `mongod` (page 925) will reject documents that have duplicate values for a field, but that ignore documents that do not have the key.

---

### 7.2.3 Index Creation

MongoDB provides several options that *only* affect the creation of the index. Specify these options in a document as the second argument to the `db.collection.ensureIndex()` (page 814) method. This section describes the uses of these creation options and their behavior.

---

<sup>3</sup>[http://en.wikipedia.org/wiki/Database\\_index#Sparse\\_index](http://en.wikipedia.org/wiki/Database_index#Sparse_index)

### Related

Some options that you can specify to `ensureIndex()` (page 814) options control the *properties of the index* (page 333), which are *not* index creation options. For example, the `unique` (page 334) option affects the behavior of the index after creation.

For a detailed description of MongoDB's index types, see *Index Types* (page 319) and *Index Properties* (page 333) for related documentation.

---

### Background Construction

By default, creating an index blocks all other operations on a database. When building an index on a collection, the database that holds the collection is unavailable for read or write operations until the index build completes. Any operation that requires a read or write lock on all databases (e.g. `listDatabases`) will wait for the foreground index build to complete.

For potentially long running index building operations, consider the `background` operation so that the MongoDB database remains available during the index building operation. For example, to create an index in the background of the `zipcode` field of the `people` collection, issue the following:

```
db.people.ensureIndex({ zipcode: 1 }, {background: true})
```

By default, `background` is `false` for building MongoDB indexes.

You can combine the `background` option with other options, as in the following:

```
db.people.ensureIndex({ zipcode: 1 }, {background: true, sparse: true})
```

### Behavior

As of MongoDB version 2.4, a `mongod` (page 925) instance can build more than one index in the background concurrently.

Changed in version 2.4: Before 2.4, a `mongod` (page 925) instance could only build one background index per database at a time.

Changed in version 2.2: Before 2.2, a single `mongod` (page 925) instance could only build one index at a time.

Background indexing operations run in the background so that other database operations can run while creating the index. However, the `mongo` (page 942) shell session or connection where you are creating the index *will* block until the index build is complete. To continue issuing commands to the database, open another connection or `mongo` (page 942) instance.

Queries will not use partially-built indexes: the index will only be usable once the index build is complete.

---

**Note:** If MongoDB is building an index in the background, you cannot perform other administrative operations involving that collection, including running `repairDatabase` (page 757), dropping the collection (i.e. `db.collection.drop()` (page 812)), and running `compact` (page 752). These operations will return an error during background index builds.

---

### Performance

The background index operation uses an incremental approach that is slower than the normal “foreground” index builds. If the index is larger than the available RAM, then the incremental process can take *much* longer than the

foreground build.

If your application includes `ensureIndex()` (page 814) operations, and an index *doesn't* exist for other operational concerns, building the index can have a severe impact on the performance of the database.

To avoid performance issues, make sure that your application checks for the indexes at start up using the `getIndexes()` (page 826) method or the equivalent method for your driver<sup>4</sup> and terminates if the proper indexes do not exist. Always build indexes in production instances using separate application code, during designated maintenance windows.

### Building Indexes on Secondaries

Background index operations on a *replica set primary* become foreground indexing operations on *secondary members* of the set. All indexing operations on secondaries block replication.

To build large indexes on secondaries the best approach is to restart one secondary at a time in *standalone* mode and build the index. After building the index, restart as a member of the replica set, allow it to catch up with the other members of the set, and then build the index on the next secondary. When all the secondaries have the new index, step down the primary, restart it as a standalone, and build the index on the former primary.

Remember, the amount of time required to build the index on a secondary must be within the window of the *oplog*, so that the secondary can catch up with the primary.

Indexes on secondary members in “recovering” mode are always built in the foreground to allow them to catch up as soon as possible.

See *Build Indexes on Replica Sets* (page 343) for a complete procedure for building indexes on secondaries.

### Drop Duplicates

MongoDB cannot create a *unique index* (page 334) on a field that has duplicate values. To force the creation of a unique index, you can specify the `dropDups` option, which will only index the first occurrence of a value for the key, and delete all subsequent values.

**Important:** As in all unique indexes, if a document does not have the indexed field, MongoDB will include it in the index with a “null” value.

If subsequent fields *do not* have the indexed field, and you have set `{dropDups: true}`, MongoDB will remove these documents from the collection when creating the index. If you combine `dropDups` with the *sparse* (page 335) option, this index will only include documents in the index that have the value, and the documents without the field will remain in the database.

To create a unique index that drops duplicates on the `username` field of the `accounts` collection, use a command in the following form:

```
db.accounts.ensureIndex({ username: 1 }, { unique: true, dropDups: true })
```

**Warning:** Specifying `{ dropDups: true }` will delete data from your database. Use with extreme caution.

By default, `dropDups` is `false`.

<sup>4</sup><http://api.mongodb.org/>

## Index Names

The default name for an index is the concatenation of the indexed keys and each key's direction in the index, 1 or -1.

---

### Example

Issue the following command to create an index on `item` and `quantity`:

```
db.products.ensureIndex({ item: 1, quantity: -1 })
```

The resulting index is named: `item_1_quantity_-1`.

---

Optionally, you can specify a name for an index instead of using the default name.

---

### Example

Issue the following command to create an index on `item` and `quantity` and specify `inventory` as the index name:

```
db.products.ensureIndex({ item: 1, quantity: -1 } , { name: "inventory" })
```

The resulting index has the name `inventory`.

---

To view the name of an index, use the [getIndexes\(\)](#) (page 826) method.

## 7.3 Indexing Tutorials

Indexes allow MongoDB to process and fulfill queries quickly by creating small and efficient representations of the documents in a collection.

The documents in this section outline specific tasks related to building and maintaining indexes for data in MongoDB collections and discusses strategies and practical approaches. For a conceptual overview of MongoDB indexing, see the [Index Concepts](#) (page 318) document.

[Index Creation Tutorials](#) (page 338) Create and configure different types of indexes for different purposes.

[Index Management Tutorials](#) (page 345) Monitor and assess index performance and rebuild indexes as needed.

[Geospatial Index Tutorials](#) (page 349) Create indexes that support data stored as [GeoJSON](#) objects and legacy coordinate pairs.

[Text Search Tutorials](#) (page 357) Build and configure indexes that support full-text searches.

[Indexing Strategies](#) (page 367) The factors that affect index performance and practical approaches to indexing in MongoDB

### 7.3.1 Index Creation Tutorials

Instructions for creating and configuring indexes in MongoDB and building indexes on replica sets and sharded clusters.

[Create an Index](#) (page 339) Build an index for any field on a collection.

[Create a Compound Index](#) (page 340) Build an index of multiple fields on a collection.

[Create a Unique Index](#) (page 340) Build an index that enforces unique values for the indexed field or fields.

[Create a Sparse Index \(page 341\)](#) Build an index that omits references to documents that do not include the indexed field. This saves space when indexing fields that are present in only some documents.

[Create a Hashed Index \(page 342\)](#) Compute a hash of the value of a field in a collection and index the hashed value. These indexes permit equality queries and may be suitable shard keys for some collections.

[Build Indexes on Replica Sets \(page 343\)](#) To build indexes on a replica set, you build the indexes separately on the primary and the secondaries, as described here.

[Build Indexes in the Background \(page 344\)](#) Background index construction allows read and write operations to continue while building the index, but take longer to complete and result in a larger index.

[Build Old Style Indexes \(page 345\)](#) A `{v : 0}` index is necessary if you need to roll back from MongoDB version 2.0 (or later) to MongoDB version 1.8.

## Create an Index

Indexes allow MongoDB to process and fulfill queries quickly by creating small and efficient representations of the documents in a [collection](#). MongoDB creates an index on the `_id` field of every collection by default, but allows users to create indexes for any collection using any field in a [document](#).

This tutorial describes how to create an index on a single field. MongoDB also supports [compound indexes \(page 322\)](#), which are indexes on multiple fields. See [Create a Compound Index \(page 340\)](#) for instructions on building compound indexes.

### Create an Index on a Single Field

To create an index, use `ensureIndex()` (page 814) or a similar method from your driver<sup>5</sup>. For example the following creates an index on the phone-number field of the people collection:

```
db.people.ensureIndex({ "phone-number": 1 })
```

`ensureIndex()` (page 814) only creates an index if an index of the same specification does not already exist.

All indexes support and optimize the performance for queries that select on this field. For queries that cannot use an index, MongoDB must scan all documents in a collection for documents that match the query.

### Examples

If you create an index on the `user_id` field in the `records`, this index is, the index will support the following query:

```
db.records.find({ user_id: 2 })
```

However, the following query, on the `profile_url` field is not supported by this index:

```
db.records.find({ profile_url: 2 })
```

### Additional Considerations

If your collection holds a large amount of data, and your application needs to be able to access the data while building the index, consider building the index in the background, as described in [Background Construction \(page 336\)](#). To build indexes on replica sets, see the [Build Indexes on Replica Sets \(page 343\)](#) section for more information.

---

<sup>5</sup><http://api.mongodb.org/>

---

**Note:** To build or rebuild indexes for a [replica set](#) see [Build Indexes on Replica Sets](#) (page 343).

---

Some drivers may specify indexes, using `NumberLong(1)` rather than `1` as the specification. This does not have any affect on the resulting index.

**See also:**

[Create a Compound Index](#) (page 340), [Indexing Tutorials](#) (page 338) and [Index Concepts](#) (page 318) for more information.

## Create a Compound Index

Indexes allow MongoDB to process and fulfill queries quickly by creating small and efficient representations of the documents in a [collection](#). MongoDB supports indexes that include content on a single field, as well as [compound indexes](#) (page 322) that include content from multiple fields. Continue reading for instructions and examples of building a compound index.

### Build a Compound Index

To create a [compound index](#) (page 322) use an operation that resembles the following prototype:

```
db.collection.ensureIndex({ a: 1, b: 1, c: 1 })
```

#### Example

The following operation will create an index on the `item`, `category`, and `price` fields of the `products` collection:

```
db.products.ensureIndex({ item: 1, category: 1, price: 1 })
```

### Additional Considerations

If your collection holds a large amount of data, and your application needs to be able to access the data while building the index, consider building the index in the background, as described in [Background Construction](#) (page 336). To build indexes on replica sets, see the [Build Indexes on Replica Sets](#) (page 343) section for more information.

---

**Note:** To build or rebuild indexes for a [replica set](#) see [Build Indexes on Replica Sets](#) (page 343).

---

Some drivers may specify indexes, using `NumberLong(1)` rather than `1` as the specification. This does not have any affect on the resulting index.

**See also:**

[Create an Index](#) (page 339), [Indexing Tutorials](#) (page 338) and [Index Concepts](#) (page 318) for more information.

## Create a Unique Index

MongoDB allows you to specify a [unique constraint](#) (page 334) on an index. These constraints prevent applications from inserting [documents](#) that have duplicate values for the inserted fields. Additionally, if you want to create an index on a collection that has existing data that might have duplicate values for the indexed field, you may chose combine unique enforcement with [duplicate dropping](#) (page 337).

## Unique Indexes

To create a [unique indexes](#) (page 334), consider the following prototype:

```
db.collection.ensureIndex({ a: 1 }, { unique: true })
```

For example, you may want to create a unique index on the "tax-id": of the accounts collection to prevent storing multiple account records for the same legal entity:

```
db.accounts.ensureIndex({ "tax-id": 1 }, { unique: true })
```

The [\\_id index](#) (page 321) is a unique index. In some situations you may consider using `_id` field itself for this kind of data rather than using a unique index on another field.

In many situations you will want to combine the `unique` constraint with the `sparse` option. When MongoDB indexes a field, if a document does not have a value for a field, the index entry for that item will be `null`. Since unique indexes cannot have duplicate values for a field, without the `sparse` option, MongoDB will reject the second document and all subsequent documents without the indexed field. Consider the following prototype.

```
db.collection.ensureIndex({ a: 1 }, { unique: true, sparse: true })
```

You can also enforce a unique constraint on [compound indexes](#) (page 322), as in the following prototype:

```
db.collection.ensureIndex({ a: 1, b: 1 }, { unique: true })
```

These indexes enforce uniqueness for the *combination* of index keys and *not* for either key individually.

## Drop Duplicates

To force the creation of a [unique index](#) (page 334) index on a collection with duplicate values in the field you are indexing you can use the `dropDups` option. This will force MongoDB to create a `unique` index by deleting documents with duplicate values when building the index. Consider the following prototype invocation of `ensureIndex()` (page 814):

```
db.collection.ensureIndex({ a: 1 }, { unique: true, dropDups: true })
```

See the full documentation of [duplicate dropping](#) (page 337) for more information.

**Warning:** Specifying `{ dropDups: true }` may delete data from your database. Use with extreme caution.

Refer to the `ensureIndex()` (page 814) documentation for additional index creation options.

## Create a Sparse Index

Sparse indexes are like non-sparse indexes, except that they omit references to documents that do not include the indexed field. For fields that are only present in some documents sparse indexes may provide a significant space savings. See [Sparse Indexes](#) (page 335) for more information about sparse indexes and their use.

### See also:

[Index Concepts](#) (page 318) and [Indexing Tutorials](#) (page 338) for more information.

## Prototype

To create a [sparse index](#) (page 335) on a field, use an operation that resembles the following prototype:

```
db.collection.ensureIndex({ a: 1 }, { sparse: true })
```

## Example

The following operation, creates a sparse index on the `users` collection that *only* includes a document in the index if the `twitter_name` field exists in a document.

```
db.users.ensureIndex({ twitter_name: 1 }, { sparse: true })
```

The index excludes all documents that do not include the `twitter_name` field.

## Considerations

---

**Note:** Sparse indexes can affect the results returned by the query, particularly with respect to sorts on fields *not* included in the index. See the [sparse index](#) (page 335) section for more information.

---

## Create a Hashed Index

New in version 2.4.

[Hashed indexes](#) (page 333) compute a hash of the value of a field in a collection and index the hashed value. These indexes permit equality queries and may be suitable shard keys for some collections.

---

### Tip

MongoDB automatically computes the hashes when resolving queries using hashed indexes. Applications do **not** need to compute hashes.

---

---

### See

[Hashed Shard Keys](#) (page 506) for more information about hashed indexes in sharded clusters, as well as [Index Concepts](#) (page 318) and [Indexing Tutorials](#) (page 338) for more information about indexes.

---

## Procedure

To create a [hashed index](#) (page 333), specify `hashed` as the value of the `index` key, as in the following example:

---

## Example

Specify a hashed index on `_id`

```
db.collection.ensureIndex({ _id: "hashed" })
```

---

## Considerations

MongoDB supports hashed indexes of any single field. The hashing function collapses sub-documents and computes the hash for the entire value, but does not support multi-key (i.e. arrays) indexes.

You may not create compound indexes that have hashed index fields.

## Build Indexes on Replica Sets

*Background index creation operations* (page 336) become *foreground* indexing operations on *secondary* members of replica sets. The foreground index building process blocks all replication and read operations on the secondaries while they build the index.

Secondaries will begin building indexes *after* the *primary* finishes building the index. In *sharded clusters*, the `mongos` (page 938) will send `ensureIndex()` (page 814) to the primary members of the replica set for each shard, which then replicate to the secondaries after the primary finishes building the index.

To minimize the impact of building an index on your replica set, use the following procedure to build indexes on secondaries:

---

### See

*Indexing Tutorials* (page 338) and *Index Concepts* (page 318) for more information.

---

## Considerations

**Warning:** Ensure that your *oplog* is large enough to permit the indexing or re-indexing operation to complete without falling too far behind to catch up. See the *oplog sizing* (page 411) documentation for additional information.

---

**Note:** This procedure *does* take one member out of the replica set at a time. However, this procedure will only affect one member of the set at a time rather than *all* secondaries at the same time.

---

## Procedure

---

**Note:** If you need to build an index in a *sharded cluster*, repeat the following procedure for each replica set that provides each *shard*.

---

**Stop One Secondary** Stop the `mongod` (page 925) process on one secondary. Restart the `mongod` (page 925) process *without* the `--rep1Set` option and running on a different port.<sup>6</sup> This instance is now in “standalone” mode.

For example, if your `mongod` (page 925) *normally* runs with on the default port of 27017 with the `--rep1Set` option you would use the following invocation:

```
mongod --port 47017
```

---

<sup>6</sup> By running the `mongod` (page 925) on a different port, you ensure that the other members of the replica set and all clients will not contact the member while you are building the index.

**Build the Index** Create the new index using the [ensureIndex\(\)](#) (page 814) in the [mongo](#) (page 942) shell, or comparable method in your driver. This operation will create or rebuild the index on this [mongod](#) (page 925) instance.

For example, to create an ascending index on the `username` field of the `records` collection, use the following [mongo](#) (page 942) shell operation:

```
db.records.ensureIndex({ username: 1 })
```

**See also:**

[Create an Index](#) (page 339) and [Create a Compound Index](#) (page 340) for more information.

**Restart the Program mongod** When the index build completes, start the [mongod](#) (page 925) instance with the `--rep1Set` option on its usual port:

```
mongod --port 27017 --rep1Set rs0
```

Modify the port number (e.g. 27017) or the replica set name (e.g. rs0) as needed.

Allow replication to catch up on this member.

**Build Indexes on all Secondaries** For each secondary in the set, build an index according to the following steps:

1. [Stop One Secondary](#) (page 343)
2. [Build the Index](#) (page 344)
3. [Restart the Program mongod](#) (page 344)

**Build the Index on the Primary** Finally, to build the index on the [primary](#), begin by stepping down the primary. Use the [rs.stepDown\(\)](#) (page 899) method in the [mongo](#) (page 942) shell to cause the current primary to become a secondary graceful and allow the set to elect another member as primary.

Then repeat the index building procedure, listed below, to build the index on the primary:

1. [Stop One Secondary](#) (page 343)
2. [Build the Index](#) (page 344)
3. [Restart the Program mongod](#) (page 344)

### Build Indexes in the Background

By default, MongoDB builds indexes in the foreground and prevent all read and write operations to the database while the index builds. Also, no operation that requires a read or write lock on all databases (e.g. [listDatabases](#)) can occur during a foreground index build.

[Background index construction](#) (page 336) allows read and write operations to continue while building the index.

---

**Note:** Background index builds take longer to complete and result in a larger index.

---

After the index finishes building, MongoDB treats indexes built in the background the same as any other index.

**See also:**

[Index Concepts](#) (page 318) and [Indexing Tutorials](#) (page 338) for more information.

## Procedure

To create an index in the background, add the `background` argument to the [ensureIndex\(\)](#) (page 814) operation, as in the following index:

```
db.collection.ensureIndex({ a: 1 }, { background: true })
```

Consider the section on [background index construction](#) (page 336) for more information about these indexes and their implications.

## Build Old Style Indexes

---

**Important:** Use this procedure *only* if you **must** have indexes that are compatible with a version of MongoDB earlier than 2.0.

---

MongoDB version 2.0 introduced the `{v:1}` index format. MongoDB versions 2.0 and later support both the `{v:1}` format and the earlier `{v:0}` format.

MongoDB versions prior to 2.0, however, support only the `{v:0}` format. If you need to roll back MongoDB to a version prior to 2.0, you must *drop* and *re-create* your indexes.

To build pre-2.0 indexes, use the [dropIndexes\(\)](#) (page 813) and [ensureIndex\(\)](#) (page 814) methods. You *cannot* simply reindex the collection. When you reindex on versions that only support `{v:0}` indexes, the `v` fields in the index definition still hold values of 1, even though the indexes would now use the `{v:0}` format. If you were to upgrade again to version 2.0 or later, these indexes would not work.

---

### Example

Suppose you rolled back from MongoDB 2.0 to MongoDB 1.8, and suppose you had the following index on the `items` collection:

```
{ "v" : 1, "key" : { "name" : 1 }, "ns" : "mydb.items", "name" : "name_1" }
```

The `v` field tells you the index is a `{v:1}` index, which is incompatible with version 1.8.

To drop the index, issue the following command:

```
db.items.dropIndex({ name : 1 })
```

To recreate the index as a `{v:0}` index, issue the following command:

```
db.foo.ensureIndex({ name : 1 } , { v : 0 })
```

---

### See also:

[Index Performance Enhancements](#) (page 1061).

### 7.3.2 Index Management Tutorials

Instructions for managing indexes and assessing index performance and use.

[Remove Indexes](#) (page 346) Drop an index from a collection.

[Rebuild Indexes](#) (page 346) In a single operation, drop all indexes on a collection and then rebuild them.

[Manage In-Progress Index Creation](#) (page 347) Check the status of indexing progress, or terminate an ongoing index build.

[Return a List of All Indexes](#) (page 347) Obtain a list of all indexes on a collection or of all indexes on all collections in a database.

[Measure Index Use](#) (page 348) Study query operations and observe index use for your database.

## Remove Indexes

To remove an index from a collection use the `dropIndex()` (page 812) method and the following procedure. If you simply need to rebuild indexes you can use the process described in the [Rebuild Indexes](#) (page 346) document.

**See also:**

[Indexing Tutorials](#) (page 338) and [Index Concepts](#) (page 318) for more information about indexes and indexing operations in MongoDB.

## Operations

To remove an index, use the `db.collection.dropIndex()` (page 812) method, as in the following example:

```
db.accounts.dropIndex({ "tax-id": 1 })
```

This will remove the index on the `"tax-id"` field in the `accounts` collection. The shell provides the following document after completing the operation:

```
{ "nIndexesWas" : 3, "ok" : 1 }
```

Where the value of `nIndexesWas` reflects the number of indexes *before* removing this index. You can also use the `db.collection.dropIndexes()` (page 813) to remove *all* indexes, except for the `_id` index (page 321) from a collection.

These shell helpers provide wrappers around the `dropIndexes` (page 750) *database command*. Your *client library* (page 95) may have a different or additional interface for these operations.

## Rebuild Indexes

If you need to rebuild indexes for a collection you can use the `db.collection.reIndex()` (page 844) method to rebuild all indexes on a collection in a single operation. This operation drops all indexes, including the `_id` index (page 321), and then rebuilds all indexes.

**See also:**

[Index Concepts](#) (page 318) and [Indexing Tutorials](#) (page 338).

## Process

The operation takes the following form:

```
db.accounts.reIndex()
```

MongoDB will return the following document when the operation completes:

```
{
 "nIndexesWas" : 2,
 "msg" : "indexes dropped for collection",
 "nIndexes" : 2,
 "indexes" : [
```

```
{
 "key" : {
 "_id" : 1,
 "tax-id" : 1
 },
 "ns" : "records.accounts",
 "name" : "_id_"
}
],
"ok" : 1
}
```

This shell helper provides a wrapper around the [reIndex](#) (page 756) *database command*. Your *client library* (page 95) may have a different or additional interface for this operation.

## Additional Considerations

---

**Note:** To build or rebuild indexes for a [replica set](#) see [Build Indexes on Replica Sets](#) (page 343).

---

## Manage In-Progress Index Creation

To see the status of the indexing processes, you can use the [db.currentOp\(\)](#) (page 879) method in the [mongo](#) (page 942) shell. The value of the `query` field and the `msg` field will indicate if the operation is an index build. The `msg` field also indicates the percent of the build that is complete.

To terminate an ongoing index build, use the [db.killOp\(\)](#) (page 890) method in the [mongo](#) (page 942) shell.

For more information see [db.currentOp\(\)](#) (page 879).

Changed in version 2.4: Before MongoDB 2.4, you could *only* terminate *background* index builds. After 2.4, you can terminate any index build, including foreground index builds.

## Return a List of All Indexes

When performing maintenance you may want to check which indexes exist on a collection. Every index on a collection has a corresponding *document* in the [system.indexes](#) (page 229) collection, and you can use standard queries (i.e. [find\(\)](#) (page 816)) to list the indexes, or in the [mongo](#) (page 942) shell, the [getIndexes\(\)](#) (page 826) method to return a list of the indexes on a collection, as in the following examples.

### See also:

[Index Concepts](#) (page 318) and [Indexing Tutorials](#) (page 338) for more information about indexes in MongoDB and common index management operations.

### List all Indexes on a Collection

To return a list of all indexes on a collection, use the [db.collection.getIndexes\(\)](#) (page 826) method or a similar *method for your driver*<sup>7</sup>.

For example, to view all indexes on the `people` collection:

---

<sup>7</sup><http://api.mongodb.org/>

```
db.people.getIndexes()
```

### List all Indexes for a Database

To return a list of all indexes on all collections in a database, use the following operation in the [mongo](#) (page 942) shell:

```
db.system.indexes.find()
```

See [system.indexes](#) (page 229) for more information about these documents.

## Measure Index Use

### Synopsis

Query performance is a good general indicator of index use; however, for more precise insight into index use, MongoDB provides a number of tools that allow you to study query operations and observe index use for your database.

#### See also:

[Index Concepts](#) (page 318) and [Indexing Tutorials](#) (page 338) for more information.

### Operations

**Return Query Plan with `explain()`** Append the [explain\(\)](#) (page 861) method to any cursor (e.g. query) to return a document with statistics about the query process, including the index used, the number of documents scanned, and the time the query takes to process in milliseconds.

**Control Index Use with `hint()`** Append the [hint\(\)](#) (page 866) to any cursor (e.g. query) with the index as the argument to force MongoDB to use a specific index to fulfill the query. Consider the following example:

```
db.people.find({ name: "John Doe", zipcode: { $gt: 63000 } }).hint({ zipcode: 1 })
```

You can use [hint\(\)](#) (page 866) and [explain\(\)](#) (page 861) in conjunction with each other to compare the effectiveness of a specific index. Specify the `$natural` operator to the [hint\(\)](#) (page 866) method to prevent MongoDB from using *any* index:

```
db.people.find({ name: "John Doe", zipcode: { $gt: 63000 } }).hint({ $natural: 1 })
```

**Instance Index Use Reporting** MongoDB provides a number of metrics of index use and operation that you may want to consider when analyzing index use for your database:

- In the output of [serverStatus](#) (page 782):
  - [indexCounters](#) (page 788)
  - [scanned](#) (page 796)
  - [scanAndOrder](#) (page 796)
- In the output of [collStats](#) (page 763):
  - [totalIndexSize](#) (page 765)
  - [indexSizes](#) (page 765)

- In the output of `dbStats` (page 767):
  - `dbStats.indexes` (page 768)
  - `dbStats.indexSize` (page 768)

### 7.3.3 Geospatial Index Tutorials

Instructions for creating and querying 2d, 2dsphere, and haystack indexes.

**Create a 2dsphere Index (page 349)** A 2dsphere index supports data stored as both GeoJSON objects and as legacy coordinate pairs.

**Query a 2dsphere Index (page 349)** Search for locations within, near, or intersected by a GeoJSON shape, or within a circle as defined by coordinate points on a sphere.

**Create a 2d Index (page 351)** Create a 2d index to support queries on data stored as legacy coordinate pairs.

**Query a 2d Index (page 352)** Search for locations using legacy coordinate pairs.

**Create a Haystack Index (page 354)** A haystack index is optimized to return results over small areas. For queries that use spherical geometry, a 2dsphere index is a better option.

**Query a Haystack Index (page 355)** Search based on location and non-location data within a small area.

**Calculate Distance Using Spherical Geometry (page 355)** Convert distances to radians and back again.

#### Create a 2dsphere Index

To create a geospatial index for GeoJSON-formatted data, use the `ensureIndex()` (page 814) method and set the value of the location field for your collection to 2dsphere. A 2dsphere index can be a *compound index* (page 322) and does not require the location field to be the first field indexed.

To create the index use the following syntax:

```
db.points.ensureIndex({ <location field> : "2dsphere" })
```

The following are four example commands for creating a 2dsphere index:

```
db.points.ensureIndex({ loc : "2dsphere" })
db.points.ensureIndex({ loc : "2dsphere" , type : 1 })
db.points.ensureIndex({ rating : 1 , loc : "2dsphere" })
db.points.ensureIndex({ loc : "2dsphere" , rating : 1 , category : -1 })
```

The first example creates a simple geospatial index on the location field `loc`. The second example creates a compound index where the second field contains non-location data. The third example creates an index where the location field is not the primary field: the location field does not have to be the first field in a 2dsphere index. The fourth example creates a compound index with three fields. You can include as many fields as you like in a 2dsphere index.

#### Query a 2dsphere Index

The following sections describe queries supported by the 2dsphere index. For an overview of recommended geospatial queries, see *Geospatial Query Compatibility* (page 643).

## GeoJSON Objects Bounded by a Polygon

The [\\$geoWithin](#) (page 635) operator queries for location data found within a GeoJSON polygon. Your location data must be stored in GeoJSON format. Use the following syntax:

```
db.<collection>.find({ <location field> :
 { $geoWithin :
 { $geometry :
 { type : "Polygon" ,
 coordinates : [<coordinates>]
 } } } })
```

The following example selects all points and shapes that exist entirely within a GeoJSON polygon:

```
db.places.find({ loc :
 { $geoWithin :
 { $geometry :
 { type : "Polygon" ,
 coordinates : [[
 [[0 , 0] ,
 [3 , 6] ,
 [6 , 1] ,
 [0 , 0]
]]
 } } } })
```

## Intersections of GeoJSON Objects

New in version 2.4.

The [\\$geoIntersects](#) (page 637) operator queries for locations that intersect a specified GeoJSON object. A location intersects the object if the intersection is non-empty. This includes documents that have a shared edge.

The [\\$geoIntersects](#) (page 637) operator uses the following syntax:

```
db.<collection>.find({ <location field> :
 { $geoIntersects :
 { $geometry :
 { type : "<GeoJSON object type>" ,
 coordinates : [<coordinates>]
 } } } })
```

The following example uses [\\$geoIntersects](#) (page 637) to select all indexed points and shapes that intersect with the polygon defined by the coordinates array.

```
db.places.find({ loc :
 { $geoIntersects :
 { $geometry :
 { type : "Polygon" ,
 coordinates: [[
 [[0 , 0] ,
 [3 , 6] ,
 [6 , 1] ,
 [0 , 0]
]]
 } } } })
```

## Proximity to a GeoJSON Point

Proximity queries return the points closest to the defined point and sorts the results by distance. A proximity query on GeoJSON data requires a `2dsphere` index.

To query for proximity to a GeoJSON point, use either the `$near` (page 637) operator or `geoNear` (page 708) command. Distance is in meters.

The `$near` (page 637) uses the following syntax:

```
db.<collection>.find({ <location field> :
 { $near :
 { $geometry :
 { type : "Point" ,
 coordinates : [<longitude> , <latitude>] } ,
 $maxDistance : <distance in meters>
 } } })
```

For examples, see `$near` (page 637).

The `geoNear` (page 708) command uses the following syntax:

```
db.runCommand({ geoNear: <collection>, near: [<x> , <y>] })
```

The `geoNear` (page 708) command offers more options and returns more information than does the `$near` (page 637) operator. To run the command, see `geoNear` (page 708).

## Points within a Circle Defined on a Sphere

To select all grid coordinates in a “spherical cap” on a sphere, use `$geoWithin` (page 635) with the `$centerSphere` (page 641) operator. Specify an array that contains:

- The grid coordinates of the circle’s center point
- The circle’s radius measured in radians. To calculate radians, see *Calculate Distance Using Spherical Geometry* (page 355).

Use the following syntax:

```
db.<collection>.find({ <location field> :
 { $geoWithin :
 { $centerSphere :
 [[<x> , <y>] , <radius>] }
 } })
```

The following example queries grid coordinates and returns all documents within a 10 mile radius of longitude 88° W and latitude 30° N. The example converts the distance, 10 miles, to radians by dividing by the approximate radius of the earth, 3959 miles:

```
db.places.find({ loc :
 { $geoWithin :
 { $centerSphere :
 [[88 , 30] , 10 / 3959]
 } } })
```

## Create a 2d Index

To build a geospatial 2d index, use the `ensureIndex()` (page 814) method and specify `2d`. Use the following syntax:

```
db.<collection>.ensureIndex({ <location field> : "2d" ,
 <additional field> : <value> } ,
 { <index-specification options> })
```

The 2d index uses the following optional index-specification options:

```
{ min : <lower bound> , max : <upper bound> ,
 bits : <bit precision> }
```

### Define Location Range for a 2d Index

By default, a 2d index assumes longitude and latitude and has boundaries of -180 inclusive and 180 non-inclusive (i.e. [-180, 180]). If documents contain coordinate data outside of the specified range, MongoDB returns an error.

---

**Important:** The default boundaries allow applications to insert documents with invalid latitudes greater than 90 or less than -90. The behavior of geospatial queries with such invalid points is not defined.

---

On 2d indexes you can change the location range.

You can build a 2d geospatial index with a location range other than the default. Use the `min` and `max` options when creating the index. Use the following syntax:

```
db.collection.ensureIndex({ <location field> : "2d" } ,
 { min : <lower bound> , max : <upper bound> })
```

### Define Location Precision for a 2d Index

By default, a 2d index on legacy coordinate pairs uses 26 bits of precision, which is roughly equivalent to 2 feet or 60 centimeters of precision using the default range of -180 to 180. Precision is measured by the size in bits of the `geohash` values used to store location data. You can configure geospatial indexes with up to 32 bits of precision.

Index precision does not affect query accuracy. The actual grid coordinates are always used in the final query processing. Advantages to lower precision are a lower processing overhead for insert operations and use of less space. An advantage to higher precision is that queries scan smaller portions of the index to return results.

To configure a location precision other than the default, use the `bits` option when creating the index. Use following syntax:

```
db.<collection>.ensureIndex({<location field> : "<index type>"} ,
 { bits : <bit precision> })
```

For information on the internals of geohash values, see [Calculation of Geohash Values for 2d Indexes](#) (page 331).

## Query a 2d Index

The following sections describe queries supported by the 2d index. For an overview of recommended geospatial queries, see [Geospatial Query Compatibility](#) (page 643).

### Points within a Shape Defined on a Flat Surface

To select all legacy coordinate pairs found within a given shape on a flat surface, use the `$geoWithin` (page 635) operator along with a shape operator. Use the following syntax:

```
db.<collection>.find({ <location field> :
 { $geoWithin :
 { $box|$polygon|$center : <coordinates>
 } } })
```

The following queries for documents within a rectangle defined by [ 0 , 0 ] at the bottom left corner and by [ 100 , 100 ] at the top right corner.

```
db.places.find({ loc :
 { $geoWithin :
 { $box : [[0 , 0] ,
 [100 , 100]]
 } } })
```

The following queries for documents that are within the circle centered on [ -74 , 40.74 ] and with a radius of 10:

```
db.places.find({ loc: { $geoWithin :
 { $center : [[-74, 40.74] , 10]
} } })
```

For syntax and examples for each shape, see the following:

- [\\$box](#) (page 641)
- [\\$polygon](#) (page 642)
- [\\$center](#) (page 640) (defines a circle)

## Points within a Circle Defined on a Sphere

MongoDB supports rudimentary spherical queries on flat 2d indexes for legacy reasons. In general, spherical calculations should use a 2dsphere index, as described in [2dsphere Indexes](#) (page 328).

To query for legacy coordinate pairs in a “spherical cap” on a sphere, use [\\$geoWithin](#) (page 635) with the [\\$centerSphere](#) (page 641) operator. Specify an array that contains:

- The grid coordinates of the circle’s center point
- The circle’s radius measured in radians. To calculate radians, see [Calculate Distance Using Spherical Geometry](#) (page 355).

Use the following syntax:

```
db.<collection>.find({ <location field> :
 { $geoWithin :
 { $centerSphere : [[<x>, <y>] , <radius>] }
 } })
```

The following example query returns all documents within a 10-mile radius of longitude 88 W and latitude 30 N. The example converts distance to radians by dividing distance by the approximate radius of the earth, 3959 miles:

```
db.<collection>.find({ loc : { $geoWithin :
 { $centerSphere :
 [[88 , 30] , 10 / 3959]
 } } })
```

## Proximity to a Point on a Flat Surface

Proximity queries return the 100 legacy coordinate pairs closest to the defined point and sort the results by distance. Use either the [\\$near](#) (page 637) operator or [geoNear](#) (page 708) command. Both require a 2d index.

The [\\$near](#) (page 637) operator uses the following syntax:

```
db.<collection>.find({ <location field> :
 { $near : [<x> , <y>]
 } })
```

For examples, see [\\$near](#) (page 637).

The [geoNear](#) (page 708) command uses the following syntax:

```
db.runCommand({ geoNear: <collection>, near: [<x> , <y>] })
```

The [geoNear](#) (page 708) command offers more options and returns more information than does the [\\$near](#) (page 637) operator. To run the command, see [geoNear](#) (page 708).

## Exact Matches on a Flat Surface

You can use the [db.collection.find\(\)](#) (page 816) method to query for an exact match on a location. These queries use the following syntax:

```
db.<collection>.find({ <location field>: [<x> , <y>] })
```

This query will return any documents with the value of [ <x> , <y> ].

## Create a Haystack Index

To build a haystack index, use the `bucketSize` option when creating the index. A `bucketSize` of 5 creates an index that groups location values that are within 5 units of the specified longitude and latitude. The `bucketSize` also determines the granularity of the index. You can tune the parameter to the distribution of your data so that in general you search only very small regions. The areas defined by buckets can overlap. A document can exist in multiple buckets.

A haystack index can reference two fields: the location field and a second field. The second field is used for exact matches. Haystack indexes return documents based on location and an exact match on a single additional criterion. These indexes are not necessarily suited to returning the closest documents to a particular location.

To build a haystack index, use the following syntax:

```
db.coll.ensureIndex({ <location field> : "geoHaystack" ,
 <additional field> : 1 } ,
 { bucketSize : <bucket value> })
```

---

### Example

If you have a collection with documents that contain fields similar to the following:

```
{ _id : 100, pos: { lng : 126.9, lat : 35.2 } , type : "restaurant"
{ _id : 200, pos: { lng : 127.5, lat : 36.1 } , type : "restaurant"
{ _id : 300, pos: { lng : 128.0, lat : 36.7 } , type : "national park"}
```

The following operations create a haystack index with buckets that store keys within 1 unit of longitude or latitude.

---

```
db.places.ensureIndex({ pos : "geoHaystack", type : 1 } ,
 { bucketSize : 1 })
```

This index stores the document with an `_id` field that has the value 200 in two different buckets:

- In a bucket that includes the document where the `_id` field has a value of 100
  - In a bucket that includes the document where the `_id` field has a value of 300
- 

To query using a haystack index you use the [geoSearch](#) (page 709) command. See [Query a Haystack Index](#) (page 355).

By default, queries that use a haystack index return 50 documents.

## Query a Haystack Index

A haystack index is a special `2d` geospatial index that is optimized to return results over small areas. To create a haystack index see [Create a Haystack Index](#) (page 354).

To query a haystack index, use the [geoSearch](#) (page 709) command. You must specify both the coordinates and the additional field to [geoSearch](#) (page 709). For example, to return all documents with the value `restaurant` in the `type` field near the example point, the command would resemble:

```
db.runCommand({ geoSearch : "places" ,
 search : { type: "restaurant" } ,
 near : [-74, 40.74] ,
 maxDistance : 10 })
```

---

**Note:** Haystack indexes are not suited to queries for the complete list of documents closest to a particular location. The closest documents could be more distant compared to the bucket size.

---

**Note:** [Spherical query operations](#) (page 355) are not currently supported by haystack indexes.

The `find()` (page 816) method and [geoNear](#) (page 708) command cannot access the haystack index.

---

## Calculate Distance Using Spherical Geometry

---

**Note:** While basic queries using spherical distance are supported by the `2d` index, consider moving to a `2dsphere` index if your data is primarily longitude and latitude.

---

The `2d` index supports queries that calculate distances on a Euclidean plane (flat surface). The index also supports the following query operators and command that calculate distances using spherical geometry:

- [\\$nearSphere](#) (page 638)
  - [\\$centerSphere](#) (page 641)
  - [\\$near](#) (page 637)
  - [geoNear](#) (page 708) command with the `{ spherical: true }` option.
- 

**Important:** These three queries use radians for distance. Other query types do not.

For spherical query operators to function properly, you must convert distances to radians, and convert from radians to the distances units used by your application.

To convert:

- *distance to radians*: divide the distance by the radius of the sphere (e.g. the Earth) in the same units as the distance measurement.
- *radians to distance*: multiply the radian measure by the radius of the sphere (e.g. the Earth) in the units system that you want to convert the distance to.

The radius of the Earth is approximately 3,959 miles or 6,371 kilometers.

---

The following query would return documents from the `places` collection within the circle described by the center `[-74, 40.74]` with a radius of 100 miles:

```
db.places.find({ loc: { $geoWithin: { $centerSphere: [[-74, 40.74] ,
100 / 3959] } } })
```

You may also use the `distanceMultiplier` option to the [geoNear](#) (page 708) to convert radians in the `mongod` (page 925) process, rather than in your application code. See [distance multiplier](#) (page 357).

The following spherical query, returns all documents in the collection `places` within 100 miles from the point `[-74, 40.74]`.

```
db.runCommand({ geoNear: "places",
near: [-74, 40.74],
spherical: true
})
```

The output of the above command would be:

```
{
 // [...]
 "results" : [
 {
 "dis" : 0.01853688938212826,
 "obj" : {
 "_id" : ObjectId(...)
 "loc" : [
 -73,
 40
]
 }
 }
],
 "stats" : {
 // [...]
 "avgDistance" : 0.01853688938212826,
 "maxDistance" : 0.01853714811400047
 },
 "ok" : 1
}
```

**Warning:** Spherical queries that wrap around the poles or at the transition from  $-180$  to  $180$  longitude raise an error.

---

**Note:** While the default Earth-like bounds for geospatial indexes are between  $-180$  inclusive, and  $180$ , valid values for latitude are between  $-90$  and  $90$ .

---

## Distance Multiplier

The `distanceMultiplier` option of the [geoNear](#) (page 708) command returns distances only after multiplying the results by an assigned value. This allows MongoDB to return converted values, and removes the requirement to convert units in application logic.

Using `distanceMultiplier` in spherical queries provides results from the [geoNear](#) (page 708) command that do not need radian-to-distance conversion. The following example uses `distanceMultiplier` in the [geoNear](#) (page 708) command with a [spherical](#) (page 355) example:

```
db.runCommand({ geoNear: "places",
 near: [-74, 40.74],
 spherical: true,
 distanceMultiplier: 3959
 })
```

The output of the above operation would resemble the following:

```
{
 // ...
 "results" : [
 {
 "dis" : 73.46525170413567,
 "obj" : {
 "_id" : ObjectId(...)
 "loc" : [
 -73,
 40
]
 }
 }
],
 "stats" : {
 // ...
 "avgDistance" : 0.01853688938212826,
 "maxDistance" : 0.01853714811400047
 },
 "ok" : 1
}
```

## 7.3.4 Text Search Tutorials

Instructions for enabling MongoDB’s text search feature, and for building and configuring text indexes.

[Enable Text Search](#) (page 358) You must explicitly enable text search in order to search string content in collections.

[Create a text Index](#) (page 358) A `text` index allows searches on text strings in the index’s specified fields.

[Search String Content for Text](#) (page 359) Use queries to find strings of text within collections.

[Specify a Language for Text Index](#) (page 362) The specified language determines the list of stop words and the rules for Text Search’s stemmer and tokenizer.

[Create text Index with Long Name](#) (page 363) Override the `text` index name limit for long index names.

[Control Search Results with Weights](#) (page 364) Give priority to certain search values by denoting the significance of an indexed field relative to other indexed fields

[Limit the Number of Entries Scanned](#) (page 365) Search only those documents that match a set of filter conditions.

*Create text Index to Cover Queries* (page 366) Perform text searches that return results without the need to scan documents.

## Enable Text Search

New in version 2.4.

The [text search](#) (page 333) is currently a *beta* feature. As a beta feature:

- You need to explicitly enable the feature before [creating a text index](#) (page 332) or using the [text](#) (page 715) command.
- To enable text search on [replica sets](#) (page 381) and [sharded clusters](#) (page 498), you need to enable on **each and every** [mongod](#) (page 925) for replica sets and on **each and every** [mongos](#) (page 938) for sharded clusters.

### Warning:

- Do **not** enable or use text search on production systems.
- Text indexes have significant storage requirements and performance costs. See [Storage Requirements and Performance Costs](#) (page 332) for more information.

You can enable the text search feature at startup with the [textSearchEnabled](#) (page 1008) parameter:

```
mongod --setParameter textSearchEnabled=true
```

You may prefer to set the [textSearchEnabled](#) (page 1008) parameter in the [configuration file](#) (page 990).

Additionally, you can enable the feature in the [mongo](#) (page 942) shell with the [setParameter](#) (page 756) command. This command does **not** propagate from the primary to the secondaries. You must enable on **each and every** [mongod](#) (page 925) for replica sets.

---

**Note:** You must set the parameter every time you start the server. You may prefer to add the parameter to the [configuration files](#) (page 990).

---

## Create a text Index

You can create a [text](#) index on the field or fields whose value is a string or an array of string elements. When creating a [text](#) index on multiple fields, you can specify the individual fields or you can wildcard specifier (`$**`).

### Index Specific Fields

The following example creates a [text](#) index on the fields `subject` and `content`:

```
db.collection.ensureIndex({ subject: "text", content: "text" })
```

This [text](#) index catalogs all string data in the `subject` field and the `content` field, where the field value is either a string or an array of string elements.

## Index All Fields

To allow for text search on all fields with string content, use the wildcard specifier (`$**`) to index all fields that contain string content.

The following example indexes any string value in the data of every field of every document in `collection` and names the index `TextIndex`:

```
db.collection.ensureIndex(
 { "$**": "text" },
 { name: "TextIndex" }
)
```

## Search String Content for Text

In 2.4, you can enable the text search feature to create `text` indexes and issue text queries using the `text` (page 715). The following tutorial offers various query patterns for using the text search feature.

The examples in this tutorial use a collection `quotes` that has a `text` index on the fields `quote` that contains a string and `related_quotes` that contains an array of string elements.

---

**Note:** You cannot combine the `text` (page 715) command, which requires a special *text index* (page 332), with a query operator that requires a different type of special index. For example you cannot combine `text` (page 715) with the `$near` (page 637) operator.

---

## Search for a Term

The following command searches for the word TOMORROW:

```
db.quotes.runCommand("text", { search: "TOMORROW" })
```

Because `text` (page 715) command is case-insensitive, the text search will match the following document in the `quotes` collection:

```
{
 "_id" : ObjectId("50ecef5f8abea0fda30ceab3"),
 "quote" : "tomorrow, and tomorrow, and tomorrow, creeps in this petty pace",
 "related_quotes" : [
 "is this a dagger which I see before me",
 "the handle toward my hand?"
],
 "src" : {
 "title" : "Macbeth",
 "from" : "Act V, Scene V"
 },
 "speaker" : "macbeth"
}
```

## Match Any of the Search Terms

If the search string is a space-delimited text, `text` (page 715) command performs a logical OR search on each term and returns documents that contains any of the terms.

For example, the search string "tomorrow largo" searches for the term tomorrow **OR** the term largo:

```
db.quotes.runCommand("text", { search: "tomorrow largo" })
```

The command will match the following documents in the quotes collection:

```
{
 "_id" : ObjectId("50ecef5f8abea0fda30ceab3"),
 "quote" : "tomorrow, and tomorrow, and tomorrow, creeps in this petty pace",
 "related_quotes" : [
 "is this a dagger which I see before me",
 "the handle toward my hand?"
],
 "src" : {
 "title" : "Macbeth",
 "from" : "Act V, Scene V"
 },
 "speaker" : "macbeth"
}

{
 "_id" : ObjectId("50ecf0cd8abea0fda30ceab4"),
 "quote" : "Es tan corto el amor y es tan largo el olvido.",
 "related_quotes" : [
 "Como para acercarla mi mirada la busca.",
 "Mi corazón la busca, y ella no está conmigo."
],
 "speaker" : "Pablo Neruda",
 "src" : {
 "title" : "Veinte poemas de amor y una canción desesperada",
 "from" : "Poema 20"
 }
}
```

### Match Phrases

To match the exact phrase that includes a space(s) as a single term, escape the quotes.

For example, the following command searches for the exact phrase "and tomorrow":

```
db.quotes.runCommand("text", { search: "\"and tomorrow\"" })
```

If the search string contains both phrases and individual terms, the [text](#) (page 715) command performs a compound logical AND of the phrases with the compound logical OR of the single terms, including the individual terms from each phrase.

For example, the following search string contains both individual terms `corto` and `largo` as well as the phrase `\"and tomorrow\"`:

```
db.quotes.runCommand("text", { search: "corto largo \"and tomorrow\"" })
```

The [text](#) (page 715) command performs the equivalent to the following logical operation, where the individual terms `corto`, `largo`, as well as the term `tomorrow` from the phrase `"and tomorrow"`, are part of a logical OR expression:

```
(corto OR largo OR tomorrow) AND ("and tomorrow")
```

As such, the results for this search will include documents that only contain the phrase `"and tomorrow"` as well as documents that contain the phrase `"and tomorrow"` and the terms `corto` and/or `largo`. Documents that contain

the phrase "and tomorrow" as well as the terms `corto` and `largo` will generally receive a higher score for this search.

### Match Some Words But Not Others

A *negated* term is a term that is prefixed by a minus sign -. If you negate a term, the [text](#) (page 715) command will exclude the documents that contain those terms from the results.

---

**Note:** If the search text contains *only* negated terms, the [text](#) (page 715) command will not return any results.

The following example returns those documents that contain the term `tomorrow` but **not** the term `petty`.

```
db.quotes.runCommand("text" , { search: "tomorrow -petty" })
```

### Limit the Number of Matching Documents in the Result Set

---

**Note:** The result from the [text](#) (page 715) command must fit within the maximum [BSON Document Size](#) (page 1015).

By default, the [text](#) (page 715) command will return up to 100 matching documents, from highest to lowest scores. To override this default limit, use the `limit` option in the [text](#) (page 715) command, as in the following example:

```
db.quotes.runCommand("text" , { search: "tomorrow" , limit: 2 })
```

The [text](#) (page 715) command will return at most 2 of the *highest scoring* results.

The `limit` can be any number as long as the result set fits within the maximum [BSON Document Size](#) (page 1015).

### Specify Which Fields to Return in the Result Set

In the [text](#) (page 715) command, use the `project` option to specify the fields to include (1) or exclude (0) in the matching documents.

---

**Note:** The `_id` field is always returned unless explicitly excluded in the `project` document.

The following example returns only the `_id` field and the `src` field in the matching documents:

```
db.quotes.runCommand("text" , { search: "tomorrow" ,
 project: { "src": 1 } })
```

### Search with Additional Query Conditions

The [text](#) (page 715) command can also use the `filter` option to specify additional query conditions.

The following example will return the documents that contain the term `tomorrow` **AND** the speaker is `macbeth`:

```
db.quotes.runCommand("text" , { search: "tomorrow" ,
 filter: { speaker : "macbeth" } })
```

#### See also:

[Limit the Number of Entries Scanned](#) (page 365)

## Search for Text in Specific Languages

You can specify the language that determines the tokenization, stemming, and removal of stop words, as in the following example:

```
db.quotes.runCommand("text", { search: "amor", language: "spanish" })
```

See [Text Search Languages](#) (page 719) for a list of supported languages as well as [Specify a Language for Text Index](#) (page 362) for specifying languages for the `text` index.

## Text Search Output

The `text` (page 715) command returns a document that contains the result set.

See [Output](#) (page 718) for information on the output.

## Specify a Language for Text Index

This tutorial describes how to [specify the default language associated with the text index](#) (page 362) and also how to [create text indexes for collections that contain documents in different languages](#) (page 362).

### Specify the Default Language for a `text` Index

The default language associated with the indexed data determines the list of stop words and the rules for the stemmer and tokenizer. The default language for the indexed data is `english`.

To specify a different language, use the `default_language` option when creating the `text` index. See [Text Search Languages](#) (page 719) for the languages available for `default_language`.

The following example creates a `text` index on the `content` field and sets the `default_language` to `spanish`:

```
db.collection.ensureIndex(
 { content : "text" },
 { default_language: "spanish" }
)
```

### Create a `text` Index for a Collection in Multiple Languages

**Specify the Index Language within the Document** If a collection contains documents that are in different languages, include a field in the documents that contain the language to use:

- If you include a field named `language` in the document, by default, the `ensureIndex()` (page 814) method will use the value of this field to override the default language.
- To use a field with a name other than `language`, you must specify the name of this field to the `ensureIndex()` (page 814) method with the `language_override` option.

See [Text Search Languages](#) (page 719) for a list of supported languages.

**Include the `language` Field** Include a field `language` that specifies the language to use for the individual documents.

For example, the documents of a multi-language collection `quotes` contain the field `language`:

```
{ _id: 1, language: "portuguese", quote: "A sorte protege os audazes" }
{ _id: 2, language: "spanish", quote: "Nada hay más surreal que la realidad." }
{ _id: 3, language: "english", quote: "is this a dagger which I see before me" }
```

Create a `text` index on the field `quote`:

```
db.quotes.ensureIndex({ quote: "text" })
```

- For the documents that contain the `language` field, the `text` index uses that language to determine the stop words and the rules for the stemmer and the tokenizer.
- For documents that do not contain the `language` field, the index uses the default language, which is English, to determine the stop words and rules for the stemmer and the tokenizer.

For example, the Spanish word `que` is a stop word. So the following `text` (page 715) command would not match any document:

```
db.quotes.runCommand("text", { search: "que", language: "spanish" })
```

**Use any Field to Specify the Language for a Document** Include a field that specifies the language to use for the individual documents. To use a field with a name other than `language`, include the `language_override` option when creating the index.

For example, the documents of a multi-language collection `quotes` contain the field `idioma`:

```
{ _id: 1, idioma: "portuguese", quote: "A sorte protege os audazes" }
{ _id: 2, idioma: "spanish", quote: "Nada hay más surreal que la realidad." }
{ _id: 3, idioma: "english", quote: "is this a dagger which I see before me" }
```

Create a `text` index on the field `quote` with the `language_override` option:

```
db.quotes.ensureIndex({ quote : "text" },
 { language_override: "idioma" })
```

- For the documents that contain the `idioma` field, the `text` index uses that language to determine the stop words and the rules for the stemmer and the tokenizer.
- For documents that do not contain the `idioma` field, the index uses the default language, which is English, to determine the stop words and rules for the stemmer and the tokenizer.

For example, the Spanish word `que` is a stop word. So the following `text` (page 715) command would not match any document:

```
db.quotes.runCommand("text", { search: "que", language: "spanish" })
```

## Create `text` Index with Long Name

The default name for the index consists of each indexed field name concatenated with `_text`. For example, the following command creates a `text` index on the fields `content`, `users.comments`, and `users.profiles`:

```
db.collection.ensureIndex(
 {
 content: "text",
 "users.comments": "text",
 "users.profiles": "text"
 }
)
```

The default name for the index is:

```
"content_text_users.comments_text_users.profiles_text"
```

To avoid creating an index with a name that exceeds the [index name length limit](#) (page 1016), you can pass the `name` option to the [db.collection.ensureIndex\(\)](#) (page 814) method:

```
db.collection.ensureIndex(
 {
 content: "text",
 "users.comments": "text",
 "users.profiles": "text"
 },
 {
 name: "MyTextIndex"
 }
)
```

---

**Note:** To drop the `text` index, use the index name. To get the name of an index, use [db.collection.getIndexes\(\)](#) (page 826).

---

## Control Search Results with Weights

This document describes how to create a `text` index with specified weights for results fields.

By default, the [text](#) (page 715) command returns matching documents based on scores, from highest to lowest. For a `text` index, the *weight* of an indexed field denotes the significance of the field relative to the other indexed fields in terms of the score. The score for a given word in a document is derived from the weighted sum of the frequency for each of the indexed fields in that document.

The default weight is 1 for the indexed fields. To adjust the weights for the indexed fields, include the `weights` option in the [db.collection.ensureIndex\(\)](#) (page 814) method.

**Warning:** Choose the weights carefully in order to prevent the need to reindex.

A collection `blog` has the following documents:

```
{ _id: 1,
 content: "This morning I had a cup of coffee.",
 about: "beverage",
 keywords: ["coffee"]

{ _id: 2,
 content: "Who doesn't like cake?",
 about: "food",
 keywords: ["cake", "food", "dessert"]
}
```

To create a `text` index with different field weights for the `content` field and the `keywords` field, include the `weights` option to the [ensureIndex\(\)](#) (page 814) method. For example, the following command creates an index on three fields and assigns weights to two of the fields:

```
db.blog.ensureIndex(
 {
 content: "text",
 keywords: "text",
 ...
 },
 {
 weight: {
 content: 2,
 keywords: 1
 }
 }
)
```

```
 about: "text"
 },
{
 weights: {
 content: 10,
 keywords: 5,
 },
 name: "TextIndex"
}
)
```

The `text` index has the following fields and weights:

- content has a weight of 10,
  - keywords has a weight of 5, and
  - about has the default weight of 1.

These weights denote the relative significance of the indexed fields to each other. For instance, a term match in the content field has:

- 2 times (i.e. 10 : 5) the impact as a term match in the keywords field and
  - 10 times (i.e. 10 : 1) the impact as a term match in the about field.

## Limit the Number of Entries Scanned

This tutorial describes how to limit the text search to scan only those documents with a field value.

The `text` (page 715) command includes the `filter` option to further restrict the results of a text search. For a filter that specifies equality conditions, this tutorial demonstrates how to perform text searches on only those documents that match the `filter` conditions, as opposed to performing a text search first on all the documents and then matching on the `filter` condition.

Consider a collection `inventory` that contains the following documents:

```
{ _id: 1, dept: "tech", description: "a fun green computer" }
{ _id: 2, dept: "tech", description: "a wireless red mouse" }
{ _id: 3, dept: "kitchen", description: "a green placemat" }
{ _id: 4, dept: "kitchen", description: "a red peeler" }
{ _id: 5, dept: "food", description: "a green apple" }
{ _id: 6, dept: "food", description: "a red potato" }
```

A common use case is to perform text searches by individual departments, such as:

```
db.inventory.runCommand("text", {
 search: "green",
 filter: { dept : "kitchen" }
})
```

To limit the text search to scan only those documents within a specific `dept`, create a compound index that specifies an ascending/descending index key on the field `dept` and a `text` index key on the field `description`:

```
db.inventory.ensureIndex({ dept: 1, description: "text" })
```

**Important:**

- The ascending/descending index keys must be listed before, or prefix, the `text` index keys.
  - By prefixing the `text` index fields with ascending/descending index fields, MongoDB will **only** index documents that have the prefix fields.
  - You cannot include *multi-key* (page 324) index fields or *geospatial* (page 327) index fields.
  - The `text` (page 715) command **must** include the `filter` option that specifies an **equality** condition for the prefix fields.
- 

Then, the text search within a particular department will limit the scan of indexed documents. For example, the following `text` (page 715) command scans only those documents with `dept` equal to `kitchen`:

```
db.inventory.runCommand("text", {
 search: "green",
 filter: { dept : "kitchen" }
})
```

The returned result includes the statistics that shows that the command scanned 1 document, as indicated by the `nscanned` field:

```
{

 "queryDebugString" : "green|||||",
 "language" : "english",
 "results" : [
 {
 "score" : 0.75,
 "obj" : {
 "_id" : 3,
 "dept" : "kitchen",
 "description" : "a green placemat"
 }
 }
],
 "stats" : {
 "nscanned" : 1,
 "nscannedObjects" : 0,
 "n" : 1,
 "nfound" : 1,
 "timeMicros" : 211
 },
 "ok" : 1
}
```

For more information on the result set, see *Output* (page 718).

## Create `text` Index to Cover Queries

To create a `text` index that can *cover queries* (page 368):

1. Append scalar index fields to a `text` index, as in the following example which specifies an ascending index key on `username`:

```
db.collection.ensureIndex({ comments: "text",
 username: 1 })
```

**Warning:** You cannot include [multi-key](#) (page 324) index field or [geospatial](#) (page 327) index field.

2. Use the `project` option in the [text](#) (page 715) to return only the fields in the index, as in the following:

```
db.quotes.runCommand("text", { search: "tomorrow",
 project: { username: 1,
 _id: 0
 }
 }
)
```

**Note:** By default, the `_id` field is included in the result set. Since the example index did not include the `_id` field, you must explicitly exclude the field in the `project` document.

### 7.3.5 Indexing Strategies

The best indexes for your application must take a number of factors into account, including the kinds of queries you expect, the ratio of reads to writes, and the amount of free memory on your system.

When developing your indexing strategy you should have a deep understanding of your application's queries. Before you build indexes, map out the types of queries you will run so that you can build indexes that reference those fields. Indexes come with a performance cost, but are more than worth the cost for frequent queries on large data set. Consider the relative frequency of each query in the application and whether the query justifies an index.

The best overall strategy for designing indexes is to profile a variety of index configurations with data sets similar to the ones you'll be running in production to see which configurations perform best. Inspect the current indexes created for your collections to ensure they are supporting your current and planned queries. If an index is no longer used, drop the index.

MongoDB can only use *one* index to support any given operation. However, each clause of an [\\$or](#) (page 625) query may use a different index.

The following documents introduce indexing strategies:

[Create Indexes to Support Your Queries \(page 367\)](#) An index supports a query when the index contains all the fields scanned by the query. Creating indexes that supports queries results in greatly increased query performance.

[Use Indexes to Sort Query Results \(page 370\)](#) To support efficient queries, use the strategies here when you specify the sequential order and sort order of index fields.

[Ensure Indexes Fit in RAM \(page 372\)](#) When your index fits in RAM, the system can avoid reading the index from disk and you get the fastest processing.

[Create Queries that Ensure Selectivity \(page 372\)](#) Selectivity is the ability of a query to narrow results using the index. Selectivity allows MongoDB to use the index for a larger portion of the work associated with fulfilling the query.

#### Create Indexes to Support Your Queries

An index supports a query when the index contains all the fields scanned by the query. The query scans the index and not the collection. Creating indexes that supports queries results in greatly increased query performance.

This document describes strategies for creating indexes that support queries.

## Create a Single-Key Index if All Queries Use the Same, Single Key

If you only ever query on a single key in a given collection, then you need to create just one single-key index for that collection. For example, you might create an index on `category` in the `product` collection:

```
db.products.ensureIndex({ "category": 1 })
```

## Create Compound Indexes to Support Several Different Queries

If you sometimes query on only one key and at other times query on that key combined with a second key, then creating a compound index is more efficient than creating a single-key index. MongoDB will use the compound index for both queries. For example, you might create an index on both `category` and `item`.

```
db.products.ensureIndex({ "category": 1, "item": 1 })
```

This allows you both options. You can query on just `category`, and you also can query on `category` combined with `item`. A single *compound index* (page 322) on multiple fields can support all the queries that search a “prefix” subset of those fields.

---

**Note:** With the exception of queries that use the `$or` (page 625) operator, a query does not use multiple indexes. A query uses only one index.

---

### Example

The following index on a collection:

```
{ x: 1, y: 1, z: 1 }
```

Can support queries that the following indexes support:

```
{ x: 1 }
{ x: 1, y: 1 }
```

There are some situations where the prefix indexes may offer better query performance: for example if `z` is a large array.

The `{ x: 1, y: 1, z: 1 }` index can also support many of the same queries as the following index:

```
{ x: 1, z: 1 }
```

Also, `{ x: 1, z: 1 }` has an additional use. Given the following query:

```
db.collection.find({ x: 5 }).sort({ z: 1 })
```

The `{ x: 1, z: 1 }` index supports both the query and the sort operation, while the `{ x: 1, y: 1, z: 1 }` index only supports the query. For more information on sorting, see [Use Indexes to Sort Query Results](#) (page 370).

---

## Create Indexes that Support Covered Queries

A covered query is a query in which:

- all the fields in the *query* (page 68) are part of an index, **and**
- all the fields returned in the results are in the same index.

Because the index “covers” the query, MongoDB can both match the [query conditions](#) (page 68) **and** return the results using only the index; MongoDB does not need to look at the documents, only the index, to fulfill the query. An index can also cover an [aggregation pipeline operation](#) (page 281) on unsharded collections.

Querying *only* the index can be much faster than querying documents outside of the index. Index keys are typically smaller than the documents they catalog, and indexes are typically available in RAM or located sequentially on disk.

MongoDB automatically uses an index that covers a query when possible. To ensure that an index can *cover* a query, create an index that includes all the fields listed in the [query document](#) (page 68) and in the query result. You can specify the fields to return in the query results with a [projection](#) (page 72) document. By default, MongoDB includes the `_id` field in the query result. So, if the index does **not** include the `_id` field, then you must exclude the `_id` field (i.e. `_id: 0`) from the query results.

---

### Example

Given collection `users` with an index on the fields `user` and `status`, as created by the following option:

```
db.users.ensureIndex({ status: 1, user: 1 })
```

Then, this index will cover the following query which selects on the `status` field and returns only the `user` field:

```
db.users.find({ status: "A" }, { user: 1, _id: 0 })
```

In the operation, the projection document explicitly specifies `_id: 0` to exclude the `_id` field from the result since the index is only on the `status` and the `user` fields.

If the projection document does not specify the exclusion of the `_id` field, the query returns the `_id` field. The following query is **not** covered by the index on the `status` and the `user` fields because with the projection document `{ user: 1 }`, the query returns both the `user` field and the `_id` field:

```
db.users.find({ status: "A" }, { user: 1 })
```

---

An index **cannot** cover a query if:

- any of the indexed fields in any of the documents in the collection includes an array. If an indexed field is an array, the index becomes a [multi-key index](#) (page 324) index and cannot support a covered query.
- any of the indexed fields are fields in subdocuments. To index fields in subdocuments, use [dot notation](#). For example, consider a collection `users` with documents of the following form:

```
{ _id: 1, user: { login: "tester" } }
```

The collection has the following indexes:

```
{ user: 1 }
```

```
{ "user.login": 1 }
```

The `{ user: 1 }` index covers the following query:

```
db.users.find({ user: { login: "tester" } }, { user: 1, _id: 0 })
```

However, the `{ "user.login": 1 }` index does **not** cover the following query:

```
db.users.find({ "user.login": "tester" }, { "user.login": 1, _id: 0 })
```

The query, however, does use the `{ "user.login": 1 }` index to find matching documents.

To determine whether a query is a covered query, use the [explain\(\)](#) (page 861) method. If the [explain\(\)](#) (page 861) output displays `true` for the [indexOnly](#) (page 864) field, the query is covered by an index, and MongoDB queries only that index to match the query **and** return the results.

For more information see [Measure Index Use](#) (page 348).

## Use Indexes to Sort Query Results

In MongoDB sort operations that sort documents based on an indexed field provide the greatest performance. Indexes in MongoDB, as in other databases, have an order: as a result, using an index to access documents returns in the same order as the index.

To sort on multiple fields, create a [compound index](#) (page 322). With compound indexes, the results can be in the sorted order of either the full index or an index prefix. An index prefix is a subset of a compound index; the subset consists of one or more fields at the start of the index, in order. For example, given an index `{ a:1, b: 1, c: 1, d: 1 }`, the following subsets are index prefixes:

```
{ a: 1 }
{ a: 1, b: 1 }
{ a: 1, b: 1, c: 1 }
```

For more information on sorting by index prefixes, see [Sort Subset Starts at the Index Beginning](#) (page 370).

If the query includes **equality** match conditions on an index prefix, you can sort on a subset of the index that starts after or overlaps with the prefix. For example, given an index `{ a: 1, b: 1, c: 1, d: 1 }`, if the query condition includes equality match conditions on `a` and `b`, you can specify a sort on the subsets `{ c: 1 }` or `{ c: 1, d: 1 }`:

```
db.collection.find({ a: 5, b: 3 }).sort({ c: 1 })
db.collection.find({ a: 5, b: 3 }).sort({ c: 1, d: 1 })
```

In these operations, the equality match and the sort documents together cover the index prefixes `{ a: 1, b: 1, c: 1 }` and `{ a: 1, b: 1, c: 1, d: 1 }` respectively.

You can also specify a sort order that includes the prefix; however, since the query condition specifies equality matches on these fields, they are constant in the resulting documents and do not contribute to the sort order:

```
db.collection.find({ a: 5, b: 3 }).sort({ a: 1, b: 1, c: 1 })
db.collection.find({ a: 5, b: 3 }).sort({ a: 1, b: 1, c: 1, d: 1 })
```

For more information on sorting by index subsets that are not prefixes, see [Sort Subset Does Not Start at the Index Beginning](#) (page 371).

---

**Note:** For in-memory sorts that do not use an index, the `sort()` (page 872) operation is significantly slower. The `sort()` (page 872) operation will abort when it uses 32 megabytes of memory.

---

## Sort With a Subset of Compound Index

If the sort document contains a subset of the compound index fields, the subset can determine whether MongoDB can use the index efficiently to both retrieve and sort the query results. If MongoDB can efficiently use the index to both retrieve and sort the query results, the output from the `explain()` (page 861) will display `scanAndOrder` (page 864) as `false` or `0`. If MongoDB can only use the index for retrieving documents that meet the query criteria, MongoDB must manually sort the resulting documents without the use of the index. For in-memory sort operations, `explain()` (page 861) will display `scanAndOrder` (page 864) as `true` or `1`.

**Sort Subset Starts at the Index Beginning** If the sort document is a subset of a compound index and starts from the beginning of the index, MongoDB can use the index to both retrieve and sort the query results.

For example, the collection `collection` has the following index:

```
{ a: 1, b: 1, c: 1, d: 1 }
```

The following operations include a sort with a subset of the index. Because the sort subset starts at beginning of the index, the operations can use the index for both the query retrieval and sort:

```
db.collection.find().sort({ a:1 })
db.collection.find().sort({ a:1, b:1 })
db.collection.find().sort({ a:1, b:1, c:1 })

db.collection.find({ a: 4 }).sort({ a: 1, b: 1 })
db.collection.find({ a: { $gt: 4 } }).sort({ a: 1, b: 1 })

db.collection.find({ b: 5 }).sort({ a: 1, b: 1 })
db.collection.find({ b: { $gt:5 }, c: { $gt: 1 } }).sort({ a: 1, b: 1 })
```

The last two operations include query conditions on the field `b` but does not include a query condition on the field `a`:

```
db.collection.find({ b: 5 }).sort({ a: 1, b: 1 })
db.collection.find({ b: { $gt:5 }, c: { $gt: 1 } }).sort({ a: 1, b: 1 })
```

Consider the case where the collection has the index `{ b: 1 }` in addition to the `{ a: 1, b: 1, c: 1, d: 1 }` index. Because of the query condition on `b`, it is not immediately obvious which index MongoDB may select as the “best” index. To explicitly specify the index to use, see [hint\(\)](#) (page 866).

**Sort Subset Does Not Start at the Index Beginning** The sort document can be a subset of a compound index that does **not** start from the beginning of the index. For instance, `{ c: 1 }` is a subset of the index `{ a: 1, b: 1, c: 1, d: 1 }` that omits the preceding index fields `a` and `b`. MongoDB can use the index efficiently **if** the query document includes all the preceding fields of the index, in this case `a` and `b`, in **equality** conditions. In other words, the equality conditions in the query document and the subset in the sort document **contiguously** cover a prefix of the index.

For example, the collection `collection` has the following index:

```
{ a: 1, b: 1, c: 1, d: 1 }
```

Then following operations can use the index efficiently:

```
db.collection.find({ a: 5 }).sort({ b: 1, c: 1 })
db.collection.find({ a: 5, c: 4, b: 3 }).sort({ d: 1 })
```

- In the first operation, the query document `{ a: 5 }` with the sort document `{ b: 1, c: 1 }` cover the prefix `{ a:1, b: 1, c: 1 }` of the index.
- In the second operation, the query document `{ a: 5, c: 4, b: 3 }` with the sort document `{ d: 1 }` covers the full index.

Only the index fields preceding the sort subset must have the equality conditions in the query document. The other index fields may have other conditions. The following operations can efficiently use the index since the equality conditions in the query document and the subset in the sort document **contiguously** cover a prefix of the index:

```
db.collection.find({ a: 5, b: 3 }).sort({ c: 1 })
db.collection.find({ a: 5, b: 3, c: { $lt: 4 } }).sort({ c: 1 })
```

The following operations specify a sort document of `{ c: 1 }`, but the query documents do not contain equality matches on the **preceding** index fields `a` and `b`:

```
db.collection.find({ a: { $gt: 2 } }).sort({ c: 1 })
db.collection.find({ c: 5 }).sort({ c: 1 })
```

These operations **will not** efficiently use the index { a: 1, b: 1, c: 1, d: 1 } and may not even use the index to retrieve the documents.

## Ensure Indexes Fit in RAM

For the fastest processing, ensure that your indexes fit entirely in RAM so that the system can avoid reading the index from disk.

To check the size of your indexes, use the `db.collection.totalIndexSize()` (page 849) helper, which returns data in bytes:

```
> db.collection.totalIndexSize()
4294976499
```

The above example shows an index size of almost 4.3 gigabytes. To ensure this index fits in RAM, you must not only have more than that much RAM available but also must have RAM available for the rest of the *working set*. Also remember:

If you have and use multiple collections, you must consider the size of all indexes on all collections. The indexes and the working set must be able to fit in memory at the same time.

There are some limited cases where indexes do not need to fit in memory. See *Indexes that Hold Only Recent Values in RAM* (page 372).

### See also:

`collStats` (page 763) and `db.collection.stats()` (page 848)

## Indexes that Hold Only Recent Values in RAM

Indexes do not have to fit *entirely* into RAM in all cases. If the value of the indexed field increments with every insert, and most queries select recently added documents; then MongoDB only needs to keep the parts of the index that hold the most recent or “right-most” values in RAM. This allows for efficient index use for read and write operations and minimize the amount of RAM required to support the index.

## Create Queries that Ensure Selectivity

Selectivity is the ability of a query to narrow results using the index. Effective indexes are more selective and allow MongoDB to use the index for a larger portion of the work associated with fulfilling the query.

To ensure selectivity, write queries that limit the number of possible documents with the indexed field. Write queries that are appropriately selective relative to your indexed data.

---

### Example

Suppose you have a field called `status` where the possible values are `new` and `processed`. If you add an index on `status` you've created a low-selectivity index. The index will be of little help in locating records.

A better strategy, depending on your queries, would be to create a *compound index* (page 322) that includes the low-selectivity field and another field. For example, you could create a compound index on `status` and `created_at`.

Another option, again depending on your use case, might be to use separate collections, one for each status.

---

---

### Example

Consider an index { a : 1 } (i.e. an index on the key `a` sorted in ascending order) on a collection where `a` has three values evenly distributed across the collection:

---

```
{ _id: ObjectId(), a: 1, b: "ab" }
{ _id: ObjectId(), a: 1, b: "cd" }
{ _id: ObjectId(), a: 1, b: "ef" }
{ _id: ObjectId(), a: 2, b: "jk" }
{ _id: ObjectId(), a: 2, b: "lm" }
{ _id: ObjectId(), a: 2, b: "no" }
{ _id: ObjectId(), a: 3, b: "pq" }
{ _id: ObjectId(), a: 3, b: "rs" }
{ _id: ObjectId(), a: 3, b: "tv" }
```

If you query for { a: 2, b: "no" } MongoDB must scan 3 *documents* in the collection to return the one matching result. Similarly, a query for { a: { \$gt: 1}, b: "tv" } must scan 6 documents, also to return one result.

Consider the same index on a collection where a has *nine* values evenly distributed across the collection:

```
{ _id: ObjectId(), a: 1, b: "ab" }
{ _id: ObjectId(), a: 2, b: "cd" }
{ _id: ObjectId(), a: 3, b: "ef" }
{ _id: ObjectId(), a: 4, b: "jk" }
{ _id: ObjectId(), a: 5, b: "lm" }
{ _id: ObjectId(), a: 6, b: "no" }
{ _id: ObjectId(), a: 7, b: "pq" }
{ _id: ObjectId(), a: 8, b: "rs" }
{ _id: ObjectId(), a: 9, b: "tv" }
```

If you query for { a: 2, b: "cd" }, MongoDB must scan only one document to fulfill the query. The index and query are more selective because the values of a are evenly distributed *and* the query can select a specific document using the index.

However, although the index on a is more selective, a query such as { a: { \$gt: 5 }, b: "tv" } would still need to scan 4 documents.

---

If overall selectivity is low, and if MongoDB must read a number of documents to return results, then some queries may perform faster without indexes. To determine performance, see [Measure Index Use](#) (page 348).

For a conceptual introduction to indexes in MongoDB see [Index Concepts](#) (page 318).

## 7.4 Indexing Reference

### 7.4.1 Indexing Methods in the mongo Shell

| Name                                                      | Description                                                                                                                                                                             |
|-----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>db.collection.createIndex()</code><br>(page 810)    | Builds an index on a collection. Use <code>db.collection.ensureIndex()</code> (page 814).                                                                                               |
| <code>db.collection.dropIndex()</code><br>(page 812)      | Removes a specified index on a collection.                                                                                                                                              |
| <code>db.collection.dropIndexes()</code><br>(page 813)    | Removes all indexes on a collection.                                                                                                                                                    |
| <code>db.collection.ensureIndex()</code><br>(page 814)    | Creates an index if it does not currently exist. If the index exists <code>ensureIndex()</code> (page 814) does nothing.                                                                |
| <code>db.collection.getIndexes()</code><br>(page 826)     | Returns an array of documents that describe the existing indexes on a collection.                                                                                                       |
| <code>db.collection.getIndexStats()</code><br>(page 810)  | Renders a human-readable view of the data collected by <code>indexStats</code> (page 774) which reflects B-tree utilization.                                                            |
| <code>db.collection.indexStats()</code><br>(page 811)     | Renders a human-readable view of the data collected by <code>indexStats</code> (page 774) which reflects B-tree utilization.                                                            |
| <code>db.collection.reIndex()</code><br>(page 844)        | Rebuilds all existing indexes on a collection.                                                                                                                                          |
| <code>db.collection.totalIndexSize()</code><br>(page 849) | Reports the total size used by the indexes on a collection. Provides a wrapper around the <code>totalIndexSize</code> (page 765) field of the <code>collStats</code> (page 763) output. |
| <code>cursor.explain()</code><br>(page 861)               | Reports on the query execution plan, including index use, for a cursor.                                                                                                                 |
| <code>cursor_hint()</code><br>(page 866)                  | Forces MongoDB to use a specific index for a query.                                                                                                                                     |
| <code>cursor.max()</code><br>(page 867)                   | Specifies an exclusive upper index bound for a cursor. For use with <code>cursor_hint()</code> (page 866)                                                                               |
| <code>cursor.min()</code><br>(page 869)                   | Specifies an inclusive lower index bound for a cursor. For use with <code>cursor_hint()</code> (page 866)                                                                               |
| <code>cursor.snapshot()</code><br>(page 872)              | Forces the cursor to use the index on the <code>_id</code> field. Ensures that the cursor returns each document, with regards to the value of the <code>_id</code> field, only once.    |

## 7.4.2 Indexing Database Commands

| Name                                          | Description                                                                          |
|-----------------------------------------------|--------------------------------------------------------------------------------------|
| <a href="#">dropIndexes</a> (page 750)        | Removes indexes from a collection.                                                   |
| <a href="#">compact</a> (page 752)            | Defragments a collection and rebuilds the indexes.                                   |
| <a href="#">reIndex</a> (page 756)            | Rebuilds all indexes on a collection.                                                |
| <a href="#">validate</a> (page 771)           | Internal command that scans for a collection's data and indexes for correctness.     |
| <a href="#">indexStats</a> (page 774)         | Experimental command that collects and aggregates statistics on all indexes.         |
| <a href="#">geoNear</a> (page 708)            | Performs a geospatial query that returns the documents closest to a given point.     |
| <a href="#">geoSearch</a> (page 709)          | Performs a geospatial query that uses MongoDB's <i>haystack index</i> functionality. |
| <a href="#">geoWalk</a> (page 710)            | An internal command to support geospatial queries.                                   |
| <a href="#">checkShardingIndex</a> (page 736) | Internal command that validates index on shard key.                                  |

## 7.4.3 Geospatial Query Selectors

| Name                                       | Description                                                       |
|--------------------------------------------|-------------------------------------------------------------------|
| <a href="#">\$geoWithin</a> (page 635)     | Selects geometries within a bounding <i>GeoJSON</i> geometry.     |
| <a href="#">\$geoIntersects</a> (page 637) | Selects geometries that intersect with a <i>GeoJSON</i> geometry. |
| <a href="#">\$near</a> (page 637)          | Returns geospatial objects in proximity to a point.               |
| <a href="#">\$nearSphere</a> (page 638)    | Returns geospatial objects in proximity to a point on a sphere.   |

## 7.4.4 Indexing Query Modifiers

| Name                                   | Description                                                                                                      |
|----------------------------------------|------------------------------------------------------------------------------------------------------------------|
| <a href="#">\$explain</a> (page 688)   | Forces MongoDB to report on query execution plans. See <a href="#">explain()</a> (page 861).                     |
| <a href="#">\$hint</a> (page 689)      | Forces MongoDB to use a specific index. See <a href="#">hint()</a> (page 866)                                    |
| <a href="#">\$max</a> (page 690)       | Specifies a minimum exclusive upper limit for the index to use in a query. See <a href="#">max()</a> (page 867). |
| <a href="#">\$min</a> (page 691)       | Specifies a minimum inclusive lower limit for the index to use in a query. See <a href="#">min()</a> (page 869). |
| <a href="#">\$returnKey</a> (page 692) | Forces the cursor to only return fields included in the index.                                                   |
| <a href="#">\$snapshot</a> (page 692)  | Forces the query to use the index on the <code>_id</code> field. See <a href="#">snapshot()</a> (page 872).      |



---

## Replication

---

A *replica set* in MongoDB is a group of `mongod` (page 925) processes that maintain the same data set. Replica sets provide redundancy and high availability, and are the basis for all production deployments. This section introduces replication in MongoDB as well as the components and architecture of replica sets. The section also provides tutorials for common tasks related to replica sets.

***Replication Introduction*** (page 377) An introduction to replica sets, their behavior, operation, and use.

***Replication Concepts*** (page 381) The core documentation of replica set operations, configurations, architectures and behaviors.

***Replica Set Members*** (page 382) Introduces the components of replica sets.

***Replica Set Deployment Architectures*** (page 390) Introduces architectural considerations related to replica sets deployment planning.

***Replica Set High Availability*** (page 396) Presents the details of the automatic failover and recovery process with replica sets.

***Replica Set Read and Write Semantics*** (page 402) Presents the semantics for targeting read and write operations to the replica set, with an awareness of location and set configuration.

***Replica Set Tutorials*** (page 419) Tutorials for common tasks related to the use and maintenance of replica sets.

***Replication Reference*** (page 467) Reference for functions and operations related to replica sets.

## 8.1 Replication Introduction

Replication is the process of synchronizing data across multiple servers.

### 8.1.1 Purpose of Replication

Replication provides redundancy and increases data availability. With multiple copies of data on different database servers, replication protects a database from the loss of a single server. Replication also allows you to recover from hardware failure and service interruptions. With additional copies of the data, you can dedicate one to disaster recovery, reporting, or backup.

In some cases, you can use replication to increase read capacity. Clients have the ability to send read and write operations to different servers. You can also maintain copies in different data centers to increase the locality and availability of data for distributed applications.

## 8.1.2 Replication in MongoDB

A replica set is a group of [mongod](#) (page 925) instances that host the same data set. One [mongod](#) (page 925), the primary, receives all write operations. All other instances, secondaries, apply operations from the primary so that they have the same data set.

The **primary** accepts all write operations from clients. Replica set can have only one primary. Because only one member can accept write operations, replica sets provide **strict consistency**. To support replication, the primary logs all changes to its data sets in its [oplog](#) (page 410). See [primary](#) (page 382) for more information.

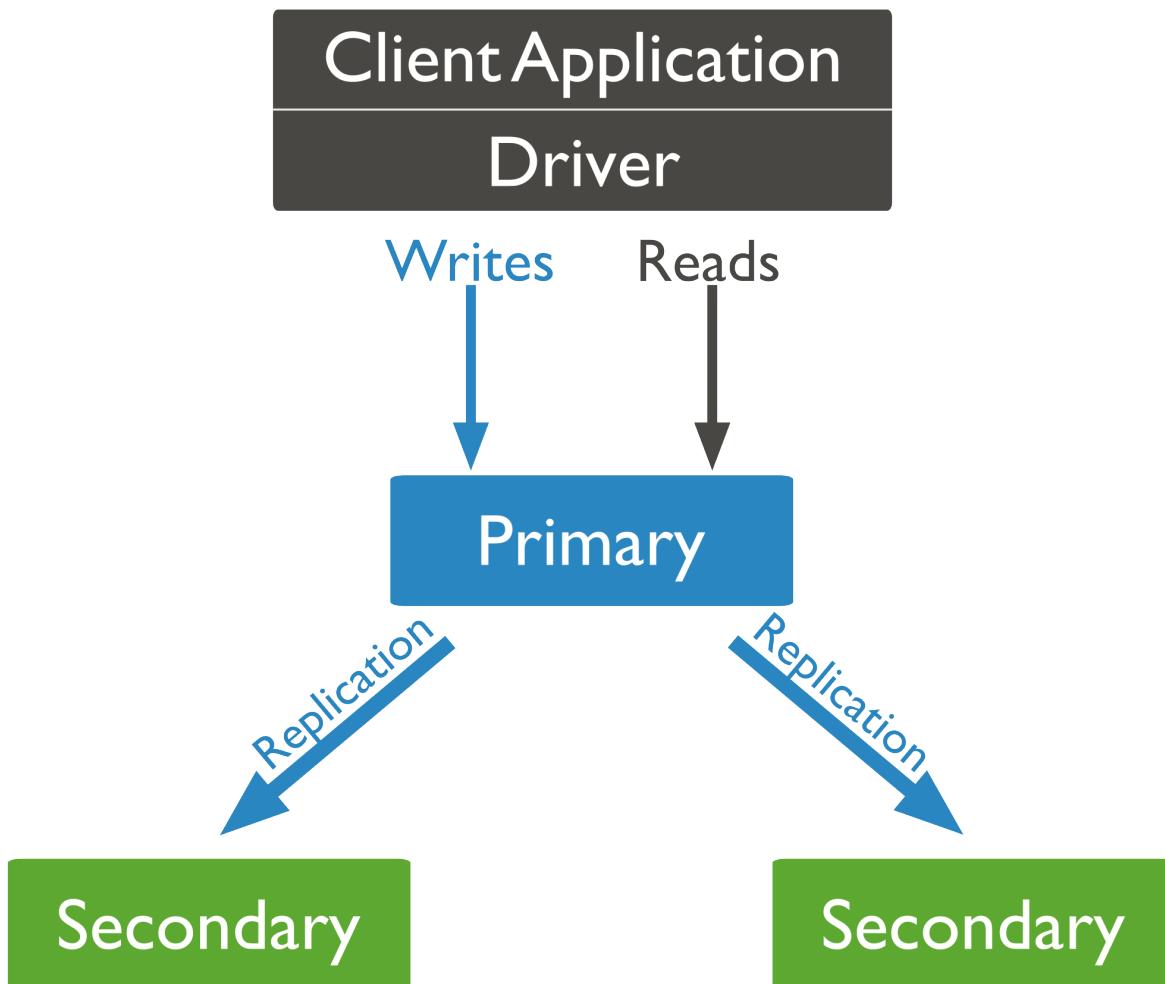


Figure 8.1: Diagram of default routing of reads and writes to the primary.

The **secondaries** replicate the primary's oplog and apply the operations to their data sets. Secondaries' data sets reflect the primary's data set. If the primary is unavailable, the replica set will elect a secondary to be primary. By default, clients read from the primary, however, clients can specify a [read preferences](#) (page 405) to send read operations to secondaries. See [secondaries](#) (page 382) for more information.

You may add an extra [mongod](#) (page 925) instance a replica set as an **arbiter**. Arbiters do not maintain a data set. Arbiters only exist to vote in elections. If your replica set has an even number of members, add an arbiter to obtain a majority of votes in an election for primary. Arbiters do not require dedicated hardware. See [arbiter](#) (page 389) for more information.

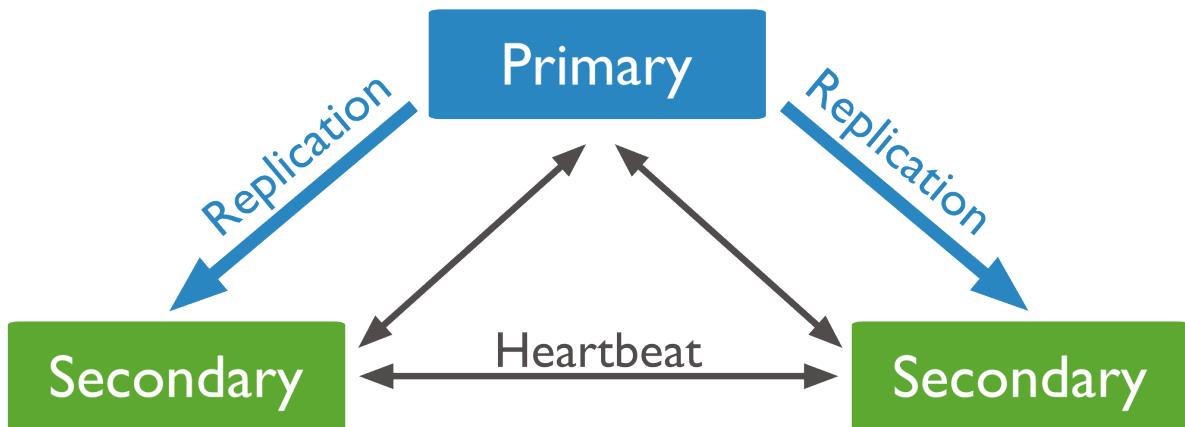


Figure 8.2: Diagram of a 3 member replica set that consists of a primary and two secondaries.

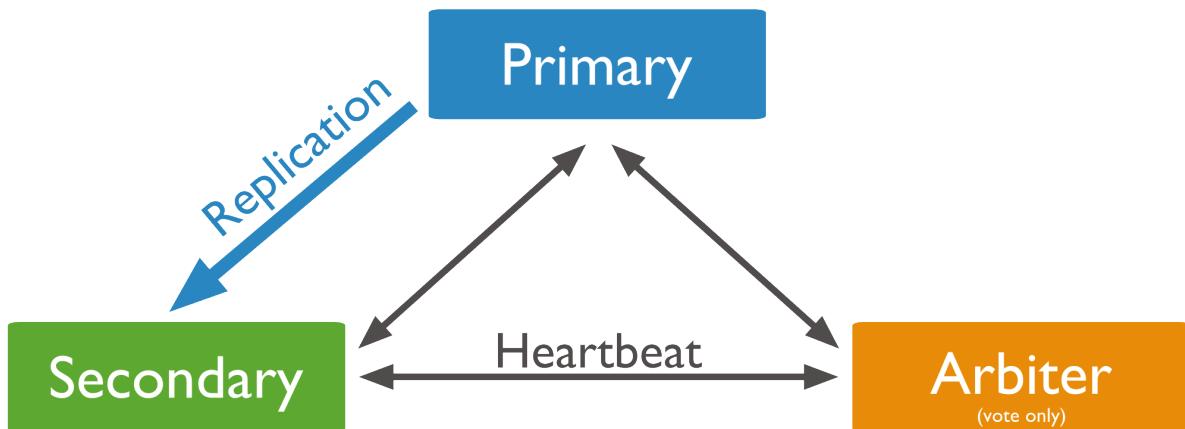


Figure 8.3: Diagram of a replica set that consists of a primary, a secondary, and an arbiter.

**Note:** An **arbiter** will always be an arbiter. A **primary** may step down and become a **secondary**. A **secondary** may become the primary during an election.

## Asynchronous Replication

Secondaries apply operations from the primary asynchronously. By applying operations after the primary, sets can continue to function without some members. However, as a result secondaries may not return the most current data to clients.

See [Replica Set Oplog](#) (page 410) and [Replica Set Data Synchronization](#) (page 412) for more information. See [Read Preference](#) (page 405) for more on read operations and secondaries.

## Automatic Failover

When a primary does not communicate with the other members of the set for more than 10 seconds, the replica set will attempt to select another member to become the new primary. The first secondary that receives a majority of the votes becomes primary.

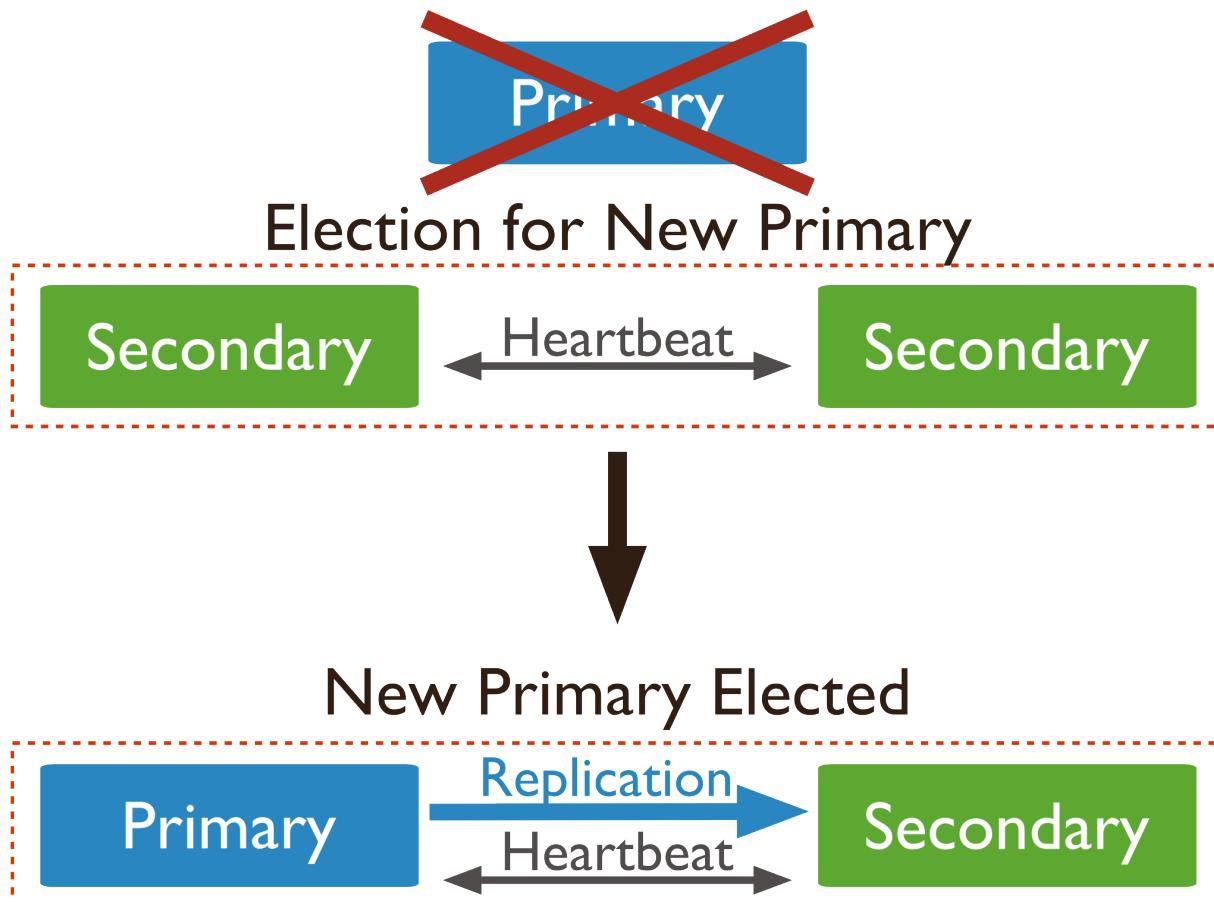


Figure 8.4: Diagram of an election of a new primary. In a three member replica set with two secondaries, the primary becomes unreachable. The loss of a primary triggers an election where one of the secondaries becomes the new primary

See [Replica Set Elections](#) (page 397) and [Rollbacks During Replica Set Failover](#) (page 401) for more information.

## Additional Features

Replica sets provide a number of options to support application needs. For example, you may deploy a replica set with [members in multiple data centers](#) (page 396), or control the outcome of elections by adjusting the [priority](#) (page 481) of some members. Replica sets also support dedicated members for reporting, disaster recovery, or backup functions.

See [Priority 0 Replica Set Members](#) (page 386), [Hidden Replica Set Members](#) (page 387) and [Delayed Replica Set Members](#) (page 387) for more information.

## 8.2 Replication Concepts

These documents describe and provide examples of replica set operation, configuration, and behavior. For an overview of replication, see [Replication Introduction](#) (page 377). For documentation of the administration of replica sets, see [Replica Set Tutorials](#) (page 419). The [Replication Reference](#) (page 467) documents commands and operations specific to replica sets.

[Replica Set Members](#) (page 382) Introduces the components of replica sets.

[Replica Set Primary](#) (page 382) The primary is the only member of a replica set that accepts write operations.

[Replica Set Secondary Members](#) (page 382) Secondary members replicate the primary's data set and accept read operations. If the set has no primary, a secondary can become primary.

[Priority 0 Replica Set Members](#) (page 386) Priority 0 members are secondaries that cannot become the primary.

[Hidden Replica Set Members](#) (page 387) Hidden members are secondaries that are invisible to applications. These members support dedicated workloads, such as reporting or backup.

[Replica Set Arbiter](#) (page 389) An arbiter does not maintain a copy of the data set but participate in elections.

[Replica Set Deployment Architectures](#) (page 390) Introduces architectural considerations related to replica sets deployment planning.

[Three Member Replica Sets](#) (page 391) Three-member replica sets provide the minimum recommended architecture for a replica set.

[Replica Sets with Four or More Members](#) (page 392) Four or more member replica sets provide greater redundancy and can support greater distribution of read operations and dedicated functionality.

[Replica Set High Availability](#) (page 396) Presents the details of the automatic failover and recovery process with replica sets.

[Replica Set Elections](#) (page 397) Elections occur when the primary becomes unavailable and the replica set members autonomously select a new primary.

[Read Preference](#) (page 405) Applications specify *read preference* to control how drivers direct read operations to members of the replica set.

[Replication Processes](#) (page 410) Mechanics of the replication process and related topics.

[Master Slave Replication](#) (page 413) Master-slave replication provided redundancy in early versions of MongoDB. Replica sets replace master-slave for most use cases.

## 8.2.1 Replica Set Members

A *replica set* in MongoDB is a group of [mongod](#) (page 925) processes that provide redundancy and high availability. The members of a replica set are:

**Primary (page ??).** The *primary* receives all write operations.

**Secondaries (page ??).** Secondaries replicate operations from the primary to maintain an identical data set. Secondaries may have additional configurations for special usage profiles. For example, secondaries may be [non-voting](#) (page 400) or [priority 0](#) (page 386).

You can also maintain an *arbiter* (page ??) as part of a replica set. Arbiters do not keep a copy of the data. However, arbiters play a role in the elections that select a primary if the current primary is unavailable.

A replica set can have up to 12 members.<sup>1</sup> However, only 7 members can vote at a time.

The minimum requirements for a replica set are: A *primary* (page ??), a *secondary* (page ??), and an *arbiter* (page ??). Most deployments, however, will keep three members that store data: A *primary* (page ??) and two *secondary members* (page ??).

### Replica Set Primary

The primary is the only member in the replica set that receives write operations. MongoDB applies write operations on the *primary* and then records the operations on the primary's [oplog](#) (page 410). *Secondary* (page ??) members replicate this log and apply the operations to their data sets.

In the following three-member replica set, the primary accepts all write operations. Then the secondaries replicate the oplog to apply to their data sets.

All members of the replica set can accept read operations. However, by default, an application directs its read operations to the primary member. See [Read Preference](#) (page 405) for details on changing the default read behavior.

The replica set can have at most one primary. If the current primary becomes unavailable, an election determines the new primary. See [Replica Set Elections](#) (page 397) for more details.

In the following 3-member replica set, the primary becomes unavailable. This triggers an election which selects one of the remaining secondaries as the new primary.

### Replica Set Secondary Members

A secondary maintains a copy of the *primary's* data set. To replicate data, a secondary applies operations from the primary's [oplog](#) (page 410) to its own data set in an asynchronous process. A replica set can have one or more secondaries.

The following three-member replica set has two secondary members. The secondaries replicate the primary's oplog and apply the operations to their data sets.

Although clients cannot write data to secondaries, clients can read data from secondary members. See [Read Preference](#) (page 405) for more information on how clients direct read operations to replica sets.

A secondary can become a primary. If the current primary becomes unavailable, the replica set holds an [election](#) to choose which of the secondaries becomes the new primary.

In the following three-member replica set, the primary becomes unavailable. This triggers an election where one of the remaining secondaries becomes the new primary.

See [Replica Set Elections](#) (page 397) for more details.

---

<sup>1</sup> While replica sets are the recommended solution for production, a replica set can support only 12 members in total. If your deployment requires more than 12 members, you'll need to use [master-slave](#) (page 413) replication. Master-slave replication lacks the automatic failover capabilities.

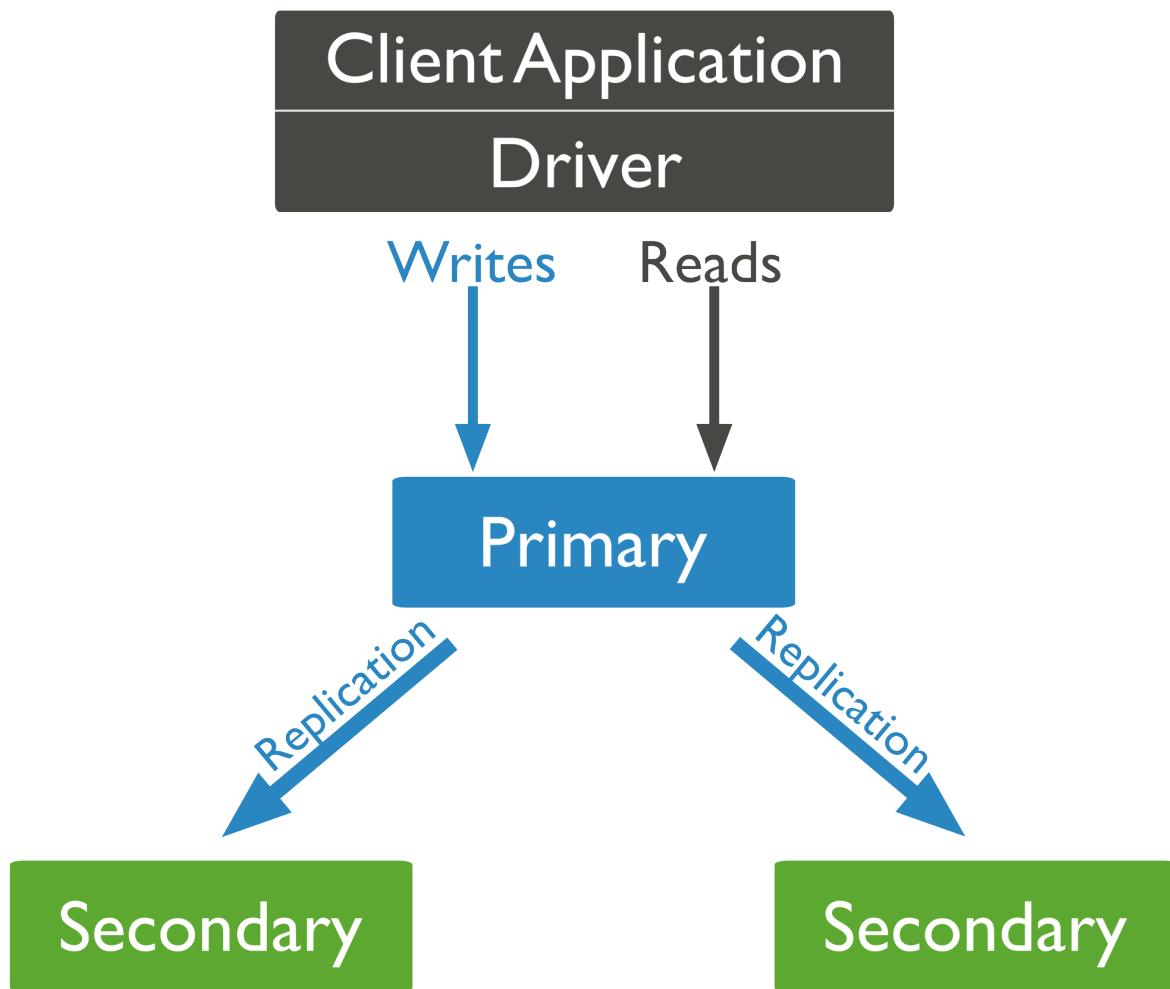


Figure 8.5: Diagram of default routing of reads and writes to the primary.

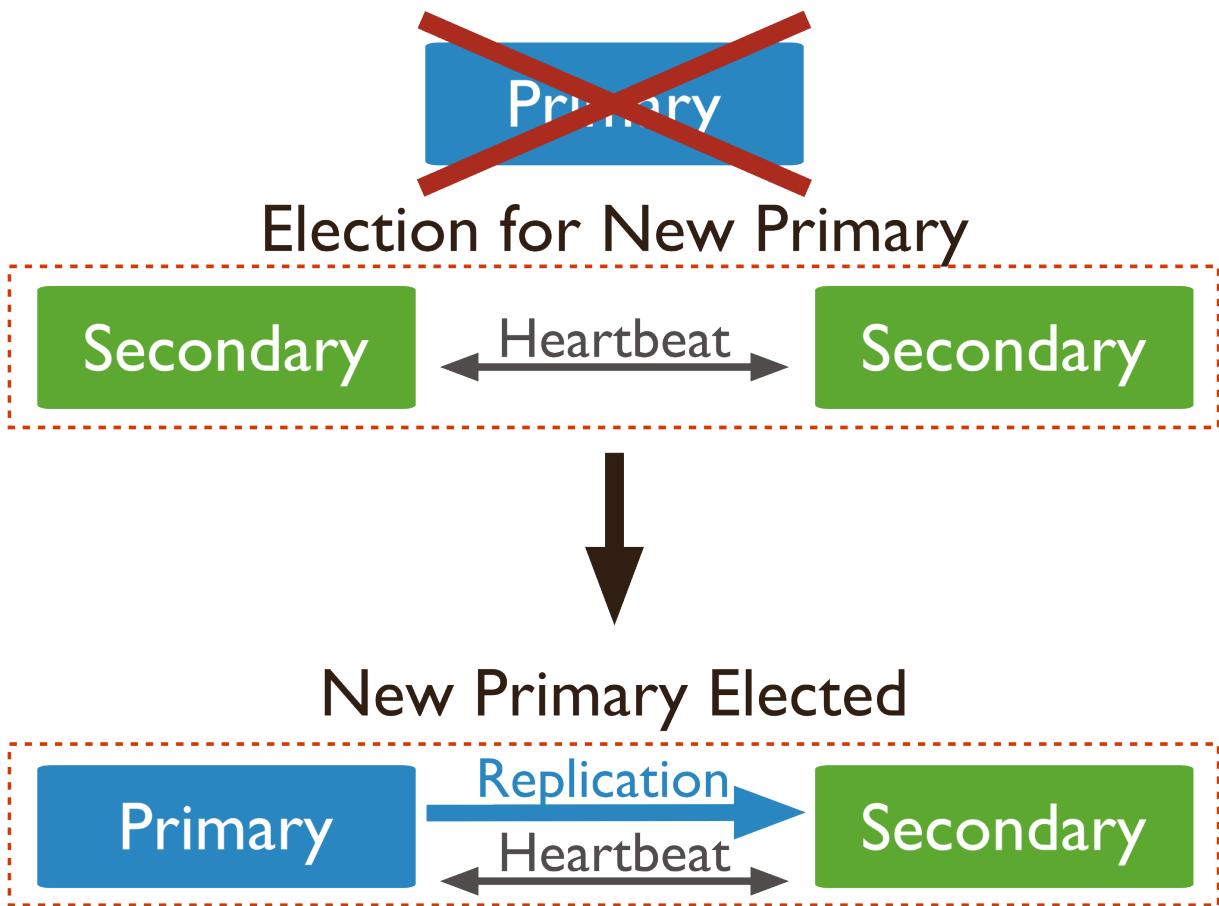


Figure 8.6: Diagram of an election of a new primary. In a three member replica set with two secondaries, the primary becomes unreachable. The loss of a primary triggers an election where one of the secondaries becomes the new primary

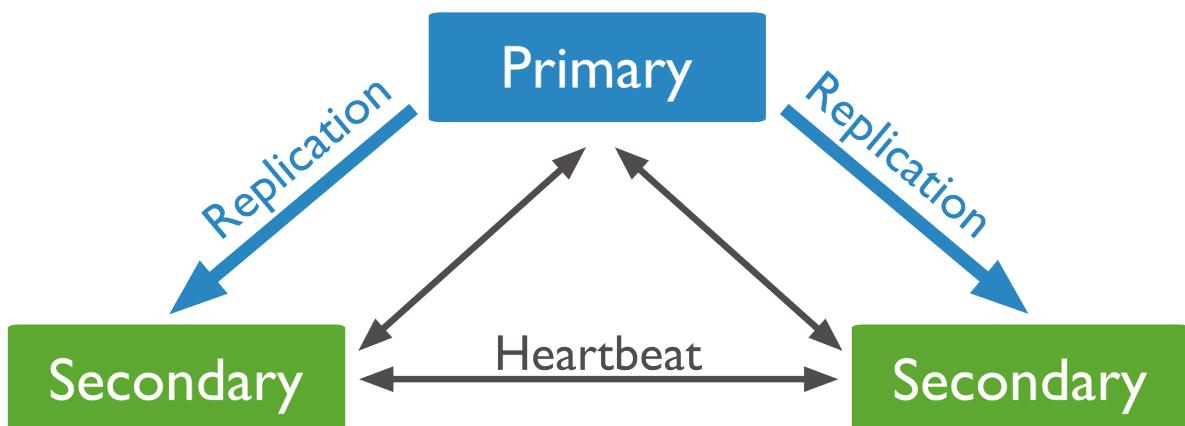


Figure 8.7: Diagram of a 3 member replica set that consists of a primary and two secondaries.

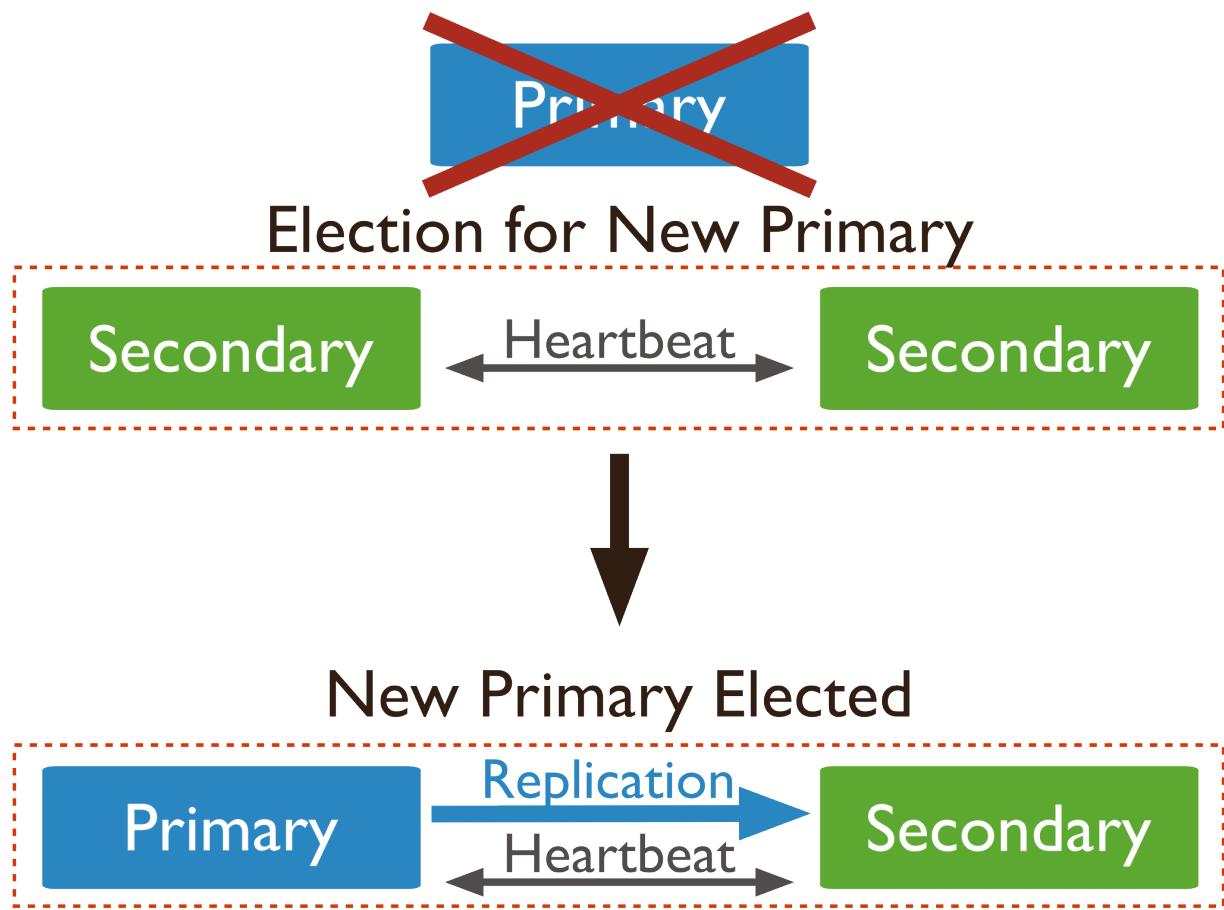


Figure 8.8: Diagram of an election of a new primary. In a three member replica set with two secondaries, the primary becomes unreachable. The loss of a primary triggers an election where one of the secondaries becomes the new primary

You can configure a secondary member for a specific purpose. You can configure a secondary to:

- Prevent it from becoming a primary in an election, which allows it to reside in a secondary data center or to serve as a cold standby. See [Priority 0 Replica Set Members](#) (page 386).
- Prevent applications from reading from it, which allows it to run applications that require separation from normal traffic. See [Hidden Replica Set Members](#) (page 387).
- Keep a running “historical” snapshot for use in recovery from certain errors, such as unintentionally deleted databases. See [Delayed Replica Set Members](#) (page 387).

### Priority 0 Replica Set Members

A *priority 0* member is a secondary that **cannot** become *primary*. *Priority 0* members cannot trigger *elections*. Otherwise these members function as normal secondaries. A *priority 0* member maintains a copy of the data set, accepts read operations, and votes in elections. Configure a *priority 0* member to prevent *secondaries* from becoming primary, which is particularly useful in multi-data center deployments.

In a three-member replica set, in one data center hosts the primary and a secondary. A second data center hosts one *priority 0* member that cannot become primary.

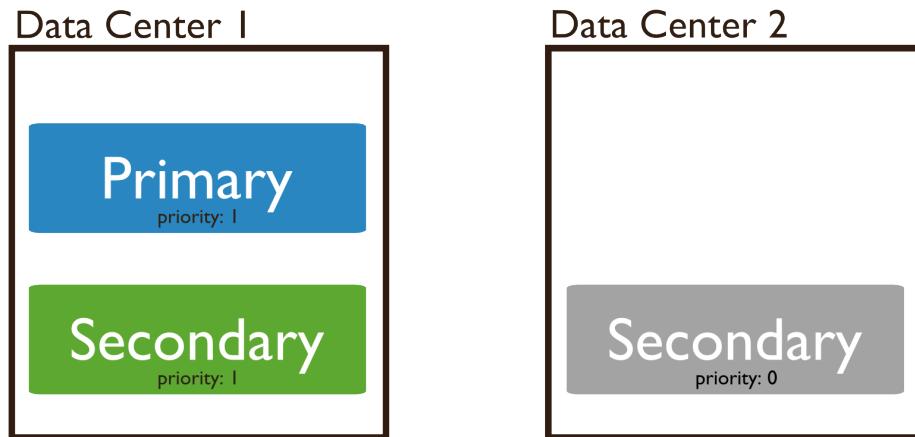


Figure 8.9: Diagram of a 3 member replica set distributed across two data centers. Replica set includes a priority 0 member.

**Priority 0 Members as Standbys** A *priority 0* member can function as a standby. In some replica sets, it might not be possible to add a new member in a reasonable amount of time. A standby member keeps a current copy of the data to be able to replace an unavailable member.

In many cases, you need not set standby to *priority 0*. However, in sets with varied hardware or *geographic distribution* (page 396), a *priority 0* standby ensures that only qualified members become primary.

A *priority 0* standby may also be valuable for some members of a set with different hardware or workload profiles. In these cases, deploy a member with *priority 0* so it can't become primary. Also consider using an *hidden member* (page 387) for this purpose.

If your set already has seven voting members, also configure the member as *non-voting* (page 400).

**Priority 0 Members and Failover** When configuring a *priority 0* member, consider potential failover patterns, including all possible network partitions. Always ensure that your main data center contains both a quorum of voting members and contains members that are eligible to be primary.

**Configuration** To configure a *priority 0* member, see [Prevent Secondary from Becoming Primary](#) (page 439).

### Hidden Replica Set Members

A hidden member maintains a copy of the *primary's* data set but is **invisible** to client applications. Hidden members are ideal for workloads with different usage patterns from the other members in the *replica set*. Hidden members are also *priority 0 members* (page 386) and **cannot become primary**. The `db.isMaster()` (page 890) method does not display hidden members. Hidden members, however, **do vote** in *elections* (page 397).

In the following five-member replica set, all four secondary members have copies of the primary's data set, but one of the secondary members is hidden.

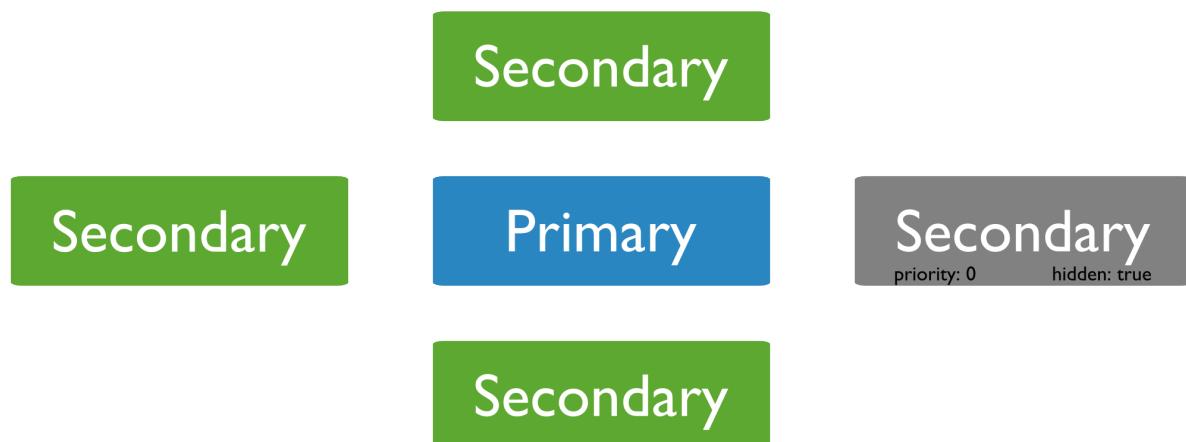


Figure 8.10: Diagram of a 5 member replica set with a hidden priority 0 member.

Secondary reads do not reach a hidden member, so the member receives no traffic beyond what replication requires. It can be useful to keep a hidden member dedicated to reporting or to do backups.

For dedicated backup, ensure that the hidden member has low network latency to the primary or likely primary. Ensure that the *replication lag* is minimal or non-existent.

Avoid stopping the `mongod` (page 925) process of a hidden members. Instead, for filesystem snapshots, use `db.fsyncLock()` (page 885) to flush all writes and lock the `mongod` (page 925) instance for the duration of the backup.

For more information about backing up MongoDB databases, see [Backup Strategies for MongoDB Systems](#) (page 136). To configure a hidden member, see [Configure a Hidden Replica Set Member](#) (page 440).

### Delayed Replica Set Members

Delayed members contain copies of a *replica set's* data set. However, a delayed member's data set reflects an earlier, or delayed, state of the set. For example, if the current time is 09:52 and a member has a delay of an hour, the delayed member has no operation more recent than 08:52.

Because delayed members are a “rolling backup” or a running “historical” snapshot of the data set, they may help you recover from various kinds of human error. For example, a delayed member can make it possible to recover from unsuccessful application upgrades and operator errors including dropped databases and collections.

### Requirements

Delayed members:

- **Must be** [priority 0](#) (page 386) members. Set the priority to 0 to prevent a delayed member from becoming primary.
- **Should be** [hidden](#) (page 387) members. Always prevent applications from seeing and querying delayed members.
- *do* vote in [elections](#) for primary.

Delayed members apply operations from the [oplog](#) on a delay. When choosing the amount of delay, consider that the amount of delay:

- must be equal to or greater than your maintenance windows.
- must be *smaller* than the capacity of the oplog. For more information on oplog size, see [Oplog Size](#) (page 411).

**Example** In the following 5-member replica set, the primary and all secondaries have copies of the data set. One member applies operations with a delay of 3600 seconds, or an hour. This delayed member is also *hidden* and is a *priority 0 member*.

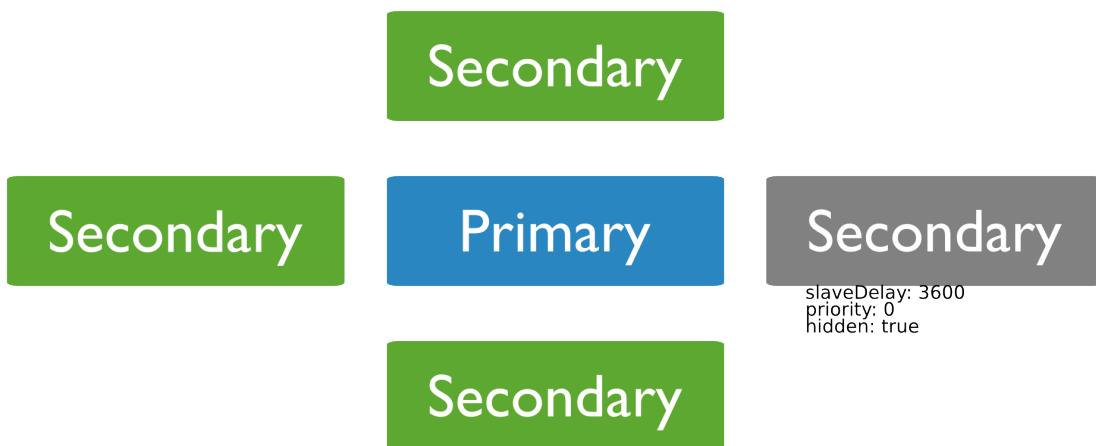


Figure 8.11: Diagram of a 5 member replica set with a hidden delayed priority 0 member.

**Configuration** A delayed member has its [priority](#) (page 481) equal to 0, [hidden](#) (page 481) equal to true, and its [slaveDelay](#) (page 482) equal to the number of seconds of delay:

```
{
 "_id" : <num>,
 "host" : <hostname:port>,
 "priority" : 0,
 "slaveDelay" : <seconds>,
 "hidden" : true
}
```

To configure a delayed member, see [Configure a Delayed Replica Set Member](#) (page 441).

## Replica Set Arbiter

An arbiter does **not** have a copy of data set and **cannot** become a primary. Replica sets may have arbiters to add a vote in [elections of or for primary](#) (page 397). Arbiters allow replica sets to have an uneven number of members, without the overhead of a member that replicates data.

---

**Important:** Do not run an arbiter on systems that also host the primary or the secondary members of the replica set.

---

Only add an arbiter to sets with even numbers of members. If you add an arbiter to a set with an odd number of members, the set may suffer from tied [elections](#). To add an arbiter, see [Add an Arbiter to Replica Set](#) (page 432).

### Example

For example, in the following replica set, an arbiter allows the set to have an odd number of votes for elections:



Figure 8.12: Diagram of a four member replica set plus an arbiter for odd number of votes.

## Security

**Authentication** When running with [auth](#) (page 993), arbiters exchange credentials with other members of the set to authenticate. MongoDB encrypts the authentication process. The MongoDB authentication exchange is cryptographically secure.

Arbiters, use [keyfiles](#) to authenticate to the replica set.

**Communication** The only communication between arbiters and other set members are: votes during elections, heartbeats, and configuration data. These exchanges are not encrypted.

**However**, if your MongoDB deployment uses SSL, MongoDB will encrypt *all* communication between replica set members. See [Connect to MongoDB with SSL](#) (page 249) for more information.

As with all MongoDB components, run arbiters on in trusted network environments.

## 8.2.2 Replica Set Deployment Architectures

The architecture of a [replica set](#) affects the set's capacity and capability. This document provides strategies for replica set deployments and describes common architectures.

The standard replica set deployment for production system is a three-member replica set. These sets provide redundancy and fault tolerance. Avoid complexity when possible, but let your application requirements dictate the architecture.

---

**Important:** If your application connects to more than one replica set, each set should have a distinct name. Some drivers group replica set connections by replica set name.

---

### Strategies

#### Determine the Number of Members

Add members in a replica set according to these strategies.

**Deploy an Odd Number of Members** An odd number of members ensures that the replica set is always able to elect a primary. If you have an even number of members, add an arbiter to get an odd number. [Arbiters](#) do not store a copy of the data and require fewer resources. As a result, you may run an arbiter on an application server or other shared process.

**Consider Fault Tolerance** *Fault tolerance* for a replica set is the number of members that can become unavailable and still leave enough members in the set to elect a primary. In other words, it is the difference between the number of members in the set and the majority needed to elect a primary. Without a primary, a replica set cannot accept write operations. Fault tolerance is an effect of replica set size, but the relationship is not direct. See the following table:

| Number of Members. | Majority Required to Elect a New Primary. | Fault Tolerance. |
|--------------------|-------------------------------------------|------------------|
| 3                  | 2                                         | 1                |
| 4                  | 3                                         | 1                |
| 5                  | 3                                         | 2                |
| 6                  | 4                                         | 2                |

Adding a member to the replica set does not *always* increase the fault tolerance. However, in these cases, additional members can provide support for dedicated functions, such as backups or reporting.

**Use Hidden and Delayed Members for Dedicated Functions** Add [hidden](#) (page 387) or [delayed](#) (page 387) members to support dedicated functions, such as backup or reporting.

**Load Balance on Read-Heavy Deployments** In a deployment with *very* high read traffic, you can improve read throughput by distributing reads to secondary members. As your deployment grows, add or move members to alternate data centers to improve redundancy and availability.

Always ensure that the main facility is able to elect a primary.

**Add Capacity Ahead of Demand** The existing members of a replica set must have spare capacity to support adding a new member. Always add new members before the current demand saturates the capacity of the set.

## Determine the Distribution of Members

**Distribute Members Geographically** To protect your data if your main data center fails, keep at least one member in an alternate data center. Set these members' [priority](#) (page 481) to 0 to prevent them from becoming primary.

**Keep a Majority of Members in One Location** When a replica set has members in multiple data centers, network partitions can prevent communication between data centers. To replicate data, members must be able to communicate to other members.

In an election, members must see each other to create a majority. To ensure that the replica set members can confirm a majority and elect a primary, keep a majority of the set's members in one location.

## Target Operations with Tags

Use [replica set tags](#) (page 451) to ensure that operations replicate to specific data centers. Tags also support targeting read operations to specific machines.

### See also:

[Data Center Awareness](#) (page 153) and [Operational Segregation in MongoDB Deployments](#) (page 153).

## Use Journaling to Protect Against Power Failures

Enable journaling to protect data against service interruptions. Without journaling MongoDB cannot recover data after unexpected shutdowns, including power failures and unexpected reboots.

All 64-bit versions of MongoDB after version 2.0 have journaling enabled by default.

## Deployment Patterns

The following documents describe common replica set deployment patterns. Other patterns are possible and effective depending on the application's requirements. If needed, combine features of each architecture in your own deployment:

[Three Member Replica Sets](#) (page 391) Three-member replica sets provide the minimum recommended architecture for a replica set.

[Replica Sets with Four or More Members](#) (page 392) Four or more member replica sets provide greater redundancy and can support greater distribution of read operations and dedicated functionality.

[Geographically Distributed Replica Sets](#) (page 396) Geographically distributed sets include members in multiple locations to protect against facility-specific failures, such as power outages.

## Three Member Replica Sets

The minimum architecture of a replica set has three members. A three member replica set can have either three members that hold data, or two members that hold data and an arbiter.

**Primary with Two Secondary Members** A replica set with three members that store data has:

- One [primary](#) (page 382).
- Two [secondary](#) (page 382) members. Both secondaries can become the primary in an [election](#) (page 397).

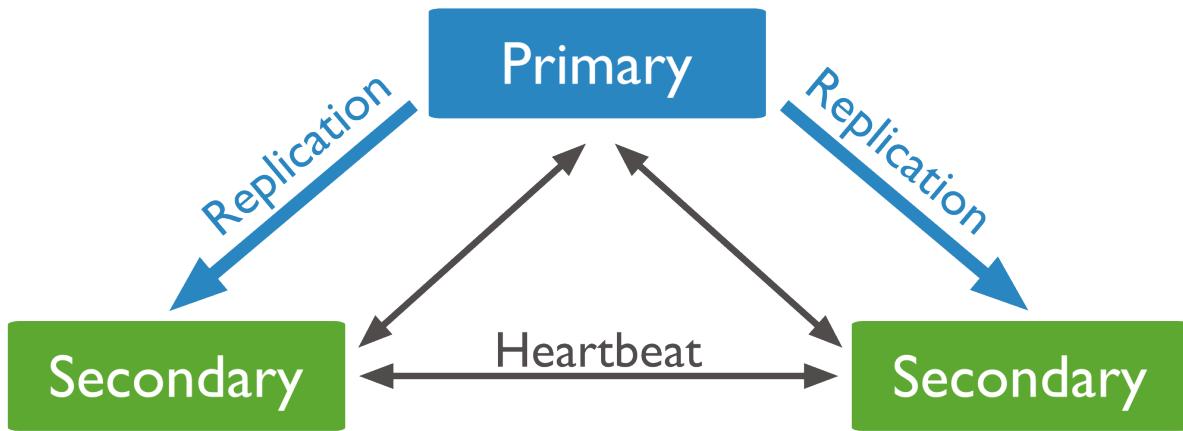


Figure 8.13: Diagram of a 3 member replica set that consists of a primary and two secondaries.

These deployments provide two complete copies of the data set at all times in addition to the primary. These replica sets provide additional fault tolerance and [high availability](#) (page 396). If the primary is unavailable, the replica set elects a secondary to be primary and continues normal operation. The old primary rejoins the set when available.

**Primary with a Secondary and an Arbiter** A three member replica set with a two members that store data has:

- One [primary](#) (page 382).
- One [secondary](#) (page 382) member. The secondary can become primary in an [election](#) (page 397).
- One [arbiter](#) (page 389). The arbiter only votes in elections.

Since the arbiter does not hold a copy of the data, these deployments provides only one complete copy of the data. Arbiters require fewer resources, at the expense of more limited redundancy and fault tolerance.

However, a deployment with a primary, secondary, and an arbiter ensures that a replica set remains available if the primary *or* the secondary is unavailable. If the primary is unavailable, the replica set will elect the secondary to be primary.

#### See also:

[Deploy a Replica Set](#) (page 420).

### Replica Sets with Four or More Members

Although the standard replica set configuration has three members you can deploy larger sets. Add additional members to a set to increase redundancy or to add capacity for distributing secondary read operations.

When adding members, ensure that:

- The set has an odd number of voting members. If you have an *even* number of voting members, deploy an [arbiter](#) (page ??) so that the set has an odd number.

The following replica set needs an arbiter to have an odd number of voting members.

- A replica set can have up to 12 members,<sup>2</sup> but only 7 voting members. See [non-voting members](#) (page 400) for more information.

<sup>2</sup> While replica sets are the recommended solution for production, a replica set can support only 12 members in total. If your deployment requires more than 12 members, you'll need to use [master-slave](#) (page 413) replication. Master-slave replication lacks the automatic failover capabilities.

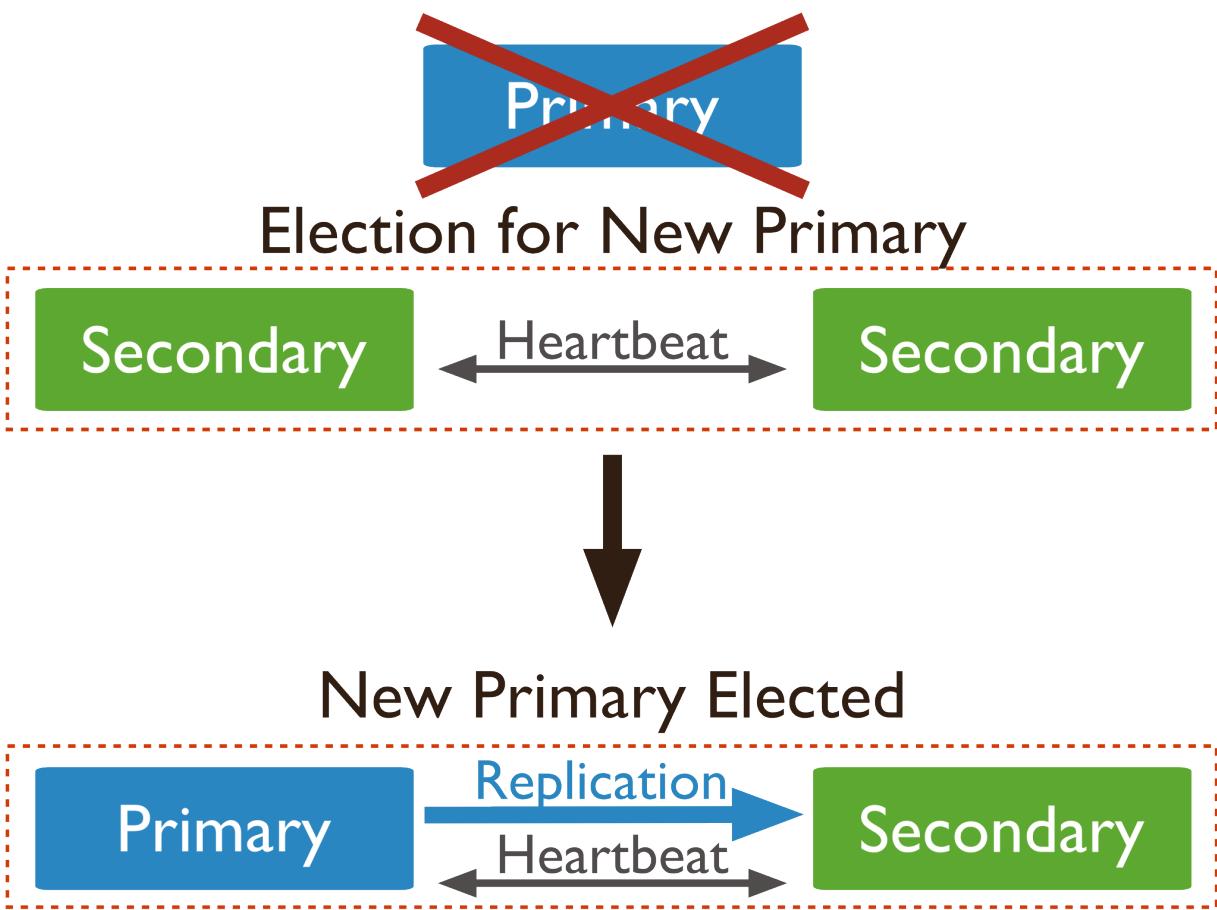


Figure 8.14: Diagram of an election of a new primary. In a three member replica set with two secondaries, the primary becomes unreachable. The loss of a primary triggers an election where one of the secondaries becomes the new primary

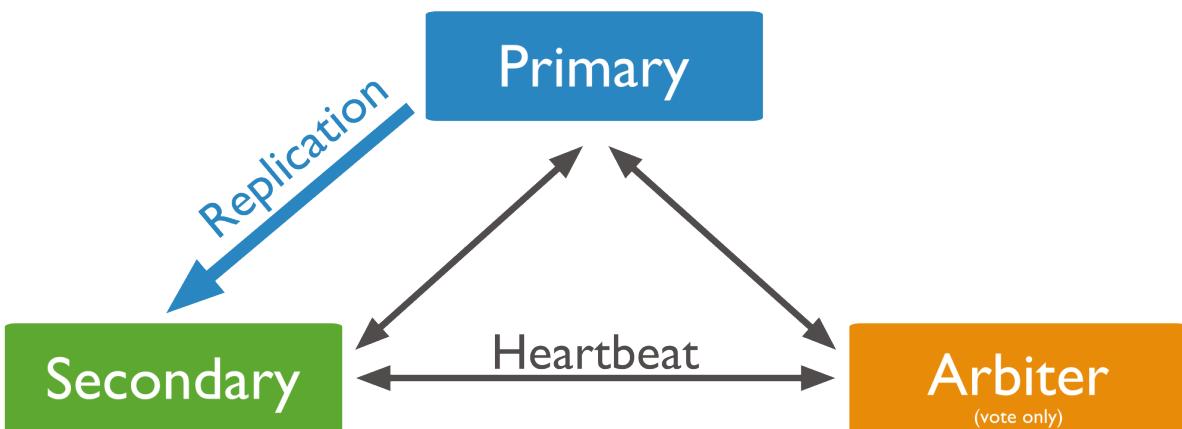


Figure 8.15: Diagram of a replica set that consists of a primary, a secondary, and an arbiter.

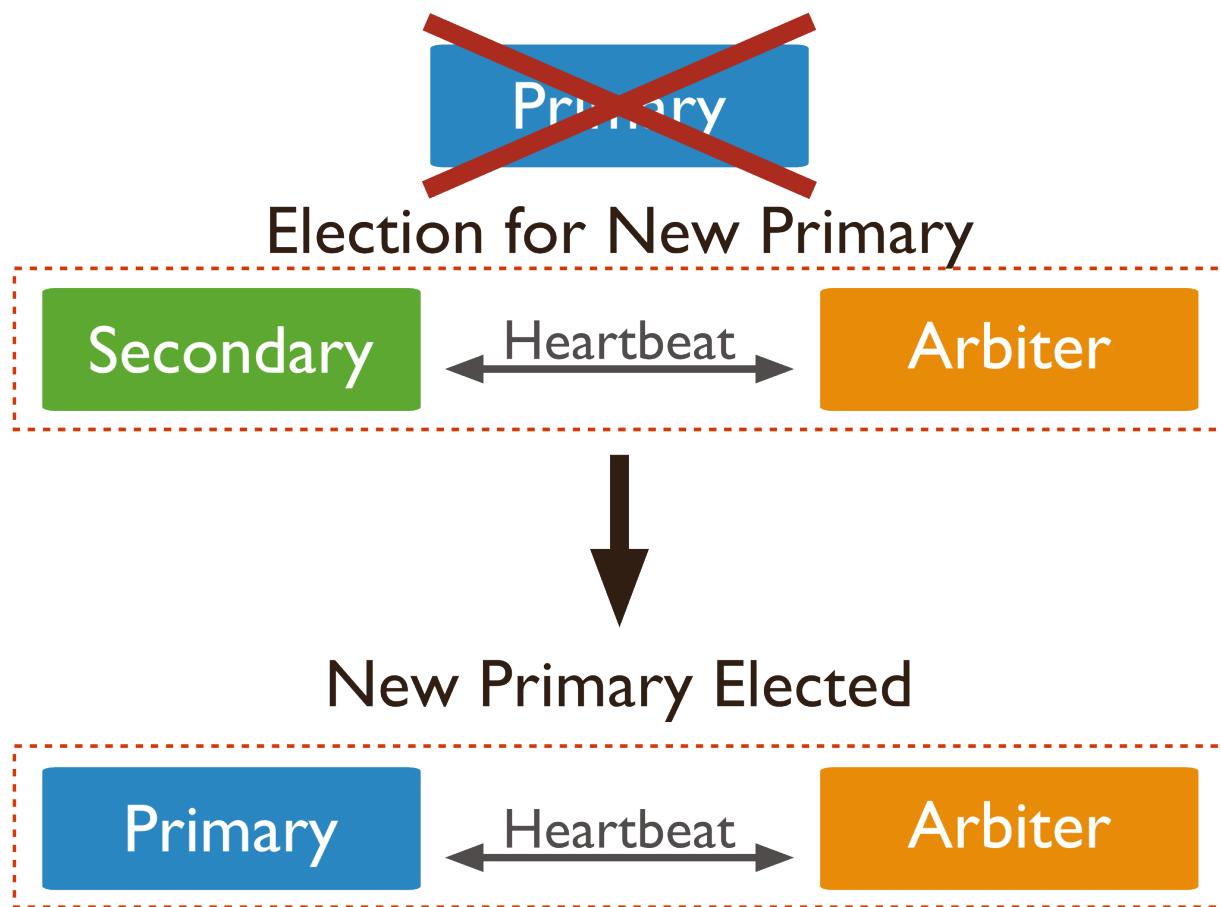


Figure 8.16: Diagram of an election of a new primary. In a three member replica set with a secondary and an arbiter, the primary becomes unreachable. The loss of a primary triggers an election where the secondary becomes new primary.

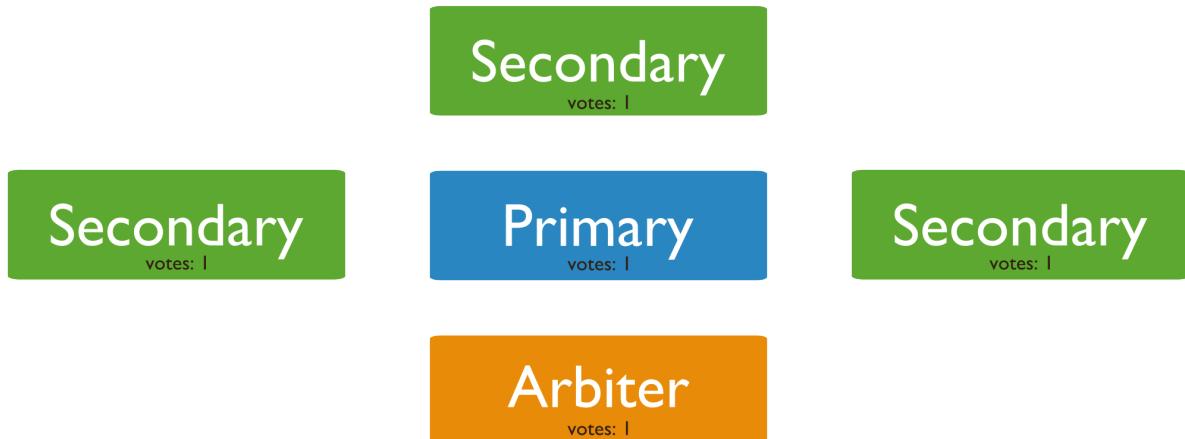


Figure 8.17: Diagram of a four member replica set plus an arbiter for odd number of votes.

The following 9 member replica set has 7 voting members and 2 non-voting members.

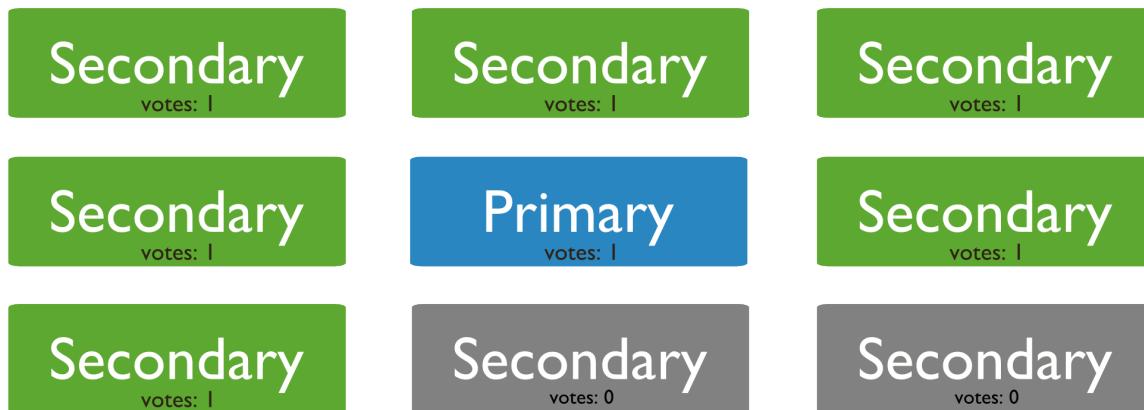


Figure 8.18: Diagram of a 9 member replica set with the maximum of 7 voting members.

- Members that cannot become primary in a [failover](#) have [priority 0 configuration](#) (page 386).

For instance, some members that have limited resources or networking constraints and should never be able to become primary. Configure members that should not become primary to have [priority 0](#) (page 386). In following replica set, the secondary member in the third data center has a priority of 0:

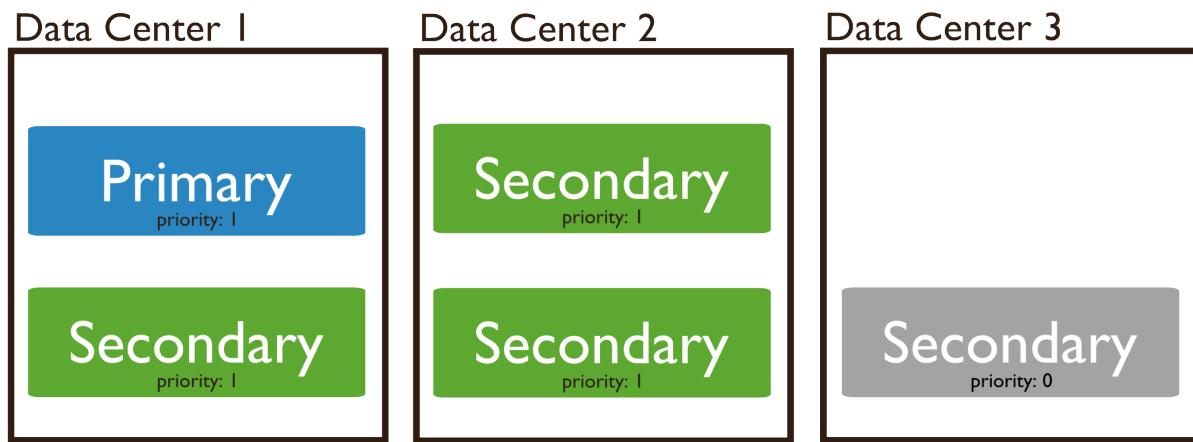


Figure 8.19: Diagram of a 5 member replica set distributed across three data centers. Replica set includes a priority 0 member.

- A majority of the set's members should be in your applications main data center.

#### See also:

[Deploy a Replica Set](#) (page 420), [Add an Arbiter to Replica Set](#) (page 432), and [Add Members to a Replica Set](#) (page 433).

## Geographically Distributed Replica Sets

Adding members to a replica set in multiple data centers adds redundancy and provides fault tolerance if one data center is unavailable. Members in additional data centers should have a [priority of 0](#) (page 386) to prevent them from becoming primary.

For example: the architecture of a geographically distributed replica set may be:

- One [primary](#) in the main data center.
- One [secondary](#) member in the main data center. This member can become primary at any time.
- One [priority 0](#) (page 386) member in a second data center. This member cannot become primary.

In the following replica set, the primary and one secondary are in *Data Center 1*, while *Data Center 2* has a [priority 0](#) (page 386) secondary that cannot become a primary.

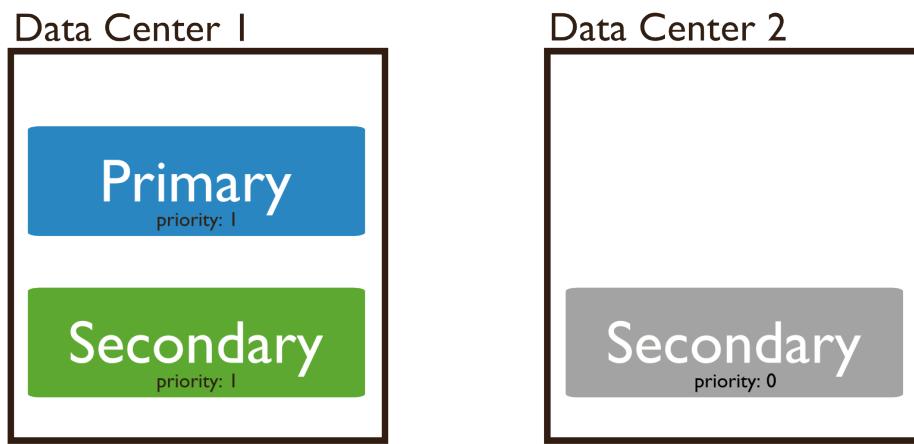


Figure 8.20: Diagram of a 3 member replica set distributed across two data centers. Replica set includes a priority 0 member.

If the primary is unavailable, the replica set will elect a new primary from *Data Center 1*. If the data centers cannot connect to each other, the member in *Data Center 2* will not become the primary.

If *Data Center 1* becomes unavailable, you can manually recover the data set from *Data Center 2* with minimal downtime. With sufficient [write concern](#) (page 55), there will be no data loss.

To facilitate elections, the main data center should hold a majority of members. Also ensure that the set has an odd number of members. If adding a member in another data center results in a set with an even number of members, deploy an [arbiter](#) (page ??). For more information on elections, see [Replica Set Elections](#) (page 397).

### See also:

[Deploy a Geographically Distributed Replica Set](#) (page 425).

### 8.2.3 Replica Set High Availability

[Replica sets](#) provide high availability using automatic [failover](#). Failover allows a [secondary](#) members to become [primary](#) if primary is unavailable. Failover, in most situations does not require manual intervention.

Replica set members keep the same data set but are otherwise independent. If the primary becomes unavailable, the replica set holds an [election](#) (page 397) to select a new primary. In some situations, the failover process may require a

[rollback](#) (page 401).<sup>3</sup>

The deployment of a replica set affects the outcome of failover situations. To support effective failover, ensure that one facility can elect a primary if needed. Choose the facility that hosts the core application systems to host the majority of the replica set. Place a majority of voting members and all the members that can become primary in this facility. Otherwise, network partitions could prevent the set from being able to form a majority.

## Failover Processes

The replica set recovers from the loss of a primary by holding an election. Consider the following:

**Replica Set Elections** (page 397) Elections occur when the primary becomes unavailable and the replica set members autonomously select a new primary.

**Rollbacks During Replica Set Failover** (page 401) A rollback reverts write operations on a former primary when the member rejoins the replica set after a failover.

## Replica Set Elections

*Replica sets* use elections to determine which set member will become *primary*. Elections occur after initiating a replica set, and also any time the primary becomes unavailable. The primary is the only member in the set that can accept write operations. If a primary becomes unavailable, elections allow the set to recover normal operations without manual intervention. Elections are part of the *failover process* (page 396).

---

**Important:** Elections are essential for independent operation of a replica set; however, elections take time to complete. While an election is in process, the replica set has no primary and cannot accept writes. MongoDB avoids elections unless necessary.

In the following three-member replica set, the primary is unavailable. The remaining secondaries hold an election to choose a new primary.

## Factors and Conditions that Affect Elections

**Heartbeats** Replica set members send heartbeats (pings) to each other every two seconds. If a heartbeat does not return within 10 seconds, the other members mark the delinquent member as inaccessible.

**Priority Comparisons** The [priority](#) (page 481) setting affects elections. Members will prefer to vote for members with the highest priority value.

Members with a priority value of 0 cannot become primary and do not seek election. For details, see *Priority 0 Replica Set Members* (page 386).

A replica set does *not* hold an election as long as the current primary has the highest priority value and is within 10 seconds of the latest [oplog](#) entry in the set. If a higher-priority member catches up to within 10 seconds of the latest oplog entry of the current primary, the set holds an election in order to provide the higher-priority node a chance to become primary.

**Optime** The [optime](#) (page 727) is the timestamp of the last operation that a member applied from the oplog. A replica set member cannot become primary unless it has the highest (i.e. most recent) [optime](#) (page 727) of any visible member in the set.

---

<sup>3</sup> Replica sets remove “rollback” data when needed without intervention. Administrators must apply or discard rollback data manually.

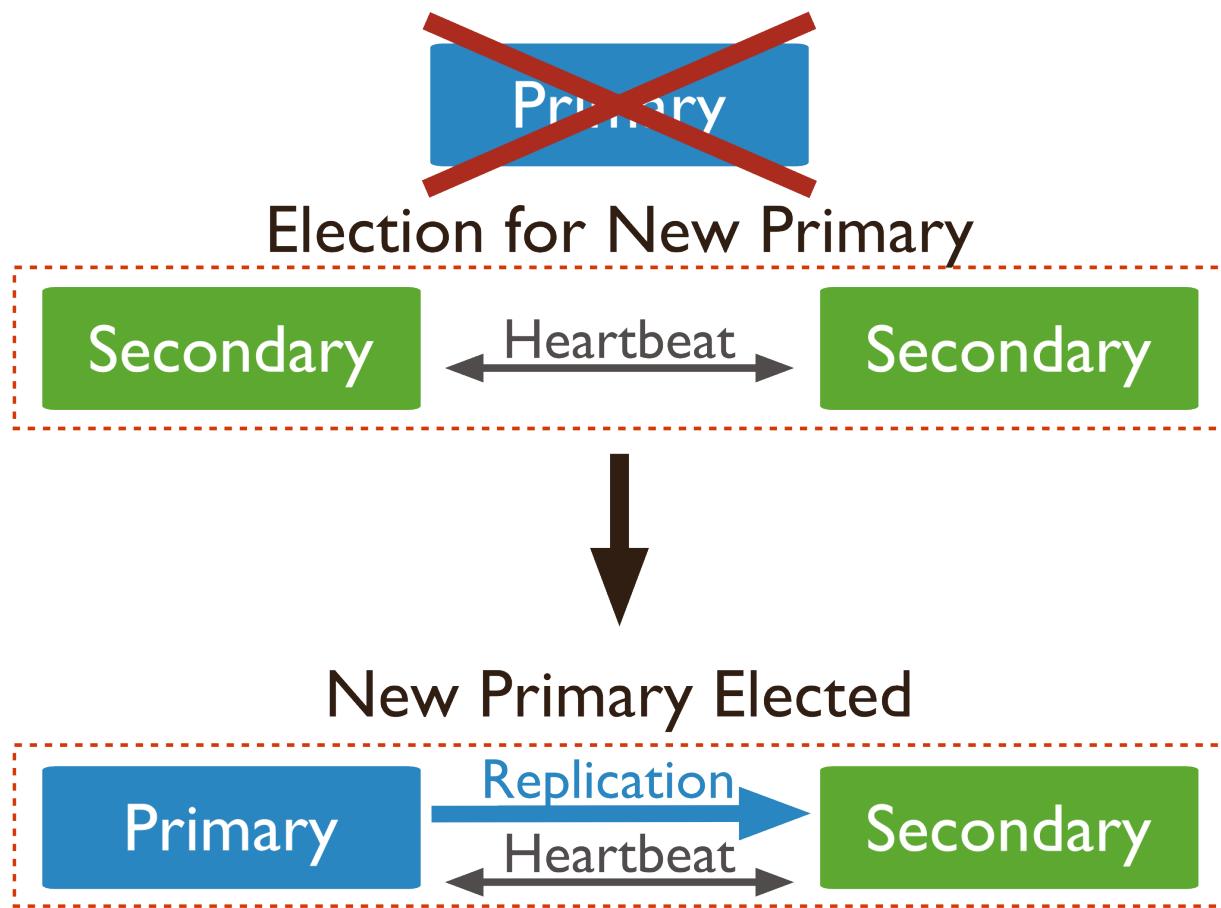


Figure 8.21: Diagram of an election of a new primary. In a three member replica set with two secondaries, the primary becomes unreachable. The loss of a primary triggers an election where one of the secondaries becomes the new primary

**Connections** A replica set member cannot become primary unless it can connect to a majority of the members in the replica set. For the purposes of elections, a majority refers to the total number of *votes*, rather than the total number of members.

If you have a three-member replica set, where every member has one vote, the set can elect a primary as long as two members can connect to each other. If two members are unavailable, the remaining member remains a *secondary* because it cannot connect to a majority of the set's members. If the remaining member is a *primary* and two members become unavailable, the primary steps down and becomes secondary.

**Network Partitions** Network partitions affect the formation of a majority for an election. If a primary steps down and neither portion of the replica set has a majority the set will **not** elect a new primary. The replica set becomes read-only.

To avoid this situation, place a majority of instances in one data center and a minority of instances in any other data centers combined.

## Election Mechanics

**Election Triggering Events** Replica sets hold an election any time there is no primary. Specifically, the following:

- the initiation of a new replica set.
- a secondary loses contact with a primary. Secondaries call for elections when they cannot see a primary.
- a primary steps down.

---

**Note:** *Priority 0 members* (page 386), do not trigger elections, even when they cannot connect to the primary.

A primary will step down:

- after receiving the `replSetStepDown` (page 730) command.
- if one of the current secondaries is eligible for election *and* has a higher priority.
- if primary cannot contact a majority of the members of the replica set.

---

**Important:** When a primary steps down, it closes all open client connections, so that clients don't attempt to write data to a secondary. This helps clients maintain an accurate view of the replica set and helps prevent *rollbacks*.

**Participation in Elections** Every replica set member has a *priority* that helps determine its eligibility to become a *primary*. In an election, the replica set elects an eligible member with the highest *priority* (page 481) value as primary. By default, all members have a priority of 1 and have an equal chance of becoming primary. In the default, all members also can trigger an election.

You can set the *priority* (page 481) value to weight the election in favor of a particular member or group of members. For example, if you have a *geographically distributed replica set* (page 396), you can adjust priorities so that only members in a specific data center can become primary.

The first member to receive the majority of votes becomes primary. By default, all members have a single vote, unless you modify the *votes* (page 482) setting. *Non-voting members* (page 442) have *votes* (page 482) value of 0.

The *state* (page 727) of a member also affects its eligibility to vote. Only members in the following states can vote: PRIMARY, SECONDARY, RECOVERING, ARBITER, and ROLLBACK.

---

**Important:** Do not alter the number of votes in a replica set to control the outcome of an election. Instead, modify the *priority* (page 481) value.

**Veto in Elections** All members of a replica set can veto an election, including *non-voting members* (page 400). A member will veto an election:

- If the member seeking an election is not a member of the voter's set.
- If the member seeking an election is not up-to-date with the most recent operation accessible in the replica set.
- If the member seeking an election has a lower priority than another member in the set that is also eligible for election.
- If a *priority 0 member* (page 386)<sup>4</sup> is the most current member at the time of the election. In this case, another eligible member of the set will catch up to the state of this secondary member and then attempt to become primary.
- If the current primary has more recent operations (i.e. a higher `optime` (page 727)) than the member seeking election, from the perspective of the voting member.
- If the current primary has the same or more recent operations (i.e. a higher or equal `optime` (page 727)) than the member seeking election.

**Non-Voting Members** Non-voting members hold copies of the replica set's data and can accept read operations from client applications. Non-voting members do not vote in elections, but **can veto** (page 400) an election and become primary.

Because a replica set can have up to 12 members but only up to seven voting members, non-voting members allow a replica set to have more than seven members.

For instance, the following nine-member replica set has seven voting members and two non-voting members.

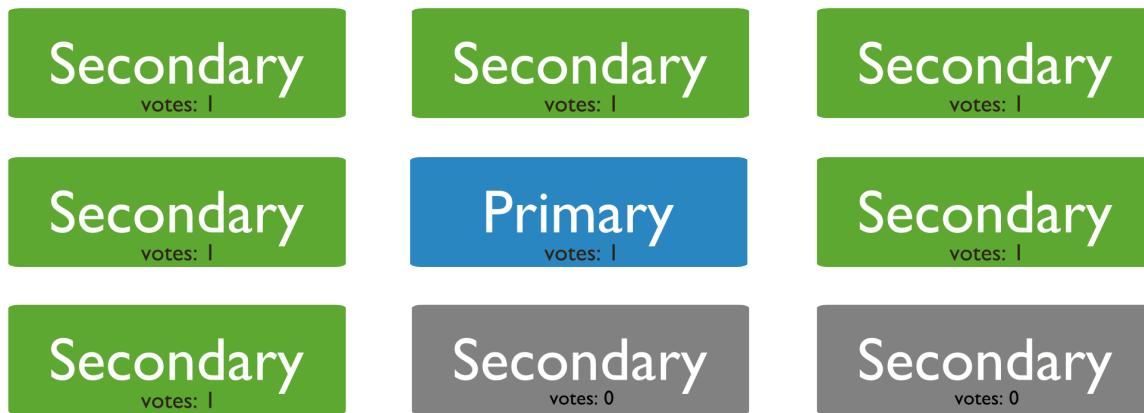


Figure 8.22: Diagram of a 9 member replica set with the maximum of 7 voting members.

A non-voting member has a `votes` (page 482) setting equal to 0 in its member configuration:

```
{
 "_id" : <num>
 "host" : <hostname:port>,
 "votes" : 0
}
```

<sup>4</sup> Remember that `hidden` (page 387) and `delayed` (page 387) imply `priority 0` (page 386) configuration.

---

**Important:** Do **not** alter the number of votes to control which members will become primary. Instead, modify the [priority](#) (page 481) option. *Only* alter the number of votes in exceptional cases. For example, to permit more than seven members.

---

When possible, all members should have only one vote. Changing the number of votes can cause ties, deadlocks, and the wrong members to become primary.

To configure a non-voting member, see [Configure Non-Voting Replica Set Member](#) (page 442).

### Rollbacks During Replica Set Failover

A rollback reverts write operations on a former *primary* when the member rejoins its *replica set* after a *failover*. A rollback is necessary only if the primary had accepted write operations that the *secondaries* had **not** successfully replicated before the primary stepped down. When the primary rejoins the set as a secondary, it reverts, or “rolls back,” its write operations to maintain database consistency with the other members.

MongoDB attempts to avoid rollbacks, which should be rare. When a rollback does occur, it is often the result of a network partition. Secondaries that can not keep up with the throughput of operations on the former primary, increase the size an impact of the rollback.

A rollback does *not* occur if the write operations replicate to another member of the replica set before the primary steps down and if that member remains available and accessible to a majority of the replica set.

**Collect Rollback Data** When a rollback does occur, administrators must decide whether to apply or ignore the rollback data. MongoDB writes the rollback data to [BSON](#) files in the `rollback/` folder under the database’s [dbpath](#) (page 993) directory. The names of rollback files have the following form:

```
<database>.<collection>.<timestamp>.bson
```

For example:

```
records.accounts.2011-05-09T18-10-04.0.bson
```

Administrators must apply rollback data manually after the member completes the rollback and returns to secondary status. Use [bsondump](#) (page 960) to read the contents of the rollback files. Then use [mongorestore](#) (page 956) to apply the changes to the new primary.

**Avoid Replica Set Rollbacks** To prevent rollbacks, use [replica acknowledged write concern](#) (page 57) to guarantee that the write operations propagate to the members of a replica set.

**Rollback Limitations** A [mongod](#) (page 925) instance will not rollback more than 300 megabytes of data. If your system must rollback more than 300 megabytes, you must manually intervene to recover the data. If this is the case, the following line will appear in your [mongod](#) (page 925) log:

```
[replica set sync] replSet syncThread: 13410 replSet too much data to roll back
```

In this situation, save the data directly or force the member to perform an initial sync. To force initial sync, sync from a “current” member of the set by deleting the content of the [dbpath](#) (page 993) directory for the member that requires a larger rollback.

**See also:**

[Replica Set High Availability](#) (page 396) and [Replica Set Elections](#) (page 397).

## 8.2.4 Replica Set Read and Write Semantics

From the perspective of a client application, whether a MongoDB instance is running as a single server (i.e. “standalone”) or a *replica set* is transparent.

By default, in MongoDB, read operations to a replica set return results from the *primary* (page 382) and are *consistent* with the last write operation.

Users may configure *read preference* on a per-connection basis to prefer that the read operations return on the *secondary* members. If clients configure the *read preference* to permit secondary reads, read operations cannot return from *secondary* members that have not replicated more recent updates or operations. When reading from a secondary, a query may return data that reflects a previous state.

This behavior is sometimes characterized as *eventual consistency* because the secondary member’s state will *eventually* reflect the primary’s state and MongoDB cannot guarantee *strict consistency* for read operations from secondary members.

To guarantee consistency for reads from secondary members, you can configure the *client* and *driver* to ensure that write operations succeed on all members before completing successfully. See *Write Concern* (page 55) for more information. Additionally, such configuration can help prevent *Rollbacks During Replica Set Failover* (page 401) during a failover.

---

**Note:** *Sharded clusters* where the shards are also replica sets provide the same operational semantics with regards to write and read operations.

---

***Write Concern for Replica Sets* (page 402)** Write concern is the guarantee an application requires from MongoDB to consider a write operation successful.

***Read Preference* (page 405)** Applications specify *read preference* to control how drivers direct read operations to members of the replica set.

***Read Preference Processes* (page 408)** With replica sets, read operations may have additional semantics and behavior.

### Write Concern for Replica Sets

MongoDB’s built-in *write concern* (page 55) confirms the success of write operations to a *replica set’s primary*. Write concern uses the `getLastError` (page 720) command after write operations to return an object with error information or confirmation that there are no errors.

From the perspective of a client application, whether a MongoDB instance is running as a single server (i.e. “standalone”) or a *replica set* is transparent. However, replica sets offer some configuration options for write and read operations.<sup>5</sup>

### Verify Write Operations

The default write concern confirms write operations only on the primary. You can configure write concern to confirm write operations to additional replica set members as well by issuing the `getLastError` (page 720) command with the `w` option.

The `w` option confirms that write operations have replicated to the specified number of replica set members, including the primary. You can either specify a number or specify `majority`, which ensures the write propagates to a majority of set members.

---

<sup>5</sup> *Sharded clusters* where the shards are also replica sets provide the same configuration options with regards to write and read operations.

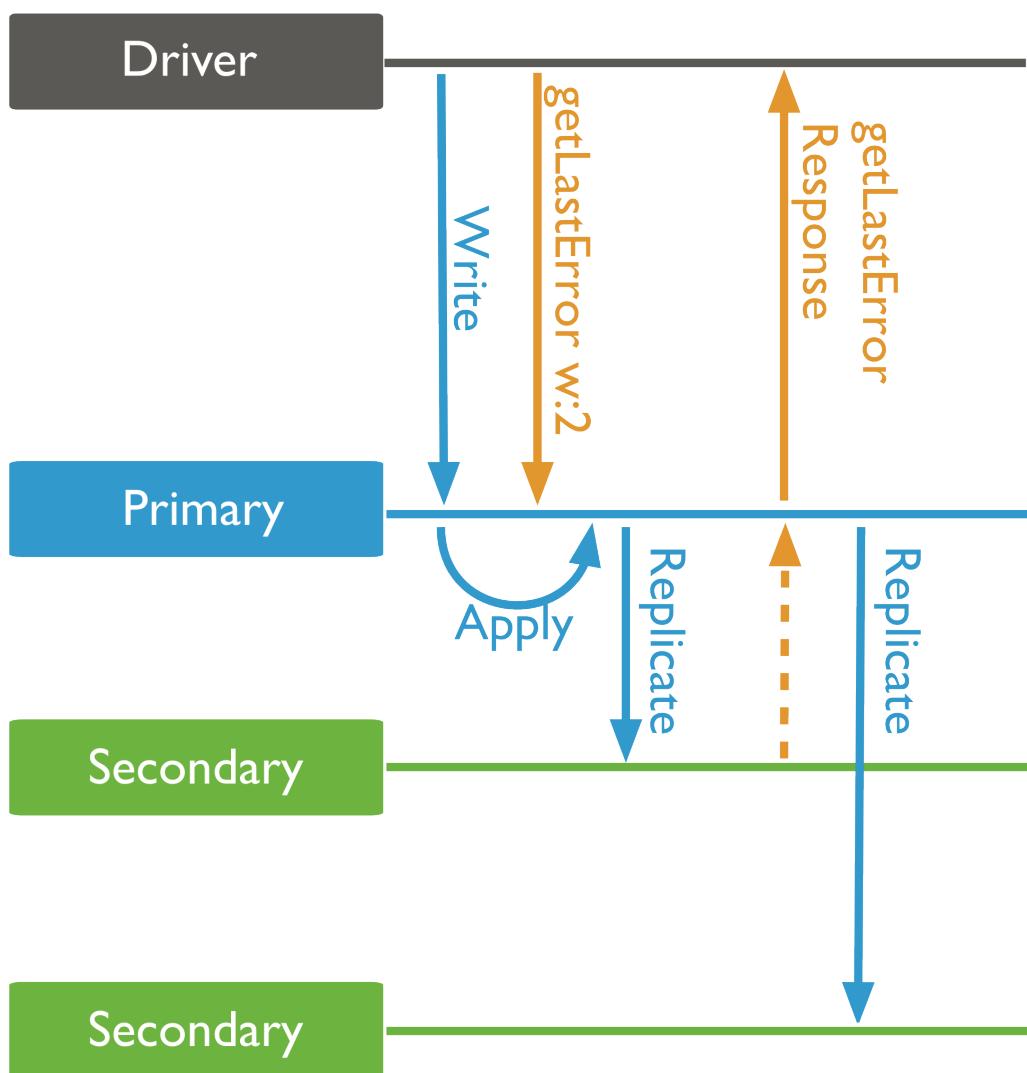


Figure 8.23: Write operation to a replica set with write concern level of `w:2` or write to the primary and at least one secondary.

If you specify a `w` value greater than the number of members that hold a copy of the data (i.e., greater than the number of non-*arbiter* members), the operation blocks until those members become available. This can cause the operation to block forever. To specify a timeout threshold for the `getLastError` (page 720) operation, use the `wtimeout` argument. A `wtimeout` value of 0 means that the operation will never time out.

See [getLastError Examples](#) (page 721) for example invocations.

### Modify Default Write Concern

You can configure your own “default” `getLastError` (page 720) behavior for a replica set. Use the `getLastErrorDefaults` (page 483) setting in the [replica set configuration](#) (page 479). The following sequence of commands creates a configuration that waits for the write operation to complete on a majority of the set members before returning:

```
cfg = rs.conf()
cfg.settings = {}
cfg.settings.getLastErrorDefaults = {w: "majority"}
rs.reconfig(cfg)
```

The `getLastErrorDefaults` (page 483) setting affects only those `getLastError` (page 720) commands that have *no* other arguments.

---

**Note:** Use of insufficient write concern can lead to [rollbacks](#) (page 401) in the case of [replica set failover](#) (page 396). Always ensure that your operations have specified the required write concern for your application.

---

#### See also:

[Write Concern](#) (page 55) and [Write Concern Options](#) (page 1012)

### Custom Write Concerns

You can use replica set tags to create custom write concerns using the `getLastErrorDefaults` (page 483) and `getLastErrorModes` (page 483) replica set settings.

---

**Note:** Custom write concern modes specify the field name and a number of *distinct* values for that field. By contrast, read preferences use the value of fields in the tag document to direct read operations.

In some cases, you may be able to use the same tags for read preferences and write concerns; however, you may need to create additional tags for write concerns depending on the requirements of your application.

---

### Single Tag Write Concerns

Consider a five member replica set, where each member has one of the following tag sets:

```
{ "use": "reporting" }
{ "use": "backup" }
{ "use": "application" }
{ "use": "application" }
{ "use": "application" }
```

You could create a custom write concern mode that will ensure that applicable write operations will not return until members with two different values of the `use` tag have acknowledged the write operation. Create the mode with the following sequence of operations in the `mongo` (page 942) shell:

```
cfg = rs.conf()
cfg.settings = { getLastErrorModes: { use2: { "use": 2 } } }
rs.reconfig(cfg)
```

To use this mode pass the string `use2` to the `w` option of `getLastError` (page 720) as follows:

```
db.runCommand({ getLastError: 1, w: "use2" })
```

## Specific Custom Write Concerns

If you have a three member replica with the following tag sets:

```
{ "disk": "ssd" }
{ "disk": "san" }
{ "disk": "spinning" }
```

You cannot specify a custom `getLastErrorModes` (page 483) value to ensure that the write propagates to the `san` before returning. However, you may implement this write concern policy by creating the following additional tags, so that the set resembles the following:

```
{ "disk": "ssd" }
{ "disk": "san", "disk.san": "san" }
{ "disk": "spinning" }
```

Then, create a custom `getLastErrorModes` (page 483) value, as follows:

```
cfg = rs.conf()
cfg.settings = { getLastErrorModes: { san: { "disk.san": 1 } } }
rs.reconfig(cfg)
```

To use this mode pass the string `san` to the `w` option of `getLastError` (page 720) as follows:

```
db.runCommand({ getLastError: 1, w: "san" })
```

This operation will not return until a replica set member with the tag `disk.san` returns.

You may set a custom write concern mode as the default write concern mode using `getLastErrorDefaults` (page 483) replica set as in the following setting:

```
cfg = rs.conf()
cfg.settings.getLastErrorDefaults = { ssd: 1 }
rs.reconfig(cfg)
```

## See also:

[Configure Replica Set Tag Sets](#) (page 451) for further information about replica set reconfiguration and tag sets.

## Read Preference

Read preference describes how MongoDB clients route read operations to members of a *replica set*.

By default, an application directs its read operations to the `primary` member in a *replica set*. Reading from the primary guarantees that read operations reflect the latest version of a document. However, by distributing some or all reads to secondary members of the replica set, you can improve read throughput or reduce latency for an application that does not require fully up-to-date data.

---

**Important:** You must exercise care when specifying read preferences: modes other than `primary` (page 489) can

*and will* return stale data because the secondary queries will not include the most recent write operations to the replica set's [primary](#).

The following are common use cases for using non-[primary](#) (page 489) read preference modes:

- Running systems operations that do not affect the front-end application.

Issuing reads to secondaries helps distribute load and prevent operations from affecting the main workload of the primary. This can be a good choice for reporting and analytics workloads, for example.

**Note:** Read preferences aren't relevant to direct connections to a single [mongod](#) (page 925) instance. However, in order to perform read operations on a direct connection to a secondary member of a replica set, you must set a read preference, such as [secondary](#).

- Providing local reads for geographically distributed applications.

If you have application servers in multiple data centers, you may consider having a [geographically distributed replica set](#) (page 396) and using a non primary read preference or the [nearest](#) (page 490). This reduces network latency by having the application server to read from a nearby secondary, rather than a distant primary.

- Maintaining availability during a failover.

Use [primaryPreferred](#) (page 489) if you want your application to do consistent reads from the primary under normal circumstances, but to allow stale reads from secondaries in an emergency. This provides a "read-only mode" for your application during a failover.

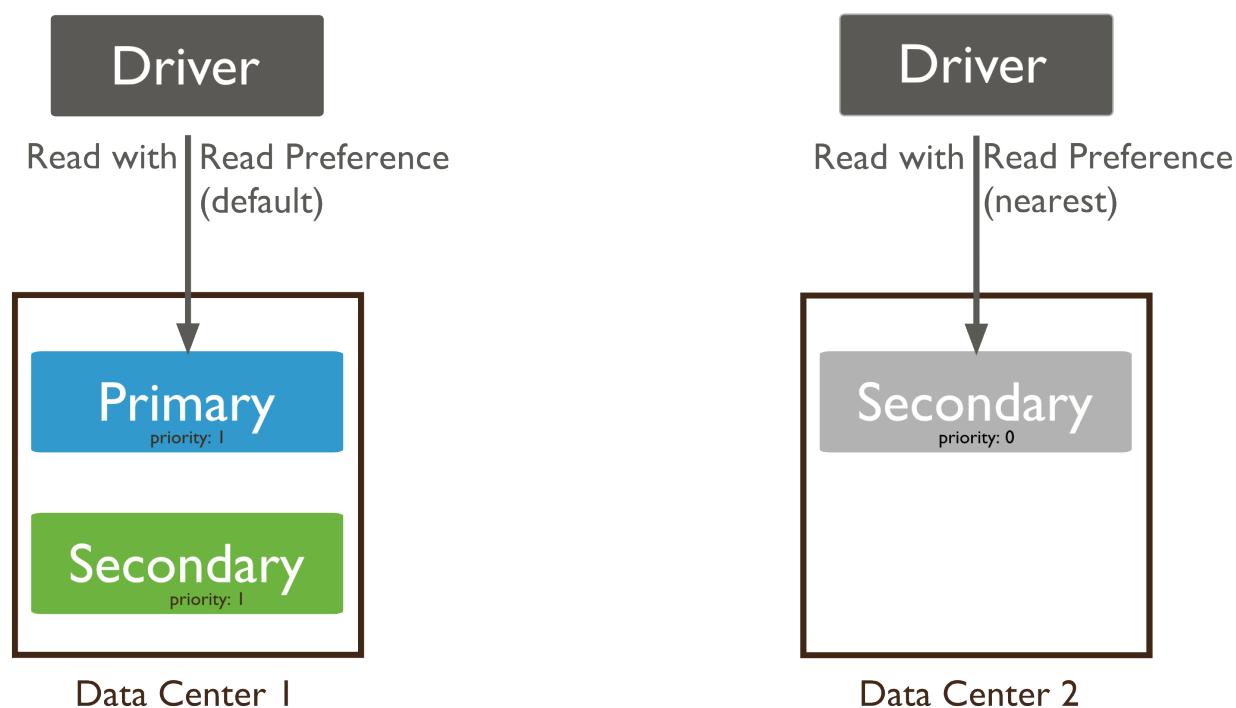


Figure 8.24: Read operations to a replica set. Default read preference routes the read to the primary. Read preference of nearest routes the read to the nearest member.

**Note:** In general, do not use [primary](#) (page 489) and [primaryPreferred](#) (page 489) to provide extra capacity. [Sharding](#) (page 493) increases read and write capacity by distributing read and write operations across a group of machines, and is often a better strategy for adding capacity.

---

**See**

[Read Preference Processes](#) (page 408) for more information about the internal application of read preferences.

---

**Read Preference Modes**

New in version 2.2.

**Important:** All read preference modes except [primary](#) (page 489) may return stale data because [secondaries](#) replicate operations from the primary with some delay. Ensure that your application can tolerate stale data if you choose to use a non-[primary](#) (page 489) mode.

---

MongoDB [drivers](#) (page 95) support five read preference modes.

| Read Preference Mode                          | Description                                                                                                                                                                              |
|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <a href="#">primary</a> (page 489)            | Default mode. All operations read from the current replica set <a href="#">primary</a> .                                                                                                 |
| <a href="#">primaryPreferred</a> (page 489)   | In most situations, operations read from the <a href="#">primary</a> but if it is unavailable, operations read from <a href="#">secondary</a> members.                                   |
| <a href="#">secondary</a> (page 489)          | All operations read from the <a href="#">secondary</a> members of the replica set.                                                                                                       |
| <a href="#">secondaryPreferred</a> (page 489) | In most situations, operations read from <a href="#">secondary</a> members but if no <a href="#">secondary</a> members are available, operations read from the <a href="#">primary</a> . |
| <a href="#">nearest</a> (page 490)            | Operations read from the <a href="#">nearest</a> member of the <a href="#">replica set</a> , irrespective of the member's type.                                                          |

You can specify a read preference mode on connection objects, database objects, collection objects, or per-operation. The syntax for specifying the read preference mode is [specific to the driver](#) and to the idioms of the host language<sup>6</sup>.

Read preference modes are also available to clients connecting to a [sharded cluster](#) through a [mongos](#) (page 938). The [mongos](#) (page 938) instance obeys specified read preferences when connecting to the [replica set](#) that provides each [shard](#) in the cluster.

In the [mongo](#) (page 942) shell, the [readPref\(\)](#) (page 871) cursor method provides access to read preferences.

If read operations account for a large percentage of your application's traffic, distributing reads to secondary members can improve read throughput. However, in most cases [sharding](#) (page 498) provides better support for larger scale operations, as clusters can distribute read and write operations across a group of machines.

For more information, see [read preference background](#) (page 405) and [read preference behavior](#) (page 408). See also the documentation for your driver<sup>7</sup>.

**Tag Sets**

Tag sets allow you to specify custom [read preferences](#) (page 405) and [write concerns](#) (page 55) so that your application can target operations to specific members.

Custom read preferences and write concerns evaluate tag sets in different ways: read preferences consider the value of a tag when selecting a member to read from, while write concerns ignore the value of a tag when selecting a member *except* to consider whether or not the value is unique.

You can specify tag sets with the following read preference modes:

<sup>6</sup><http://api.mongodb.org/>

<sup>7</sup><http://api.mongodb.org/>

- [primaryPreferred](#) (page 489)
- [secondary](#) (page 489)
- [secondaryPreferred](#) (page 489)
- [nearest](#) (page 490)

Tags are not compatible with [primary](#) (page 489) and, in general, only apply when [selecting](#) (page 408) a [secondary](#) member of a set for a read operation. However, the [nearest](#) (page 490) read mode, when combined with a tag set will select the nearest member that matches the specified tag set, which may be a primary or secondary.

All interfaces use the same [member selection logic](#) (page 408) to choose the member to which to direct read operations, basing the choice on read preference mode and tag sets.

For information on configuring tag sets, see the [Configure Replica Set Tag Sets](#) (page 451) tutorial.

For more information on how read preference [modes](#) (page 489) interact with tag sets, see the [documentation for each read preference mode](#) (page 488).

## Read Preference Processes

Changed in version 2.2.

MongoDB drivers use the following procedures to direct operations to replica sets and sharded clusters. To determine how to route their operations, applications periodically update their view of the replica set's state, identifying which members are up or down, which member is [primary](#), and verifying the latency to each [mongod](#) (page 925) instance.

### Member Selection

Clients, by way of their drivers, and [mongos](#) (page 938) instances for sharded clusters, periodically update their view of the replica set's state.

When you select non-[primary](#) (page 489) read preference, the driver will determine which member to target using the following process:

1. Assembles a list of suitable members, taking into account member type (i.e. secondary, primary, or all members).
2. Excludes members not matching the tag sets, if specified.
3. Determines which suitable member is the closest to the client in absolute terms.
4. Builds a list of members that are within a defined ping distance (in milliseconds) of the “absolute nearest” member.

Applications can configure the threshold used in this stage. The default “acceptable latency” is 15 milliseconds, which you can override in the drivers with their own `secondaryAcceptableLatencyMS` option.

For [mongos](#) (page 938) you can use the `--localThreshold` or [localThreshold](#) (page 1002) runtime options to set this value.

5. Selects a member from these hosts at random. The member receives the read operation.

Drivers can then associate the thread or connection with the selected member. This [request association](#) (page 409) is configurable by the application. See your [driver](#) (page 95) documentation about request association configuration and default behavior.

## Request Association

**Important:** *Request association* is configurable by the application. See your [driver](#) (page 95) documentation about request association configuration and default behavior.

Because [secondary](#) members of a [replica set](#) may lag behind the current [primary](#) by different amounts, reads for [secondary](#) members may reflect data at different points in time. To prevent sequential reads from jumping around in time, the driver **can** associate application threads to a specific member of the set after the first read, thereby preventing reads from other members. The thread will continue to read from the same member until:

- The application performs a read with a different read preference,
- The thread terminates, or
- The client receives a socket exception, as is the case when there's a network error or when the [mongod](#) (page 925) closes connections during a [failover](#). This triggers a [retry](#) (page 409), which may be transparent to the application.

When using request association, if the client detects that the set has elected a new [primary](#), the driver will discard all associations between threads and members.

## Auto-Retry

Connections between MongoDB drivers and [mongod](#) (page 925) instances in a [replica set](#) must balance two concerns:

1. The client should attempt to prefer current results, and any connection should read from the same member of the replica set as much as possible.
2. The client should minimize the amount of time that the database is inaccessible as the result of a connection issue, networking problem, or [failover](#) in a replica set.

As a result, MongoDB drivers and [mongos](#) (page 938):

- Reuse a connection to specific [mongod](#) (page 925) for as long as possible after establishing a connection to that instance. This connection is *pinned* to this [mongod](#) (page 925).
- Attempt to reconnect to a new member, obeying existing [read preference modes](#) (page 489), if the connection to [mongod](#) (page 925) is lost.

Reconnections are transparent to the application itself. If the connection permits reads from [secondary](#) members, after reconnecting, the application can receive two sequential reads returning from different secondaries. Depending on the state of the individual secondary member's replication, the documents can reflect the state of your database at different moments.

- Return an error *only* after attempting to connect to three members of the set that match the [read preference mode](#) (page 489) and [tag set](#) (page 407). If there are fewer than three members of the set, the client will error after connecting to all existing members of the set.

After this error, the driver selects a new member using the specified read preference mode. In the absence of a specified read preference, the driver uses [primary](#) (page 489).

- After detecting a failover situation,<sup>8</sup> the driver attempts to refresh the state of the replica set as quickly as possible.

<sup>8</sup> When a [failover](#) occurs, all members of the set close all client connections that produce a socket error in the driver. This behavior prevents or minimizes [rollback](#).

## Read Preference in Sharded Clusters

Changed in version 2.2: Before version 2.2, [mongos](#) (page 938) did not support the [read preference mode semantics](#) (page 489).

In most [sharded clusters](#), each shard consists of a [replica set](#). As such, read preferences are also applicable. With regard to read preference, read operations in a sharded cluster are identical to unsharded replica sets.

Unlike simple replica sets, in sharded clusters, all interactions with the shards pass from the clients to the [mongos](#) (page 938) instances that are actually connected to the set members. [mongos](#) (page 938) is then responsible for the application of read preferences, which is transparent to applications.

There are no configuration changes required for full support of read preference modes in sharded environments, as long as the [mongos](#) (page 938) is at least version 2.2. All [mongos](#) (page 938) maintain their own connection pool to the replica set members. As a result:

- A request without a specified preference has [primary](#) (page 489), the default, unless, the [mongos](#) (page 938) reuses an existing connection that has a different mode set.

To prevent confusion, always explicitly set your read preference mode.

- All [nearest](#) (page 490) and latency calculations reflect the connection between the [mongos](#) (page 938) and the [mongod](#) (page 925) instances, not the client and the [mongod](#) (page 925) instances.

This produces the desired result, because all results must pass through the [mongos](#) (page 938) before returning to the client.

## 8.2.5 Replication Processes

Members of a [replica set](#) replicate data continuously. First, a member uses *initial sync* to capture the data set. Then the member continuously records and applies every operation that modifies the data set. Every member records operations in its [oplog](#) (page 410), which is a [capped collection](#).

**Replica Set Oplog (page 410)** The oplog records all operations that modify the data in the replica set.

**Replica Set Data Synchronization (page 412)** Secondaries must replicate all changes accepted by the primary. This process is the basis of replica set operations.

### Replica Set Oplog

The [oplog](#) (operations log) is a special [capped collection](#) that keeps a rolling record of all operations that modify the data stored in your databases. MongoDB applies database operations on the [primary](#) and then records the operations on the primary's oplog. The [secondary](#) members then copy and apply these operations in an asynchronous process. All replica set members contain a copy of the oplog, allowing them to maintain the current state of the database.

To facilitate replication, all replica set members send heartbeats (pings) to all other members. Any member can import oplog entries from any other member.

Whether applied once or multiple times to the target dataset, each operation in the oplog produces the same results, i.e. each operation in the oplog is [idempotent](#). For proper replication operations, entries in the oplog must be idempotent:

- initial sync
- post-rollback catch-up
- sharding chunk migrations

## Oplog Size

When you start a replica set member for the first time, MongoDB creates an oplog of a default size. The size depends on the architectural details of your operating system.

In most cases, the default oplog size is sufficient. For example, if an oplog is 5% of free disk space and fills up in 24 hours of operations, then secondaries can stop copying entries from the oplog for up to 24 hours without becoming stale. However, most replica sets have much lower operation volumes, and their oplogs can hold much higher numbers of operations.

Before `mongod` (page 925) creates an oplog, you can specify its size with the `oplogSize` (page 1000) option. However, after you have started a replica set member for the first time, you can only change the size of the oplog using the *Change the Size of the Oplog* (page 446) procedure.

By default, the size of the oplog is as follows:

- For 64-bit Linux, Solaris, FreeBSD, and Windows systems, MongoDB allocates 5% of the available free disk space to the oplog. If this amount is smaller than a gigabyte, then MongoDB allocates 1 gigabyte of space.
- For 64-bit OS X systems, MongoDB allocates 183 megabytes of space to the oplog.
- For 32-bit systems, MongoDB allocates about 48 megabytes of space to the oplog.

## Workloads that Might Require a Larger Oplog Size

If you can predict your replica set’s workload to resemble one of the following patterns, then you might want to create an oplog that is larger than the default. Conversely, if your application predominantly performs reads and writes only a small amount of data, you will oplog may be sufficient.

The following workloads might require a larger oplog size.

**Updates to Multiple Documents at Once** The oplog must translate multi-updates into individual operations in order to maintain *idempotency*. This can use a great deal of oplog space without a corresponding increase in data size or disk use.

**Deletions Equal the Same Amount of Data as Inserts** If you delete roughly the same amount of data as you insert, the database will not grow significantly in disk use, but the size of the operation log can be quite large.

**Significant Number of In-Place Updates** If a significant portion of the workload is in-place updates, the database records a large number of operations but does not change the quantity of data on disk.

## Oplog Status

To view oplog status, including the size and the time range of operations, issue the `db.printReplicationInfo()` (page 891) method. For more information on oplog status, see *Check the Size of the Oplog* (page 465).

Under various exceptional situations, updates to a `secondary`’s oplog might lag behind the desired performance time. Use `db.getReplicationInfo()` (page 887) from a secondary member and the *replication status* (page 887) output to assess the current state of replication and determine if there is any unintended replication delay.

See *Replication Lag* (page 463) for more information.

## Replica Set Data Synchronization

In order to maintain up-to-date copies of the shared data set, members of a replica set *sync* or replicate data from other members. MongoDB uses two forms of data synchronization: [initial sync](#) (page 412) to populate new members with the full data set, and replication to apply ongoing changes to the entire data set.

### Initial Sync

Initial sync copies all the data from one member of the replica set to another member. A member uses initial sync when the member has no data, such as when the member is new, or when the member has data but is missing a history of the set's replication.

When you perform an initial sync, MongoDB does the following:

1. Clones all databases. To clone, the [mongod](#) (page 925) queries every collection in each source database and inserts all data into its own copies of these collections.
2. Applies all changes to the data set. Using the oplog from the source, the [mongod](#) (page 925) updates its data set to reflect the current state of the replica set.
3. Builds all indexes on all collections.

When the [mongod](#) (page 925) finishes building all index builds, the member can transition to a normal state, i.e. *secondary*.

To perform an initial sync, see [Resync a Member of a Replica Set](#) (page 450).

### Replication

Replica set members replicate data continuously after the initial sync. This process keeps the members up to date with all changes to the replica set's data. In most cases, secondaries synchronize from the primary. Secondaries may automatically change their *sync targets* if needed based on changes in the ping time and state of other members' replication.

For a member to sync from another, the [buildIndexes](#) (page 481) setting for both members must have the same value/ [buildIndexes](#) (page 481) must be either `true` or `false` for both members.

Beginning in version 2.2, secondaries avoid syncing from [delayed members](#) (page 387) and [hidden members](#) (page 387).

### Consistency and Durability

In a replica set, only the primary can accept write operations. Writing only to the primary provides *strict consistency* among members.

[Journaling](#) provides single-instance write durability. Without journaling, if a MongoDB instance terminates ungracefully, you should assume that the database is in a corrupt or inconsistent state.

### Multithreaded Replication

MongoDB applies write operations in batches using multiple threads to improve concurrency. MongoDB groups batches by namespace and applies operations using a group of threads, but always applies the write operations to a namespace in order.

While applying a batch, MongoDB blocks all reads. As a result, secondaries can never return data that reflects a state that never existed on the primary.

#### Pre-Fetching Indexes to Improve Replication Throughput

To help improve the performance of applying oplog entries, MongoDB fetches memory pages that hold affected data and indexes. This *pre-fetch* stage minimizes the amount of time MongoDB holds the write lock while applying oplog entries. By default, secondaries will pre-fetch all [Indexes](#) (page 313).

Optionally, you can disable all pre-fetching or only pre-fetch the index on the `_id` field. See the [replIndexPrefetch](#) (page 1000) setting for more information.

### 8.2.6 Master Slave Replication

---

**Important:** [Replica sets](#) (page 381) replace [master-slave](#) replication for most use cases. If possible, use replica sets rather than master-slave replication for all new production deployments. This documentation remains to support legacy deployments and for archival purposes only.

---

In addition to providing all the functionality of master-slave deployments, replica sets are also more robust for production use. Master-slave replication preceded replica sets and made it possible have a large number of non-master (i.e. slave) nodes, as well as to restrict replicated operations to only a single database; however, master-slave replication provides less redundancy and does not automate failover. See [Deploy Master-Slave Equivalent using Replica Sets](#) (page 415) for a replica set configuration that is equivalent to master-slave replication. If you wish to convert an existing master-slave deployment to a replica set, see [Convert a Master-Slave Deployment to a Replica Set](#) (page 416).

#### Fundamental Operations

##### Initial Deployment

To configure a [master-slave](#) deployment, start two [mongod](#) (page 925) instances: one in [master](#) (page 1000) mode, and the other in [slave](#) (page 1001) mode.

To start a [mongod](#) (page 925) instance in [master](#) (page 1000) mode, invoke [mongod](#) (page 925) as follows:

```
mongod --master --dbpath /data/masterdb/
```

With the `--master` option, the [mongod](#) (page 925) will create a [local.oplog.\\$main](#) (page 486) collection, which the “operation log” that queues operations that the slaves will apply to replicate operations from the master. The `--dbpath` is optional.

To start a [mongod](#) (page 925) instance in [slave](#) (page 1001) mode, invoke [mongod](#) (page 925) as follows:

```
mongod --slave --source <masterhostname><:<port>> --dbpath /data/slavedb/
```

Specify the hostname and port of the master instance to the `--source` argument. The `--dbpath` is optional.

For [slave](#) (page 1001) instances, MongoDB stores data about the source server in the [local.sources](#) (page 486) collection.

#### Configuration Options for Master-Slave Deployments

As an alternative to specifying the `--source` run-time option, can add a document to [local.sources](#) (page 486) specifying the [master](#) (page 1000) instance, as in the following operation in the [mongo](#) (page 942) shell:

```
1 use local
2 db.sources.find()
3 db.sources.insert({ host: <masterhostname> <,only: databasename> });
```

In line 1, you switch context to the `local` database. In line 2, the `find()` (page 816) operation should return no documents, to ensure that there are no documents in the `sources` collection. Finally, line 3 uses `db.collection.insert()` (page 832) to insert the source document into the `local.sources` (page 486) collection. The model of the `local.sources` (page 486) document is as follows:

### host

The host field specifies the `master` (page 1000)`mongod` (page 925) instance, and holds a resolvable hostname, i.e. IP address, or a name from a host file, or preferably a fully qualified domain name.

You can append `<:port>` to the host name if the `mongod` (page 925) is not running on the default 27017 port.

### only

Optional. Specify a name of a database. When specified, MongoDB will only replicate the indicated database.

## Operational Considerations for Replication with Master Slave Deployments

Master instances store operations in an *oplog* which is a *capped collection* (page 156). As a result, if a slave falls too far behind the state of the master, it cannot “catchup” and must re-sync from scratch. Slave may become out of sync with a master if:

- The slave falls far behind the data updates available from that master.
- The slave stops (i.e. shuts down) and restarts later after the master has overwritten the relevant operations from the master.

When slaves, are out of sync, replication stops. Administrators must intervene manually to restart replication. Use the `resync` (page 731) command. Alternatively, the `--autoresync` allows a slave to restart replication automatically, after ten second pause, when the slave falls out of sync with the master. With `--autoresync` specified, the slave will only attempt to re-sync once in a ten minute period.

To prevent these situations you should specify a larger oplog when you start the `master` (page 1000) instance, by adding the `--oplogSize` option when starting `mongod` (page 925). If you do not specify `--oplogSize`, `mongod` (page 925) will allocate 5% of available disk space on start up to the oplog, with a minimum of 1GB for 64bit machines and 50MB for 32bit machines.

## Run time Master-Slave Configuration

MongoDB provides a number of run time configuration options for `mongod` (page 925) instances in *master-slave* deployments. You can specify these options in *configuration files* (page 145) or on the command-line. See documentation of the following:

- For *master* nodes:
  - `master` (page 1000)
  - `slave` (page 1001)
- For *slave* nodes:
  - `source` (page 1001)
  - `only` (page 1001)
  - `slaveDelay` (page 1001)

---

Also consider the [Master-Slave Replication Command Line Options](#) (page 934) for related options.

## Diagnostics

On a *master* instance, issue the following operation in the [mongo](#) (page 942) shell to return replication status from the perspective of the master:

```
db.printReplicationInfo()
```

On a *slave* instance, use the following operation in the [mongo](#) (page 942) shell to return the replication status from the perspective of the slave:

```
db.printSlaveReplicationInfo()
```

Use the [serverStatus](#) (page 782) as in the following operation, to return status of the replication:

```
db.serverStatus()
```

See [server status repl fields](#) (page 790) for documentation of the relevant section of output.

## Security

When running with [auth](#) (page 993) enabled, in *master-slave* deployments configure a [keyFile](#) (page 993) so that slave [mongod](#) (page 925) instances can authenticate and communicate with the master [mongod](#) (page 925) instance.

To enable authentication and configure the [keyFile](#) (page 993) add the following option to your configuration file:

```
keyFile = /srv/mongodb/keyfile
```

---

**Note:** You may chose to set these run-time configuration options using the `--keyFile` option on the command line.

Setting [keyFile](#) (page 993) enables authentication and specifies a key file for the [mongod](#) (page 925) instances to use when authenticating to each other. The content of the key file is arbitrary but must be the same on all members of the deployment can connect to each other.

The key file must be less one kilobyte in size and may only contain characters in the base64 set. The key file must not have group or “world” permissions on UNIX systems. Use the following command to use the OpenSSL package to generate “random” content for use in a key file:

```
openssl rand -base64 741
```

### See also:

[Security](#) (page 235) for more information about security in MongoDB

## Ongoing Administration and Operation of Master-Slave Deployments

### Deploy Master-Slave Equivalent using Replica Sets

If you want a replication configuration that resembles *master-slave* replication, using *replica sets* replica sets, consider the following replica configuration document. In this deployment hosts <master> and <slave><sup>9</sup> provide replication that is roughly equivalent to a two-instance master-slave deployment:

---

<sup>9</sup> In replica set configurations, the [host](#) (page 480) field must hold a resolvable hostname.

```
{
 _id : 'setName',
 members : [
 { _id : 0, host : "<master>", priority : 1 },
 { _id : 1, host : "<slave>", priority : 0, votes : 0 }
]
}
```

See [Replica Set Configuration](#) (page 479) for more information about replica set configurations.

## Convert a Master-Slave Deployment to a Replica Set

To convert a master-slave deployment to a replica set, restart the current master as a one-member replica set. Then remove the data directors from previous secondaries and add them as new secondaries to the new replica set.

1. To confirm that the current instance is master, run:

```
db.isMaster()
```

This should return a document that resembles the following:

```
{
 "ismaster" : true,
 "maxBsonObjectSize" : 16777216,
 "maxMessageSizeBytes" : 48000000,
 "localTime" : ISODate("2013-07-08T20:15:13.664Z"),
 "ok" : 1
}
```

2. Shut down the `mongod` (page 925) processes on the master and all slave(s), using the following command while connected to each instance:

```
db.adminCommand({shutdown : 1, force : true})
```

3. Back up your /data/db directories, in case you need to revert to the master-slave deployment.

4. Start the former master with the `--replSet` option, as in the following:

```
mongod --replSet <setname>
```

5. Connect to the `mongod` (page 925) with the `mongo` (page 942) shell, and initiate the replica set with the following command:

```
rs.initiate()
```

When the command returns, you will have successfully deployed a one-member replica set. You can check the status of your replica set at any time by running the following command:

```
rs.status()
```

You can now follow the [convert a standalone to a replica set](#) (page 432) tutorial to deploy your replica set, picking up from the [Expand the Replica Set](#) (page 433) section.

## Failing over to a Slave (Promotion)

To permanently failover from a unavailable or damaged `master` (A in the following example) to a `slave` (B):

1. Shut down A.

2. Stop `mongod` (page 925) on B.
3. Back up and move all data files that begin with `local` on B from the `dbpath` (page 993).

**Warning:** Removing `local.*` is irrevocable and cannot be undone. Perform this step with extreme caution.

4. Restart `mongod` (page 925) on B with the `--master` option.

**Note:** This is a one time operation, and is not reversible. A cannot become a slave of B until it completes a full resync.

## Inverting Master and Slave

If you have a *master* (A) and a *slave* (B) and you would like to reverse their roles, follow this procedure. The procedure assumes A is healthy, up-to-date and available.

If A is not healthy but the hardware is okay (power outage, server crash, etc.), skip steps 1 and 2 and in step 8 replace all of A's files with B's files in step 8.

If A is not healthy and the hardware is not okay, replace A with a new machine. Also follow the instructions in the previous paragraph.

To invert the master and slave in a deployment:

1. Halt writes on A using the `fsync` command.
2. Make sure B is up to date with the state of A.
3. Shut down B.
4. Back up and move all data files that begin with `local` on B from the `dbpath` (page 993) to remove the existing `local.sources` data.

**Warning:** Removing `local.*` is irrevocable and cannot be undone. Perform this step with extreme caution.

5. Start B with the `--master` option.
  6. Do a write on B, which primes the `oplog` to provide a new sync start point.
  7. Shut down B. B will now have a new set of data files that start with `local`.
  8. Shut down A and replace all files in the `dbpath` (page 993) of A that start with `local` with a copy of the files in the `dbpath` (page 993) of B that begin with `local`.
- Considering compressing the `local` files from B while you copy them, as they may be quite large.
9. Start B with the `--master` option.
  10. Start A with all the usual slave options, but include `fastsync`.

## Creating a Slave from an Existing Master's Disk Image

If you can stop write operations to the *master* for an indefinite period, you can copy the data files from the master to the new *slave* and then start the slave with `--fastsync`.

**Warning:** Be careful with `--fastsync`. If the data on both instances is identical, a discrepancy will exist forever.

`fastsync` (page 1000) is a way to start a slave by starting with an existing master disk image/backup. This option declares that the administrator guarantees the image is correct and completely up-to-date with that of the master. If you have a full and complete copy of data from a master you can use this option to avoid a full synchronization upon starting the slave.

### Creating a Slave from an Existing Slave's Disk Image

You can just copy the other *slave's* data file snapshot without any special options. Only take data snapshots when a `mongod` (page 925) process is down or locked using `db.fsyncLock()` (page 885).

### Resyncing a Slave that is too Stale to Recover

*Slaves* asynchronously apply write operations from the *master* that the slaves poll from the master's *oplog*. The oplog is finite in length, and if a slave is too far behind, a full resync will be necessary. To resync the slave, connect to a slave using the `mongo` (page 942) and issue the `resync` (page 731) command:

```
use admin
db.runCommand({ resync: 1 })
```

This forces a full resync of all data (which will be very slow on a large database). You can achieve the same effect by stopping `mongod` (page 925) on the slave, deleting the entire content of the `dbpath` (page 993) on the slave, and restarting the `mongod` (page 925).

### Slave Chaining

*Slaves* cannot be “chained.” They must all connect to the *master* directly.

If a slave attempts “slave from” another slave you will see the following line in the `mongod` (page 925) log of the shell:

```
assertion 13051 tailable cursor requested on non capped collection ns:local.oplog.$main
```

### Correcting a Slave's Source

To change a *slave's* source, manually modify the slave's `local.sources` (page 486) collection.

---

#### Example

Consider the following: If you accidentally set an incorrect hostname for the slave's `source` (page 1001), as in the following example:

```
mongod --slave --source prod.mississippi
```

You can correct this, by restarting the slave without the `--slave` and `--source` arguments:

```
mongod
```

Connect to this `mongod` (page 925) instance using the `mongo` (page 942) shell and update the `local.sources` (page 486) collection, with the following operation sequence:

```
use local
```

```
db.sources.update({ host : "prod.mississippi" },
 { $set : { host : "prod.mississippi.example.net" } })
```

Restart the slave with the correct command line arguments or with no `--source` option. After configuring `local.sources` (page 486) the first time, the `--source` will have no subsequent effect. Therefore, both of the following invocations are correct:

```
mongod --slave --source prod.mississippi.example.net
```

or

```
mongod --slave
```

The slave now polls data from the correct *master*.

---

## 8.3 Replica Set Tutorials

The administration of *replica sets* includes the initial deployment of the set, adding and removing members to a set, and configuring the operational parameters and properties of the set. Administrators generally need not intervene in failover or replication processes as MongoDB automates these functions. In the exceptional situations that require manual interventions, the tutorials in these sections describe processes such as resyncing a member. The tutorials in this section form the basis for all replica set administration.

**[Replica Set Deployment Tutorials \(page 420\)](#)** Instructions for deploying replica sets, as well as adding and removing members from an existing replica set.

**[Deploy a Replica Set \(page 420\)](#)** Configure a three-member replica set for either a production system.

**[Convert a Standalone to a Replica Set \(page 432\)](#)** Convert an existing standalone `mongod` instance into a three-member replica set.

**[Add Members to a Replica Set \(page 433\)](#)** Add a new member to an existing replica set.

**[Remove Members from Replica Set \(page 436\)](#)** Remove a member from a replica set.

**[Member Configuration Tutorials \(page 438\)](#)** Tutorials that describe the process for configuring replica set members.

**[Adjust Priority for Replica Set Member \(page 438\)](#)** Change the precedence given to a replica set members in an election for primary.

**[Prevent Secondary from Becoming Primary \(page 439\)](#)** Make a secondary member ineligible for election as primary.

**[Configure a Hidden Replica Set Member \(page 440\)](#)** Configure a secondary member to be invisible to applications in order to support significantly different usage, such as a dedicated backups.

**[Replica Set Maintenance Tutorials \(page 445\)](#)** Procedures and tasks for common operations on active replica set deployments.

**[Change the Size of the Oplog \(page 446\)](#)** Increase the size of the *oplog* which logs operations. In most cases, the default oplog size is sufficient.

**[Resync a Member of a Replica Set \(page 450\)](#)** Sync the data on a member. Either perform initial sync on a new member or resync the data on an existing member that has fallen too far behind to catch up by way of normal replication.

**[Change the Size of the Oplog \(page 446\)](#)** Increase the size of the *oplog* which logs operations. In most cases, the default oplog size is sufficient.

**[Force a Member to Become Primary \(page 448\)](#)** Force a replica set member to become primary.

**[Change Hostnames in a Replica Set \(page 458\)](#)** Update the replica set configuration to reflect changes in members' hostnames.

**Troubleshoot Replica Sets (page 462)** Describes common issues and operational challenges for replica sets. For additional diagnostic information, see *FAQ: MongoDB Diagnostics* (page 616).

### 8.3.1 Replica Set Deployment Tutorials

The following tutorials provide information in deploying replica sets.

**Deploy a Replica Set (page 420)** Configure a three-member replica set for either a production system.

**Deploy a Replica Set for Testing and Development (page 423)** Configure a three-member replica set for either a development and testing systems.

**Deploy a Geographically Distributed Replica Set (page 425)** Create a geographically distributed replica set to protect against location-centered availability limitations (e.g. network and power interruptions).

**Add an Arbiter to Replica Set (page 432)** Add an arbiter give a replica set an odd number of voting members to prevent election ties.

**Convert a Standalone to a Replica Set (page 432)** Convert an existing standalone `mongod` instance into a three-member replica set.

**Add Members to a Replica Set (page 433)** Add a new member to an existing replica set.

**Remove Members from Replica Set (page 436)** Remove a member from a replica set.

**Replace a Replica Set Member (page 437)** Update the replica set configuration when the hostname of a member's corresponding `mongod` instance has changed.

## Deploy a Replica Set

This tutorial describes how to create a three-member *replica set* from three existing `mongod` (page 925) instances.

If you wish to deploy a replica set from a single MongoDB instance, see *Convert a Standalone to a Replica Set* (page 432). For more information on replica set deployments, see the *Replication* (page 377) and *Replica Set Deployment Architectures* (page 390) documentation.

### Overview

Three member *replica sets* provide enough redundancy to survive most network partitions and other system failures. These sets also have sufficient capacity for many distributed read operations. Replica sets should always have an odd number of members. This ensures that *elections* (page 397) will proceed smoothly. For more about designing replica sets, see *the Replication overview* (page 377).

The basic procedure is to start the `mongod` (page 925) instances that will become members of the replica set, configure the replica set itself, and then add the `mongod` (page 925) instances to it.

### Requirements

For production deployments, you should maintain as much separation between members as possible by hosting the `mongod` (page 925) instances on separate machines. When using virtual machines for production deployments, you should place each `mongod` (page 925) instance on a separate host server serviced by redundant power circuits and redundant network paths.

Before you can deploy a replica set, you must install MongoDB on each system that will be part of your *replica set*. If you have not already installed MongoDB, see the *installation tutorials* (page 3).

Before creating your replica set, you should verify that your network configuration allows all possible connections between each member. For a successful replica set deployment, every member must be able to connect to every other member. For instructions on how to check your connection, see [Test Connections Between all Members](#) (page 464).

## Procedure

- Each member of the replica set resides on its own machine and all of the MongoDB processes bind to port 27017 (the standard MongoDB port).
- Each member of the replica set must be accessible by way of resolvable DNS or hostnames, as in the following scheme:
  - `mongodb0.example.net`
  - `mongodb1.example.net`
  - `mongodb2.example.net`
  - `mongodbn.example.net`

You will need to *either* configure your DNS names appropriately, *or* set up your systems' `/etc/hosts` file to reflect this configuration.

- Ensure that network traffic can pass between all members in the network securely and efficiently. Consider the following:
  - Establish a virtual private network. Ensure that your network topology routes all traffic between members within a single site over the local area network.
  - Configure authentication using `auth` (page 993) and `keyFile` (page 993), so that only servers and processes with authentication can connect to the replica set.
  - Configure networking and firewall rules so that only traffic (incoming and outgoing packets) on the default MongoDB port (e.g. 27017) from *within* your deployment is permitted.

For more information on security and firewalls, see [Inter-Process Authentication](#) (page 238).

- You must specify the run time configuration on each system in a `configuration file` (page 990) stored in `/etc/mongodb.conf` or a related location. *Do not* specify the set's configuration in the `mongo` (page 942) shell.

Use the following configuration for each of your MongoDB instances. You should set values that are appropriate for your systems, as needed:

```
port = 27017
bind_ip = 10.8.0.10
dbpath = /srv/mongodb/
fork = true
replSet = rs0
```

The `dbpath` (page 993) indicates where you want `mongod` (page 925) to store data files. The `dbpath` (page 993) must exist before you start `mongod` (page 925). If it does not exist, create the directory and ensure `mongod` (page 925) has permission to read and write data to this path. For more information on permissions, see the [security operations documentation](#) (page 236).

Modifying `bind_ip` (page 991) ensures that `mongod` (page 925) will only listen for connections from applications on the configured address.

For more information about the run time options used above and other configuration options, see [Configuration File Options](#) (page 990).

**To deploy a production replica set:**

1. Start a [mongod](#) (page 925) instance on each system that will be part of your replica set. Specify the same replica set name on each instance. For additional [mongod](#) (page 925) configuration options specific to replica sets, see [Replication Options](#) (page 933).

---

**Important:** If your application connects to more than one replica set, each set should have a distinct name. Some drivers group replica set connections by replica set name.

---

If you use a configuration file, then start each [mongod](#) (page 925) instance with a command similar to following, where `mongodb.conf` is the configuration file:

```
mongod --config /etc/mongodb.conf
```

---

**Note:** You will likely want to use and configure a [control script](#) to manage this process in production deployments. Control scripts are beyond the scope of this document.

---

2. Open a [mongo](#) (page 942) shell connected to one of the hosts by issuing the following command:

```
mongo
```

3. Use [rs.initiate\(\)](#) (page 897) to initiate a replica set consisting of the current member and using the default configuration, as follows:

```
rs.initiate()
```

4. Display the current [replica configuration](#) (page 479):

```
rs.conf()
```

The replica set configuration object resembles the following

```
{
 "_id" : "rs0",
 "version" : 4,
 "members" : [
 {
 "_id" : 1,
 "host" : "mongodb0.example.net:27017"
 }
]
}
```

1. In the [mongo](#) (page 942) shell connected to the [primary](#), add the remaining members to the replica set using [rs.add\(\)](#) (page 895) in the [mongo](#) (page 942) shell on the current primary (in this example, `mongodb0.example.net`). The commands should resemble the following:

```
rs.add("mongodb1.example.net")
rs.add("mongodb2.example.net")
```

When complete, you should have a fully functional replica set. The new replica set will elect a [primary](#).

Check the status of your replica set at any time with the [rs.status\(\)](#) (page 898) operation.

**See also:**

The documentation of the following shell functions for more information:

- `rs.initiate()` (page 897)
- `rs.conf()` (page 896)
- `rs.reconfig()` (page 897)
- `rs.add()` (page 895)

Refer to [Replica Set Read and Write Semantics](#) (page 402) for a detailed explanation of read and write semantics in MongoDB.

## Deploy a Replica Set for Testing and Development

---

**Note:** This tutorial provides instructions for deploying a replica set in a development or test environment. For a production deployment, refer to the [Deploy a Replica Set](#) (page 420) tutorial.

---

This tutorial describes how to create a three-member [replica set](#) from three existing [mongod](#) (page 925) instances.

If you wish to deploy a replica set from a single MongoDB instance, see [Convert a Standalone to a Replica Set](#) (page 432). For more information on replica set deployments, see the [Replication](#) (page 377) and [Replica Set Deployment Architectures](#) (page 390) documentation.

### Overview

Three member [replica sets](#) provide enough redundancy to survive most network partitions and other system failures. These sets also have sufficient capacity for many distributed read operations. Replica sets should always have an odd number of members. This ensures that [elections](#) (page 397) will proceed smoothly. For more about designing replica sets, see [the Replication overview](#) (page 377).

The basic procedure is to start the [mongod](#) (page 925) instances that will become members of the replica set, configure the replica set itself, and then add the [mongod](#) (page 925) instances to it.

### Requirements

For test and development systems, you can run your [mongod](#) (page 925) instances on a local system, or within a virtual instance.

Before you can deploy a replica set, you must install MongoDB on each system that will be part of your [replica set](#). If you have not already installed MongoDB, see the [installation tutorials](#) (page 3).

Before creating your replica set, you should verify that your network configuration allows all possible connections between each member. For a successful replica set deployment, every member must be able to connect to every other member. For instructions on how to check your connection, see [Test Connections Between all Members](#) (page 464).

### Procedure

---

**Important:** These instructions should only be used for test or development deployments.

---

The examples in this procedure create a new replica set named `rs0`.

---

**Important:** If your application connects to more than one replica set, each set should have a distinct name. Some drivers group replica set connections by replica set name.

---

You will begin by starting three [mongod](#) (page 925) instances as members of a replica set named `rs0`.

1. Create the necessary data directories for each member by issuing a command similar to the following:

```
mkdir -p /srv/mongodb/rs0-0 /srv/mongodb/rs0-1 /srv/mongodb/rs0-2
```

This will create directories called “`rs0-0`”, “`rs0-1`”, and “`rs0-2`”, which will contain the instances’ database files.

2. Start your [mongod](#) (page 925) instances in their own shell windows by issuing the following commands:

First member:

```
mongod --port 27017 --dbpath /srv/mongodb/rs0-0 --replSet rs0 --smallfiles --oplogSize 128
```

Second member:

```
mongod --port 27018 --dbpath /srv/mongodb/rs0-1 --replSet rs0 --smallfiles --oplogSize 128
```

Third member:

```
mongod --port 27019 --dbpath /srv/mongodb/rs0-2 --replSet rs0 --smallfiles --oplogSize 128
```

This starts each instance as a member of a replica set named `rs0`, each running on a distinct port, and specifies the path to your data directory with the `--dbpath` setting. If you are already using the suggested ports, select different ports.

The `--smallfiles` and `--oplogSize` settings reduce the disk space that each [mongod](#) (page 925) instance uses. This is ideal for testing and development deployments as it prevents overloading your machine. For more information on these and other configuration options, see [Configuration File Options](#) (page 990).

3. Connect to one of your [mongod](#) (page 925) instances through the [mongo](#) (page 942) shell. You will need to indicate which instance by specifying its port number. For the sake of simplicity and clarity, you may want to choose the first one, as in the following command;

```
mongo --port 27017
```

4. In the [mongo](#) (page 942) shell, use `rs.initiate()` (page 897) to initiate the replica set. You can create a replica set configuration object in the [mongo](#) (page 942) shell environment, as in the following example:

```
rsconf = {
 _id: "rs0",
 members: [
 {
 _id: 0,
 host: "<hostname>:27017"
 }
]
}
```

replacing `<hostname>` with your system’s hostname, and then pass the `rsconf` file to `rs.initiate()` (page 897) as follows:

```
rs.initiate(rsconf)
```

5. Display the current [replica configuration](#) (page 479) by issuing the following command:

```
rs.conf()
```

The replica set configuration object resembles the following

```
{
 "_id" : "rs0",
```

```

 "version" : 4,
 "members" : [
 {
 "_id" : 1,
 "host" : "localhost:27017"
 }
]
}

```

- In the [mongo](#) (page 942) shell connected to the *primary*, add the second and third [mongod](#) (page 925) instances to the replica set using the [rs.add\(\)](#) (page 895) method. Replace <hostname> with your system's hostname in the following examples:

```

rs.add("<hostname>:27018")
rs.add("<hostname>:27019")

```

When complete, you should have a fully functional replica set. The new replica set will elect a *primary*.

Check the status of your replica set at any time with the [rs.status\(\)](#) (page 898) operation.

#### See also:

The documentation of the following shell functions for more information:

- [rs.initiate\(\)](#) (page 897)
- [rs.conf\(\)](#) (page 896)
- [rs.reconfig\(\)](#) (page 897)
- [rs.add\(\)](#) (page 895)

You may also consider the [simple setup script](#)<sup>10</sup> as an example of a basic automatically-configured replica set.

Refer to [Replica Set Read and Write Semantics](#) (page 402) for a detailed explanation of read and write semantics in MongoDB.

## Deploy a Geographically Distributed Replica Set

This tutorial outlines the process for deploying a *replica set* with members in multiple locations. The tutorial addresses three-member sets, four-member sets, and sets with more than four members.

For appropriate background, see [Replication](#) (page 377) and [Replica Set Deployment Architectures](#) (page 390). For related tutorials, see [Deploy a Replica Set](#) (page 420) and [Add Members to a Replica Set](#) (page 433).

### Overview

While *replica sets* provide basic protection against single-instance failure, replica sets whose members are all located in a single facility are susceptible to errors in that facility. Power outages, network interruptions, and natural disasters are all issues that can affect replica sets whose members are colocated. To protect against these classes of failures, deploy a replica set with one or more members in a geographically distinct facility or data center.

### Requirements

In general, the requirements for any geographically distributed replica set are as follows:

---

<sup>10</sup><https://github.com/mongodb/mongo-snippets/blob/master/replication/simple-setup.py>

- Ensure that a majority of the *voting members* (page 400) are within a primary facility, “Site A”. This includes *priority 0 members* (page 386) and *arbiters* (page 389). Other members can be distributed in secondary facilities, “Site B”, “Site C”, etc. For more information on the need to keep the voting majority on one site, see *Replica Set Elections* (page 397).
- If you deploy a replica set with an even number of members, deploy an *arbiter* (page 389) on Site A. The arbiter must be on site A to keep the majority there.

For instance, for a three-member replica set you need two instances in a Site A, and one member in a secondary facility, Site B. Site A should be the same facility or very close to your primary application infrastructure (i.e. application servers, caching layer, users, etc.)

A four-member replica set should have at least two members in Site A, with the remaining members in one or more secondary sites, as well as a single *arbiter* in Site A.

For all configurations in this tutorial, deploy each replica set member on a separate system. Although you may deploy more than one replica set member on a single system, doing so reduces the redundancy and capacity of the replica set. Such deployments are typically for testing purposes and beyond the scope of this tutorial.

This tutorial assumes you have installed MongoDB on each system that will be part of your replica set. If you have not already installed MongoDB, see the *installation tutorials* (page 3).

## Procedures

### General Considerations

- Each member of the replica set resides on its own machine and all of the MongoDB processes bind to port 27017 (the standard MongoDB port).
- Each member of the replica set must be accessible by way of resolvable DNS or hostnames, as in the following scheme:
  - `mongodb0.example.net`
  - `mongodb1.example.net`
  - `mongodb2.example.net`
  - `mongodbn.example.net`

You will need to *either* configure your DNS names appropriately, *or* set up your systems’ `/etc/hosts` file to reflect this configuration.

- Ensure that network traffic can pass between all members in the network securely and efficiently. Consider the following:
  - Establish a virtual private network. Ensure that your network topology routes all traffic between members within a single site over the local area network.
  - Configure authentication using `auth` (page 993) and `keyFile` (page 993), so that only servers and processes with authentication can connect to the replica set.
  - Configure networking and firewall rules so that only traffic (incoming and outgoing packets) on the default MongoDB port (e.g. 27017) from *within* your deployment is permitted.

For more information on security and firewalls, see *Inter-Process Authentication* (page 238).

- You must specify the run time configuration on each system in a *configuration file* (page 990) stored in `/etc/mongodb.conf` or a related location. *Do not* specify the set’s configuration in the `mongo` (page 942) shell.

Use the following configuration for each of your MongoDB instances. You should set values that are appropriate for your systems, as needed:

```

port = 27017
bind_ip = 10.8.0.10
dbpath = /srv/mongodb/
fork = true
replSet = rs0

```

The `dbpath` (page 993) indicates where you want `mongod` (page 925) to store data files. The `dbpath` (page 993) must exist before you start `mongod` (page 925). If it does not exist, create the directory and ensure `mongod` (page 925) has permission to read and write data to this path. For more information on permissions, see the *security operations documentation* (page 236).

Modifying `bind_ip` (page 991) ensures that `mongod` (page 925) will only listen for connections from applications on the configured address.

For more information about the run time options used above and other configuration options, see *Configuration File Options* (page 990).

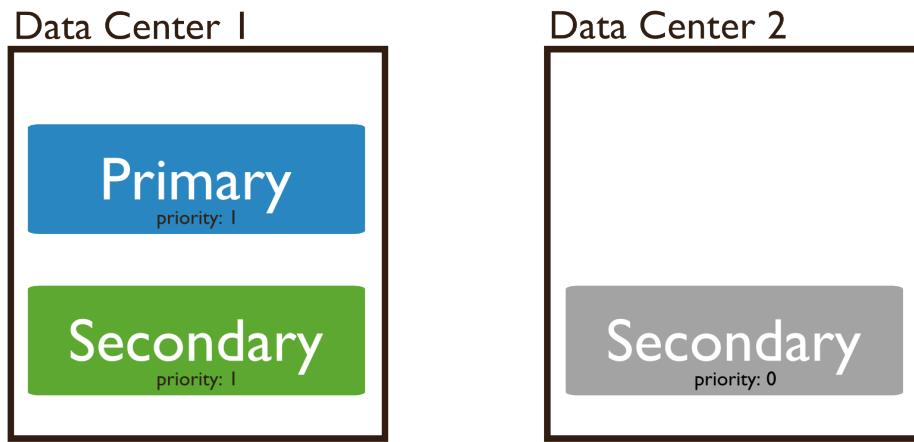


Figure 8.25: Diagram of a 3 member replica set distributed across two data centers. Replica set includes a priority 0 member.

### Deploy a Distributed Three-Member Replica Set

- Start a `mongod` (page 925) instance on each system that will be part of your replica set. Specify the same replica set name on each instance. For additional `mongod` (page 925) configuration options specific to replica sets, see *Replication Options* (page 933).

---

**Important:** If your application connects to more than one replica set, each set should have a distinct name. Some drivers group replica set connections by replica set name.

---

If you use a configuration file, then start each `mongod` (page 925) instance with a command similar to following, where `mongodb.conf` is the configuration file:

```
mongod --config /etc/mongodb.conf
```

---

**Note:** You will likely want to use and configure a *control script* to manage this process in production deploy-

ments. Control scripts are beyond the scope of this document.

---

2. Open a `mongo` (page 942) shell connected to one of the hosts by issuing the following command:

```
mongo
```

3. Use `rs.initiate()` (page 897) to initiate a replica set consisting of the current member and using the default configuration, as follows:

```
rs.initiate()
```

4. Display the current *replica configuration* (page 479):

```
rs.conf()
```

The replica set configuration object resembles the following

```
{
 "_id" : "rs0",
 "version" : 4,
 "members" : [
 {
 "_id" : 1,
 "host" : "mongodb0.example.net:27017"
 }
]
}
```

1. In the `mongo` (page 942) shell connected to the *primary*, add the remaining members to the replica set using `rs.add()` (page 895) in the `mongo` (page 942) shell on the current primary (in this example, `mongodb0.example.net`). The commands should resemble the following:

```
rs.add("mongodb1.example.net")
rs.add("mongodb2.example.net")
```

When complete, you should have a fully functional replica set. The new replica set will elect a *primary*.

6. Make sure that you have configured the member located in Site B (in this example, `mongodb2.example.net`) as a *priority 0 member* (page 386):

- (a) Issue the following command to determine the `members` (page 480) array position for the member:

```
rs.conf()
```

- (b) In the `members` (page 480) array, save the position of the member whose priority you wish to change. The example in the next step assumes this value is 2, for the third item in the list. You must record *array position*, not `_id`, as these ordinals will be different if you remove a member.

- (c) In the `mongo` (page 942) shell connected to the replica set's primary, issue a command sequence similar to the following:

```
cfg = rs.conf()
cfg.members[2].priority = 0
rs.reconfig(cfg)
```

When the operations return, `mongodb2.example.net` has a priority of 0. It cannot become primary.

---

**Note:** The `rs.reconfig()` (page 897) shell method can force the current primary to step down, causing an election. When the primary steps down, all clients will disconnect. This is the intended behavior. While most elections complete within a minute, always make sure any replica configuration changes occur during scheduled maintenance periods.

---

After these commands return, you have a geographically distributed three-member replica set.

Check the status of your replica set at any time with the `rs.status()` (page 898) operation.

**See also:**

The documentation of the following shell functions for more information:

- `rs.initiate()` (page 897)
- `rs.conf()` (page 896)
- `rs.reconfig()` (page 897)
- `rs.add()` (page 895)

Refer to *Replica Set Read and Write Semantics* (page 402) for a detailed explanation of read and write semantics in MongoDB.

**Deploy a Distributed Four-Member Replica Set** A geographically distributed four-member deployment has two additional considerations:

- One host (e.g. `mongodb3.example.net`) must be an *arbiter*. This host can run on a system that is also used for an application server or on the same machine as another MongoDB process.
- You must decide how to distribute your systems. There are three possible architectures for the four-member replica set:
  - Three members in Site A, one *priority 0 member* (page 386) in Site B, and an arbiter in Site A.
  - Two members in Site A, two *priority 0 members* (page 386) in Site B, and an arbiter in Site A.
  - Two members in Site A, one priority 0 member in Site B, one priority 0 member in Site C, and an arbiter in site A.

In most cases, the first architecture is preferable because it is the least complex.

**To deploy a geographically distributed four-member set:**

1. Start a `mongod` (page 925) instance on each system that will be part of your replica set. Specify the same replica set name on each instance. For additional `mongod` (page 925) configuration options specific to replica sets, see *Replication Options* (page 933).

---

**Important:** If your application connects to more than one replica set, each set should have a distinct name. Some drivers group replica set connections by replica set name.

If you use a configuration file, then start each `mongod` (page 925) instance with a command similar to following, where `mongodb.conf` is the configuration file:

```
mongod --config /etc/mongodb.conf
```

---

**Note:** You will likely want to use and configure a *control script* to manage this process in production deployments. Control scripts are beyond the scope of this document.

2. Open a `mongo` (page 942) shell connected to one of the hosts by issuing the following command:

```
mongo
```

3. Use `rs.initiate()` (page 897) to initiate a replica set consisting of the current member and using the default configuration, as follows:

```
rs.initiate()
```

4. Display the current *replica configuration* (page 479):

```
rs.conf()
```

The replica set configuration object resembles the following

```
{
 "_id" : "rs0",
 "version" : 4,
 "members" : [
 {
 "_id" : 1,
 "host" : "mongodb0.example.net:27017"
 }
]
}
```

5. Add the remaining members to the replica set using `rs.add()` (page 895) in a `mongo` (page 942) shell connected to the current primary. The commands should resemble the following:

```
rs.add("mongodb1.example.net")
rs.add("mongodb2.example.net")
rs.add("mongodb3.example.net")
```

When complete, you should have a fully functional replica set. The new replica set will elect a *primary*.

6. In the same shell session, issue the following command to add the arbiter (e.g. `mongodb4.example.net`):

```
rs.addArb("mongodb4.example.net")
```

7. Make sure that you have configured each member located outside of Site A (e.g. `mongodb3.example.net`) as a *priority 0 member* (page 386):

- (a) Issue the following command to determine the `members` (page 480) array position for the member:

```
rs.conf()
```

- (b) In the `members` (page 480) array, save the position of the member whose priority you wish to change. The example in the next step assumes this value is 2, for the third item in the list. You must record *array position*, not `_id`, as these ordinals will be different if you remove a member.

- (c) In the `mongo` (page 942) shell connected to the replica set's primary, issue a command sequence similar to the following:

```
cfg = rs.conf()
cfg.members[2].priority = 0
rs.reconfig(cfg)
```

When the operations return, `mongodb2.example.net` has a priority of 0. It cannot become primary.

---

**Note:** The `rs.reconfig()` (page 897) shell method can force the current primary to step down, causing an election. When the primary steps down, all clients will disconnect. This is the intended behavior. While most elections complete within a minute, always make sure any replica configuration changes occur during scheduled maintenance periods.

---

After these commands return, you have a geographically distributed four-member replica set.

Check the status of your replica set at any time with the `rs.status()` (page 898) operation.

#### See also:

The documentation of the following shell functions for more information:

- `rs.initiate()` (page 897)
- `rs.conf()` (page 896)
- `rs.reconfig()` (page 897)
- `rs.add()` (page 895)

Refer to [Replica Set Read and Write Semantics](#) (page 402) for a detailed explanation of read and write semantics in MongoDB.

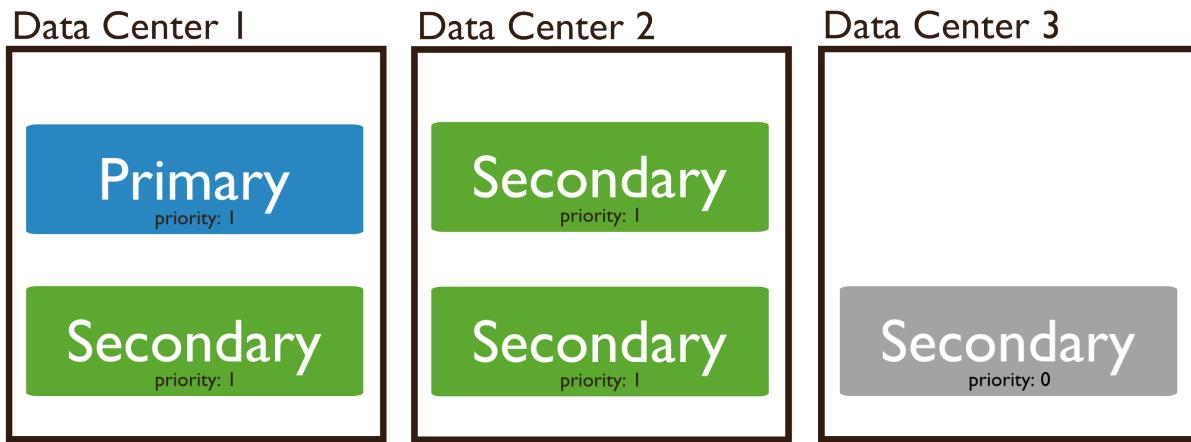


Figure 8.26: Diagram of a 5 member replica set distributed across three data centers. Replica set includes a priority 0 member.

**Deploy a Distributed Set with More than Four Members** The above procedures detail the steps necessary for deploying a geographically distributed replica set. Larger replica set deployments follow the same steps, but have additional considerations:

- Never deploy more than seven voting members.
- If you have an even number of members, use [the procedure for a four-member set](#) (page 429)). Ensure that the a single facility, “Site A”, always has a majority of the members by deploying the `arbiter` in that site. For example, if a set has six members, deploy at least three voting members in addition to the arbiter in Site A, and the remaining members in alternate sites.
- If you have an odd number of members, use [the procedure for a three-member set](#) (page 427). Ensure that a single facility, “Site A” always has a majority of the members of the set. For example, if a set has five members, deploy three members within Site A and two members in other facilities.
- If you have a majority of the members of the set *outside* of Site A and the network partitions to prevent communication between sites, the current primary in Site A will step down, even if none of the members outside of Site A are eligible to become primary.ß

## Add an Arbiter to Replica Set

Arbiters are [mongod](#) (page 925) instances that are part of [replica set](#) but do not hold data. Arbiters participate in [elections](#) (page 397) in order to break ties. If a replica set has an even number of members, add an arbiter.

Arbiters have minimal resource requirements and do not require dedicated hardware. You can deploy an arbiter on an application server, monitoring host.

---

**Important:** Do not run an arbiter on the same system as a member of the replica set.

---

### Add an Arbiter

1. Create a data directory (e.g. [dbpath](#) (page 993)) for the arbiter. The [mongod](#) (page 925) instance uses the directory for configuration data. The directory *will not* hold the data set. For example, create the /data/arb directory:

```
mkdir /data/arb
```

2. Start the arbiter. Specify the data directory and the replica set name. The following, starts an arbiter using the /data/arb [dbpath](#) (page 993) for the rs replica set:

```
mongod --port 30000 --dbpath /data/arb --replSet rs
```

3. Connect to the primary and add the arbiter to the replica set. Use the [rs.addArb\(\)](#) (page 896) method, as in the following example:

```
rs.addArb("m1.example.net:30000")
```

This operation adds the arbiter running on port 30000 on the m1.example.net host.

## Convert a Standalone to a Replica Set

- [Procedure](#) (page 432)
  - [Expand the Replica Set](#) (page 433)
  - [Sharding Considerations](#) (page 433)

This tutorial describes the process for converting a [standalone](#) [mongod](#) (page 925) instance into a three-member [replica set](#). Use standalone instances for testing and development, but always use replica sets in production. To install a standalone instance, see the [installation tutorials](#) (page 3).

To deploy a replica set without using a pre-existing [mongod](#) (page 925) instance, see [Deploy a Replica Set](#) (page 420).

### Procedure

1. Shut down the [standalone](#) [mongod](#) (page 925) instance.
2. Restart the instance. Use the [--replSet](#) option to specify the name of the new replica set.

For example, the following command starts a standalone instance as a member of a new replica set named rs0. The command uses the standalone's existing database path of /srv/mongodb/db0:

```
mongod --port 27017 --dbpath /srv/mongodb/db0 --replSet rs0
```

---

**Important:** If your application connects to more than one replica set, each set should have a distinct name. Some drivers group replica set connections by replica set name.

---

For more information on configuration options, see [Configuration File Options](#) (page 990) and the [mongod](#) (page 925) manual page.

3. Connect to the [mongod](#) (page 925) instance.
4. Use `rs.initiate()` (page 897) to initiate the new replica set:

```
rs.initiate()
```

The replica set is now operational.

To view the replica set configuration, use `rs.conf()` (page 896). To check the status of the replica set, use `rs.status()` (page 898).

#### Expand the Replica Set

Add additional replica set members by doing the following:

1. On two distinct systems, start two new standalone [mongod](#) (page 925) instances. For information on starting a standalone instance, see the [installation tutorial](#) (page 3) specific to your environment.
2. On your connection to the original [mongod](#) (page 925) instance (the former standalone instance), issue a command in the following form for each new instance to add to the replica set:

```
rs.add("<hostname><:port>")
```

Replace `<hostname>` and `<port>` with the resolvable hostname and port of the [mongod](#) (page 925) instance to add to the set. For more information on adding a host to a replica set, see [Add Members to a Replica Set](#) (page 433).

#### Sharding Considerations

If the new replica set is part of a [sharded cluster](#), change the shard host information in the [config database](#) by doing the following:

1. Connect to one of the sharded cluster's [mongos](#) (page 938) instances and issue a command in the following form:

```
db.getSiblingDB("config").shards.save({_id: "<name>", host: "<replica-set>/<member,><member,><>"})
```

Replace `<name>` with the name of the shard. Replace `<replica-set>` with the name of the replica set. Replace `<member,><member,><>` with the list of the members of the replica set.

2. Restart all [mongos](#) (page 938) instances. If possible, restart all components of the replica sets (i.e., all [mongos](#) (page 938) and all shard [mongod](#) (page 925) instances).

## Add Members to a Replica Set

### Overview

This tutorial explains how to add an additional member to an existing [replica set](#). For background on replication deployment patterns, see the [Replica Set Deployment Architectures](#) (page 390) document.

**Maximum Voting Members** A replica set can have a maximum of seven [voting members](#) (page 397). To add a member to a replica set that already has seven votes, you must either add the member as a [non-voting member](#) (page 400) or remove a vote from an [existing member](#) (page 482).

**Control Scripts** In production deployments you can configure a *control script* to manage member processes.

**Existing Members** You can use these procedures to add new members to an existing set. You can also use the same procedure to “re-add” a removed member. If the removed member’s data is still relatively recent, it can recover and catch up easily.

**Data Files** If you have a backup or snapshot of an existing member, you can move the data files (e.g. the `dbpath` (page 993) directory) to a new system and use them to quickly initiate a new member. The files must be:

- A consistent copy of the database from a member of the same replica set. See *Backup and Restore with Filesystem Snapshots* (page 184) document for more information.

---

**Important:** Always use filesystem snapshots to create a copy a member of the existing replica set. **Do not** use `mongodump` (page 951) and `mongorestore` (page 956) to seed a new replica set member.

---

- More recent than the oldest operation in the *primary’s oplog*. The new member must be able to become current by applying operations from the primary’s oplog.

## Requirements

1. An active replica set.
2. A new MongoDB system capable of supporting your data set, accessible by the active replica set through the network.

Otherwise, use the MongoDB *installation tutorial* (page 3) and the *Deploy a Replica Set* (page 420) tutorials.

## Procedures

**Prepare the Data Directory** Before adding a new member to an existing *replica set*, prepare the new member’s *data directory* using one of the following strategies:

- Make sure the new member’s data directory *does not* contain data. The new member will copy the data from an existing member.

If the new member is in a *recovering* state, it must exit and become a *secondary* before MongoDB can copy all data as part of the replication process. This process takes time but does not require administrator intervention.

- Manually copy the data directory from an existing member. The new member becomes a secondary member and will catch up to the current state of the replica set. Copying the data over may shorten the amount of time for the new member to become current.

Ensure that you can copy the data directory to the new member and begin replication within the *window allowed by the oplog* (page 411). Otherwise, the new instance will have to perform an initial sync, which completely resynchronizes the data, as described in *Resync a Member of a Replica Set* (page 450).

Use `db.printReplicationInfo()` (page 891) to check the current state of replica set members with regards to the oplog.

For background on replication deployment patterns, see the *Replica Set Deployment Architectures* (page 390) document.

## Add a Member to an Existing Replica Set

- Start the new `mongod` (page 925) instance. Specify the data directory and the replica set name. The following example specifies the `/srv/mongodb/db0` data directory and the `rs0` replica set:

```
mongod --dbpath /srv/mongodb/db0 --replSet rs0
```

Take note of the host name and port information for the new `mongod` (page 925) instance.

For more information on configuration options, see the `mongod` (page 925) manual page.

---

### Optional

You can specify the data directory and replica set in the `mongo.conf` *configuration file* (page 990), and start the `mongod` (page 925) with the following command:

```
mongod --config /etc/mongodb.conf
```

---

- Connect to the replica set's primary.

You can only add members while connected to the primary. If you do not know which member is the primary, log into any member of the replica set and issue the `db.isMaster()` (page 890) command.

- Use `rs.add()` (page 895) to add the new member to the replica set. For example, to add a member at host `mongodb3.example.net`, issue the following command:

```
rs.add("mongodb3.example.net")
```

You can include the port number, depending on your setup:

```
rs.add("mongodb3.example.net:27017")
```

- Verify that the member is now part of the replica set. Call the `rs.conf()` (page 896) method, which displays the *replica set configuration* (page 479):

```
rs.conf()
```

To view replica set status, issue the `rs.status()` (page 898) method. For a description of the status fields, see `replicaSetGetStatus` (page 726).

**Configure and Add a Member** You can add a member to a replica set by passing to the `rs.add()` (page 895) method a `members` (page 480) document. The document must be in the form of a `local.system.replset.members` (page 480) document. These documents define a replica set member in the same form as the *replica set configuration document* (page 480).

---

**Important:** Specify a value for the `_id` field of the `members` (page 480) document. MongoDB does not automatically populate the `_id` field in this case. Finally, the `members` (page 480) document must declare the `host` value. All other fields are optional.

---

### Example

To add a member with the following configuration:

- an `_id` of 1.
- a `hostname` and `port number` (page 480) of `mongodb3.example.net:27017`.
- a `priority` (page 481) value within the replica set of 0.
- a configuration as `hidden` (page 481),

Issue the following:

```
rs.add({_id: 1, host: "mongodb3.example.net:27017", priority: 0, hidden: true})
```

---

### Remove Members from Replica Set

To remove a member of a *replica set* use either of the following procedures.

#### Remove a Member Using `rs.remove()`

1. Shut down the `mongod` (page 925) instance for the member you wish to remove. To shut down the instance, connect using the `mongo` (page 942) shell and the `db.shutdownServer()` (page 894) method.
2. Connect to the replica set's current *primary*. To determine the current primary, use `db.isMaster()` (page 890) while connected to any member of the replica set.
3. Use `rs.remove()` (page 898) in either of the following forms to remove the member:

```
rs.remove("mongodb3.example.net:27017")
rs.remove("mongodb3.example.net")
```

MongoDB disconnects the shell briefly as the replica set elects a new primary. The shell then automatically reconnects. The shell displays a `DBCClientCursor::init call()` failed error even though the command succeeds.

#### Remove a Member Using `rs.reconfig()`

To remove a member you can manually edit the *replica set configuration document* (page 479), as described here.

1. Shut down the `mongod` (page 925) instance for the member you wish to remove. To shut down the instance, connect using the `mongo` (page 942) shell and the `db.shutdownServer()` (page 894) method.
2. Connect to the replica set's current *primary*. To determine the current primary, use `db.isMaster()` (page 890) while connected to any member of the replica set.
3. Issue the `rs.conf()` (page 896) method to view the current configuration document and determine the position in the `members` array of the member to remove:

---

#### Example

`mongod_C.example.net` is in position 2 of the following configuration file:

```
{
 "_id" : "rs",
 "version" : 7,
 "members" : [
 {
 "_id" : 0,
 "host" : "mongodb_A.example.net:27017"
 },
 {
 "_id" : 1,
 "host" : "mongodb_B.example.net:27017"
 },
 {
 "_id" : 2,
```

```

 "host" : "mongod_C.example.net:27017"
 }
]
}

```

---

4. Assign the current configuration document to the variable `cfg`:

```
cfg = rs.conf()
```

5. Modify the `cfg` object to remove the member.

#### Example

To remove `mongod_C.example.net:27017` use the following JavaScript operation:

```
cfg.members.splice(2, 1)
```

6. Overwrite the replica set configuration document with the new configuration by issuing the following:

```
rs.reconfig(cfg)
```

As a result of `rs.reconfig()` (page 897) the shell will disconnect while the replica set renegotiates which member is primary. The shell displays a `DBClientCursor::init call()` failed error even though the command succeeds, and will automatically reconnected.

7. To confirm the new configuration, issue `rs.conf()` (page 896).

For the example above the output would be:

```

{
 "_id" : "rs",
 "version" : 8,
 "members" : [
 {
 "_id" : 0,
 "host" : "mongod_A.example.net:27017"
 },
 {
 "_id" : 1,
 "host" : "mongod_B.example.net:27017"
 }
]
}

```

## Replace a Replica Set Member

If you need to change the hostname of a replica set member without changing the configuration of that member or the set, you can use the operation outlined in this tutorial. For example if you must re-provision systems or rename hosts, you can use this pattern to minimize the scope of that change.

### Operation

To change the hostname for a replica set member modify the `host` (page 480) field. The value of `_id` (page 480) field will not change when you reconfigure the set.

See *Replica Set Configuration* (page 479) and `rs.reconfig()` (page 897) for more information.

---

**Note:** Any replica set configuration change can trigger the current *primary* to step down, which forces an *election* (page 397). During the election, the current shell session and clients connected to this replica set disconnect, which produces an error even when the operation succeeds.

---

### Example

To change the hostname to `mongo2.example.net` for the replica set member configured at `members[0]`, issue the following sequence of commands:

```
cfg = rs.conf()
cfg.members[0].host = "mongo2.example.net"
rs.reconfig(cfg)
```

## 8.3.2 Member Configuration Tutorials

The following tutorials provide information in configuring replica set members to support specific operations, such as to provide dedicated backups, to support reporting, or to act as a cold standby.

**[Adjust Priority for Replica Set Member \(page 438\)](#)** Change the precedence given to a replica set members in an election for primary.

**[Prevent Secondary from Becoming Primary \(page 439\)](#)** Make a secondary member ineligible for election as primary.

**[Configure a Hidden Replica Set Member \(page 440\)](#)** Configure a secondary member to be invisible to applications in order to support significantly different usage, such as a dedicated backups.

**[Configure a Delayed Replica Set Member \(page 441\)](#)** Configure a secondary member to keep a delayed copy of the data set in order to provide a rolling backup.

**[Configure Non-Voting Replica Set Member \(page 442\)](#)** Create a secondary member that keeps a copy of the data set but does not vote in an election.

**[Convert a Secondary to an Arbiter \(page 443\)](#)** Convert a secondary to an arbiter.

### Adjust Priority for Replica Set Member

To change the value of the `prioriy` (page 481) in the replica set configuration, use the following sequence of commands in the `mongo` (page 942) shell:

```
cfg = rs.conf()
cfg.members[0].priority = 0.5
cfg.members[1].priority = 2
cfg.members[2].priority = 2
rs.reconfig(cfg)
```

The first operation uses `rs.conf()` (page 896) to set the local variable `cfg` to the contents of the current replica set configuration, which is a *document*. The next three operations change the `priortiy` (page 481) value in the `cfg` document for the first three members configured in the `members` (page 480) array. The final operation calls `rs.reconfig()` (page 897) with the argument of `cfg` to initialize the new configuration.

When updating the replica configuration object, access the replica set members in the `members` (page 480) array with the **array index**. The array index begins with 0. Do **not** confuse this index value with the value of the `_id` (page 480) field in each document in the `members` (page 480) array.

If a member has [priority](#) (page 481) set to 0, it is ineligible to become [primary](#) and will not seek election. [Hidden members](#) (page 387), [delayed members](#) (page 387), and [arbiters](#) (page ??) all have [priority](#) (page 481) set to 0.

All members have a [priority](#) (page 481) equal to 1 by default.

The value of [priority](#) (page 481) can be any floating point (i.e. decimal) number between 0 and 1000. Priorities are only used to determine the preference in election. The priority value is used only in relation to other members. With the exception of members with a priority of 0, the absolute value of the [priority](#) (page 481) value is irrelevant.

Replica sets will preferentially elect and maintain the primary status of the member with the highest [priority](#) (page 481) setting.

**Warning:** Replica set reconfiguration can force the current primary to step down, leading to an election for primary in the replica set. Elections cause the current primary to close all open [client](#) connections. Perform routine replica set reconfiguration during scheduled maintenance windows.

#### See also:

The [Replica Reconfiguration Usage](#) (page 483) example revolves around changing the priorities of the [members](#) (page 480) of a replica set.

### Prevent Secondary from Becoming Primary

To prevent a [secondary](#) member from ever becoming a [primary](#) in a [failover](#), assign the secondary a priority of 0, as described here. You can set this “secondary-only mode” for any member of the [replica set](#), except the current primary. For a detailed description of secondary-only members and their purposes, see [Priority 0 Replica Set Members](#) (page 386).

To configure a member as secondary-only, set its [priority](#) (page 481) value to 0 in the [members](#) (page 480) document in its replica set configuration. Any member with a [priority](#) (page 481) equal to 0 will never seek [election](#) (page 397) and cannot become primary in any situation.

```
{
 "_id" : <num>,
 "host" : <hostname:port>,
 "priority" : 0
}
```

MongoDB does not permit the current [primary](#) to have a priority of 0. To prevent the current primary from again becoming a primary, you must first step down the current primary using [rs.stepDown\(\)](#) (page 899), and then you must [reconfigure the replica set](#) (page 483) with [rs.conf\(\)](#) (page 896) and [rs.reconfig\(\)](#) (page 897).

#### Example

As an example of modifying member priorities, assume a four-member replica set. Use the following sequence of operations to modify member priorities in the [mongo](#) (page 942) shell connected to the primary. Identify each member by its array index in the [members](#) (page 480) array:

```
cfg = rs.conf()
cfg.members[0].priority = 2
cfg.members[1].priority = 1
cfg.members[2].priority = 0.5
cfg.members[3].priority = 0
rs.reconfig(cfg)
```

The sequence of operations reconfigures the set with the following priority settings:

- Member at 0 has a priority of 2 so that it becomes primary under most circumstances.
- Member at 1 has a priority of 1, which is the default value. Member 1 becomes primary if no member with a *higher* priority is eligible.
- Member at 2 has a priority of 0.5, which makes it less likely to become primary than other members but doesn't prohibit the possibility.
- Member at 3 has a priority of 0. Member at 3 **cannot** become the *primary* member under any circumstances.

When updating the replica configuration object, access the replica set members in the `members` (page 480) array with the **array index**. The array index begins with 0. Do **not** confuse this index value with the value of the `_id` (page 480) field in each document in the `members` (page 480) array.

**Warning:**

- The `rs.reconfig()` (page 897) shell method can force the current primary to step down, which causes an *election* (page 397). When the primary steps down, the `mongod` (page 925) closes all client connections. While this typically takes 10-20 seconds, try to make these changes during scheduled maintenance periods.
- To successfully reconfigure a replica set, a majority of the members must be accessible. If your replica set has an even number of members, add an *arbiter* (page 432) to ensure that members can quickly obtain a majority of votes in an election for primary.

## Related Documents

- [priority](#) (page 481)
- [Adjust Priority for Replica Set Member](#) (page 438)
- [Replica Set Reconfiguration](#) (page 483)
- [Replica Set Elections](#) (page 397)

## Configure a Hidden Replica Set Member

Hidden members are part of a *replica set* but cannot become *primary* and are invisible to client applications. Hidden members do, however, vote in *elections* (page 397). For a detailed description of hidden members and their purposes, see [Hidden Replica Set Members](#) (page 387).

If the `chainingAllowed` (page 482) setting allows secondary members to sync from other secondaries, MongoDB by default prefers non-hidden members over hidden members when selecting a sync target. MongoDB will only choose hidden members as a last resort. If you want a secondary to sync from a hidden member, use the `replSetSyncFrom` (page 730) database command to override the default sync target. See the documentation for `replSetSyncFrom` (page 730) before using the command.

**See also:**

[Manage Chained Replication](#) (page 457)

To configure a secondary member as hidden, set its `priority` (page 481) value to 0 and set its `hidden` (page 481) value to `true` in its member configuration:

```
{
 "_id" : <num>
 "host" : <hostname:port>,
 "priority" : 0,
 "hidden" : true
}
```

## Example

The following example hides the secondary member currently at the index 0 in the `members` (page 480) array. To configure a *hidden member*, use the following sequence of operations in a `mongo` (page 942) shell connected to the primary, specifying the member to configure by its array index in the `members` (page 480) array:

```
cfg = rs.conf()
cfg.members[0].priority = 0
cfg.members[0].hidden = true
rs.reconfig(cfg)
```

After re-configuring the set, this secondary member has a priority of 0 so that it cannot become primary and is hidden. The other members in the set will not advertise the hidden member in the `isMaster` (page 732) or `db.isMaster()` (page 890) output.

When updating the replica configuration object, access the replica set members in the `members` (page 480) array with the **array index**. The array index begins with 0. Do **not** confuse this index value with the value of the `_id` (page 480) field in each document in the `members` (page 480) array.

### Warning:

- The `rs.reconfig()` (page 897) shell method can force the current primary to step down, which causes an *election* (page 397). When the primary steps down, the `mongod` (page 925) closes all client connections. While this typically takes 10-20 seconds, try to make these changes during scheduled maintenance periods.
- To successfully reconfigure a replica set, a majority of the members must be accessible. If your replica set has an even number of members, add an *arbiter* (page 432) to ensure that members can quickly obtain a majority of votes in an election for primary.

Changed in version 2.0: For *sharded clusters* running with replica sets before 2.0, if you reconfigured a member as hidden, you *had* to restart `mongos` (page 938) to prevent queries from reaching the hidden member.

## Related Documents

- *Replica Set Reconfiguration* (page 483)
- *Replica Set Elections* (page 397)
- *Read Preference* (page 405)

## Configure a Delayed Replica Set Member

To configure a delayed secondary member, set its `priority` (page 481) value to 0, its `hidden` (page 481) value to `true`, and its `slaveDelay` (page 482) value to the number of seconds to delay.

**Important:** The length of the secondary `slaveDelay` (page 482) must fit within the window of the oplog. If the oplog is shorter than the `slaveDelay` (page 482) window, the delayed member cannot successfully replicate operations.

When you configure a delayed member, the delay applies both to replication and to the member's *oplog*. For details on delayed members and their uses, see *Delayed Replica Set Members* (page 387).

## Example

The following example sets a 1-hour delay on a secondary member currently at the index 0 in the `members` (page 480) array. To set the delay, issue the following sequence of operations in a `mongo` (page 942) shell connected to the primary:

```
cfg = rs.conf()
cfg.members[0].priority = 0
cfg.members[0].hidden = true
cfg.members[0].slaveDelay = 3600
rs.reconfig(cfg)
```

After the replica set reconfigures, the delayed secondary member cannot become `primary` and is hidden from applications. The `slaveDelay` (page 482) value delays both replication and the member's `oplog` by 3600 seconds (1 hour).

When updating the replica configuration object, access the replica set members in the `members` (page 480) array with the **array index**. The array index begins with 0. Do **not** confuse this index value with the value of the `_id` (page 480) field in each document in the `members` (page 480) array.

### Warning:

- The `rs.reconfig()` (page 897) shell method can force the current primary to step down, which causes an `election` (page 397). When the primary steps down, the `mongod` (page 925) closes all client connections. While this typically takes 10-20 seconds, try to make these changes during scheduled maintenance periods.
- To successfully reconfigure a replica set, a majority of the members must be accessible. If your replica set has an even number of members, add an `arbiter` (page 432) to ensure that members can quickly obtain a majority of votes in an election for primary.

## Related Documents

- `slaveDelay` (page 482)
- *Replica Set Reconfiguration* (page 483)
- *Oplog Size* (page 411)
- *Change the Size of the Oplog* (page 446) tutorial
- *Replica Set Elections* (page 397)

## Configure Non-Voting Replica Set Member

Non-voting members allow you to add additional members for read distribution beyond the maximum seven voting members. To configure a member as non-voting, set its `votes` (page 482) value to 0.

## Example

To disable the ability to vote in elections for the fourth, fifth, and sixth replica set members, use the following command sequence in the `mongo` (page 942) shell connected to the primary. You identify each replica set member by its array index in the `members` (page 480) array:

```
cfg = rs.conf()
cfg.members[3].votes = 0
cfg.members[4].votes = 0
```

```
cfg.members[5].votes = 0
rs.reconfig(cfg)
```

This sequence gives 0 votes to the fourth, fifth, and sixth members of the set according to the order of the `members` (page 480) array in the output of `rs.conf()` (page 896). This setting allows the set to elect these members as *primary* but does not allow them to vote in elections. Place voting members so that your designated primary or primaries can reach a majority of votes in the event of a network partition.

When updating the replica configuration object, access the replica set members in the `members` (page 480) array with the **array index**. The array index begins with 0. Do **not** confuse this index value with the value of the `_id` (page 480) field in each document in the `members` (page 480) array.

#### Warning:

- The `rs.reconfig()` (page 897) shell method can force the current primary to step down, which causes an *election* (page 397). When the primary steps down, the `mongod` (page 925) closes all client connections. While this typically takes 10-20 seconds, try to make these changes during scheduled maintenance periods.
- To successfully reconfigure a replica set, a majority of the members must be accessible. If your replica set has an even number of members, add an *arbiter* (page 432) to ensure that members can quickly obtain a majority of votes in an election for primary.

In general and when possible, all members should have only 1 vote. This prevents intermittent ties, deadlocks, or the wrong members from becoming primary. Use `priority` (page 481) to control which members are more likely to become primary.

#### Related Documents

- `votes` (page 482)
- *Replica Set Reconfiguration* (page 483)
- *Replica Set Elections* (page 397)

#### Convert a Secondary to an Arbiter

- Convert Secondary to Arbiter and Reuse the Port Number (page 444)
- Convert Secondary to Arbiter Running on a New Port Number (page 444)

If you have a *secondary* in a *replica set* that no longer needs to hold data but that needs to remain in the set to ensure that the set can *elect a primary* (page 397), you may convert the secondary to an *arbiter* (page ??) using either procedure in this tutorial. Both procedures are operationally equivalent:

- You may operate the arbiter on the same port as the former secondary. In this procedure, you must shut down the secondary and remove its data before restarting and reconfiguring it as an arbiter.

For this procedure, see *Convert Secondary to Arbiter and Reuse the Port Number* (page 444).

- Run the arbiter on a new port. In this procedure, you can reconfigure the server as an arbiter before shutting down the instance running as a secondary.

For this procedure, see *Convert Secondary to Arbiter Running on a New Port Number* (page 444).

## Convert Secondary to Arbiter and Reuse the Port Number

1. If your application is connecting directly to the secondary, modify the application so that MongoDB queries don't reach the secondary.
2. Shut down the secondary.
3. Remove the *secondary* from the *replica set* by calling the `rs.remove()` (page 898) method. Perform this operation while connected to the current *primary* in the `mongo` (page 942) shell:

```
rs.remove("<hostname><:port>")
```

4. Verify that the replica set no longer includes the secondary by calling the `rs.conf()` (page 896) method in the `mongo` (page 942) shell:

```
rs.conf()
```

5. Move the secondary's data directory to an archive folder. For example:

```
mv /data/db /data/db-old
```

---

### Optional

You may remove the data instead.

---

6. Create a new, empty data directory to point to when restarting the `mongod` (page 925) instance. You can reuse the previous name. For example:

```
mkdir /data/db
```

7. Restart the `mongod` (page 925) instance for the secondary, specifying the port number, the empty data directory, and the replica set. You can use the same port number you used before. Issue a command similar to the following:

```
mongod --port 27021 --dbpath /data/db --replSet rs
```

8. In the `mongo` (page 942) shell convert the secondary to an arbiter using the `rs.addArb()` (page 896) method:

```
rs.addArb("<hostname><:port>")
```

9. Verify the arbiter belongs to the replica set by calling the `rs.conf()` (page 896) method in the `mongo` (page 942) shell.

```
rs.conf()
```

The arbiter member should include the following:

```
"arbiterOnly" : true
```

## Convert Secondary to Arbiter Running on a New Port Number

1. If your application is connecting directly to the secondary or has a connection string referencing the secondary, modify the application so that MongoDB queries don't reach the secondary.
2. Create a new, empty data directory to be used with the new port number. For example:

```
mkdir /data/db-temp
```

- Start a new `mongod` (page 925) instance on the new port number, specifying the new data directory and the existing replica set. Issue a command similar to the following:

```
mongod --port 27021 --dbpath /data/db-temp --replSet rs
```

- In the `mongo` (page 942) shell connected to the current primary, convert the new `mongod` (page 925) instance to an arbiter using the `rs.addArb()` (page 896) method:

```
rs.addArb("<hostname><:port>")
```

- Verify the arbiter has been added to the replica set by calling the `rs.conf()` (page 896) method in the `mongo` (page 942) shell.

```
rs.conf()
```

The arbiter member should include the following:

```
"arbiterOnly" : true
```

- Shut down the secondary.

- Remove the `secondary` from the `replica set` by calling the `rs.remove()` (page 898) method in the `mongo` (page 942) shell:

```
rs.remove("<hostname><:port>")
```

- Verify that the replica set no longer includes the old secondary by calling the `rs.conf()` (page 896) method in the `mongo` (page 942) shell:

```
rs.conf()
```

- Move the secondary's data directory to an archive folder. For example:

```
mv /data/db /data/db-old
```

---

#### Optional

You may remove the data instead.

---

### 8.3.3 Replica Set Maintenance Tutorials

The following tutorials provide information in maintaining existing replica sets.

[Change the Size of the Oplog \(page 446\)](#) Increase the size of the `oplog` which logs operations. In most cases, the default oplog size is sufficient.

[Force a Member to Become Primary \(page 448\)](#) Force a replica set member to become primary.

[Resync a Member of a Replica Set \(page 450\)](#) Sync the data on a member. Either perform initial sync on a new member or resync the data on an existing member that has fallen too far behind to catch up by way of normal replication.

[Configure Replica Set Tag Sets \(page 451\)](#) Assign tags to replica set members for use in targeting read and write operations to specific members.

[Reconfigure a Replica Set with Unavailable Members \(page 455\)](#) Reconfigure a replica set when a majority of replica set members are down or unreachable.

[Manage Chained Replication \(page 457\)](#) Disable or enable chained replication. Chained replication occurs when a secondary replicates from another secondary instead of the primary.

[Change Hostnames in a Replica Set \(page 458\)](#) Update the replica set configuration to reflect changes in members' hostnames.

[Configure a Secondary's Sync Target \(page 462\)](#) Specify the member that a secondary member synchronizes from.

## Change the Size of the Oplog

The *oplog* exists internally as a [capped collection](#), so you cannot modify its size in the course of normal operations. In most cases the [default oplog size](#) (page 411) is an acceptable size; however, in some situations you may need a larger or smaller oplog. For example, you might need to change the oplog size if your applications perform large numbers of multi-updates or deletes in short periods of time.

This tutorial describes how to resize the oplog. For a detailed explanation of oplog sizing, see [Oplog Size](#) (page 411). For details how oplog size affects [delayed members](#) and affects [replication lag](#), see [Delayed Replica Set Members](#) (page 387).

### Overview

To change the size of the oplog, you must perform maintenance on each member of the replica set in turn. The procedure requires: stopping the [mongod](#) (page 925) instance and starting as a standalone instance, modifying the oplog size, and restarting the member.

---

**Important:** Always start rolling replica set maintenance with the secondaries, and finish with the maintenance on primary member.

---

### Procedure

- Restart the member in standalone mode.

---

#### Tip

Always use [rs.stepDown\(\)](#) (page 899) to force the primary to become a secondary before stopping a primary. This facilitates a more efficient election process.

- Recreate the oplog with the new size and with an old oplog entry as a seed.
- Restart the [mongod](#) (page 925) instance as a member of the replica set.

**Restart a Secondary in Standalone Mode on a Different Port** Shut down the [mongod](#) (page 925) instance for one of the non-primary members of your replica set. For example, to shut down, use the [db.shutdownServer\(\)](#) (page 894) method:

```
db.shutdownServer()
```

Restart this [mongod](#) (page 925) as a standalone instance running on a different port and *without* the `--repSet` parameter. Use a command similar to the following:

```
mongod --port 37017 --dbpath /srv/mongodb
```

**Create a Backup of the Oplog (Optional)** Optionally, backup the existing oplog on the standalone instance, as in the following example:

```
mongodump --db local --collection 'oplog.rs' --port 37017
```

**Recreate the Oplog with a New Size and a Seed Entry** Save the last entry from the oplog. For example, connect to the instance using the [mongo](#) (page 942) shell, and enter the following command to switch to the `local` database:

```
use local
```

In [mongo](#) (page 942) shell scripts you can use the following operation to set the `db` object:

```
db = db.getSiblingDB('local')
```

Use the `db.collection.save()` (page 846) method and a sort on reverse *natural order* to find the last entry and save it to a temporary collection:

```
db.temp.save(db.oplog.rs.find({}), { ts: 1, h: 1 }).sort({ $natural : -1 }).limit(1).next())
```

To see this oplog entry, use the following operation:

```
db.temp.find()
```

**Remove the Existing Oplog Collection** Drop the old `oplog.rs` collection in the `local` database. Use the following command:

```
db = db.getSiblingDB('local')
db.oplog.rs.drop()
```

This returns `true` in the shell.

**Create a New Oplog** Use the [create](#) (page 747) command to create a new oplog of a different size. Specify the `size` argument in bytes. A value of `2 * 1024 * 1024 * 1024` will create a new oplog that's 2 gigabytes:

```
db.runCommand({ create: "oplog.rs", capped: true, size: (2 * 1024 * 1024 * 1024) })
```

Upon success, this command returns the following status:

```
{ "ok" : 1 }
```

**Insert the Last Entry of the Old Oplog into the New Oplog** Insert the previously saved last entry from the old oplog into the new oplog. For example:

```
db.oplog.rs.save(db.temp.findOne())
```

To confirm the entry is in the new oplog, use the following operation:

```
db.oplog.rs.find()
```

**Restart the Member** Restart the [mongod](#) (page 925) as a member of the replica set on its usual port. For example:

```
db.shutdownServer()
mongod --replSet rs0 --dbpath /srv/mongodb
```

The replica set member will recover and “catch up” before it is eligible for election to primary.

**Repeat Process for all Members that may become Primary** Repeat this procedure for all members you want to change the size of the oplog. Repeat the procedure for the primary as part of the following step.

**Change the Size of the Oolog on the Primary** To finish the rolling maintenance operation, step down the primary with the `rs.stepDown()` (page 899) method and repeat the oplog resizing procedure above.

## Force a Member to Become Primary

### Synopsis

You can force a *replica set* member to become *primary* by giving it a higher *priority* (page 481) value than any other member in the set.

Optionally, you also can force a member never to become primary by setting its *priority* (page 481) value to 0, which means the member can never seek *election* (page 397) as primary. For more information, see *Priority 0 Replica Set Members* (page 386).

### Procedures

#### Force a Member to be Primary by Setting its Priority High

Changed in version 2.0.

For more information on priorities, see *priority* (page 481).

This procedure assumes your current *primary* is `m1.example.net` and that you'd like to instead make `m3.example.net` primary. The procedure also assumes you have a three-member *replica set* with the configuration below. For more information on configurations, see *Replica Set Configuration Use* (page 483).

This procedure assumes this configuration:

```
{
 "_id" : "rs",
 "version" : 7,
 "members" : [
 {
 "_id" : 0,
 "host" : "m1.example.net:27017"
 },
 {
 "_id" : 1,
 "host" : "m2.example.net:27017"
 },
 {
 "_id" : 2,
 "host" : "m3.example.net:27017"
 }
]
}
```

1. In the `mongo` (page 942) shell, use the following sequence of operations to make `m3.example.net` the primary:

```
cfg = rs.conf()
cfg.members[0].priority = 0.5
cfg.members[1].priority = 0.5
cfg.members[2].priority = 1
rs.reconfig(cfg)
```

This sets m3.example.net to have a higher `local.system.replset.members[n].priority` (page 481) value than the other `mongod` (page 925) instances.

The following sequence of events occur:

- m3.example.net and m2.example.net sync with m1.example.net (typically within 10 seconds).
  - m1.example.net sees that it no longer has highest priority and, in most cases, steps down. m1.example.net *does not* step down if m3.example.net's sync is far behind. In that case, m1.example.net waits until m3.example.net is within 10 seconds of its optime and then steps down. This minimizes the amount of time with no primary following failover.
  - The step down forces an election in which m3.example.net becomes primary based on its `priority` (page 481) setting.
2. Optionally, if m3.example.net is more than 10 seconds behind m1.example.net's optime, and if you don't need to have a primary designated within 10 seconds, you can force m1.example.net to step down by running:

```
db.adminCommand({replSetStepDown:1000000, force:1})
```

This prevents m1.example.net from being primary for 1,000,000 seconds, even if there is no other member that can become primary. When m3.example.net catches up with m1.example.net it will become primary.

If you later want to make m1.example.net primary again while it waits for m3.example.net to catch up, issue the following command to make m1.example.net seek election again:

```
rs.freeze()
```

The `rs.freeze()` (page 897) provides a wrapper around the `replSetFreeze` (page 726) database command.

### Force a Member to be Primary Using Database Commands Changed in version 1.8.

Consider a *replica set* with the following members:

- mdb0.example.net - the current *primary*.
- mdb1.example.net - a *secondary*.
- mdb2.example.net - a secondary .

To force a member to become primary use the following procedure:

1. In a `mongo` (page 942) shell, run `rs.status()` (page 898) to ensure your replica set is running as expected.
2. In a `mongo` (page 942) shell connected to the `mongod` (page 925) instance running on mdb2.example.net, freeze mdb2.example.net so that it does not attempt to become primary for 120 seconds.

```
rs.freeze(120)
```

3. In a `mongo` (page 942) shell connected to the `mongod` (page 925) running on mdb0.example.net, step down this instance so that the `mongod` (page 925) is not eligible to become primary for 120 seconds:

```
rs.stepDown(120)
```

mdb1.example.net becomes primary.

---

**Note:** During the transition, there is a short window where the set does not have a primary.

---

For more information, consider the `rs.freeze()` (page 897) and `rs.stepDown()` (page 899) methods that wrap the `replSetFreeze` (page 726) and `replSetStepDown` (page 730) commands.

### Resync a Member of a Replica Set

A *replica set* member becomes “stale” when its replication process falls so far behind that the *primary* overwrites oplog entries the member has not yet replicated. The member cannot catch up and becomes “stale.” When this occurs, you must completely resynchronize the member by removing its data and performing an *initial sync* (page 412).

This tutorial addressed both resyncing a stale member and to creating a new member using seed data from another member. When syncing a member, choose a time when the system has the bandwidth to move a large amount of data. Schedule the synchronization during a time of low usage or during a maintenance window.

MongoDB provides two options for performing an initial sync:

- Restart the `mongod` (page 925) with an empty data directory and let MongoDB’s normal initial syncing feature restore the data. This is the more simple option but may take longer to replace the data.

See [Automatically Sync a Member](#) (page 450).

- Restart the machine with a copy of a recent data directory from another member in the replica set. This procedure can replace the data more quickly but requires more manual steps.

See [Sync by Copying Data Files from Another Member](#) (page 450).

### Automatically Sync a Member

This procedure relies on MongoDB’s regular process for *initial sync* (page 412). This will store the current data on the member. For an overview of MongoDB initial sync process, see the [Replication Processes](#) (page 410) section.

To sync or resync a member:

1. If the member is an existing member, do the following:
  - (a) Stop the member’s `mongod` (page 925) instance. To ensure a clean shutdown, use the `db.shutdownServer()` (page 894) method from the `mongo` (page 942) shell or on Linux systems, the `mongod --shutdown` option.
  - (b) Delete all data and sub-directories from the member’s data directory. By removing the data `dbpath` (page 993), MongoDB will perform a complete resync. Consider making a backup first.
2. Start the `mongod` (page 925) instance on the member. For example:

```
mongod --dbpath /data/db/ --replSet rsProduction
```

At this point, the `mongod` (page 925) will perform an initial sync. The length of the initial sync may process depends on the size of the database and network connection between members of the replica set.

Initial sync operations can impact the other members of the set and create additional traffic to the primary and can only occur if another member of the set is accessible and up to date.

### Sync by Copying Data Files from Another Member

This approach “seeds” a new or stale member using the data files from an existing member of the replica set. The data files **must** be sufficiently recent to allow the new member to catch up with the *oplog*. Otherwise the member would need to perform an initial sync.

**Copy the Data Files** You can capture the data files as either a snapshot or a direct copy. However, in most cases you cannot copy data files from a running `mongod` (page 925) instance to another because the data files will change during the file copy operation.

---

**Important:** If copying data files, you must copy the content of the `local` database.

---

You *cannot* use a `mongodump` (page 951) backup to for the data files, **only a snapshot backup**. For approaches to capture a consistent snapshot of a running `mongod` (page 925) instance, see the *Backup Strategies for MongoDB Systems* (page 136) documentation.

**Sync the Member** After you have copied the data files from the “seed” source, start the `mongod` (page 925) instance and allow it to apply all operations from the oplog until it reflects the current state of the replica set.

## Configure Replica Set Tag Sets

- Differences Between Read Preferences and Write Concerns (page 451)
- Add Tag Sets to a Replica Set (page 452)
- Custom Multi-Datacenter Write Concerns (page 453)
- Configure Tag Sets for Functional Segregation of Read and Write Operations (page 454)

Tag sets let you customize *write concern* and *read preferences* for a *replica set*. MongoDB stores tag sets in the replica set configuration object, which is the document returned by `rs.conf()` (page 896), in the `members[n].tags` (page 482) sub-document.

This section introduces the configuration of tag sets. For an overview on tag sets and their use, see *Replica Set Write Concern* (page 57) and *Tag Sets* (page 407).

### Differences Between Read Preferences and Write Concerns

Custom read preferences and write concerns evaluate tags sets in different ways:

- Read preferences consider the value of a tag when selecting a member to read from.
- Write concerns do not use the value of a tag to select a member except to consider whether or not the value is unique.

For example, a tag set for a read operation may resemble the following document:

```
{ "disk": "ssd", "use": "reporting" }
```

To fulfill such a read operation, a member would need to have both of these tags. Any of the following tag sets would satisfy this requirement:

```
{ "disk": "ssd", "use": "reporting" }
{ "disk": "ssd", "use": "reporting", "rack": "a" }
{ "disk": "ssd", "use": "reporting", "rack": "d" }
{ "disk": "ssd", "use": "reporting", "mem": "r" }
```

The following tag sets would *not* be able to fulfill this query:

```
{ "disk": "ssd" }
{ "use": "reporting" }
{ "disk": "ssd", "use": "production" }
```

```
{ "disk": "ssd", "use": "production", "rack": "k" }
{ "disk": "spinning", "use": "reporting", "mem": "32" }
```

## Add Tag Sets to a Replica Set

Given the following replica set configuration:

```
{
 "_id" : "rs0",
 "version" : 1,
 "members" : [
 {
 "_id" : 0,
 "host" : "mongodb0.example.net:27017"
 },
 {
 "_id" : 1,
 "host" : "mongodb1.example.net:27017"
 },
 {
 "_id" : 2,
 "host" : "mongodb2.example.net:27017"
 }
]
}
```

You could add tag sets to the members of this replica set with the following command sequence in the mongo (page 942) shell:

```
conf = rs.conf()
conf.members[0].tags = { "dc": "east", "use": "production" }
conf.members[1].tags = { "dc": "east", "use": "reporting" }
conf.members[2].tags = { "use": "production" }
rs.reconfig(conf)
```

After this operation the output of `rs.conf()` (page 896) would resemble the following:

```
{
 "_id" : "rs0",
 "version" : 2,
 "members" : [
 {
 "_id" : 0,
 "host" : "mongodb0.example.net:27017",
 "tags" : {
 "dc": "east",
 "use": "production"
 }
 },
 {
 "_id" : 1,
 "host" : "mongodb1.example.net:27017",
 "tags" : {
 "dc": "east",
 "use": "reporting"
 }
 },
 {
 "_id" : 2,
 "host" : "mongodb2.example.net:27017",
 "tags" : {
 "use": "production"
 }
 }
]
}
```

```

 {
 "_id" : 2,
 "host" : "mongodb2.example.net:27017",
 "tags" : {
 "use": "production"
 }
 }
}

```

**Important:** In tag sets, all tag values must be strings.

### Custom Multi-Datacenter Write Concerns

Given a five member replica set with members in two data centers:

1. a facility VA tagged dc.va
2. a facility GTO tagged dc.gto

Create a custom write concern to require confirmation from two data centers using replica set tags, using the following sequence of operations in the [mongo](#) (page 942) shell:

1. Create a replica set configuration JavaScript object conf:

```
conf = rs.conf()
```

2. Add tags to the replica set members reflecting their locations:

```

conf.members[0].tags = { "dc.va": "rack1" }
conf.members[1].tags = { "dc.va": "rack2" }
conf.members[2].tags = { "dc.gto": "rack1" }
conf.members[3].tags = { "dc.gto": "rack2" }
conf.members[4].tags = { "dc.va": "rack1" }
rs.reconfig(conf)

```

3. Create a custom [getLastErrorModes](#) (page 483) setting to ensure that the write operation will propagate to at least one member of each facility:

```
conf.settings = { getLastErrorModes: { MultipleDC : { "dc.va": 1, "dc.gto": 1 } } }
```

4. Reconfigure the replica set using the modified conf configuration object:

```
rs.reconfig(conf)
```

To ensure that a write operation propagates to at least one member of the set in both data centers, use the `MultipleDC` write concern mode as follows:

```
db.runCommand({ getLastError: 1, w: "MultipleDC" })
```

Alternatively, if you want to ensure that each write operation propagates to at least 2 racks in each facility, reconfigure the replica set as follows in the [mongo](#) (page 942) shell:

1. Create a replica set configuration object conf:

```
conf = rs.conf()
```

2. Redefine the [getLastErrorModes](#) (page 483) value to require two different values of both dc.va and dc.gto:

```
conf.settings = { getLastErrorModes: { MultipleDC : { "dc.va": 2, "dc.gto": 2 } }}
```

3. Reconfigure the replica set using the modified `conf` configuration object:

```
rs.reconfig(conf)
```

Now, the following write concern operation will only return after the write operation propagates to at least two different racks in each facility:

```
db.runCommand({ getLastError: 1, w: "MultipleDC" })
```

### Configure Tag Sets for Functional Segregation of Read and Write Operations

Given a replica set with tag sets that reflect:

- data center facility,
- physical rack location of instance, and
- storage system (i.e. disk) type.

Where each member of the set has a tag set that resembles one of the following:<sup>11</sup>

```
{ "dc.va": "rack1", disk:"ssd", ssd: "installed" }
{ "dc.va": "rack2", disk:"raid" }
{ "dc.gto": "rack1", disk:"ssd", ssd: "installed" }
{ "dc.gto": "rack2", disk:"raid" }
{ "dc.va": "rack1", disk:"ssd", ssd: "installed" }
```

To target a read operation to a member of the replica set with a disk type of `ssd`, you could use the following tag set:

```
{ disk: "ssd" }
```

However, to create comparable write concern modes, you would specify a different set of `getLastErrorModes` (page 483) configuration. Consider the following sequence of operations in the `mongo` (page 942) shell:

1. Create a replica set configuration object `conf`:

```
conf = rs.conf()
```

2. Redefine the `getLastErrorModes` (page 483) value to configure two write concern modes:

```
conf.settings = {
 "getLastErrorModes" : {
 "ssd" : {
 "ssd" : 1
 },
 "MultipleDC" : {
 "dc.va" : 1,
 "dc.gto" : 1
 }
 }
}
```

3. Reconfigure the replica set using the modified `conf` configuration object:

```
rs.reconfig(conf)
```

---

<sup>11</sup> Since read preferences and write concerns use the value of fields in tag sets differently, larger deployments may have some redundancy.

Now you can specify the `MultipleDC` write concern mode, as in the following operation, to ensure that a write operation propagates to each data center.

```
db.runCommand({ getLastError: 1, w: "MultipleDC" })
```

Additionally, you can specify the `ssd` write concern mode to ensure that a write operation propagates to at least one instance with an SSD.

## Reconfigure a Replica Set with Unavailable Members

To reconfigure a *replica set* when a **minority** of members are unavailable, use the `rs.reconfig()` (page 897) operation on the current *primary*, following the example in the *Replica Set Reconfiguration Procedure* (page 483).

This document provides the following options for re-configuring a replica set when a **majority** of members are *not* accessible:

- *Reconfigure by Forcing the Reconfiguration* (page 455)
- *Reconfigure by Replacing the Replica Set* (page 456)

You may need to use one of these procedures, for example, in a geographically distributed replica set, where *no* local group of members can reach a majority. See *Replica Set Elections* (page 397) for more information on this situation.

### Reconfigure by Forcing the Reconfiguration

Changed in version 2.0.

This procedure lets you recover while a majority of *replica set* members are down or unreachable. You connect to any surviving member and use the `force` option to the `rs.reconfig()` (page 897) method.

The `force` option forces a new configuration onto the. Use this procedure only to recover from catastrophic interruptions. Do not use `force` every time you reconfigure. Also, do not use the `force` option in any automatic scripts and do not use `force` when there is still a *primary*.

To force reconfiguration:

1. Back up a surviving member.
2. Connect to a surviving member and save the current configuration. Consider the following example commands for saving the configuration:

```
cfg = rs.conf()
printjson(cfg)
```

3. On the same member, remove the down and unreachable members of the replica set from the `members` (page 480) array by setting the array equal to the surviving members alone. Consider the following example, which uses the `cfg` variable created in the previous step:

```
cfg.members = [cfg.members[0] , cfg.members[4] , cfg.members[7]]
```

4. On the same member, reconfigure the set by using the `rs.reconfig()` (page 897) command with the `force` option set to `true`:

```
rs.reconfig(cfg, {force : true})
```

This operation forces the secondary to use the new configuration. The configuration is then propagated to all the surviving members listed in the `members` array. The replica set then elects a new primary.

**Note:** When you use `force : true`, the version number in the replica set configuration increases significantly, by tens or hundreds of thousands. This is normal and designed to prevent set version collisions if you accidentally force re-configurations on both sides of a network partition and then the network partitioning ends.

---

5. If the failure or partition was only temporary, shut down or decommission the removed members as soon as possible.

### Reconfigure by Replacing the Replica Set

Use the following procedure **only** for versions of MongoDB prior to version 2.0. If you’re running MongoDB 2.0 or later, use the above procedure, [Reconfigure by Forcing the Reconfiguration](#) (page 455).

These procedures are for situations where a *majority* of the `replica set` members are down or unreachable. If a majority is *running*, then skip these procedures and instead use the `rs.reconfig()` (page 897) command according to the examples in [Example Reconfiguration Operations](#) (page 483).

If you run a pre-2.0 version and a majority of your replica set is down, you have the two options described here. Both involve replacing the replica set.

**Reconfigure by Turning Off Replication** This option replaces the `replica set` with a *standalone* server.

1. Stop the surviving `mongod` (page 925) instances. To ensure a clean shutdown, use an existing *control script* or use the `db.shutdownServer()` (page 894) method.

For example, to use the `db.shutdownServer()` (page 894) method, connect to the server using the `mongo` (page 942) shell and issue the following sequence of commands:

```
use admin
db.shutdownServer()
```

2. Create a backup of the data directory (i.e. `dbpath` (page 993)) of the surviving members of the set.

---

#### Optional

If you have a backup of the database you may instead remove this data.

---

3. Restart one of the `mongod` (page 925) instances *without* the `--replSet` parameter.

The data is now accessible and provided by a single server that is not a replica set member. Clients can use this server for both reads and writes.

When possible, re-deploy a replica set to provide redundancy and to protect your deployment from operational interruption.

**Reconfigure by “Breaking the Mirror”** This option selects a surviving `replica set` member to be the new *primary* and to “seed” a new replica set. In the following procedure, the new primary is `db0.example.net`. MongoDB copies the data from `db0.example.net` to all the other members.

1. Stop the surviving `mongod` (page 925) instances. To ensure a clean shutdown, use an existing *control script* or use the `db.shutdownServer()` (page 894) method.

For example, to use the `db.shutdownServer()` (page 894) method, connect to the server using the `mongo` (page 942) shell and issue the following sequence of commands:

```
use admin
db.shutdownServer()
```

2. Move the data directories (i.e. `dbpath` (page 993)) for all the members except `db0.example.net`, so that all the members except `db0.example.net` have empty data directories. For example:

```
mv /data/db /data/db-old
```

3. Move the data files for local database (i.e. `local.*`) so that `db0.example.net` has no local database. For example

```
mkdir /data/local-old
mv /data/db/local* /data/local-old/
```

4. Start each member of the replica set normally.
5. Connect to `db0.example.net` in a `mongo` (page 942) shell and run `rs.initiate()` (page 897) to initiate the replica set.
6. Add the other set members using `rs.add()` (page 895). For example, to add a member running on `db1.example.net` at port 27017, issue the following command:

```
rs.add("db1.example.net:27017")
```

MongoDB performs an initial sync on the added members by copying all data from `db0.example.net` to the added members.

#### See also:

[Resync a Member of a Replica Set](#) (page 450)

## Manage Chained Replication

Starting in version 2.0, MongoDB supports chained replication. A chained replication occurs when a `secondary` member replicates from another secondary member instead of from the `primary`. This might be the case, for example, if a secondary selects its replication target based on ping time and if the closest member is another secondary.

Chained replication can reduce load on the primary. But chained replication can also result in increased replication lag, depending on the topology of the network.

New in version 2.2.2.

You can use the `chainingAllowed` (page 482) setting in [Replica Set Configuration](#) (page 479) to disable chained replication for situations where chained replication is causing lag.

MongoDB enables chained replication by default. This procedure describes how to disable it and how to re-enable it.

---

**Note:** If chained replication is disabled, you still can use `replSetSyncFrom` (page 730) to specify that a secondary replicates from another secondary. But that configuration will last only until the secondary recalculates which member to sync from.

---

### Disable Chained Replication

To disable chained replication, set the `chainingAllowed` (page 482) field in [Replica Set Configuration](#) (page 479) to `false`.

You can use the following sequence of commands to set `chainingAllowed` (page 482) to `false`:

1. Copy the configuration settings into the `cfg` object:

```
cfg = rs.config()
```

2. Take note of whether the current configuration settings contain the `settings` sub-document. If they do, skip this step.

**Warning:** To avoid data loss, skip this step if the configuration settings contain the `settings` sub-document.

If the current configuration settings **do not** contain the `settings` sub-document, create the sub-document by issuing the following command:

```
cfg.settings = { }
```

3. Issue the following sequence of commands to set `chainingAllowed` (page 482) to `false`:

```
cfg.settings.chainingAllowed = false
rs.reconfig(cfg)
```

### Re-enable Chained Replication

To re-enable chained replication, set `chainingAllowed` (page 482) to `true`. You can use the following sequence of commands:

```
cfg = rs.config()
cfg.settings.chainingAllowed = true
rs.reconfig(cfg)
```

### Change Hostnames in a Replica Set

- Overview (page 458)
  - Assumptions (page 459)
  - Change Hostnames while Maintaining Replica Set Availability (page 459)
  - Change All Hostnames at the Same Time (page 461)

For most *replica sets*, the hostnames in the `host` (page 480) field never change. However, if organizational needs change, you might need to migrate some or all host names.

---

**Note:** Always use resolvable hostnames for the value of the `host` (page 480) field in the replica set configuration to avoid confusion and complexity.

---

#### Overview

This document provides two separate procedures for changing the hostnames in the `host` (page 480) field. Use either of the following approaches:

- *Change hostnames without disrupting availability* (page 459). This approach ensures your applications will always be able to read and write data to the replica set, but the approach can take a long time and may incur downtime at the application layer.

If you use the first procedure, you must configure your applications to connect to the replica set at both the old and new locations, which often requires a restart and reconfiguration at the application layer and which may affect the availability of your applications. Re-configuring applications is beyond the scope of this document.

- [Stop all members running on the old hostnames at once](#) (page 461). This approach has a shorter maintenance window, but the replica set will be unavailable during the operation.

**See also:**

[Replica Set Reconfiguration Process](#) (page 483), [Deploy a Replica Set](#) (page 420), and [Add Members to a Replica Set](#) (page 433).

### Assumptions

Given a [replica set](#) with three members:

- database0.example.com:27017 (the [primary](#))
- database1.example.com:27017
- database2.example.com:27017

And with the following `rs.conf()` (page 896) output:

```
{
 "_id" : "rs",
 "version" : 3,
 "members" : [
 {
 "_id" : 0,
 "host" : "database0.example.com:27017"
 },
 {
 "_id" : 1,
 "host" : "database1.example.com:27017"
 },
 {
 "_id" : 2,
 "host" : "database2.example.com:27017"
 }
]
}
```

The following procedures change the members' hostnames as follows:

- mongodb0.example.net:27017 (the primary)
- mongodb1.example.net:27017
- mongodb2.example.net:27017

Use the most appropriate procedure for your deployment.

### Change Hostnames while Maintaining Replica Set Availability

This procedure uses the above [assumptions](#) (page 459).

1. For each [secondary](#) in the replica set, perform the following sequence of operations:
  - (a) Stop the secondary.
  - (b) Restart the secondary at the new location.
  - (c) Open a `mongo` (page 942) shell connected to the replica set's primary. In our example, the primary runs on port 27017 so you would issue the following command:

```
mongo --port 27017
```

- (d) Use `rs.reconfig()` (page 897) to update the *replica set configuration document* (page 479) with the new hostname.

For example, the following sequence of commands updates the hostname for the secondary at the array index 1 of the `members` array (i.e. `members[1]`) in the replica set configuration document:

```
cfg = rs.conf()
cfg.members[1].host = "mongodb1.example.net:27017"
rs.reconfig(cfg)
```

For more information on updating the configuration document, see *Example Reconfiguration Operations* (page 483).

- (e) Make sure your client applications are able to access the set at the new location and that the secondary has a chance to catch up with the other members of the set.

Repeat the above steps for each non-primary member of the set.

2. Open a `mongo` (page 942) shell connected to the primary and step down the primary using the `rs.stepDown()` (page 899) method:

```
rs.stepDown()
```

The replica set elects another member to become primary.

3. When the step down succeeds, shut down the old primary.
4. Start the `mongod` (page 925) instance that will become the new primary in the new location.
5. Connect to the current primary, which was just elected, and update the *replica set configuration document* (page 479) with the hostname of the node that is to become the new primary.

For example, if the old primary was at position 0 and the new primary's hostname is `mongodb0.example.net:27017`, you would run:

```
cfg = rs.conf()
cfg.members[0].host = "mongodb0.example.net:27017"
rs.reconfig(cfg)
```

6. Open a `mongo` (page 942) shell connected to the new primary.
7. To confirm the new configuration, call `rs.conf()` (page 896) in the `mongo` (page 942) shell.

Your output should resemble:

```
{
 "_id" : "rs",
 "version" : 4,
 "members" : [
 {
 "_id" : 0,
 "host" : "mongodb0.example.net:27017"
 },
 {
 "_id" : 1,
 "host" : "mongodb1.example.net:27017"
 },
 {
 "_id" : 2,
 "host" : "mongodb2.example.net:27017"
 }
]
}
```

```

 }
]
}

```

### Change All Hostnames at the Same Time

This procedure uses the above [assumptions](#) (page 459).

1. Stop all members in the [replica set](#).
2. Restart each member *on a different port* and *without* using the `--replicaSet` run-time option. Changing the port number during maintenance prevents clients from connecting to this host while you perform maintenance. Use the member's usual `--dbpath`, which in this example is `/data/db1`. Use a command that resembles the following:

```
mongod --dbpath /data/db1/ --port 37017
```

3. For each member of the replica set, perform the following sequence of operations:
  - (a) Open a [mongo](#) (page 942) shell connected to the [mongod](#) (page 925) running on the new, temporary port. For example, for a member running on a temporary port of 37017, you would issue this command:

```
mongo --port 37017
```

- (b) Edit the replica set configuration manually. The replica set configuration is the only document in the `system.replset` collection in the `local` database. Edit the replica set configuration with the new hostnames and correct ports for all the members of the replica set. Consider the following sequence of commands to change the hostnames in a three-member set:

```
use local

cfg = db.system.replset.findOne({ "_id": "rs" })

cfg.members[0].host = "mongodb0.example.net:27017"

cfg.members[1].host = "mongodb1.example.net:27017"

cfg.members[2].host = "mongodb2.example.net:27017"

db.system.replset.update({ "_id": "rs" } , cfg)
```

- (c) Stop the [mongod](#) (page 925) process on the member.
4. After re-configuring all members of the set, start each [mongod](#) (page 925) instance in the normal way: use the usual port number and use the `--replicaSet` option. For example:

```
mongod --dbpath /data/db1/ --port 27017 --replicaSet rs
```

5. Connect to one of the [mongod](#) (page 925) instances using the [mongo](#) (page 942) shell. For example:

```
mongo --port 27017
```

6. To confirm the new configuration, call `rs.conf()` (page 896) in the [mongo](#) (page 942) shell.

Your output should resemble:

```
{
 "_id" : "rs",
 "version" : 4,
```

```
"members" : [
 {
 "_id" : 0,
 "host" : "mongodb0.example.net:27017"
 },
 {
 "_id" : 1,
 "host" : "mongodb1.example.net:27017"
 },
 {
 "_id" : 2,
 "host" : "mongodb2.example.net:27017"
 }
]
```

## Configure a Secondary's Sync Target

To override the default sync target selection logic, you may manually configure a *secondary* member's sync target for pulling *oplog* entries temporarily. The following operations provide access to this functionality:

- `replSetSyncFrom` (page 730) command, or
- `rs.syncFrom()` (page 899) helper in the `mongo` (page 942) shell

Only modify the default sync logic as needed, and always exercise caution. `rs.syncFrom()` (page 899) will not affect an in-progress initial sync operation. To affect the sync target for the initial sync, run `rs.syncFrom()` (page 899) operation *before* initial sync.

If you run `rs.syncFrom()` (page 899) during initial sync, MongoDB produces no error messages, but the sync target will not change until after the initial sync operation.

---

**Note:** `replSetSyncFrom` (page 730) and `rs.syncFrom()` (page 899) provide a temporary override of default behavior. `mongod` (page 925) will revert to the default sync behavior in the following situations:

- The `mongod` (page 925) instance restarts.
- The connection between the `mongod` (page 925) and the sync target closes.

Changed in version 2.4: The sync target falls more than 30 seconds behind another member of the replica set; the `mongod` (page 925) will revert to the default sync target.

---

### 8.3.4 Troubleshoot Replica Sets

This section describes common strategies for troubleshooting *replica set* deployments.

#### Check Replica Set Status

To display the current state of the replica set and current state of each member, run the `rs.status()` (page 898) method in a `mongo` (page 942) shell connected to the replica set's *primary*. For descriptions of the information displayed by `rs.status()` (page 898), see `replSetGetStatus` (page 726).

---

**Note:** The `rs.status()` (page 898) method is a wrapper that runs the `replSetGetStatus` (page 726) database command.

---

## Check the Replication Lag

Replication lag is a delay between an operation on the *primary* and the application of that operation from the *oplog* to the *secondary*. Replication lag can be a significant issue and can seriously affect MongoDB *replica set* deployments. Excessive replication lag makes “lagged” members ineligible to quickly become primary and increases the possibility that distributed read operations will be inconsistent.

To check the current length of replication lag:

- In a `mongo` (page 942) shell connected to the primary, call the `db.printSlaveReplicationInfo()` (page 892) method.

The returned document displays the `syncedTo` value for each member, which shows you when each member last read from the oplog, as shown in the following example:

```
source: m1.example.net:30001
syncedTo: Tue Oct 02 2012 11:33:40 GMT-0400 (EDT)
= 7475 secs ago (2.08hrs)
source: m2.example.net:30002
syncedTo: Tue Oct 02 2012 11:33:40 GMT-0400 (EDT)
= 7475 secs ago (2.08hrs)
```

---

**Note:** The `rs.status()` (page 898) method is a wrapper around the `replSetGetStatus` (page 726) database command.

---

- Monitor the rate of replication by watching the oplog time in the “replica” graph in the MongoDB Management Service<sup>12</sup>. For more information see the documentation for MMS<sup>13</sup>.

Possible causes of replication lag include:

- **Network Latency**

Check the network routes between the members of your set to ensure that there is no packet loss or network routing issue.

Use tools including `ping` to test latency between set members and `traceroute` to expose the routing of packets network endpoints.

- **Disk Throughput**

If the file system and disk device on the secondary is unable to flush data to disk as quickly as the primary, then the secondary will have difficulty keeping state. Disk-related issues are incredibly prevalent on multi-tenant systems, including vitalized instances, and can be transient if the system accesses disk devices over an IP network (as is the case with Amazon’s EBS system.)

Use system-level tools to assess disk status, including `iostat` or `vmstat`.

- **Concurrency**

In some cases, long-running operations on the primary can block replication on secondaries. For best results, configure *write concern* (page 55) to require confirmation of replication to secondaries, as described in *replica set write concern* (page 57). This prevents write operations from returning if replication cannot keep up with the write load.

Use the *database profiler* to see if there are slow queries or long-running operations that correspond to the incidences of lag.

- **Appropriate Write Concern**

---

<sup>12</sup><http://mms.mongodb.com/>

<sup>13</sup><http://mms.mongodb.com/help/>

If you are performing a large data ingestion or bulk load operation that requires a large number of writes to the primary, particularly with [unacknowledged write concern](#) (page 55), the secondaries will not be able to read the oplog fast enough to keep up with changes.

To prevent this, require [write acknowledgment or journaled write concern](#) (page 55) after every 100, 1,000, or an another interval to provide an opportunity for secondaries to catch up with the primary.

For more information see:

- [Replica Acknowledge Write Concern](#) (page 57)
- [Replica Set Write Concern](#) (page 60)
- [Oplog Size](#) (page 411)

## Test Connections Between all Members

All members of a [replica set](#) must be able to connect to every other member of the set to support replication. Always verify connections in both “directions.” Networking topologies and firewall configurations prevent normal and required connectivity, which can block replication.

Consider the following example of a bidirectional test of networking:

---

### Example

Given a replica set with three members running on three separate hosts:

- m1.example.net
- m2.example.net
- m3.example.net

1. Test the connection from m1.example.net to the other hosts with the following operation set from m1.example.net:

```
mongo --host m2.example.net --port 27017
```

```
mongo --host m3.example.net --port 27017
```

2. Test the connection from m2.example.net to the other two hosts with the following operation set from m2.example.net, as in:

```
mongo --host m1.example.net --port 27017
```

```
mongo --host m3.example.net --port 27017
```

You have now tested the connection between m2.example.net and m1.example.net in both directions.

3. Test the connection from m3.example.net to the other two hosts with the following operation set from the m3.example.net host, as in:

```
mongo --host m1.example.net --port 27017
```

```
mongo --host m2.example.net --port 27017
```

If any connection, in any direction fails, check your networking and firewall configuration and reconfigure your environment to allow these connections.

---

## Socket Exceptions when Rebooting More than One Secondary

When you reboot members of a replica set, ensure that the set is able to elect a primary during the maintenance. This means ensuring that a majority of the set's `'votes'` (page 482) are available.

When a set's active members can no longer form a majority, the set's *primary* steps down and becomes a *secondary*. The former primary closes all open connections to client applications. Clients attempting to write to the former primary receive socket exceptions and *Connection reset* errors until the set can elect a primary.

---

### Example

Given a three-member replica set where every member has one vote, the set can elect a primary only as long as two members can connect to each other. If two you reboot the two secondaries once, the primary steps down and becomes a secondary. Until the at least one secondary becomes available, the set has no primary and cannot elect a new primary.

---

For more information on votes, see [Replica Set Elections](#) (page 397). For related information on connection errors, see [Does TCP keepalive time affect sharded clusters and replica sets?](#) (page 617).

## Check the Size of the Oolog

A larger *oplog* can give a replica set a greater tolerance for lag, and make the set more resilient.

To check the size of the oplog for a given *replica set* member, connect to the member in a `mongo` (page 942) shell and run the `db.printReplicationInfo()` (page 891) method.

The output displays the size of the oplog and the date ranges of the operations contained in the oplog. In the following example, the oplog is about 10MB and is able to fit about 26 hours (94400 seconds) of operations:

```
configured oplog size: 10.10546875MB
log length start to end: 94400 (26.22hrs)
oplog first event time: Mon Mar 19 2012 13:50:38 GMT-0400 (EDT)
oplog last event time: Wed Oct 03 2012 14:59:10 GMT-0400 (EDT)
now: Wed Oct 03 2012 15:00:21 GMT-0400 (EDT)
```

The oplog should be long enough to hold all transactions for the longest downtime you expect on a secondary. At a minimum, an oplog should be able to hold minimum 24 hours of operations; however, many users prefer to have 72 hours or even a week's work of operations.

For more information on how oplog size affects operations, see:

- [Oplog Size](#) (page 411),
- [Delayed Replica Set Members](#) (page 387), and
- [Check the Replication Lag](#) (page 463).

---

**Note:** You normally want the oplog to be the same size on all members. If you resize the oplog, resize it on all members.

---

To change oplog size, see the [Change the Size of the Oplog](#) (page 446) tutorial.

## Oolog Entry Timestamp Error

Consider the following error in `mongod` (page 925) output and logs:

```
replSet error fatal couldn't query the local local.oplog.rs collection. Terminating mongod after 30
<timestamp> [rsStart] bad replSet oplog entry?
```

Often, an incorrectly typed value in the `ts` field in the last `oplog` entry causes this error. The correct data type is `Timestamp`.

Check the type of the `ts` value using the following two queries against the `oplog` collection:

```
db = db.getSiblingDB("local")
db.oplog.rs.find().sort({$natural:-1}).limit(1)
db.oplog.rs.find({ts:{$type:17}}).sort({$natural:-1}).limit(1)
```

The first query returns the last document in the `oplog`, while the second returns the last document in the `oplog` where the `ts` value is a `Timestamp`. The `$type` (page 630) operator allows you to select *BSON type* 17, is the `Timestamp` data type.

If the queries don't return the same document, then the last document in the `oplog` has the wrong data type in the `ts` field.

---

### Example

If the first query returns this as the last `oplog` entry:

```
{ "ts" : {t: 1347982456000, i: 1},
 "h" : NumberLong("8191276672478122996"),
 "op" : "n",
 "ns" : "",
 "o" : { "msg" : "Reconfig set", "version" : 4 } }
```

And the second query returns this as the last entry where `ts` has the `Timestamp` type:

```
{ "ts" : Timestamp(1347982454000, 1),
 "h" : NumberLong("6188469075153256465"),
 "op" : "n",
 "ns" : "",
 "o" : { "msg" : "Reconfig set", "version" : 3 } }
```

Then the value for the `ts` field in the last `oplog` entry is of the wrong data type.

---

To set the proper type for this value and resolve this issue, use an update operation that resembles the following:

```
db.oplog.rs.update({ ts: { t:1347982456000, i:1 } },
 { $set: { ts: new Timestamp(1347982456000, 1) } })
```

Modify the timestamp values as needed based on your `oplog` entry. This operation may take some period to complete because the update must scan and pull the entire `oplog` into memory.

### Duplicate Key Error on `local.slaves`

The *duplicate key on local.slaves* error, occurs when a `secondary` or `slave` changes its hostname and the `primary` or `master` tries to update its `local.slaves` collection with the new name. The update fails because it contains the same `_id` value as the document containing the previous hostname. The error itself will resemble the following.

```
exception 11000 E11000 duplicate key error index: local.slaves.$_id_ dup key: { : ObjectId('<object>')}
```

This is a benign error and does not affect replication operations on the `secondary` or `slave`.

To prevent the error from appearing, drop the `local.slaves` collection from the `primary` or `master`, with the following sequence of operations in the `mongo` (page 942) shell:

```
use local
db.slaves.drop()
```

The next time a *secondary* or *slave* polls the *primary* or *master*, the *primary* or *master* recreates the `local.slaves` collection.

## 8.4 Replication Reference

### 8.4.1 Replication Methods in the mongo Shell

| Name                                     | Description                                                                                                                                                                                           |
|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>rs.add()</code><br>(page 895)      | Adds a member to a replica set.                                                                                                                                                                       |
| <code>rs.addArb()</code><br>(page 896)   | Adds an <i>arbiter</i> to a replica set.                                                                                                                                                              |
| <code>rs.conf()</code><br>(page 896)     | Returns the replica set configuration document.                                                                                                                                                       |
| <code>rs.freeze()</code><br>(page 897)   | Prevents the current member from seeking election as primary for a period of time.                                                                                                                    |
| <code>rs.help()</code><br>(page 897)     | Returns basic help text for <i>replica set</i> functions.                                                                                                                                             |
| <code>rs.initiate()</code><br>(page 897) | Initializes a new replica set.                                                                                                                                                                        |
| <code>rs.reconfig()</code><br>(page 897) | Re-configures a replica set by applying a new replica set configuration object.                                                                                                                       |
| <code>rs.remove()</code><br>(page 898)   | Remove a member from a replica set.                                                                                                                                                                   |
| <code>rs.slaveOk()</code><br>(page 898)  | Sets the <code>slaveOk</code> property for the current connection. Deprecated. Use <code>readPref()</code> (page 871) and <code>Mongo.setReadPref()</code> (page 919) to set <i>read preference</i> . |
| <code>rs.status()</code><br>(page 898)   | Returns a document with information about the state of the replica set.                                                                                                                               |
| <code>rs.stepDown()</code><br>(page 899) | Causes the current <i>primary</i> to become a secondary which forces an <i>election</i> .                                                                                                             |
| <code>rs.syncFrom()</code><br>(page 899) | Sets the member that this replica set member will sync from, overriding the default sync target selection logic.                                                                                      |

## 8.4.2 Replication Database Commands

| Name                                          | Description                                                                                                              |
|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| <a href="#">replSetFreeze</a> (page 726)      | Prevents the current member from seeking election as <i>primary</i> for a period of time.                                |
| <a href="#">replSetGetStatus</a> (page 726)   | Returns a document that reports on the status of the replica set.                                                        |
| <a href="#">replSetInitiate</a> (page 728)    | Initializes a new replica set.                                                                                           |
| <a href="#">replSetMaintenance</a> (page 729) | Enables or disables a maintenance mode, which puts a <i>secondary</i> node in a RECOVERING state.                        |
| <a href="#">replSetReconfig</a> (page 729)    | Applies a new configuration to an existing replica set.                                                                  |
| <a href="#">replSetStepDown</a> (page 730)    | Forces the current <i>primary</i> to step down and become a <i>secondary</i> , forcing an election.                      |
| <a href="#">replSetSyncFrom</a> (page 730)    | Explicitly override the default logic for selecting a member to replicate from.                                          |
| <a href="#">resync</a> (page 731)             | Forces a <a href="#">mongod</a> (page 925) to re-synchronize from the <i>master</i> . For master-slave replication only. |
| <a href="#">applyOps</a> (page 732)           | Internal command that applies <i>oplog</i> entries to the current data set.                                              |
| <a href="#">isMaster</a> (page 732)           | Displays information about this member's role in the replica set, including whether it is the master.                    |
| <a href="#">getoptime</a> (page 734)          | Internal command to support replication, returns the optime.                                                             |

## 8.4.3 Replica Set Reference Documentation

[Replica Set Commands](#) (page 468) A quick reference for all *commands* and [mongo](#) (page 942) shell methods that support replication.

[Replica Set Configuration](#) (page 479) Complete documentation of the *replica set* configuration object returned by `rs.conf()` (page 896).

[The local Database](#) (page 485) Complete documentation of the content of the `local` database that [mongod](#) (page 925) instances use to support replication.

[Replica Set Member States](#) (page 487) Reference for the replica set member states.

[Read Preference Reference](#) (page 488) Complete documentation of the five read preference modes that the MongoDB drivers support.

### Replica Set Commands

This reference collects documentation for all *JavaScript methods* (page 468) for the [mongo](#) (page 942) shell that support *replica set* functionality, as well as all *database commands* (page 473) related to replication function.

See [Replication](#) (page 377), for a list of all replica set documentation.

### JavaScript Methods

The following methods apply to replica sets. For a complete list of all methods, see [mongo Shell Methods](#) (page 806).

`rs.status()`

**Returns** A *document* with status information.

This output reflects the current status of the replica set, using data derived from the heartbeat packets sent by the other members of the replica set.

This method provides a wrapper around the [rep1SetGetStatus](#) (page 726) *database command*.

`db.isMaster()`

**Returns** A document that describes the role of the [mongod](#) (page 925) instance.

If the [mongod](#) (page 925) is a member of a *replica set*, then the `ismaster` (page 733) and `secondary` (page 733) fields report if the instance is the *primary* or if it is a *secondary* member of the replica set.

---

### See

[isMaster](#) (page 732) for the complete documentation of the output of `db.isMaster()` (page 890).

---

## Description

`rs.initiate(configuration)`

Initiates a *replica set*. Optionally takes a configuration argument in the form of a *document* that holds the configuration of a replica set.

The [rs.initiate\(\)](#) (page 897) method has the following parameter:

**param document configuration** A *document* that specifies [configuration settings](#) (page 479) for the new replica set. If a configuration is not specified, MongoDB uses a default configuration.

The [rs.initiate\(\)](#) (page 897) method provides a wrapper around the “[rep1SetInitiate](#) (page 728)” *database command*.

## Replica Set Configuration

See [Member Configuration Tutorials](#) (page 438) and [Replica Set Configuration](#) (page 479) for examples of replica set configuration and invitation objects.

`rs.conf()`

**Returns** a *document* that contains the current *replica set* configuration document.

See [Replica Set Configuration](#) (page 479) for more information on the replica set configuration document.

`rs.config()`

`rs.config()` (page 896) is an alias of `rs.conf()` (page 896).

## Definition

`rs.reconfig(configuration, force)`

Initializes a new *replica set* configuration. Disconnects the shell briefly and forces a reconnection as the replica set renegotiates which member will be *primary*. As a result, the shell will display an error even if this command succeeds.

**param document configuration** A *document* that specifies the configuration of a replica set.

**param document force** “If set as { `force: true` }, this forces the replica set to accept the new configuration even if a majority of the members are not accessible. Use with caution, as this can lead to term:*rollback* situations.”

`rs.reconfig()` (page 897) overwrites the existing replica set configuration. Retrieve the current configuration object with `rs.conf()` (page 896), modify the configuration as needed and then use `rs.reconfig()` (page 897) to submit the modified configuration object.

`rs.reconfig()` (page 897) provides a wrapper around the “`replSetReconfig` (page 729)” *database command*.

### Examples

To reconfigure a replica set, use the following sequence of operations:

```
conf = rs.conf()

// modify conf to change configuration

rs.reconfig(conf)
```

If you want to force the reconfiguration if a majority of the set is not connected to the current member, or you are issuing the command against a secondary, use the following form:

```
conf = rs.conf()

// modify conf to change configuration

rs.reconfig(conf, { force: true })
```

**Warning:** Forcing a `rs.reconfig()` (page 897) can lead to `rollback` situations and other difficult to recover from situations. Exercise caution when using this option.

### See also:

[Replica Set Configuration](#) (page 479) and [Replica Set Tutorials](#) (page 419).

### Definition

`rs.add(host, arbiterOnly)`

Adds a member to a *replica set*.

**param string,document host** The new member to add to the replica set. If a string, specifies the hostname and optionally the port number for the new member. If a document, specifies a replica set members document, as found in the `members` (page 480) array. To view a replica set’s members array, run `rs.conf()` (page 896).

**param boolean arbiterOnly** Applies only if the `<host>` value is a string. If `true`, the added host is an arbiter.”

You may specify new hosts in one of two ways:

- 1.as a “hostname” with an optional port number to use the default configuration as in the [Add a Member to an Existing Replica Set](#) (page 435) example.
- 2.as a configuration *document*, as in the [Configure and Add a Member](#) (page 435) example.

This function will disconnect the shell briefly and forces a reconnection as the replica set renegotiates which member will be `primary`. As a result, the shell will display an error even if this command succeeds.

`rs.add()` (page 895) provides a wrapper around some of the functionality of the “`replSetReconfig` (page 729)” *database command* and the corresponding shell helper `rs.reconfig()` (page 897). See the *Replica Set Configuration* (page 479) document for full documentation of all replica set configuration options.

## Example

To add a `mongod` (page 925) accessible on the default port 27017 running on the host `mongodb3.example.net`, use the following `rs.add()` (page 895) invocation:

```
rs.add('mongodb3.example.net:27017')
```

If `mongodb3.example.net` is an arbiter, use the following form:

```
rs.add('mongodb3.example.net:27017', true)
```

To add `mongodb3.example.net` as a *secondary-only* (page 386) member of set, use the following form of `rs.add()` (page 895):

```
rs.add({ "_id": 3, "host": "mongodb3.example.net:27017", "priority": 0 })
```

Replace, 3 with the next unused `_id` value in the replica set. See `rs.conf()` (page 896) to see the existing `_id` values in the replica set configuration document.

See the *Replica Set Configuration* (page 479) and *Replica Set Tutorials* (page 419) documents for more information.

## Description

`rs.addArb(host)`

Adds a new *arbiter* to an existing replica set.

The `rs.addArb()` (page 896) method takes the following parameter:

**param string host** Specifies the hostname and optionally the port number of the arbiter member to add to replica set.

This function briefly disconnects the shell and forces a reconnection as the replica set renegotiates which member will be *primary*. As a result, the shell displays an error even if this command succeeds.

## Description

`rs.stepDown(seconds)`

Forces the current *replica set* member to step down as *primary* and then attempt to avoid election as primary for the designated number of seconds. Produces an error if the current member is not the primary.

The `rs.stepDown()` (page 899) method has the following parameter:

**param number seconds** The duration of time that the stepped-down member attempts to avoid re-election as primary. If this parameter is not specified, the method uses the default value of 60 seconds.

This function disconnects the shell briefly and forces a reconnection as the replica set renegotiates which member will be primary. As a result, the shell will display an error even if this command succeeds.

`rs.stepDown()` (page 899) provides a wrapper around the *database command* `replSetStepDown` (page 730).

## Description

### `rs.freeze(seconds)`

Makes the current *replica set* member ineligible to become *primary* for the period specified.

The `rs.freeze()` (page 897) method has the following parameter:

**param number seconds** The duration the member is ineligible to become primary.

`rs.freeze()` (page 897) provides a wrapper around the *database command* `replSetFreeze` (page 726).

## Definition

### `rs.remove(hostname)`

Removes the member described by the `hostname` parameter from the current *replica set*. This function will disconnect the shell briefly and forces a reconnection as the *replica set* renegotiates which member will be *primary*. As a result, the shell will display an error even if this command succeeds.

The `rs.remove()` (page 898) method has the following parameter:

**param string hostname** The hostname of a system in the replica set.

---

**Note:** Before running the `rs.remove()` (page 898) operation, you must *shut down* the replica set member that you're removing.

Changed in version 2.2: This procedure is no longer required when using `rs.remove()` (page 898), but it remains good practice.

---

### `rs.slaveOk()`

Provides a shorthand for the following operation:

```
db.getMongo().setSlaveOk()
```

This allows the current connection to allow read operations to run on *secondary* members. See the `readPref()` (page 871) method for more fine-grained control over *read preference* (page 405) in the `mongo` (page 942) shell.

### `db.isMaster()`

**Returns** A document that describes the role of the `mongod` (page 925) instance.

If the `mongod` (page 925) is a member of a *replica set*, then the `isMaster` (page 733) and `secondary` (page 733) fields report if the instance is the *primary* or if it is a *secondary* member of the replica set.

---

## See

`isMaster` (page 732) for the complete documentation of the output of `db.isMaster()` (page 890).

---

### `rs.help()`

Returns a basic help text for all of the *replication* (page 377) related shell functions.

### `rs.syncFrom()`

New in version 2.2.

Provides a wrapper around the `replSetSyncFrom` (page 730), which allows administrators to configure the member of a replica set that the current member will pull data from. Specify the name of the member you want to replicate from in the form of `[hostname] : [port]`.

See `replSetSyncFrom` (page 730) for more details.

## Database Commands

The following commands apply to replica sets. For a complete list of all commands, see [Database Commands](#) (page 694).

### Definition

#### **isMaster**

[isMaster](#) (page 732) returns a document that describes the role of the [mongod](#) (page 925) instance.

If the instance is a member of a replica set, then [isMaster](#) (page 732) returns a subset of the replica set configuration and status including whether or not the instance is the [primary](#) of the replica set.

When sent to a [mongod](#) (page 925) instance that is not a member of a replica set, [isMaster](#) (page 732) returns a subset of this information.

MongoDB [drivers](#) and [clients](#) use [isMaster](#) (page 732) to determine the state of the replica set members and to discover additional members of a [replica set](#).

The [db.isMaster\(\)](#) (page 890) method in the [mongo](#) (page 942) shell provides a wrapper around [isMaster](#) (page 732).

The command takes the following form:

```
{ isMaster: 1 }
```

### See also:

[db.isMaster\(\)](#) (page 890)

### Output

**All Instances** The following [isMaster](#) (page 732) fields are common across all roles:

#### **isMaster.ismaster**

A boolean value that reports when this node is writable. If `true`, then this instance is a [primary](#) in a [replica set](#), or a [master](#) in a master-slave configuration, or a [mongos](#) (page 938) instance, or a standalone [mongod](#) (page 925).

This field will be `false` if the instance is a [secondary](#) member of a replica set or if the member is an [arbiter](#) of a replica set.

#### **isMaster.maxBsonObjectSize**

The maximum permitted size of a [BSON](#) object in bytes for this [mongod](#) (page 925) process. If not provided, clients should assume a max size of “`4 * 1024 * 1024`”.

#### **isMaster.maxMessageSizeBytes**

New in version 2.4.

The maximum permitted size of a [BSON](#) wire protocol message. The default value is `48000000` bytes.

#### **isMaster.localTime**

New in version 2.2.

Returns the local server time in UTC. This value is an [ISO date](#).

**Sharded Instances** `mongos` (page 938) instances add the following field to the `isMaster` (page 732) response document:

**isMaster.msg**

Contains the value `isdbgrid` when `isMaster` (page 732) returns from a `mongos` (page 938) instance.

**Replica Sets** `isMaster` (page 732) contains these fields when returned by a member of a replica set:

**isMaster.setName**

The name of the current :replica set.

**isMaster.secondary**

A boolean value that, when `true`, indicates if the `mongod` (page 925) is a `secondary` member of a `replica set`.

**isMaster.hosts**

An array of strings in the format of "`[hostname] : [port]`" that lists all members of the `replica set` that are neither `hidden`, `passive`, nor `arbiters`.

Drivers use this array and the `isMaster.passives` (page 733) to determine which members to read from.

**isMaster.passives**

An array of strings in the format of "`[hostname] : [port]`" listing all members of the `replica set` which have a `priority` (page 481) of 0.

This field only appears if there is at least one member with a `priority` (page 481) of 0.

Drivers use this array and the `isMaster.hosts` (page 733) to determine which members to read from.

**isMaster.arbiters**

An array of strings in the format of "`[hostname] : [port]`" listing all members of the `replica set` that are `arbiters`.

This field only appears if there is at least one arbiter in the replica set.

**isMaster.primary**

A string in the format of "`[hostname] : [port]`" listing the current `primary` member of the replica set.

**isMaster.arbiterOnly**

A boolean value that, when `true`, indicates that the current instance is an `arbiter`. The `arbiterOnly` (page 733) field is only present, if the instance is an arbiter.

**isMaster.passive**

A boolean value that, when `true`, indicates that the current instance is `hidden`. The `passive` (page 734) field is only present for hidden members.

**isMaster.hidden**

A boolean value that, when `true`, indicates that the current instance is `hidden`. The `hidden` (page 734) field is only present for hidden members.

**isMaster.tags**

A document that lists any tags assigned to this member. This field is only present if there are tags assigned to the member. See *Configure Replica Set Tag Sets* (page 451) for more information.

**isMaster.me**

The `[hostname] : [port]` of the member that returned `isMaster` (page 732).

**resync**

The `resync` (page 731) command forces an out-of-date slave `mongod` (page 925) instance to re-synchronize itself. Note that this command is relevant to master-slave replication only. It does not apply to replica sets.

**Warning:** This command obtains a global write lock and will block other operations until it has completed.

**replSetFreeze**

The [replSetFreeze](#) (page 726) command prevents a replica set member from seeking election for the specified number of seconds. Use this command in conjunction with the [replSetStepDown](#) (page 730) command to make a different node in the replica set a primary.

The [replSetFreeze](#) (page 726) command uses the following syntax:

```
{ replSetFreeze: <seconds> }
```

If you want to unfreeze a replica set member before the specified number of seconds has elapsed, you can issue the command with a seconds value of 0:

```
{ replSetFreeze: 0 }
```

Restarting the [mongod](#) (page 925) process also unfreezes a replica set member.

[replSetFreeze](#) (page 726) is an administrative command, and you must issue it against the [admin database](#).

**Definition****replSetGetStatus**

The [replSetGetStatus](#) command returns the status of the replica set from the point of view of the current server. You must run the command against the [admin database](#). The command has the following prototype format:

```
{ replSetGetStatus: 1 }
```

The value specified does not affect the output of the command. Data provided by this command derives from data included in heartbeats sent to the current instance by other members of the replica set. Because of the frequency of heartbeats, these data can be several seconds out of date.

You can also access this functionality through the [rs.status\(\)](#) (page 898) helper in the [mongo](#) (page 942) shell.

The [mongod](#) (page 925) must have replication enabled and be a member of a replica set for the [replSetGetStatus](#) (page 726) to return successfully.

**Output****replSetGetStatus.set**

The **set** value is the name of the replica set, configured in the [replSet](#) (page 1000) setting. This is the same value as [\\_id](#) (page 480) in [rs.conf\(\)](#) (page 896).

**replSetGetStatus.date**

The value of the **date** field is an [ISODate](#) of the current time, according to the current server. Compare this to the value of the [lastHeartbeat](#) (page 728) to find the operational lag between the current host and the other hosts in the set.

**replSetGetStatus.myState**

The value of [myState](#) (page 727) is an integer between 0 and 10 that represents the [replica state](#) (page 487) of the current member.

**replSetGetStatus.members**

The **members** field holds an array that contains a document for every member in the replica set.

**replSetGetStatus.members.name**

The **name** field holds the name of the server.

`replicaSetGetStatus.members.self`

The `self` field is only included in the document for the current mongod instance in the members array. Its value is true.

`replicaSetGetStatus.members.errmsg`

This field contains the most recent error or status message received from the member. This field may be empty (e.g. "") in some cases.

`replicaSetGetStatus.members.health`

The `health` value is only present for the other members of the replica set (i.e. not the member that returns `rs.status` (page 898).) This field conveys if the member is up (i.e. 1) or down (i.e. 0.)

`replicaSetGetStatus.members.state`

The value of `state` (page 727) is an array of documents, each containing an integer between 0 and 10 that represents the *replica state* (page 487) of the corresponding member.

`replicaSetGetStatus.members.stateStr`

A string that describes `state` (page 727).

`replicaSetGetStatus.members.uptime`

The `uptime` (page 727) field holds a value that reflects the number of seconds that this member has been online.

This value does not appear for the member that returns the `rs.status()` (page 898) data.

`replicaSetGetStatus.members.optime`

A document that contains information regarding the last operation from the operation log that this member has applied.

`replicaSetGetStatus.members.optime.t`

A 32-bit timestamp of the last operation applied to this member of the replica set from the *oplog*.

`replicaSetGetStatus.members.optime.i`

An incremented field, which reflects the number of operations in since the last time stamp. This value only increases if there is more than one operation per second.

`replicaSetGetStatus.members.optimeDate`

An *ISODate* formatted date string that reflects the last entry from the *oplog* that this member applied. If this differs significantly from `lastHeartbeat` (page 728) this member is either experiencing “replication lag” or there have not been any new operations since the last update. Compare `members.optimeDate` between all of the members of the set.

`replicaSetGetStatus.members.lastHeartbeat`

The `lastHeartbeat` value provides an *ISODate* formatted date of the last heartbeat received from this member. Compare this value to the value of the `date` (page 727) field to track latency between these members.

This value does not appear for the member that returns the `rs.status()` (page 898) data.

`replicaSetGetStatus.members.pingMS`

The `pingMS` represents the number of milliseconds (ms) that a round-trip packet takes to travel between the remote member and the local instance.

This value does not appear for the member that returns the `rs.status()` (page 898) data.

`replicaSetGetStatus.syncingTo`

The `syncingTo` field is only present on the output of `rs.status()` (page 898) on `secondary` and recovering members, and holds the hostname of the member from which this instance is syncing.

`replicaSetInitiate`

The `replicaSetInitiate` (page 728) command initializes a new replica set. Use the following syntax:

```
{ replSetInitiate : <config_document> }
```

The <config\_document> is a [document](#) that specifies the replica set's configuration. For instance, here's a config document for creating a simple 3-member replica set:

```
{
 _id : <setname>,
 members : [
 {_id : 0, host : <host0>},
 {_id : 1, host : <host1>},
 {_id : 2, host : <host2>},
]
}
```

A typical way of running this command is to assign the config document to a variable and then to pass the document to the `rs.initiate()` (page 897) helper:

```
config = {
 _id : "my_replica_set",
 members : [
 {_id : 0, host : "rs1.example.net:27017"},
 {_id : 1, host : "rs2.example.net:27017"},
 {_id : 2, host : "rs3.example.net", arbiterOnly: true},
]
}

rs.initiate(config)
```

Notice that omitting the port cause the host to use the default port of 27017. Notice also that you can specify other options in the config documents such as the `arbiterOnly` setting in this example.

#### See also:

[Replica Set Configuration](#) (page 479), [Replica Set Tutorials](#) (page 419), and [Replica Set Reconfiguration](#) (page 483).

#### `replSetMaintenance`

The `replSetMaintenance` (page 729) admin command enables or disables the maintenance mode for a `secondary` member of a `replica set`.

The command has the following prototype form:

```
{ replSetMaintenance: <boolean> }
```

Consider the following behavior when running the `replSetMaintenance` (page 729) command:

- You cannot run the command on the Primary.
- You must run the command against the `admin` database.
- When enabled `replSetMaintenance: 1`, the member enters the RECOVERING state. While the secondary is RECOVERING:
  - The member is not accessible for read operations.
  - The member continues to sync its [oplog](#) from the Primary.

---

**Important:** On secondaries, the `compact` (page 752) command forces the secondary to enter RECOVERING (page 488) state. This prevents clients from reading during compaction. Once the operation finishes, the secondary returns to SECONDARY (page 487) state.

See [Replica Set Member States](#) (page 487) for more information about replica set member states. Refer to the “partial script for automating step down and compaction<sup>14</sup>” for an example of this procedure.

---

### **replSetReconfig**

The [replSetReconfig](#) (page 729) command modifies the configuration of an existing replica set. You can use this command to add and remove members, and to alter the options set on existing members. Use the following syntax:

```
{ replSetReconfig: <new_config_document>, force: false }
```

You may also run the command using the shell’s [rs.reconfig\(\)](#) (page 897) method.

Be aware of the following [replSetReconfig](#) (page 729) behaviors:

- You must issue this command against the [admin database](#) of the current primary member of the replica set.
- You can optionally force the replica set to accept the new configuration by specifying `force: true`. Use this option if the current member is not primary or if a majority of the members of the set are not accessible.

**Warning:** Forcing the [replSetReconfig](#) (page 729) command can lead to a [rollback](#) situation. Use with caution.

Use the `force` option to restore a replica set to new servers with different hostnames. This works even if the set members already have a copy of the data.

- A majority of the set’s members must be operational for the changes to propagate properly.
- This command can cause downtime as the set renegotiates primary-status. Typically this is 10-20 seconds, but could be as long as a minute or more. Therefore, you should attempt to reconfigure only during scheduled maintenance periods.
- In some cases, [replSetReconfig](#) (page 729) forces the current primary to step down, initiating an election for primary among the members of the replica set. When this happens, the set will drop all current connections.

---

**Note:** [replSetReconfig](#) (page 729) obtains a special mutually exclusive lock to prevent more than one [replSetReconfig](#) (page 729) operation from occurring at the same time.

---

### Description

#### **replSetSyncFrom**

New in version 2.2.

Explicitly configures which host the current [mongod](#) (page 925) pulls [oplog](#) entries from. This operation is useful for testing different patterns and in situations where a set member is not replicating from the desired host.

The [replSetSyncFrom](#) (page 730) command has the following form:

```
{ replSetSyncFrom: "hostname<:port>" }
```

The [replSetSyncFrom](#) (page 730) command has the following field:

**field string replSetSyncFrom** The name and port number of the replica set member that this member should replicate from. Use the `[hostname] : [port]` form.

---

<sup>14</sup><https://github.com/mongodb/mongo-snippets/blob/master/js/compact-example.js>

## The Target Member

The member to replicate from must be a valid source for data in the set. The member cannot be:

- The same as the [mongod](#) (page 925) on which you run [rep1SetSyncFrom](#) (page 730). In other words, a member cannot replicate from itself.
- An arbiter, because arbiters do not hold data.
- A member that does not build indexes.
- An unreachable member.
- A [mongod](#) (page 925) instance that is not a member of the same replica set.

If you attempt to replicate from a member that is more than 10 seconds behind the current member, [mongod](#) (page 925) will log a warning but will still replicate from the lagging member.

If you run [rep1SetSyncFrom](#) (page 730) during initial sync, MongoDB produces no error messages, but the sync target will not change until after the initial sync operation.

## Run from the mongo Shell

To run the command in the [mongo](#) (page 942) shell, use the following invocation:

```
db.adminCommand({ rep1SetSyncFrom: "hostname<:port>" })
```

You may also use the [rs.syncFrom\(\)](#) (page 899) helper in the [mongo](#) (page 942) shell in an operation with the following form:

```
rs.syncFrom("hostname<:port>")
```

---

**Note:** [rep1SetSyncFrom](#) (page 730) and [rs.syncFrom\(\)](#) (page 899) provide a temporary override of default behavior. [mongod](#) (page 925) will revert to the default sync behavior in the following situations:

- The [mongod](#) (page 925) instance restarts.
- The connection between the [mongod](#) (page 925) and the sync target closes.

Changed in version 2.4: The sync target falls more than 30 seconds behind another member of the replica set; the [mongod](#) (page 925) will revert to the default sync target.

---

## Replica Set Configuration

### Synopsis

This reference provides an overview of replica set configuration options and settings.

Use [rs.conf\(\)](#) (page 896) in the [mongo](#) (page 942) shell to retrieve this configuration. Note that default values are not explicitly displayed.

## Example Configuration Document

The following document provides a representation of a replica set configuration document. Angle brackets (e.g. < and >) enclose all optional fields.

```
{
 _id : <setname>,
 version: <int>,
 members: [
 {
 _id : <ordinal>,
 host : hostname<:port>,
 <arbiterOnly : <boolean>>,
 <buildIndexes : <boolean>>,
 <hidden : <boolean>>,
 <priority: <priority>>,
 <tags: { <document> }>,
 <slaveDelay : <number>>,
 <votes : <number>>
 }
 , ...
],
 <settings: {
 <getLastErrorHandlerDefaults : <lasterrdefaults>>,
 <chainingAllowed : <boolean>>
 <getLastErrorHandlerModes : <modes>>
 }>
}
```

## Configuration Variables

`local.system.replset._id`

**Type:** string

**Value:** <setname>

An `_id` field holding the name of the replica set. This reflects the set name configured with `replSet` (page 1000) or `mongod --replSet`.

`local.system.replset.members`

**Type:** array

Contains an array holding an embedded `document` for each member of the replica set. The `members` document contains a number of fields that describe the configuration of each member of the replica set.

The `members` (page 480) field in the replica set configuration document is a zero-indexed array.

`local.system.replset.members[n]._id`

**Type:** ordinal

Provides the zero-indexed identifier of every member in the replica set.

---

**Note:** When updating the replica configuration object, access the replica set members in the `members` (page 480) array with the **array index**. The array index begins with 0. Do **not** confuse this index value with the value of the `_id` (page 480) field in each document in the `members` (page 480) array.

---

`local.system.replset.members[n].host`

**Type:** <hostname><:port>

Identifies the host name of the set member with a hostname and port number. This name must be resolvable for every host in the replica set.

**Warning:** `host` (page 480) cannot hold a value that resolves to `localhost` or the local interface unless *all* members of the set are on hosts that resolve to `localhost`.

`local.system.replset.members[n].arbiterOnly`

*Optional.*

**Type:** boolean

**Default:** false

Identifies an arbiter. For arbiters, this value is `true`, and is automatically configured by `rs.addArb()` (page 896)".

`local.system.replset.members[n].buildIndexes`

*Optional.*

**Type:** boolean

**Default:** true

Determines whether the `mongod` (page 925) builds *indexes* on this member. Do not set to `false` if a replica set *can* become a primary, or if any clients ever issue queries against this instance.

Omitting index creation, and thus this setting, may be useful, **if**:

- You are only using this instance to perform backups using `mongodump` (page 951),
- this instance will receive no queries, *and*
- index creation and maintenance overburdens the host system.

If set to `false`, secondaries configured with this option *do* build indexes on the `_id` field, to facilitate operations required for replication.

**Warning:** You may only set this value when adding a member to a replica set. You may not reconfigure a replica set to change the value of the `buildIndexes` (page 481) field after adding the member to the set. Other secondaries cannot replicate from a members where `buildIndexes` (page 481) is `false`.

`local.system.replset.members[n].hidden`

*Optional.*

**Type:** boolean

**Default:** false

When this value is `true`, the replica set hides this instance, and does not include the member in the output of `db.isMaster()` (page 890) or `isMaster` (page 732). This prevents read operations (i.e. queries) from ever reaching this host by way of secondary *read preference*.

**See also:**

*Hidden Replica Set Members* (page 387)

`local.system.replset.members[n].priority`

*Optional.*

**Type:** Number, between 0 and 100.0 including decimals.

**Default:** 1

Specify higher values to make a member *more* eligible to become *primary*, and lower values to make the member *less* eligible to become primary. Priorities are only used in comparison to each other. Members of the set will veto election requests from members when another eligible member has a higher priority value. Changing the balance of priority in a replica set will trigger an election.

A [priority](#) (page 481) of 0 makes it impossible for a member to become primary.

**See also:**

[priority](#) (page 481) and [Replica Set Elections](#) (page 397).

`local.system.replset.members[n].tags`

*Optional.*

**Type:** [MongoDB Document](#)

**Default:** none

Used to represent arbitrary values for describing or tagging members for the purposes of extending [write concern](#) to allow configurable data center awareness.

Use in conjunction with [getLastErrorModes](#) (page 483) and [getLastErrorDefaults](#) (page 483) and `db.getLastError()` (page 886) (i.e. `getLastError` (page 720).)

For procedures on configuring tag sets, see [Configure Replica Set Tag Sets](#) (page 451).

---

**Important:** In tag sets, all tag values must be strings.

---

`local.system.replset.members[n].slaveDelay`

*Optional.*

**Type:** Integer. (seconds.)

**Default:** 0

Describes the number of seconds “behind” the primary that this replica set member should “lag.” Use this option to create [delayed members](#) (page 387), that maintain a copy of the data that reflects the state of the data set at some amount of time in the past, specified in seconds. Typically such delayed members help protect against human error, and provide some measure of insurance against the unforeseen consequences of changes and updates.

`local.system.replset.members[n].votes`

*Optional.*

**Type:** Integer

**Default:** 1

Controls the number of votes a server will cast in a [replica set election](#) (page 397). The number of votes each member has can be any non-negative integer, but it is highly recommended each member has 1 or 0 votes.

If you need more than 7 members in one replica set, use this setting to add additional non-voting members with a [votes](#) (page 482) value of 0.

For most deployments and most members, use the default value, 1, for [votes](#) (page 482).

`local.system.replset.settings`

*Optional.*

**Type:** [MongoDB Document](#)

The `settings` document configures options that apply to the whole replica set.

---

`local.system.replset.settings.chainingAllowed`  
*Optional.*

**Type:** boolean

**Default:** true

New in version 2.2.4.

When `chainingAllowed` (page 482) is `true`, the replica set allows *secondary* members to replicate from other secondary members. When `chainingAllowed` (page 482) is `false`, secondaries can replicate only from the *primary*.

When you run `rs.config()` (page 896) to view a replica set's configuration, the `chainingAllowed` (page 482) field appears only when set to `false`. If not set, `chainingAllowed` (page 482) is `true`.

**See also:**

[Manage Chained Replication](#) (page 457)

`local.system.replset.settings.getLastErrorDefaults`  
*Optional.*

**Type:** *MongoDB Document*

Specify arguments to the `getLastError` (page 720) that members of this replica set will use when no arguments to `getLastError` (page 720) has no arguments. If you specify *any* arguments, `getLastError` (page 720), ignores these defaults.

`local.system.replset.settings.getLastErrorModes`  
*Optional.*

**Type:** *MongoDB Document*

Defines the names and combination of `members` (page 480) for use by the application layer to guarantee *write concern* to database using the `getLastError` (page 720) command to provide *data-center awareness*.

## Example Reconfiguration Operations

Most modifications of *replica set* configuration use the `mongo` (page 942) shell. Consider the following reconfiguration operation:

---

### Example

Given the following replica set configuration:

```
{
 "_id" : "rs0",
 "version" : 1,
 "members" : [
 {
 "_id" : 0,
 "host" : "mongodb0.example.net:27017"
 },
 {
 "_id" : 1,
 "host" : "mongodb1.example.net:27017"
 },
 {
 "_id" : 2,
 "host" : "mongodb2.example.net:27017"
 }
]
}
```

```
]
 }
```

The following reconfiguration operation updates the [priority](#) (page 481) of the replica set members:

```
cfg = rs.conf()
cfg.members[0].priority = 0.5
cfg.members[1].priority = 2
cfg.members[2].priority = 2
rs.reconfig(cfg)
```

First, this operation sets the local variable `cfg` to the current replica set configuration using the [rs.conf\(\)](#) (page 896) method. Then it adds priority values to the `cfg` [document](#) for the three sub-documents in the `members` (page 480) array, accessing each replica set member with the array index and **not** the replica set member's `_id` (page 480) field. Finally, it calls the [rs.reconfig\(\)](#) (page 897) method with the argument of `cfg` to initialize this new configuration. The replica set configuration after this operation will resemble the following:

```
{
 "_id" : "rs0",
 "version" : 1,
 "members" : [
 {
 "_id" : 0,
 "host" : "mongodb0.example.net:27017",
 "priority" : 0.5
 },
 {
 "_id" : 1,
 "host" : "mongodb1.example.net:27017",
 "priority" : 2
 },
 {
 "_id" : 2,
 "host" : "mongodb2.example.net:27017",
 "priority" : 1
 }
]
}
```

---

Using the “dot notation” demonstrated in the above example, you can modify any existing setting or specify any of optional [replica set configuration variables](#) (page 480). Until you run `rs.reconfig(cfg)` at the shell, no changes will take effect. You can issue `cfg = rs.conf()` at any time before using [rs.reconfig\(\)](#) (page 897) to undo your changes and start from the current configuration. If you issue `cfg` as an operation at any point, the [mongo](#) (page 942) shell at any point will output the complete [document](#) with modifications for your review.

The [rs.reconfig\(\)](#) (page 897) operation has a “force” option, to make it possible to reconfigure a replica set if a majority of the replica set is not visible, and there is no [primary](#) member of the set. use the following form:

```
rs.reconfig(cfg, { force: true })
```

**Warning:** Forcing a `rs.reconfig()` (page 897) can lead to [rollback](#) situations and other difficult to recover from situations. Exercise caution when using this option.

---

**Note:** The [rs.reconfig\(\)](#) (page 897) shell method can force the current primary to step down and triggers an election in some situations. When the primary steps down, all clients will disconnect. This is by design. Since this typically takes 10-20 seconds, attempt to make such changes during scheduled maintenance periods.

---

## The local Database

### Overview

Every `mongod` (page 925) instance has its own `local` database, which stores data used in the replication process, and other instance-specific data. The `local` database is invisible to replication: collections in the `local` database are not replicated.

In replication, the `local` database store stores internal replication data for each member of a *replica set*. The `local` stores the following collections:

Changed in version 2.4: When running with authentication (i.e. `auth` (page 993)), authenticating to the `local` database is **not** equivalent to authenticating to the `admin` database. In previous versions, authenticating to the `local` database provided access to all databases.

### Collection on all mongod Instances

#### `local.startup_log`

On startup, each `mongod` (page 925) instance inserts a document into `startup_log` (page 485) with diagnostic information about the `mongod` (page 925) instance itself and host information. `startup_log` (page 485) is a capped collection. This information is primarily useful for diagnostic purposes.

---

#### Example

Consider the following prototype of a document from the `startup_log` (page 485) collection:

```
{
 "_id" : "<string>",
 "hostname" : "<string>",
 "startTime" : ISODate("<date>"),
 "startTimeLocal" : "<string>",
 "cmdLine" : {
 "dbpath" : "<path>",
 "<option>" : <value>
 },
 "pid" : <number>,
 "buildinfo" : {
 "version" : "<string>",
 "gitVersion" : "<string>",
 "sysInfo" : "<string>",
 "loaderFlags" : "<string>",
 "compilerFlags" : "<string>",
 "allocator" : "<string>",
 "versionArray" : [<num>, <num>, <...>],
 "javascriptEngine" : "<string>",
 "bits" : <number>,
 "debug" : <boolean>,
 "maxBsonObjectSize" : <number>
 }
}
```

Documents in the `startup_log` (page 485) collection contain the following fields:

#### `local.startup_log._id`

Includes the system hostname and a millisecond epoch value.

#### `local.startup_log.hostname`

The system's hostname.

### `local.startup_log.startTime`

A UTC `ISODate` value that reflects when the server started.

### `local.startup_log.startTimeLocal`

A string that reports the `startTime` (page 485) in the system's local time zone.

### `local.startup_log.cmdLine`

A sub-document that reports the `mongod` (page 925) runtime options and their values.

### `local.startup_log.pid`

The process identifier for this process.

### `local.startup_log.buildinfo`

A sub-document that reports information about the build environment and settings used to compile this `mongod` (page 925). This is the same output as `buildInfo` (page 762). See `buildInfo` (page 762).

---

## Collections on Replica Set Members

### `local.system.replset`

`local.system.replset` (page 486) holds the replica set's configuration object as its single document. To view the object's configuration information, issue `rs.conf()` (page 896) from the `mongo` (page 942) shell. You can also query this collection directly.

### `local.oplog.rs`

`local.oplog.rs` (page 486) is the capped collection that holds the `oplog`. You set its size at creation using the `oplogSize` (page 1000) setting. To resize the oplog after replica set initiation, use the *Change the Size of the Oplog* (page 446) procedure. For additional information, see the *Oplog Size* (page 411) section.

### `local.replset.invalid`

This contains an object used internally by replica sets to track replication status.

### `local.slaves`

This contains information about each member of the set and the latest point in time that this member has synced to. If this collection becomes out of date, you can refresh it by dropping the collection and allowing MongoDB to automatically refresh it during normal replication:

```
db.getSiblingDB("local").slaves.drop()
```

## Collections used in Master/Slave Replication

In `master/slave` replication, the `local` database contains the following collections:

- On the master:

### `local.oplog.$main`

This is the oplog for the master-slave configuration.

### `local.slaves`

This contains information about each slave.

- On each slave:

### `local.sources`

This contains information about the slave's master server.

## Replica Set Member States

Members of replica sets have states that reflect the startup process, basic operations, and potential error states.

| Num-ber | Name                                  | State Description                                                                                                                                                                                            |
|---------|---------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0       | <a href="#">STARTUP</a> (page 487)    | Cannot vote. All members start up in this state. The <a href="#">mongod</a> (page 925) parses the <a href="#">replica set configuration document</a> (page 438) while in <a href="#">STARTUP</a> (page 487). |
| 1       | <a href="#">PRIMARY</a> (page 487)    | Can vote. The <a href="#">primary</a> (page 382) is the only member to accept write operations.                                                                                                              |
| 2       | <a href="#">SECONDARY</a> (page 487)  | Can vote. The <a href="#">secondary</a> (page 382) replicates the data store.                                                                                                                                |
| 3       | <a href="#">RECOVERING</a> (page 488) | Can vote. Members either perform startup self-checks, or transition from completing a <a href="#">rollback</a> (page 401) or <a href="#">resync</a> (page 450).                                              |
| 4       | <a href="#">FATAL</a> (page 488)      | Cannot vote. Has encountered an unrecoverable error.                                                                                                                                                         |
| 5       | <a href="#">STARTUP2</a> (page 488)   | Cannot vote. Forks replication and election threads before becoming a secondary.                                                                                                                             |
| 6       | <a href="#">UNKNOWN</a> (page 488)    | Cannot vote. Has never connected to the replica set.                                                                                                                                                         |
| 7       | <a href="#">ARBITER</a> (page 487)    | Can vote. <a href="#">Arbiters</a> (page ??) do not replicate data and exist solely to participate in elections.                                                                                             |
| 8       | <a href="#">DOWN</a> (page 488)       | Cannot vote. Is not accessible to the set.                                                                                                                                                                   |
| 9       | <a href="#">ROLLBACK</a> (page 488)   | Can vote. Performs a <a href="#">rollback</a> (page 401).                                                                                                                                                    |
| 10      | <a href="#">SHUNNED</a> (page 488)    | Cannot vote. Was once in the replica set but has now been removed.                                                                                                                                           |

## States

### Core States

#### [PRIMARY](#)

Members in [PRIMARY](#) (page 487) state accept write operations. A replica set has only one primary at a time. A [SECONDARY](#) (page 487) member becomes primary after an [election](#) (page 397). Members in the [PRIMARY](#) (page 487) state are eligible to vote.

#### [SECONDARY](#)

Members in [SECONDARY](#) (page 487) state replicate the primary's data set and can be configured to accept read operations. Secondaries are eligible to vote in elections, and may be elected to the [PRIMARY](#) (page 487) state if the primary becomes unavailable.

#### [ARBITER](#)

Members in [ARBITER](#) (page 487) state do not replicate data or accept write operations. They are eligible to vote, and exist solely to break a tie during elections. Replica sets should only have a member in the [ARBITER](#) (page 487) state if the set would otherwise have an even number of members, and could suffer from tied elections. Like primaries, there should only be at most one arbiter in any replica set.

See [Replica Set Members](#) (page 382) for more information on core states.

### Initialization States

#### [STARTUP](#)

Each member of a replica set starts up in [STARTUP](#) (page 487) state. [mongod](#) (page 925) then loads that

member's replica set configuration, and transitions the member's state to [STARTUP2](#) (page 488). Members in [STARTUP](#) (page 487) are not eligible to vote.

### **STARTUP2**

Each member of a replica set enters the [STARTUP2](#) (page 488) state as soon as `mongod` (page 925) finishes loading that member's configuration. While in the [STARTUP2](#) (page 488) state, the member creates threads to handle internal replication operations. Members are in the [STARTUP2](#) (page 488) state for a short period of time before entering the [RECOVERING](#) (page 488) state. Members in the [STARTUP2](#) (page 488) state are not eligible to vote.

### **RECOVERING**

A member of a replica set enters [RECOVERING](#) (page 488) state when it is not ready to accept reads. The [RECOVERING](#) (page 488) state can occur during normal operation, and doesn't necessarily reflect an error condition. Members in the [RECOVERING](#) (page 488) state are eligible to vote in elections, but is not eligible to enter the [PRIMARY](#) (page 487) state.

During startup, members transition through [RECOVERING](#) (page 488) after [STARTUP2](#) (page 488) and before becoming [SECONDARY](#) (page 487).

During normal operation, if a [secondary](#) falls behind the other members of the replica set, it may need to [resync](#) (page 450) with the rest of the set. While resyncing, the member enters the [RECOVERING](#) (page 488) state.

Whenever the replica set replaces a [primary](#) in an election, the old primary's data collection may contain documents that did not have time to replicate to the [secondary](#) members. In this case the member rolls back those writes. During [rollback](#) (page 401), the member will have [RECOVERING](#) (page 488) state.

On secondaries, the [compact](#) (page 752) and [replSetMaintenance](#) (page 729) commands force the secondary to enter [RECOVERING](#) (page 488) state. This prevents clients from reading during those operations.

**Error States** Members in any error state can't vote.

### **FATAL**

Members that encounter an unrecoverable error enter the [FATAL](#) (page 488) state. Members in this state requires administrator intervention.

### **UNKNOWN**

Members that have never communicated status information to the replica set are in the [UNKNOWN](#) (page 488) state.

### **DOWN**

Members that lose their connection to the replica set enter the [DOWN](#) (page 488) state.

### **SHUNNED**

Members that are removed from the replica set enter the [SHUNNED](#) (page 488) state.

### **ROLLBACK**

When a [SECONDARY](#) (page 487) rolls back a write operation after transitioning from [PRIMARY](#) (page 487), it enters the [ROLLBACK](#) (page 488) state. See [Rollbacks During Replica Set Failover](#) (page 401).

## Read Preference Reference

Read preference describes how MongoDB clients route read operations to members of a [replica set](#).

By default, an application directs its read operations to the [primary](#) member in a [replica set](#). Reading from the primary guarantees that read operations reflect the latest version of a document. However, by distributing some or all reads to secondary members of the replica set, you can improve read throughput or reduce latency for an application that does not require fully up-to-date data.

| Read Preference Mode                          | Description                                                                                                                                                   |
|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <a href="#">primary</a> (page 489)            | Default mode. All operations read from the current replica set <i>primary</i> .                                                                               |
| <a href="#">primaryPreferred</a> (page 489)   | In most situations, operations read from the <i>primary</i> but if it is unavailable, operations read from <i>secondary</i> members.                          |
| <a href="#">secondary</a> (page 489)          | All operations read from the <i>secondary</i> members of the replica set.                                                                                     |
| <a href="#">secondaryPreferred</a> (page 489) | In most situations, operations read from <i>secondary</i> members but if no <i>secondary</i> members are available, operations read from the <i>primary</i> . |
| <a href="#">nearest</a> (page 490)            | Operations read from the <i>nearest</i> member of the <i>replica set</i> , irrespective of the member's type.                                                 |

## Read Preference Modes

### **primary**

All read operations use only the current replica set *primary*. This is the default. If the primary is unavailable, read operations produce an error or throw an exception.

The [primary](#) (page 489) read preference mode is not compatible with read preference modes that use *tag sets* (page 407). If you specify a tag set with [primary](#) (page 489), the driver will produce an error.

### **primaryPreferred**

In most situations, operations read from the *primary* member of the set. However, if the primary is unavailable, as is the case during *failover* situations, operations read from secondary members.

When the read preference includes a *tag set* (page 407), the client reads first from the primary, if available, and then from *secondaries* that match the specified tags. If no secondaries have matching tags, the read operation produces an error.

Since the application may receive data from a secondary, read operations using the [primaryPreferred](#) (page 489) mode may return stale data in some situations.

**Warning:** Changed in version 2.2: [mongos](#) (page 938) added full support for read preferences.

When connecting to a [mongos](#) (page 938) instance older than 2.2, using a client that supports read preference modes, [primaryPreferred](#) (page 489) will send queries to secondaries.

### **secondary**

Operations read *only* from the *secondary* members of the set. If no secondaries are available, then this read operation produces an error or exception.

Most sets have at least one secondary, but there are situations where there may be no available secondary. For example, a set with a primary, a secondary, and an *arbiter* may not have any secondaries if a member is in recovering state or unavailable.

When the read preference includes a *tag set* (page 407), the client attempts to find secondary members that match the specified tag set and directs reads to a random secondary from among the *nearest group* (page 408). If no secondaries have matching tags, the read operation produces an error.<sup>15</sup>

Read operations using the [secondary](#) (page 489) mode may return stale data.

### **secondaryPreferred**

In most situations, operations read from *secondary* members, but in situations where the set consists of a single [primary](#) (and no other members,) the read operation will use the set's primary.

<sup>15</sup> If your set has more than one secondary, and you use the [secondary](#) (page 489) read preference mode, consider the following effect. If you have a *three member replica set* (page 391) with a primary and two secondaries, and if one secondary becomes unavailable, all [secondary](#) (page 489) queries must target the remaining secondary. This will double the load on this secondary. Plan and provide capacity to support this as needed.

When the read preference includes a [tag set](#) (page 407), the client attempts to find a secondary member that matches the specified tag set and directs reads to a random secondary from among the [nearest group](#) (page 408). If no secondaries have matching tags, the read operation produces an error.

Read operations using the [secondaryPreferred](#) (page 489) mode may return stale data.

**Warning:** In some situations using [secondaryPreferred](#) (page 489) to distribute read load to replica sets may carry significant operational risk: if all secondaries are unavailable and your set has enough [arbiters](#) to prevent the primary from stepping down, then the primary will receive all traffic from clients. For this reason, use [secondary](#) (page 489) to distribute read load to replica sets, not [secondaryPreferred](#) (page 489).

### [nearest](#)

The driver reads from the [nearest](#) member of the [set](#) according to the [member selection](#) (page 408) process. Reads in the [nearest](#) (page 490) mode do not consider the member's [type](#). Reads in [nearest](#) (page 490) mode may read from both primaries and secondaries.

Set this mode to minimize the effect of network latency on read operations without preference for current or stale data.

If you specify a [tag set](#) (page 407), the client attempts to find a replica set member that matches the specified tag set and directs reads to an arbitrary member from among the [nearest group](#) (page 408).

Read operations using the [nearest](#) (page 490) mode may return stale data.

**Note:** All operations read from a member of the nearest group of the replica set that matches the specified read preference mode. The [nearest](#) (page 490) mode prefers low latency reads over a member's [primary](#) or [secondary](#) status.

For [nearest](#) (page 490), the client assembles a list of acceptable hosts based on tag set and then narrows that list to the host with the shortest ping time and all other members of the set that are within the “local threshold,” or acceptable latency. See [Member Selection](#) (page 408) for more information.

---

## Read Preferences for Database Commands

Because some [database commands](#) read and return data from the database, all of the official drivers support full [read preference mode semantics](#) (page 489) for the following commands:

- [group](#) (page 697)
- [mapReduce](#) (page 701)<sup>16</sup>
- [aggregate](#) (page 694)
- [collStats](#) (page 763)
- [dbStats](#) (page 767)
- [count](#) (page 695)
- [distinct](#) (page 696)
- [geoNear](#) (page 708)
- [geoSearch](#) (page 709)
- [geoWalk](#) (page 710)

<sup>16</sup> Only “inline” [mapReduce](#) (page 701) operations that do not write data support read preference, otherwise these operations must run on the [primary](#) members.

New in version 2.4: [mongos](#) (page 938) adds support for routing commands to shards using read preferences. Previously [mongos](#) (page 938) sent all commands to shards' primaries.



---

## Sharding

---

Sharding is the process of storing data records across multiple machines and is MongoDB's approach to meeting the demands of data growth. As the size of the data increases, a single machine may not be sufficient to store the data nor provide an acceptable read and write throughput. Sharding solves the problem with horizontal scaling. With sharding, you add more machines to support data growth and the demands of read and write operations.

**Sharding Introduction** (page 493) A high-level introduction to horizontal scaling, data partitioning, and sharded clusters in MongoDB.

**Sharding Concepts** (page 498) The core documentation of sharded cluster features, configuration, architecture and behavior.

**Sharded Cluster Components** (page 499) A sharded cluster consists of shards, config servers, and `mongos` (page 938) instances.

**Sharded Cluster Architectures** (page 503) Outlines the requirements for sharded clusters, and provides examples of several possible architectures for sharded clusters.

**Sharded Cluster Behavior** (page 505) Discusses the operations of sharded clusters with regards to the automatic balancing of data in a cluster and other related availability and security considerations.

**Sharding Mechanics** (page 515) Discusses the internal operation and behavior of sharded clusters, including chunk migration, balancing, and the cluster metadata.

**Sharded Cluster Tutorials** (page 521) Tutorials that describe common procedures and administrative operations relevant to the use and maintenance of sharded clusters.

**Sharding Reference** (page 563) Reference for sharding-related functions and operations.

## 9.1 Sharding Introduction

Sharding is a method for storing data across multiple machines. MongoDB uses sharding to support deployments with very large data sets and high throughput operations.

### 9.1.1 Purpose of Sharding

Database systems with large data sets and high throughput applications can challenge the capacity of a single server. High query rates can exhaust the CPU capacity of the server. Larger data sets exceed the storage capacity of a single machine. Finally, working set sizes larger than the system's RAM stress the I/O capacity of disk drives.

To address these issues of scales, database systems have two basic approaches: **vertical scaling** and **sharding**.

**Vertical scaling** adds more CPU and storage resources to increase capacity. Scaling by adding capacity has limitations: high performance systems with large numbers of CPUs and large amount of RAM are disproportionately *more expensive* than smaller systems. Additionally, cloud-based providers may only allow users to provision smaller instances. As a result there is a *practical maximum* capability for vertical scaling.

**Sharding**, or *horizontal scaling*, by contrast, divides the data set and distributes the data over multiple servers, or **shards**. Each shard is an independent database, and collectively, the shards make up a single logical database.

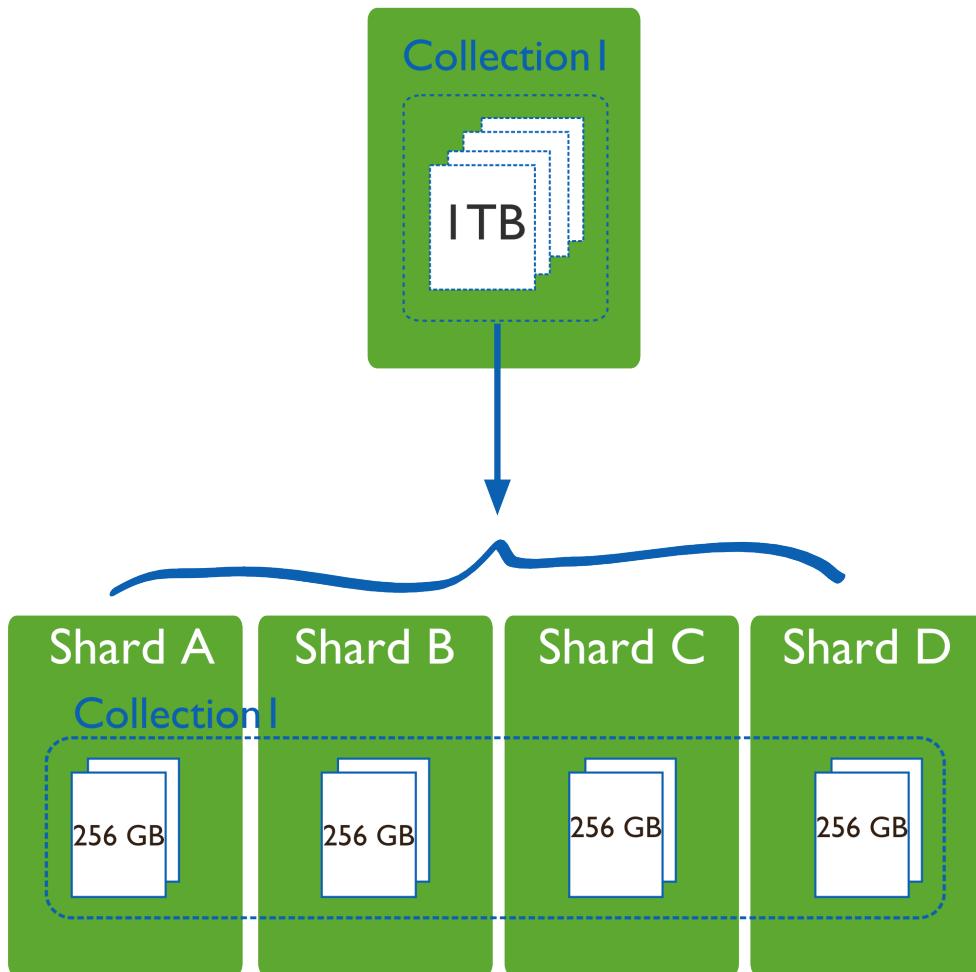


Figure 9.1: Diagram of a large collection with data distributed across 4 shards.

Sharding addresses the challenge of scaling to support high throughput and large data sets:

- Sharding reduces the number of operations each shard handles. Each shard processes fewer operations as the cluster grows. As a result, shared clusters can increase capacity and throughput *horizontally*.

For example, to insert data, the application only needs to access the shard responsible for that records.

- Sharding reduces the amount of data that each server needs to store. Each shard stores less data as the cluster grows.

For example, if a database has a 1 terabyte data set, and there are 4 shards, then each shard might hold only 256GB of data. If there are 40 shards, then each shard might hold only 25GB of data.

### 9.1.2 Sharding in MongoDB

MongoDB supports sharding through the configuration of a [sharded clusters](#).

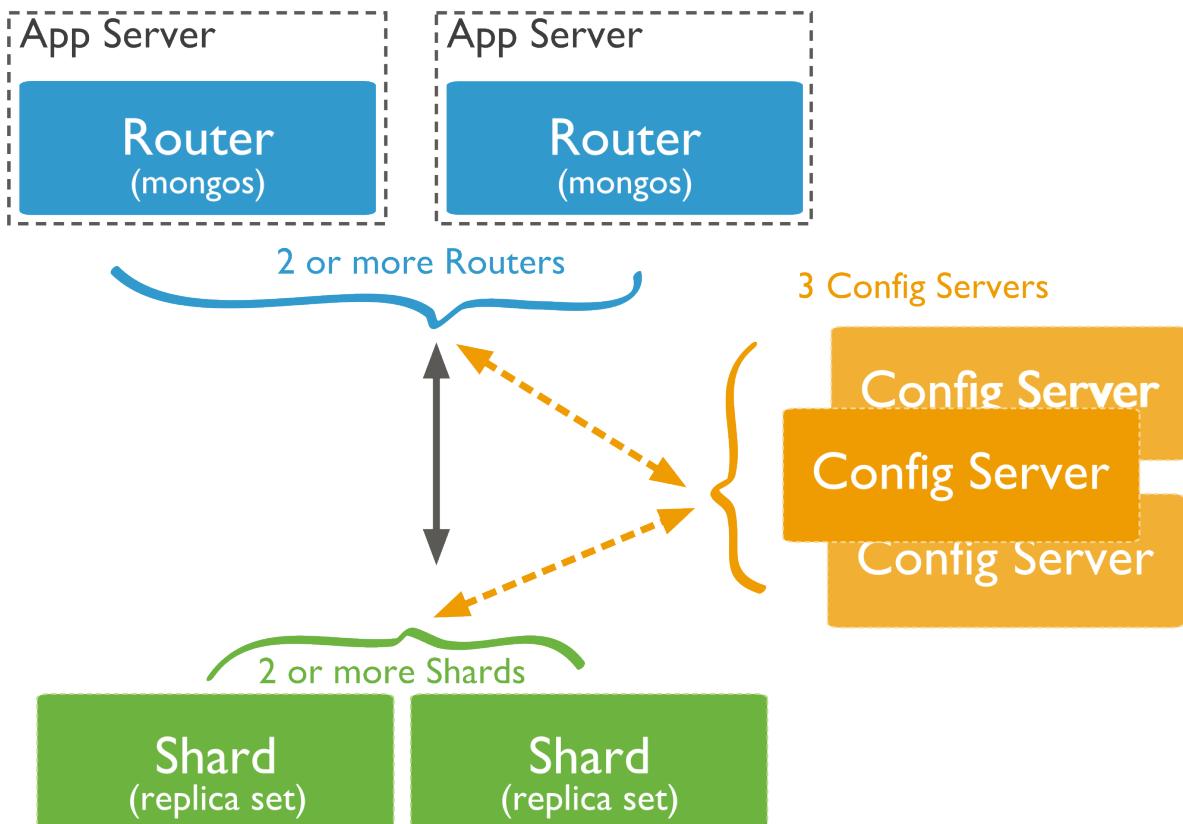


Figure 9.2: Diagram of a sample sharded cluster for production purposes. Contains exactly 3 config servers, 2 or more [mongos](#) (page 938) query routers, and at least 2 shards. The shards are replica sets.

Sharded cluster has the following components: [shards](#), [query routers](#) and [config servers](#).

**Shards** store the data. To provide high availability and data consistency, in a production sharded cluster, each shard is a [replica set](#)<sup>1</sup>. For more information on replica sets, see [Replica Sets](#) (page 381).

**Query Routers**, or [mongos](#) (page 938) instances, interface with client applications and direct operations to the appropriate shard or shards. The query router processes and targets operations to shards and then returns results to the clients. A sharded cluster can contain more than one query router to divide the client request load. A client sends requests to one query router. Most sharded cluster have many query routers.

**Config servers** store the cluster's metadata. This data contains a mapping of the cluster's data set to the shards. The query router uses this metadata to target operations to specific shards. Production sharded clusters have *exactly* 3 config servers.

### 9.1.3 Data Partitioning

MongoDB distributes data, or shards, at the collection level. Sharding partitions a collection's data by the **shard key**.

<sup>1</sup> For development and testing purposes only, each **shard** can be a single [mongod](#) (page 925) instead of a replica set. Do **not** deploy production clusters without 3 config servers.

## Shard Keys

To shard a collection, you need to select a **shard key**. A *shard key* is either an indexed field or an indexed compound field that exists in every document in the collection. MongoDB divides the shard key values into **chunks** and distributes the *chunks* evenly across the shards. To divide the shard key values into chunks, MongoDB uses either **range based partitioning** and **hash based partitioning**. See [Shard Keys](#) (page 506) for more information.

## Range Based Sharding

For *range-based sharding*, MongoDB divides the data set into ranges determined by the shard key values to provide **range based partitioning**. Consider a numeric shard key: If you visualize a number line that goes from negative infinity to positive infinity, each value of the shard key falls at some point on that line. MongoDB partitions this line into smaller, non-overlapping ranges called **chunks** where a chunk is range of values from some minimum value to some maximum value.

Given a range based partitioning system, documents with “close” shard key values are likely to be in the same chunk, and therefore on the same shard.

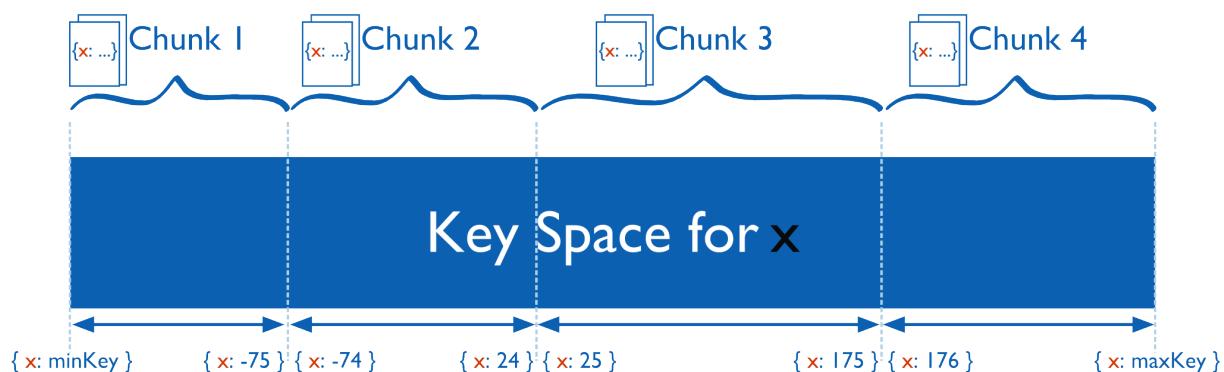


Figure 9.3: Diagram of the shard key value space segmented into smaller ranges or chunks.

## Hash Based Sharding

For *hash based partitioning*, MongoDB computes a hash of a field’s value, and then uses these hashes to create chunks. With hash based partitioning, two documents with “close” shard key values are *unlikely* to be part of the same chunk. This ensures a more random distribution of a collection in the cluster.

## Performance Distinctions between Range and Hash Based Partitioning

Range based partitioning supports more efficient range queries. Given a range query on the shard key, the query router can easily determine which chunks overlap that range and route the query to only those shards that contain these chunks.

However, range based partitioning can result in an uneven distribution of data, which may negate some of the benefits of sharding. For example, if the shard key is a linearly increasing field, such as time, then all requests for a given time range will map to the same chunk, and thus the same shard. In this situation, a small set of shards may receive the majority of requests and the system would not scale very well.

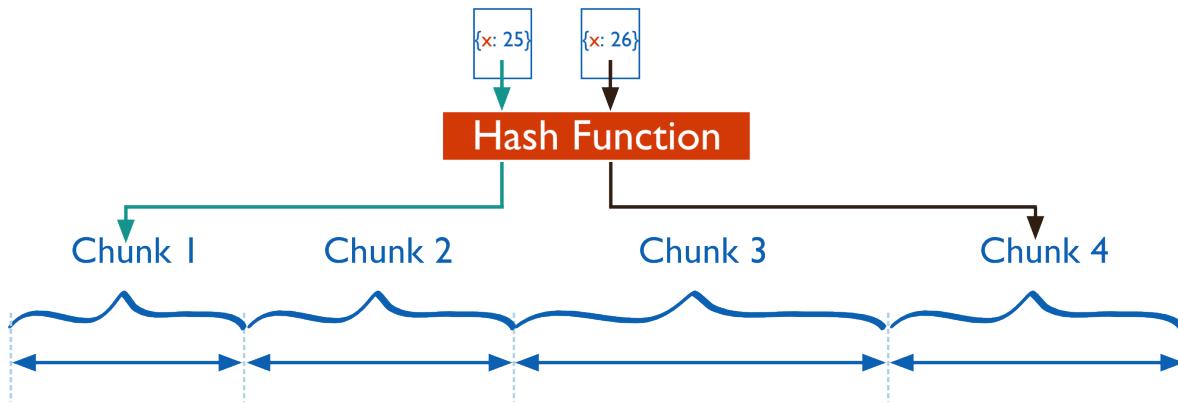


Figure 9.4: Diagram of the hashed based segmentation.

Hash based partitioning, by contrast, ensures an even distribution of data at the expense of efficient range queries. Hashed key values results in random distribution of data across chunks and therefore shards. But random distribution makes it more likely that a range query on the shard key will not be able to target a few shards but would more likely query every shard in order to return a result.

#### 9.1.4 Maintaining a Balanced Data Distribution

The addition of new data or the addition of new servers can result in data distribution imbalances within the cluster, such as a particular shard contains significantly more chunks than another shard or a size of a chunk is significantly greater than other chunk sizes.

MongoDB ensures a balanced cluster using two background processes: splitting and the balancer.

##### Splitting

Splitting is a background process that keeps chunks from growing too large. When a chunk grows beyond a [specified chunk size](#) (page 519), MongoDB splits the chunk in half. Inserts and updates triggers splits. Splits are an efficient meta-data change. To create splits, MongoDB does *not* migrate any data or affect the shards.

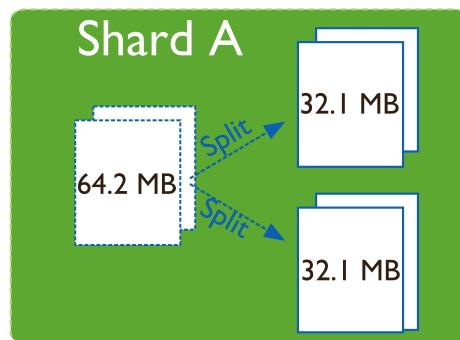


Figure 9.5: Diagram of a shard with a chunk that exceeds the default [chunk size](#) (page 519) of 64 MB and triggers a split of the chunk into two chunks.

## Balancing

The [balancer](#) (page 516) is a background process that manages chunk migrations. The balancer runs in all of the query routers in a cluster.

When the distribution of a sharded collection in a cluster is uneven, the balancer process migrates chunks from the shard that has the largest number of chunks to the shard with the least number of chunks until the collection balances. For example: if collection `users` has 100 chunks on *shard 1* and 50 chunks on *shard 2*, the balancer will migrate chunks from *shard 1* to *shard 2* until the collection achieves balance.

The shards manage *chunk migrations* as a background operation. During migration, all requests for a chunk's data address the “origin” shard.

In a chunk migration, the *destination shard* receives all the documents in the chunk from the *origin shard*. Then, the destination shard captures and applies all changes made to the data during migration process. Finally, the destination shard updates the metadata regarding the location of the on *config server*.

If there’s an error during the migration, the balancer aborts the process leaving the chunk on the origin shard. MongoDB removes the chunks data from the origin shard **after** the migration completes successfully.

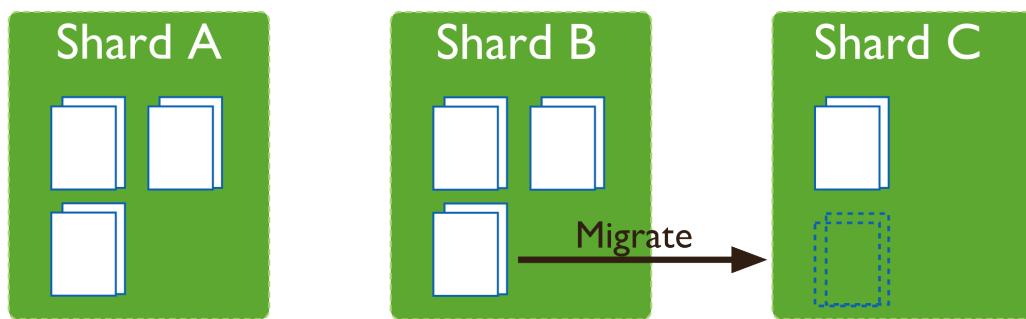


Figure 9.6: Diagram of a collection distributed across three shards. For this collection, the difference in the number of chunks between the shards reaches the [migration thresholds](#) (page 517) (in this case, 2) and triggers migration.

## Adding and Removing Shards from the Cluster

Adding a shard to a cluster creates an imbalance since the new shard has no chunks. While MongoDB begins migrating data to the new shard immediately, it can take some time before the cluster balances.

When removing a shard, the balancer migrates all chunks from to other shards. After migrating all data and updating the meta data, you can safely remove the shard.

## 9.2 Sharding Concepts

These documents present the details of sharding in MongoDB. These include the components, the architectures, and the behaviors of MongoDB sharded clusters. For an overview of sharding and sharded clusters, see [Sharding Introduction](#) (page 493).

**Sharded Cluster Components (page 499)** A sharded cluster consists of shards, config servers, and `mongos` (page 938) instances.

**Shards (page 499)** A shard is a `mongod` (page 925) instance that holds a part of the sharded collection’s data.

**Config Servers** (page 502) Config servers hold the metadata about the cluster, such as the shard location of the data.

**Sharded Cluster Architectures** (page 503) Outlines the requirements for sharded clusters, and provides examples of several possible architectures for sharded clusters.

**Sharded Cluster Requirements** (page 503) Discusses the requirements for sharded clusters in MongoDB.

**Production Cluster Architecture** (page 504) Sharded cluster for production has component requirements to provide redundancy and high availability.

**Sharded Cluster Behavior** (page 505) Discusses the operations of sharded clusters with regards to the automatic balancing of data in a cluster and other related availability and security considerations.

**Shard Keys** (page 506) MongoDB uses the shard key to divide a collection's data across the cluster's shards.

**Sharded Cluster High Availability** (page 508) Sharded clusters provide ways to address some availability concerns.

**Sharded Cluster Query Routing** (page 510) The cluster's routers, or `mongos` instances, send reads and writes to the relevant shard or shards.

**Sharding Mechanics** (page 515) Discusses the internal operation and behavior of sharded clusters, including chunk migration, balancing, and the cluster metadata.

**Sharded Collection Balancing** (page 516) Balancing distributes a sharded collection's data cluster to all of the shards.

**Sharded Cluster Metadata** (page 520) The cluster maintains internal metadata that reflects the location of data within the cluster.

## 9.2.1 Sharded Cluster Components

*Sharded clusters* implement *sharding*. A sharded cluster consists of the following components:

**Shards** A shard is a MongoDB instance that holds a subset of a collection's data. Each shard is either a single `mongod` (page 925) instance or a *replica set*. In production, all shards are replica sets. For more information see [Shards](#) (page 499).

**Config Servers** Each *config server* (page 502) is a `mongod` (page 925) instance that holds metadata about the cluster. The metadata maps *chunks* to shards. For more information, see [Config Servers](#) (page 502).

**Routing Instances** Each router is a `mongos` (page 938) instance that routes the reads and writes from applications to the shards. Applications do not access the shards directly. For more information see [Sharded Cluster Query Routing](#) (page 510).

Enable sharding in MongoDB on a per-collection basis. For each collection you shard, you will specify a *shard key* for that collection.

Deploy a sharded cluster, see [Deploy a Sharded Cluster](#) (page 522).

### Shards

A shard is a *replica set* or a single `mongod` (page 925) that contains a subset of the data for the sharded cluster. Together, the cluster's shards hold the entire data set for the cluster.

Typically each shard is a replica set. The replica set provides redundancy and high availability for the data in each shard.

---

**Important:** MongoDB shards data on a *per collection* basis. You *must* access all data in a sharded cluster via the `mongos` (page 938) instances. If you connect directly to a shard, you will see only its fraction of the cluster's data.

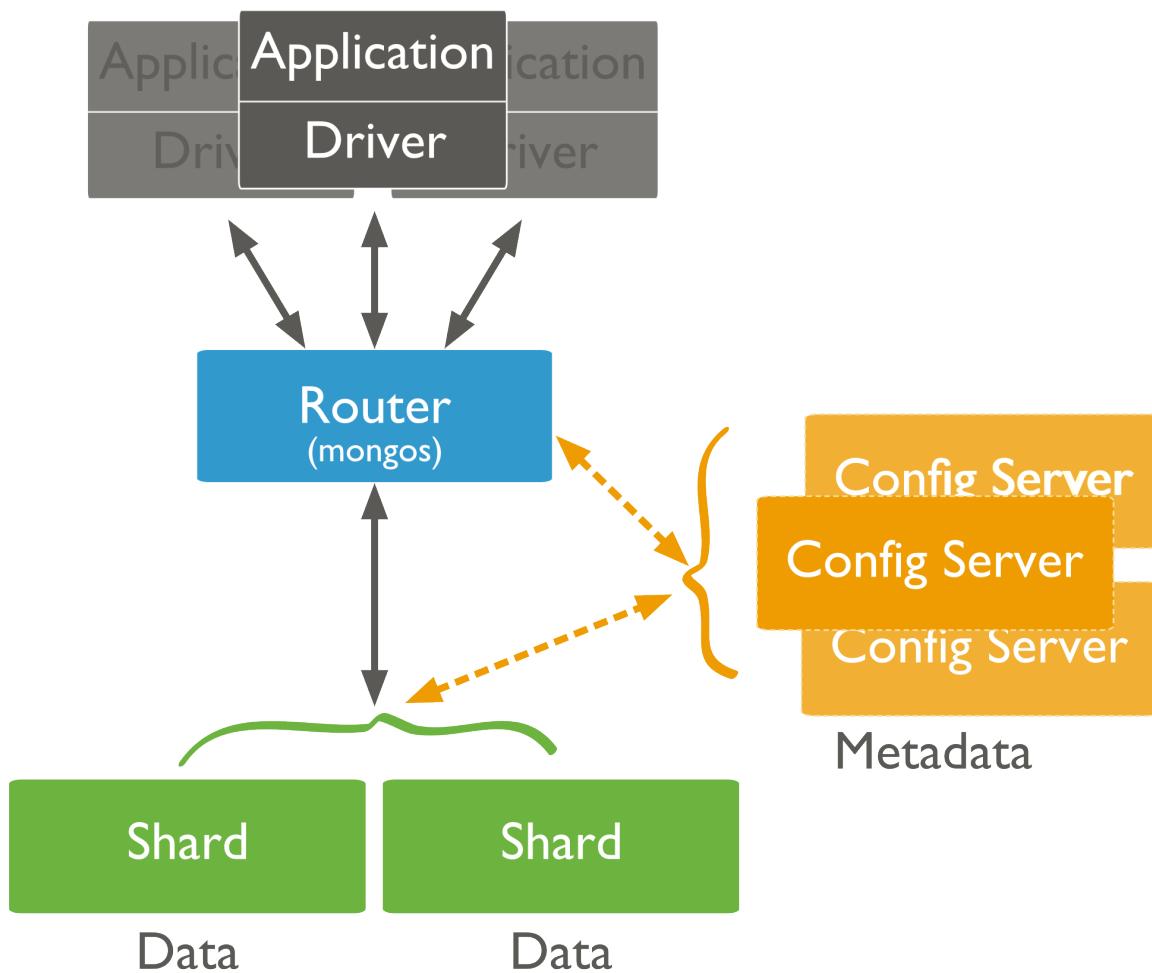


Figure 9.7: Diagram of a sharded cluster.

There is no particular order to the data set on a specific shard. MongoDB does not guarantee that any two contiguous chunks will reside on a single shard.

### Primary Shard

Every database has a “primary”<sup>2</sup> shard that holds all the un-sharded collections in that database.

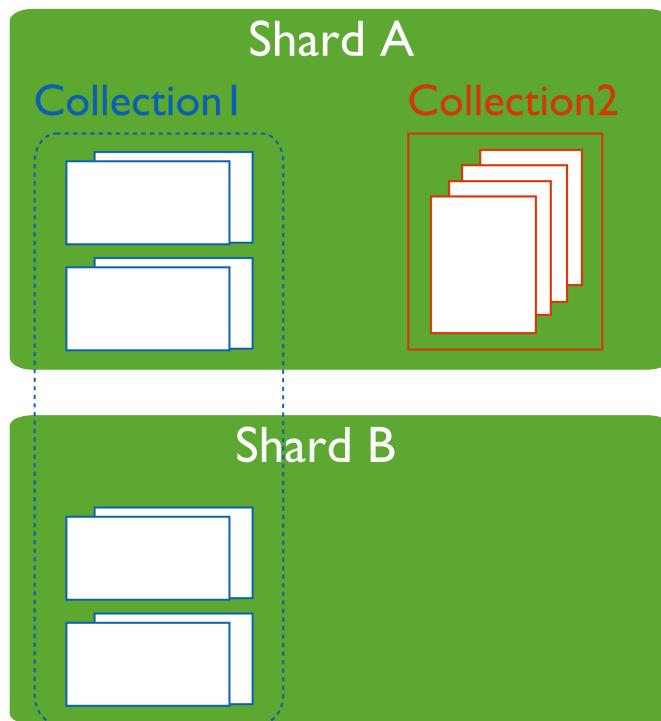


Figure 9.8: Diagram of a primary shard. A primary shard contains non-sharded collections as well as chunks of documents from sharded collections. Shard A is the primary shard.

To change the primary shard for a database, use the [movePrimary](#) (page 743) command.

**Warning:** The [movePrimary](#) (page 743) command can be expensive because it copies all non-sharded data to the new shard. During this time, this data will be unavailable for other operations.

When you deploy a new *sharded cluster*, the “first” shard becomes the primary shard for all existing databases before enabling sharding. Databases created subsequently may reside on any shard in the cluster.

### Shard Status

Use the `sh.status()` (page 910) method in the `mongo` (page 942) shell to see an overview of the cluster. This reports includes which shard is primary for the database and the *chunk* distribution across the shards. See `sh.status()` (page 910) method for more details.

<sup>2</sup> The term “primary” shard has nothing to do with the term *primary* in the context of *replica sets*.

## Config Servers

Config servers are special [mongod](#) (page 925) instances that store the [metadata](#) (page 520) for a sharded cluster. Config servers use a two-phase commit to ensure immediate consistency and reliability. Config servers *do not* run as replica sets. All config servers must be available to deploy a sharded cluster or to make any changes to cluster metadata.

A production sharded cluster has *exactly three* config servers. For testing purposes you may deploy a cluster with a single config server. But to ensure redundancy and safety in production, you should always use three.

**Warning:** If your cluster has a single config server, then the config server is a single point of failure. If the config server is inaccessible, the cluster is not accessible. If you cannot recover the data on a config server, the cluster will be inoperable.

**Always** use three config servers for production deployments.

Config servers store metadata for a single sharded cluster. Each cluster must have its own config servers.

---

### Tip

Use CNAMEs to identify your config servers to the cluster so that you can rename and renumber your config servers without downtime.

---

## Config Database

Config servers store the metadata in the [config database](#) (page 564). The [mongos](#) (page 938) instances cache this data and use it to route reads and writes to shards.

### Read and Write Operations on Config Servers

MongoDB only writes data to the config server in the following cases:

- To create splits in existing chunks. For more information, see [chunk splitting](#) (page 519).
- To migrate a chunk between shards. For more information, see [chunk migration](#) (page 518).

MongoDB reads data from the config server data in the following cases:

- A new [mongos](#) (page 938) starts for the first time, or an existing [mongos](#) (page 938) restarts.
- After a chunk migration, the [mongos](#) (page 938) instances update themselves with the new cluster metadata.

MongoDB also uses the config server to manage distributed locks.

## Config Server Availability

If one or two config servers become unavailable, the cluster's metadata becomes *read only*. You can still read and write data from the shards, but no chunk migrations or splits will occur until all three servers are available.

If all three config servers are unavailable, you can still use the cluster if you do not restart the [mongos](#) (page 938) instances until after the config servers are accessible again. If you restart the [mongos](#) (page 938) instances before the config servers are available, the [mongos](#) (page 938) will be unable to route reads and writes.

Clusters become inoperable without the cluster metadata. *Always*, ensure that the config servers remain available and intact. As such, backups of config servers are critical. The data on the config server is small compared to the data

stored in a cluster. This means the config server has a relatively low activity load, and the config server does not need to be always available to support a sharded cluster. As a result, it is easy to back up the config servers.

If the name or address that a sharded cluster uses to connect to a config server changes, you must restart **every** `mongod` (page 925) and `mongos` (page 938) instance in the sharded cluster. Avoid downtime by using CNAMEs to identify config servers within the MongoDB deployment.

See [Renaming Config Servers and Cluster Availability](#) (page 509) for more information.

## 9.2.2 Sharded Cluster Architectures

The following documents introduce deployment patterns for sharded clusters.

[Sharded Cluster Requirements](#) (page 503) Discusses the requirements for sharded clusters in MongoDB.

[Production Cluster Architecture](#) (page 504) Sharded cluster for production has component requirements to provide redundancy and high availability.

[Sharded Cluster Test Architecture](#) (page 505) Sharded clusters for testing and development can have fewer components.

### Sharded Cluster Requirements

While sharding is a powerful and compelling feature, sharded clusters have significant infrastructure requirements and increases the overall complexity of a deployment. As a result, only deploy sharded clusters when indicated by application and operational requirements

Sharding is the *only* solution for some classes of deployments. Use `sharded clusters` if:

- your data set approaches or exceeds the storage capacity of a single MongoDB instance.
- the size of your system's active *working set* will soon exceed the capacity of your system's *maximum RAM*.
- a single MongoDB instance cannot meet the demands of your write operations, and all other approaches have not reduced contention.

If these attributes are not present in your system, sharding will only add complexity to your system without adding much benefit.

---

**Important:** It takes time and resources to deploy sharding. If your system has *already* reached or exceeded its capacity, it will be difficult to deploy sharding without impacting your application.

As a result, if you think you will need to partition your database in the future, **do not** wait until your system is overcapacity to enable sharding.

---

When designing your data model, take into consideration your sharding needs.

### Data Quantity Requirements

Your cluster should manage a large quantity of data if sharding is to have an effect. The default `chunk` size is 64 megabytes. And the `balancer` (page 516) will not begin moving data across shards until the imbalance of chunks among the shards exceeds the `migration threshold` (page 517). In practical terms, unless your cluster has many hundreds of megabytes of data, your data will remain on a single shard.

In some situations, you may need to shard a small collection of data. But most of the time, sharding a small collection is not worth the added complexity and overhead unless you need additional write capacity. If you have a small data

set, a properly configured single MongoDB instance or a replica set will usually be enough for your persistence layer needs.

[Chunk](#) size is *user configurable*. For most deployments, the default value is of 64 megabytes is ideal. See [Chunk Size](#) (page 519) for more information.

## Production Cluster Architecture

In a production cluster, you must ensure that data is redundant and that your systems are highly available. To that end, a production cluster must have the following components:

- Three [config servers](#) (page 502). Each config servers must be on separate machines. A single [sharded cluster](#) must have exclusive use of its [config servers](#) (page 502). If you have multiple sharded clusters, you will need to have a group of config servers for each cluster.
- Two or more [replica sets](#). These replica sets are the [shards](#). For information on replica sets, see [Replication](#) (page 377).
- One or more [mongos](#) (page 938) instances. [mongos](#) (page 938) is the routers for the cluster. Typically, deployments have one [mongos](#) (page 938) instance on each application server. You may also may deploy a group of [mongos](#) (page 938) instances and use a proxy/load balancer between the application and the [mongos](#) (page 938).

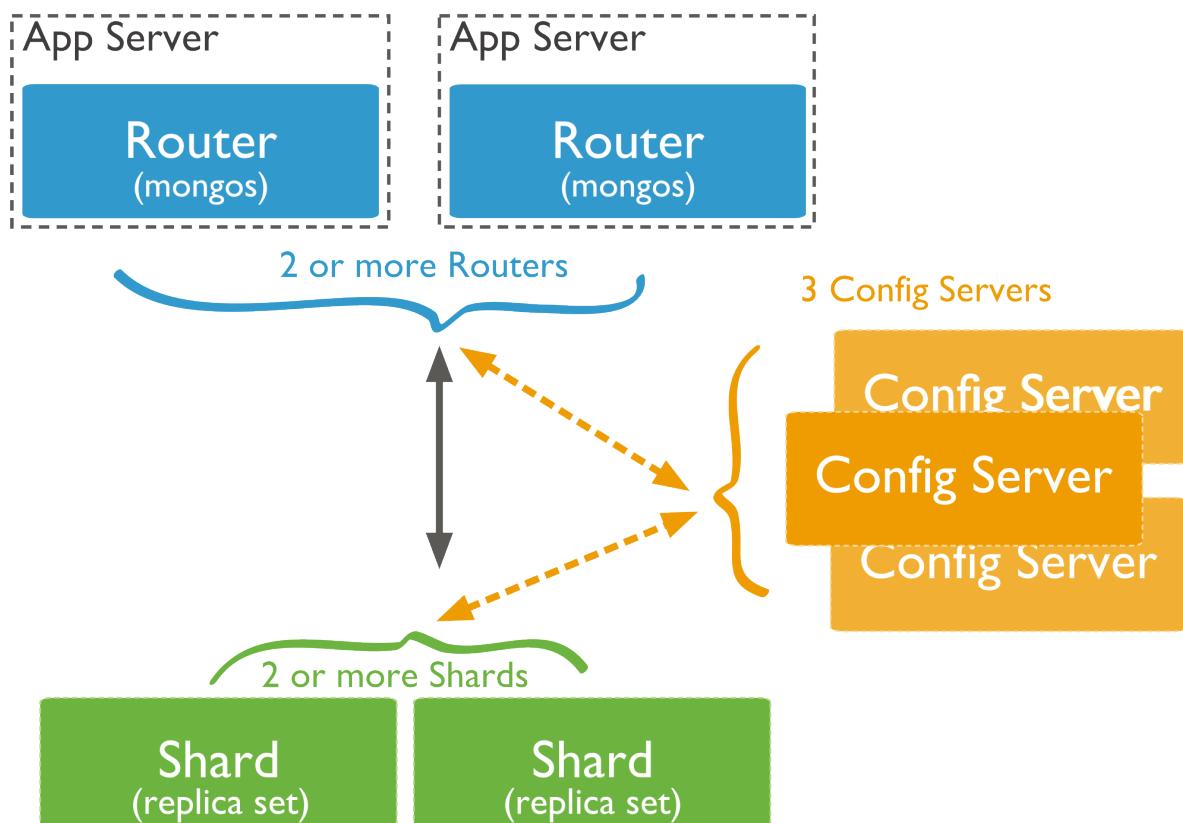


Figure 9.9: Diagram of a sample sharded cluster for production purposes. Contains exactly 3 config servers, 2 or more [mongos](#) (page 938) query routers, and at least 2 shards. The shards are replica sets.

## Sharded Cluster Test Architecture

**Warning:** Use the test cluster architecture for testing and development only.

For testing and development, you can deploy a minimal sharded clusters cluster. These **non-production** clusters have the following components:

- One [config server](#) (page 502).
- At least one shard. Shards are either [replica sets](#) or a standalone [mongod](#) (page 925) instances.
- One [mongos](#) (page 938) instance.

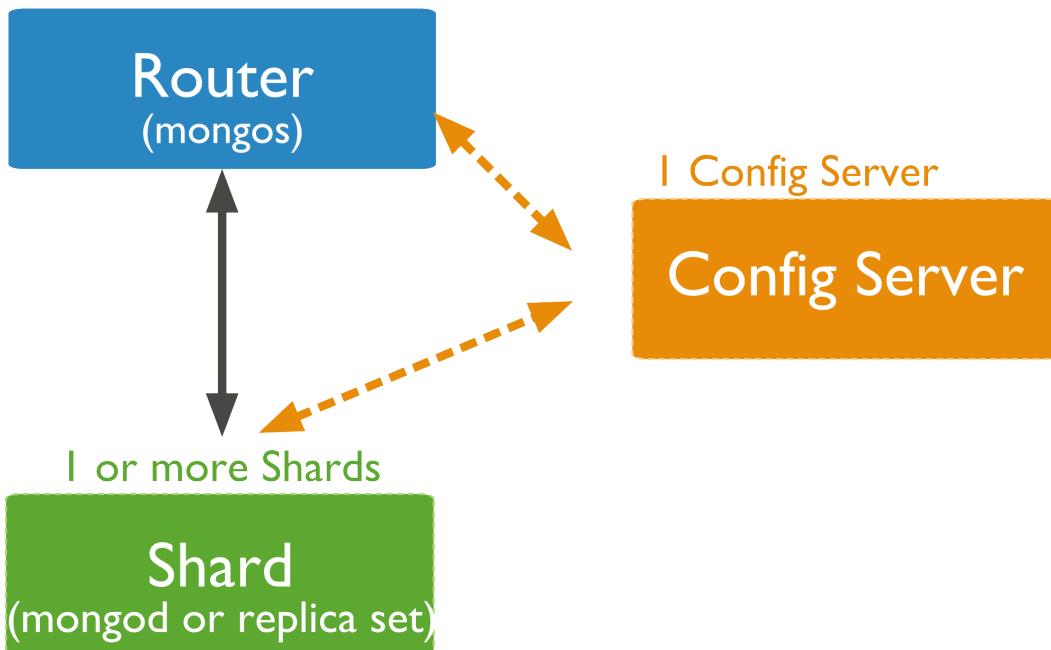


Figure 9.10: Diagram of a sample sharded cluster for testing/development purposes only. Contains only 1 config server, 1 [mongos](#) (page 938) router, and at least 1 shard. The shard can be either a replica set or a standalone [mongod](#) (page 925) instance.

### See

[Production Cluster Architecture](#) (page 504)

### 9.2.3 Sharded Cluster Behavior

These documents address the distribution of data and queries to a sharded cluster as well as specific security and availability considerations for sharded clusters.

[Shard Keys](#) (page 506) MongoDB uses the shard key to divide a collection's data across the cluster's shards.

[Sharded Cluster High Availability](#) (page 508) Sharded clusters provide ways to address some availability concerns.

[Sharded Cluster Security](#) (page 509) MongoDB controls access to sharded clusters with key files.

**Sharded Cluster Query Routing** (page 510) The cluster's routers, or `mongos` instances, send reads and writes to the relevant shard or shards.

## Shard Keys

The shard key determines the distribution of the collection's *documents* among the cluster's *shards*. The shard key is either an indexed *field* or an indexed compound field that exists in every document in the collection.

MongoDB partitions data in the collection using ranges of shard key values. Each range, or *chunk*, defines a non-overlapping range of shard key values. MongoDB distributes the chunks, and their documents, among the shards in the cluster.

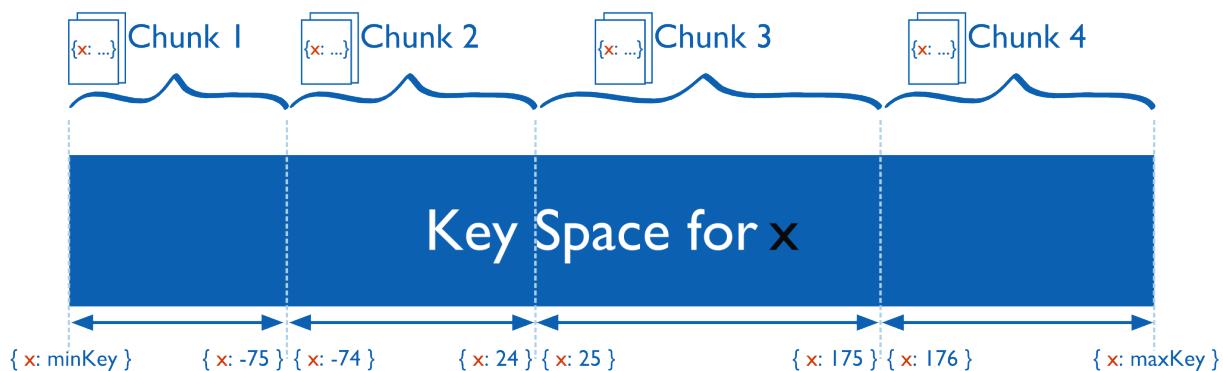


Figure 9.11: Diagram of the shard key value space segmented into smaller ranges or chunks.

When a chunk grows beyond the *chunk size* (page 519), MongoDB *splits* the chunk into smaller chunks, always based on ranges in the shard key.

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**Important:** Shard keys are immutable and cannot be changed after insertion. See the *system limits for sharded cluster* (page 1017) for more information.

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## Hashed Shard Keys

New in version 2.4.

Hashed shard keys use a *hashed index* (page 342) of a single field as the *shard key* to partition data across your sharded cluster.

The field you choose as your hashed shard key should have a good cardinality, or large number of different values. Hashed keys work well with fields that increase monotonically like *ObjectId* values or timestamps.

If you shard an empty collection using a hashed shard key, MongoDB will automatically create and migrate chunks so that each shard has two chunks. You can control how many chunks MongoDB will create with the `numInitialChunks` parameter to `shardCollection` (page 738) or by manually creating chunks on the empty collection using the `split` (page 739) command.

To shard a collection using a hashed shard key, see *Shard a Collection Using a Hashed Shard Key* (page 528).

---

### Tip

MongoDB automatically computes the hashes when resolving queries using hashed indexes. Applications do **not** need to compute hashes.

## Impacts of Shard Keys on Cluster Operations

The shard key affects write and query performance by determining how the MongoDB partitions data in the cluster and how effectively the [mongos](#) (page 938) instances can direct operations to the cluster. Consider the following operational impacts of shard key selection:

**Write Scaling** Some possible shard keys will allow your application to take advantage of the increased write capacity that the cluster can provide, while others do not. Consider the following example where you shard by the values of the default `_id` field, which is [ObjectID](#).

MongoDB generates Object ID values upon document creation to produce a unique identifier for the object. However, the most significant bits of data in this value represent a time stamp, which means that they increment in a regular and predictable pattern. Even though this value has [high cardinality](#) (page 527), when using this, *any date, or other monotonically increasing number* as the shard key, all insert operations will be storing data into a single chunk, and therefore, a single shard. As a result, the write capacity of this shard will define the effective write capacity of the cluster.

A shard key that increases monotonically will not hinder performance if you have a very low insert rate, or if most of your write operations are [update\(\)](#) (page 849) operations distributed through your entire data set. Generally, choose shard keys that have *both* high cardinality and will distribute write operations across the *entire cluster*.

Typically, a computed shard key that has some amount of “randomness,” such as ones that include a cryptographic hash (i.e. MD5 or SHA1) of other content in the document, will allow the cluster to scale write operations. However, random shard keys do not typically provide [query isolation](#) (page 507), which is another important characteristic of shard keys.

New in version 2.4: MongoDB makes it possible to shard a collection on a hashed index. This can greatly improve write scaling. See [Shard a Collection Using a Hashed Shard Key](#) (page 528).

**Querying** The [mongos](#) (page 938) provides an interface for applications to interact with sharded clusters that hides the complexity of [data partitioning](#). A [mongos](#) (page 938) receives queries from applications, and uses metadata from the [config server](#) (page 502), to route queries to the [mongod](#) (page 925) instances with the appropriate data. While the [mongos](#) (page 938) succeeds in making all querying operational in sharded environments, the [shard key](#) you select can have a profound affect on query performance.

### See also:

The [Sharded Cluster Query Routing](#) (page 510) and [config server](#) (page 502) sections for a more general overview of querying in sharded environments.

**Query Isolation** The fastest queries in a sharded environment are those that [mongos](#) (page 938) will route to a single shard, using the [shard key](#) and the cluster meta data from the [config server](#) (page 502). For queries that don’t include the shard key, [mongos](#) (page 938) must query all shards, wait for their response and then return the result to the application. These “scatter/gather” queries can be long running operations.

If your query includes the first component of a compound shard key <sup>3</sup>, the [mongos](#) (page 938) can route the query directly to a single shard, or a small number of shards, which provides better performance. Even if you query values of the shard key reside in different chunks, the [mongos](#) (page 938) will route queries directly to specific shards.

To select a shard key for a collection:

<sup>3</sup> In many ways, you can think of the shard key a cluster-wide unique index. However, be aware that sharded systems cannot enforce cluster-wide unique indexes *unless* the unique field is in the shard key. Consider the [Index Concepts](#) (page 318) page for more information on indexes and compound indexes.

- determine the most commonly included fields in queries for a given application
- find which of these operations are most performance dependent.

If this field has low cardinality (i.e not sufficiently selective) you should add a second field to the shard key making a compound shard key. The data may become more splittable with a compound shard key.

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## See

[Sharded Cluster Query Routing](#) (page 510) for more information on query operations in the context of sharded clusters.

---

**Sorting** In sharded systems, the [mongos](#) (page 938) performs a merge-sort of all sorted query results from the shards. See [Sharded Cluster Query Routing](#) (page 510) and [Use Indexes to Sort Query Results](#) (page 370) for more information.

## Sharded Cluster High Availability

A [production](#) (page 504) [cluster](#) has no single point of failure. This section introduces the availability concerns for MongoDB deployments in general and highlights potential failure scenarios and available resolutions.

### Application Servers or [mongos](#) Instances Become Unavailable

If each application server has its own [mongos](#) (page 938) instance, other application servers can continue access the database. Furthermore, [mongos](#) (page 938) instances do not maintain persistent state, and they can restart and become unavailable without loosing any state or data. When a [mongos](#) (page 938) instance starts, it retrieves a copy of the [config database](#) and can begin routing queries.

### A Single [mongod](#) Becomes Unavailable in a Shard

[Replica sets](#) (page 377) provide high availability for shards. If the unavailable [mongod](#) (page 925) is a [primary](#), then the replica set will [elect](#) (page 397) a new primary. If the unavailable [mongod](#) (page 925) is a [secondary](#), and it disconnects the primary and secondary will continue to hold all data. In a three member replica set, even if a single member of the set experiences catastrophic failure, two other members have full copies of the data.<sup>4</sup>

Always investigate availability interruptions and failures. If a system is unrecoverable, replace it and create a new member of the replica set as soon as possible to replace the lost redundancy.

### All Members of a Replica Set Become Unavailable

If all members of a replica set within a shard are unavailable, all data held in that shard is unavailable. However, the data on all other shards will remain available, and it's possible to read and write data to the other shards. However, your application must be able to deal with partial results, and you should investigate the cause of the interruption and attempt to recover the shard as soon as possible.

---

<sup>4</sup> If an unavailable secondary becomes available while it still has current oplog entries, it can catch up to the latest state of the set using the normal [replication process](#), otherwise it must perform an [initial sync](#).

## One or Two Config Databases Become Unavailable

Three distinct `mongod` (page 925) instances provide the *config database* using a special two-phase commits to maintain consistent state between these `mongod` (page 925) instances. Cluster operation will continue as normal but *chunk migration* (page 516) and the cluster can create no new *chunk splits* (page 548). Replace the config server as soon as possible. If all multiple config databases become unavailable, the cluster can become inoperable.

---

**Note:** All config servers must be running and available when you first initiate a *sharded cluster*.

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## Renaming Config Servers and Cluster Availability

If the name or address that a sharded cluster uses to connect to a config server changes, you must restart **every** `mongod` (page 925) and `mongos` (page 938) instance in the sharded cluster. Avoid downtime by using CNAMEs to identify config servers within the MongoDB deployment.

To avoid downtime when renaming config servers, use DNS names unrelated to physical or virtual hostnames to refer to your *config servers* (page 502).

Generally, refer to each config server using a name in DNS (e.g. a CNAME record). When specifying the config server connection string to `mongos` (page 938), DNS use this name. These records make it possible to renumber or rename config servers without changing the connection string and without having to restart the entire cluster.

## Shard Keys and Cluster Availability

The most important consideration when choosing a *shard key* are:

- to ensure that MongoDB will be able to distribute data evenly among shards, and
- to scale writes across the cluster, and
- to ensure that `mongos` (page 938) can isolate most queries to a specific `mongod` (page 925).

Furthermore:

- Each shard should be a *replica set*, if a specific `mongod` (page 925) instance fails, the replica set members will elect another to be *primary* and continue operation. However, if an entire shard is unreachable or fails for some reason, that data will be unavailable.
- If the shard key allows the `mongos` (page 938) to isolate most operations to a single shard, then the failure of a single shard will only render *some* data unavailable.
- If your shard key distributes data required for every operation throughout the cluster, then the failure of the entire shard will render the entire cluster unavailable.

In essence, this concern for reliability simply underscores the importance of choosing a shard key that isolates query operations to a single shard.

## Sharded Cluster Security

In most respects security for sharded clusters similar to other MongoDB deployments. Sharded clusters use the same *keyfile* (page 238) and *access control* (page 237) as all MongoDB deployments. However, there are additional considerations when using authentication with sharded clusters.

---

**Important:** In addition to the mechanisms described in this section, always run sharded clusters in a trusted networking environment. Ensure that the network only permits trusted traffic to reach `mongos` (page 938) and `mongod` (page 925) instances.

**See also:**

[Enable Authentication in a Sharded Cluster](#) (page 528).

### Access Control Privileges in Sharded Clusters

In sharded clusters, MongoDB provides separate administrative privileges for the sharded cluster and for each shard.

**Sharded Cluster Authentication.** When connected to a [mongos](#) (page 938), you can grant access to the sharded cluster’s admin database.<sup>5</sup> These credentials reside on the config servers.

Users can access to the cluster according to their [permissions](#) (page 265). To receive privileges for the cluster, you must authenticate while connected to a [mongos](#) (page 938) instance.

**Shard Server Authentication.** To allow administrators to connect and authenticate directly to specific shards, create users in the admin database on the [mongod](#) (page 925) instance, or [replica set](#), that provide each shard.

These users only have access to *a single shard* and are *completely* distinct from the cluster-wide credentials.

---

**Important:** Always connect and authenticate to sharded clusters via a [mongos](#) (page 938) instance.

Beyond these proprieties, privileges for sharded clusters are functionally the same as any other MongoDB deployment. See [Access Control](#) (page 237) for more information.

### Access a Sharded Cluster with Authentication

To access a sharded cluster as an authenticated user, from the command line, use the authentication options when connecting to a [mongos](#) (page 938). Or, you can connect first and then authenticate with the [authenticate](#) (page 725) command or the [db.auth\(\)](#) (page 876) method.

To close an authenticated session, see the [logout](#) (page 724) command.

### Restriction on localhost Interface

Sharded clusters have restrictions on the use of localhost interface. If the host identifier for a MongoDB instance is either localhost or “127.0.0.1”, then you must use “localhost” or “127.0.0.1” to identify *all* MongoDB instances in a deployment. This applies to the host argument to the [addShard](#) (page 736) command as well as to the [--configdb](#) (page 940) option for the [mongos](#) (page 938). If you mix localhost addresses with remote host address, sharded clusters will not function correctly.

### Sharded Cluster Query Routing

MongoDB [mongos](#) (page 938) instances route queries and write operations to [shards](#) in a sharded cluster. [mongos](#) (page 938) provide the only interface to a sharded cluster from the perspective of applications. Applications never connect or communicate directly with the shards.

The [mongos](#) (page 938) tracks what data is on which shard by caching the metadata from the [config servers](#) (page 502). The [mongos](#) (page 938) uses the metadata to route operations from applications and clients to the [mongod](#) (page 925) instances. A [mongos](#) (page 938) has no *persistent* state and consumes minimal system resources.

---

<sup>5</sup> Credentials for databases *other* than the admin database reside in the [mongod](#) (page 925) instance (or sharded cluster) that is the [primary shard](#) (page 501) for that database.

The most common practice is to run [mongos](#) (page 938) instances on the same systems as your application servers, but you can maintain [mongos](#) (page 938) instances on the shards or on other dedicated resources.

---

**Note:** Changed in version 2.1.

Some aggregation operations using the [aggregate](#) (page 694) command (i.e. `db.collection.aggregate()` (page 808)) will cause [mongos](#) (page 938) instances to require more CPU resources than in previous versions. This modified performance profile may dictate alternate architecture decisions if you use the [aggregation framework](#) extensively in a sharded environment.

---

## Routing Process

A [mongos](#) (page 938) instance uses the following processes to route queries and return results.

**How mongos Determines which Shards Receive a Query** A [mongos](#) (page 938) instance routes a query to a *cluster* by:

1. Determining the list of *shards* that must receive the query.
2. Establishing a cursor on all targeted shards.

In some cases, when the *shard key* or a prefix of the shard key is a part of the query, the [mongos](#) (page 938) can route the query to a subset of the shards. Otherwise, the [mongos](#) (page 938) must direct the query to *all* shards that hold documents for that collection.

---

## Example

Given the following shard key:

```
{ zipcode: 1, u_id: 1, c_date: 1 }
```

Depending on the distribution of chunks in the cluster, the [mongos](#) (page 938) may be able to target the query at a subset of shards, if the query contains the following fields:

```
{ zipcode: 1 }
{ zipcode: 1, u_id: 1 }
{ zipcode: 1, u_id: 1, c_date: 1 }
```

---

**How mongos Handles Query Modifiers** If the result of the query is not sorted, the [mongos](#) (page 938) instance opens a result cursor that “round robins” results from all cursors on the shards.

Changed in version 2.0.5: In versions prior to 2.0.5, the [mongos](#) (page 938) exhausted each cursor, one by one.

If the query specifies sorted results using the [sort\(\)](#) (page 872) cursor method, the [mongos](#) (page 938) instance passes the [\\$orderby](#) (page 691) option to the shards. When the [mongos](#) (page 938) receives results it performs an incremental *merge sort* of the results while returning them to the client.

If the query limits the size of the result set using the [limit\(\)](#) (page 867) cursor method, the [mongos](#) (page 938) instance passes that limit to the shards and then re-applies the limit to the result before returning the result to the client.

If the query specifies a number of records to *skip* using the [skip\(\)](#) (page 871) cursor method, the [mongos](#) (page 938) *cannot* pass the skip to the shards, but rather retrieves unskipped results from the shards and skips the appropriate number of documents when assembling the complete result. However, when used in conjunction with a [limit\(\)](#) (page 867), the [mongos](#) (page 938) will pass the *limit* plus the value of the [skip\(\)](#) (page 871) to the shards to improve the efficiency of these operations.

## Detect Connections to mongos Instances

To detect if the MongoDB instance that your client is connected to is [mongos](#) (page 938), use the `isMaster` (page 732) command. When a client connects to a [mongos](#) (page 938), `isMaster` (page 732) returns a document with a `msg` field that holds the string `isdbgrid`. For example:

```
{
 "ismaster" : true,
 "msg" : "isdbgrid",
 "maxBsonObjectSize" : 16777216,
 "ok" : 1
}
```

If the application is instead connected to a [mongod](#) (page 925), the returned document does not include the `isdbgrid` string.

## Broadcast Operations and Targeted Operations

In general, operations in a sharded environment are either:

- Broadcast to all shards in the cluster that hold documents in a collection
- Targeted at a single shard or a limited group of shards, based on the shard key

For best performance, use targeted operations whenever possible. While some operations must broadcast to all shards, you can ensure MongoDB uses targeted operations whenever possible by always including the shard key.

**Broadcast Operations** [mongos](#) (page 938) instances broadcast queries to all shards for the collection **unless** the [mongos](#) (page 938) can determine which shard or subset of shards stores this data.

Multi-update operations are always broadcast operations.

The `remove()` (page 844) operation is always a broadcast operation, unless the operation specifies the shard key in full.

**Targeted Operations** All `insert()` (page 832) operations target to one shard.

All single `update()` (page 849) (including `upsert` operations) and `remove()` (page 844) operations must target to one shard.

---

**Important:** All single `update()` (page 849) and `remove()` (page 844) operations must include the `shard key` or the `_id` field in the query specification. `update()` (page 849) or `remove()` (page 844) operations that affect a single document in a sharded collection without the `shard key` or the `_id` field return an error.

---

For queries that include the shard key or portion of the shard key, [mongos](#) (page 938) can target the query at a specific shard or set of shards. This is the case only if the portion of the shard key included in the query is a *prefix* of the shard key. For example, if the shard key is:

```
{ a: 1, b: 1, c: 1 }
```

The [mongos](#) (page 938) program *can* route queries that include the full shard key or either of the following shard key prefixes at a specific shard or set of shards:

```
{ a: 1 }
{ a: 1, b: 1 }
```

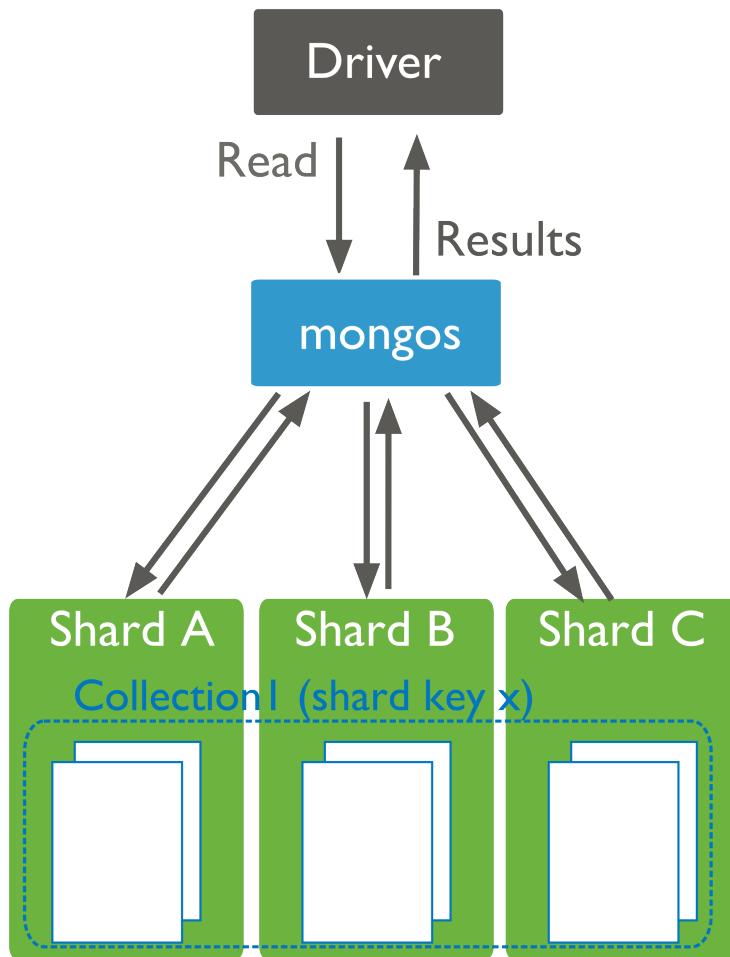


Figure 9.12: Read operations to a sharded cluster. Query criteria does not include the shard key. The query router mongos must broadcast query to all shards for the collection.

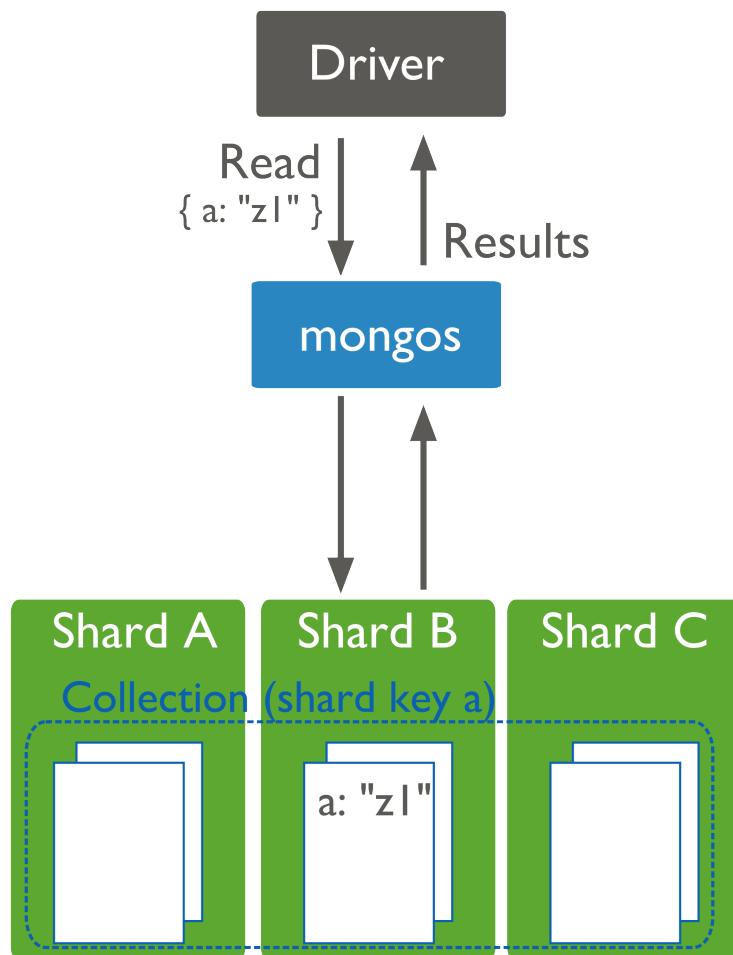


Figure 9.13: Read operations to a sharded cluster. Query criteria includes the shard key. The query router mongos can target the query to the appropriate shard or shards.

Depending on the distribution of data in the cluster and the selectivity of the query, [mongos](#) (page 938) may still have to contact multiple shards<sup>6</sup> to fulfill these queries.

### Sharded and Non-Sharded Data

Sharding operates on the collection level. You can shard multiple collections within a database or have multiple databases with sharding enabled.<sup>7</sup> However, in production deployments, some databases and collections will use sharding, while other databases and collections will only reside on a single shard.

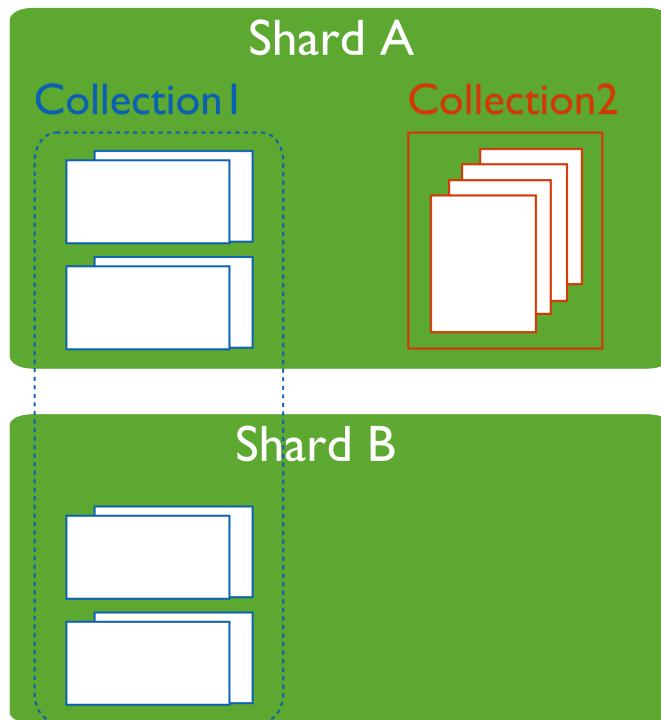


Figure 9.14: Diagram of a primary shard. A primary shard contains non-sharded collections as well as chunks of documents from sharded collections. Shard A is the primary shard.

Regardless of the data architecture of your [sharded cluster](#), ensure that all queries and operations use the [mongos](#) router to access the data cluster. Use the [mongos](#) (page 938) even for operations that do not impact the sharded data.

## 9.2.4 Sharding Mechanics

The following documents describe sharded cluster processes.

**Sharded Collection Balancing (page 516)** Balancing distributes a sharded collection's data cluster to all of the shards.

**Chunk Migration Across Shards (page 518)** MongoDB migrates chunks to shards as part of the balancing process.

<sup>6</sup> [mongos](#) (page 938) will route some queries, even some that include the shard key, to all shards, if needed.

<sup>7</sup> As you configure sharding, you will use the [enableSharding](#) (page 736) command to enable sharding for a database. This simply makes it possible to use the [shardCollection](#) (page 738) command on a collection within that database.

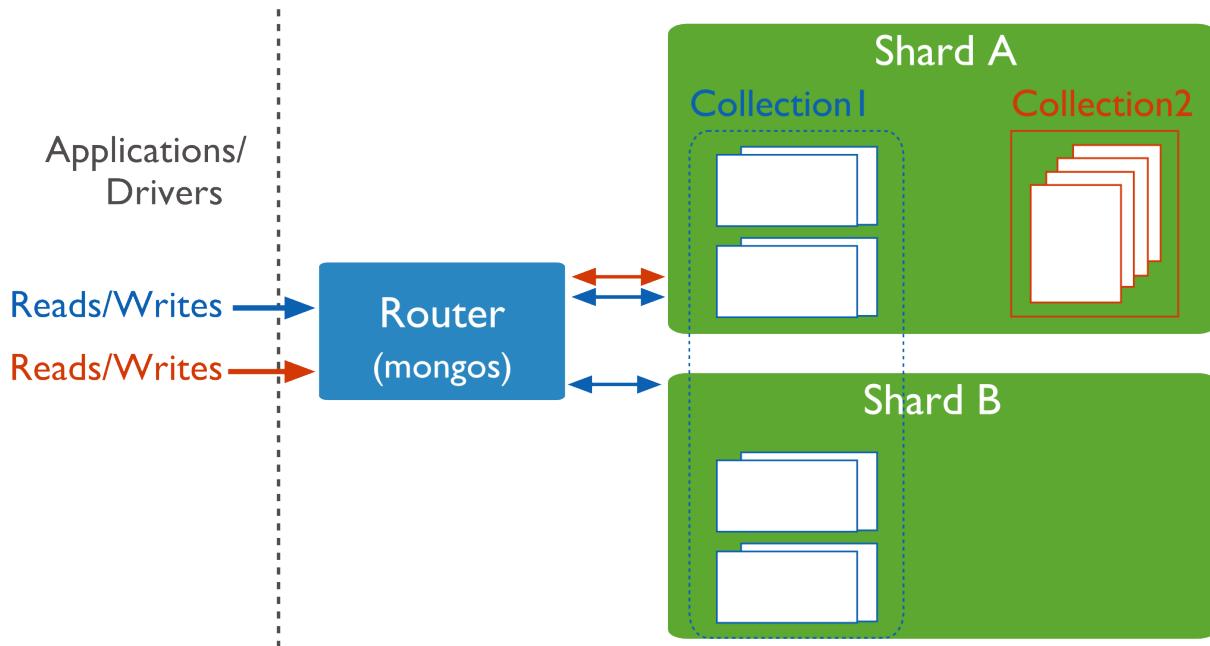


Figure 9.15: Diagram of applications/drivers issuing queries to mongos for unsharded collection as well as sharded collection. Config servers not shown.

**Chunk Splits in a Sharded Cluster (page 519)** When a chunk grows beyond the configured size, MongoDB splits the chunk in half.

**Shard Key Indexes (page 520)** Sharded collections must keep an index that starts with the shard key.

**Sharded Cluster Metadata (page 520)** The cluster maintains internal metadata that reflects the location of data within the cluster.

## Sharded Collection Balancing

Balancing is the process MongoDB uses to distribute data of a sharded collection evenly across a *sharded cluster*. When a *shard* has too many of a sharded collection's *chunks* compared to other shards, MongoDB automatically balances the chunks across the shards. The balancing procedure for *sharded clusters* is entirely transparent to the user and application layer.

### Cluster Balancer

The *balancer* process is responsible for redistributing the chunks of a sharded collection evenly among the shards for every sharded collection. By default, the balancer process is always running.

Any *mongos* (page 938) instance in the cluster can start a balancing round. When a balancer process is active, the responsible *mongos* (page 938) acquires a "lock" by modifying a document in the `lock` collection in the *Config Database* (page 564).

**Note:** Changed in version 2.0: Before MongoDB version 2.0, large differences in timekeeping (i.e. clock skew) between *mongos* (page 938) instances could lead to failed distributed locks. This carries the possibility of data loss, particularly with skews larger than 5 minutes. Always use the network time protocol (NTP) by running `ntpd` on your servers to minimize clock skew.

To address uneven chunk distribution for a sharded collection, the balancer [migrates chunks](#) (page 518) from shards with more chunks to shards with a fewer number of chunks. The balancer migrates the chunks, one at a time, until there is an even dispersion of chunks for the collection across the shards.

Chunk migrations carry some overhead in terms of bandwidth and workload, both of which can impact database performance. The [balancer](#) attempts to minimize the impact by:

- Moving only one chunk at a time.
- Starting a balancing round **only** when the difference in the number of chunks between the shard with the greatest number of chunks for a sharded collection and the shard with the lowest number of chunks for that collection reaches the [migration threshold](#) (page 517).

You may disable the balancer temporarily for maintenance. See [Disable the Balancer](#) (page 552) for details.

You can also limit the window during which the balancer runs to prevent it from impacting production traffic. See [Schedule the Balancing Window](#) (page 551) for details.

---

**Note:** The specification of the balancing window is relative to the local time zone of all individual [mongos](#) (page 938) instances in the cluster.

---

#### See also:

[Manage Sharded Cluster Balancer](#) (page 551).

### Migration Thresholds

To minimize the impact of balancing on the cluster, the [balancer](#) will not begin balancing until the distribution of chunks for a sharded collection has reached certain thresholds. The thresholds apply to the difference in number of [chunks](#) between the shard with the most chunks for the collection and the shard with the fewest chunks for that collection. The balancer has the following thresholds:

Changed in version 2.2: The following thresholds appear first in 2.2. Prior to this release, a balancing round would only start if the shard with the most chunks had 8 more chunks than the shard with the least number of chunks.

| Number of Chunks | Migration Threshold |
|------------------|---------------------|
| Less than 20     | 2                   |
| 21-80            | 4                   |
| Greater than 80  | 8                   |

Once a balancing round starts, the balancer will not stop until, for the collection, the difference between the number of chunks on any two shards for that collection is *less than two* or a chunk migration fails.

### Shard Size

By default, MongoDB will attempt to fill all available disk space with data on every shard as the data set grows. To ensure that the cluster always has the capacity to handle data growth, monitor disk usage as well as other performance metrics.

When adding a shard, you may set a “maximum size” for that shard. This prevents the [balancer](#) from migrating chunks to the shard when the value of [mapped](#) (page 787) exceeds the “maximum size”. Use the `maxSize` parameter of the [addShard](#) (page 736) command to set the “maximum size” for the shard.

#### See also:

[Change the Maximum Storage Size for a Given Shard](#) (page 549) and [Monitoring for MongoDB](#) (page 138).

## Chunk Migration Across Shards

Chunk migration moves the chunks of a sharded collection from one shard to another and is part of the [balancer](#) (page 516) process.

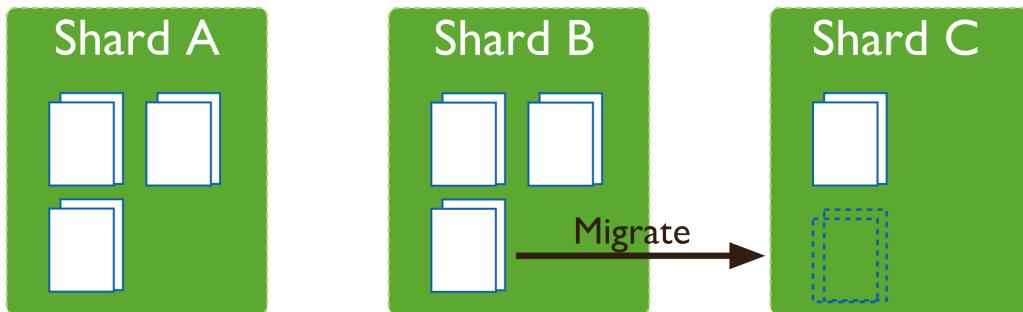


Figure 9.16: Diagram of a collection distributed across three shards. For this collection, the difference in the number of chunks between the shards reaches the [migration thresholds](#) (page 517) (in this case, 2) and triggers migration.

## Chunk Migration

MongoDB migrates chunks in a [sharded cluster](#) to distribute the chunks of a sharded collection evenly among shards. Migrations may be either:

- Manual. Only use manual migration in limited cases, such as to distribute data during bulk inserts. See [Migrating Chunks Manually](#) (page 546) for more details.
- Automatic. The [balancer](#) (page 516) process automatically migrates chunks when there is an uneven distribution of a sharded collection's chunks across the shards. See [Migration Thresholds](#) (page 517) for more details.

All chunk migrations use the following procedure:

1. The balancer process sends the [moveChunk](#) (page 742) command to the source shard.
2. The source starts the move with an internal [moveChunk](#) (page 742) command. During the migration process, operations to the chunk route to the source shard. The source shard is responsible for incoming write operations for the chunk.
3. The destination shard begins requesting documents in the chunk and starts receiving copies of the data.
4. After receiving the final document in the chunk, the destination shard starts a synchronization process to ensure that it has the changes to the migrated documents that occurred during the migration.
5. When fully synchronized, the destination shard connects to the [config database](#) and updates the cluster metadata with the new location for the chunk.
6. After the destination shard completes the update of the metadata, and once there are no open cursors on the chunk, the source shard deletes its copy of the documents.

The migration process ensures consistency and maximizes the availability of chunks during balancing.

Changed in version 2.4: While copying and deleting data during migrations, the balancer waits for replication to secondaries. See [Secondary Throttle in the v2.2 Manual](#)<sup>8</sup> for details.

<sup>8</sup><http://docs.mongodb.org/v2.2/tutorial/configure-sharded-cluster-balancer/#sharded-cluster-config-secondary-throttle>

## Chunk Splits in a Sharded Cluster

When a chunk grows beyond the [specified chunk size](#) (page 519), a [mongos](#) (page 938) instance will split the chunk in half. Splits may lead to an uneven distribution of the chunks for a collection across the shards. In such cases, the [mongos](#) (page 938) instances will initiate a round of migrations to redistribute chunks across shards. See [Sharded Collection Balancing](#) (page 516) for more details on balancing chunks across shards.

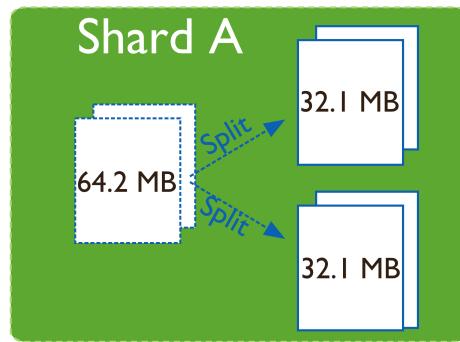


Figure 9.17: Diagram of a shard with a chunk that exceeds the default [chunk size](#) (page 519) of 64 MB and triggers a split of the chunk into two chunks.

## Chunk Size

The default [chunk](#) size in MongoDB is 64 megabytes. You can [increase or reduce the chunk size](#) (page 547), mindful of its effect on the cluster's efficiency.

1. Small chunks lead to a more even distribution of data at the expense of more frequent migrations. This creates expense at the query routing ([mongos](#) (page 938)) layer.
2. Large chunks lead to fewer migrations. This is more efficient both from the networking perspective *and* in terms of internal overhead at the query routing layer. But, these efficiencies come at the expense of a potentially more uneven distribution of data.

For many deployments, it makes sense to avoid frequent and potentially spurious migrations at the expense of a slightly less evenly distributed data set.

## Limitations

Changing the chunk size affects when chunks split but there are some limitations to its effects.

- Automatic splitting only occurs during inserts or updates. If you lower the chunk size, it may take time for all chunks to split to the new size.
- Splits cannot be “undone”. If you increase the chunk size, existing chunks must grow through inserts or updates until they reach the new size.

---

**Note:** Chunk ranges are inclusive of the lower boundary and exclusive of the upper boundary.

---

## Shard Key Indexes

All sharded collections **must** have an index that starts with the *shard key*. If you shard a collection without any documents and *without* such an index, the [shardCollection](#) (page 738) command will create the index on the shard key. If the collection already has documents, you must create the index before using [shardCollection](#) (page 738).

Changed in version 2.2: The index on the shard key no longer needs to be only on the shard key. This index can be an index of the shard key itself, or a [compound index](#) where the shard key is a prefix of the index.

---

**Important:** The index on the shard key **cannot** be a [multikey index](#) (page 324).

---

A sharded collection named `people` has for its shard key the field `zipcode`. It currently has the index `{ zipcode: 1 }`. You can replace this index with a compound index `{ zipcode: 1, username: 1 }`, as follows:

1. Create an index on `{ zipcode: 1, username: 1 }`:

```
db.people.ensureIndex({ zipcode: 1, username: 1 });
```

2. When MongoDB finishes building the index, you can safely drop the existing index on `{ zipcode: 1 }`:

```
db.people.dropIndex({ zipcode: 1 });
```

Since the index on the shard key cannot be a multikey index, the index `{ zipcode: 1, username: 1 }` can only replace the index `{ zipcode: 1 }` if there are no array values for the `username` field.

If you drop the last valid index for the shard key, recover by recreating an index on just the shard key.

For restrictions on shard key indexes, see [Shard Key Limitations](#) (page 1017).

## Sharded Cluster Metadata

[Config servers](#) (page 502) store the metadata for a sharded cluster. The metadata reflects state and organization of the sharded data sets and system. The metadata includes the list of chunks on every shard and the ranges that define the chunks. The [mongos](#) (page 938) instances cache this data and use it to route read and write operations to shards.

Config servers store the metadata in the [Config Database](#) (page 564).

---

**Important:** Always back up the `config` database before doing any maintenance on the config server.

---

To access the `config` database, issue the following command from the [mongo](#) (page 942) shell:

```
use config
```

In general, you should *never* edit the content of the `config` database directly. The `config` database contains the following collections:

- [changelog](#) (page 565)
- [chunks](#) (page 566)
- [collections](#) (page 567)
- [databases](#) (page 567)
- [lockpings](#) (page 568)
- [locks](#) (page 568)
- [mongos](#) (page 568)

- `settings` (page 569)
- `shards` (page 569)
- `version` (page 569)

For more information on these collections and their role in sharded clusters, see [Config Database](#) (page 564). See [Read and Write Operations on Config Servers](#) (page 502) for more information about reads and updates to the metadata.

## 9.3 Sharded Cluster Tutorials

The following tutorials provide instructions for administering *sharded clusters*. For a higher-level overview, see [Sharding](#) (page 493).

**Sharded Cluster Deployment Tutorials** (page 521) Instructions for deploying sharded clusters, adding shards, selecting shard keys, and the initial configuration of sharded clusters.

**Deploy a Sharded Cluster** (page 522) Set up a sharded cluster by creating the needed data directories, starting the required MongoDB instances, and configuring the cluster settings.

**Considerations for Selecting Shard Keys** (page 526) Choose the field that MongoDB uses to parse a collection's documents for distribution over the cluster's shards. Each shard holds documents with values within a certain range.

**Shard a Collection Using a Hashed Shard Key** (page 528) Shard a collection based on hashes of a field's values in order to ensure even distribution over the collection's shards.

**Add Shards to a Cluster** (page 529) Add a shard to add capacity to a sharded cluster.

Continue reading from [Sharded Cluster Deployment Tutorials](#) (page 521) for additional tutorials.

**Sharded Cluster Maintenance Tutorials** (page 536) Procedures and tasks for common operations on active sharded clusters.

**View Cluster Configuration** (page 538) View status information about the cluster's databases, shards, and chunks.

**Remove Shards from an Existing Sharded Cluster** (page 553) Migrate a single shard's data and remove the shard.

**Migrate Config Servers with Different Hostnames** (page 540) Migrate a config server to a new system that uses a new hostname. If possible, avoid changing the hostname and instead use the [Migrate Config Servers with the Same Hostname](#) (page 540) procedure.

**Manage Shard Tags** (page 536) Use tags to associate specific ranges of shard key values with specific shards.

Continue reading from [Sharded Cluster Maintenance Tutorials](#) (page 536) for additional tutorials.

**Sharded Cluster Data Management** (page 557) Practices that address common issues in managing large sharded data sets.

**Troubleshoot Sharded Clusters** (page 561) Presents solutions to common issues and concerns relevant to the administration and use of sharded clusters. Refer to [FAQ: MongoDB Diagnostics](#) (page 616) for general diagnostic information.

### 9.3.1 Sharded Cluster Deployment Tutorials

The following tutorials provide information on deploying sharded clusters.

**Deploy a Sharded Cluster** (page 522) Set up a sharded cluster by creating the needed data directories, starting the required MongoDB instances, and configuring the cluster settings.

**Considerations for Selecting Shard Keys** (page 526) Choose the field that MongoDB uses to parse a collection's documents for distribution over the cluster's shards. Each shard holds documents with values within a certain range.

**Shard a Collection Using a Hashed Shard Key** (page 528) Shard a collection based on hashes of a field's values in order to ensure even distribution over the collection's shards.

**Enable Authentication in a Sharded Cluster** (page 528) Control access to a sharded cluster through a key file and the keyFile setting on each of the cluster's components.

**Add Shards to a Cluster** (page 529) Add a shard to add capacity to a sharded cluster.

**Convert a Replica Set to a Replicated Sharded Cluster** (page 530) Convert a replica set to a sharded cluster in which each shard is its own replica set.

## Deploy a Sharded Cluster

### Deploy Sharded Cluster:

- Start the Config Server Database Instances (page 522)
- Start the mongos Instances (page 523)
- Add Shards to the Cluster (page 523)
- Enable Sharding for a Database (page 524)
- Enable Sharding for a Collection (page 525)

Use the following sequence of tasks to deploy a sharded cluster:

#### Warning: Sharding and “localhost” Addresses

If you use either “localhost” or 127.0.0.1 as the hostname portion of any host identifier, for example as the host argument to `addShard` (page 736) or the value to the `--configdb` run time option, then you must use “localhost” or 127.0.0.1 for *all* host settings for any MongoDB instances in the cluster. If you mix localhost addresses and remote host address, MongoDB will error.

### Start the Config Server Database Instances

The config server processes are `mongod` (page 925) instances that store the cluster's metadata. You designate a `mongod` (page 925) as a config server using the `--configsvr` option. Each config server stores a complete copy of the cluster's metadata.

In production deployments, you must deploy exactly three config server instances, each running on different servers to assure good uptime and data safety. In test environments, you can run all three instances on a single server.

**Important:** All members of a sharded cluster must be able to connect to *all* other members of a sharded cluster, including all shards and all config servers. Ensure that the network and security systems including all interfaces and firewalls, allow these connections.

1. Create data directories for each of the three config server instances. By default, a config server stores its data files in the `/data/configdb` directory. You can choose a different location. To create a data directory, issue a command similar to the following:

```
mkdir /data/configdb
```

- Start the three config server instances. Start each by issuing a command using the following syntax:

```
mongod --configsvr --dbpath <path> --port <port>
```

The default port for config servers is 27019. You can specify a different port. The following example starts a config server using the default port and default data directory:

```
mongod --configsvr --dbpath /data/configdb --port 27019
```

For additional command options, see [mongod](#) (page 925) or [Configuration File Options](#) (page 990).

---

**Note:** All config servers must be running and available when you first initiate a [sharded cluster](#).

---

### Start the `mongos` Instances

The [mongos](#) (page 938) instances are lightweight and do not require data directories. You can run a [mongos](#) (page 938) instance on a system that runs other cluster components, such as on an application server or a server running a [mongod](#) (page 925) process. By default, a [mongos](#) (page 938) instance runs on port 27017.

When you start the [mongos](#) (page 938) instance, specify the hostnames of the three config servers, either in the configuration file or as command line parameters.

---

#### Tip

To avoid downtime, give each config server a logical DNS name (unrelated to the server's physical or virtual hostname). Without logical DNS names, moving or renaming a config server requires shutting down every [mongod](#) (page 925) and [mongos](#) (page 938) instance in the sharded cluster.

To start a [mongos](#) (page 938) instance, issue a command using the following syntax:

```
mongos --configdb <config server hostnames>
```

For example, to start a [mongos](#) (page 938) that connects to config server instance running on the following hosts and on the default ports:

- cfg0.example.net
- cfg1.example.net
- cfg2.example.net

You would issue the following command:

```
mongos --configdb cfg0.example.net:27019,cfg1.example.net:27019,cfg2.example.net:27019
```

Each [mongos](#) (page 938) in a sharded cluster must use the same [configdb](#) (page 1001) string, with identical host names listed in identical order.

If you start a [mongos](#) (page 938) instance with a string that does not exactly match the string used by the other [mongos](#) (page 938) instances in the cluster, the [mongos](#) (page 938) fails and you receive the [Config Database String Error](#) (page 561) error.

### Add Shards to the Cluster

A [shard](#) can be a standalone [mongod](#) (page 925) or a [replica set](#). In a production environment, each shard should be a replica set.

1. From a `mongo` (page 942) shell, connect to the `mongos` (page 938) instance. Issue a command using the following syntax:

```
mongo --host <hostname of machine running mongos> --port <port mongos listens on>
```

For example, if a `mongos` (page 938) is accessible at `mongos0.example.net` on port 27017, issue the following command:

```
mongo --host mongos0.example.net --port 27017
```

2. Add each shard to the cluster using the `sh.addShard()` (page 903) method, as shown in the examples below. Issue `sh.addShard()` (page 903) separately for each shard. If the shard is a replica set, specify the name of the replica set and specify a member of the set. In production deployments, all shards should be replica sets.

---

### Optional

You can instead use the `addShard` (page 736) database command, which lets you specify a name and maximum size for the shard. If you do not specify these, MongoDB automatically assigns a name and maximum size. To use the database command, see `addShard` (page 736).

---

The following are examples of adding a shard with `sh.addShard()` (page 903):

- To add a shard for a replica set named `rs1` with a member running on port 27017 on `mongodb0.example.net`, issue the following command:

```
sh.addShard("rs1/mongodb0.example.net:27017")
```

Changed in version 2.0.3.

For MongoDB versions prior to 2.0.3, you must specify all members of the replica set. For example:

```
sh.addShard("rs1/mongodb0.example.net:27017,mongodb1.example.net:27017,mongodb2.example.net:27017")
```

- To add a shard for a standalone `mongod` (page 925) on port 27017 of `mongodb0.example.net`, issue the following command:

```
sh.addShard("mongodb0.example.net:27017")
```

---

**Note:** It might take some time for `chunks` to migrate to the new shard.

---

### Enable Sharding for a Database

Before you can shard a collection, you must enable sharding for the collection’s database. Enabling sharding for a database does not redistribute data but make it possible to shard the collections in that database.

Once you enable sharding for a database, MongoDB assigns a *primary shard* for that database where MongoDB stores all data before sharding begins.

1. From a `mongo` (page 942) shell, connect to the `mongos` (page 938) instance. Issue a command using the following syntax:

```
mongo --host <hostname of machine running mongos> --port <port mongos listens on>
```

2. Issue the `sh.enableSharding()` (page 905) method, specifying the name of the database for which to enable sharding. Use the following syntax:

---

```
sh.enableSharding("<database>")
```

Optionally, you can enable sharding for a database using the `enableSharding` (page 736) command, which uses the following syntax:

```
db.runCommand({ enableSharding: <database> })
```

## Enable Sharding for a Collection

You enable sharding on a per-collection basis.

1. Determine what you will use for the *shard key*. Your selection of the shard key affects the efficiency of sharding. See the selection considerations listed in the *Considerations for Selecting Shard Key* (page 526).
2. If the collection already contains data you must create an index on the *shard key* using `ensureIndex()` (page 814). If the collection is empty then MongoDB will create the index as part of the `sh.shardCollection()` (page 908) step.
3. Enable sharding for a collection by issuing the `sh.shardCollection()` (page 908) method in the `mongo` (page 942) shell. The method uses the following syntax:

```
sh.shardCollection("<database>.<collection>", shard-key-pattern)
```

Replace the `<database>.<collection>` string with the full namespace of your database, which consists of the name of your database, a dot (e.g. `.`), and the full name of the collection. The `shard-key-pattern` represents your shard key, which you specify in the same form as you would an `index` (page 814) key pattern.

---

### Example

The following sequence of commands shards four collections:

```
sh.shardCollection("records.people", { "zipcode": 1, "name": 1 })
sh.shardCollection("people.addresses", { "state": 1, "_id": 1 })
sh.shardCollection("assets.chairs", { "type": 1, "_id": 1 })

db.alerts.ensureIndex({ _id : "hashed" })
sh.shardCollection("events.alerts", { "_id": "hashed" })
```

---

In order, these operations shard:

- (a) The `people` collection in the `records` database using the shard key `{ "zipcode": 1, "name": 1 }`.

This shard key distributes documents by the value of the `zipcode` field. If a number of documents have the same value for this field, then that `chunk` will be *splittable* (page 527) by the values of the `name` field.

- (b) The `addresses` collection in the `people` database using the shard key `{ "state": 1, "_id": 1 }`.

This shard key distributes documents by the value of the `state` field. If a number of documents have the same value for this field, then that `chunk` will be *splittable* (page 527) by the values of the `_id` field.

- (c) The `chairs` collection in the `assets` database using the shard key `{ "type": 1, "_id": 1 }`.

This shard key distributes documents by the value of the `type` field. If a number of documents have the same value for this field, then that `chunk` will be *splittable* (page 527) by the values of the `_id` field.

(d) The `alerts` collection in the `events` database using the shard key `{ "_id": "hashed" }`.

New in version 2.4.

This shard key distributes documents by a hash of the value of the `_id` field. MongoDB computes the hash of the `_id` field for the *hashed index* (page 342), which should provide an even distribution of documents across a cluster.

## Considerations for Selecting Shard Keys

### Choosing a Shard Key

For many collections there may be no single, naturally occurring key that possesses all the qualities of a good shard key. The following strategies may help construct a useful shard key from existing data:

1. Compute a more ideal shard key in your application layer, and store this in all of your documents, potentially in the `_id` field.
2. Use a compound shard key that uses two or three values from all documents that provide the right mix of cardinality with scalable write operations and query isolation.
3. Determine that the impact of using a less than ideal shard key is insignificant in your use case, given:
  - limited write volume,
  - expected data size, or
  - application query patterns.
4. New in version 2.4: Use a *hashed shard key*. Choose a field that has high cardinality and create a *hashed index* (page 342) on that field. MongoDB uses these hashed index values as shard key values, which ensures an even distribution of documents across the shards.

---

#### Tip

MongoDB automatically computes the hashes when resolving queries using hashed indexes. Applications do **not** need to compute hashes.

---

**Considerations for Selecting Shard Key** Choosing the correct shard key can have a great impact on the performance, capability, and functioning of your database and cluster. Appropriate shard key choice depends on the schema of your data and the way that your applications query and write data.

### Create a Shard Key that is Easily Divisible

An easily divisible shard key makes it easy for MongoDB to distribute content among the shards. Shard keys that have a limited number of possible values can result in chunks that are “unsplittable.”

#### See also:

*Cardinality* (page 527)

### Create a Shard Key that has High Degree of Randomness

A shard key with high degree of randomness prevents any single shard from becoming a bottleneck and will distribute write operations among the cluster.

**See also:**

[Write Scaling](#) (page 507)

**Create a Shard Key that Targets a Single Shard**

A shard key that targets a single shard makes it possible for the `mongos` program to return most query operations directly from a single *specific* `mongod` instance. Your shard key should be the primary field used by your queries. Fields with a high degree of “randomness” make it difficult to target operations to specific shards.

**See also:**

[Query Isolation](#) (page 507)

**Shard Using a Compound Shard Key**

The challenge when selecting a shard key is that there is not always an obvious choice. Often, an existing field in your collection may not be the optimal key. In those situations, computing a special purpose shard key into an additional field or using a compound shard key may help produce one that is more ideal.

**Cardinality**

Cardinality in the context of MongoDB, refers to the ability of the system to *partition* data into *chunks*. For example, consider a collection of data such as an “address book” that stores address records:

- Consider the use of a `state` field as a shard key:

The `state` key’s value holds the US state for a given address document. This field has a *low cardinality* as all documents that have the same value in the `state` field *must* reside on the same shard, even if a particular state’s chunk exceeds the maximum chunk size.

Since there are a limited number of possible values for the `state` field, MongoDB may distribute data unevenly among a small number of fixed chunks. This may have a number of effects:

- If MongoDB cannot split a chunk because all of its documents have the same shard key, migrations involving these un-splittable chunks will take longer than other migrations, and it will be more difficult for your data to stay balanced.
- If you have a fixed maximum number of chunks, you will never be able to use more than that number of shards for this collection.

- Consider the use of a `zipcode` field as a shard key:

While this field has a large number of possible values, and thus has potentially higher cardinality, it’s possible that a large number of users could have the same value for the shard key, which would make this chunk of users un-splittable.

In these cases, cardinality depends on the data. If your address book stores records for a geographically distributed contact list (e.g. “Dry cleaning businesses in America,”) then a value like `zipcode` would be sufficient. However, if your address book is more geographically concentrated (e.g. “ice cream stores in Boston Massachusetts,”) then you may have a much lower cardinality.

- Consider the use of a `phone-number` field as a shard key:

Phone number has a *high cardinality*, because users will generally have a unique value for this field, MongoDB will be able to split as many chunks as needed.

While “high cardinality,” is necessary for ensuring an even distribution of data, having a high cardinality does not guarantee sufficient *query isolation* (page 507) or appropriate *write scaling* (page 507).

### Shard a Collection Using a Hashed Shard Key

New in version 2.4.

*Hashed shard keys* (page 506) use a *hashed index* (page 342) of a field as the *shard key* to partition data across your sharded cluster.

For suggestions on choosing the right field as your hashed shard key, see *Hashed Shard Keys* (page 506). For limitations on hashed indexes, see *Create a Hashed Index* (page 342).

---

**Note:** If chunk migrations are in progress while creating a hashed shard key collection, the initial chunk distribution may be uneven until the balancer automatically balances the collection.

---

### Shard the Collection

To shard a collection using a hashed shard key, use an operation in the `mongo` (page 942) that resembles the following:

```
sh.shardCollection("records.active", { a: "hashed" })
```

This operation shards the `active` collection in the `records` database, using a hash of the `a` field as the shard key.

### Specify the Initial Number of Chunks

If you shard an empty collection using a hashed shard key, MongoDB automatically creates and migrates empty chunks so that each shard has two chunks. To control how many chunks MongoDB creates when sharding the collection, use `shardCollection` (page 738) with the `numInitialChunks` parameter.

---

**Important:** MongoDB 2.4 adds support for hashed shard keys. After sharding a collection with a hashed shard key, you must use the MongoDB 2.4 or higher `mongos` (page 938) and `mongod` (page 925) instances in your sharded cluster.

---

**Warning:** MongoDB hashed indexes truncate floating point numbers to 64-bit integers before hashing. For example, a hashed index would store the same value for a field that held a value of `2.3`, `2.2`, and `2.9`. To prevent collisions, do not use a hashed index for floating point numbers that cannot be consistently converted to 64-bit integers (and then back to floating point). MongoDB hashed indexes do not support floating point values larger than  $2^{53}$ .

### Enable Authentication in a Sharded Cluster

New in version 2.0: Support for authentication with sharded clusters.

To control access to a sharded cluster, create key files and then set the `keyFile` (page 993) option on *all* components of the sharded cluster, including all `mongos` (page 938) instances, all config server `mongod` (page 925) instances, and all shard `mongod` (page 925) instances. The content of the key file is arbitrary but must be the same on all cluster members.

---

**Note:** For an overview of authentication, see *Access Control* (page 237). For an overview of security, see *Security* (page 235).

---

## Procedure

To enable authentication, do the following:

1. Generate a key file to store authentication information, as described in the [Generate a Key File](#) (page 258) section.
2. On each component in the sharded cluster, enable authentication by doing one of the following:
  - In the configuration file, set the `keyFile` (page 993) option to the key file's path and then start the component, as in the following example:

```
keyFile = /srv/mongodb/keyfile
```

- When starting the component, set `--keyFile` option, which is an option for both `mongos` (page 938) instances and `mongod` (page 925) instances. Set the `--keyFile` to the key file's path.

---

**Note:** The `keyFile` (page 993) setting implies `auth` (page 993), which means in most cases you do not need to set `auth` (page 993) explicitly.

3. Add the first administrative user and then add subsequent users. See [Create a User Administrator](#) (page 255).

## Add Shards to a Cluster

You add shards to a *sharded cluster* after you create the cluster or anytime that you need to add capacity to the cluster. If you have not created a sharded cluster, see [Deploy a Sharded Cluster](#) (page 522).

When adding a shard to a cluster, you should always ensure that the cluster has enough capacity to support the migration without affecting legitimate production traffic.

In production environments, all shards should be *replica sets*.

### Add a Shard to a Cluster

You interact with a sharded cluster by connecting to a `mongos` (page 938) instance.

1. From a `mongo` (page 942) shell, connect to the `mongos` (page 938) instance. For example, if a `mongos` (page 938) is accessible at `mongos0.example.net` on port 27017, issue the following command:

```
mongo --host mongos0.example.net --port 27017
```

2. Add a shard to the cluster using the `sh.addShard()` (page 903) method, as shown in the examples below. Issue `sh.addShard()` (page 903) separately for each shard. If the shard is a replica set, specify the name of the replica set and specify a member of the set. In production deployments, all shards should be replica sets.

---

### Optional

You can instead use the `addShard` (page 736) database command, which lets you specify a name and maximum size for the shard. If you do not specify these, MongoDB automatically assigns a name and maximum size. To use the database command, see `addShard` (page 736).

---

The following are examples of adding a shard with `sh.addShard()` (page 903):

- To add a shard for a replica set named `rs1` with a member running on port 27017 on `mongodb0.example.net`, issue the following command:

```
sh.addShard("rs1/mongodb0.example.net:27017")
```

Changed in version 2.0.3.

For MongoDB versions prior to 2.0.3, you must specify all members of the replica set. For example:

```
sh.addShard("rs1/mongodb0.example.net:27017,mongodb1.example.net:27017,mongodb2.example.net:27017")
```

- To add a shard for a standalone `mongod` (page 925) on port 27017 of `mongodb0.example.net`, issue the following command:

```
sh.addShard("mongodb0.example.net:27017")
```

---

**Note:** It might take some time for `chunks` to migrate to the new shard.

---

## Convert a Replica Set to a Replicated Sharded Cluster

### Overview

Following this tutorial, you will convert a single 3-member replica set to a cluster that consists of 2 shards. Each shard will consist of an independent 3-member replica set.

The tutorial uses a test environment running on a local system UNIX-like system. You should feel encouraged to “follow along at home.” If you need to perform this process in a production environment, notes throughout the document indicate procedural differences.

The procedure, from a high level, is as follows:

1. Create or select a 3-member replica set and insert some data into a collection.
2. Start the config databases and create a cluster with a single shard.
3. Create a second replica set with three new `mongod` (page 925) instances.
4. Add the second replica set as a shard in the cluster.
5. Enable sharding on the desired collection or collections.

### Process

Install MongoDB according to the instructions in the [MongoDB Installation Tutorial](#) (page 3).

**Deploy a Replica Set with Test Data** If have an existing MongoDB `replica set` deployment, you can omit the this step and continue from [Deploy Sharding Infrastructure](#) (page 532).

Use the following sequence of steps to configure and deploy a replica set and to insert test data.

1. Create the following directories for the first replica set instance, named `firstset`:
  - `/data/example/firstset1`
  - `/data/example/firstset2`
  - `/data/example/firstset3`

To create directories, issue the following command:

```
mkdir -p /data/example/firstset1 /data/example/firstset2 /data/example/firstset3
```

2. In a separate terminal window or GNU Screen window, start three `mongod` (page 925) instances by running each of the following commands:

```
mongod --dbpath /data/example/firstset1 --port 10001 --replSet firstset --oplogSize 700 --rest
mongod --dbpath /data/example/firstset2 --port 10002 --replSet firstset --oplogSize 700 --rest
mongod --dbpath /data/example/firstset3 --port 10003 --replSet firstset --oplogSize 700 --rest
```

---

**Note:** The `--oplogSize 700` option restricts the size of the operation log (i.e. oplog) for each `mongod` (page 925) instance to 700MB. Without the `--oplogSize` option, each `mongod` (page 925) reserves approximately 5% of the free disk space on the volume. By limiting the size of the oplog, each instance starts more quickly. Omit this setting in production environments.

---

3. In a `mongo` (page 942) shell session in a new terminal, connect to the `mongodb` instance on port 10001 by running the following command. If you are in a production environment, first read the note below.

```
mongo localhost:10001/admin
```

---

**Note:** Above and hereafter, if you are running in a production environment or are testing this process with `mongod` (page 925) instances on multiple systems, replace “localhost” with a resolvable domain, hostname, or the IP address of your system.

---

4. In the `mongo` (page 942) shell, initialize the first replica set by issuing the following command:

```
db.runCommand({ "replSetInitiate" :
 { "_id" : "firstset", "members" : [{ "_id" : 1, "host" : "localhost:10001" },
 { "_id" : 2, "host" : "localhost:10002" },
 { "_id" : 3, "host" : "localhost:10003" }
] } })
{
 "info" : "Config now saved locally. Should come online in about a minute.",
 "ok" : 1
}
```

5. In the `mongo` (page 942) shell, create and populate a new collection by issuing the following sequence of JavaScript operations:

```
use test
switched to db test
people = ["Marc", "Bill", "George", "Eliot", "Matt", "Trey", "Tracy", "Greg", "Steve", "Kristina"]
for(var i=0; i<1000000; i++) {
 name = people[Math.floor(Math.random()*people.length)];
 user_id = i;
 boolean = [true, false][Math.floor(Math.random()*2)];
 added_at = new Date();
 number = Math.floor(Math.random()*10001);
 db.test_collection.save({ "name":name, "user_id":user_id, "boolean":boolean });
}
```

The above operations add one million documents to the collection `test_collection`. This can take several minutes, depending on your system.

The script adds the documents in the following form:

```
{ "_id" : ObjectId("4ed5420b8fc1dd1df5886f70"), "name" : "Greg", "user_id" : 4, "boolean" : true, "a
```

**Deploy Sharding Infrastructure** This procedure creates the three config databases that store the cluster's metadata.

**Note:** For development and testing environments, a single config database is sufficient. In production environments, use three config databases. Because config instances store only the *metadata* for the sharded cluster, they have minimal resource requirements.

---

1. Create the following data directories for three *config database* instances:

- /data/example/config1
- /data/example/config2
- /data/example/config3

Issue the following command at the system prompt:

```
mkdir -p /data/example/config1 /data/example/config2 /data/example/config3
```

2. In a separate terminal window or GNU Screen window, start the config databases by running the following commands:

```
mongod --configsvr --dbpath /data/example/config1 --port 20001
mongod --configsvr --dbpath /data/example/config2 --port 20002
mongod --configsvr --dbpath /data/example/config3 --port 20003
```

3. In a separate terminal window or GNU Screen window, start *mongos* (page 938) instance by running the following command:

```
mongos --configdb localhost:20001,localhost:20002,localhost:20003 --port 27017 --chunkSize 1
```

---

**Note:** If you are using the collection created earlier or are just experimenting with sharding, you can use a small *--chunkSize* (1MB works well.) The default *chunkSize* (page 1002) of 64MB means that your cluster must have 64MB of data before the MongoDB's automatic sharding begins working.

In production environments, do not use a small shard size.

---

The *configdb* (page 1001) options specify the *configuration databases* (e.g. `localhost:20001`, `localhost:20002`, and `localhost:2003`). The *mongos* (page 938) instance runs on the default "MongoDB" port (i.e. 27017), while the databases themselves are running on ports in the 30001 series. In this example, you may omit the *--port 27017* option, as 27017 is the default port.

4. Add the first shard in *mongos* (page 938). In a new terminal window or GNU Screen session, add the first shard, according to the following procedure:

- (a) Connect to the *mongos* (page 938) with the following command:

```
mongo localhost:27017/admin
```

- (b) Add the first shard to the cluster by issuing the *addShard* (page 736) command:

```
db.runCommand({ addShard : "firstset/localhost:10001,localhost:10002,localhost:10003" })
```

- (c) Observe the following message, which denotes success:

```
{ "shardAdded" : "firstset", "ok" : 1 }
```

**Deploy a Second Replica Set** This procedure deploys a second replica set. This closely mirrors the process used to establish the first replica set above, omitting the test data.

1. Create the following data directories for the members of the second replica set, named `secondset`:

- `/data/example/secondset1`
- `/data/example/secondset2`
- `/data/example/secondset3`

2. In three new terminal windows, start three instances of `mongod` (page 925) with the following commands:

```
mongod --dbpath /data/example/secondset1 --port 10004 --replSet secondset --oplogSize 700 --rest
mongod --dbpath /data/example/secondset2 --port 10005 --replSet secondset --oplogSize 700 --rest
mongod --dbpath /data/example/secondset3 --port 10006 --replSet secondset --oplogSize 700 --rest
```

---

**Note:** As above, the second replica set uses the smaller `oplogSize` (page 1000) configuration. Omit this setting in production environments.

---

3. In the `mongo` (page 942) shell, connect to one `mongodb` instance by issuing the following command:

```
mongo localhost:10004/admin
```

4. In the `mongo` (page 942) shell, initialize the second replica set by issuing the following command:

```
db.runCommand({ "replSetInitiate" :
 { "_id" : "secondset",
 "members" : [{ "_id" : 1, "host" : "localhost:10004" },
 { "_id" : 2, "host" : "localhost:10005" },
 { "_id" : 3, "host" : "localhost:10006" }
] } })
{
 "info" : "Config now saved locally. Should come online in about a minute.",
 "ok" : 1
}
```

5. Add the second replica set to the cluster. Connect to the `mongos` (page 938) instance created in the previous procedure and issue the following sequence of commands:

```
use admin
db.runCommand({ addShard : "secondset/localhost:10004,localhost:10005,localhost:10006" })
```

This command returns the following success message:

```
{ "shardAdded" : "secondset", "ok" : 1 }
```

6. Verify that both shards are properly configured by running the `listShards` (page 737) command. View this and example output below:

```
db.runCommand({listShards:1})
{
 "shards" : [
 {
 "_id" : "firstset",
 "host" : "firstset/localhost:10001,localhost:10003,localhost:10002"
 },
 {
 "_id" : "secondset",
 "host" : "secondset/localhost:10004,localhost:10006,localhost:10005"
 }
]
}
```

```
 }
],
 "ok" : 1
}
```

**Enable Sharding** MongoDB must have [sharding](#) enabled on *both* the database and collection levels.

**Enabling Sharding on the Database Level** Issue the [enableSharding](#) (page 736) command. The following example enables sharding on the “test” database:

```
db.runCommand({ enableSharding : "test" })
{ "ok" : 1 }
```

**Create an Index on the Shard Key** MongoDB uses the shard key to distribute documents between shards. Once selected, you cannot change the shard key. Good shard keys:

- have values that are evenly distributed among all documents,
- group documents that are often accessed at the same time into contiguous chunks, and
- allow for effective distribution of activity among shards.

Typically shard keys are compound, comprising of some sort of hash and some sort of other primary key. Selecting a shard key depends on your data set, application architecture, and usage pattern, and is beyond the scope of this document. For the purposes of this example, we will shard the “number” key. This typically would *not* be a good shard key for production deployments.

Create the index with the following procedure:

```
use test
db.test_collection.ensureIndex({number:1})
```

#### See also:

The [Shard Key Overview](#) (page 506) and [Shard Key](#) (page 506) sections.

**Shard the Collection** Issue the following command:

```
use admin
db.runCommand({ shardCollection : "test.test_collection", key : {"number":1} })
{ "collectionsharded" : "test.test_collection", "ok" : 1 }
```

The collection `test_collection` is now sharded!

Over the next few minutes the Balancer begins to redistribute chunks of documents. You can confirm this activity by switching to the `test` database and running [db.stats\(\)](#) (page 894) or [db.printShardingStatus\(\)](#) (page 892).

As clients insert additional documents into this collection, [mongos](#) (page 938) distributes the documents evenly between the shards.

In the [mongo](#) (page 942) shell, issue the following commands to return statics against each cluster:

```
use test
db.stats()
db.printShardingStatus()
```

Example output of the [db.stats\(\)](#) (page 894) command:

```
{
 "raw" : {
 "firstset/localhost:10001,localhost:10003,localhost:10002" : {
 "db" : "test",
 "collections" : 3,
 "objects" : 973887,
 "avgObjSize" : 100.33173458522396,
 "dataSize" : 97711772,
 "storageSize" : 141258752,
 "numExtents" : 15,
 "indexes" : 2,
 "indexSize" : 56978544,
 "fileSize" : 1006632960,
 "nsSizeMB" : 16,
 "ok" : 1
 },
 "secondset/localhost:10004,localhost:10006,localhost:10005" : {
 "db" : "test",
 "collections" : 3,
 "objects" : 26125,
 "avgObjSize" : 100.33286124401914,
 "dataSize" : 2621196,
 "storageSize" : 11194368,
 "numExtents" : 8,
 "indexes" : 2,
 "indexSize" : 2093056,
 "fileSize" : 201326592,
 "nsSizeMB" : 16,
 "ok" : 1
 }
 },
 "objects" : 1000012,
 "avgObjSize" : 100.33176401883178,
 "dataSize" : 100332968,
 "storageSize" : 152453120,
 "numExtents" : 23,
 "indexes" : 4,
 "indexSize" : 59071600,
 "fileSize" : 1207959552,
 "ok" : 1
}
}
```

Example output of the `db.printShardingStatus()` (page 892) command:

```
--- Sharding Status ---
sharding version: { "_id" : 1, "version" : 3 }
shards:
 { "_id" : "firstset", "host" : "firstset/localhost:10001,localhost:10003,localhost:10002" }
 { "_id" : "secondset", "host" : "secondset/localhost:10004,localhost:10006,localhost:10005" }
databases:
 { "_id" : "admin", "partitioned" : false, "primary" : "config" }
 { "_id" : "test", "partitioned" : true, "primary" : "firstset" }
 test.test_collection chunks:
 secondset 5
 firstset 186
[...]
```

In a few moments you can run these commands for a second time to demonstrate that *chunks* are migrating from

firstset to secondset.

When this procedure is complete, you will have converted a replica set into a cluster where each shard is itself a replica set.

### 9.3.2 Sharded Cluster Maintenance Tutorials

The following tutorials provide information in maintaining sharded clusters.

[Manage Shard Tags \(page 536\)](#) Use tags to associate specific ranges of shard key values with specific shards.

[View Cluster Configuration \(page 538\)](#) View status information about the cluster's databases, shards, and chunks.

[Deploy Three Config Servers for Production Deployments \(page 539\)](#) Convert a test deployment with one config server to a production deployment with three config servers.

[Migrate Config Servers with the Same Hostname \(page 540\)](#) Migrate a config server to a new system while keeping the same hostname. This procedure requires changing the DNS entry to point to the new system.

[Migrate Config Servers with Different Hostnames \(page 540\)](#) Migrate a config server to a new system that uses a new hostname. If possible, avoid changing the hostname and instead use the [Migrate Config Servers with the Same Hostname \(page 540\)](#) procedure.

[Replace a Config Server \(page 541\)](#) Replaces a config server that has become inoperable. This procedure assumes that the hostname does not change.

[Migrate a Sharded Cluster to Different Hardware \(page 542\)](#) Migrate a sharded cluster to a different hardware system, for example, when moving a pre-production environment to production.

[Backup Cluster Metadata \(page 545\)](#) Create a backup of a sharded cluster's metadata while keeping the cluster operational.

[Create Chunks in a Sharded Cluster \(page 545\)](#) Pre-split empty collection.

[Migrate Chunks in a Sharded Cluster \(page 546\)](#) Manually migrate chunks.

[Modify Chunk Size in a Sharded Cluster \(page 547\)](#) Modify the chunk size.

[Split Chunks in a Sharded Cluster \(page 548\)](#) Manually split chunks.

[Configure Behavior of Balancer Process in Sharded Clusters \(page 549\)](#) Manage the balancer's behavior by scheduling a balancing window, changing size settings, or requiring replication before migration.

[Manage Sharded Cluster Balancer \(page 551\)](#) View balancer status and manage balancer behavior.

[Remove Shards from an Existing Sharded Cluster \(page 553\)](#) Migrate a single shard's data and remove the shard.

[Convert Sharded Cluster to Replica Set \(page 555\)](#) Replace your sharded cluster with a single replica set.

## Manage Shard Tags

In a sharded cluster, you can use tags to associate specific ranges of a `shard key` with a specific `shard` or subset of shards.

### Tag a Shard

Associate tags with a particular shard using the `sh.addShardTag()` (page 904) method when connected to a `mongos` (page 938) instance. A single shard may have multiple tags, and multiple shards may also have the same tag.

---

### Example

The following example adds the tag NYC to two shards, and the tags SFO and NRT to a third shard:

```
sh.addShardTag("shard0000", "NYC")
sh.addShardTag("shard0001", "NYC")
sh.addShardTag("shard0002", "SFO")
sh.addShardTag("shard0002", "NRT")
```

---

You may remove tags from a particular shard using the `sh.removeShardTag()` (page 908) method when connected to a `mongos` (page 938) instance, as in the following example, which removes the NRT tag from a shard:

```
sh.removeShardTag("shard0002", "NRT")
```

## Tag a Shard Key Range

To assign a tag to a range of shard keys use the `sh.addTagRange()` (page 904) method when connected to a `mongos` (page 938) instance. Any given shard key range may only have *one* assigned tag. You cannot overlap defined ranges, or tag the same range more than once.

---

### Example

Given a collection named `users` in the `records` database, sharded by the `zipcode` field. The following operations assign:

- two ranges of zip codes in Manhattan and Brooklyn the NYC tag
- one range of zip codes in San Francisco the SFO tag

```
sh.addTagRange("records.users", { zipcode: "10001" }, { zipcode: "10281" }, "NYC")
sh.addTagRange("records.users", { zipcode: "11201" }, { zipcode: "11240" }, "NYC")
sh.addTagRange("records.users", { zipcode: "94102" }, { zipcode: "94135" }, "SFO")
```

---

**Note:** Shard ranges are always inclusive of the lower value and exclusive of the upper boundary.

---

## Remove a Tag From a Shard Key Range

The `mongod` (page 925) does not provide a helper for removing a tag range. You may delete tag assignment from a shard key range by removing the corresponding document from the `tags` (page 569) collection of the `config` database.

Each document in the `tags` (page 569) holds the `namespace` of the sharded collection and a minimum shard key value.

---

### Example

The following example removes the NYC tag assignment for the range of zip codes within Manhattan:

```
use config
db.tags.remove({ _id: { ns: "records.users" }, min: { zipcode: "10001" } }, tag: "NYC")
```

---

## View Existing Shard Tags

The output from `sh.status()` (page 910) lists tags associated with a shard, if any, for each shard. A shard's tags exist in the shard's document in the `shards` (page 569) collection of the `config` database. To return all shards with

a specific tag, use a sequence of operations that resemble the following, which will return only those shards tagged with NYC:

```
use config
db.shards.find({ tags: "NYC" })
```

You can find tag ranges for all *namespaces* in the `tags` (page 569) collection of the `config` database. The output of `sh.status()` (page 910) displays all tag ranges. To return all shard key ranges tagged with NYC, use the following sequence of operations:

```
use config
db.tags.find({ tags: "NYC" })
```

## View Cluster Configuration

### List Databases with Sharding Enabled

To list the databases that have sharding enabled, query the `databases` collection in the *Config Database* (page 564). A database has sharding enabled if the value of the `partitioned` field is `true`. Connect to a `mongos` (page 938) instance with a `mongo` (page 942) shell, and run the following operation to get a full list of databases with sharding enabled:

```
use config
db.databases.find({ "partitioned": true })
```

---

### Example

You can use the following sequence of commands when to return a list of all databases in the cluster:

```
use config
db.databases.find()
```

If this returns the following result set:

```
{ "_id" : "admin", "partitioned" : false, "primary" : "config" }
{ "_id" : "animals", "partitioned" : true, "primary" : "m0.example.net:30001" }
{ "_id" : "farms", "partitioned" : false, "primary" : "m1.example2.net:27017" }
```

Then sharding is only enabled for the `animals` database.

---

## List Shards

To list the current set of configured shards, use the `listShards` (page 737) command, as follows:

```
use admin
db.runCommand({ listShards : 1 })
```

## View Cluster Details

To view cluster details, issue `db.printShardingStatus()` (page 892) or `sh.status()` (page 910). Both methods return the same output.

---

### Example

In the following example output from `sh.status()` (page 910)

- `sharding version` displays the version number of the shard metadata.
- `shards` displays a list of the `mongod` (page 925) instances used as shards in the cluster.
- `databases` displays all databases in the cluster, including database that do not have sharding enabled.
- The `chunks` information for the `foo` database displays how many chunks are on each shard and displays the range of each chunk.

```
--- Sharding Status ---
sharding version: { "_id" : 1, "version" : 3 }
shards:
{ "_id" : "shard0000", "host" : "m0.example.net:30001" }
{ "_id" : "shard0001", "host" : "m3.example2.net:50000" }
databases:
{ "_id" : "admin", "partitioned" : false, "primary" : "config" }
{ "_id" : "contacts", "partitioned" : true, "primary" : "shard0000" }
 foo.contacts
 shard key: { "zip" : 1 }
 chunks:
 shard0001 2
 shard0002 3
 shard0000 2
 { "zip" : { "$minKey" : 1 } } -->> { "zip" : 56000 } on : shard0001 { "t" : 2, "i" : 0 }
 { "zip" : 56000 } -->> { "zip" : 56800 } on : shard0002 { "t" : 3, "i" : 4 }
 { "zip" : 56800 } -->> { "zip" : 57088 } on : shard0002 { "t" : 4, "i" : 2 }
 { "zip" : 57088 } -->> { "zip" : 57500 } on : shard0002 { "t" : 4, "i" : 3 }
 { "zip" : 57500 } -->> { "zip" : 58140 } on : shard0001 { "t" : 4, "i" : 0 }
 { "zip" : 58140 } -->> { "zip" : 59000 } on : shard0000 { "t" : 4, "i" : 1 }
 { "zip" : 59000 } -->> { "zip" : { "$maxKey" : 1 } } on : shard0000 { "t" : 3, "i" : 3 }
{ "_id" : "test", "partitioned" : false, "primary" : "shard0000" }
```

## Deploy Three Config Servers for Production Deployments

This procedure converts a test deployment with only one *config server* (page 502) to a production deployment with three config servers.

### Tip

Use CNAMEs to identify your config servers to the cluster so that you can rename and renumber your config servers without downtime.

For redundancy, all production *sharded clusters* (page 493) should deploy three config servers on three different machines. Use a single config server only for testing deployments, never for production deployments. When you shift to production, upgrade immediately to three config servers.

To convert a test deployment with one config server to a production deployment with three config servers:

1. Shut down all existing MongoDB processes in the cluster. This includes:
  - all `mongod` (page 925) instances or *replica sets* that provide your shards.
  - all `mongos` (page 938) instances in your cluster.
2. Copy the entire `dbpath` (page 993) file system tree from the existing config server to the two machines that will provide the additional config servers. These commands, issued on the system with the existing *Config Database* (page 564), `mongo-config0.example.net` may resemble the following:

```
rsync -az /data/configdb mongo-config1.example.net:/data/configdb
rsync -az /data/configdb mongo-config2.example.net:/data/configdb
```

3. Start all three config servers, using the same invocation that you used for the single config server.

```
mongod --configsvr
```

4. Restart all shard `mongod` (page 925) and `mongos` (page 938) processes.

## Migrate Config Servers with the Same Hostname

This procedure migrates a *config server* (page 502) in a *sharded cluster* (page 498) to a new system that uses *the same* hostname.

To migrate all the config servers in a cluster, perform this procedure for each config server separately and migrate the config servers in reverse order from how they are listed in the `mongos` (page 938) instances' `configdb` (page 1001) string. Start with the last config server listed in the `configdb` (page 1001) string.

1. Shut down the config server.

This renders all config data for the sharded cluster “read only.”

2. Change the DNS entry that points to the system that provided the old config server, so that the *same* hostname points to the new system. How you do this depends on how you organize your DNS and hostname resolution services.

3. Copy the contents of `dbpath` (page 993) from the old config server to the new config server.

For example, to copy the contents of `dbpath` (page 993) to a machine named `mongodb.config2.example.net`, you might issue a command similar to the following:

```
rsync -az /data/configdb mongodb.config2.example.net:/data/configdb
```

4. Start the config server instance on the new system. The default invocation is:

```
mongod --configsvr
```

When you start the third config server, your cluster will become writable and it will be able to create new splits and migrate chunks as needed.

## Migrate Config Servers with Different Hostnames

This procedure migrates a *config server* (page 502) in a *sharded cluster* (page 498) to a new server that uses a different hostname. Use this procedure only if the config server *will not* be accessible via the same hostname.

Changing a *config server's* (page 502) hostname **requires downtime** and requires restarting every process in the sharded cluster. If possible, avoid changing the hostname so that you can instead use the procedure to *migrate a config server and use the same hostname* (page 540).

To migrate all the config servers in a cluster, perform this procedure for each config server separately and migrate the config servers in reverse order from how they are listed in the `mongos` (page 938) instances' `configdb` (page 1001) string. Start with the last config server listed in the `configdb` (page 1001) string.

1. Disable the cluster balancer process temporarily. See *Disable the Balancer* (page 552) for more information.
2. Shut down the config server.

This renders all config data for the sharded cluster “read only.”

3. Copy the contents of `dbpath` (page 993) from the old config server to the new config server.

---

#### Example

To copy the contents of `dbpath` (page 993) to a machine named `mongodb.config2.example.net`, use a command that resembles the following:

```
rsync -az /data/configdb mongodb.config2.example.net:/data/configdb
```

---

4. Start the config server instance on the new system. The default invocation is:

```
mongod --configsvr
```

5. Shut down all existing MongoDB processes. This includes:

- the `mongod` (page 925) instances or `replica sets` that provide your shards.
- the `mongod` (page 925) instances that provide your existing `config databases` (page 564).
- the `mongos` (page 938) instances.

6. Restart all `mongod` (page 925) processes that provide the shard servers.

7. Update the `configdb` (page 1001) setting for each `mongos` (page 938) instances.

8. Restart the `mongos` (page 938) instances.

9. Re-enable the balancer to allow the cluster to resume normal balancing operations. See the *Disable the Balancer* (page 552) section for more information on managing the balancer process.

## Replace a Config Server

This procedure replaces an inoperable `config server` (page 502) in a `sharded cluster` (page 498). Use this procedure only to replace a config server that has become inoperable (e.g. hardware failure).

This process assumes that the hostname of the instance will not change. If you must change the hostname of the instance, use the procedure to *migrate a config server and use a new hostname* (page 540).

1. Disable the cluster balancer process temporarily. See *Disable the Balancer* (page 552) for more information.
2. Provision a new system, with the same hostname as the previous host.

You will have to ensure that the new system has the same IP address and hostname as the system it's replacing or you will need to modify the DNS records and wait for them to propagate.

3. Shut down *one* (and only one) of the existing config servers. Copy all of this host's `dbpath` (page 993) file system tree from the current system to the system that will provide the new config server. This command, issued on the system with the data files, may resemble the following:

```
rsync -az /data/configdb mongodb.config2.example.net:/data/configdb
```

4. Restart the config server process that you used in the previous step to copy the data files to the new config server instance.

5. Start the new config server instance. The default invocation is:

```
mongod --configsvr
```

6. Re-enable the balancer to allow the cluster to resume normal balancing operations. See the *Disable the Balancer* (page 552) section for more information on managing the balancer process.

---

**Note:** In the course of this procedure *never* remove a config server from the [configdb](#) (page 1001) parameter on any of the [mongos](#) (page 938) instances. If you need to change the name of a config server, always make sure that all [mongos](#) (page 938) instances have three config servers specified in the [configdb](#) (page 1001) setting at all times.

---

## Migrate a Sharded Cluster to Different Hardware

### Migrate Sharded Cluster:

- Disable the Balancer (page 542)
- Migrate Each Config Server Separately (page 542)
- Restart the [mongos](#) Instances (page 543)
- Migrate the Shards (page 543)
  - Migrate a Replica Set Shard (page 544)
    - \* Migrate a Member of a Replica Set Shard (page 544)
    - \* Migrate the Primary in a Replica Set Shard (page 544)
  - Migrate a Standalone Shard (page 544)
- Re-Enable the Balancer (page 545)

This procedure moves the components of the *sharded cluster* to a new hardware system without downtime for reads and writes.

---

**Important:** While the migration is in progress, do not attempt to change to the [cluster metadata](#) (page 520). Do not use any operation that modifies the cluster metadata *in any way*. For example, do not create or drop databases, create or drop collections, or use any sharding commands.

---

If your cluster includes a shard backed by a *standalone* [mongod](#) (page 925) instance, consider [converting the standalone to a replica set](#) (page 432) to simplify migration and to let you keep the cluster online during future maintenance. Migrating a shard as standalone is a multi-step process that may require downtime.

To migrate a cluster to new hardware, perform the following tasks.

### Disable the Balancer

Disable the balancer to stop [chunk migration](#) (page 518) and do not perform any metadata write operations until the process finishes. If a migration is in progress, the balancer will complete the in-progress migration before stopping.

To disable the balancer, connect to one of the cluster's [mongos](#) (page 938) instances and issue the following method:

```
sh.stopBalancer()
```

To check the balancer state, issue the `sh.getBalancerState()` (page 906) method.

For more information, see [Disable the Balancer](#) (page 552).

### Migrate Each Config Server Separately

Migrate each *config server* (page 502) by starting with the *last* config server listed in the [configdb](#) (page 1001) string. Proceed in reverse order of the [configdb](#) (page 1001) string. Migrate and restart a config server before proceeding to the next. Do not rename a config server during this process.

---

**Note:** If the name or address that a sharded cluster uses to connect to a config server changes, you must restart **every**

`mongod` (page 925) and `mongos` (page 938) instance in the sharded cluster. Avoid downtime by using CNAMEs to identify config servers within the MongoDB deployment.

See [Migrate Config Servers with Different Hostnames](#) (page 540) for more information.

---

**Important:** Start with the *last* config server listed in `configdb` (page 1001).

---

1. Shut down the config server.

This renders all config data for the sharded cluster “read only.”

2. Change the DNS entry that points to the system that provided the old config server, so that the *same* hostname points to the new system. How you do this depends on how you organize your DNS and hostname resolution services.
3. Copy the contents of `dbpath` (page 993) from the old config server to the new config server.

For example, to copy the contents of `dbpath` (page 993) to a machine named `mongodb.config2.example.net`, you might issue a command similar to the following:

```
rsync -az /data/configdb mongodb.config2.example.net:/data/configdb
```

4. Start the config server instance on the new system. The default invocation is:

```
mongod --configsvr
```

### Restart the `mongos` Instances

If the `configdb` (page 1001) string will change as part of the migration, you must shut down *all* `mongos` (page 938) instances before changing the `configdb` (page 1001) string. This avoids errors in the sharded cluster over `configdb` (page 1001) string conflicts.

If the `configdb` (page 1001) string will remain the same, you can migrate the `mongos` (page 938) instances sequentially or all at once.

1. Shut down the `mongos` (page 938) instances using the `shutdown` (page 759) command. If the `configdb` (page 1001) string is changing, shut down *all* `mongos` (page 938) instances.
2. If the hostname has changed for any of the config servers, update the `configdb` (page 1001) string for each `mongos` (page 938) instance. The `mongos` (page 938) instances must all use the same `configdb` (page 1001) string. The strings must list identical host names in identical order.

---

#### Tip

To avoid downtime, give each config server a logical DNS name (unrelated to the server’s physical or virtual hostname). Without logical DNS names, moving or renaming a config server requires shutting down every `mongod` (page 925) and `mongos` (page 938) instance in the sharded cluster.

3. Restart the `mongos` (page 938) instances being sure to use the updated `configdb` (page 1001) string if hostnames have changed.

For more information, see [Start the mongos Instances](#) (page 523).

### Migrate the Shards

Migrate the shards one at a time. For each shard, follow the appropriate procedure in this section.

**Migrate a Replica Set Shard** To migrate a sharded cluster, migrate each member separately. First migrate the non-primary members, and then migrate the *primary* last.

If the replica set has two voting members, add an *arbiter* (page 389) to the replica set to ensure the set keeps a majority of its votes available during the migration. You can remove the arbiter after completing the migration.

### Migrate a Member of a Replica Set Shard

1. Shut down the `mongod` (page 925) process. To ensure a clean shutdown, use the `shutdown` (page 759) command.
2. Move the data directory (i.e., the `dbpath` (page 993)) to the new machine.
3. Restart the `mongod` (page 925) process at the new location.
4. Connect to the replica set's current primary.
5. If the hostname of the member has changed, use `rs.reconfig()` (page 897) to update the *replica set configuration document* (page 479) with the new hostname.

For example, the following sequence of commands updates the hostname for the instance at position 2 in the `members` array:

```
cfg = rs.conf()
cfg.members[2].host = "pocatello.example.net:27017"
rs.reconfig(cfg)
```

For more information on updating the configuration document, see *Example Reconfiguration Operations* (page 483).

6. To confirm the new configuration, issue `rs.conf()` (page 896).
7. Wait for the member to recover. To check the member's state, issue `rs.status()` (page 898).

**Migrate the Primary in a Replica Set Shard** While migrating the replica set's primary, the set must elect a new primary. This failover process which renders the replica set unavailable to perform reads or accept writes for the duration of the election, which typically completes quickly. If possible, plan the migration during a maintenance window.

1. Step down the primary to allow the normal *failover* (page 396) process. To step down the primary, connect to the primary and issue the either the `replSetStepDown` (page 730) command or the `rs.stepDown()` (page 899) method. The following example shows the `rs.stepDown()` (page 899) method:

```
rs.stepDown()
```

2. Once the primary has stepped down and another member has become `PRIMARY` (page 487) state. To migrate the stepped-down primary, follow the *Migrate a Member of a Replica Set Shard* (page 544) procedure

You can check the output of `rs.status()` (page 898) to confirm the change in status.

**Migrate a Standalone Shard** The ideal procedure for migrating a standalone shard is to *convert the standalone to a replica set* (page 432) and then use the procedure for *migrating a replica set shard* (page 544). In production clusters, all shards should be replica sets, which provides continued availability during maintenance windows.

Migrating a shard as standalone is a multi-step process during which part of the shard may be unavailable. If the shard is the *primary shard* for a database, the process includes the `movePrimary` (page 743) command. While the `movePrimary` (page 743) runs, you should stop modifying data in that database. To migrate the standalone shard, use the *Remove Shards from an Existing Sharded Cluster* (page 553) procedure.

## Re-Enable the Balancer

To complete the migration, re-enable the balancer to resume *chunk migrations* (page 518).

Connect to one of the cluster's `mongos` (page 938) instances and pass `true` to the `sh.setBalancerState()` (page 908) method:

```
sh.setBalancerState(true)
```

To check the balancer state, issue the `sh.getBalancerState()` (page 906) method.

For more information, see *Enable the Balancer* (page 553).

## Backup Cluster Metadata

This procedure shuts down the `mongod` (page 925) instance of a *config server* (page 502) in order to create a backup of a *sharded cluster's* (page 493) metadata. The cluster's config servers store all of the cluster's metadata, most importantly the mapping from *chunks* to *shards*.

When you perform this procedure, the cluster remains operational<sup>9</sup>.

1. Disable the cluster balancer process temporarily. See *Disable the Balancer* (page 552) for more information.
2. Shut down one of the config databases.
3. Create a full copy of the data files (i.e. the path specified by the `dbpath` (page 993) option for the config instance.)
4. Restart the original configuration server.
5. Re-enable the balancer to allow the cluster to resume normal balancing operations. See the *Disable the Balancer* (page 552) section for more information on managing the balancer process.

### See also:

*Backup Strategies for MongoDB Systems* (page 136).

## Create Chunks in a Sharded Cluster

Pre-splitting the chunk ranges in an empty sharded collection allows clients to insert data into an already partitioned collection. In most situations a *sharded cluster* will create and distribute chunks automatically without user intervention. However, in a limited number of cases, MongoDB cannot create enough chunks or distribute data fast enough to support required throughput. For example:

- If you want to partition an existing data collection that resides on a single shard.
- If you want to ingest a large volume of data into a cluster that isn't balanced, or where the ingestion of data will lead to data imbalance. For example, monotonically increasing or decreasing shard keys insert all data into a single chunk.

These operations are resource intensive for several reasons:

- Chunk migration requires copying all the data in the chunk from one shard to another.
- MongoDB can migrate only a single chunk at a time.
- MongoDB creates splits only after an insert operation.

---

<sup>9</sup> While one of the three config servers is unavailable, the cluster cannot split any chunks nor can it migrate chunks between shards. Your application will be able to write data to the cluster. See *Config Servers* (page 502) for more information.

**Warning:** Only pre-split an empty collection. If a collection already has data, MongoDB automatically splits the collection’s data when you enable sharding for the collection. Subsequent attempts to manually create splits can lead to unpredictable chunk ranges and sizes as well as inefficient or ineffective balancing behavior.

To create chunks manually, use the following procedure:

1. Split empty chunks in your collection by manually performing the [split](#) (page 739) command on chunks.

---

#### Example

To create chunks for documents in the `myapp.users` collection using the `email` field as the *shard key*, use the following operation in the [mongo](#) (page 942) shell:

```
for (var x=97; x<97+26; x++){
 for(var y=97; y<97+26; y+=6) {
 var prefix = String.fromCharCode(x) + String.fromCharCode(y);
 db.runCommand({ split : "myapp.users" , middle : { email : prefix } });
 }
}
```

This assumes a collection size of 100 million documents.

---

For information on the balancer and automatic distribution of chunks across shards, see [Cluster Balancer](#) (page 516) and [Chunk Migration](#) (page 518). For information on manually migrating chunks, see [Migrate Chunks in a Sharded Cluster](#) (page 546).

## Migrate Chunks in a Sharded Cluster

In most circumstances, you should let the automatic *balancer* migrate *chunks* between *shards*. However, you may want to migrate chunks manually in a few cases:

- When *pre-splitting* an empty collection, migrate chunks manually to distribute them evenly across the shards. Use pre-splitting in limited situations to support bulk data ingestion.
- If the balancer in an active cluster cannot distribute chunks within the *balancing window* (page 551), then you will have to migrate chunks manually.

To manually migrate chunks, use the [moveChunk](#) (page 742) command. For more information on how the automatic balancer moves chunks between shards, see [Cluster Balancer](#) (page 516) and [Chunk Migration](#) (page 518).

---

#### Example

Migrate a single chunk

The following example assumes that the field `username` is the *shard key* for a collection named `users` in the `myapp` database, and that the value `smith` exists within the *chunk* to migrate. Migrate the chunk using the following command in the [mongo](#) (page 942) shell.

```
db.adminCommand({ moveChunk : "myapp.users",
 find : {username : "smith"}, to : "mongodb-shard3.example.net" })
```

This command moves the chunk that includes the shard key value “`smith`” to the *shard* named `mongodb-shard3.example.net`. The command will block until the migration is complete.

---

#### Tip

To return a list of shards, use the [listShards](#) (page 737) command.

---

## Example

Evenly migrate chunks

To evenly migrate chunks for the `myapp.users` collection, put each prefix chunk on the next shard from the other and run the following commands in the mongo shell:

```
var shServer = ["sh0.example.net", "sh1.example.net", "sh2.example.net", "sh3.example.net", "sh4.example.net"];
for (var x=97; x<97+26; x++) {
 for(var y=97; y<97+26; y+=6) {
 var prefix = String.fromCharCode(x) + String.fromCharCode(y);
 db.adminCommand({moveChunk : "myapp.users", find : {email : prefix}, to : shServer[(y-97)/6]});
 }
}
```

---

See [Create Chunks in a Sharded Cluster](#) (page 545) for an introduction to pre-splitting.

New in version 2.2: The `moveChunk` (page 742) command has the: `_secondaryThrottle` parameter. When set to `true`, MongoDB ensures that changes to shards as part of chunk migrations replicate to `secondaries` throughout the migration operation. For more information, see [Require Replication before Chunk Migration \(Secondary Throttle\)](#) (page 550).

Changed in version 2.4: In 2.4, `_secondaryThrottle` is `true` by default.

**Warning:** The `moveChunk` (page 742) command may produce the following error message:

The collection's metadata lock is already taken.

This occurs when clients have too many open `cursors` that access the migrating chunk. You may either wait until the cursors complete their operations or close the cursors manually.

## Modify Chunk Size in a Sharded Cluster

When the first `mongos` (page 938) connects to a set of `config servers`, it initializes the sharded cluster with a default chunk size of 64 megabytes. This default chunk size works well for most deployments; however, if you notice that automatic migrations have more I/O than your hardware can handle, you may want to reduce the chunk size. For automatic splits and migrations, a small chunk size leads to more rapid and frequent migrations.

To modify the chunk size, use the following procedure:

1. Connect to any `mongos` (page 938) in the cluster using the `mongo` (page 942) shell.
2. Issue the following command to switch to the `Config Database` (page 564):

```
use config
```

3. Issue the following `save()` (page 846) operation to store the global chunk size configuration value:

```
db.settings.save({ _id:"chunksize", value: <size> })
```

---

**Note:** The `chunkSize` (page 1002) and `--chunkSize` options, passed at runtime to the `mongos` (page 938), **do not** affect the chunk size after you have initialized the cluster.

To avoid confusion, *always* set the chunk size using the above procedure instead of the runtime options.

---

Modifying the chunk size has several limitations:

- Automatic splitting only occurs on insert or update.
- If you lower the chunk size, it may take time for all chunks to split to the new size.
- Splits cannot be undone.
- If you increase the chunk size, existing chunks grow only through insertion or updates until they reach the new size.

## Split Chunks in a Sharded Cluster

Normally, MongoDB splits a [chunk](#) after an insert if the chunk exceeds the maximum [chunk size](#) (page 519). However, you may want to split chunks manually if:

- you have a large amount of data in your cluster and very few [chunks](#), as is the case after deploying a cluster using existing data.
- you expect to add a large amount of data that would initially reside in a single chunk or shard. For example, you plan to insert a large amount of data with [shard key](#) values between 300 and 400, *but* all values of your shard keys are between 250 and 500 are in a single chunk.

---

**Note:** Chunks cannot be merged or combined once they've been split.

---

The [balancer](#) may migrate recently split chunks to a new shard immediately if [mongos](#) (page 938) predicts future insertions will benefit from the move. The balancer does not distinguish between chunks split manually and those split automatically by the system.

**Warning:** Be careful when splitting data in a sharded collection to create new chunks. When you shard a collection that has existing data, MongoDB automatically creates chunks to evenly distribute the collection. To split data effectively in a sharded cluster you must consider the number of documents in a chunk and the average document size to create a uniform chunk size. When chunks have irregular sizes, shards may have an equal number of chunks but have very different data sizes. Avoid creating splits that lead to a collection with differently sized chunks.

Use [sh.status\(\)](#) (page 910) to determine the current chunk ranges across the cluster.

To split chunks manually, use the [split](#) (page 739) command with either fields `middle` or `find`. The [mongo](#) (page 942) shell provides the helper methods [sh.splitFind\(\)](#) (page 909) and [sh.splitAt\(\)](#) (page 909).

[splitFind\(\)](#) (page 909) splits the chunk that contains the *first* document returned that matches this query into two equally sized chunks. You must specify the full namespace (i.e. “`<database>.<collection>`”) of the sharded collection to [splitFind\(\)](#) (page 909). The query in [splitFind\(\)](#) (page 909) does not need to use the shard key, though it nearly always makes sense to do so.

---

### Example

The following command splits the chunk that contains the value of 63109 for the `zipcode` field in the `people` collection of the `records` database:

```
sh.splitFind("records.people", { "zipcode": 63109 })
```

---

Use [splitAt\(\)](#) (page 909) to split a chunk in two, using the queried document as the lower bound in the new chunk:

---

### Example

The following command splits the chunk that contains the value of 63109 for the `zipcode` field in the `people` collection of the `records` database.

```
sh.splitAt("records.people", { "zipcode": 63109 })
```

---

**Note:** `splitAt()` (page 909) does not necessarily split the chunk into two equally sized chunks. The split occurs at the location of the document matching the query, regardless of where that document is in the chunk.

---

## Configure Behavior of Balancer Process in Sharded Clusters

The balancer is a process that runs on *one* of the `mongos` (page 938) instances in a cluster and ensures that `chunks` are evenly distributed throughout a sharded cluster. In most deployments, the default balancer configuration is sufficient for normal operation. However, administrators might need to modify balancer behavior depending on application or operational requirements. If you encounter a situation where you need to modify the behavior of the balancer, use the procedures described in this document.

For conceptual information about the balancer, see *Sharded Collection Balancing* (page 516) and *Cluster Balancer* (page 516).

### Schedule a Window of Time for Balancing to Occur

You can schedule a window of time during which the balancer can migrate chunks, as described in the following procedures:

- *Schedule the Balancing Window* (page 551)
- *Remove a Balancing Window Schedule* (page 552).

The `mongos` (page 938) instances user their own local timezones to when respecting balancer window.

### Configure Default Chunk Size

The default chunk size for a sharded cluster is 64 megabytes. In most situations, the default size is appropriate for splitting and migrating chunks. For information on how chunk size affects deployments, see details, see *Chunk Size* (page 519).

Changing the default chunk size affects chunks that are processes during migrations and auto-splits but does not retroactively affect all chunks.

To configure default chunk size, see *Modify Chunk Size in a Sharded Cluster* (page 547).

### Change the Maximum Storage Size for a Given Shard

The `maxSize` field in the `shards` (page 569) collection in the `config database` (page 564) sets the maximum size for a shard, allowing you to control whether the balancer will migrate chunks to a shard. If `dataSize` (page 768) is above a shard's `maxSize`, the balancer will not move chunks to the shard. Also, the balancer will not move chunks off an overloaded shard. This must happen manually. The `maxSize` value only affects the balancer's selection of destination shards.

By default, `maxSize` is not specified, allowing shards to consume the total amount of available space on their machines if necessary.

You can set `maxSize` both when adding a shard and once a shard is running.

To set `maxSize` when adding a shard, set the [addShard](#) (page 736) command's `maxSize` parameter to the maximum size in megabytes. For example, the following command run in the [mongo](#) (page 942) shell adds a shard with a maximum size of 125 megabytes:

```
db.runCommand({ addshard : "example.net:34008", maxSize : 125 })
```

To set `maxSize` on an existing shard, insert or update the `maxSize` field in the [shards](#) (page 569) collection in the [config database](#) (page 564). Set the `maxSize` in megabytes.

---

### Example

Assume you have the following shard without a `maxSize` field:

```
{ "_id" : "shard0000", "host" : "example.net:34001" }
```

Run the following sequence of commands in the [mongo](#) (page 942) shell to insert a `maxSize` of 125 megabytes:

```
use config
db.shards.update({ _id : "shard0000" }, { $set : { maxSize : 125 } })
```

To later increase the `maxSize` setting to 250 megabytes, run the following:

```
use config
db.shards.update({ _id : "shard0000" }, { $set : { maxSize : 250 } })
```

---

### Require Replication before Chunk Migration (Secondary Throttle)

New in version 2.2.1: `_secondaryThrottle` became an option to the balancer and to command [moveChunk](#) (page 742). `_secondaryThrottle` makes it possible to require the balancer wait for replication to secondaries during migrations.

Changed in version 2.4: `_secondaryThrottle` became the default mode for all balancer and [moveChunk](#) (page 742) operations.

Before 2.2.1, the write operations required to migrate chunks between shards do not need to replicate to secondaries in order to succeed. However, you can configure the balancer to require migration related write operations to replicate to secondaries. This throttles or slows the migration process and in doing so reduces the potential impact of migrations on a sharded cluster.

You can throttle migrations by enabling the balancer's `_secondaryThrottle` parameter. When enabled, secondary throttle requires a `{ w : 2 }` write concern on delete and insertion operations, so that every operation propagates to at least one secondary before the balancer issues the next operation.

Starting with version 2.4 the default `secondaryThrottle` value is `true`. To revert to previous behavior, set `_secondaryThrottle` to `false`.

You enable or disable `_secondaryThrottle` directly in the [settings](#) (page 569) collection in the [config database](#) (page 564) by running the following commands from the [mongo](#) (page 942) shell:

```
use config
db.settings.update({ "_id" : "balancer" } , { $set : { "_secondaryThrottle" : true } } , { upsert : true })
```

You also can enable secondary throttle when issuing the [moveChunk](#) (page 742) command by setting `_secondaryThrottle` to `true`. For more information, see [moveChunk](#) (page 742).

## Manage Sharded Cluster Balancer

This page describes common administrative procedures related to balancing. For an introduction to balancing, see [Sharded Collection Balancing](#) (page 516). For lower level information on balancing, see [Cluster Balancer](#) (page 516).

### See also:

[Configure Behavior of Balancer Process in Sharded Clusters](#) (page 549)

### Check the Balancer State

The following command checks if the balancer is enabled (i.e. that the balancer is allowed to run). The command does not check if the balancer is active (i.e. if it is actively balancing chunks).

To see if the balancer is enabled in your [cluster](#), issue the following command, which returns a boolean:

```
sh.getBalancerState()
```

### Check the Balancer Lock

To see if the balancer process is active in your [cluster](#), do the following:

1. Connect to any [mongos](#) (page 938) in the cluster using the [mongo](#) (page 942) shell.
2. Issue the following command to switch to the [Config Database](#) (page 564):

```
use config
```

3. Use the following query to return the balancer lock:

```
db.locks.find({ _id : "balancer" }).pretty()
```

When this command returns, you will see output like the following:

```
{ "_id" : "balancer",
"process" : "mongos0.example.net:1292810611:1804289383",
"state" : 2,
"ts" : ObjectId("4d0f872630c42d1978be8a2e"),
"when" : "Mon Dec 20 2010 11:41:10 GMT-0500 (EST)",
"who" : "mongos0.example.net:1292810611:1804289383:Balancer:846930886",
"why" : "doing balance round" }
```

This output confirms that:

- The balancer originates from the [mongos](#) (page 938) running on the system with the hostname `mongos0.example.net`.
- The value in the `state` field indicates that a [mongos](#) (page 938) has the lock. For version 2.0 and later, the value of an active lock is 2; for earlier versions the value is 1.

### Schedule the Balancing Window

In some situations, particularly when your data set grows slowly and a migration can impact performance, it's useful to be able to ensure that the balancer is active only at certain times. Use the following procedure to specify a window during which the [balancer](#) will be able to migrate chunks:

1. Connect to any [mongos](#) (page 938) in the cluster using the [mongo](#) (page 942) shell.

2. Issue the following command to switch to the [Config Database](#) (page 564):

```
use config
```

3. Use an operation modeled on the following example [update\(\)](#) (page 849) operation to modify the balancer's window:

```
db.settings.update({ _id : "balancer" }, { $set : { activeWindow : { start : "<start-time>", stop : "<end-time>" } } })
```

Replace `<start-time>` and `<end-time>` with time values using two digit hour and minute values (e.g. `HH:MM`) that describe the beginning and end boundaries of the balancing window. These times will be evaluated relative to the time zone of each individual [mongos](#) (page 938) instance in the sharded cluster. If your [mongos](#) (page 938) instances are physically located in different time zones, use a common time zone (e.g. `GMT`) to ensure that the balancer window is interpreted correctly.

For instance, running the following will force the balancer to run between 11PM and 6AM local time only:

```
db.settings.update({ _id : "balancer" }, { $set : { activeWindow : { start : "23:00", stop : "06:00" } } })
```

---

**Note:** The balancer window must be sufficient to *complete* the migration of all data inserted during the day.

As data insert rates can change based on activity and usage patterns, it is important to ensure that the balancing window you select will be sufficient to support the needs of your deployment.

---

## Remove a Balancing Window Schedule

If you have [set the balancing window](#) (page 551) and wish to remove the schedule so that the balancer is always running, issue the following sequence of operations:

```
use config
db.settings.update({ _id : "balancer" }, { $unset : { activeWindow : true } })
```

## Disable the Balancer

By default the balancer may run at any time and only moves chunks as needed. To disable the balancer for a short period of time and prevent all migration, use the following procedure:

1. Connect to any [mongos](#) (page 938) in the cluster using the [mongo](#) (page 942) shell.
2. Issue the following operation to disable the balancer:

```
sh.setBalancerState(false)
```

If a migration is in progress, the system will complete the in-progress migration before stopping.

3. To verify that the balancer has stopped, issue the following command, which returns `false` if the balancer is stopped:

```
sh.getBalancerState()
```

Optionally, to verify no migrations are in progress after disabling, issue the following operation in the [mongo](#) (page 942) shell:

```
use config
while(sh.isBalancerRunning()) {
 print("waiting...");
 sleep(1000);
}
```

---

**Note:** To disable the balancer from a driver that does not have the `sh.startBalancer()` (page 910) helper, issue the following command from the `config` database:

```
db.settings.update({ _id: "balancer" }, { $set : { stopped: true } } , true)
```

---

## Enable the Balancer

Use this procedure if you have disabled the balancer and are ready to re-enable it:

1. Connect to any `mongos` (page 938) in the cluster using the `mongo` (page 942) shell.
2. Issue one of the following operations to enable the balancer:

From the `mongo` (page 942) shell, issue:

```
sh.setBalancerState(true)
```

From a driver that does not have the `sh.startBalancer()` (page 910) helper, issue the following from the `config` database:

```
db.settings.update({ _id: "balancer" }, { $set : { stopped: false } } , true)
```

## Disable Balancing During Backups

If MongoDB migrates a `chunk` during a `backup` (page 136), you can end with an inconsistent snapshot of your `sharded cluster`. Never run a backup while the balancer is active. To ensure that the balancer is inactive during your backup operation:

- Set the `balancing window` (page 551) so that the balancer is inactive during the backup. Ensure that the backup can complete while you have the balancer disabled.
- *manually disable the balancer* (page 552) for the duration of the backup procedure.

If you turn the balancer off while it is in the middle of a balancing round, the shut down is not instantaneous. The balancer completes the chunk move in-progress and then ceases all further balancing rounds.

Before starting a backup operation, confirm that the balancer is not active. You can use the following command to determine if the balancer is active:

```
!sh.getBalancerState() && !sh.isBalancerRunning()
```

When the backup procedure is complete you can reactivate the balancer process.

## Remove Shards from an Existing Sharded Cluster

### Remove Shards:

- Ensure the Balancer Process is Enabled (page 554)
- Determine the Name of the Shard to Remove (page 554)
- Remove Chunks from the Shard (page 554)
- Check the Status of the Migration (page 554)
- Move Unsharded Data (page 555)
- Finalize the Migration (page 555)

To remove a [shard](#) you must ensure the shard’s data is migrated to the remaining shards in the cluster. This procedure describes how to safely migrate data and how to remove a shard.

This procedure describes how to safely remove a *single* shard. *Do not* use this procedure to migrate an entire cluster to new hardware. To migrate an entire shard to new hardware, migrate individual shards as if they were independent replica sets.

To remove a shard, first connect to one of the cluster’s [mongos](#) (page 938) instances using [mongo](#) (page 942) shell. Then use the sequence of tasks in this document to remove a shard from the cluster.

### Ensure the Balancer Process is Enabled

To successfully migrate data from a shard, the [balancer](#) process **must** be enabled. Check the balancer state using the [sh.getBalancerState\(\)](#) (page 906) helper in the [mongo](#) (page 942) shell. For more information, see the section on [balancer operations](#) (page 552).

### Determine the Name of the Shard to Remove

To determine the name of the shard, connect to a [mongos](#) (page 938) instance with the [mongo](#) (page 942) shell and either:

- Use the [listShards](#) (page 737) command, as in the following:

```
db.adminCommand({ listShards: 1 })
```

- Run either the [sh.status\(\)](#) (page 910) or the [db.printShardingStatus\(\)](#) (page 892) method.

The `shards._id` field lists the name of each shard.

### Remove Chunks from the Shard

Run the [removeShard](#) (page 737) command. This begins “draining” chunks from the shard you are removing to other shards in the cluster. For example, for a shard named `mongodb0`, run:

```
db.runCommand({ removeShard: "mongodb0" })
```

This operation returns immediately, with the following response:

```
{ msg : "draining started successfully" , state: "started" , shard :"mongodb0" , ok : 1 }
```

Depending on your network capacity and the amount of data, this operation can take from a few minutes to several days to complete.

### Check the Status of the Migration

To check the progress of the migration at any stage in the process, run [removeShard](#) (page 737). For example, for a shard named `mongodb0`, run:

```
db.runCommand({ removeShard: "mongodb0" })
```

The command returns output similar to the following:

```
{ msg: "draining ongoing" , state: "ongoing" , remaining: { chunks: NumberLong(42) , dbs : NumberLong
```

In the output, the `remaining` document displays the remaining number of chunks that MongoDB must migrate to other shards and the number of MongoDB databases that have “primary” status on this shard.

Continue checking the status of the `removeShard` command until the number of chunks remaining is 0. Then proceed to the next step.

### Move Unsharded Data

If the shard is the *primary shard* for one or more databases in the cluster, then the shard will have unsharded data. If the shard is not the primary shard for any databases, skip to the next task, [Finalize the Migration](#) (page 555).

In a cluster, a database with unsharded collections stores those collections only on a single shard. That shard becomes the primary shard for that database. (Different databases in a cluster can have different primary shards.)

**Warning:** Do not perform this procedure until you have finished draining the shard.

1. To determine if the shard you are removing is the primary shard for any of the cluster’s databases, issue one of the following methods:
  - `sh.status()` (page 910)
  - `db.printShardingStatus()` (page 892)

In the resulting document, the `databases` field lists each database and its primary shard. For example, the following `database` field shows that the `products` database uses `mongodb0` as the primary shard:

```
{ "_id" : "products", "partitioned" : true, "primary" : "mongodb0" }
```

2. To move a database to another shard, use the `movePrimary` (page 743) command. For example, to migrate all remaining unsharded data from `mongodb0` to `mongodb1`, issue the following command:

```
db.runCommand({ movePrimary: "products", to: "mongodb1" })
```

This command does not return until MongoDB completes moving all data, which may take a long time. The response from this command will resemble the following:

```
{ "primary" : "mongodb1", "ok" : 1 }
```

### Finalize the Migration

To clean up all metadata information and finalize the removal, run `removeShard` (page 737) again. For example, for a shard named `mongodb0`, run:

```
db.runCommand({ removeShard: "mongodb0" })
```

A success message appears at completion:

```
{ msg: "remove shard completed successfully", stage: "completed", host: "mongodb0", ok : 1 }
```

Once the value of the `stage` field is “completed”, you may safely stop the processes comprising the `mongodb0` shard.

### Convert Sharded Cluster to Replica Set

- Convert a Cluster with a Single Shard into a Replica Set (page 556)
- Convert a Sharded Cluster into a Replica Set (page 556)

This tutorial describes the process for converting a *sharded cluster* to a non-sharded *replica set*. To convert a replica set into a sharded cluster [Convert a Replica Set to a Replicated Sharded Cluster](#) (page 530). See the [Sharding](#) (page 493) documentation for more information on sharded clusters.

### Convert a Cluster with a Single Shard into a Replica Set

In the case of a *sharded cluster* with only one shard, that shard contains the full data set. Use the following procedure to convert that cluster into a non-sharded *replica set*:

1. Reconfigure the application to connect to the primary member of the replica set hosting the single shard that system will be the new replica set.
2. Optionally remove the `--shardsrv` option, if your `mongod` (page 925) started with this option.

---

#### Tip

Changing the `--shardsrv` option will change the port that `mongod` (page 925) listens for incoming connections on.

---

The single-shard cluster is now a non-sharded *replica set* that will accept read and write operations on the data set.

You may now decommission the remaining sharding infrastructure.

### Convert a Sharded Cluster into a Replica Set

Use the following procedure to transition from a *sharded cluster* with more than one shard to an entirely new *replica set*.

1. With the *sharded cluster* running, [deploy a new replica set](#) (page 420) in addition to your sharded cluster. The replica set must have sufficient capacity to hold all of the data files from all of the current shards combined. Do not configure the application to connect to the new replica set until the data transfer is complete.
2. Stop all writes to the *sharded cluster*. You may reconfigure your application or stop all `mongos` (page 938) instances. If you stop all `mongos` (page 938) instances, the applications will not be able to read from the database. If you stop all `mongos` (page 938) instances, start a temporary `mongos` (page 938) instance on that applications cannot access for the data migration procedure.
3. Use [mongodump and mongorestore](#) (page 181) to migrate the data from the `mongos` (page 938) instance to the new *replica set*.

---

**Note:** Not all collections on all databases are necessarily sharded. Do not solely migrate the sharded collections. Ensure that all databases and all collections migrate correctly.

---

4. Reconfigure the application to use the non-sharded *replica set* instead of the `mongos` (page 938) instance.

The application will now use the un-sharded *replica set* for reads and writes. You may now decommission the remaining unused sharded cluster infrastructure.

**See also:**

[Backup and Restore Sharded Clusters](#) (page 188)

### 9.3.3 Sharded Cluster Data Management

The following documents provide information in managing data in sharded clusters.

**Tag Aware Sharding (page 557)** Tags associate specific ranges of *shard key* values with specific shards for use in managing deployment patterns.

**Enforce Unique Keys for Sharded Collections (page 558)** Ensure that a field is always unique in all collections in a sharded cluster.

**Shard GridFS Data Store (page 560)** Choose whether to shard GridFS data in a sharded collection.

#### Tag Aware Sharding

MongoDB supports tagging a range of *shard key* values to associate that range with a shard or group of shards. Those shards receive all inserts within the tagged range.

The balancer obeys tagged range associations, which enables the following deployment patterns:

- isolate a specific subset of data on a specific set of shards.
- ensure that the most relevant data reside on shards that are geographically closest to the application servers.

This document describes the behavior, operation, and use of tag aware sharding in MongoDB deployments.

---

**Note:** *Shard key* range tags are distinct from *replica set member tags* (page 407).

---

**Important:** *Hash-based sharding* does not support tag-aware sharding.

---

#### Behavior and Operations

The balancer migrates chunks of documents in a sharded collections to the shards associated with a tag that has a *shard key* range with an *upper bound greater* than the chunk's *lower bound*.

---

**Note:** If the chunks in sharded collection are already balanced, then the balancer will not migrate any chunks. If chunks in a sharded collection are not balanced, the balancer migrates chunks in tagged ranges to shards associated with those tags.

---

After configuring tags with a shard key range, and associating it with a shard or shards, the cluster may take some time to balance the data among the shards. This depends on the division of chunks and the current distribution of data in the cluster.

Once configured, the balancer respects tag ranges during future *balancing rounds* (page 516).

**See also:**

[Manage Shard Tags \(page 536\)](#)

#### Chunks that Span Multiple Tag Ranges

A single chunk may contain data with a *shard key* values that falls into ranges associated with more than one tag. To accommodate these situations, the balancer may migrate chunks to shards that contain shard key values that exceed the upper bound of the selected tag range.

---

#### Example

Given a sharded collection with two configured tag ranges:

- *Shard key* values between 100 and 200 have tags to direct corresponding chunks to shards tagged NYC.
- Shard key values between 200 and 300 have tags to direct corresponding chunks to shards tagged SFO.

For this collection cluster, the balancer will migrate a chunk with *shard key* values ranging between 150 and 220 to a shard tagged NYC, since 150 is closer to 200 than 300.

---

To ensure that your collection has no potentially ambiguously tagged chunks, *create splits on your tag boundaries* (page 548). You can then manually migrate chunks to the appropriate shards, or wait for the balancer to automatically migrate these chunks.

## Enforce Unique Keys for Sharded Collections

### Overview

The [unique](#) (page 814) constraint on indexes ensures that only one document can have a value for a field in a *collection*. For *sharded collections* these unique indexes cannot enforce uniqueness (page 1017) because insert and indexing operations are local to each shard.<sup>10</sup>

If your need to ensure that a field is always unique in all collections in a sharded environment, there are two options:

1. Enforce uniqueness of the *shard key* (page 506).

MongoDB can enforce uniqueness for the *shard key*. For compound shard keys, MongoDB will enforce uniqueness on the *entire* key combination, and not for a specific component of the shard key.

You cannot specify a unique constraint on a *hashed index* (page 333).

2. Use a secondary collection to enforce uniqueness.

Create a minimal collection that only contains the unique field and a reference to a document in the main collection. If you always insert into a secondary collection *before* inserting to the main collection, MongoDB will produce an error if you attempt to use a duplicate key.

---

**Note:** If you have a small data set, you may not need to shard this collection and you can create multiple unique indexes. Otherwise you can shard on a single unique key.

---

Always use the default [acknowledged](#) (page 55) *write concern* (page 55) in conjunction with a *recent MongoDB driver* (page 1089).

### Unique Constraints on the Shard Key

**Process** To shard a collection using the [unique](#) constraint, specify the [shardCollection](#) (page 738) command in the following form:

```
db.runCommand({ shardCollection : "test.users" , key : { email : 1 } , unique : true });
```

Remember that the `_id` field index is always unique. By default, MongoDB inserts an `ObjectID` into the `_id` field. However, you can manually insert your own value into the `_id` field and use this as the shard key. To use the `_id` field as the shard key, use the following operation:

---

<sup>10</sup> If you specify a unique index on a sharded collection, MongoDB will be able to enforce uniqueness only among the documents located on a single shard *at the time of creation*.

```
db.runCommand({ shardCollection : "test.users" })
```

**Warning:** In any sharded collection where you are *not* sharding by the `_id` field, you must ensure uniqueness of the `_id` field. The best way to ensure `_id` is always unique is to use `ObjectId`, or another universally unique identifier (UUID.)

## Limitations

- You can only enforce uniqueness on one single field in the collection using this method.
- If you use a compound shard key, you can only enforce uniqueness on the *combination* of component keys in the shard key.

In most cases, the best shard keys are compound keys that include elements that permit *write scaling* (page 507) and *query isolation* (page 507), as well as *high cardinality* (page 527). These ideal shard keys are not often the same keys that require uniqueness and requires a different approach.

## Unique Constraints on Arbitrary Fields

If you cannot use a unique field as the shard key or if you need to enforce uniqueness over multiple fields, you must create another *collection* to act as a “proxy collection”. This collection must contain both a reference to the original document (i.e. its `ObjectId`) and the unique key.

If you must shard this “proxy” collection, then shard on the unique key using the *above procedure* (page 558); otherwise, you can simply create multiple unique indexes on the collection.

**Process** Consider the following for the “proxy collection:”

```
{
 "_id" : ObjectId("..."),
 "email" : "...",
}
```

The `_id` field holds the `ObjectId` of the *document* it reflects, and the `email` field is the field on which you want to ensure uniqueness.

To shard this collection, use the following operation using the `email` field as the *shard key*:

```
db.runCommand({ shardCollection : "records.proxy" , key : { email : 1 } , unique : true });
```

If you do not need to shard the proxy collection, use the following command to create a unique index on the `email` field:

```
db.proxy.ensureIndex({ "email" : 1 } , {unique : true})
```

You may create multiple unique indexes on this collection if you do not plan to shard the proxy collection.

To insert documents, use the following procedure in the *JavaScript shell* (page 942):

```
use records;

var primary_id = ObjectId();

db.proxy.insert({
 "_id" : primary_id
 "email" : "example@example.net"
```

```
})

// if: the above operation returns successfully,
// then continue:

db.information.insert({
 "_id" : primary_id
 "email": "example@example.net"
 // additional information...
})
```

You must insert a document into the proxy collection first. If this operation succeeds, the `email` field is unique, and you may continue by inserting the actual document into the `information` collection.

---

### See

The full documentation of: [ensureIndex\(\)](#) (page 814) and [shardCollection](#) (page 738).

---

## Considerations

- Your application must catch errors when inserting documents into the “proxy” collection and must enforce consistency between the two collections.
- If the proxy collection requires sharding, you must shard on the single field on which you want to enforce uniqueness.
- To enforce uniqueness on more than one field using sharded proxy collections, you must have *one* proxy collection for *every* field for which to enforce uniqueness. If you create multiple unique indexes on a single proxy collection, you will *not* be able to shard proxy collections.

## Shard GridFS Data Store

When sharding a `GridFS` store, consider the following:

### files Collection

Most deployments will not need to shard the `files` collection. The `files` collection is typically small, and only contains metadata. None of the required keys for GridFS lend themselves to an even distribution in a sharded situation. If you *must* shard the `files` collection, use the `_id` field possibly in combination with an application field.

Leaving `files` unsharded means that all the file metadata documents live on one shard. For production GridFS stores you *must* store the `files` collection on a replica set.

### chunks Collection

To shard the `chunks` collection by `{ files_id : 1, n : 1 }`, issue commands similar to the following:

```
db.fs.chunks.ensureIndex({ files_id : 1 , n : 1 })

db.runCommand({ shardCollection : "test.fs.chunks" , key : { files_id : 1 , n : 1 } })
```

You may also want to shard using just the `file_id` field, as in the following operation:

---

```
db.runCommand({ shardCollection : "test.fs.chunks" , key : { files_id : 1 } })
```

---

**Important:** { files\_id : 1 , n : 1 } and { files\_id : 1 } are the **only** supported shard keys for the chunks collection of a GridFS store.

---

**Note:** Changed in version 2.2.

Before 2.2, you had to create an additional index on files\_id to shard using *only* this field.

---

The default files\_id value is an *ObjectId*, as a result the values of files\_id are always ascending, and applications will insert all new GridFS data to a single chunk and shard. If your write load is too high for a single server to handle, consider a different shard key or use a different value for \_id in the files collection.

### 9.3.4 Troubleshoot Sharded Clusters

This section describes common strategies for troubleshooting *sharded cluster* deployments.

#### Config Database String Error

Start all `mongos` (page 938) instances in a sharded cluster with an identical `configdb` (page 1001) string. If a `mongos` (page 938) instance tries to connect to the sharded cluster with a `configdb` (page 1001) string that does not *exactly* match the string used by the other `mongos` (page 938) instances, including the order of the hosts, the following errors occur:

```
could not initialize sharding on connection
```

And:

```
mongos specified a different config database string
```

To solve the issue, restart the `mongos` (page 938) with the correct string.

#### Cursor Fails Because of Stale Config Data

A query returns the following warning when one or more of the `mongos` (page 938) instances has not yet updated its cache of the cluster's metadata from the `config database`:

```
could not initialize cursor across all shards because : stale config detected
```

This warning *should* not propagate back to your application. The warning will repeat until all the `mongos` (page 938) instances refresh their caches. To force an instance to refresh its cache, run the `flushRouterConfig` (page 735) command.

#### Avoid Downtime when Moving Config Servers

Use CNAMEs to identify your config servers to the cluster so that you can rename and renumber your config servers without downtime.



## 9.4 Sharding Reference

### 9.4.1 Sharding Methods in the mongo Shell

| Name                                                 | Description                                                                                                                                                                          |
|------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>sh._adminCommand</code><br>(page 902)          | Runs a <i>database command</i> against the admin database, like <code>db.runCommand()</code> (page 893), but can confirm that it is issued against a <code>mongos</code> (page 938). |
| <code>sh._checkFullName()</code><br>(page 902)       | Tests a namespace to determine if its well formed.                                                                                                                                   |
| <code>sh._checkMongos()</code><br>(page 902)         | Tests to see if the <code>mongo</code> (page 942) shell is connected to a <code>mongos</code> (page 938) instance.                                                                   |
| <code>sh._lastMigration()</code><br>(page 902)       | Reports on the last <i>chunk</i> migration.                                                                                                                                          |
| <code>sh.addShard()</code><br>(page 903)             | Adds a <i>shard</i> to a sharded cluster.                                                                                                                                            |
| <code>sh.addShardTag()</code><br>(page 904)          | Associates a shard with a tag, to support <i>tag aware sharding</i> (page 557).                                                                                                      |
| <code>sh.addTagRange()</code><br>(page 904)          | Associates range of shard keys with a shard tag, to support <i>tag aware sharding</i> (page 557).                                                                                    |
| <code>sh.disableBalancing</code><br>(page 905)       | Disable balancing on a single collection in a sharded database. Does not affect balancing of other collections in a sharded cluster.                                                 |
| <code>sh.enableBalancing</code><br>(page 905)        | Activates the sharded collection balancer process if previously disabled using <code>sh.disableBalancing()</code> (page 905).                                                        |
| <code>sh.enableSharding()</code><br>(page 905)       | Enables sharding on a specific database.                                                                                                                                             |
| <code>sh.getBalancerHost</code><br>(page 906)        | Returns the name of a <code>mongos</code> (page 938) that's responsible for the balancer process.                                                                                    |
| <code>sh.getBalancerState</code><br>(page 906)       | Returns a boolean to report if the <i>balancer</i> is currently enabled.                                                                                                             |
| <code>sh.help()</code> (page 906)                    | Returns help text for the <code>sh</code> methods.                                                                                                                                   |
| <code>sh.isBalancerRunning</code><br>(page 907)      | Returns a boolean to report if the balancer process is currently migrating chunks.                                                                                                   |
| <code>sh.moveChunk()</code><br>(page 907)            | Migrates a <i>chunk</i> in a <i>sharded cluster</i> .                                                                                                                                |
| <code>sh.removeShardTag()</code><br>(page 908)       | Removes the association between a shard and a shard tag shard tag.                                                                                                                   |
| <code>sh.setBalancerState</code><br>(page 908)       | Enables or disables the <i>balancer</i> which migrates <i>chunks</i> between <i>shards</i> .                                                                                         |
| <code>sh.shardCollection</code><br>(page 908)        | Enables sharding for a collection.                                                                                                                                                   |
| <code>sh.splitAt()</code><br>(page 909)              | Divides an existing <i>chunk</i> into two chunks using a specific value of the <i>shard key</i> as the dividing point.                                                               |
| <code>sh.splitFind()</code><br>(page 909)            | Divides an existing <i>chunk</i> that contains a document matching a query into two approximately equal chunks.                                                                      |
| <code>sh.startBalancer()</code><br>(page 910)        | Enables the <i>balancer</i> and waits for balancing to start.                                                                                                                        |
| <code>sh.status()</code><br>(page 910)               | Reports on the status of a <i>sharded cluster</i> , as <code>db.printShardingStatus()</code> (page 892).                                                                             |
| <code>sh.stopBalancer()</code><br>(page 912)         | Disables the <i>balancer</i> and waits for any in progress balancing rounds to complete.                                                                                             |
| <code>sh.waitForBalancer</code><br>(page 913)        | Internal. Waits for the balancer state to change.                                                                                                                                    |
| <code>sh.waitForBalancer</code><br>(page 913)        | Internal. Waits until the balancer stops running.                                                                                                                                    |
| <code>sh.waitForDistributedLock</code><br>(page 914) | Internal. Waits for a specified distributed <i>sharded cluster</i> lock.                                                                                                             |
| <code>sh.waitForPingChange</code><br>(page 914)      | Internal. Waits for a change in ping state from one of the <code>mongos</code> (page 938) in the sharded cluster.                                                                    |

## 9.4.2 Sharding Database Commands

The following database commands support *sharded clusters*.

| Name                                             | Description                                                                                                                               |
|--------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| <a href="#">flushRouterConfig</a><br>(page 735)  | Forces an update to the cluster metadata cached by a <code>mongos</code> (page 938).                                                      |
| <a href="#">addShard</a> (page 736)              | Adds a <i>shard</i> to a <i>sharded cluster</i> .                                                                                         |
| <a href="#">checkShardingIndex</a><br>(page 736) | Internal command that validates index on shard key.                                                                                       |
| <a href="#">enableSharding</a><br>(page 736)     | Enables sharding on a specific database.                                                                                                  |
| <a href="#">listShards</a><br>(page 737)         | Returns a list of configured shards.                                                                                                      |
| <a href="#">removeShard</a><br>(page 737)        | Starts the process of removing a shard from a sharded cluster.                                                                            |
| <a href="#">getShardMap</a><br>(page 737)        | Internal command that reports on the state of a sharded cluster.                                                                          |
| <a href="#">getShardVersion</a><br>(page 737)    | Internal command that returns the <i>config server</i> version.                                                                           |
| <a href="#">setShardVersion</a><br>(page 737)    | Internal command to sets the <i>config server</i> version.                                                                                |
| <a href="#">shardCollection</a><br>(page 738)    | Enables the sharding functionality for a collection, allowing the collection to be sharded.                                               |
| <a href="#">shardingState</a><br>(page 738)      | Reports whether the <code>mongod</code> (page 925) is a member of a sharded cluster.                                                      |
| <a href="#">unsetSharding</a><br>(page 739)      | Internal command that affects connections between instances in a MongoDB deployment.                                                      |
| <a href="#">split</a> (page 739)                 | Creates a new <i>chunk</i> .                                                                                                              |
| <a href="#">splitChunk</a><br>(page 741)         | Internal command to split chunk. Instead use the methods <code>sh.splitFind()</code> (page 909) and <code>sh.splitAt()</code> (page 909). |
| <a href="#">splitVector</a><br>(page 742)        | Internal command that determines split points.                                                                                            |
| <a href="#">medianKey</a> (page 742)             | Deprecated internal command. See <a href="#">splitVector</a> (page 742).                                                                  |
| <a href="#">moveChunk</a> (page 742)             | Internal command that migrates chunks between shards.                                                                                     |
| <a href="#">movePrimary</a><br>(page 743)        | Reassigns the <i>primary shard</i> when removing a shard from a sharded cluster.                                                          |
| <a href="#">isdbgrid</a> (page 743)              | Verifies that a process is a <code>mongos</code> (page 938).                                                                              |

## 9.4.3 Reference Documentation

**Config Database** (page 564) Complete documentation of the content of the `local` database that MongoDB uses to store sharded cluster metadata.

**Sharding Command Quick Reference** (page 570) A quick reference for all *commands* and `mongo` (page 942) shell methods that support sharding and sharded clusters.

### Config Database

The `config` database supports *sharded cluster* operation. See the [Sharding](#) (page 493) section of this manual for full documentation of sharded clusters.

**Important:** Consider the schema of the `config` database *internal* and may change between releases of MongoDB.

The `config` database is not a dependable API, and users should not write data to the `config` database in the course of normal operation or maintenance.

**Warning:** Modification of the `config` database on a functioning system may lead to instability or inconsistent data sets. If you must modify the `config` database, use [mongodump](#) (page 951) to create a full backup of the `config` database.

To access the `config` database, connect to a [mongos](#) (page 938) instance in a sharded cluster, and use the following helper:

```
use config
```

You can return a list of the collections, with the following helper:

```
show collections
```

## Collections

### `config`

#### `config.changelog`

---

### Internal MongoDB Metadata

The `config` (page 565) database is internal: applications and administrators should not modify or depend upon its content in the course of normal operation.

The `changelog` (page 565) collection stores a document for each change to the metadata of a sharded collection.

---

### Example

The following example displays a single record of a chunk split from a `changelog` (page 565) collection:

```
{
 "_id" : "<hostname>-<timestamp>-<increment>",
 "server" : "<hostname><:port>",
 "clientAddr" : "127.0.0.1:63381",
 "time" : ISODate("2012-12-11T14:09:21.039Z"),
 "what" : "split",
 "ns" : "<database>.<collection>",
 "details" : {
 "before" : {
 "min" : {
 "<database>" : { $minKey : 1 }
 },
 "max" : {
 "<database>" : { $maxKey : 1 }
 },
 "lastmod" : Timestamp(1000, 0),
 "lastmodEpoch" : ObjectId("00000000000000000000000000000000")
 },
 "left" : {
 "min" : {
 "<database>" : { $minKey : 1 }
 },
 "max" : {
 "<database>" : { $maxKey : 1 }
 }
 }
 }
}
```

```
 "max" : {
 "<database>" : "<value>"
 },
 "lastmod" : Timestamp(1000, 1),
 "lastmodEpoch" : ObjectId(<...>)
 },
 "right" : {
 "min" : {
 "<database>" : "<value>"
 },
 "max" : {
 "<database>" : { $maxKey : 1 }
 },
 "lastmod" : Timestamp(1000, 2),
 "lastmodEpoch" : ObjectId("<...>")
 }
}
}
```

---

Each document in the [changelog](#) (page 565) collection contains the following fields:

**config.changelog.\_id**

The value of `changelog._id` is: <hostname>-<timestamp>-<increment>.

**config.changelog.server**

The hostname of the server that holds this data.

**config.changelog.clientAddr**

A string that holds the address of the client, a [mongos](#) (page 938) instance that initiates this change.

**config.changelog.time**

A [ISODATE](#) timestamp that reflects when the change occurred.

**config.changelog.what**

Reflects the type of change recorded. Possible values are:

- `dropCollection`
- `dropCollection.start`
- `dropDatabase`
- `dropDatabase.start`
- `moveChunk.start`
- `moveChunk.commit`
- `split`
- `multi-split`

**config.changelog.ns**

Namespace where the change occurred.

**config.changelog.details**

A [document](#) that contains additional details regarding the change. The structure of the `details` (page 566) document depends on the type of change.

---

**config.chunks**

---

---

## Internal MongoDB Metadata

The [config](#) (page 565) database is internal: applications and administrators should not modify or depend upon its content in the course of normal operation.

---

The [chunks](#) (page 566) collection stores a document for each chunk in the cluster. Consider the following example of a document for a chunk named `records.pets-animal_\\"cat\\"`:

```
{
 "_id" : "mydb.foo-a_\\"cat\\\"",
 "lastmod" : Timestamp(1000, 3),
 "lastmodEpoch" : ObjectId("5078407bd58b175c5c225fdc"),
 "ns" : "mydb.foo",
 "min" : {
 "animal" : "cat"
 },
 "max" : {
 "animal" : "dog"
 },
 "shard" : "shard0004"
}
```

These documents store the range of values for the shard key that describe the chunk in the `min` and `max` fields. Additionally the `shard` field identifies the shard in the cluster that “owns” the chunk.

### `config.collections`

---

## Internal MongoDB Metadata

The [config](#) (page 565) database is internal: applications and administrators should not modify or depend upon its content in the course of normal operation.

---

The [collections](#) (page 567) collection stores a document for each sharded collection in the cluster. Given a collection named `pets` in the `records` database, a document in the [collections](#) (page 567) collection would resemble the following:

```
{
 "_id" : "records.pets",
 "lastmod" : ISODate("1970-01-16T15:00:58.107Z"),
 "dropped" : false,
 "key" : {
 "a" : 1
 },
 "unique" : false,
 "lastmodEpoch" : ObjectId("5078407bd58b175c5c225fdc")
}
```

### `config.databases`

---

## Internal MongoDB Metadata

The [config](#) (page 565) database is internal: applications and administrators should not modify or depend upon its content in the course of normal operation.

---

The [databases](#) (page 567) collection stores a document for each database in the cluster, and tracks if the database has sharding enabled. [databases](#) (page 567) represents each database in a distinct document. When a databases have sharding enabled, the `primary` field holds the name of the *primary shard*.

```
{ "_id" : "admin", "partitioned" : false, "primary" : "config" }
{ "_id" : "mydb", "partitioned" : true, "primary" : "shard0000" }
```

config.**lockpings**

---

### Internal MongoDB Metadata

The config (page 565) database is internal: applications and administrators should not modify or depend upon its content in the course of normal operation.

---

The lockpings (page 568) collection keeps track of the active components in the sharded cluster. Given a cluster with a mongos (page 938) running on example.com:30000, the document in the lockpings (page 568) collection would resemble:

```
{ "_id" : "example.com:30000:1350047994:16807", "ping" : ISODate("2012-10-12T18:32:54.892Z") }
```

config.**locks**

---

### Internal MongoDB Metadata

The config (page 565) database is internal: applications and administrators should not modify or depend upon its content in the course of normal operation.

---

The locks (page 568) collection stores a distributed lock. This ensures that only one mongos (page 938) instance can perform administrative tasks on the cluster at once. The mongos (page 938) acting as *balancer* takes a lock by inserting a document resembling the following into the locks collection.

```
{
 "_id" : "balancer",
 "process" : "example.net:40000:1350402818:16807",
 "state" : 2,
 "ts" : ObjectId("507daeedf40e1879df62e5f3"),
 "when" : ISODate("2012-10-16T19:01:01.593Z"),
 "who" : "example.net:40000:1350402818:16807:Balancer:282475249",
 "why" : "doing balance round"
}
```

If a mongos (page 938) holds the balancer lock, the state field has a value of 2, which means that balancer is active. The when field indicates when the balancer began the current operation.

Changed in version 2.0: The value of the state field was 1 before MongoDB 2.0.

config.**mongos**

---

### Internal MongoDB Metadata

The config (page 565) database is internal: applications and administrators should not modify or depend upon its content in the course of normal operation.

---

The mongos (page 568) collection stores a document for each mongos (page 938) instance affiliated with the cluster. mongos (page 938) instances send pings to all members of the cluster every 30 seconds so the cluster can verify that the mongos (page 938) is active. The ping field shows the time of the last ping, while the up field reports the uptime of the mongos (page 938) as of the last ping. The cluster maintains this collection for reporting purposes.

The following document shows the status of the `mongos` (page 938) running on `example.com:30000`.

```
{ "_id" : "example.com:30000", "ping" : ISODate("2012-10-12T17:08:13.538Z"), "up" : 13699, "wait
```

`config.settings`

---

### Internal MongoDB Metadata

The `config` (page 565) database is internal: applications and administrators should not modify or depend upon its content in the course of normal operation.

The `settings` (page 569) collection holds the following sharding configuration settings:

- Chunk size. To change chunk size, see *Modify Chunk Size in a Sharded Cluster* (page 547).
- Balancer status. To change status, see *Disable the Balancer* (page 552).

The following is an example `settings` collection:

```
{ "_id" : "chunksize", "value" : 64 }
{ "_id" : "balancer", "stopped" : false }
```

`config.shards`

---

### Internal MongoDB Metadata

The `config` (page 565) database is internal: applications and administrators should not modify or depend upon its content in the course of normal operation.

The `shards` (page 569) collection represents each shard in the cluster in a separate document. If the shard is a replica set, the `host` field displays the name of the replica set, then a slash, then the hostname, as in the following example:

```
{ "_id" : "shard0000", "host" : "shard1/localhost:30000" }
```

If the shard has `tags` (page 557) assigned, this document has a `tags` field, that holds an array of the tags, as in the following example:

```
{ "_id" : "shard0001", "host" : "localhost:30001", "tags": ["NYC"] }
```

`config.tags`

---

### Internal MongoDB Metadata

The `config` (page 565) database is internal: applications and administrators should not modify or depend upon its content in the course of normal operation.

The `tags` (page 569) collection holds documents for each tagged shard key range in the cluster. The documents in the `tags` (page 569) collection resemble the following:

```
{
 "_id" : { "ns" : "records.users", "min" : { "zipcode" : "10001" } },
 "ns" : "records.users",
 "min" : { "zipcode" : "10001" },
 "max" : { "zipcode" : "10281" },
 "tag" : "NYC"
}
```

`config.version`

---

### Internal MongoDB Metadata

The `config` (page 565) database is internal: applications and administrators should not modify or depend upon its content in the course of normal operation.

---

The `version` (page 569) collection holds the current metadata version number. This collection contains only one document:

To access the `version` (page 569) collection you must use the `db.getCollection()` (page 886) method. For example, to display the collection's document:

```
mongos> db.getCollection("version").find()
{ "_id" : 1, "version" : 3 }
```

---

**Note:** Like all databases in MongoDB, the `config` database contains a `system.indexes` (page 229) collection which contains metadata for all indexes in the database for information on indexes, see *Indexes* (page 313).

---

## Sharding Command Quick Reference

### JavaScript Methods

#### Definition

`sh.addShard(host)`

Adds a database instance or replica set to a *sharded cluster*. The optimal configuration is to deploy shards across *replica sets*. This method must be run on a `mongos` (page 938) instance.

The `sh.addShard()` (page 903) method has the following parameter:

**param string host** The hostname of either a standalone database instance or of a replica set. Include the port number if the instance is running on a non-standard port. Include the replica set name if the instance is a replica set, as explained below.

The `sh.addShard()` (page 903) method has the following prototype form:

```
sh.addShard("<host>")
```

The `host` parameter can be in any of the following forms:

```
[hostname]
[hostname]:[port]
[replica-set-name]/[hostname]
[replica-set-name]/[hostname]:port
```

**Warning:** Do not use `localhost` for the hostname unless your *configuration server* is also running on `localhost`.

The `sh.addShard()` (page 903) method is a helper for the `addShard` (page 736) command. The `addShard` (page 736) command has additional options which are not available with this helper.

## Example

To add a shard on a replica set, specify the name of the replica set and the hostname of at least one member of the replica set, as a seed. If you specify additional hostnames, all must be members of the same replica set.

The following example adds a replica set named `rep10` and specifies one member of the replica set:

```
sh.addShard("rep10/mongodb3.example.net:27327")
```

## Definition

`sh.enableSharding(database)`

Enables sharding on the specified database. This does not automatically shard any collections but makes it possible to begin sharding collections using `sh.shardCollection()` (page 908).

The `sh.enableSharding()` (page 905) method has the following parameter:

**param string database** The name of the database shard. Enclose the name in quotation marks.

### See also:

`sh.shardCollection()` (page 908)

## Definition

`sh.shardCollection(namespace, key, unique)`

Shards a collection using the key as a the *shard key*. `sh.shardCollection()` (page 908) takes the following arguments:

**param string namespace** The *namespace* of the collection to shard.

**param document key** A *document* that specifies the *shard key* to use to *partition* and distribute objects among the shards. A shard key may be one field or multiple fields. A shard key with multiple fields is called a “compound shard key.”

**param Boolean unique** When true, ensures that the underlying index enforces a unique constraint.

*Hashed shard keys* do not support unique constraints.

New in version 2.4: Use the form `{field: "hashed"}` to create a *hashed shard key*. Hashed shard keys may not be compound indexes.

**Warning:** MongoDB provides no method to deactivate sharding for a collection after calling `shardCollection` (page 738). Additionally, after `shardCollection` (page 738), you cannot change shard keys or modify the value of any field used in your shard key index.

### See also:

`shardCollection` (page 738) for additional options, *Sharding* (page 493) and *Sharding Introduction* (page 493) for an overview of sharding, *Deploy a Sharded Cluster* (page 522) for a tutorial, and *Shard Keys* (page 506) for choosing a shard key.

## Example

Given the `people` collection in the `records` database, the following command shards the collection by the `zipcode` field:

```
sh.shardCollection("records.people", { zipcode: 1})
```

## Definition

`sh.splitFind(namespace, query)`

Splits the chunk containing the document specified by the `query` at its median point, creating two roughly equal chunks. Use `sh.splitAt()` (page 909) to split a collection in a specific point.

In most circumstances, you should leave chunk splitting to the automated processes. However, when initially deploying a *sharded cluster* it is necessary to perform some measure of *pre-splitting* using manual methods including `sh.splitFind()` (page 909).

**param string namespace** The namespace (i.e. <database>.<collection>) of the sharded collection that contains the chunk to split.

**param document query** A query to identify a document in a specific chunk. Typically specify the `shard key` for a document as the query.

## Definition

`sh.splitAt(namespace, query)`

Splits the chunk containing the document specified by the query as if that document were at the “middle” of the collection, even if the specified document is not the actual median of the collection.

**param string namespace** The namespace (i.e. <database>.<collection>) of the sharded collection that contains the chunk to split.

**param document query** A query to identify a document in a specific chunk. Typically specify the `shard key` for a document as the query.

Use this command to manually split chunks unevenly. Use the “`sh.splitFind()` (page 909)” function to split a chunk at the actual median.

In most circumstances, you should leave chunk splitting to the automated processes within MongoDB. However, when initially deploying a *sharded cluster* it is necessary to perform some measure of *pre-splitting* using manual methods including `sh.splitAt()` (page 909).

## Definition

`sh.moveChunk(namespace, query, destination)`

Moves the `chunk` that contains the document specified by the `query` to the `destination shard`. `sh.moveChunk()` (page 907) provides a wrapper around the `moveChunk` (page 742) database command and takes the following arguments:

**param string namespace** The `namespace` of the sharded collection that contains the chunk to migrate.

**param document query** An equality match on the shard key that selects the chunk to move.

**param string destination** The name of the shard to move.

---

**Important:** In most circumstances, allow the `balancer` to automatically migrate `chunks`, and avoid calling `sh.moveChunk()` (page 907) directly.

---

**See also:**

`moveChunk` (page 742), `sh.splitAt()` (page 909), `sh.splitFind()` (page 909), *Sharding* (page 493), and *chunk migration* (page 518).

**Example**

Given the `people` collection in the `records` database, the following operation finds the chunk that contains the documents with the `zipcode` field set to 53187 and then moves that chunk to the shard named `shard0019`:

```
sh.moveChunk("records.people", { zipcode: 53187 }, "shard0019")
```

**Description****sh.setBalancerState(state)**

Enables or disables the *balancer*. Use `sh.getBalancerState()` (page 906) to determine if the balancer is currently enabled or disabled and `sh.isBalancerRunning()` (page 907) to check its current state.

The `sh.getBalancerState()` (page 906) method has the following parameter:

**param Boolean state** Set this to `true` to enable the balancer and `false` to disable it.

**See also:**

- `sh.enableBalancing()` (page 905)
- `sh.disableBalancing()` (page 905)
- `sh.getBalancerHost()` (page 906)
- `sh.getBalancerState()` (page 906)
- `sh.isBalancerRunning()` (page 907)
- `sh.startBalancer()` (page 910)
- `sh.stopBalancer()` (page 912)
- `sh.waitForBalancer()` (page 913)
- `sh.waitForBalancerOff()` (page 913)

**sh.isBalancerRunning()**

**Returns** boolean

Returns true if the *balancer* process is currently running and migrating chunks and false if the balancer process is not running. Use `sh.getBalancerState()` (page 906) to determine if the balancer is enabled or disabled.

**See also:**

- `sh.enableBalancing()` (page 905)
- `sh.disableBalancing()` (page 905)
- `sh.getBalancerHost()` (page 906)
- `sh.getBalancerState()` (page 906)
- `sh.setBalancerState()` (page 908)
- `sh.startBalancer()` (page 910)
- `sh.stopBalancer()` (page 912)

- `sh.waitForBalancer()` (page 913)
- `sh.waitForBalancerOff()` (page 913)

### `sh.status()`

Prints a formatted report of the sharding configuration and the information regarding existing chunks in a *sharded cluster*. The default behavior suppresses the detailed chunk information if the total number of chunks is greater than or equal to 20.

The `sh.status()` (page 910) method has the following parameter:

**param Boolean verbose** If `true`, the method displays details of the document distribution across chunks when you have 20 or more chunks.

### See also:

`db.printShardingStatus()` (page 892)

## Definition

### `sh.addShardTag(shard, tag)`

New in version 2.2.

Associates a shard with a tag or identifier. MongoDB uses these identifiers to direct *chunks* that fall within a tagged range to specific shards. `sh.addTagRange()` (page 904) associates chunk ranges with tag ranges.

**param string shard** The name of the shard to which to give a specific tag.

**param string tag** The name of the tag to add to the shard.

Always issue `sh.addShardTag()` (page 904) when connected to a `mongos` (page 938) instance.

## Example

The following example adds three tags, NYC, LAX, and NRT, to three shards:

```
sh.addShardTag("shard0000", "NYC")
sh.addShardTag("shard0001", "LAX")
sh.addShardTag("shard0002", "NRT")
```

### See also:

`sh.addTagRange()` (page 904) and `sh.removeShardTag()` (page 908).

## Definition

### `sh.addTagRange(namespace, minimum, maximum, tag)`

New in version 2.2.

Attaches a range of shard key values to a shard tag created using the `sh.addShardTag()` (page 904) method. `sh.addTagRange()` (page 904) takes the following arguments:

**param string namespace** The `namespace` of the sharded collection to tag.

**param document minimum** The minimum value of the `shard key` range to include in the tag. Specify the minimum value in the form of `<fieldname>:<value>`. This value must be of the same BSON type or types as the shard key.

**param document maximum** The maximum value of the shard key range to include in the tag. Specify the maximum value in the form of <fieldname>:<value>. This value must be of the same BSON type or types as the shard key.

**param string tag** The name of the tag to attach the range specified by the `minimum` and `maximum` arguments to.

Use `sh.addShardTag()` (page 904) to ensure that the balancer migrates documents that exist within the specified range to a specific shard or set of shards.

Always issue `sh.addTagRange()` (page 904) when connected to a `mongos` (page 938) instance.

---

**Note:** If you add a tag range to a collection using `sh.addTagRange()` (page 904) and then later drop the collection or its database, MongoDB does not remove the tag association. If you later create a new collection with the same name, the old tag association will apply to the new collection.

---

## Example

Given a shard key of `{state: 1, zip: 1}`, the following operation creates a tag range covering zip codes in New York State:

```
sh.addTagRange("examplerdb.collection",
 { state: "NY", zip: MinKey },
 { state: "NY", zip: MaxKey },
 "NY"
)
```

## Definition

`sh.removeShardTag(shard, tag)`

New in version 2.2.

Removes the association between a tag and a shard. Always issue `sh.removeShardTag()` (page 908) when connected to a `mongos` (page 938) instance.

**param string shard** The name of the shard from which to remove a tag.

**param string tag** The name of the tag to remove from the shard.

**See also:**

`sh.addShardTag()` (page 904), `sh.addTagRange()` (page 904)

`sh.help()`

**Returns** a basic help text for all sharding related shell functions.

## Database Commands

The following database commands support *sharded clusters*.

## Definition

### addShard

Adds either a database instance or a *replica set* to a *sharded cluster*. The optimal configuration is to deploy

shards across replica sets.

Run `addShard` (page 736) when connected to a `mongos` (page 938) instance. The command takes the following form when adding a single database instance as a shard:

```
{ addShard: "<hostname><:port>", maxSize: <size>, name: "<shard_name>" }
```

When adding a replica set as a shard, use the following form:

```
{ addShard: "<replica_set>/<hostname><:port>", maxSize: <size>, name: "<shard_name>" }
```

The command contains the following fields:

**field string addShard** The hostname and port of the `mongod` (page 925) instance to be added as a shard. To add a replica set as a shard, specify the name of the replica set and the hostname and port of a member of the replica set.

**field integer maxSize** The maximum size in megabytes of the shard. If you set `maxSize` to 0, MongoDB does not limit the size of the shard.

**field string name** A name for the shard. If this is not specified, MongoDB automatically provides a unique name.

The `addShard` (page 736) command stores shard configuration information in the *config database*.

Specify a `maxSize` when you have machines with different disk capacities, or if you want to limit the amount of data on some shards. The `maxSize` constraint prevents the *balancer* from migrating chunks to the shard when the value of `mem.mapped` (page 787) exceeds the value of `maxSize`.

### Examples

The following command adds the database instance running on port “27027” on the host `mongodb0.example.net` as a shard:

```
db.runCommand({addShard: "mongodb0.example.net:27027"})
```

**Warning:** Do not use `localhost` for the hostname unless your *configuration server* is also running on `localhost`.

The following command adds a replica set as a shard:

```
db.runCommand({ addShard: "rep10/mongodb3.example.net:27327" })
```

You may specify all members in the replica set. All additional hostnames must be members of the same replica set.

#### **listShards**

Use the `listShards` (page 737) command to return a list of configured shards. The command takes the following form:

```
{ listShards: 1 }
```

#### **enableSharding**

The `enableSharding` (page 736) command enables sharding on a per-database level. Use the following command form:

```
{ enableSharding: "<database name>" }
```

Once you’ve enabled sharding in a database, you can use the `shardCollection` (page 738) command to begin the process of distributing data among the shards.

## Definition

### **shardCollection**

Enables a collection for sharding and allows MongoDB to begin distributing data among shards. You must run [enableSharding](#) (page 736) on a database before running the [shardCollection](#) (page 738) command. [shardCollection](#) (page 738) has the following form:

```
{ shardCollection: "<database>.<collection>", key: <shardkey> }
```

[shardCollection](#) (page 738) has the following fields:

**field string shardCollection** The [namespace](#) of the collection to shard in the form `<database>.<collection>`.

**field document key** The index specification document to use as the shard key. The index must exist prior to the [shardCollection](#) (page 738) command, unless the collection is empty. If the collection is empty, in which case MongoDB creates the index prior to sharding the collection. New in version 2.4: The key may be in the form `{ field : "hashed" }`, which will use the specified field as a hashed shard key.

**field Boolean unique** When `true`, the `unique` option ensures that the underlying index enforces a unique constraint. Hashed shard keys do not support unique constraints.

**field integer numInitialChunks** To support [hashed sharding](#) (page 506) added in MongoDB 2.4, `numInitialChunks` specifies the number of chunks to create when sharding an collection with a hashed shard key. MongoDB will then create and balance chunks across the cluster. The `numInitialChunks` must be less than 8192.

**Warning:** Do not run more than one [shardCollection](#) (page 738) command on the same collection at the same time.

**Shard Keys** Choosing the best shard key to effectively distribute load among your shards requires some planning. Review [Shard Keys](#) (page 506) regarding choosing a shard key.

**Hashed Shard Keys** New in version 2.4.

[Hashed shard keys](#) (page 506) use a hashed index of a single field as the shard key.

**Warning:** MongoDB provides no method to deactivate sharding for a collection after calling [shardCollection](#) (page 738). Additionally, after [shardCollection](#) (page 738), you cannot change shard keys or modify the value of any field used in your shard key index.

## See also:

[Sharding](#) (page 493), [Sharding Concepts](#) (page 498), and [Deploy a Sharded Cluster](#) (page 522).

## Example

The following operation enables sharding for the `people` collection in the `records` database and uses the `zipcode` field as the [shard key](#) (page 506):

```
db.runCommand({ shardCollection: "records.people", key: { zipcode: 1 } })
```

**shardingState**

`shardingState` (page 738) is an admin command that reports if `mongod` (page 925) is a member of a *sharded cluster*. `shardingState` (page 738) has the following prototype form:

```
{ shardingState: 1 }
```

For `shardingState` (page 738) to detect that a `mongod` (page 925) is a member of a sharded cluster, the `mongod` (page 925) must satisfy the following conditions:

- 1.the `mongod` (page 925) is a primary member of a replica set, and
- 2.the `mongod` (page 925) instance is a member of a sharded cluster.

If `shardingState` (page 738) detects that a `mongod` (page 925) is a member of a sharded cluster, `shardingState` (page 738) returns a document that resembles the following prototype:

```
{
 "enabled" : true,
 "configServer" : "<configdb-string>",
 "shardName" : "<string>",
 "shardHost" : "string:",
 "versions" : {
 "<database>.<collection>" : Timestamp(<...>),
 "<database>.<collection>" : Timestamp(<...>)
 },
 "ok" : 1
}
```

Otherwise, `shardingState` (page 738) will return the following document:

```
{ "note" : "from execCommand", "ok" : 0, "errmsg" : "not master" }
```

The response from `shardingState` (page 738) when used with a *config server* is:

```
{ "enabled": false, "ok": 1 }
```

---

**Note:** `mongos` (page 938) instances do not provide the `shardingState` (page 738).

---

**Warning:** This command obtains a write lock on the affected database and will block other operations until it has completed; however, the operation is typically short lived.

**removeShard**

Starts the process of removing a shard from a *cluster*. This is a multi-stage process. Begin by issuing the following command:

```
{ removeShard : "[shardName]" }
```

The balancer will then migrate chunks from the shard specified by `[shardName]`. This process happens slowly to avoid placing undue load on the overall cluster.

The command returns immediately, with the following message:

```
{ msg : "draining started successfully" , state: "started" , shard: "shardName" , ok : 1 }
```

If you run the command again, you'll see the following progress output:

```
{ msg: "draining ongoing" , state: "ongoing" , remaining: { chunks: 23 , dbs: 1 } , ok: 1 }
```

The remaining *document* specifies how many chunks and databases remain on the shard. Use `db.printShardingStatus()` (page 892) to list the databases that you must move from the shard.

Each database in a sharded cluster has a primary shard. If the shard you want to remove is also the primary of one of the cluster's databases, then you must manually move the database to a new shard. This can be only after the shard is empty. See the [movePrimary](#) (page 743) command for details.

After removing all chunks and databases from the shard, you may issue the command again, to return:

```
{ msg: "remove shard completed successfully", state: "completed", host: "shardName", ok : 1 }
```



---

## Frequently Asked Questions

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### 10.1 FAQ: MongoDB Fundamentals

#### Frequently Asked Questions:

- What kind of database is MongoDB? (page 581)
- Do MongoDB databases have tables? (page 582)
- Do MongoDB databases have schemas? (page 582)
- What languages can I use to work with MongoDB? (page 582)
- Does MongoDB support SQL? (page 582)
- What are typical uses for MongoDB? (page 582)
- Does MongoDB support transactions? (page 583)
- Does MongoDB require a lot of RAM? (page 583)
- How do I configure the cache size? (page 583)
- Does MongoDB require a separate caching layer for application-level caching? (page 583)
- Does MongoDB handle caching? (page 584)
- Are writes written to disk immediately, or lazily? (page 584)
- What language is MongoDB written in? (page 584)
- What are the limitations of 32-bit versions of MongoDB? (page 584)

This document addresses basic high level questions about MongoDB and its use.

If you don't find the answer you're looking for, check the [complete list of FAQs](#) (page 581) or post your question to the [MongoDB User Mailing List](#)<sup>1</sup>.

#### 10.1.1 What kind of database is MongoDB?

MongoDB is a *document*-oriented DBMS. Think of MySQL but with *JSON*-like objects comprising the data model, rather than RDBMS tables. Significantly, MongoDB supports neither joins nor transactions. However, it features secondary indexes, an expressive query language, atomic writes on a per-document level, and fully-consistent reads.

Operationally, MongoDB features master-slave replication with automated failover and built-in horizontal scaling via automated range-based partitioning.

---

**Note:** MongoDB uses *BSON*, a binary object format similar to, but more expressive than *JSON*.

---

<sup>1</sup><https://groups.google.com/forum/?fromgroups#!forum/mongodb-user>

### 10.1.2 Do MongoDB databases have tables?

Instead of tables, a MongoDB database stores its data in *collections*, which are the rough equivalent of RDBMS tables. A collection holds one or more *documents*, which corresponds to a record or a row in a relational database table, and each document has one or more fields, which corresponds to a column in a relational database table.

Collections have important differences from RDBMS tables. Documents in a single collection may have a unique combination and set of fields. Documents need not have identical fields. You can add a field to some documents in a collection without adding that field to all documents in the collection.

---

**See**

*SQL to MongoDB Mapping Chart* (page 98)

---

### 10.1.3 Do MongoDB databases have schemas?

MongoDB uses dynamic schemas. You can create collections without defining the structure, i.e. the fields or the types of their values, of the documents in the collection. You can change the structure of documents simply by adding new fields or deleting existing ones. Documents in a collection need not have an identical set of fields.

In practice, it is common for the documents in a collection to have a largely homogeneous structure; however, this is not a requirement. MongoDB's flexible schemas mean that schema migration and augmentation are very easy in practice, and you will rarely, if ever, need to write scripts that perform "alter table" type operations, which simplifies and facilitates iterative software development with MongoDB.

---

**See**

*SQL to MongoDB Mapping Chart* (page 98)

---

### 10.1.4 What languages can I use to work with MongoDB?

MongoDB *client drivers* exist for all of the most popular programming languages, and many other ones. See the [latest list of drivers](#)<sup>2</sup> for details.

**See also:**

*MongoDB Drivers and Client Libraries* (page 95).

### 10.1.5 Does MongoDB support SQL?

No.

However, MongoDB does support a rich, ad-hoc query language of its own.

**See also:**

*Operators* (page 621)

### 10.1.6 What are typical uses for MongoDB?

MongoDB has a general-purpose design, making it appropriate for a large number of use cases. Examples include content management systems, mobile applications, gaming, e-commerce, analytics, archiving, and logging.

---

<sup>2</sup><http://docs.mongodb.org/ecosystem/drivers>

Do not use MongoDB for systems that require SQL, joins, and multi-object transactions.

### 10.1.7 Does MongoDB support transactions?

MongoDB does not provide ACID transactions.

However, MongoDB does provide some basic transactional capabilities. Atomic operations are possible within the scope of a single document: that is, we can debit `a` and credit `b` as a transaction if they are fields within the same document. Because documents can be rich, some documents contain thousands of fields, with support for testing fields in sub-documents.

Additionally, you can make writes in MongoDB durable (the ‘D’ in ACID). To get durable writes, you must enable journaling, which is on by default in 64-bit builds. You must also issue writes with a write concern of `{ j: true }` to ensure that the writes block until the journal has synced to disk.

Users have built successful e-commerce systems using MongoDB, but applications requiring multi-object commits with rollback generally aren’t feasible.

### 10.1.8 Does MongoDB require a lot of RAM?

Not necessarily. It’s certainly possible to run MongoDB on a machine with a small amount of free RAM.

MongoDB automatically uses all free memory on the machine as its cache. System resource monitors show that MongoDB uses a lot of memory, but its usage is dynamic. If another process suddenly needs half the server’s RAM, MongoDB will yield cached memory to the other process.

Technically, the operating system’s virtual memory subsystem manages MongoDB’s memory. This means that MongoDB will use as much free memory as it can, swapping to disk as needed. Deployments with enough memory to fit the application’s working data set in RAM will achieve the best performance.

**See also:**

*FAQ: MongoDB Diagnostics* (page 616) for answers to additional questions about MongoDB and Memory use.

### 10.1.9 How do I configure the cache size?

MongoDB has no configurable cache. MongoDB uses all *free* memory on the system automatically by way of memory-mapped files. Operating systems use the same approach with their file system caches.

### 10.1.10 Does MongoDB require a separate caching layer for application-level caching?

No. In MongoDB, a document’s representation in the database is similar to its representation in application memory. This means the database already stores the usable form of data, making the data usable in both the persistent store and in the application cache. This eliminates the need for a separate caching layer in the application.

This differs from relational databases, where caching data is more expensive. Relational databases must transform data into object representations that applications can read and must store the transformed data in a separate cache: if these transformation from data to application objects require joins, this process increases the overhead related to using the database which increases the importance of the caching layer.

### 10.1.11 Does MongoDB handle caching?

Yes. MongoDB keeps all of the most recently used data in RAM. If you have created indexes for your queries and your working data set fits in RAM, MongoDB serves all queries from memory.

MongoDB does not implement a query cache: MongoDB serves all queries directly from the indexes and/or data files.

### 10.1.12 Are writes written to disk immediately, or lazily?

Writes are physically written to the *journal* (page 232) within 100 milliseconds, by default. At that point, the write is “durable” in the sense that after a pull-plug-from-wall event, the data will still be recoverable after a hard restart. See [journalCommitInterval](#) (page 995) for more information on the journal commit window.

While the journal commit is nearly instant, MongoDB writes to the data files lazily. MongoDB may wait to write data to the data files for as much as one minute by default. This does not affect durability, as the journal has enough information to ensure crash recovery. To change the interval for writing to the data files, see [syncdelay](#) (page 998).

### 10.1.13 What language is MongoDB written in?

MongoDB is implemented in C++. *Drivers* and client libraries are typically written in their respective languages, although some drivers use C extensions for better performance.

### 10.1.14 What are the limitations of 32-bit versions of MongoDB?

MongoDB uses *memory-mapped files* (page 610). When running a 32-bit build of MongoDB, the total storage size for the server, including data and indexes, is 2 gigabytes. For this reason, do not deploy MongoDB to production on 32-bit machines.

If you’re running a 64-bit build of MongoDB, there’s virtually no limit to storage size. For production deployments, 64-bit builds and operating systems are strongly recommended.

**See also:**

“Blog Post: 32-bit Limitations<sup>3</sup>“

---

**Note:** 32-bit builds disable *journaling* by default because journaling further limits the maximum amount of data that the database can store.

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## 10.2 FAQ: MongoDB for Application Developers

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<sup>3</sup><http://blog.mongodb.org/post/137788967/32-bit-limitations>

**Frequently Asked Questions:**

- What is a namespace in MongoDB? (page 585)
- How do you copy all objects from one collection to another? (page 585)
- If you remove a document, does MongoDB remove it from disk? (page 586)
- When does MongoDB write updates to disk? (page 586)
- How do I do transactions and locking in MongoDB? (page 586)
- How do you aggregate data with MongoDB? (page 586)
- Why does MongoDB log so many “Connection Accepted” events? (page 587)
- Does MongoDB run on Amazon EBS? (page 587)
- Why are MongoDB’s data files so large? (page 587)
- How do I optimize storage use for small documents? (page 587)
- When should I use GridFS? (page 588)
- How does MongoDB address SQL or Query injection? (page 588)
  - BSON (page 588)
  - JavaScript (page 589)
  - Dollar Sign Operator Escaping (page 589)
  - Driver-Specific Issues (page 590)
- How does MongoDB provide concurrency? (page 590)
- What is the compare order for BSON types? (page 590)
- How do I query for fields that have null values? (page 591)
- Are there any restrictions on the names of Collections? (page 592)
- How do I isolate cursors from intervening write operations? (page 592)
- When should I embed documents within other documents? (page 593)
- Can I manually pad documents to prevent moves during updates? (page 593)

This document answers common questions about application development using MongoDB.

If you don’t find the answer you’re looking for, check the [complete list of FAQs](#) (page 581) or post your question to the MongoDB User Mailing List<sup>4</sup>.

### 10.2.1 What is a namespace in MongoDB?

A “namespace” is the concatenation of the *database* name and the *collection* names<sup>5</sup> with a period character in between.

Collections are containers for documents that share one or more indexes. Databases are groups of collections stored on disk using a single set of data files.<sup>6</sup>

For an example `acme.users` namespace, `acme` is the database name and `users` is the collection name. Period characters **can** occur in collection names, so that `acme.user.history` is a valid namespace, with `acme` as the database name, and `user.history` as the collection name.

While data models like this appear to support nested collections, the collection namespace is flat, and there is no difference from the perspective of MongoDB between `acme`, `acme.users`, and `acme.records`.

### 10.2.2 How do you copy all objects from one collection to another?

In the `mongo` (page 942) shell, you can use the following operation to duplicate the entire collection:

<sup>4</sup><https://groups.google.com/forum/?fromgroups#!forum/mongodb-user>

<sup>5</sup> Each index also has its own namespace.

<sup>6</sup> MongoDB database have a configurable limit on the `number of namespaces` (page 1015) in a database.

```
db.people.find().forEach(function(x) {db.user.insert(x) });
```

---

**Note:** Because this process decodes [BSON](#) documents to [JSON](#) during the copy procedure, documents may incur a loss of type-fidelity.

Consider using [mongodump](#) (page 951) and [mongorestore](#) (page 956) to maintain type fidelity.

---

Also consider the [cloneCollection](#) (page 748) [command](#) that may provide some of this functionality.

### 10.2.3 If you remove a document, does MongoDB remove it from disk?

Yes.

When you use [remove\(\)](#) (page 844), the object will no longer exist in MongoDB's on-disk data storage.

### 10.2.4 When does MongoDB write updates to disk?

MongoDB flushes writes to disk on a regular interval. In the default configuration, MongoDB writes data to the main data files on disk every 60 seconds and commits the [journal](#) roughly every 100 milliseconds. These values are configurable with the [journalCommitInterval](#) (page 995) and [syncdelay](#) (page 998).

These values represent the *maximum* amount of time between the completion of a write operation and the point when the write is durable in the journal, if enabled, and when MongoDB flushes data to the disk. In many cases MongoDB and the operating system flush data to disk more frequently, so that the above values represents a theoretical maximum.

However, by default, MongoDB uses a “lazy” strategy to write to disk. This is advantageous in situations where the database receives a thousand increments to an object within one second, MongoDB only needs to flush this data to disk once. In addition to the aforementioned configuration options, you can also use [fsync](#) (page 751) and [getLastError](#) (page 720) to modify this strategy.

### 10.2.5 How do I do transactions and locking in MongoDB?

MongoDB does not have support for traditional locking or complex transactions with rollback. MongoDB aims to be lightweight, fast, and predictable in its performance. This is similar to the MySQL MyISAM autocommit model. By keeping transaction support extremely simple, MongoDB can provide greater performance especially for [partitioned](#) or [replicated](#) systems with a number of database server processes.

MongoDB *does* have support for atomic operations *within* a single document. Given the possibilities provided by nested documents, this feature provides support for a large number of use-cases.

**See also:**

The [Isolate Sequence of Operations](#) (page 84) page.

### 10.2.6 How do you aggregate data with MongoDB?

In version 2.1 and later, you can use the new [aggregation framework](#) (page 279), with the [aggregate](#) (page 694) command.

MongoDB also supports [map-reduce](#) with the [mapReduce](#) (page 701) command, as well as basic aggregation with the [group](#) (page 697), [count](#) (page 695), and [distinct](#) (page 696). commands.

**See also:**

The [Aggregation](#) (page 275) page.

### 10.2.7 Why does MongoDB log so many “Connection Accepted” events?

If you see a very large number connection and re-connection messages in your MongoDB log, then clients are frequently connecting and disconnecting to the MongoDB server. This is normal behavior for applications that do not use request pooling, such as CGI. Consider using FastCGI, an Apache Module, or some other kind of persistent application server to decrease the connection overhead.

If these connections do not impact your performance you can use the run-time `quiet` (page 998) option or the command-line option `--quiet` to suppress these messages from the log.

### 10.2.8 Does MongoDB run on Amazon EBS?

Yes.

MongoDB users of all sizes have had a great deal of success using MongoDB on the EC2 platform using EBS disks.

**See also:**

[Amazon EC2](#)<sup>7</sup>

### 10.2.9 Why are MongoDB’s data files so large?

MongoDB aggressively preallocates data files to reserve space and avoid file system fragmentation. You can use the `smallfiles` (page 998) setting to modify the file preallocation strategy.

**See also:**

*Why are the files in my data directory larger than the data in my database?* (page 611)

### 10.2.10 How do I optimize storage use for small documents?

Each MongoDB document contains a certain amount of overhead. This overhead is normally insignificant but becomes significant if all documents are just a few bytes, as might be the case if the documents in your collection only have one or two fields.

Consider the following suggestions and strategies for optimizing storage utilization for these collections:

- Use the `_id` field explicitly.

MongoDB clients automatically add an `_id` field to each document and generate a unique 12-byte `ObjectId` for the `_id` field. Furthermore, MongoDB always indexes the `_id` field. For smaller documents this may account for a significant amount of space.

To optimize storage use, users can specify a value for the `_id` field explicitly when inserting documents into the collection. This strategy allows applications to store a value in the `_id` field that would have occupied space in another portion of the document.

You can store any value in the `_id` field, but because this value serves as a primary key for documents in the collection, it must uniquely identify them. If the field’s value is not unique, then it cannot serve as a primary key as there would be collisions in the collection.

- Use shorter field names.

MongoDB stores all field names in every document. For most documents, this represents a small fraction of the space used by a document; however, for small documents the field names may represent a proportionally large amount of space. Consider a collection of documents that resemble the following:

<sup>7</sup><http://docs.mongodb.org/ecosystem/platforms/amazon-ec2>

```
{ last_name : "Smith", best_score: 3.9 }
```

If you shorten the field named `last_name` to `lname` and the field name `best_score` to `score`, as follows, you could save 9 bytes per document.

```
{ lname : "Smith", score : 3.9 }
```

Shortening field names reduces expressiveness and does not provide considerable benefit on for larger documents and where document overhead is not significant concern. Shorter field names do not reduce the size of indexes, because indexes have a predefined structure.

In general it is not necessary to use short field names.

- Embed documents.

In some cases you may want to embed documents in other documents and save on the per-document overhead.

### 10.2.11 When should I use GridFS?

For documents in a MongoDB collection, you should always use [GridFS](#) for storing files larger than 16 MB.

In some situations, storing large files may be more efficient in a MongoDB database than on a system-level filesystem.

- If your filesystem limits the number of files in a directory, you can use GridFS to store as many files as needed.
- When you want to keep your files and metadata automatically synced and deployed across a number of systems and facilities. When using [geographically distributed replica sets](#) (page 396) MongoDB can distribute files and their metadata automatically to a number of `mongod` (page 925) instances and facilities.
- When you want to access information from portions of large files without having to load whole files into memory, you can use GridFS to recall sections of files without reading the entire file into memory.

Do not use GridFS if you need to update the content of the entire file atomically. As an alternative you can store multiple versions of each file and specify the current version of the file in the metadata. You can update the metadata field that indicates “latest” status in an atomic update after uploading the new version of the file, and later remove previous versions if needed.

Furthermore, if your files are all smaller the 16 MB [BSON Document Size](#) (page 1015) limit, consider storing the file manually within a single document. You may use the BinData data type to store the binary data. See your [drivers](#) (page 95) documentation for details on using BinData.

For more information on GridFS, see [GridFS](#) (page 154).

### 10.2.12 How does MongoDB address SQL or Query injection?

#### BSON

As a client program assembles a query in MongoDB, it builds a BSON object, not a string. Thus traditional SQL injection attacks are not a problem. More details and some nuances are covered below.

MongoDB represents queries as [BSON](#) objects. Typically [client libraries](#) (page 95) provide a convenient, injection free, process to build these objects. Consider the following C++ example:

```
 BSONObj my_query = BSON("name" << a_name);
auto_ptr<DBClientCursor> cursor = c.query("tutorial.persons", my_query);
```

Here, `my_query` then will have a value such as `{ name : "Joe" }`. If `my_query` contained special characters, for example `,`, `:`, and `{`, the query simply wouldn’t match any documents. For example, users cannot hijack a query and convert it to a delete.

## JavaScript

---

**Note:** You can disable all server-side execution of JavaScript, by passing the `--noscripting` option on the command line or setting `noscripting` (page 996) in a configuration file.

---

All of the following MongoDB operations permit you to run arbitrary JavaScript expressions directly on the server:

- `$where` (page 634)
- `db.eval()` (page 884)
- `mapReduce` (page 701)
- `group` (page 697)

You must exercise care in these cases to prevent users from submitting malicious JavaScript.

Fortunately, you can express most queries in MongoDB without JavaScript and for queries that require JavaScript, you can mix JavaScript and non-JavaScript in a single query. Place all the user-supplied fields directly in a  `BSON` field and pass JavaScript code to the `$where` (page 634) field.

- If you need to pass user-supplied values in a `$where` (page 634) clause, you may escape these values with the `CodeWScope` mechanism. When you set user-submitted values as variables in the scope document, you can avoid evaluating them on the database server.
- If you need to use `db.eval()` (page 884) with user supplied values, you can either use a `CodeWScope` or you can supply extra arguments to your function. For instance:

```
db.eval(function(userVal){...},
 user_value);
```

This will ensure that your application sends `user_value` to the database server as data rather than code.

## Dollar Sign Operator Escaping

Field names in MongoDB’s query language have semantic meaning. The dollar sign (i.e `$`) is a reserved character used to represent `operators` (page 621) (i.e. `$inc` (page 651).) Thus, you should ensure that your application’s users cannot inject operators into their inputs.

In some cases, you may wish to build a BSON object with a user-provided key. In these situations, keys will need to substitute the reserved `$` and `.` characters. Any character is sufficient, but consider using the Unicode full width equivalents: U+FF04 (i.e. “`”$”`) and U+FF0E (i.e. “`.”`”).

Consider the following example:

```
BSONObj my_object = BSON(a_key << a_name);
```

The user may have supplied a `$` value in the `a_key` value. At the same time, `my_object` might be `{ $where : "things" }`. Consider the following cases:

- **Insert.** Inserting this into the database does no harm. The insert process does not evaluate the object as a query.

---

**Note:** MongoDB client drivers, if properly implemented, check for reserved characters in keys on inserts.

---

- **Update.** The `update()` (page 849) operation permits `$` operators in the update argument but does not support the `$where` (page 634) operator. Still, some users may be able to inject operators that can manipulate a single document only. Therefore your application should escape keys, as mentioned above, if reserved characters are possible.

- **Query** Generally this is not a problem for queries that resemble `{ x : user_obj }`: dollar signs are not top level and have no effect. Theoretically it may be possible for the user to build a query themselves. But checking the user-submitted content for `$` characters in key names may help protect against this kind of injection.

## Driver-Specific Issues

See the “[PHP MongoDB Driver Security Notes](#)<sup>8</sup>” page in the PHP driver documentation for more information

### 10.2.13 How does MongoDB provide concurrency?

MongoDB implements a readers-writer lock. This means that at any one time, only one client may be writing or any number of clients may be reading, but that reading and writing cannot occur simultaneously.

In standalone and *replica sets* the lock’s scope applies to a single `mongod` (page 925) instance or *primary* instance. In a sharded cluster, locks apply to each individual shard, not to the whole cluster.

For more information, see [FAQ: Concurrency](#) (page 596).

### 10.2.14 What is the compare order for BSON types?

MongoDB permits documents within a single collection to have fields with different *BSON* types. For instance, the following documents may exist within a single collection.

```
{ x: "string" }
{ x: 42 }
```

When comparing values of different *BSON* types, MongoDB uses the following comparison order, from lowest to highest:

1. MinKey (internal type)
2. Null
3. Numbers (ints, longs, doubles)
4. Symbol, String
5. Object
6. Array
7. BinData
8. ObjectId
9. Boolean
10. Date, Timestamp
11. Regular Expression
12. MaxKey (internal type)

---

**Note:** MongoDB treats some types as equivalent for comparison purposes. For instance, numeric types undergo conversion before comparison.

---

Consider the following `mongo` (page 942) example:

---

<sup>8</sup><http://us.php.net/manual/en/mongo.security.php>

```
db.test.insert({x : 3});
db.test.insert({x : 2.9});
db.test.insert({x : new Date()});
db.test.insert({x : true});

db.test.find().sort({x:1});
{ "_id" : ObjectId("4b0315dce8de6586fb002c7"), "x" : 2.9 }
{ "_id" : ObjectId("4b03154cce8de6586fb002c6"), "x" : 3 }
{ "_id" : ObjectId("4b031566ce8de6586fb002c9"), "x" : true }
{ "_id" : ObjectId("4b031563ce8de6586fb002c8"), "x" : "Tue Nov 17 2009 16:28:03 GMT-0500 (EST)" }
```

The `$type` (page 630) operator provides access to  *BSON type* comparison in the MongoDB query syntax. See the documentation on [BSON types](#) and the `$type` (page 630) operator for additional information.

**Warning:** Storing values of the different types in the same field in a collection is *strongly discouraged*.

#### See also:

- The [Tailable Cursors](#) (page 82) page for an example of a C++ use of MinKey.

### 10.2.15 How do I query for fields that have null values?

Fields in a document may store null values, as in a notional collection, `test`, with the following documents:

```
{ _id: 1, cancelDate: null }
{ _id: 2 }
```

Different query operators treat null values differently:

- The `{ cancelDate : null }` query matches documents that either contains the `cancelDate` field whose value is null *or* that do not contain the `cancelDate` field:

```
db.test.find({ cancelDate: null })
```

The query returns both documents:

```
{ "_id" : 1, "cancelDate" : null }
{ "_id" : 2 }
```

- The `{ cancelDate : { $type: 10 } }` query matches documents that contains the `cancelDate` field whose value is null *only*; i.e. the value of the `cancelDate` field is of BSON Type Null (i.e. 10):

```
db.test.find({ cancelDate : { $type: 10 } })
```

The query returns only the document that contains the null value:

```
{ "_id" : 1, "cancelDate" : null }
```

- The `{ cancelDate : { $exists: false } }` query matches documents that do not contain the `cancelDate` field:

```
db.test.find({ cancelDate : { $exists: false } })
```

The query returns only the document that does *not* contain the `cancelDate` field:

```
{ "_id" : 2 }
```

#### See also:

The reference documentation for the `$type` (page 630) and `$exists` (page 629) operators.

## 10.2.16 Are there any restrictions on the names of Collections?

Collection names can be any UTF-8 string with the following exceptions:

- A collection name should begin with a letter or an underscore.
- The empty string (" ") is not a valid collection name.
- Collection names cannot contain the \$ character. (version 2.2 only)
- Collection names cannot contain the null character: \0
- Do not name a collection using the system. prefix. MongoDB reserves system. for system collections, such as the system.indexes collection.
- The maximum size of a collection name is 128 characters, including the name of the database. However, for maximum flexibility, collections should have names less than 80 characters.

If your collection name includes special characters, such as the underscore character, then to access the collection use the `db.getCollection()` (page 886) method or a similar method for your driver<sup>9</sup>.

---

### Example

To create a collection `_foo` and insert the `{ a : 1 }` document, use the following operation:

```
db.getCollection("foo").insert({ a : 1 })
```

To perform a query, use the `find()` (page 816) method, in as the following:

```
db.getCollection("foo").find()
```

---

## 10.2.17 How do I isolate cursors from intervening write operations?

MongoDB cursors can return the same document more than once in some situations.<sup>10</sup> You can use the `snapshot()` (page 872) method on a cursor to isolate the operation for a very specific case.

`snapshot()` (page 872) traverses the index on the `_id` field and guarantees that the query will return each document (with respect to the value of the `_id` field) no more than once.<sup>11</sup>

The `snapshot()` (page 872) does not guarantee that the data returned by the query will reflect a single moment in time *nor* does it provide isolation from insert or delete operations.

### Warning:

- You **cannot** use `snapshot()` (page 872) with *sharded collections*.
- You **cannot** use `snapshot()` (page 872) with `sort()` (page 872) or `hint()` (page 866) cursor methods.

As an alternative, if your collection has a field or fields that are never modified, you can use a *unique* index on this field or these fields to achieve a similar result as the `snapshot()` (page 872). Query with `hint()` (page 866) to explicitly force the query to use that index.

<sup>9</sup><http://api.mongodb.org/>

<sup>10</sup> As a cursor returns documents other operations may interleave with the query: if some of these operations are *updates* (page 50) that cause the document to move (in the case of a table scan, caused by document growth,) or that change the indexed field on the index used by the query; then the cursor will return the same document more than once.

<sup>11</sup> MongoDB does not permit changes to the value of the `_id` field; it is not possible for a cursor that transverses this index to pass the same document more than once.

## 10.2.18 When should I embed documents within other documents?

When [modeling data in MongoDB](#) (page 117), embedding is frequently the choice for:

- “contains” relationships between entities.
- one-to-many relationships when the “many” objects *always* appear with or are viewed in the context of their parents.

You should also consider embedding for performance reasons if you have a collection with a large number of small documents. Nevertheless, if small, separate documents represent the natural model for the data, then you should maintain that model.

If, however, you can group these small documents by some logical relationship *and* you frequently retrieve the documents by this grouping, you might consider “rolling-up” the small documents into larger documents that contain an array of subdocuments. Keep in mind that if you often only need to retrieve a subset of the documents within the group, then “rolling-up” the documents may not provide better performance.

“Rolling up” these small documents into logical groupings means that queries to retrieve a group of documents involve sequential reads and fewer random disk accesses.

Additionally, “rolling up” documents and moving common fields to the larger document benefit the index on these fields. There would be fewer copies of the common fields *and* there would be fewer associated key entries in the corresponding index. See [Index Concepts](#) (page 318) for more information on indexes.

## 10.2.19 Can I manually pad documents to prevent moves during updates?

An update can cause a document to move on disk if the document grows in size. To *minimize* document movements, MongoDB uses [padding](#) (page 65).

You should not have to pad manually because MongoDB adds [padding automatically](#) (page 65) and can adaptively adjust the amount of padding added to documents to prevent document relocations following updates. You can change the default [paddingFactor](#) (page 764) calculation by using the [collMod](#) (page 755) command with the [usePowerOf2Sizes](#) (page 755) flag. The [usePowerOf2Sizes](#) (page 755) flag ensures that MongoDB allocates document space in sizes that are powers of 2, which helps ensure that MongoDB can efficiently reuse space created by document deletion or relocation.

However, *if you must* pad a document manually, you can add a temporary field to the document and then [\\$unset](#) (page 655) the field, as in the following example.

**Warning:** Do not manually pad documents in a capped collection. Applying manual padding to a document in a capped collection can break replication. Also, the padding is not preserved if you re-sync the MongoDB instance.

```
var myTempPadding = ["aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa",
 "aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa",
 "aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa",
 "aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa"];

db.myCollection.insert({ _id: 5, paddingField: myTempPadding });

db.myCollection.update({ _id: 5 },
 { $unset: { paddingField: "" } }
)

db.myCollection.update({ _id: 5 },
 { $set: { realField: "Some text that I might have needed padding for" } }
)
```

**See also:**

*Padding Factor* (page 65)

## 10.3 FAQ: The mongo Shell

**Frequently Asked Questions:**

- How can I enter multi-line operations in the mongo shell? (page 594)
- How can I access different databases temporarily? (page 594)
- Does the mongo shell support tab completion and other keyboard shortcuts? (page 594)
- How can I customize the mongo shell prompt? (page 595)
- Can I edit long shell operations with an external text editor? (page 595)

### 10.3.1 How can I enter multi-line operations in the mongo shell?

If you end a line with an open parenthesis ('('), an open brace ('{'), or an open bracket ('['), then the subsequent lines start with ellipsis ("...") until you enter the corresponding closing parenthesis (')'), the closing brace ('}') or the closing bracket (']'). The mongo (page 942) shell waits for the closing parenthesis, closing brace, or the closing bracket before evaluating the code, as in the following example:

```
> if (x > 0) {
... count++;
... print (x);
... }
```

You can exit the line continuation mode if you enter two blank lines, as in the following example:

```
> if (x > 0
...
...
>
```

### 10.3.2 How can I access different databases temporarily?

You can use `db.getSiblingDB()` (page 888) method to access another database without switching databases, as in the following example which first switches to the `test` database and then accesses the `sampleDB` database from the `test` database:

```
use test

db.getSiblingDB('sampleDB').getCollectionNames();
```

### 10.3.3 Does the mongo shell support tab completion and other keyboard shortcuts?

The mongo (page 942) shell supports keyboard shortcuts. For example,

- Use the up/down arrow keys to scroll through command history. See `.dbshell` (page 946) documentation for more information on the `.dbshell` file.

- Use <Tab> to autocomplete or to list the completion possibilities, as in the following example which uses <Tab> to complete the method name starting with the letter 'c':

```
db.myCollection.c<Tab>
```

Because there are many collection methods starting with the letter 'c', the <Tab> will list the various methods that start with 'c'.

For a full list of the shortcuts, see [Shell Keyboard Shortcuts](#) (page 947)

#### 10.3.4 How can I customize the mongo shell prompt?

New in version 1.9.

You can change the [mongo](#) (page 942) shell prompt by setting the `prompt` variable. This makes it possible to display additional information in the prompt.

Set `prompt` to any string or arbitrary JavaScript code that returns a string, consider the following examples:

- Set the shell prompt to display the hostname and the database issued:

```
var host = db.serverStatus().host;
var prompt = function() { return db+"@"+host+">> ";
```

The [mongo](#) (page 942) shell prompt should now reflect the new prompt:

```
test@my-machine.local>
```

- Set the shell prompt to display the database statistics:

```
var prompt = function() {
 return "Uptime:"+db.serverStatus().uptime+" Documents:"+db.stats().objects+">> "
```

The [mongo](#) (page 942) shell prompt should now reflect the new prompt:

```
Uptime:1052 Documents:25024787 >
```

You can add the logic for the prompt in the [.mongorc.js](#) (page 946) file to set the prompt each time you start up the [mongo](#) (page 942) shell.

#### 10.3.5 Can I edit long shell operations with an external text editor?

You can use your own editor in the [mongo](#) (page 942) shell by setting the `EDITOR` (page 946) environment variable before starting the [mongo](#) (page 942) shell. Once in the [mongo](#) (page 942) shell, you can edit with the specified editor by typing `edit <variable>` or `edit <function>`, as in the following example:

1. Set the `EDITOR` (page 946) variable from the command line prompt:

```
EDITOR=vim
```

2. Start the [mongo](#) (page 942) shell:

```
mongo
```

3. Define a function `myFunction`:

```
function myFunction () { }
```

4. Edit the function using your editor:

```
edit myFunction
```

The command should open the `vim` edit session. Remember to save your changes.

5. Type `myFunction` to see the function definition:

```
myFunction
```

The result should be the changes from your saved edit:

```
function myFunction() {
 print("This was edited");
}
```

## 10.4 FAQ: Concurrency

### Frequently Asked Questions:

- What type of locking does MongoDB use? (page 596)
- How granular are locks in MongoDB? (page 597)
- How do I see the status of locks on my `mongod` (page 925) instances? (page 597)
- Does a read or write operation ever yield the lock? (page 597)
- Which operations lock the database? (page 597)
- Which administrative commands lock the database? (page 598)
- Does a MongoDB operation ever lock more than one database? (page 599)
- How does sharding affect concurrency? (page 599)
- How does concurrency affect a replica set primary? (page 599)
- How does concurrency affect secondaries? (page 599)
- What kind of concurrency does MongoDB provide for JavaScript operations? (page 599)

Changed in version 2.2.

MongoDB allows multiple clients to read and write a single corpus of data using a locking system to ensure that all clients receive a consistent view of the data *and* to prevent multiple applications from modifying the exact same pieces of data at the same time. Locks help guarantee that all writes to a single document occur either in full or not at all.

#### See also:

Presentation on Concurrency and Internals in 2.2<sup>12</sup>

### 10.4.1 What type of locking does MongoDB use?

MongoDB uses a readers-writer<sup>13</sup> lock that allows concurrent reads access to a database but gives exclusive access to a single write operation.

When a read lock exists, many read operations may use this lock. However, when a write lock exists, a single write operation holds the lock exclusively, and no other read *or* write operations may share the lock.

Locks are “writer greedy,” which means writes have preference over reads. When both a read and write are waiting for a lock, MongoDB grants the lock to the write.

<sup>12</sup><http://www.mongodb.com/presentations/concurrency-internals-mongodb-2-2>

<sup>13</sup> You may be familiar with a “readers-writer” lock as “multi-reader” or “shared exclusive” lock. See the Wikipedia page on Readers-Writer Locks ([http://en.wikipedia.org/wiki/Readers%20writer\\_lock](http://en.wikipedia.org/wiki/Readers%20writer_lock)) for more information.

## 10.4.2 How granular are locks in MongoDB?

Changed in version 2.2.

Beginning with version 2.2, MongoDB implements locks on a per-database basis for most read and write operations. Some global operations, typically short lived operations involving multiple databases, still require a global “instance” wide lock. Before 2.2, there is only one “global” lock per [mongod](#) (page 925) instance.

For example, if you have six databases and one takes a write lock, the other five are still available for read and write.

## 10.4.3 How do I see the status of locks on my mongod instances?

For reporting on lock utilization information on locks, use any of the following methods:

- [db.serverStatus\(\)](#) (page 893),
- [db.currentOp\(\)](#) (page 879),
- [mongotop](#) (page 979),
- [mongostat](#) (page 974), and/or
- the [MongoDB Management Service \(MMS\)](#)<sup>14</sup>

Specifically, the [locks](#) (page 783) document in the [output of serverStatus](#) (page 782), or the [locks](#) (page 882) field in the [current operation reporting](#) (page 879) provides insight into the type of locks and amount of lock contention in your [mongod](#) (page 925) instance.

To terminate an operation, use [db.killOp\(\)](#) (page 890).

## 10.4.4 Does a read or write operation ever yield the lock?

In some situations, read and write operations can yield their locks.

Long running read and write operations, such as queries, updates, and deletes, yield under many conditions. In MongoDB 2.0, operations yielded based on time slices and the number of operations waiting for the actively held lock. After 2.2, more adaptive algorithms allow operations to yield based on predicted disk access (i.e. page faults).

New in version 2.0: Read and write operations will yield their locks if the [mongod](#) (page 925) receives a [page fault](#) or fetches data that is unlikely to be in memory. Yielding allows other operations that only need to access documents that are already in memory to complete while [mongod](#) (page 925) loads documents into memory.

Additionally, write operations that affect multiple documents (i.e. [update\(\)](#) (page 849) with the `multi` parameter,) will yield periodically to allow read operations during these long write operations. Similarly, long running read locks will yield periodically to ensure that write operations have the opportunity to complete.

Changed in version 2.2: The use of yielding expanded greatly in MongoDB 2.2. Including the “yield for page fault.” MongoDB tracks the contents of memory and predicts whether data is available before performing a read. If MongoDB predicts that the data is not in memory a read operation yields its lock while MongoDB loads the data to memory. Once data is available in memory, the read will reacquire the lock to complete the operation.

## 10.4.5 Which operations lock the database?

Changed in version 2.2.

The following table lists common database operations and the types of locks they use.

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<sup>14</sup><http://mms.mongodb.com/>

| Operation                                   | Lock Type                                                                                                                                                                  |
|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Issue a query                               | Read lock                                                                                                                                                                  |
| Get more data from a <a href="#">cursor</a> | Read lock                                                                                                                                                                  |
| Insert data                                 | Write lock                                                                                                                                                                 |
| Remove data                                 | Write lock                                                                                                                                                                 |
| Update data                                 | Write lock                                                                                                                                                                 |
| <a href="#">Map-reduce</a>                  | Read lock and write lock, unless operations are specified as non-atomic. Portions of map-reduce jobs can run concurrently.                                                 |
| Create an index                             | Building an index in the foreground, which is the default, locks the database for extended periods of time.                                                                |
| <a href="#">db.eval()</a> (page 884)        | Write lock. <a href="#">db.eval()</a> (page 884) blocks all other JavaScript processes.                                                                                    |
| <a href="#">eval</a> (page 722)             | Write lock. If used with the <code>nolock</code> lock option, the <a href="#">eval</a> (page 722) option does not take a write lock and cannot write data to the database. |
| <a href="#">aggregate()</a> (page 808)      | Read lock                                                                                                                                                                  |

#### 10.4.6 Which administrative commands lock the database?

Certain administrative commands can exclusively lock the database for extended periods of time. In some deployments, for large databases, you may consider taking the [mongod](#) (page 925) instance offline so that clients are not affected. For example, if a [mongod](#) (page 925) is part of a [replica set](#), take the [mongod](#) (page 925) offline and let other members of the set service load while maintenance is in progress.

The following administrative operations require an exclusive (i.e. write) lock on the database for extended periods:

- [db.collection.ensureIndex\(\)](#) (page 814), when issued *without* setting `background` to `true`,
- [reIndex](#) (page 756),
- [compact](#) (page 752),
- [db.repairDatabase\(\)](#) (page 892),
- [db.createCollection\(\)](#) (page 878), when creating a very large (i.e. many gigabytes) capped collection,
- [db.collection.validate\(\)](#) (page 856), and
- [db.copyDatabase\(\)](#) (page 878). This operation may lock all databases. See [Does a MongoDB operation ever lock more than one database?](#) (page 599).

The following administrative commands lock the database but only hold the lock for a very short time:

- [db.collection.dropIndex\(\)](#) (page 812),
- [db.getLastError\(\)](#) (page 886),
- [db.isMaster\(\)](#) (page 890),
- [rs.status\(\)](#) (page 898) (i.e. [replSetGetStatus](#) (page 726),)
- [db.serverStatus\(\)](#) (page 893),
- [db.auth\(\)](#) (page 876), and
- [db.addUser\(\)](#) (page 875).

#### 10.4.7 Does a MongoDB operation ever lock more than one database?

The following MongoDB operations lock multiple databases:

- `db.copyDatabase()` (page 878) must lock the entire `mongod` (page 925) instance at once.
- *Journaling*, which is an internal operation, locks all databases for short intervals. All databases share a single journal.
- *User authentication* (page 237) locks the `admin` database as well as the database the user is accessing.
- All writes to a replica set's *primary* lock both the database receiving the writes and the `local` database. The lock for the `local` database allows the `mongod` (page 925) to write to the primary's *oplog*.

#### 10.4.8 How does sharding affect concurrency?

*Sharding* improves concurrency by distributing collections over multiple `mongod` (page 925) instances, allowing shard servers (i.e. `mongos` (page 938) processes) to perform any number of operations concurrently to the various downstream `mongod` (page 925) instances.

Each `mongod` (page 925) instance is independent of the others in the shard cluster and uses the MongoDB *readers-writer lock* (page 596). The operations on one `mongod` (page 925) instance do not block the operations on any others.

#### 10.4.9 How does concurrency affect a replica set primary?

In *replication*, when MongoDB writes to a collection on the *primary*, MongoDB also writes to the primary's *oplog*, which is a special collection in the `local` database. Therefore, MongoDB must lock both the collection's database and the `local` database. The `mongod` (page 925) must lock both databases at the same time to keep both data consistent and ensure that write operations, even with replication, are “all-or-nothing” operations.

#### 10.4.10 How does concurrency affect secondaries?

In *replication*, MongoDB does not apply writes serially to *secondaries*. Secondaries collect oplog entries in batches and then apply those batches in parallel. Secondaries do not allow reads while applying the write operations, and apply write operations in the order that they appear in the oplog.

MongoDB can apply several writes in parallel on replica set secondaries, in two phases:

1. During the first *prefer* phase, under a read lock, the `mongod` (page 925) ensures that all documents affected by the operations are in memory. During this phase, other clients may execute queries against this member.
2. A thread pool using write locks applies all write operations in the batch as part of a coordinated write phase.

#### 10.4.11 What kind of concurrency does MongoDB provide for JavaScript operations?

Changed in version 2.4: The V8 JavaScript engine added in 2.4 allows multiple JavaScript operations to run at the same time. Prior to 2.4, a single `mongod` (page 925) could only run a *single* JavaScript operation at once.

## 10.5 FAQ: Sharding with MongoDB

### Frequently Asked Questions:

- Is sharding appropriate for a new deployment? (page 600)
- How does sharding work with replication? (page 600)
- Can I change the shard key after sharding a collection? (page 601)
- What happens to unsharded collections in sharded databases? (page 601)
- How does MongoDB distribute data across shards? (page 601)
- What happens if a client updates a document in a chunk during a migration? (page 601)
- What happens to queries if a shard is inaccessible or slow? (page 601)
- How does MongoDB distribute queries among shards? (page 601)
- How does MongoDB sort queries in sharded environments? (page 602)
- How does MongoDB ensure unique `_id` field values when using a shard key *other* than `_id`? (page 602)
- I've enabled sharding and added a second shard, but all the data is still on one server. Why? (page 602)
- Is it safe to remove old files in the `moveChunk` directory? (page 602)
- How does `mongos` use connections? (page 603)
- Why does `mongos` hold connections open? (page 603)
- Where does MongoDB report on connections used by `mongos`? (page 603)
- What does `writebacklisten` in the log mean? (page 603)
- How should administrators deal with failed migrations? (page 603)
- What is the process for moving, renaming, or changing the number of config servers? (page 603)
- When do the `mongos` servers detect config server changes? (page 603)
- Is it possible to quickly update `mongos` servers after updating a replica set configuration? (page 604)
- What does the `maxConns` setting on `mongos` do? (page 604)
- How do indexes impact queries in sharded systems? (page 604)
- Can shard keys be randomly generated? (page 604)
- Can shard keys have a non-uniform distribution of values? (page 604)
- Can you shard on the `_id` field? (page 604)
- What do `moveChunk` commit failed errors mean? (page 605)
- How does draining a shard affect the balancing of uneven chunk distribution? (page 605)

This document answers common questions about horizontal scaling using MongoDB's *sharding*.

If you don't find the answer you're looking for, check the *complete list of FAQs* (page 581) or post your question to the MongoDB User Mailing List<sup>15</sup>.

### 10.5.1 Is sharding appropriate for a new deployment?

Sometimes.

If your data set fits on a single server, you should begin with an unsharded deployment.

Converting an unsharded database to a *sharded cluster* is easy and seamless, so there is *little advantage* in configuring sharding while your data set is small.

Still, all production deployments should use *replica sets* to provide high availability and disaster recovery.

### 10.5.2 How does sharding work with replication?

To use replication with sharding, deploy each *shard* as a *replica set*.

<sup>15</sup><https://groups.google.com/forum/?fromgroups#!forum/mongodb-user>

### 10.5.3 Can I change the shard key after sharding a collection?

No.

There is no automatic support in MongoDB for changing a shard key after sharding a collection. This reality underscores the importance of choosing a good *shard key* (page 506). If you *must* change a shard key after sharding a collection, the best option is to:

- dump all data from MongoDB into an external format.
- drop the original sharded collection.
- configure sharding using a more ideal shard key.
- *pre-split* (page 545) the shard key range to ensure initial even distribution.
- restore the dumped data into MongoDB.

See [shardCollection](#) (page 738), [sh.shardCollection\(\)](#) (page 908), the [Shard Key](#) (page 506), [Deploy a Sharded Cluster](#) (page 522), and [SERVER-4000](#)<sup>16</sup> for more information.

### 10.5.4 What happens to unsharded collections in sharded databases?

In the current implementation, all databases in a *sharded cluster* have a “primary *shard*.” All unsharded collection within that database will reside on the same shard.

### 10.5.5 How does MongoDB distribute data across shards?

Sharding must be specifically enabled on a collection. After enabling sharding on the collection, MongoDB will assign various ranges of collection data to the different shards in the cluster. The cluster automatically corrects imbalances between shards by migrating ranges of data from one shard to another.

### 10.5.6 What happens if a client updates a document in a chunk during a migration?

The [mongos](#) (page 938) routes the operation to the “old” shard, where it will succeed immediately. Then the *shard* [mongod](#) (page 925) instances will replicate the modification to the “new” shard before the *sharded cluster* updates that chunk’s “ownership,” which effectively finalizes the migration process.

### 10.5.7 What happens to queries if a shard is inaccessible or slow?

If a *shard* is inaccessible or unavailable, queries will return with an error.

However, a client may set the `partial` query bit, which will then return results from all available shards, regardless of whether a given shard is unavailable.

If a shard is responding slowly, [mongos](#) (page 938) will merely wait for the shard to return results.

### 10.5.8 How does MongoDB distribute queries among shards?

Changed in version 2.0.

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<sup>16</sup><https://jira.mongodb.org/browse/SERVER-4000>

The exact method for distributing queries to *shards* in a *cluster* depends on the nature of the query and the configuration of the sharded cluster. Consider a sharded collection, using the *shard key* `user_id`, that has `last_login` and `email` attributes:

- For a query that selects one or more values for the `user_id` key:

`mongos` (page 938) determines which shard or shards contains the relevant data, based on the cluster metadata, and directs a query to the required shard or shards, and returns those results to the client.

- For a query that selects `user_id` and also performs a sort:

`mongos` (page 938) can make a straightforward translation of this operation into a number of queries against the relevant shards, ordered by `user_id`. When the sorted queries return from all shards, the `mongos` (page 938) merges the sorted results and returns the complete result to the client.

- For queries that select on `last_login`:

These queries must run on all shards: `mongos` (page 938) must parallelize the query over the shards and perform a merge-sort on the `email` of the documents found.

### 10.5.9 How does MongoDB sort queries in sharded environments?

If you call the `cursor.sort()` (page 872) method on a query in a sharded environment, the `mongod` (page 925) for each shard will sort its results, and the `mongos` (page 938) merges each shard's results before returning them to the client.

### 10.5.10 How does MongoDB ensure unique `_id` field values when using a shard key other than `_id`?

If you do not use `_id` as the shard key, then your application/client layer must be responsible for keeping the `_id` field unique. It is problematic for collections to have duplicate `_id` values.

If you're not sharding your collection by the `_id` field, then you should be sure to store a globally unique identifier in that field. The default  `BSON ObjectID` (page 103) works well in this case.

### 10.5.11 I've enabled sharding and added a second shard, but all the data is still on one server. Why?

First, ensure that you've declared a *shard key* for your collection. Until you have configured the shard key, MongoDB will not create *chunks*, and *sharding* will not occur.

Next, keep in mind that the default chunk size is 64 MB. As a result, in most situations, the collection needs to have at least 64 MB of data before a migration will occur.

Additionally, the system which balances chunks among the servers attempts to avoid superfluous migrations. Depending on the number of shards, your shard key, and the amount of data, systems often require at least 10 chunks of data to trigger migrations.

You can run `db.printShardingStatus()` (page 892) to see all the chunks present in your cluster.

### 10.5.12 Is it safe to remove old files in the `moveChunk` directory?

Yes. `mongod` (page 925) creates these files as backups during normal *shard* balancing operations.

Once these migrations are complete, you may delete these files.

### 10.5.13 How does mongos use connections?

Each client maintains a connection to a [mongos](#) (page 938) instance. Each [mongos](#) (page 938) instance maintains a pool of connections to the members of a replica set supporting the sharded cluster. Clients use connections between [mongos](#) (page 938) and [mongod](#) (page 925) instances one at a time. Requests are not multiplexed or pipelined. When client requests complete, the [mongos](#) (page 938) returns the connection to the pool.

See the [System Resource Utilization](#) (page 225) section of the [UNIX ulimit Settings](#) (page 225) document.

### 10.5.14 Why does mongos hold connections open?

[mongos](#) (page 938) uses a set of connection pools to communicate with each [shard](#). These pools do not shrink when the number of clients decreases.

This can lead to an unused [mongos](#) (page 938) with a large number of open connections. If the [mongos](#) (page 938) is no longer in use, it is safe to restart the process to close existing connections.

### 10.5.15 Where does MongoDB report on connections used by mongos?

Connect to the [mongos](#) (page 938) with the [mongo](#) (page 942) shell, and run the following command:

```
db._adminCommand("connPoolStats");
```

### 10.5.16 What does writebacklisten in the log mean?

The writeback listener is a process that opens a long poll to relay writes back from a [mongod](#) (page 925) or [mongos](#) (page 938) after migrations to make sure they have not gone to the wrong server. The writeback listener sends writes back to the correct server if necessary.

These messages are a key part of the sharding infrastructure and should not cause concern.

### 10.5.17 How should administrators deal with failed migrations?

Failed migrations require no administrative intervention. Chunk moves are consistent and deterministic.

If a migration fails to complete for some reason, the [cluster](#) will retry the operation. When the migration completes successfully, the data will reside only on the new shard.

### 10.5.18 What is the process for moving, renaming, or changing the number of config servers?

See [Sharded Cluster Tutorials](#) (page 521) for information on migrating and replacing config servers.

### 10.5.19 When do the mongos servers detect config server changes?

[mongos](#) (page 938) instances maintain a cache of the [config database](#) that holds the metadata for the [sharded cluster](#). This metadata includes the mapping of [chunks](#) to [shards](#).

[mongos](#) (page 938) updates its cache lazily by issuing a request to a shard and discovering that its metadata is out of date. There is no way to control this behavior from the client, but you can run the [flushRouterConfig](#) (page 735) command against any [mongos](#) (page 938) to force it to refresh its cache.

## 10.5.20 Is it possible to quickly update mongos servers after updating a replica set configuration?

The `mongos` (page 938) instances will detect these changes without intervention over time. However, if you want to force the `mongos` (page 938) to reload its configuration, run the `flushRouterConfig` (page 735) command against to each `mongos` (page 938) directly.

## 10.5.21 What does the `maxConns` setting on `mongos` do?

The `maxConns` (page 992) option limits the number of connections accepted by `mongos` (page 938).

If your client driver or application creates a large number of connections but allows them to time out rather than closing them explicitly, then it might make sense to limit the number of connections at the `mongos` (page 938) layer.

Set `maxConns` (page 992) to a value slightly higher than the maximum number of connections that the client creates, or the maximum size of the connection pool. This setting prevents the `mongos` (page 938) from causing connection spikes on the individual `shards`. Spikes like these may disrupt the operation and memory allocation of the `sharded cluster`.

## 10.5.22 How do indexes impact queries in sharded systems?

If the query does not include the `shard key`, the `mongos` (page 938) must send the query to all shards as a “scatter/gather” operation. Each shard will, in turn, use *either* the shard key index or another more efficient index to fulfill the query.

If the query includes multiple sub-expressions that reference the fields indexed by the shard key *and* the secondary index, the `mongos` (page 938) can route the queries to a specific shard and the shard will use the index that will allow it to fulfill most efficiently. See [this presentation](#)<sup>17</sup> for more information.

## 10.5.23 Can shard keys be randomly generated?

`Shard keys` can be random. Random keys ensure optimal distribution of data across the cluster.

`Sharded clusters`, attempt to route queries to *specific* shards when queries include the shard key as a parameter, because these directed queries are more efficient. In many cases, random keys can make it difficult to direct queries to specific shards.

## 10.5.24 Can shard keys have a non-uniform distribution of values?

Yes. There is no requirement that documents be evenly distributed by the shard key.

However, documents that have the shard key *must* reside in the same `chunk` and therefore on the same server. If your sharded data set has too many documents with the exact same shard key you will not be able to distribute *those* documents across your sharded cluster.

## 10.5.25 Can you shard on the `_id` field?

You can use any field for the shard key. The `_id` field is a common shard key.

Be aware that `ObjectID()` values, which are the default value of the `_id` field, increment as a timestamp. As a result, when used as a shard key, all new documents inserted into the collection will initially belong to the same chunk

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<sup>17</sup><http://www.slideshare.net/mongodb/how-queries-work-with-sharding>

on a single shard. Although the system will eventually divide this chunk and migrate its contents to distribute data more evenly, at any moment the cluster can only direct insert operations at a single shard. This can limit the throughput of inserts. If most of your write operations are updates, this limitation should not impact your performance. However, if you have a high insert volume, this may be a limitation.

To address this issue, MongoDB 2.4 provides [hashed shard keys](#) (page 506).

### 10.5.26 What do moveChunk commit failed errors mean?

Consider the following error message:

```
ERROR: moveChunk commit failed: version is at <n>|<nn> instead of <N>|<NN>" and "ERROR: TERMINATING"
```

`mongod` (page 925) issues this message if, during a [chunk migration](#) (page 518), the *shard* could not connect to the *config database* to update chunk information at the end of the migration process. If the shard cannot update the config database after [moveChunk](#) (page 742), the cluster will have an inconsistent view of all chunks. In these situations, the *primary* member of the shard will terminate itself to prevent data inconsistency. If the *secondary* member can access the config database, the shard's data will be accessible after an election. Administrators will need to resolve the chunk migration failure independently.

If you encounter this issue, contact the [MongoDB User Group](#)<sup>18</sup> or MongoDB support to address this issue.

### 10.5.27 How does draining a shard affect the balancing of uneven chunk distribution?

The sharded cluster balancing process controls both migrating chunks from decommissioned shards (i.e. draining,) and normal cluster balancing activities. Consider the following behaviors for different versions of MongoDB in situations where you remove a shard in a cluster with an uneven chunk distribution:

- After MongoDB 2.2, the balancer first removes the chunks from the draining shard and then balances the remaining uneven chunk distribution.
- Before MongoDB 2.2, the balancer handles the uneven chunk distribution and *then* removes the chunks from the draining shard.

## 10.6 FAQ: Replica Sets and Replication in MongoDB

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<sup>18</sup><http://groups.google.com/group/mongodb-user>

**Frequently Asked Questions:**

- What kinds of replication does MongoDB support? (page 606)
- What do the terms “primary” and “master” mean? (page 606)
- What do the terms “secondary” and “slave” mean? (page 606)
- How long does replica set failover take? (page 606)
- Does replication work over the Internet and WAN connections? (page 607)
- Can MongoDB replicate over a “noisy” connection? (page 607)
- What is the preferred replication method: master/slave or replica sets? (page 607)
- What is the preferred replication method: replica sets or replica pairs? (page 607)
- Why use journaling if replication already provides data redundancy? (page 607)
- Are write operations durable if write concern does not acknowledge writes? (page 608)
- How many arbiters do replica sets need? (page 608)
- What information do arbiters exchange with the rest of the replica set? (page 608)
- Which members of a replica set vote in elections? (page 609)
- Do hidden members vote in replica set elections? (page 609)
- Is it normal for replica set members to use different amounts of disk space? (page 609)

This document answers common questions about database replication in MongoDB.

If you don’t find the answer you’re looking for, check the [complete list of FAQs](#) (page 581) or post your question to the [MongoDB User Mailing List](#)<sup>19</sup>.

### 10.6.1 What kinds of replication does MongoDB support?

MongoDB supports master-slave replication and a variation on master-slave replication known as replica sets. Replica sets are the recommended replication topology.

### 10.6.2 What do the terms “primary” and “master” mean?

*Primary* and *master* nodes are the nodes that can accept writes. MongoDB’s replication is “single-master:” only one node can accept write operations at a time.

In a replica set, if the current “primary” node fails or becomes inaccessible, the other members can autonomously *elect* one of the other members of the set to be the new “primary”.

By default, clients send all reads to the primary; however, *read preference* is configurable at the client level on a per-connection basis, which makes it possible to send reads to secondary nodes instead.

### 10.6.3 What do the terms “secondary” and “slave” mean?

*Secondary* and *slave* nodes are read-only nodes that replicate from the *primary*.

Replication operates by way of an *oplog*, from which secondary/slave members apply new operations to themselves. This replication process is asynchronous, so secondary/slave nodes may not always reflect the latest writes to the primary. But usually, the gap between the primary and secondary nodes is just few milliseconds on a local network connection.

### 10.6.4 How long does replica set failover take?

It varies, but a replica set will select a new primary within a minute.

<sup>19</sup><https://groups.google.com/forum/?fromgroups#!forum/mongodb-user>

It may take 10-30 seconds for the members of a *replica set* to declare a *primary* inaccessible. This triggers an *election*. During the election, the cluster is unavailable for writes.

The election itself may take another 10-30 seconds.

---

**Note:** *Eventually consistent* reads, like the ones that will return from a replica set are only possible with a *write concern* that permits reads from *secondary* members.

---

## 10.6.5 Does replication work over the Internet and WAN connections?

Yes.

For example, a deployment may maintain a *primary* and *secondary* in an East-coast data center along with a *secondary* member for disaster recovery in a West-coast data center.

**See also:**

*Deploy a Geographically Distributed Replica Set* (page 425)

## 10.6.6 Can MongoDB replicate over a “noisy” connection?

Yes, but not without connection failures and the obvious latency.

Members of the set will attempt to reconnect to the other members of the set in response to networking flaps. This does not require administrator intervention. However, if the network connections among the nodes in the replica set are very slow, it might not be possible for the members of the node to keep up with the replication.

If the TCP connection between the secondaries and the *primary* instance breaks, a *replica set* will automatically elect one of the *secondary* members of the set as primary.

## 10.6.7 What is the preferred replication method: master/slave or replica sets?

New in version 1.8.

*Replica sets* are the preferred *replication* mechanism in MongoDB. However, if your deployment requires more than 12 nodes, you must use master/slave replication.

## 10.6.8 What is the preferred replication method: replica sets or replica pairs?

Deprecated since version 1.6.

*Replica sets* replaced *replica pairs* in version 1.6. *Replica sets* are the preferred *replication* mechanism in MongoDB.

## 10.6.9 Why use journaling if replication already provides data redundancy?

*Journaling* facilitates faster crash recovery. Prior to journaling, crashes often required *database repairs* (page 757) or full data resync. Both were slow, and the first was unreliable.

Journaling is particularly useful for protection against power failures, especially if your replica set resides in a single data center or power circuit.

When a *replica set* runs with journaling, `mongod` (page 925) instances can safely restart without any administrator intervention.

**Note:** Journaling requires some resource overhead for write operations. Journaling has no effect on read performance, however.

Journaling is enabled by default on all 64-bit builds of MongoDB v2.0 and greater.

---

### 10.6.10 Are write operations durable if write concern does not acknowledge writes?

Yes.

However, if you want confirmation that a given write has arrived at the server, use [write concern](#) (page 55). The [getLastError](#) (page 720) command provides the facility for write concern. However, after the [default write concern change](#) (page 1089), the default write concern acknowledges all write operations, and unacknowledged writes must be explicitly configured. See the [MongoDB Drivers and Client Libraries](#) (page 95) documentation for your driver for more information.

### 10.6.11 How many arbiters do replica sets need?

Some configurations do not require any [arbiter](#) instances. Arbiters vote in [elections](#) for [primary](#) but do not replicate the data like [secondary](#) members.

[Replica sets](#) require a majority of the remaining nodes present to elect a primary. Arbiters allow you to construct this majority without the overhead of adding replicating nodes to the system.

There are many possible replica set [architectures](#) (page 390).

If you have a three node replica set, you don't need an arbiter.

But a common configuration consists of two replicating nodes, one of which is [primary](#) and the other is [secondary](#), as well as an arbiter for the third node. This configuration makes it possible for the set to elect a primary in the event of a failure without requiring three replicating nodes.

You may also consider adding an arbiter to a set if it has an equal number of nodes in two facilities and network partitions between the facilities are possible. In these cases, the arbiter will break the tie between the two facilities and allow the set to elect a new primary.

#### See also:

[Replica Set Deployment Architectures](#) (page 390)

### 10.6.12 What information do arbiters exchange with the rest of the replica set?

Arbiters never receive the contents of a collection but do exchange the following data with the rest of the replica set:

- Credentials used to authenticate the arbiter with the replica set. All MongoDB processes within a replica set use keyfiles. These exchanges are encrypted.
- Replica set configuration data and voting data. This information is not encrypted. Only credential exchanges are encrypted.

If your MongoDB deployment uses SSL, then all communications between arbiters and the other members of the replica set are secure. See the documentation for [Connect to MongoDB with SSL](#) (page 249) for more information. Run all arbiters on secure networks, as with all MongoDB components.

---

#### See

The overview of [Arbiter Members of Replica Sets](#) (page ??).

### 10.6.13 Which members of a replica set vote in elections?

All members of a replica set, unless the value of `votes` (page 482) is equal to 0, vote in elections. This includes all `delayed` (page 387), `hidden` (page 387) and `secondary-only` (page 386) members, as well as the `arbiters` (page ??).

Additionally, the `state` (page 727) of the voting members also determine whether the member can vote. Only voting members in the following states are eligible to vote:

- PRIMARY
- SECONDARY
- RECOVERING
- ARBITER
- ROLLBACK

See also:

[Replica Set Elections](#) (page 397)

### 10.6.14 Do hidden members vote in replica set elections?

`Hidden members` (page 387) of `replica sets` do vote in elections. To exclude a member from voting in an `election`, change the value of the member's `votes` (page 482) configuration to 0.

See also:

[Replica Set Elections](#) (page 397)

### 10.6.15 Is it normal for replica set members to use different amounts of disk space?

Yes.

Factors including: different oplog sizes, different levels of storage fragmentation, and MongoDB's data file pre-allocation can lead to some variation in storage utilization between nodes. Storage use disparities will be most pronounced when you add members at different times.

## 10.7 FAQ: MongoDB Storage

#### Frequently Asked Questions:

- What are memory mapped files? (page 610)
- How do memory mapped files work? (page 610)
- How does MongoDB work with memory mapped files? (page 610)
- What are page faults? (page 610)
- What is the difference between soft and hard page faults? (page 611)
- What tools can I use to investigate storage use in MongoDB? (page 611)
- What is the working set? (page 611)
- Why are the files in my data directory larger than the data in my database? (page 611)
- How can I check the size of a collection? (page 612)
- How can I check the size of indexes? (page 613)
- How do I know when the server runs out of disk space? (page 613)

This document addresses common questions regarding MongoDB's storage system.

If you don't find the answer you're looking for, check the *complete list of FAQs* (page 581) or post your question to the MongoDB User Mailing List<sup>20</sup>.

#### 10.7.1 What are memory mapped files?

A memory-mapped file is a file with data that the operating system places in memory by way of the `mmap()` system call. `mmap()` thus *maps* the file to a region of virtual memory. Memory-mapped files are the critical piece of the storage engine in MongoDB. By using memory mapped files MongoDB can treat the contents of its data files as if they were in memory. This provides MongoDB with an extremely fast and simple method for accessing and manipulating data.

#### 10.7.2 How do memory mapped files work?

Memory mapping assigns files to a block of virtual memory with a direct byte-for-byte correlation. Once mapped, the relationship between file and memory allows MongoDB to interact with the data in the file as if it were memory.

#### 10.7.3 How does MongoDB work with memory mapped files?

MongoDB uses memory mapped files for managing and interacting with all data. MongoDB memory maps data files to memory as it accesses documents. Data that isn't accessed is *not* mapped to memory.

#### 10.7.4 What are page faults?

Page faults will occur if you're attempting to access part of a memory-mapped file that *isn't* in memory.

If there is free memory, then the operating system can find the page on disk and load it to memory directly. However, if there is no free memory, the operating system must:

- find a page in memory that is stale or no longer needed, and write the page to disk.
- read the requested page from disk and load it into memory.

This process, particularly on an active system can take a long time, particularly in comparison to reading a page that is already in memory.

---

<sup>20</sup><https://groups.google.com/forum/?fromgroups#!forum/mongodb-user>

### 10.7.5 What is the difference between soft and hard page faults?

*Page faults* occur when MongoDB needs access to data that isn't currently in active memory. A "hard" page fault refers to situations when MongoDB must access a disk to access the data. A "soft" page fault, by contrast, merely moves memory pages from one list to another, such as from an operating system file cache. In production, MongoDB will rarely encounter soft page faults.

### 10.7.6 What tools can I use to investigate storage use in MongoDB?

The `db.stats()` (page 894) method in the `mongo` (page 942) shell, returns the current state of the "active" database. The `dbStats command` (page 767) document describes the fields in the `db.stats()` (page 894) output.

### 10.7.7 What is the working set?

Working set represents the total body of data that the application uses in the course of normal operation. Often this is a subset of the total data size, but the specific size of the working set depends on actual moment-to-moment use of the database.

If you run a query that requires MongoDB to scan every document in a collection, the working set will expand to include every document. Depending on physical memory size, this may cause documents in the working set to "page out," or to be removed from physical memory by the operating system. The next time MongoDB needs to access these documents, MongoDB may incur a hard page fault.

If you run a query that requires MongoDB to scan every *document* in a collection, the working set includes every active document in memory.

For best performance, the majority of your *active* set should fit in RAM.

### 10.7.8 Why are the files in my data directory larger than the data in my database?

The data files in your data directory, which is the `/data/db` directory in default configurations, might be larger than the data set inserted into the database. Consider the following possible causes:

- Preallocated data files.

In the data directory, MongoDB preallocates data files to a particular size, in part to prevent file system fragmentation. MongoDB names the first data file `<dbname>.0`, the next `<dbname>.1`, etc. The first file `mongod` (page 925) allocates 64 megabytes, the next 128 megabytes, and so on, up to 2 gigabytes, at which point all subsequent files are 2 gigabytes. The data files include files with allocated space but that hold no data. `mongod` (page 925) may allocate a 1 gigabyte data file that may be 90% empty. For most larger databases, unused allocated space is small compared to the database.

On Unix-like systems, `mongod` (page 925) preallocates an additional data file and initializes the disk space to 0. Preallocating data files in the background prevents significant delays when a new database file is next allocated.

You can disable preallocation with the `noprealloc` (page 996) run time option. However `noprealloc` (page 996) is **not** intended for use in production environments: only use `noprealloc` (page 996) for testing and with small data sets where you frequently drop databases.

On Linux systems you can use `hdparm` to get an idea of how costly allocation might be:

```
time hdparm --fallocate $((1024*1024)) testfile
```

- The *oplog*.

If this `mongod` (page 925) is a member of a replica set, the data directory includes the `oplog.rs` file, which is a preallocated *capped collection* in the local database. The default allocation is approximately 5% of disk space on 64-bit installations, see *Oplog Sizing* (page 411) for more information. In most cases, you should not need to resize the oplog. However, if you do, see *Change the Size of the Oplog* (page 446).

- The *journal*.

The data directory contains the journal files, which store write operations on disk prior to MongoDB applying them to databases. See *Journaling Mechanics* (page 232).

- Empty records.

MongoDB maintains lists of empty records in data files when deleting documents and collections. MongoDB can reuse this space, but will never return this space to the operating system.

To de-fragment allocated storage, use `compact` (page 752), which de-fragments allocated space which allows. By de-fragmenting storage, MongoDB can effectively use the allocated space. `compact` (page 752) requires up to 2 gigabytes of extra disk space to run. Do not use `compact` (page 752) if you are critically low on disk space.

---

**Important:** `compact` (page 752) only removes fragmentation from MongoDB data files and does not return any disk space to the operating system.

---

To reclaim deleted space, use `repairDatabase` (page 757), which rebuilds the database which de-fragments the storage and may release space to the operating system. `repairDatabase` (page 757) requires up to 2 gigabytes of extra disk space to run. Do not use `repairDatabase` (page 757) if you are critically low on disk space.

**Warning:** `repairDatabase` (page 757) requires enough free disk space to hold both the old and new database files while the repair is running. Be aware that `repairDatabase` (page 757) will block all other operations and may take a long time to complete.

### 10.7.9 How can I check the size of a collection?

To view the size of a collection and other information, use the `db.collection.stats()` (page 848) method from the `mongo` (page 942) shell. The following example issues `db.collection.stats()` (page 848) for the `orders` collection:

```
db.orders.stats();
```

To view specific measures of size, use these methods:

- `db.collection.dataSize()` (page 812): data size in bytes for the collection.
- `db.collection.storageSize()` (page 849): allocation size in bytes, including unused space.
- `db.collection.totalSize()` (page 849): the data size plus the index size in bytes.
- `db.collection.totalIndexSize()` (page 849): the index size in bytes.

Also, the following scripts print the statistics for each database and collection:

```
db._adminCommand("listDatabases").databases.forEach(function(d) {mdb = db.getSiblingDB(d.name); print(mdb.stats());});
db._adminCommand("listDatabases").databases.forEach(function(d) {mdb = db.getSiblingDB(d.name); mdb.stats()});
```

### 10.7.10 How can I check the size of indexes?

To view the size of the data allocated for an index, use one of the following procedures in the [mongo](#) (page 942) shell:

- Use the `db.collection.stats()` (page 848) method using the index namespace. To retrieve a list of namespaces, issue the following command:

```
db.system.namespaces.find()
```

- Check the value of `indexSizes` (page 765) in the output of the `db.collection.stats()` (page 848) command.

---

#### Example

Issue the following command to retrieve index namespaces:

```
db.system.namespaces.find()
```

The command returns a list similar to the following:

```
{ "name" : "test.orders" }
{ "name" : "test.system.indexes" }
{ "name" : "test.orders._id" }
```

View the size of the data allocated for the `orders._id` index with the following sequence of operations:

```
use test
db.orders._id.stats().indexSizes
```

---

### 10.7.11 How do I know when the server runs out of disk space?

If your server runs out of disk space for data files, you will see something like this in the log:

```
Thu Aug 11 13:06:09 [FileAllocator] allocating new data file dbms/test.13, filling with zeroes...
Thu Aug 11 13:06:09 [FileAllocator] error failed to allocate new file: dbms/test.13 size: 2146435072
Thu Aug 11 13:06:09 [FileAllocator] will try again in 10 seconds
Thu Aug 11 13:06:19 [FileAllocator] allocating new data file dbms/test.13, filling with zeroes...
Thu Aug 11 13:06:19 [FileAllocator] error failed to allocate new file: dbms/test.13 size: 2146435072
Thu Aug 11 13:06:19 [FileAllocator] will try again in 10 seconds
```

The server remains in this state forever, blocking all writes including deletes. However, reads still work. To delete some data and compact, using the [compact](#) (page 752) command, you must restart the server first.

If your server runs out of disk space for journal files, the server process will exit. By default, [mongod](#) (page 925) creates journal files in a sub-directory of [dbpath](#) (page 993) named `journal`. You may elect to put the journal files on another storage device using a filesystem mount or a symlink.

---

**Note:** If you place the journal files on a separate storage device you will not be able to use a file system snapshot tool to capture a consistent snapshot of your data files and journal files.

---

## 10.8 FAQ: Indexes

**Frequently Asked Questions:**

- Should you run `ensureIndex()` after every insert? (page 614)
- How do you know what indexes exist in a collection? (page 614)
- How do you determine the size of an index? (page 614)
- What happens if an index does not fit into RAM? (page 614)
- How do you know what index a query used? (page 615)
- How do you determine what fields to index? (page 615)
- How do write operations affect indexes? (page 615)
- Will building a large index affect database performance? (page 615)
- Can I use index keys to constrain query matches? (page 615)
- Using `$ne` and `$nin` in a query is slow. Why? (page 615)
- Can I use a multi-key index to support a query for a whole array? (page 615)
- How can I effectively use indexes strategy for attribute lookups? (page 616)

This document addresses common questions regarding MongoDB indexes.

If you don't find the answer you're looking for, check the [complete list of FAQs](#) (page 581) or post your question to the MongoDB User Mailing List<sup>21</sup>. See also [Indexing Tutorials](#) (page 338).

### 10.8.1 Should you run `ensureIndex()` after every insert?

No. You only need to create an index once for a single collection. After initial creation, MongoDB automatically updates the index as data changes.

While running `ensureIndex()` (page 814) is usually ok, if an index doesn't exist because of ongoing administrative work, a call to `ensureIndex()` (page 814) may disrupt database availability. Running `ensureIndex()` (page 814) can render a replica set inaccessible as the index creation is happening. See [Build Indexes on Replica Sets](#) (page 343).

### 10.8.2 How do you know what indexes exist in a collection?

To list a collection's indexes, use the `db.collection.getIndexes()` (page 826) method or a similar method for your driver<sup>22</sup>.

### 10.8.3 How do you determine the size of an index?

To check the sizes of the indexes on a collection, use `db.collection.stats()` (page 848).

### 10.8.4 What happens if an index does not fit into RAM?

When an index is too large to fit into RAM, MongoDB must read the index from disk, which is a much slower operation than reading from RAM. Keep in mind an index fits into RAM when your server has RAM available for the index combined with the rest of the *working set*.

In certain cases, an index does not need to fit *entirely* into RAM. For details, see [Indexes that Hold Only Recent Values in RAM](#) (page 372).

<sup>21</sup><https://groups.google.com/forum/?fromgroups#!forum/mongodb-user>

<sup>22</sup><http://api.mongodb.org/>

### 10.8.5 How do you know what index a query used?

To inspect how MongoDB processes a query, use the `explain()` (page 861) method in the `mongo` (page 942) shell, or in your application driver.

### 10.8.6 How do you determine what fields to index?

A number of factors determine what fields to index, including *selectivity* (page 372), fitting indexes into RAM, reusing indexes in multiple queries when possible, and creating indexes that can support all the fields in a given query. For detailed documentation on choosing which fields to index, see *Indexing Tutorials* (page 338).

### 10.8.7 How do write operations affect indexes?

Any write operation that alters an indexed field requires an update to the index in addition to the document itself. If you update a document that causes the document to grow beyond the allotted record size, then MongoDB must update all indexes that include this document as part of the update operation.

Therefore, if your application is write-heavy, creating too many indexes might affect performance.

### 10.8.8 Will building a large index affect database performance?

Building an index can be an IO-intensive operation, especially if you have a large collection. This is true on any database system that supports secondary indexes, including MySQL. If you need to build an index on a large collection, consider building the index in the background. See *Index Creation* (page 335).

If you build a large index without the background option, and if doing so causes the database to stop responding, do one of the following:

- Wait for the index to finish building.
- Kill the current operation (see `db.killOp()` (page 890)). The partial index will be deleted.

### 10.8.9 Can I use index keys to constrain query matches?

You can use the `min()` (page 869) and `max()` (page 867) methods to constrain the results of the cursor returned from `find()` (page 816) by using index keys.

### 10.8.10 Using `$ne` and `$nin` in a query is slow. Why?

The `$ne` (page 624) and `$nin` (page 624) operators are not selective. See *Create Queries that Ensure Selectivity* (page 372). If you need to use these, it is often best to make sure that an additional, more selective criterion is part of the query.

### 10.8.11 Can I use a multi-key index to support a query for a whole array?

Not entirely. The index can partially support these queries because it can speed the selection of the first element of the array; however, comparing all subsequent items in the array cannot use the index and must scan the documents individually.

### 10.8.12 How can I effectively use indexes strategy for attribute lookups?

For simple attribute lookups that don't require sorted result sets or range queries, consider creating a field that contains an array of documents where each document has a field (e.g. `attrib`) that holds a specific type of attribute. You can index this `attrib` field.

For example, the `attrib` field in the following document allows you to add an unlimited number of attributes types:

```
{ _id : ObjectId(...),
 attrib : [
 { k: "color", v: "red" },
 { k: "shape": v: "rectangle" },
 { k: "color": v: "blue" },
 { k: "avail": v: true }
]
}
```

Both of the following queries could use the same `{ "attrib.k": 1, "attrib.v": 1 }` index:

```
db.mycollection.find({ attrib: { $elemMatch : { k: "color", v: "blue" } } })
db.mycollection.find({ attrib: { $elemMatch : { k: "avail", v: true } } })
```

## 10.9 FAQ: MongoDB Diagnostics

### Frequently Asked Questions:

- Where can I find information about a `mongod` process that stopped running unexpectedly? (page 616)
- Does TCP keepalive time affect sharded clusters and replica sets? (page 617)
- What tools are available for monitoring MongoDB? (page 617)
- Memory Diagnostics (page 617)
  - Do I need to configure swap space? (page 617)
  - What is “working set” and how can I estimate its size? (page 618)
  - Must my working set size fit RAM? (page 618)
  - How do I calculate how much RAM I need for my application? (page 618)
  - How do I read memory statistics in the UNIX `top` command (page 619)
- Sharded Cluster Diagnostics (page 619)
  - In a new sharded cluster, why does all data remain on one shard? (page 619)
  - Why would one shard receive a disproportionate amount of traffic in a sharded cluster? (page 619)
  - What can prevent a sharded cluster from balancing? (page 620)
  - Why do chunk migrations affect sharded cluster performance? (page 620)

This document provides answers to common diagnostic questions and issues.

If you don't find the answer you're looking for, check the *complete list of FAQs* (page 581) or post your question to the MongoDB User Mailing List<sup>23</sup>.

### 10.9.1 Where can I find information about a `mongod` process that stopped running unexpectedly?

If `mongod` (page 925) shuts down unexpectedly on a UNIX or UNIX-based platform, and if `mongod` (page 925) fails to log a shutdown or error message, then check your system logs for messages pertaining to MongoDB. For example,

<sup>23</sup><https://groups.google.com/forum/?fromgroups#!forum/mongodb-user>

for logs located in `/var/log/messages`, use the following commands:

```
sudo grep mongod /var/log/messages
sudo grep score /var/log/messages
```

### 10.9.2 Does TCP keepalive time affect sharded clusters and replica sets?

If you experience socket errors between members of a sharded cluster or replica set, that do not have other reasonable causes, check the TCP keep alive value, which Linux systems store as the `tcp_keepalive_time` value. A common keep alive period is 7200 seconds (2 hours); however, different distributions and OS X may have different settings. For MongoDB, you will have better experiences with shorter keepalive periods, on the order of 300 seconds (five minutes).

On Linux systems you can use the following operation to check the value of `tcp_keepalive_time`:

```
cat /proc/sys/net/ipv4/tcp_keepalive_time
```

You can change the `tcp_keepalive_time` value with the following operation:

```
echo 300 > /proc/sys/net/ipv4/tcp_keepalive_time
```

The new `tcp_keepalive_time` value takes effect without requiring you to restart the `mongod` (page 925) or `mongos` (page 938) servers. When you reboot or restart your system you will need to set the new `tcp_keepalive_time` value, or see your operating system's documentation for setting the TCP keepalive value persistently.

For OS X systems, issue the following command to view the keep alive setting:

```
sysctl net.inet.tcp.keepinit
```

To set a shorter keep alive period use the following invocation:

```
sysctl -w net.inet.tcp.keepinit=300
```

If your replica set or sharded cluster experiences keepalive-related issues, you must alter the `tcp_keepalive_time` value on all machines hosting MongoDB processes. This includes all machines hosting `mongos` (page 938) or `mongod` (page 925) servers.

Windows users should consider the [Windows Server Technet Article on KeepAliveTime configuration<sup>24</sup>](#) for more information on setting keep alive for MongoDB deployments on Windows systems.

### 10.9.3 What tools are available for monitoring MongoDB?

The *MongoDB Management Services* <<http://mms.mongodb.com>> includes monitoring. MMS Monitoring is a free, hosted services for monitoring MongoDB deployments. A full list of third-party tools is available as part of the [Monitoring for MongoDB](#) (page 138) documentation. Also consider the [MMS Documentation<sup>25</sup>](#).

### 10.9.4 Memory Diagnostics

#### Do I need to configure swap space?

Always configure systems to have swap space. Without swap, your system may not be reliant in some situations with extreme memory constraints, memory leaks, or multiple programs using the same memory. Think of the swap space

<sup>24</sup>[http://technet.microsoft.com/en-us/library/dd349797.aspx#BKMK\\_2](http://technet.microsoft.com/en-us/library/dd349797.aspx#BKMK_2)

<sup>25</sup><http://mms.mongodb.com/help/>

as something like a steam release valve that allows the system to release extra pressure without affecting the overall functioning of the system.

Nevertheless, systems running MongoDB *do not* need swap for routine operation. Database files are [memory-mapped](#) (page 610) and should constitute most of your MongoDB memory use. Therefore, it is unlikely that `mongod` (page 925) will ever use any swap space in normal operation. The operating system will release memory from the memory mapped files without needing swap and MongoDB can write data to the data files without needing the swap system.

### What is “working set” and how can I estimate its size?

The *working set* for a MongoDB database is the portion of your data that clients access most often. You can estimate size of the working set, using the [workingSet](#) (page 795) document in the output of [serverStatus](#) (page 782). To return [serverStatus](#) (page 782) with the [workingSet](#) (page 795) document, issue a command in the following form:

```
db.runCommand({ serverStatus: 1, workingSet: 1 })
```

### Must my working set size fit RAM?

Your working set should stay in memory to achieve good performance. Otherwise many random disk IO’s will occur, and unless you are using SSD, this can be quite slow.

One area to watch specifically in managing the size of your working set is index access patterns. If you are inserting into indexes at random locations (as would happen with id’s that are randomly generated by hashes), you will continually be updating the whole index. If instead you are able to create your id’s in approximately ascending order (for example, day concatenated with a random id), all the updates will occur at the right side of the b-tree and the working set size for index pages will be much smaller.

It is fine if databases and thus virtual size are much larger than RAM.

### How do I calculate how much RAM I need for my application?

The amount of RAM you need depends on several factors, including but not limited to:

- The relationship between [database storage](#) (page 609) and working set.
- The operating system’s cache strategy for LRU (Least Recently Used)
- The impact of [journaling](#) (page 232)
- The number or rate of page faults and other MMS gauges to detect when you need more RAM

MongoDB defers to the operating system when loading data into memory from disk. It simply [memory maps](#) (page 610) all its data files and relies on the operating system to cache data. The OS typically evicts the least-recently-used data from RAM when it runs low on memory. For example if clients access indexes more frequently than documents, then indexes will more likely stay in RAM, but it depends on your particular usage.

To calculate how much RAM you need, you must calculate your working set size, or the portion of your data that clients use most often. This depends on your access patterns, what indexes you have, and the size of your documents.

If page faults are infrequent, your working set fits in RAM. If fault rates rise higher than that, you risk performance degradation. This is less critical with SSD drives than with spinning disks.

## How do I read memory statistics in the UNIX `top` command

Because `mongod` (page 925) uses *memory-mapped files* (page 610), the memory statistics in `top` require interpretation in a special way. On a large database, `VSIZE` (virtual bytes) tends to be the size of the entire database. If the `mongod` (page 925) doesn't have other processes running, `RSIZE` (resident bytes) is the total memory of the machine, as this counts file system cache contents.

For Linux systems, use the `vmstat` command to help determine how the system uses memory. On OS X systems use `vm_stat`.

## 10.9.5 Sharded Cluster Diagnostics

The two most important factors in maintaining a successful sharded cluster are:

- *choosing an appropriate shard key* (page 506) and
- *sufficient capacity to support current and future operations* (page 503).

You can prevent most issues encountered with sharding by ensuring that you choose the best possible *shard key* for your deployment and ensure that you are always adding additional capacity to your cluster well before the current resources become saturated. Continue reading for specific issues you may encounter in a production environment.

### In a new sharded cluster, why does all data remains on one shard?

Your cluster must have sufficient data for sharding to make sense. Sharding works by migrating chunks between the shards until each shard has roughly the same number of chunks.

The default chunk size is 64 megabytes. MongoDB will not begin migrations until the imbalance of chunks in the cluster exceeds the *migration threshold* (page 517). While the default chunk size is configurable with the `chunkSize` (page 1002) setting, these behaviors help prevent unnecessary chunk migrations, which can degrade the performance of your cluster as a whole.

If you have just deployed a sharded cluster, make sure that you have enough data to make sharding effective. If you do not have sufficient data to create more than eight 64 megabyte chunks, then all data will remain on one shard. Either lower the *chunk size* (page 519) setting, or add more data to the cluster.

As a related problem, the system will split chunks only on inserts or updates, which means that if you configure sharding and do not continue to issue insert and update operations, the database will not create any chunks. You can either wait until your application inserts data or *split chunks manually* (page 548).

Finally, if your shard key has a low *cardinality* (page 527), MongoDB may not be able to create sufficient splits among the data.

### Why would one shard receive a disproportionate amount of traffic in a sharded cluster?

In some situations, a single shard or a subset of the cluster will receive a disproportionate portion of the traffic and workload. In almost all cases this is the result of a shard key that does not effectively allow *write scaling* (page 507).

It's also possible that you have "hot chunks." In this case, you may be able to solve the problem by splitting and then migrating parts of these chunks.

In the worst case, you may have to consider re-sharding your data and *choosing a different shard key* (page 526) to correct this pattern.

## What can prevent a sharded cluster from balancing?

If you have just deployed your sharded cluster, you may want to consider the [troubleshooting suggestions for a new cluster where data remains on a single shard](#) (page 619).

If the cluster was initially balanced, but later developed an uneven distribution of data, consider the following possible causes:

- You have deleted or removed a significant amount of data from the cluster. If you have added additional data, it may have a different distribution with regards to its shard key.
- Your [shard key](#) has low [cardinality](#) (page 527) and MongoDB cannot split the chunks any further.
- Your data set is growing faster than the balancer can distribute data around the cluster. This is uncommon and typically is the result of:
  - a [balancing window](#) (page 551) that is too short, given the rate of data growth.
  - an uneven distribution of [write operations](#) (page 507) that requires more data migration. You may have to choose a different shard key to resolve this issue.
  - poor network connectivity between shards, which may lead to chunk migrations that take too long to complete. Investigate your network configuration and interconnections between shards.

## Why do chunk migrations affect sharded cluster performance?

If migrations impact your cluster or application's performance, consider the following options, depending on the nature of the impact:

1. If migrations only interrupt your clusters sporadically, you can limit the [balancing window](#) (page 551) to prevent balancing activity during peak hours. Ensure that there is enough time remaining to keep the data from becoming out of balance again.
2. If the balancer is always migrating chunks to the detriment of overall cluster performance:
  - You may want to attempt [decreasing the chunk size](#) (page 547) to limit the size of the migration.
  - Your cluster may be over capacity, and you may want to attempt to [add one or two shards](#) (page 529) to the cluster to distribute load.

It's also possible that your shard key causes your application to direct all writes to a single shard. This kind of activity pattern can require the balancer to migrate most data soon after writing it. Consider redeploying your cluster with a shard key that provides better [write scaling](#) (page 507).

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## Reference

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# 11.1 MongoDB Interface

## 11.1.1 Operators

*[Query and Projection Operators \(page 621\)](#)* Query operators provide ways to locate data within the database and projection operators modify how data is presented.

*[Update Operators \(page 651\)](#)* Update operators are operators that enable you to modify the data in your database or add additional data.

*[Aggregation Framework Operators \(page 663\)](#)* Aggregation pipeline operations have a collection of operators available to define and manipulate documents in pipeline stages.

*[Meta-Query Operators \(page 687\)](#)* Query modifiers determine the way that queries will be executed.

### Query and Projection Operators

- [Query Selectors \(page 621\)](#)
  - [Comparison \(page 621\)](#)
  - [Logical \(page 625\)](#)
  - [Element \(page 629\)](#)
  - [Evaluation \(page 632\)](#)
  - [Geospatial \(page 635\)](#)
  - [Array \(page 644\)](#)
- [Projection Operators \(page 646\)](#)

#### Query Selectors

##### Comparison

**Comparison Query Operators**

| Name                             | Description                                                                        |
|----------------------------------|------------------------------------------------------------------------------------|
| <a href="#">\$gt</a> (page 622)  | Matches values that are greater than the value specified in the query.             |
| <a href="#">\$gte</a> (page 622) | Matches values that are equal to or greater than the value specified in the query. |
| <a href="#">\$in</a> (page 623)  | Matches any of the values that exist in an array specified in the query.           |
| <a href="#">\$lt</a> (page 623)  | Matches values that are less than the value specified in the query.                |
| <a href="#">\$lte</a> (page 624) | Matches values that are less than or equal to the value specified in the query.    |
| <a href="#">\$ne</a> (page 624)  | Matches all values that are not equal to the value specified in the query.         |
| <a href="#">\$nin</a> (page 624) | Matches values that <b>do not</b> exist in an array specified to the query.        |

**\$gt****\$gt**

*Syntax:* {field: { \$gt: value} }

[\\$gt](#) (page 622) selects those documents where the value of the `field` is greater than (i.e. `>`) the specified value.

Consider the following example:

```
db.inventory.find({ qty: { $gt: 20 } })
```

This query will select all documents in the `inventory` collection where the `qty` field value is greater than 20.

Consider the following example which uses the [\\$gt](#) (page 622) operator with a field from an embedded document:

```
db.inventory.update({ "carrier.fee": { $gt: 2 } }, { $set: { price: 9.99 } })
```

This [update\(\)](#) (page 849) operation will set the value of the `price` field in the documents that contain the embedded document `carrier` whose `fee` field value is greater than 2.

**See also:**

[find\(\)](#) (page 816), [update\(\)](#) (page 849), [\\$set](#) (page 655).

**\$gte****\$gte**

*Syntax:* {field: { \$gte: value} }

[\\$gte](#) (page 622) selects the documents where the value of the `field` is greater than or equal to (i.e. `>=`) a specified value (e.g. `value`.)

Consider the following example:

```
db.inventory.find({ qty: { $gte: 20 } })
```

This query would select all documents in `inventory` where the `qty` field value is greater than or equal to 20.

Consider the following example which uses the [\\$gte](#) (page 622) operator with a field from an embedded document:

```
db.inventory.update({ "carrier.fee": { $gte: 2 } }, { $set: { price: 9.99 } })
```

This [update\(\)](#) (page 849) operation will set the value of the `price` field that contain the embedded document `carrier` whose `fee` field value is greater than or equal to 2.

**See also:**

[find\(\)](#) (page 816), [update\(\)](#) (page 849), [\\$set](#) (page 655).

**\$in****\$in**

*Syntax:* { field: { \$in: [<value1>, <value2>, ... <valueN>] } }

`$in` (page 623) selects the documents where the field value equals any value in the specified array (e.g. <value1>, <value2>, etc.)

Consider the following example:

```
db.inventory.find({ qty: { $in: [5, 15] } })
```

This query selects all documents in the `inventory` collection where the `qty` field value is either 5 or 15. Although you can express this query using the `$or` (page 625) operator, choose the `$in` (page 623) operator rather than the `$or` (page 625) operator when performing equality checks on the same field.

If the `field` holds an array, then the `$in` (page 623) operator selects the documents whose `field` holds an array that contains at least one element that matches a value in the specified array (e.g. <value1>, <value2>, etc.)

Consider the following example:

```
db.inventory.update(
 { tags: { $in: ["appliances", "school"] } },
 { $set: { sale:true } }
)
```

This `update()` (page 849) operation will set the `sale` field value in the `inventory` collection where the `tags` field holds an array with at least one element matching an element in the array `["appliances", "school"]`.

---

**Note:** When using two or more `$in` (page 623) expressions, the product of the number of `distinct` elements in the `$in` (page 623) arrays must be less than 4000000. Otherwise, MongoDB will throw an exception of "combinatorial limit of `$in` partitioning of result set exceeded".

---

**See also:**

[find\(\)](#) (page 816), [update\(\)](#) (page 849), [\\$or](#) (page 625), [\\$set](#) (page 655).

**\$lt****\$lt**

*Syntax:* {field: { \$lt: value} }

`$lt` (page 623) selects the documents where the value of the `field` is less than (i.e. `<`) the specified `value`.

Consider the following example:

```
db.inventory.find({ qty: { $lt: 20 } })
```

This query will select all documents in the `inventory` collection where the `qty` field value is less than 20.

Consider the following example which uses the `$lt` (page 623) operator with a field from an embedded document:

```
db.inventory.update({ "carrier.fee": { $lt: 20 } }, { $set: { price: 9.99 } })
```

This `update()` (page 849) operation will set the `price` field value in the documents that contain the embedded document `carrier` whose `fee` field value is less than 20.

**See also:**

[find\(\)](#) (page 816), [update\(\)](#) (page 849), [\\$set](#) (page 655).

### \$lte

#### \$lte

*Syntax:* { field: { \$lte: value} }

[\\$lte](#) (page 624) selects the documents where the value of the `field` is less than or equal to (i.e. `<=`) the specified value.

Consider the following example:

```
db.inventory.find({ qty: { $lte: 20 } })
```

This query will select all documents in the `inventory` collection where the `qty` field value is less than or equal to 20.

Consider the following example which uses the [\\$lt](#) (page 623) operator with a field from an embedded document:

```
db.inventory.update({ "carrier.fee": { $lte: 5 } }, { $set: { price: 9.99 } })
```

This [update\(\)](#) (page 849) operation will set the `price` field value in the documents that contain the embedded document `carrier` whose `fee` field value is less than or equal to 5.

**See also:**

[find\(\)](#) (page 816), [update\(\)](#) (page 849), [\\$set](#) (page 655).

### \$ne

#### \$ne

*Syntax:* {field: { \$ne: value} }

[\\$ne](#) (page 624) selects the documents where the value of the `field` is not equal (i.e. `!=`) to the specified value. This includes documents that do not contain the `field`.

Consider the following example:

```
db.inventory.find({ qty: { $ne: 20 } })
```

This query will select all documents in the `inventory` collection where the `qty` field value does not equal 20, including those documents that do not contain the `qty` field.

Consider the following example which uses the [\\$ne](#) (page 624) operator with a field from an embedded document:

```
db.inventory.update({ "carrier.state": { $ne: "NY" } }, { $set: { qty: 20 } })
```

This [update\(\)](#) (page 849) operation will set the `qty` field value in the documents that contains the embedded document `carrier` whose `state` field value does not equal “NY”, or where the `state` field or the `carrier` embedded document does not exist.

**See also:**

[find\(\)](#) (page 816), [update\(\)](#) (page 849), [\\$set](#) (page 655).

### \$nin

#### \$nin

*Syntax:* { field: { \$nin: [ <value1>, <value2> ... <valueN> ] } }

[\\$nin](#) (page 624) selects the documents where:

- the `field` value is not in the specified array **or**

- the field does not exist.

Consider the following query:

```
db.inventory.find({ qty: { $nin: [5, 15] } })
```

This query will select all documents in the `inventory` collection where the `qty` field value does **not** equal 5 nor 15. The selected documents will include those documents that do *not* contain the `qty` field.

If the `field` holds an array, then the `$nin` (page 624) operator selects the documents whose `field` holds an array with **no** element equal to a value in the specified array (e.g. <value1>, <value2>, etc.).

Consider the following query:

```
db.inventory.update({ tags: { $nin: ["appliances", "school"] } }, { $set: { sale: false } })
```

This `update()` (page 849) operation will set the `sale` field value in the `inventory` collection where the `tags` field holds an array with **no** elements matching an element in the array `["appliances", "school"]` or where a document does not contain the `tags` field.

#### See also:

`find()` (page 816), `update()` (page 849), `$set` (page 655).

## Logical

### Logical Query Operators

| Name                          | Description                                                                                                   |
|-------------------------------|---------------------------------------------------------------------------------------------------------------|
| <code>\$or</code> (page 625)  | Joins query clauses with a logical OR returns all documents that match the conditions clause.                 |
| <code>\$and</code> (page 626) | Joins query clauses with a logical AND returns all documents that match the condition clauses.                |
| <code>\$not</code> (page 627) | Inverts the effect of a query expression and returns documents that do <i>not</i> match the query expression. |
| <code>\$nor</code> (page 628) | Joins query clauses with a logical NOR returns all documents that fail to match both clauses.                 |

### \$or

#### \$or

New in version 1.6.

Changed in version 2.0: You may nest `$or` (page 625) operations; however, these expressions are not as efficiently optimized as top-level.

**Syntax:** { `$or`: [ { <expression1> }, { <expression2> }, ... , { <expressionN> } ] }

The `$or` (page 625) operator performs a logical OR operation on an array of *two or more* <expressions> and selects the documents that satisfy *at least* one of the <expressions>.

Consider the following query:

```
db.inventory.find({ price: 1.99, $or: [{ qty: { $lt: 20 } }, { sale: true }] })
```

This query will select all documents in the `inventory` collection where:

- the `price` field value equals 1.99 *and*
- either the `qty` field value is less than 20 **or** the `sale` field value is `true`.

Consider the following example which uses the `$or` (page 625) operator to select fields from embedded documents:

```
db.inventory.update({ $or: [{ price:10.99 }, { "carrier.state": "NY" }] }, { $set: { sale: true } })
```

This `update()` (page 849) operation will set the value of the `sale` field in the documents in the `inventory` collection where:

- the `price` field value equals `10.99` or
- the `carrier` embedded document contains a field `state` whose value equals `NY`.

When using `$or` (page 625) with <expressions> that are equality checks for the value of the same field, choose the `$in` (page 623) operator over the `$or` (page 625) operator.

Consider the query to select all documents in the `inventory` collection where:

- either `price` field value equals `1.99` or the `sale` field value equals `true`, and
- either `qty` field value equals `20` or `qty` field value equals `50`,

The most effective query would be:

```
db.inventory.find({ $or: [{ price: 1.99 }, { sale: true }], qty: { $in: [20, 50] } })
```

Consider the following behaviors when using the `$or` (page 625) operator:

- When using indexes with `$or` (page 625) queries, remember that each clause of an `$or` (page 625) query will execute in parallel. These clauses can each use their own index. Consider the following query:

```
db.inventory.find({ $or: [{ price: 1.99 }, { sale: true }] })
```

For this query, you would create one index on `price` (`db.inventory.ensureIndex( { price: 1 } )`) and another index on `sale` (`db.inventory.ensureIndex( { sale: 1 } )`) rather than a compound index.

- Also, when using the `$or` (page 625) operator with the `sort()` (page 872) method in a query, the query will **not** use the indexes on the `$or` (page 625) fields. Consider the following query which adds a `sort()` (page 872) method to the above query:

```
db.inventory.find({ $or: [{ price: 1.99 }, { sale: true }] }).sort({item:1})
```

This modified query will not use the index on `price` nor the index on `sale`.

- You cannot use the `$or` (page 625) with 2d *geospatial queries* (page 330).

**See also:**

`find()` (page 816), `update()` (page 849), `$set` (page 655), `$and` (page 626), `sort()` (page 872).

### **\$and**

#### **\$and**

New in version 2.0.

**Syntax:** { `$and`: [ { <expression1> }, { <expression2> } , ... , { <expressionN> } ] }

`$and` (page 626) performs a logical AND operation on an array of *two or more* expressions (e.g. `<expression1>`, `<expression2>`, etc.) and selects the documents that satisfy *all* the expressions in the array. The `$and` (page 626) operator uses *short-circuit evaluation*. If the first expression (e.g. `<expression1>`) evaluates to `false`, MongoDB will not evaluate the remaining expressions.

Consider the following example:

```
db.inventory.find({ $and: [{ price: 1.99 }, { qty: { $lt: 20 } }, { sale: true }] })
```

This query will select all documents in the `inventory` collection where:

- `price` field value equals `1.99` **and**
- `qty` field value is less than `20` **and**
- `sale` field value is equal to `true`.

MongoDB provides an implicit AND operation when specifying a comma separated list of expressions. For example, you may write the above query as:

```
db.inventory.find({ price: 1.99, qty: { $lt: 20 } , sale: true })
```

If, however, a query requires an AND operation on the same field such as `{ price: { $ne: 1.99 } }` AND `{ price: { $exists: true } }`, then either use the `$and` (page 626) operator for the two separate expressions or combine the operator expressions for the field `{ price: { $ne: 1.99, $exists: true } }`.

Consider the following examples:

```
db.inventory.update({ $and: [{ price: { $ne: 1.99 } }, { price: { $exists: true } }] }, { $set: { qty: 15 } })
```

```
db.inventory.update({ price: { $ne: 1.99, $exists: true } } , { $set: { qty: 15 } })
```

Both `update()` (page 849) operations will set the value of the `qty` field in documents where:

- the `price` field value does not equal `1.99` **and**
- the `price` field exists.

**See also:**

[find\(\)](#) (page 816), [update\(\)](#) (page 849), [\\$ne](#) (page 624), [\\$exists](#) (page 629), [\\$set](#) (page 655).

## \$not

### \$not

**Syntax:** `{ field: { $not: { <operator-expression> } } }`

`$not` (page 627) performs a logical NOT operation on the specified `<operator-expression>` and selects the documents that do *not* match the `<operator-expression>`. This includes documents that do not contain the field.

Consider the following query:

```
db.inventory.find({ price: { $not: { $gt: 1.99 } } })
```

This query will select all documents in the `inventory` collection where:

- the `price` field value is less than or equal to `1.99` **or**
- the `price` field does not exist

`{ $not: { $gt: 1.99 } }` is different from the `$lte` (page 624) operator. `{ $lte: 1.99 }` returns *only* the documents where `price` field exists and its value is less than or equal to `1.99`.

Remember that the `$not` (page 627) operator only affects *other operators* and cannot check fields and documents independently. So, use the `$not` (page 627) operator for logical disjunctions and the `$ne` (page 624) operator to test the contents of fields directly.

Consider the following behaviors when using the `$not` (page 627) operator:

- The operation of the `$not` (page 627) operator is consistent with the behavior of other operators but may yield unexpected results with some data types like arrays.

- The `$not` (page 627) operator does **not** support operations with the `$regex` (page 633) operator. Instead use `http://docs.mongodb.org/manual/` or in your driver interfaces, use your language's regular expression capability to create regular expression objects.

Consider the following example which uses the pattern match expression `http://docs.mongodb.org/manual/`:

```
db.inventory.find({ item: { $not: /^p.*/ } })
```

The query will select all documents in the `inventory` collection where the `item` field value does *not* start with the letter p.

If you are using Python, you can write the above query with the PyMongo driver and Python's `python:re.compile()` method to compile a regular expression, as follows:

```
import re
for noMatch in db.inventory.find({ "item": { "$not": re.compile("^p.*") } }):
 print noMatch
```

### See also:

`find()` (page 816), `update()` (page 849), `$set` (page 655), `$gt` (page 622), `$regex` (page 633), Py-Mongo<sup>1</sup>, *driver*.

## \$nor

### \$nor

*Syntax:* { `$nor`: [ { <expression1> }, { <expression2> }, ... { <expressionN> } ] }

`$nor` (page 628) performs a logical NOR operation on an array of *two or more* <expressions> and selects the documents that **fail** all the <expressions> in the array.

Consider the following example:

```
db.inventory.find({ $nor: [{ price: 1.99 }, { qty: { $lt: 20 } }, { sale: true }] })
```

This query will select all documents in the `inventory` collection where:

- the `price` field value does *not* equal 1.99 **and**
- the `qty` field value is *not* less than 20 **and**
- the `sale` field value is *not* equal to `true`

including those documents that do not contain these field(s).

The exception in returning documents that do not contain the field in the `$nor` (page 628) expression is when the `$nor` (page 628) operator is used with the `$exists` (page 629) operator.

Consider the following query which uses only the `$nor` (page 628) operator:

```
db.inventory.find({ $nor: [{ price: 1.99 }, { sale: true }] })
```

This query will return all documents that:

- contain the `price` field whose value is *not* equal to 1.99 and contain the `sale` field whose value is *not* equal to `true` **or**

---

<sup>1</sup><http://api.mongodb.org/pythoncurrent>

- contain the `price` field whose value is *not* equal to `1.99` *but* do *not* contain the `sale` field **or**
- do *not* contain the `price` field *but* contain the `sale` field whose value is *not* equal to `true` **or**
- do *not* contain the `price` field *and* do *not* contain the `sale` field

Compare that with the following query which uses the `$nor` (page 628) operator with the `$exists` (page 629) operator:

```
db.inventory.find({ $nor: [{ price: 1.99 }, { price: { $exists: false } },
 { sale: true }, { sale: { $exists: false } }] })
```

This query will return all documents that:

- contain the `price` field whose value is *not* equal to `1.99` *and* contain the `sale` field whose value is *not* equal to `true`

#### See also:

[find\(\)](#) (page 816), [update\(\)](#) (page 849), [\\$set](#) (page 655), [\\$exists](#) (page 629).

## Element

| Name                                | Description                                            |
|-------------------------------------|--------------------------------------------------------|
| <a href="#">\$exists</a> (page 629) | Matches documents that have the specified field.       |
| <a href="#">\$type</a> (page 630)   | Selects documents if a field is of the specified type. |

## \$exists

### Definition

#### \$exists

Syntax: { `field`: { `$exists`: <boolean> } }

`$exists` (page 629) selects the documents that contain the field if <boolean> is `true`. If <boolean> is `false`, the query only returns the documents that do not contain the field. `$exists` (page 629) **does** match documents that contain the field that stores the `null` value.

When you specify `true` to the `$exist` operator, the query will select documents where the value of the specified field is `null`. If you specify `false` to `$exist`, the query will **not** match fields that hold the `null` value.

MongoDB `$exists` does **not** correspond to SQL operator `exists`. For SQL `exists`, refer to the [\\$in](#) (page 623) operator.

#### See also:

[\\$nin](#) (page 624), [\\$in](#) (page 623), and [How do I query for fields that have null values?](#) (page 591).

## Examples

### Exists and Not Equal To

Consider the following example:

```
db.inventory.find({ qty: { $exists: true, $nin: [5, 15] } })
```

This query will select all documents in the `inventory` collection where the `qty` field exists *and* its value does not equal 5 or 15.

**Null Values** Given a collection named `records` with the following documents:

```
{ a: 5, b: 5, c: null }
{ a: 3, b: null, c: 8 }
{ a: null, b: 3, c: 9 }
{ a: 1, b: 2, c: 3 }
{ a: 2, c: 5 }
{ a: 3, b: 2 }
{ a: 4 }
{ b: 2, c: 4 }
{ b: 2 }
{ c: 6 }
```

Consider the output of the following queries:

**Query:**

```
db.records.find({ a: { $exists: true } })
```

**Result:**

```
{ a: 5, b: 5, c: null }
{ a: 3, b: null, c: 8 }
{ a: null, b: 3, c: 9 }
{ a: 1, b: 2, c: 3 }
{ a: 2, c: 5 }
{ a: 3, b: 2 }
{ a: 4 }
```

**Query:**

```
db.records.find({ b: { $exists: false } })
```

**Result:**

```
{ a: 2, c: 5 }
{ a: 4 }
{ c: 6 }
```

**Query:**

```
db.records.find({ c: { $exists: false } })
```

**Result:**

```
{ a: 3, b: 2 }
{ a: 4 }
{ b: 2 }
```

**\$type**

**\$type**

*Syntax:* { field: { \$type: <BSON type> } }

`$type` (page 630) selects the documents where the *value* of the *field* is the specified *BSON* type.

Consider the following example:

```
db.inventory.find({ price: { $type : 1 } })
```

This query will select all documents in the `inventory` collection where the `price` field value is a Double.

If the `field` holds an array, the `$type` (page 630) operator performs the type check against the array elements and **not** the field.

Consider the following example where the `tags` field holds an array:

```
db.inventory.find({ tags: { $type : 4 } })
```

This query will select all documents in the `inventory` collection where the `tags` array contains an element that is itself an array.

If instead you want to determine whether the `tags` field is an array type, use the `$where` (page 634) operator:

```
db.inventory.find({ $where : "Array.isArray(this.tags)" })
```

See the SERVER-1475<sup>2</sup> for more information about the array type.

Refer to the following table for the available  `BSON` types and their corresponding numbers.

| Type                    | Number |
|-------------------------|--------|
| Double                  | 1      |
| String                  | 2      |
| Object                  | 3      |
| Array                   | 4      |
| Binary data             | 5      |
| Undefined (deprecated)  | 6      |
| Object id               | 7      |
| Boolean                 | 8      |
| Date                    | 9      |
| Null                    | 10     |
| Regular Expression      | 11     |
| JavaScript              | 13     |
| Symbol                  | 14     |
| JavaScript (with scope) | 15     |
| 32-bit integer          | 16     |
| Timestamp               | 17     |
| 64-bit integer          | 18     |
| Min key                 | 255    |
| Max key                 | 127    |

`MinKey` and `MaxKey` compare less than and greater than all other possible  `BSON` element values, respectively, and exist primarily for internal use.

---

**Note:** To query if a field value is a `MinKey`, you must use the `$type` (page 630) with `-1` as in the following example:

```
db.collection.find({ field: { $type: -1 } })
```

---

### Example

Consider the following example operation sequence that demonstrates both type comparison *and* the special `MinKey` and `MaxKey` values:

```
db.test.insert({x : 3});
db.test.insert({x : 2.9});
db.test.insert({x : new Date()});
db.test.insert({x : true});
```

<sup>2</sup><https://jira.mongodb.org/browse/SERVER-1475>

```
db.test.insert({x : MaxKey})
db.test.insert({x : MinKey})

db.test.find().sort({x:1})
{ "_id" : ObjectId("4b04094b7c65b846e2090112"), "x" : { $minKey : 1 } }
{ "_id" : ObjectId("4b03155dce8de6586fb002c7"), "x" : 2.9 }
{ "_id" : ObjectId("4b03154cce8de6586fb002c6"), "x" : 3 }
{ "_id" : ObjectId("4b031566ce8de6586fb002c9"), "x" : true }
{ "_id" : ObjectId("4b031563ce8de6586fb002c8"), "x" : "Tue Jul 25 2012 18:42:03 GMT-0500 (EST)" }
{ "_id" : ObjectId("4b0409487c65b846e2090111"), "x" : { $maxKey : 1 } }
```

To query for the minimum value of a *shard key* of a *sharded cluster*, use the following operation when connected to the `mongos` (page 938):

```
use config
db.chunks.find({ "min.shardKey": { $type: -1 } })
```

**Warning:** Storing values of the different types in the same field in a collection is *strongly discouraged*.

#### See also:

`find()` (page 816), `insert()` (page 832), `$where` (page 634),  `BSON`, `shard key`, `sharded cluster`.

## Evaluation

### Evaluation Query Operators

| Name                            | Description                                                                            |
|---------------------------------|----------------------------------------------------------------------------------------|
| <code>\$mod</code> (page 632)   | Performs a modulo operation on the value of a field and selects documents with result. |
| <code>\$regex</code> (page 633) | Selects documents where values match a specified regular expression.                   |
| <code>\$where</code> (page 634) | Matches documents that satisfy a JavaScript expression.                                |

### `$mod` `$mod`

*Syntax:* { field: { \$mod: [ divisor, remainder ] } }

`$mod` (page 632) selects the documents where the `field` value divided by the `divisor` has the specified remainder.

Consider the following example:

```
db.inventory.find({ qty: { $mod: [4, 0] } })
```

This query will select all documents in the `inventory` collection where the `qty` field value modulo 4 equals 0, such as documents with `qty` value equal to 0 or 12.

In some cases, you can query using the `$mod` (page 632) operator rather than the more expensive `$where` (page 634) operator. Consider the following example using the `$mod` (page 632) operator:

```
db.inventory.find({ qty: { $mod: [4, 0] } })
```

The above query is less expensive than the following query which uses the `$where` (page 634) operator:

---

```
db.inventory.find({ $where: "this.qty % 4 == 0" })
```

**See also:**

[find\(\)](#) (page 816), [update\(\)](#) (page 849), [\\$set](#) (page 655).

## \$regex

### \$regex

The [\\$regex](#) (page 633) operator provides regular expression capabilities for pattern matching *strings* in queries. MongoDB uses Perl compatible regular expressions (i.e. “PCRE.”)

You can specify regular expressions using regular expression objects or using the [\\$regex](#) (page 633) operator. The following examples are equivalent:

```
db.collection.find({ field: /acme.*corp/i });
db.collection.find({ field: { $regex: 'acme.*corp', $options: 'i' } });
```

These expressions match all documents in `collection` where the value of `field` matches the case-insensitive regular expression `acme.*corp`.

[\\$regex](#) (page 633) uses “Perl Compatible Regular Expressions” (PCRE) as the matching engine.

### \$options

[\\$regex](#) (page 633) provides four option flags:

- `i` toggles case insensitivity, and allows all letters in the pattern to match upper and lower cases.
- `m` toggles multiline regular expression. Without this option, all regular expression match within one line.  
If there are no newline characters (e.g. `\n`) or no start/end of line construct, the `m` option has no effect.
- `x` toggles an “extended” capability. When set, [\\$regex](#) (page 633) ignores all white space characters unless escaped or included in a character class.

Additionally, it ignores characters between an un-escaped `#` character and the next new line, so that you may include comments in complicated patterns. This only applies to data characters; white space characters may never appear within special character sequences in a pattern.

The `x` option does not affect the handling of the VT character (i.e. code 11.)

New in version 1.9.0.

- `s` allows the dot (e.g. `.`) character to match all characters *including* newline characters.

[\\$regex](#) (page 633) only provides the `i` and `m` options for the native JavaScript regular expression objects (e.g. `http://docs.mongodb.org/manual/acme.*corp/i`). To use `x` and `s` you must use the “[\\$regex](#) (page 633)” operator with the “[\\$options](#) (page 633)” syntax.

To combine a regular expression match with other operators, you need to use the “[\\$regex](#) (page 633)” operator. For example:

```
db.collection.find({ field: { $regex: /acme.*corp/i, $nin: ['acmeblahcorp'] } });
```

This expression returns all instances of `field` in `collection` that match the case insensitive regular expression `acme.*corp` that *don't* match `acmeblahcorp`.

[\\$regex](#) (page 633) can only use an `index` efficiently when the regular expression has an anchor for the beginning (i.e. `^`) of a string and is a case-sensitive match. Additionally, while `http://docs.mongodb.org/manual^a/`, `http://docs.mongodb.org/manual^a.*/`, and `http://docs.mongodb.org/manual^a.*$/` match equivalent strings, they have

different performance characteristics. All of these expressions use an index if an appropriate index exists; however, [http://docs.mongodb.org/manual^a.\\*/](http://docs.mongodb.org/manual^a.*/), and [http://docs.mongodb.org/manual^a.\\*\\$/](http://docs.mongodb.org/manual^a.*$/) are slower. <http://docs.mongodb.org/manual^a/> can stop scanning after matching the prefix.

### \$where

#### \$where

Use the [\\$where](#) (page 634) operator to pass either a string containing a JavaScript expression or a full JavaScript function to the query system. The [\\$where](#) (page 634) provides greater flexibility, but requires that the database processes the JavaScript expression or function for *each* document in the collection. Reference the document in the JavaScript expression or function using either `this` or `obj`.

#### Warning:

- Do not write to the database within the [\\$where](#) (page 634) JavaScript function.
- [\\$where](#) (page 634) evaluates JavaScript and cannot take advantage of indexes. Therefore, query performance improves when you express your query using the standard MongoDB operators (e.g., [\\$gt](#) (page 622), [\\$in](#) (page 623)).
- In general, you should use [\\$where](#) (page 634) only when you can't express your query using another operator. If you must use [\\$where](#) (page 634), try to include at least one other standard query operator to filter the result set. Using [\\$where](#) (page 634) alone requires a table scan.

Consider the following examples:

```
db.myCollection.find({ $where: "this.credits == this.debits" });
db.myCollection.find({ $where: "obj.credits == obj.debits" });

db.myCollection.find({ $where: function() { return (this.credits == this.debits) } });
db.myCollection.find({ $where: function() { return obj.credits == obj.debits; } });
```

Additionally, if the query consists only of the [\\$where](#) (page 634) operator, you can pass in just the JavaScript expression or JavaScript functions, as in the following examples:

```
db.myCollection.find("this.credits == this.debits || this.credits > this.debits");
db.myCollection.find(function() { return (this.credits == this.debits || this.credits > this.debits) });
```

You can include both the standard MongoDB operators and the [\\$where](#) (page 634) operator in your query, as in the following examples:

```
db.myCollection.find({ active: true, $where: "this.credits - this.debits < 0" });
db.myCollection.find({ active: true, $where: function() { return obj.credits - obj.debits < 0; } });
```

Using normal non-[\\$where](#) (page 634) query statements provides the following performance advantages:

- MongoDB will evaluate non-[\\$where](#) (page 634) components of query before [\\$where](#) (page 634) statements. If the non-[\\$where](#) (page 634) statements match no documents, MongoDB will not perform any query evaluation using [\\$where](#) (page 634).
- The non-[\\$where](#) (page 634) query statements may use an *index*.

---

**Note:** Changed in version 2.4.

In MongoDB 2.4, [map-reduce operations](#) (page 701), the [group](#) (page 697) command, and [\\$where](#) (page 634) operator expressions **cannot** access certain global functions or properties, such as `db`, that are available in the [mongo](#) (page 942) shell.

When upgrading to MongoDB 2.4, you will need to refactor your code if your `map-reduce operations` (page 701), `group` (page 697) commands, or `$where` (page 634) operator expressions include any global shell functions or properties that are no longer available, such as `db`.

The following JavaScript functions and properties **are available** to `map-reduce operations` (page 701), the `group` (page 697) command, and `$where` (page 634) operator expressions in MongoDB 2.4:

| Available Properties | Available Functions      |                                 |
|----------------------|--------------------------|---------------------------------|
| <code>args</code>    | <code>assert()</code>    | <code>Map()</code>              |
| <code>MaxKey</code>  | <code>BinData()</code>   | <code>MD5()</code>              |
| <code>MinKey</code>  | <code>DBPointer()</code> | <code>NumberInt()</code>        |
|                      | <code>DBRef()</code>     | <code>NumberLong()</code>       |
|                      | <code>doassert()</code>  | <code>ObjectId()</code>         |
|                      | <code>emit()</code>      | <code>print()</code>            |
|                      | <code>gc()</code>        | <code>printjson()</code>        |
|                      | <code>HexData()</code>   | <code>printjsononeline()</code> |
|                      | <code>hex_md5()</code>   | <code>sleep()</code>            |
|                      | <code>isNumber()</code>  | <code>Timestamp()</code>        |
|                      | <code>isObject()</code>  | <code>tojson()</code>           |
|                      | <code>ISODate()</code>   | <code>tojsononeline()</code>    |
|                      | <code>isString()</code>  | <code>tojsonObject()</code>     |
|                      |                          | <code>UUID()</code>             |
|                      |                          | <code>version()</code>          |

## Geospatial

### Geospatial Query Operators

#### Operators

|                 | Name                                    | Description                                                             |
|-----------------|-----------------------------------------|-------------------------------------------------------------------------|
| Query Selectors | <code>\$geoWithin</code> (page 635)     | Selects geometries within a bounding <code>GeoJSON</code> geometry.     |
|                 | <code>\$geoIntersects</code> (page 637) | Selects geometries that intersect with a <code>GeoJSON</code> geometry. |
|                 | <code>\$near</code> (page 637)          | Returns geospatial objects in proximity to a point.                     |
|                 | <code>\$nearSphere</code> (page 638)    | Returns geospatial objects in proximity to a point on a sphere.         |

#### `$geoWithin`

#### `$geoWithin`

New in version 2.4: `$geoWithin` (page 635) replaces `$within` (page 636) which is deprecated.

The `$geoWithin` (page 635) operator is a geospatial query operator that queries for a defined point, line or shape that exists entirely within another defined shape. When determining inclusion, MongoDB considers the border of a shape to be part of the shape, subject to the precision of floating point numbers.

The `$geoWithin` (page 635) operator queries for inclusion in a `GeoJSON` polygon or a shape defined by legacy coordinate pairs.

The `$geoWithin` (page 635) operator does not return sorted results. As a result MongoDB can return `$geoWithin` (page 635) queries more quickly than geospatial `$near` (page 637) or `$nearSphere` (page 638) queries, which sort results.

The `2dsphere` and `2d` indexes both support the `$geoWithin` (page 635) operator.

Changed in version 2.2.3: `$geoWithin` (page 635) does not require a geospatial index. However, a geospatial index will improve query performance.

If querying for geometries that exist within a GeoJSON `polygon` on a sphere, pass the polygon to `$geoWithin` (page 635) using the `$geometry` (page 639) operator.

For a polygon with only an exterior ring use following syntax:

```
db.<collection>.find({ <location field> :
 { $geoWithin :
 { $geometry :
 { type : "Polygon" ,
 coordinates : [[[<lng1>, <lat1>] , [<lng2>, <lat2>] ...]
 } } } })
```

---

**Important:** Specify coordinates in `longitude, latitude` order.

---

For a polygon with an exterior and interior ring use following syntax:

```
db.<collection>.find({ <location field> :
 { $geoWithin :
 { $geometry :
 { type : "Polygon" ,
 coordinates : [[[<lng1>, <lat1>] , [<lng2>, <lat2>] ...]
 [[<lngA>, <latA>] , [<lngB>, <latB>] ...]
 } } } })
```

The following example selects all indexed points and shapes that exist entirely within a GeoJSON polygon:

```
db.places.find({ loc :
 { $geoWithin :
 { $geometry :
 { type : "Polygon" ,
 coordinates: [[[0 , 0] , [3 , 6] , [6 , 1] , [0 , 0]]]
 } } } })
```

If querying for inclusion in a shape defined by legacy coordinate pairs on a plane, use the following syntax:

```
db.<collection>.find({ <location field> :
 { $geoWithin :
 { <shape operator> : <coordinates>
 } } })
```

For the syntax of shape operators, see: `$box` (page 641), `$polygon` (page 642), `$center` (page 640) (defines a circle), and `$centerSphere` (page 641) (defines a circle on a sphere).

---

**Note:** Any geometry specified with `GeoJSON` to `$geoWithin` (page 635) queries, **must** fit within a single hemisphere. MongoDB interprets geometries larger than half of the sphere as queries for the smaller of the complementary geometries.

---

#### `$within`

Deprecated since version 2.4: `$geoWithin` (page 635) replaces `$within` (page 636) in MongoDB 2.4.

**\$geoIntersects****\$geoIntersects**

New in version 2.4.

The [\\$geoIntersects](#) (page 637) operator is a geospatial query operator that selects all locations that intersect with a [GeoJSON](#) object. A location intersects a GeoJSON object if the intersection is non-empty. This includes documents that have a shared edge. The [\\$geoIntersects](#) (page 637) operator uses spherical geometry.

The `2dsphere` geospatial index supports [\\$geoIntersects](#) (page 637).

To query for intersection, pass the GeoJSON object to [\\$geoIntersects](#) (page 637) through the [\\$geometry](#) (page 639) operator. Use the following syntax:

```
db.<collection>.find({ <location field> :
 { $geoIntersects :
 { $geometry :
 { type : "<GeoJSON object type>" ,
 coordinates : [<coordinates>]
 } } } })
```

---

**Important:** Specify coordinates in this order: “**longitude, latitude.**”

---

The following example uses [\\$geoIntersects](#) (page 637) to select all indexed points and shapes that intersect with the polygon defined by the `coordinates` array.

```
db.places.find({ loc :
 { $geoIntersects :
 { $geometry :
 { type : "Polygon" ,
 coordinates: [[[0 , 0] , [3 , 6] , [6 , 1] , [0 , 0]]] }
 } } })
```

---

**Note:** Any geometry specified with [GeoJSON](#) to [\\$geoIntersects](#) (page 637) queries, **must** fit within a single hemisphere. MongoDB interprets geometries larger than half of the sphere as queries for the smaller of the complementary geometries.

---

**\$near****\$near**

Changed in version 2.4.

Specifies a point for which a [geospatial](#) query returns the closest documents first. The query sorts the documents from nearest to farthest.

The [\\$near](#) (page 637) operator can query for a [GeoJSON](#) point or for a point defined by legacy coordinate pairs.

The optional [\\$maxDistance](#) (page 640) operator limits a [\\$near](#) (page 637) query to return only those documents that fall within a maximum distance of a point. If you query for a GeoJSON point, specify [\\$maxDistance](#) (page 640) in meters. If you query for legacy coordinate pairs, specify [\\$maxDistance](#) (page 640) in radians.

The [\\$near](#) (page 637) operator requires a geospatial index: a `2dsphere` index for GeoJSON points; a `2d` index for legacy coordinate pairs. Queries that use a `2d` index return a limit of 100 documents.

---

**Note:** You cannot combine the [\\$near](#) (page 637) operator, which requires a special [geospatial index](#)

(page 327), with a query operator or command that uses a different type of special index. For example you cannot combine `$near` (page 637) with the `text` (page 715) command.

---

For queries on GeoJSON data, use the following syntax:

```
db.<collection>.find({ <location field> :
 { $near :
 { $geometry :
 { type : "Point" ,
 coordinates : [<longitude> , <latitude>] } },
 $maxDistance : <distance in meters>
 } })
```

---

**Important:** Specify coordinates in this order: “**longitude, latitude.**”

---

The following example selects the documents with coordinates nearest to [ 40 , 5 ] and limits the maximum distance to 500 meters from the specified GeoJSON point:

```
db.places.find({ loc : { $near :
 { $geometry :
 { type : "Point" ,
 coordinates: [40 , 5] } },
 $maxDistance : 500
} })
```

For queries on legacy coordinate pairs, use the following syntax:

```
db.<collection>.find({ <location field> :
 { $near : [<x> , <y>] ,
 $maxDistance: <distance>
 } })
```

---

**Important:** If you use longitude and latitude, specify **longitude first**.

---

The following example selects the 100 documents with coordinates nearest to [ 40 , 5 ]:

```
db.places.find({ loc :
 { $near : [40 , 5] ,
 $maxDistance : 10
} })
```

---

**Note:** You can further limit the number of results using `cursor.limit()` (page 867).

Specifying a batch size (i.e. `batchSize()` (page 859)) in conjunction with queries that use the `$near` (page 637) is not defined. See SERVER-5236<sup>3</sup> for more information.

---

## \$nearSphere

### \$nearSphere

New in version 1.8.

Specifies a point for which a `geospatial` query returns the closest documents first. The query sorts the documents from nearest to farthest. MongoDB calculates distances for `$nearSphere` (page 638) using spherical geometry.

---

<sup>3</sup><https://jira.mongodb.org/browse/SERVER-5236>

The `$nearSphere` (page 638) operator queries for points defined by either `GeoJSON` objects or legacy coordinate pairs.

The optional `$maxDistance` (page 640) operator limits a `$nearSphere` (page 638) query to return only those documents that fall within a maximum distance of a point. If you use `$maxDistance` (page 640) on `GeoJSON` points, the distance is measured in meters. If you use `$maxDistance` (page 640) on legacy coordinate pairs, the distance is measured in radians.

The `$nearSphere` (page 638) operator requires a geospatial index. The `2dsphere` and `2d` indexes both support `$nearSphere` (page 638) with both legacy coordinate pairs and `GeoJSON` points. Queries that use a `2d` index return at most 100 documents.

---

**Important:** If you use longitude and latitude, specify **longitude first**.

---

For queries on `GeoJSON` data, use the following syntax:

```
db.<collection>.find({ <location field> :
 { $nearSphere :
 { $geometry :
 { type : "Point" ,
 coordinates : [<longitude> , <latitude>] } ,
 $maxDistance : <distance in meters>
 } } })
```

For queries on legacy coordinate pairs, use the following syntax:

```
db.<collection>.find({ <location field> :
 { $nearSphere: [<x> , <y>] ,
 $maxDistance: <distance in radians>
 } })
```

The following example selects the 100 documents with legacy coordinates pairs nearest to [ 40 , 5 ], as calculated by spherical geometry:

```
db.places.find({ loc :
 { $nearSphere : [40 , 5]
 $maxDistance : 10
 } })
```

|                            | Name                         | Description                                                                                                                                                                                        |
|----------------------------|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Geometry Specifiers</b> | \$geometry<br>(page 639)     | Specifies a geometry in <code>GeoJSON</code> format to geospatial query operators.                                                                                                                 |
|                            | \$maxDistance<br>(page 640)  | Specifies a distance to limit the results of <code>\$near</code> (page 637) and <code>\$nearSphere</code> (page 638) queries.                                                                      |
|                            | \$center<br>(page 640)       | Specifies a circle using legacy coordinate pairs to <code>\$geoWithin</code> (page 635) queries when using planar geometry.                                                                        |
|                            | \$centerSphere<br>(page 641) | Specifies a circle using either legacy coordinate pairs or <code>GeoJSON</code> format for <code>\$geoWithin</code> (page 635) queries when using spherical geometry.                              |
|                            | \$box<br>(page 641)          | Specifies a rectangular box using legacy coordinate pairs for <code>\$geoWithin</code> (page 635) queries.                                                                                         |
|                            | \$polygon<br>(page 642)      | Specifies a polygon to using legacy coordinate pairs for <code>\$geoWithin</code> (page 635) queries.                                                                                              |
|                            | \$uniqueDocs<br>(page 643)   | Modifies a <code>\$geoWithin</code> (page 635) and <code>\$near</code> (page 637) queries to ensure that even if a document matches the query multiple times, the query returns the document once. |

## \$geometry

## \$geometry

New in version 2.4.

The [\\$geometry](#) (page 639) operator specifies a [GeoJSON](#) for a geospatial query operators. For details on using [\\$geometry](#) (page 639) with an operator, see the operator:

- [\\$geoWithin](#) (page 635)
- [\\$geoIntersects](#) (page 637)
- [\\$near](#) (page 637)

## \$maxDistance

### \$maxDistance

The [\\$maxDistance](#) (page 640) operator constrains the results of a geospatial [\\$near](#) (page 637) or [\\$nearSphere](#) (page 638) query to the specified distance. The measuring units for the maximum distance are determined by the coordinate system in use. For [GeoJSON](#) point object, specify the distance in meters, not radians.

The `2d` and `2dsphere` geospatial indexes both support [\\$maxDistance](#) (page 640).

The following example query returns documents with location values that are 10 or fewer units from the point `[ 100 , 100 ]`.

```
db.places.find({ loc : { $near : [100 , 100] ,
 $maxDistance: 10 }
})
```

MongoDB orders the results by their distance from `[ 100 , 100 ]`. The operation returns the first 100 results, unless you modify the query with the [cursor.limit\(\)](#) (page 867) method.

## \$center

### \$center

New in version 1.4.

The [\\$center](#) (page 640) operator specifies a circle for a [geospatial \\$geoWithin](#) (page 635) query. The query returns legacy coordinate pairs that are within the bounds of the circle. The operator does *not* return GeoJSON objects.

The query calculates distances using flat (planar) geometry.

The `2d` geospatial index supports the [\\$center](#) (page 640) operator.

To use the [\\$center](#) (page 640) operator, specify an array that contains:

- The grid coordinates of the circle's center point
- The circle's radius, as measured in the units used by the coordinate system

---

**Important:** If you use longitude and latitude, specify **longitude first**.

---

Use the following syntax:

```
{ <location field> : { $geoWithin : { $center : [[<x> , <y>] , <radius>] } } }
```

The following example query returns all documents that have coordinates that exist within the circle centered on `[ -74 , 40.74 ]` and with a radius of 10:

---

```
db.places.find({ loc: { $geoWithin :
 { $center : [[-74, 40.74], 10] }
 } })
```

Changed in version 2.2.3: Applications can use [\\$center](#) (page 640) *without* having a geospatial index. However, geospatial indexes support much faster queries than the unindexed equivalents. Before 2.2.3, a geospatial index *must* exist on a field holding coordinates before using any of the geospatial query operators.

## \$centerSphere

### \$centerSphere

New in version 1.8.

The [\\$centerSphere](#) (page 641) operator defines a circle for a [geospatial](#) query that uses spherical geometry. The query returns documents that are within the bounds of the circle.

You can use the [\\$centerSphere](#) (page 641) operator on both [GeoJSON](#) objects and legacy coordinate pairs.

The 2d and 2dsphere geospatial indexes both support [\\$centerSphere](#) (page 641).

To use [\\$centerSphere](#) (page 641), specify an array that contains:

- The grid coordinates of the circle's center point
- The circle's radius measured in radians. To calculate radians, see [Calculate Distance Using Spherical Geometry](#) (page 355).

Use the following syntax:

```
db.<collection>.find({ <location field> :
 { $geoWithin :
 { $centerSphere : [[<x>, <y>] , <radius>] }
 } })
```

---

**Important:** If you use longitude and latitude, specify **longitude first**.

The following example queries grid coordinates and returns all documents within a 10 mile radius of longitude 88° W and latitude 30° N. The query converts the distance to radians by dividing by the approximate radius of the earth, 3959 miles:

```
db.places.find({ loc : { $geoWithin :
 { $centerSphere :
 [[88 , 30] , 10 / 3959]
 } } })
```

Changed in version 2.2.3: Applications can use [\\$centerSphere](#) (page 641) *without* having a geospatial index. However, geospatial indexes support much faster queries than the unindexed equivalents. Before 2.2.3, a geospatial index *must* exist on a field holding coordinates before using any of the geospatial query operators.

## \$box

### \$box

New in version 1.4.

The [\\$box](#) (page 641) operator specifies a rectangle for a [geospatial](#) [\\$geoWithin](#) (page 635) query. The query returns documents that are within the bounds of the rectangle, according to their point-based location data. The [\\$box](#) (page 641) operator returns documents based on [grid coordinates](#) (page 330) and does *not* query for GeoJSON shapes.

The query calculates distances using flat (planar) geometry. The 2d geospatial index supports the [\\$box](#) (page 641) operator.

To use the [\\$box](#) (page 641) operator, you must specify the bottom left and top right corners of the rectangle in an array object. Use the following syntax:

```
{ <location field> : { $geoWithin : { $box :
 [[<bottom left coordinates>] ,
 [<upper right coordinates>]] } } }
```

---

**Important:** If you use longitude and latitude, specify **longitude first**.

---

The following example query returns all documents that are within the box having points at: [ 0 , 0 ], [ 0 , 100 ], [ 100 , 0 ], and [ 100 , 100 ].

```
db.places.find({ loc : { $geoWithin : { $box :
 [[0 , 0] ,
 [100 , 100]] } } })
```

Changed in version 2.2.3: Applications can use [\\$box](#) (page 641) *without* having a geospatial index. However, geospatial indexes support much faster queries than the unindexed equivalents. Before 2.2.3, a geospatial index *must* exist on a field holding coordinates before using any of the geospatial query operators.

## \$polygon

### \$polygon

New in version 1.9.

The [\\$polygon](#) (page 642) operator specifies a polygon for a [geospatial \\$geoWithin](#) (page 635) query on legacy coordinate pairs. The query returns pairs that are within the bounds of the polygon. The operator does *not* query for GeoJSON objects.

The [\\$polygon](#) (page 642) operator calculates distances using flat (planar) geometry.

The 2d geospatial index supports the [\\$polygon](#) (page 642) operator.

To define the polygon, specify an array of coordinate points. Use the following syntax:

```
{ <location field> : { $geoWithin : { $polygon : [[<x1> , <y1>] ,
 [<x2> , <y2>] ,
 [<x3> , <y3>]] } } }
```

---

**Important:** If you use longitude and latitude, specify **longitude first**.

---

The last point specified is always implicitly connected to the first. You can specify as many points, and therefore sides, as you like.

The following query returns all documents that have coordinates that exist within the polygon defined by [ 0 , 0 ], [ 3 , 6 ], and [ 6 , 0 ]:

```
db.places.find({ loc : { $geoWithin : { $polygon : [[0 , 0] ,
 [3 , 6] ,
 [6 , 0]] } } })
```

Changed in version 2.2.3: Applications can use [\\$polygon](#) (page 642) *without* having a geospatial index. However, geospatial indexes support much faster queries than the unindexed equivalents. Before 2.2.3, a geospatial index *must* exist on a field holding coordinates before using any of the geospatial query operators.

**\$uniqueDocs****\$uniqueDocs**

New in version 2.0.

The [\\$uniqueDocs](#) (page 643) operator returns a document only once for a [geospatial](#) query if the document matches the query multiple times. A document might match a query multiple times if the documents contains multiple coordinate values.

You can use [\\$uniqueDocs](#) (page 643) only with the [\\$geoWithin](#) (page 635) and [\\$near](#) (page 637) operators. The 2d geospatial index supports [\\$uniqueDocs](#) (page 643).

---

**Example**

Given a collection of addresses with documents in the following form:

```
{ addrs : [{ name : "H" , loc : [55.5 , 42.3] } , { name : "W" , loc : [32.3 , 44.2] }] }
```

The following query would return the same document multiple times:

```
db.list.find({ "addrs.loc" : { $geoWithin : { $box : [[0 , 0] , [100 , 100]] } } })
```

The following query would return each matching document only once:

```
db.list.find({ "addrs.loc" : { $geoWithin : { $box : [[0 , 0] , [100 , 100]] } } } , $uniqueDocs : true)
```

---

**Note:** If you specify a value of `false` for [\\$uniqueDocs](#) (page 643), MongoDB will return multiple instances of a single document.

---

**Geospatial Query Compatibility** While numerous combinations of query operators are possible, the following table shows the recommended operators for different types of queries. The table uses the [\\$geoWithin](#) (page 635), [\\$geoIntersects](#) (page 637) and [\\$near](#) (page 637) operators.

| Query Document                                                                            | Geometry of the Query Condition | Surface Type for Query Calculation | Units for Query Calculation | Supported by this Index            |
|-------------------------------------------------------------------------------------------|---------------------------------|------------------------------------|-----------------------------|------------------------------------|
| <b>Returns points, lines and polygons</b>                                                 |                                 |                                    |                             |                                    |
| { \$geoWithin : {<br>\$geometry : <GeoJSON Polygon><br>} }                                | polygon                         | sphere                             | meters                      | 2dsphere                           |
| { \$geoIntersects : {<br>\$geometry : <GeoJSON><br>} }                                    | point, line or polygon          | sphere                             | meters                      | 2dsphere                           |
| { \$near : {<br>\$geometry : <GeoJSON Point>,<br>\$maxDistance : d<br>} }                 | point                           | sphere                             | meters                      | 2dsphere<br>The index is required. |
| <b>Returns points only</b>                                                                |                                 |                                    |                             |                                    |
| { \$geoWithin : {<br>\$box : [[x1, y1], [x2, y2]]<br>} }                                  | rectangle                       | flat                               | flat units                  | 2d                                 |
| { \$geoWithin : {<br>\$polygon : [[x1, y1],<br>[x1, y2],<br>[x2, y2],<br>[x2, y1]]<br>} } | polygon                         | flat                               | flat units                  | 2d                                 |
| { \$geoWithin : {<br>\$center : [[x1, y1], r]<br>} }                                      | circular region                 | flat                               | flat units                  | 2d                                 |
| { \$geoWithin : {<br>\$centerSphere :<br>[[x, y], radius]<br>} }                          | circular region                 | sphere                             | radians                     | 2d<br>2dsphere                     |
| { \$near : [x1, y1],<br>\$maxDistance : d<br>}                                            | point                           | flat / flat units                  | flat units                  | 2d<br>The index is required.       |

**Array**

|                             | Name                                   | Description                                                                                                                 |
|-----------------------------|----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| <b>Query Operator Array</b> | <a href="#">\$all (page 645)</a>       | Matches arrays that contain all elements specified in the query.                                                            |
|                             | <a href="#">\$elemMatch (page 645)</a> | Selects documents if element in the array field matches all the specified <a href="#">\$elemMatch (page 645)</a> condition. |
|                             | <a href="#">\$size (page 646)</a>      | Selects documents if the array field is a specified size.                                                                   |

**\$all****\$all1**

*Syntax:* { field: { \$all: [ <value> , <value1> ... ] } }

[\\$all \(page 645\)](#) selects the documents where the `field` holds an array and contains all elements (e.g. `<value>`, `<value1>`, etc.) in the array.

Consider the following example:

```
db.inventory.find({ tags: { $all: ["appliances", "school", "book"] } })
```

This query selects all documents in the `inventory` collection where the `tags` field contains an array with the elements, `appliances`, `school`, and `book`.

Therefore, the above query will match documents in the `inventory` collection that have a `tags` field that hold *either* of the following arrays:

```
["school", "book", "bag", "headphone", "appliances"]
["appliances", "school", "book"]
```

The [\\$all \(page 645\)](#) operator exists to describe and specify arrays in MongoDB queries. However, you may use the [\\$all \(page 645\)](#) operator to select against a non-array `field`, as in the following example:

```
db.inventory.find({ qty: { $all: [50] } })
```

**However**, use the following form to express the same query:

```
db.inventory.find({ qty: 50 })
```

Both queries will select all documents in the `inventory` collection where the value of the `qty` field equals 50.

---

**Note:** In most cases, MongoDB does not treat arrays as sets. This operator provides a notable exception to this approach.

In the current release queries that use the [\\$all \(page 645\)](#) operator must scan all the documents that match the first element in the query array. As a result, even with an index to support the query, the operation may be long running, particularly when the first element in the array is not very selective.

---

**See also:**

[find \(\)](#) (page 816), [update \(\)](#) (page 849), and [\\$set \(page 655\)](#).

**\$elemMatch (query) See also:**

[\\$elemMatch \(projection\)](#) (page 648)

**\$elemMatch**

New in version 1.4.

The [\\$elemMatch \(page 645\)](#) operator matches more than one component within an array element. For example,

```
db.collection.find({ array: { $elemMatch: { value1: 1, value2: { $gt: 1 } } } });
```

returns all documents in `collection` where the array `array` satisfies all of the conditions in the `$elemMatch` (page 645) expression, or where the value of `value1` is 1 and the value of `value2` is greater than 1. Matching arrays must have at least one element that matches all specified criteria. Therefore, the following document would not match the above query:

```
{ array: [{ value1:1, value2:0 }, { value1:2, value2:2 }] }
```

while the following document would match this query:

```
{ array: [{ value1:1, value2:0 }, { value1:1, value2:2 }] }
```

## \$size

### \$size

The `$size` (page 646) operator matches any array with the number of elements specified by the argument. For example:

```
db.collection.find({ field: { $size: 2 } });
```

returns all documents in `collection` where `field` is an array with 2 elements. For instance, the above expression will return `{ field: [ red, green ] }` and `{ field: [ apple, lime ] }` but *not* `{ field: fruit }` or `{ field: [ orange, lemon, grapefruit ] }`. To match fields with only one element within an array use `$size` (page 646) with a value of 1, as follows:

```
db.collection.find({ field: { $size: 1 } });
```

`$size` (page 646) does not accept ranges of values. To select documents based on fields with different numbers of elements, create a counter field that you increment when you add elements to a field.

Queries cannot use indexes for the `$size` (page 646) portion of a query, although the other portions of a query can use indexes if applicable.

## Projection Operators

|                      | Name                   | Description                                                                                                             |
|----------------------|------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Projection Operators | \$ (page 646)          | Projects the first element in an array that matches the query condition.                                                |
|                      | \$elemMatch (page 648) | Projects only the first element from an array that matches the specified <code>\$elemMatch</code> (page 648) condition. |
|                      | \$slice (page 650)     | Limits the number of elements projected from an array. Supports skip and limit slices.                                  |

## \$ (projection)

### \$

The positional `$` (page 646) operator limits the contents of the `<array>` field that is included in the query results to contain the **first** matching element. To specify an array element to update, see the *positional \$ operator for updates* (page 656).

Used in the `projection` document of the `find()` (page 816) method or the `findOne()` (page 824) method:

- The `$` (page 646) projection operator limits the content of the `<array>` field to the **first** element that matches the `query document` (page 68).
- The `<array>` field **must** appear in the `query document` (page 68)

---

```
db.collection.find({ <array>: <value> ... },
 { "<array>.$": 1 })
db.collection.find({ <array.field>: <value> ... },
 { "<array>.$": 1 })
```

The `<value>` can be documents that contains [query operator expressions](#) (page 621).

- Only **one** positional `$` (page 646) operator can appear in the projection document.
- Only **one** array field can appear in the [query document](#) (page 68); i.e. the following query is **incorrect**:

```
db.collection.find({ <array>: <value>, <someOtherArray>: <value2> },
 { "<array>.$": 1 })
```

---

### Example

A collection `students` contains the following documents:

```
{ "_id" : 1, "semester" : 1, "grades" : [70, 87, 90] }
{ "_id" : 2, "semester" : 1, "grades" : [90, 88, 92] }
{ "_id" : 3, "semester" : 1, "grades" : [85, 100, 90] }
{ "_id" : 4, "semester" : 2, "grades" : [79, 85, 80] }
{ "_id" : 5, "semester" : 2, "grades" : [88, 88, 92] }
{ "_id" : 6, "semester" : 2, "grades" : [95, 90, 96] }
```

In the following query, the projection `{ "grades.$": 1 }` returns only the first element greater than or equal to 85 for the `grades` field.

```
db.students.find({ semester: 1, grades: { $gte: 85 } },
 { "grades.$": 1 })
```

The operation returns the following documents:

```
{ "_id" : 1, "grades" : [87] }
{ "_id" : 2, "grades" : [90] }
{ "_id" : 3, "grades" : [85] }
```

Although the array field `grades` may contain multiple elements that are greater than or equal to 85, the `$` (page 646) projection operator returns only the first matching element from the array.

---

**Important:** When the `find()` (page 816) method includes a `sort()` (page 872), the `find()` (page 816) method applies the `sort()` (page 872) to order the matching documents **before** it applies the positional `$` (page 646) projection operator.

---

If an array field contains multiple documents with the same field name and the `find()` (page 816) method includes a `sort()` (page 872) on that repeating field, the returned documents may not reflect the sort order because the sort was applied to the elements of the array before the `$` (page 646) projection operator.

---

### Example

A `students` collection contains the following documents where the `grades` field is an array of documents; each document contain the three field names `grade`, `mean`, and `std`:

```
{ "_id" : 7, semester: 3, "grades" : [{ grade: 80, mean: 75, std: 8 },
 { grade: 85, mean: 90, std: 5 },
 { grade: 90, mean: 85, std: 3 }] }
{ "_id" : 8, semester: 3, "grades" : [{ grade: 92, mean: 88, std: 8 },
 { grade: 88, mean: 85, std: 5 },
 { grade: 95, mean: 90, std: 3 }] }
```

```
{ "grade": 78, "mean": 90, "std": 5 },
{ "grade": 88, "mean": 85, "std": 3 }] }
```

In the following query, the projection `{ "grades.$": 1 }` returns only the first element with the mean greater than 70 for the `grades` field. The query also includes a `sort()` (page 872) to order by ascending `grades.grade` field:

```
db.students.find({ "grades.mean": { $gt: 70 } },
 { "grades.$": 1 }
).sort({ "grades.grade": 1 })
```

The `find()` (page 816) method sorts the matching documents **before** it applies the `$` (page 646) projection operator on the `grades` array. Thus, the results with the projected array elements do not reflect the ascending `grades.grade` sort order:

```
{ "_id" : 8, "grades" : [{ "grade" : 92, "mean" : 88, "std" : 8 }] }
{ "_id" : 7, "grades" : [{ "grade" : 80, "mean" : 75, "std" : 8 }] }
```

---

**Note:** Since only **one** array field can appear in the query document, if the array contains documents, to specify criteria on multiple fields of these documents, use the `$elemMatch (query)` (page 645) operator, e.g.:

```
db.students.find({ grades: { $elemMatch: {
 mean: { $gt: 70 },
 grade: { $gt: 90 }
 } } },
 { "grades.$": 1 })
```

---

## See also:

`$elemMatch (projection)` (page 648)

## `$elemMatch (projection)` See also:

`$elemMatch (query)` (page 645)

### `$elemMatch`

New in version 2.2.

The `$elemMatch` (page 648) projection operator limits the contents of an array field that is included in the query results to contain only the array element that matches the `$elemMatch` (page 648) condition.

#### Note:

- The elements of the array are documents.
- If multiple elements match the `$elemMatch` (page 648) condition, the operator returns the **first** matching element in the array.
- The `$elemMatch` (page 648) projection operator is similar to the positional `$` (page 646) projection operator.

---

The examples on the `$elemMatch` (page 648) projection operator assumes a collection `school` with the following documents:

```
{
 _id: 1,
 zipcode: 63109,
 students: [
```

```

 { name: "john", school: 102, age: 10 },
 { name: "jess", school: 102, age: 11 },
 { name: "jeff", school: 108, age: 15 }
]
}
{
 _id: 2,
 zipcode: 63110,
 students: [
 { name: "ajax", school: 100, age: 7 },
 { name: "achilles", school: 100, age: 8 },
]
}
{
 _id: 3,
 zipcode: 63109,
 students: [
 { name: "ajax", school: 100, age: 7 },
 { name: "achilles", school: 100, age: 8 },
]
}
{
 _id: 4,
 zipcode: 63109,
 students: [
 { name: "barney", school: 102, age: 7 },
]
}

```

---

### Example

The following `find()` (page 816) operation queries for all documents where the value of the `zipcode` field is 63109. The `$elemMatch` (page 648) projection returns only the **first** matching element of the `students` array where the `school` field has a value of 102:

```
db.schools.find({ zipcode: 63109 },
 { students: { $elemMatch: { school: 102 } } })
```

The operation returns the following documents:

```
{ "_id" : 1, "students" : [{ "name" : "john", "school" : 102, "age" : 10 }] }
{ "_id" : 3 }
{ "_id" : 4, "students" : [{ "name" : "barney", "school" : 102, "age" : 7 }] }
```

- For the document with `_id` equal to 1, the `students` array contains multiple elements with the `school` field equal to 102. However, the `$elemMatch` (page 648) projection returns only the first matching element from the array.
- The document with `_id` equal to 3 does not contain the `students` field in the result since no element in its `students` array matched the `$elemMatch` (page 648) condition.

---

The `$elemMatch` (page 648) projection can specify criteria on multiple fields:

---

### Example

The following `find()` (page 816) operation queries for all documents where the value of the `zipcode` field is 63109. The projection includes the `first` matching element of the `students` array where the `school` field has a value of 102 **and** the `age` field is greater than 10:

```
db.schools.find({ zipcode: 63109 },
 { students: { $elemMatch: { school: 102, age: { $gt: 10 } } } })
```

The operation returns the three documents that have `zipcode` equal to 63109:

```
{ "_id" : 1, "students" : [{ "name" : "jess", "school" : 102, "age" : 11 }] }
{ "_id" : 3 }
{ "_id" : 4 }
```

Documents with `_id` equal to 3 and `_id` equal to 4 do not contain the `students` field since no element matched the `$elemMatch` (page 648) criteria.

---

When the `find()` (page 816) method includes a `sort()` (page 872), the `find()` (page 816) method applies the `sort()` (page 872) to order the matching documents **before** it applies the projection.

If an array field contains multiple documents with the same field name and the `find()` (page 816) method includes a `sort()` (page 872) on that repeating field, the returned documents may not reflect the sort order because the `sort()` (page 872) was applied to the elements of the array before the `$elemMatch` (page 648) projection.

---

### Example

The following query includes a `sort()` (page 872) to order by descending `students.age` field:

```
db.schools.find(
 { zipcode: 63109 },
 { students: { $elemMatch: { school: 102 } } }
).sort({ "students.age": -1 })
```

The operation applies the `sort()` (page 872) to order the documents that have the field `zipcode` equal to 63109 and then applies the projection. The operation returns the three documents in the following order:

```
{ "_id" : 1, "students" : [{ "name" : "john", "school" : 102, "age" : 10 }] }
{ "_id" : 3 }
{ "_id" : 4, "students" : [{ "name" : "barney", "school" : 102, "age" : 7 }] }
```

---

### See also:

`$ (projection)` (page 646) operator

### `$slice (projection)`

#### `$slice`

The `$slice` (page 650) operator controls the number of items of an array that a query returns. For information on limiting the size of an array during an update with `$push` (page 659), see the `$slice` (page 661) modifier instead.

Consider the following prototype query:

```
db.collection.find({ field: value }, { array: { $slice: count } });
```

This operation selects the document `collection` identified by a field named `field` that holds `value` and returns the number of elements specified by the value of `count` from the array stored in the `array` field. If `count` has a value greater than the number of elements in `array` the query returns all elements of the array.

`$slice` (page 650) accepts arguments in a number of formats, including negative values and arrays. Consider the following examples:

```
db.posts.find({}, { comments: { $slice: 5 } })
```

Here, `$slice` (page 650) selects the first five items in an array in the `comments` field.

```
db.posts.find({}, { comments: { $slice: -5 } })
```

This operation returns the last five items in array.

The following examples specify an array as an argument to `$slice` (page 650). Arrays take the form of `[ skip, limit ]`, where the first value indicates the number of items in the array to skip and the second value indicates the number of items to return.

```
db.posts.find({}, { comments: { $slice: [20, 10] } })
```

Here, the query will only return 10 items, after skipping the first 20 items of that array.

```
db.posts.find({}, { comments: { $slice: [-20, 10] } })
```

This operation returns 10 items as well, beginning with the item that is 20th from the last item of the array.

## Update Operators

### Update Operators

#### Fields

#### Field Update Operators

| Name                                  | Description                                                                                                                                |
|---------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| <code>\$inc</code> (page 651)         | Increments the value of the field by the specified amount.                                                                                 |
| <code>\$rename</code> (page 652)      | Renames a field.                                                                                                                           |
| <code>\$setOnInsert</code> (page 654) | Sets the value of a field upon documentation creation during an upsert. Has no effect on update operations that modify existing documents. |
| <code>\$set</code> (page 655)         | Sets the value of a field in an existing document.                                                                                         |
| <code>\$unset</code> (page 655)       | Removes the specified field from an existing document.                                                                                     |

#### `$inc`

#### `$inc`

The `$inc` (page 651) operator increments a value of a field by a specified amount. If the field does not exist, `$inc` (page 651) sets the field to the specified amount. `$inc` (page 651) accepts positive and negative incremental amounts.

The following example increments the value of `field1` by the value of `amount` for the *first* matching document in the collection where `field` equals `value`:

```
db.collection.update({ field: value },
 { $inc: { field1: amount } });
```

To update all matching documents in the collection, specify `multi:true` in the `update()` (page 849) method:

```
db.collection.update({ age: 20 }, { $inc: { age: 1 } }, { multi: true });
db.collection.update({ name: "John" }, { $inc: { age: 2 } }, { multi: true });
```

The first `update()` (page 849) operation increments the value of the `age` field by 1 for all documents in the collection that have an `age` field equal to 20. The second operation increments the value of the `age` field by 2 for all documents in the collection with the `name` field equal to "John".

## \$rename

### \$rename

New in version 1.7.2.

**Syntax:** `{ $rename: { <old name1>: <new name1>, <old name2>: <new name2>, ... } }`

The `$rename` (page 652) operator updates the name of a field. The new field name must differ from the existing field name.

Consider the following example:

```
db.students.update({ _id: 1 }, { $rename: { 'nickname': 'alias', 'cell': 'mobile' } })
```

This operation renames the field `nickname` to `alias`, and the field `cell` to `mobile`.

If the document already has a field with the *new* field name, the `$rename` (page 652) operator removes that field and renames the field with the *old* field name to the *new* field name.

The `$rename` (page 652) operator will expand arrays and sub-documents to find a match for field names. When renaming a field in a sub-document to another sub-document or to a regular field, the sub-document itself remains.

Consider the following examples involving the sub-document of the following document:

```
{ "_id": 1,
 "alias": ["The American Cincinnatus", "The American Fabius"],
 "mobile": "555-555-5555",
 "nmae": { "first": "george", "last": "washington" }
}
```

- To rename a sub-document, call the `$rename` (page 652) operator with the name of the sub-document as you would any other field:

```
db.students.update({ _id: 1 }, { $rename: { "nmae": "name" } })
```

This operation renames the sub-document `nmae` to `name`:

```
{ "_id": 1,
 "alias": ["The American Cincinnatus", "The American Fabius"],
 "mobile": "555-555-5555",
 "name": { "first": "george", "last": "washington" }
}
```

- To rename a field within a sub-document, call the `$rename` (page 652) operator using the *dot notation* (page 94) to refer to the field. Include the name of the sub-document in the new field name to ensure the field remains in the sub-document:

```
db.students.update({ _id: 1 }, { $rename: { "name.first": "name.fname" } })
```

This operation renames the sub-document field `first` to `fname`:

```
{ "_id": 1,
 "alias": ["The American Cincinnatus", "The American Fabius"],
 "mobile": "555-555-5555",
 "name": { "first": "george", "last": "washington" }
}
```

```

 "name" : { "fname" : "george", "last" : "washington" }
}

```

- To rename a field within a sub-document and move it to another sub-document, call the `$rename` (page 652) operator using the *dot notation* (page 94) to refer to the field. Include the name of the new sub-document in the new name:

```
db.students.update({ _id: 1 }, { $rename: { "name.last": "contact.lname" } })
```

This operation renames the sub-document field `last` to `lname` and moves it to the sub-document `contact`:

```

{ "_id" : 1,
 "alias" : ["The American Cincinnatus", "The American Fabius"],
 "contact" : { "lname" : "washington" },
 "mobile" : "555-555-5555",
 "name" : { "fname" : "george" }
}

```

If the new field name does not include a sub-document name, the field moves out of the subdocument and becomes a regular document field.

Consider the following behavior when the specified old field name does not exist:

- When renaming a single field and the existing field name refers to a non-existing field, the `$rename` (page 652) operator does nothing, as in the following:

```
db.students.update({ _id: 1 }, { $rename: { 'wife': 'spouse' } })
```

This operation does nothing because there is no field named `wife`.

- When renaming multiple fields and **all** of the old field names refer to non-existing fields, the `$rename` (page 652) operator does nothing, as in the following:

```
db.students.update({ _id: 1 }, { $rename: { 'wife': 'spouse',
 'vice': 'vp',
 'office': 'term' } })
```

This operation does nothing because there are no fields named `wife`, `vice`, and `office`.

- When renaming multiple fields and **some** but not all old field names refer to non-existing fields, the `$rename` (page 652) operator performs the following operations:

Changed in version 2.2.

– Renames the fields that exist to the specified new field names.

– Ignores the non-existing fields.

Consider the following query that renames both an existing field `mobile` and a non-existing field `wife`. The field named `wife` does not exist and `$rename` (page 652) sets the field to a name that already exists `alias`.

```
db.students.update({ _id: 1 }, { $rename: { 'wife': 'alias',
 'mobile': 'cell' } })
```

This operation renames the `mobile` field to `cell`, and has no other impact action occurs.

```

{ "_id" : 1,
 "alias" : ["The American Cincinnatus", "The American Fabius"],
 "cell" : "555-555-5555",
}

```

```
"name" : { "lname" : "washington" },
"places" : { "d" : "Mt Vernon", "b" : "Colonial Beach" }
}
```

---

**Note:** Before version 2.2, when renaming multiple fields and only some (but not all) old field names refer to non-existing fields:

–For the fields with the old names that do exist, the `$rename` (page 652) operator renames these fields to the specified new field names.

–For the fields with the old names that do **not** exist:

\***if** no field exists with the new field name, the `$rename` (page 652) operator does nothing.

\***if** fields already exist with the new field names, the `$rename` (page 652) operator drops these fields.

Consider the following operation that renames both the field `mobile`, which exists, and the field `wife`, which does not exist. The operation tries to set the field named `wife` to `alias`, which is the name of an existing field:

```
db.students.update({ _id: 1 }, { $rename: { 'wife': 'alias', 'mobile': 'cell' } })
```

Before 2.2, the operation renames the field `mobile` to `cell` *and* drops the `alias` field even though the field `wife` does not exist:

```
{ "_id" : 1,
 "cell" : "555-555-5555",
 "name" : { "lname" : "washington" },
 "places" : { "d" : "Mt Vernon", "b" : "Colonial Beach" }
}
```

---

## \$setOnInsert

### \$setOnInsert

New in version 2.4.

The `$setOnInsert` (page 654) operator assigns values to fields during an `upsert` (page 849) **only** when using the `upsert` option to the `update()` (page 849) operation performs an insert.

```
db.collection.update(<query>,
 { $setOnInsert: { <field1>: <value1>, ... } },
 { upsert: true }
)
```

---

### Example

A collection named `products` contains no documents.

Then, the following `upsert` (page 849) operation performs an insert and applies the `$setOnInsert` (page 654) to set the field `defaultQty` to 100:

```
db.products.update(
 { _id: 1 },
 { $setOnInsert: { defaultQty: 100 } },
 { upsert: true }
)
```

The `products` collection contains the newly-inserted document:

---

```
{ "_id" : 1, "defaultQty" : 100 }
```

---

**Note:** The `$setOnInsert` (page 654) operator only affects `update()` (page 849) operations with the `upsert` flag that perform an `insert` (page 50).

If the `update()` (page 849) has the `upsert` flag and performs an `update` (page 50), `$setOnInsert` (page 654) has no effect.

---

### Example

A collection named `products` has the following document:

```
{ "_id" : 1, "defaultQty" : 100 }
```

The following `update()` (page 849) with the `upsert` flag operation performs an update:

```
db.products.update(
 { _id: 1 },
 { $setOnInsert: { defaultQty: 500, inStock: true },
 $set: { item: "apple" },
 { upsert: true }
)
```

Because the `update()` (page 849) with `upsert` operation only performs an update, MongoDB ignores the `$setOnInsert` (page 654) operation and only applies the `$set` (page 655) operation.

The `products` collection now contains the following modified document:

```
{ "_id" : 1, "defaultQty" : 100, "item" : "apple" }
```

---

### \$set

#### \$set

Use the `$set` (page 655) operator to set a particular value. The `$set` (page 655) operator requires the following syntax:

```
db.collection.update({ field: value1 }, { $set: { field1: value2 } });
```

This statement updates in the document in `collection` where `field` matches `value1` by replacing the value of the field `field1` with `value2`. This operator will add the specified field or fields if they do not exist in this document *or* replace the existing value of the specified field(s) if they already exist.

### \$unset

#### \$unset

The `$unset` (page 655) operator deletes a particular field. Consider the following example:

```
db.collection.update({ field: value1 }, { $unset: { field1: "" } });
```

The above example deletes `field1` in `collection` from documents where `field` has a value of `value1`. The value of the field in the `$unset` (page 655) statement (i.e. `""` above) does not impact the operation.

If documents match the initial query (e.g. `{ field: value1 }` above) but do not have the field specified in the `$unset` (page 655) operation (e.g. `field1`), then the statement has no effect on the document.

## Array

## Array Update Operators

### Update Operators

| Name                                  | Description                                                                                     |
|---------------------------------------|-------------------------------------------------------------------------------------------------|
| <a href="#">\$ (page 656)</a>         | Acts as a placeholder to update the first element that matches the query condition in an array. |
| <a href="#">\$addToSet (page 657)</a> | Adds elements to an existing array only if they do not already exist in the set.                |
| <a href="#">\$pop (page 657)</a>      | Removes the first or last item of an array.                                                     |
| <a href="#">\$pullAll (page 658)</a>  | Removes multiple values from an array.                                                          |
| <a href="#">\$pull (page 658)</a>     | Removes items from an array that match a query statement.                                       |
| <a href="#">\$pushAll (page 659)</a>  | <i>Deprecated.</i> Adds several items to an array.                                              |
| <a href="#">\$push (page 659)</a>     | Adds an item to an array.                                                                       |

#### \$ (query)

**\$**

Syntax: { "<array>.\$" : value }

The positional \$ (page 656) operator identifies an element in an array field to update without explicitly specifying the position of the element in the array. To project, or return, an array element from a read operation, see the \$ (page 646) projection operator.

When used with the [update \(\)](#) (page 849) method,

- the positional \$ (page 656) operator acts as a placeholder for the **first** element that matches the [query document](#) (page 68), and
- the array field **must** appear as part of the query document.

```
db.collection.update({ <array>: value ... }, { <update operator>: { "<array>.$" : value } })
```

Consider a collection students with the following documents:

```
{ "_id" : 1, "grades" : [80, 85, 90] }
{ "_id" : 2, "grades" : [88, 90, 92] }
{ "_id" : 3, "grades" : [85, 100, 90] }
```

To update 80 to 82 in the grades array in the first document, use the positional \$ (page 656) operator if you do not know the position of the element in the array:

```
db.students.update({ _id: 1, grades: 80 }, { $set: { "grades.$" : 82 } })
```

Remember that the positional \$ (page 656) operator acts as a placeholder for the **first match** of the update [query document](#) (page 68).

The positional \$ (page 656) operator facilitates updates to arrays that contain embedded documents. Use the positional \$ (page 656) operator to access the fields in the embedded documents with the [dot notation](#) (page 94) on the \$ (page 656) operator.

```
db.collection.update({ <query selector> }, { <update operator>: { "array.$field" : value } })
```

Consider the following document in the students collection whose grades field value is an array of embedded documents:

```
{ "_id" : 4, "grades" : [{ grade: 80, mean: 75, std: 8 },
 { grade: 85, mean: 90, std: 5 },
 { grade: 90, mean: 85, std: 3 }] }
```

Use the positional `$` (page 656) operator to update the value of the `std` field in the embedded document with the grade of 85:

```
db.students.update({ _id: 4, "grades.grade": 85 }, { $set: { "grades.$.std" : 6 } })
```

---

**Note:**

- Do not use the positional operator `$` (page 656) with `upsert` operations because inserts will use the `$` as a field name in the inserted document.
- When used with the `$unset` (page 655) operator, the positional `$` (page 656) operator does not remove the matching element from the array but rather sets it to null.

---

**See also:**

`update()` (page 849), `$set` (page 655) and `$unset` (page 655)

## \$addToSet

### \$addToSet

The `$addToSet` (page 657) operator adds a value to an array only *if* the value is *not* in the array already. If the value *is* in the array, `$addToSet` (page 657) returns without modifying the array. Consider the following example:

```
db.collection.update({ <field>: <value> }, { $addToSet: { <field>: <addition> } });
```

Here, `$addToSet` (page 657) appends `<addition>` to the array stored in `<field>` that includes the element `<value>`, *only if* `<addition>` is not already a member of this array.

---

**Note:** `$addToSet` (page 657) only ensures that there are no duplicate items *added* to the set and does not affect existing duplicate elements. `$addToSet` (page 657) does not guarantee a particular ordering of elements in the modified set.

Use the `$each` (page 660) modifier with the `$addToSet` (page 657) operator to add multiple values to an array `<field>` if the values do not exist in the `<field>`.

```
db.collection.update(<query>,
 {
 $addToSet: { <field>: { $each: [<value1>, <value2> ...] } }
 }
)
```

---

**See also:**

`$push` (page 659)

## \$pop

### \$pop

The `$pop` (page 657) operator removes the first or last element of an array. Pass `$pop` (page 657) a value of `1` to remove the last element in an array and a value of `-1` to remove the first element of an array. Consider the following syntax:

```
db.collection.update({ field: value }, { $pop: { field: 1 } });
```

This operation removes the last item of the array in `field` in the document that matches the query statement `{ field: value }`. The following example removes the *first* item of the same array:

```
db.collection.update({field: value}, { $pop: { field: -1 } });
```

Be aware of the following `$pop` (page 657) behaviors:

- The `$pop` (page 657) operation fails if `field` is not an array.
- `$pop` (page 657) will successfully remove the last item in an array. `field` will then hold an empty array.

New in version 1.1.

## **\$pullAll**

### **\$pullAll**

The `$pullAll` (page 658) operator removes multiple values from an existing array. `$pullAll` (page 658) provides the inverse operation of the `$pushAll` (page 659) operator. Consider the following example:

```
db.collection.update({ field: value}, { $pullAll: { field1: [value1, value2, value3] } });
```

Here, `$pullAll` (page 658) removes `[ value1, value2, value3 ]` from the array in `field1`, in the document that matches the query statement `{ field: value }` in `collection`.

## **\$pull**

### **\$pull**

The `$pull` (page 658) operator removes all instances of a value from an existing array, as in the following prototype:

```
db.collection.update({ field: <query> }, { $pull: { field: <query> } });
```

`$pull` (page 658) removes items from the array in the field named `field` that match the query in the `$pull` (page 658) statement.

If a value (i.e. `<value>`) exists multiple times in an array, `$pull` (page 658) will remove all instances of the value.

---

### **Example**

Given the following document in the `cpuinfo` collection:

```
{ flags: ['vme', 'de', 'pse', 'tsc', 'msr', 'pae', 'mce'] }
```

The following operation will remove the `msr` value from the `flags` array:

```
db.cpuinfo.update({ flags: 'msr' }, { $pull: { flags: 'msr' } })
```

---

### **Example**

Given the following document in the `profiles` collection:

```
{ votes: [3, 5, 6, 7, 7, 8] }
```

The following operation will remove all occurrences of 7 from the `votes` array.

```
db.profiles.update({ votes: 3 }, { $pull: { votes: 7 } })
```

---

Therefore, the `votes` array would resemble the following:

```
{ votes: [3, 5, 6, 8] }
```

Conversely, the following operation will remove all items from the array that are larger than 6:

---

```
db.profiles.update({ votes: 3 }, { $pull: { votes: { $gt: 6 } } })
```

Therefore, the `votes` array would resemble the following:

```
{ votes: [3, 5] }
```

---

## \$pushAll

### \$pushAll

Deprecated since version 2.4: Use the [\\$push](#) (page 659) operator with [\\$each](#) (page 660) instead.

The [\\$pushAll](#) (page 659) operator is similar to the [\\$push](#) (page 659) but adds the ability to append several values to an array at once.

```
db.collection.update({ field: value }, { $pushAll: { field1: [value1, value2, value3] } });
```

Here, [\\$pushAll](#) (page 659) appends the values in `[ value1, value2, value3 ]` to the array in `field1` in the document matched by the statement `{ field: value }` in `collection`.

If you specify a single value, [\\$pushAll](#) (page 659) will behave as [\\$push](#) (page 659).

## \$push

### \$push

The [\\$push](#) (page 659) operator appends a specified value to an array.

```
db.collection.update(<query>,
 { $push: { <field>: <value> } }
)
```

The following example appends 89 to the `scores` array for the first document where the `name` field equals `joe`:

```
db.students.update(
 { name: "joe" },
 { $push: { scores: 89 } }
)
```

---

#### Note:

- If the field is absent in the document to update, [\\$push](#) (page 659) adds the array field with the value as its element.
- If the field is **not** an array, the operation will fail.
- If the value is an array, [\\$push](#) (page 659) appends the whole array as a *single* element. To add each element of the value separately, use [\\$push](#) (page 659) with the [\\$each](#) (page 660) modifier.

The following example appends each element of `[ 90, 92, 85 ]` to the `scores` array for the document where the `name` field equals `joe`:

```
db.students.update(
 { name: "joe" },
 { $push: { scores: { $each: [90, 92, 85] } } }
)
```

Changed in version 2.4: MongoDB adds support for the [\\$each](#) (page 660) modifier to the [\\$push](#) (page 659) operator. Before 2.4, use [\\$pushAll](#) (page 659) for similar functionality.

Changed in version 2.4: You can use the `$push` (page 659) operator with the following modifiers:

- `$each` (page 660) appends multiple values to the array field,
- `$slice` (page 661), which is only available with `$each` (page 660), limits the number of array elements, and
- `$sort` (page 661), which is only available when used with *both* `$each` (page 660) and `$slice` (page 661), orders elements of the array. `$sort` (page 661) can only order array elements that are documents.

The following example uses:

- the `$each` (page 660) modifier to append documents to the `quizzes` array,
- the `$sort` (page 661) modifier to sort all the elements of the modified `quizzes` array by the ascending `score` field, and
- the `$slice` (page 661) modifier to keep only the **last** five sorted elements of the `quizzes` array.

```
db.students.update({ name: "joe" },
 { $push: { quizzes: { $each: [{ id: 3, score: 8 },
 { id: 4, score: 7 },
 { id: 5, score: 6 }],
 $sort: { score: 1 },
 $slice: -5
 }
}
)
```

## Update Operator Modifiers

| Name                               | Description                                                                                                                     |
|------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| <code>\$each</code><br>(page 660)  | Modifies the <code>\$push</code> (page 659) and <code>\$addToSet</code> (page 657) operators to append items for array updates. |
| <code>\$slice</code><br>(page 661) | Modifies the <code>\$push</code> (page 659) operator to limit the size of updated arrays.                                       |
| <code>\$sort</code><br>(page 661)  | Modifies the <code>\$push</code> (page 659) operator to reorder documents stored in an array.                                   |

### `$each`

**Note:** The `$each` (page 660) modifier is only used with the `$addToSet` (page 657) and `$push` (page 659) operators. See the documentation of `$addToSet` (page 657) and `$push` (page 659) for more information.

---

### `$each`

The `$each` (page 660) modifier is available for use with the `$addToSet` (page 657) operator and the `$push` (page 659) operator.

Use the `$each` (page 660) modifier with the `$addToSet` (page 657) operator to add multiple values to an array `<field>` if the values do not exist in the `<field>`.

```
db.collection.update(<query>,
 {
 $addToSet: { <field>: { $each: [<value1>, <value2> ...] } }
 }
)
```

Use the `$each` (page 660) modifier with the `$push` (page 659) operator to append multiple values to an array `<field>`.

```
db.collection.update(<query>,
 {
 $push: { <field>: { $each: [<value1>, <value2> ...] } }
 }
)
```

Changed in version 2.4: MongoDB adds support for the `$each` (page 660) modifier to the `$push` (page 659) operator.

## `$slice`

### `$slice`

New in version 2.4.

The `$slice` (page 661) modifier limits the number of array elements during a `$push` (page 659) operation. To project, or return, a specified number of array elements from a read operation, see the `$slice` (page 650) projection operator instead.

To use the `$slice` (page 661) modifier, it must appear with the `$each` (page 660) modifier, *and* the `$each` (page 660) modifier must be the first modifier for the `$push` (page 659) operation.

```
db.collection.update(<query>,
 {
 $push: {
 <field>: {
 $each: [<value1>, <value2>, ...],
 $slice: <num>
 }
 }
 }
)
```

The `<num>` is either a **negative** number or **zero**:

- If `<num>` is **negative**, the array `<field>` contains only the last `<num>` elements.
- If `<num>` is **zero**, the array `<field>` is an empty array.

```
db.students.update({ _id: 2 },
 {
 $push: { grades: {
 $each: [80, 78, 86],
 $slice: -5
 }
 }
)
```

## `$sort`

### `$sort`

New in version 2.4.

The `$sort` (page 661) modifier orders the elements of an array during a `$push` (page 659) operation. The elements of the array **must** be documents.

`$sort` (page 661) modifies `$push` (page 659) updates that use *both* the `$each` (page 660) and `$slice` (page 661) modifiers, where `$each` (page 660) is the first modifier for the `$push` (page 659) operation.

```
db.collection.update(<query>,
 {
 $push: {
 <field>: {

```

```
 $each: [<document1>,
 <document2>,
 ...
],
 $slice: <num>,
 $sort: <sort <document>,
 }
 }
)
}
```

---

**Important:** The `<sort <document>` only accesses the fields from the elements in the array and does **not** refer to the array `<field>`.

---

Consider the following example where the collection `students` contain the following document:

```
{ "_id": 3,
 "name": "joe",
 "quizzes": [
 { "id": 1, "score": 6 },
 { "id": 2, "score": 9 }
]
}
```

The following update appends additional documents to the `quizzes` array, sorts all the elements of the array by ascending `score` field, and slices the array to keep the last five elements:

```
db.students.update({ name: "joe" },
 { $push: { quizzes: { $each: [{ id: 3, score: 8 },
 { id: 4, score: 7 },
 { id: 5, score: 6 }],
 $sort: { score: 1 },
 $slice: -5
 }
 }
}
```

After the update, the array elements are in order of ascending `score` field.:.

```
{
 "_id": 3,
 "name": "joe",
 "quizzes": [
 { "id": 1, "score": 6 },
 { "id": 5, "score": 6 },
 { "id": 4, "score": 7 },
 { "id": 3, "score": 8 },
 { "id": 2, "score": 9 }
]
}
```

## Bitwise

| Bitwise Update Operator | Name                          | Description                                            |
|-------------------------|-------------------------------|--------------------------------------------------------|
|                         | <code>\$bit</code> (page 663) | Performs bitwise AND and OR updates of integer values. |

**\$bit****\$bit**

The [\\$bit](#) (page 663) operator performs a bitwise update of a field. Only use this with integer fields, as in the following examples:

```
db.collection.update({ field: NumberInt(1) }, { $bit: { field: { and: NumberInt(5) } } });
```

```
db.collection.update({ field: NumberInt(1) }, { $bit: { field: { or: NumberInt(5) } } });
```

Here, the [\\$bit](#) (page 663) operator updates the integer value of the field named `field`: in the first example with a bitwise `and: 5` operation; and in the second example with a bitwise `or: 5` operation. [\\$bit](#) (page 663) only works with integers.

[\\$bit](#) (page 663) only supports AND and OR bitwise operations.

---

**Note:** All numbers in the [mongo](#) (page 942) shell are doubles, not integers. Use the `NumberInt()` constructor to specify integers. See [NumberInt](#) (page 201) for more information.

---

**Isolation**

| Isolation Update Operator | Name                                  | Description                                                                   |
|---------------------------|---------------------------------------|-------------------------------------------------------------------------------|
|                           | <a href="#">\$isolated</a> (page 663) | Modifies behavior of multi-updates to improve the isolation of the operation. |

**\$isolated****\$isolated**

[\\$isolated](#) (page 663) isolation operator **isolates** a write operation that affects multiple documents from other write operations.

---

**Note:** The [\\$isolated](#) (page 663) isolation operator does **not** provide “all-or-nothing” atomicity for write operations.

---

Consider the following example:

```
db.foo.update({ field1 : 1 , $isolated : 1 }, { $inc : { field2 : 1 } } , { multi: true })
```

Without the [\\$isolated](#) (page 663) operator, multi-updates will allow other operations to interleave with these updates. If these interleaved operations contain writes, the update operation may produce unexpected results. By specifying [\\$isolated](#) (page 663) you can guarantee isolation for the entire multi-update.

**Warning:** [\\$isolated](#) (page 663) does not work with [sharded clusters](#).

**See also:**

See [db.collection.update\(\)](#) (page 849) for more information about the [db.collection.update\(\)](#) (page 849) method.

**\$atomic**

Deprecated since version 2.2: The [\\$isolated](#) (page 663) replaces [\\$atomic](#) (page 663).

**Aggregation Framework Operators**

New in version 2.2.

## Pipeline Operators

**Warning:** The pipeline cannot operate on values of the following types: Binary, Symbol, MinKey, MaxKey, DBRef, Code, and CodeWScope.

Pipeline operators appear in an array. Documents pass through the operators in a sequence.

| Name                                     | Description                                                                                                                                                             |
|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <a href="#">\$project<br/>(page 664)</a> | Reshapes a document stream. <a href="#">\$project</a> (page 664) can rename, add, or remove fields as well as create computed values and sub-documents.                 |
| <a href="#">\$match<br/>(page 666)</a>   | Filters the document stream, and only allows matching documents to pass into the next pipeline stage. <a href="#">\$match</a> (page 666) uses standard MongoDB queries. |
| <a href="#">\$limit<br/>(page 667)</a>   | Restricts the number of documents in an aggregation pipeline.                                                                                                           |
| <a href="#">\$skip<br/>(page 668)</a>    | Skips over a specified number of documents from the pipeline and returns the rest.                                                                                      |
| <a href="#">\$unwind<br/>(page 668)</a>  | Takes an array of documents and returns them as a stream of documents.                                                                                                  |
| <a href="#">\$group<br/>(page 669)</a>   | Groups documents together for the purpose of calculating aggregate values based on a collection of documents.                                                           |
| <a href="#">\$sort<br/>(page 670)</a>    | Takes all input documents and returns them in a stream of sorted documents.                                                                                             |
| <a href="#">\$geoNear<br/>(page 671)</a> | Returns an ordered stream of documents based on proximity to a geospatial point.                                                                                        |

| Name                                     | Description                                                                                                                                                             |
|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <a href="#">\$project<br/>(page 664)</a> | Reshapes a document stream. <a href="#">\$project</a> (page 664) can rename, add, or remove fields as well as create computed values and sub-documents.                 |
| <a href="#">\$match<br/>(page 666)</a>   | Filters the document stream, and only allows matching documents to pass into the next pipeline stage. <a href="#">\$match</a> (page 666) uses standard MongoDB queries. |
| <a href="#">\$limit<br/>(page 667)</a>   | Restricts the number of documents in an aggregation pipeline.                                                                                                           |
| <a href="#">\$skip<br/>(page 668)</a>    | Skips over a specified number of documents from the pipeline and returns the rest.                                                                                      |
| <a href="#">\$unwind<br/>(page 668)</a>  | Takes an array of documents and returns them as a stream of documents.                                                                                                  |
| <a href="#">\$group<br/>(page 669)</a>   | Groups documents together for the purpose of calculating aggregate values based on a collection of documents.                                                           |
| <a href="#">\$sort<br/>(page 670)</a>    | Takes all input documents and returns them in a stream of sorted documents.                                                                                             |
| <a href="#">\$geoNear<br/>(page 671)</a> | Returns an ordered stream of documents based on proximity to a geospatial point.                                                                                        |

### \$project (aggregation)

#### \$project

Reshapes a document stream by renaming, adding, or removing fields. Also use [\\$project](#) (page 664) to create computed values or sub-documents. Use [\\$project](#) (page 664) to:

- Include fields from the original document.
- Insert computed fields.
- Rename fields.

- Create and populate fields that hold sub-documents.

Use `$project` (page 664) to quickly select the fields that you want to include or exclude from the response. Consider the following aggregation framework operation.

```
db.article.aggregate(
 { $project : {
 title : 1 ,
 author : 1 ,
 } }
);
```

This operation includes the `title` field and the `author` field in the document that returns from the aggregation *pipeline*.

---

**Note:** The `_id` field is always included by default. You may explicitly exclude `_id` as follows:

```
db.article.aggregate(
 { $project : {
 _id : 0 ,
 title : 1 ,
 author : 1
 } }
);
```

Here, the projection excludes the `_id` field but includes the `title` and `author` fields.

---

Projections can also add computed fields to the document stream passing through the pipeline. A computed field can use any of the *expression operators* (page 673). Consider the following example:

```
db.article.aggregate(
 { $project : {
 title : 1,
 doctoredPageViews : { $add:["$pageViews", 10] }
 } }
);
```

Here, the field `doctoredPageViews` represents the value of the `pageViews` field after adding 10 to the original field using the `$add` (page 681).

---

**Note:** You must enclose the expression that defines the computed field in braces, so that the expression is a valid object.

---

You may also use `$project` (page 664) to rename fields. Consider the following example:

```
db.article.aggregate(
 { $project : {
 title : 1 ,
 page_views : "$pageViews" ,
 bar : "$other.foo"
 } }
);
```

This operation renames the `pageViews` field to `page_views`, and renames the `foo` field in the `other` sub-document as the top-level field `bar`. The field references used for renaming fields are direct expressions and do not use an operator or surrounding braces. All aggregation field references can use dotted paths to refer to fields in nested documents.

Finally, you can use the [\\$project](#) (page 664) to create and populate new sub-documents. Consider the following example that creates a new object-valued field named `stats` that holds a number of values:

```
db.article.aggregate(
 { $project : {
 title : 1 ,
 stats : {
 pv : "$pageViews",
 foo : "$other.foo",
 dpv : { $add:["$pageViews", 10] }
 }
 }
) ;
```

This projection includes the `title` field and places [\\$project](#) (page 664) into “inclusive” mode. Then, it creates the `stats` documents with the following fields:

- `pv` which includes and renames the `pageViews` from the top level of the original documents.
- `foo` which includes the value of `other.foo` from the original documents.
- `dpv` which is a computed field that adds 10 to the value of the `pageViews` field in the original document using the [\\$add](#) (page 681) aggregation expression.

## \$match (aggregation)

### \$match

[\\$match](#) (page 666) pipes the documents that match its conditions to the next operator in the pipeline.

The [\\$match](#) (page 666) query syntax is identical to the [read operation query](#) (page 68) syntax.

---

### Example

The following operation uses [\\$match](#) (page 666) to perform a simple equality match:

```
db.articles.aggregate(
 { $match : { author : "dave" } }
) ;
```

The [\\$match](#) (page 666) selects the documents where the `author` field equals `dave`, and the aggregation returns the following:

```
{ "result" : [
 {
 "_id" : ObjectId("512bc95fe835e68f199c8686"),
 "author": "dave",
 "score" : 80
 },
 { "_id" : ObjectId("512bc962e835e68f199c8687"),
 "author" : "dave",
 "score" : 85
 }
,
 "ok" : 1 }
```

---

### Example

The following example selects documents to process using the [\\$match](#) (page 666) pipeline operator and then pipes the results to the [\\$group](#) (page 669) pipeline operator to compute a count of the documents:

```
db.articles.aggregate([
 { $match : { score : { $gt : 70, $lte : 90 } } },
 { $group: { _id: null, count: { $sum: 1 } } }
]);
```

In the aggregation pipeline, `$match` (page 666) selects the documents where the `score` is greater than 70 and less than or equal to 90. These documents are then piped to the `$group` (page 669) to perform a count. The aggregation returns the following:

```
{
 "result" : [
 {
 "_id" : null,
 "count" : 3
 }
],
 "ok" : 1 }
```

**Note:**

- Place the `$match` (page 666) as early in the aggregation *pipeline* as possible. Because `$match` (page 666) limits the total number of documents in the aggregation pipeline, earlier `$match` (page 666) operations minimize the amount of processing down the pipe.
- If you place a `$match` (page 666) at the very beginning of a pipeline, the query can take advantage of `indexes` like any other `db.collection.find()` (page 816) or `db.collection.findOne()` (page 824).

New in version 2.4: `$match` (page 666) queries can support the geospatial `$geoWithin` (page 635) operations.

**Warning:** You cannot use `$where` (page 634) in `$match` (page 666) queries as part of the aggregation pipeline.

## \$limit (aggregation)

### \$limit

Restricts the number of *documents* that pass through the `$limit` (page 667) in the *pipeline*.

`$limit` (page 667) takes a single numeric (positive whole number) value as a parameter. Once the specified number of documents pass through the pipeline operator, no more will. Consider the following example:

```
db.article.aggregate(
 { $limit : 5 }
);
```

This operation returns only the first 5 documents passed to it from by the pipeline. `$limit` (page 667) has no effect on the content of the documents it passes.

**Note:** Changed in version 2.4: `$sort` (page 670) and memory requirements:

- When a `$sort` (page 670) immediately precedes a `$limit` (page 667) in the pipeline, the `$sort` (page 670) operation only maintains the top n results as it progresses, where n is the specified limit, and MongoDB only needs to store the number of items specified by `$limit` (page 667) in memory. Before MongoDB 2.4, `$sort` (page 670) would sort all the results in memory, and then limit the results to n results.

- Unless the [\\$sort](#) (page 670) operator can use an index or immediately precedes a [\\$limit](#) (page 667), the [\\$sort](#) (page 670) operation must fit within memory. Before MongoDB 2.4, unless the [\\$sort](#) (page 670) operator can use an index, the [\\$sort](#) (page 670) operation must fit within memory.

[\\$sort](#) (page 670) produces an error if the operation consumes 10 percent or more of RAM.

---

### \$skip (aggregation)

#### \$skip

Skips over the specified number of [documents](#) that pass through the [\\$skip](#) (page 668) in the [pipeline](#) before passing all of the remaining input.

[\\$skip](#) (page 668) takes a single numeric (positive whole number) value as a parameter. Once the operation has skipped the specified number of documents, it passes all the remaining documents along the [pipeline](#) without alteration. Consider the following example:

```
db.article.aggregate(
 { $skip : 5 }
)
```

This operation skips the first 5 documents passed to it by the pipeline. [\\$skip](#) (page 668) has no effect on the content of the documents it passes along the pipeline.

### \$unwind (aggregation)

#### \$unwind

Peels off the elements of an array individually, and returns a stream of documents. [\\$unwind](#) (page 668) returns one document for every member of the unwound array within every source document. Take the following aggregation command:

```
db.article.aggregate(
 { $project : {
 author : 1 ,
 title : 1 ,
 tags : 1
 } ,
 { $unwind : "$tags" }
)
```

---

**Note:** The dollar sign (i.e. \$) must proceed the field specification handed to the [\\$unwind](#) (page 668) operator.

---

In the above aggregation [\\$project](#) (page 664) selects (inclusively) the `author`, `title`, and `tags` fields, as well as the `_id` field implicitly. Then the pipeline passes the results of the projection to the [\\$unwind](#) (page 668) operator, which will unwind the `tags` field. This operation may return a sequence of documents that resemble the following for a collection that contains one document holding a `tags` field with an array of 3 items.

```
{
 "result" : [
 {
 "_id" : ObjectId("4e6e4ef557b77501a49233f6") ,
 "title" : "this is my title" ,
 "author" : "bob" ,
 "tags" : "fun"
 } ,
 {
 "_id" : ObjectId("4e6e4ef557b77501a49233f6") ,
 "title" : "another title" ,
 "author" : "bob" ,
 "tags" : "fun"
 } ,
 {
 "_id" : ObjectId("4e6e4ef557b77501a49233f6") ,
 "title" : "third title" ,
 "author" : "bob" ,
 "tags" : "fun"
 }
]
}
```

```

 "title" : "this is my title",
 "author" : "bob",
 "tags" : "good"
 },
 {
 "_id" : ObjectId("4e6e4ef557b77501a49233f6"),
 "title" : "this is my title",
 "author" : "bob",
 "tags" : "fun"
 }
],
"OK" : 1
}

```

A single document becomes 3 documents: each document is identical except for the value of the `tags` field. Each value of `tags` is one of the values in the original “tags” array.

---

**Note:** `$unwind` (page 668) has the following behaviors:

- `$unwind` (page 668) is most useful in combination with `$group` (page 669).
  - You may undo the effects of unwind operation with the `$group` (page 669) pipeline operator.
  - If you specify a target field for `$unwind` (page 668) that does not exist in an input document, the pipeline ignores the input document, and will generate no result documents.
  - If you specify a target field for `$unwind` (page 668) that is not an array, `db.collection.aggregate()` (page 808) generates an error.
  - If you specify a target field for `$unwind` (page 668) that holds an empty array ([]) in an input document, the pipeline ignores the input document, and will generate no result documents.
- 

## `$group` (aggregation)

### `$group`

Groups documents together for the purpose of calculating aggregate values based on a collection of documents. In practice, `$group` (page 669) often supports tasks such as average page views for each page in a website on a daily basis.

---

**Important:** The output of `$group` (page 669) is not ordered.

The output of `$group` (page 669) depends on how you define groups. Begin by specifying an identifier (i.e. an `_id` field) for the group you’re creating with this pipeline. For this `_id` field, you can specify various expressions, including a single field from the documents in the pipeline, a computed value from a previous stage, a document that consists of multiple fields, and other valid expressions, such as constant or subdocument fields. You can use `$project` (page 664) operators in expressions for the `_id` field.

The following example of an `_id` field specifies a document that consists of multiple fields:

```
{ _id : { author: '$author', pageViews: '$pageViews', posted: '$posted' } }
```

Every `$group` (page 669) expression **must** specify an `_id` field. In addition to the `_id` field, `$group` (page 669) expression can include computed fields. These other fields must use one of the following *accumulators*:

- `$addToSet` (page 674)
- `$first` (page 675)

- [\\$last](#) (page 675)
- [\\$max](#) (page 675)
- [\\$min](#) (page 675)
- [\\$avg](#) (page 676)
- [\\$push](#) (page 677)
- [\\$sum](#) (page 678)

With the exception of the `_id` field, [\\$group](#) (page 669) cannot output nested documents.

---

**Tip**

Use [\\$project](#) (page 664) as needed to rename the grouped field after a [\\$group](#) (page 669) operation.

---

**Warning:** The aggregation system currently stores [\\$group](#) (page 669) operations in memory, which may cause problems when processing a larger number of groups.

**Example** Consider the following example:

```
db.article.aggregate(
 { $group : {
 _id : "$author",
 docsPerAuthor : { $sum : 1 },
 viewsPerAuthor : { $sum : "$pageViews" }
 } }
) ;
```

This aggregation pipeline groups by the `author` field and computes two fields, the first `docsPerAuthor` is a counter field that increments by one for each document with a given author field using the [\\$sum](#) (page 678) function. The `viewsPerAuthor` field is the sum of all of the `pageViews` fields in the documents for each group.

## \$sort (aggregation)

### \$sort

The [\\$sort](#) (page 670) *pipeline* operator sorts all input documents and returns them to the pipeline in sorted order. Consider the following prototype form:

```
db.<collection-name>.aggregate(
 { $sort : { <sort-key> } }
) ;
```

This sorts the documents in the collection named `<collection-name>`, according to the key and specification in the `{ <sort-key> }` document.

Specify the sort in a document with a field or fields that you want to sort by and a value of `1` or `-1` to specify an ascending or descending sort respectively, as in the following example:

```
db.users.aggregate(
 { $sort : { age : -1, posts: 1 } }
) ;
```

This operation sorts the documents in the `users` collection, in descending order according by the `age` field and then in ascending order according to the value in the `posts` field.

When comparing values of different [BSON](#) types, MongoDB uses the following comparison order, from lowest to highest:

- 1.MinKey (internal type)
- 2.Null
- 3.Numbers (ints, longs, doubles)
- 4.Symbol, String
- 5.Object
- 6.Array
- 7.BinData
- 8.ObjectId
- 9.Boolean
- 10.Date, Timestamp
- 11.Regular Expression
- 12.MaxKey (internal type)

---

**Note:** MongoDB treats some types as equivalent for comparison purposes. For instance, numeric types undergo conversion before comparison.

---

**Important:** The `$sort` (page 670) cannot begin sorting documents until previous operators in the pipeline have returned all output.

---

`$sort` (page 670) operator can take advantage of an index when placed at the **beginning** of the pipeline or placed **before** the following aggregation operators: `$project` (page 664), `$unwind` (page 668), and `$group` (page 669).

Changed in version 2.4: `$sort` (page 670) and memory requirements:

- When a `$sort` (page 670) immediately precedes a `$limit` (page 667) in the pipeline, the `$sort` (page 670) operation only maintains the top n results as it progresses, where n is the specified limit, and MongoDB only needs to store the number of items specified by `$limit` (page 667) in memory. Before MongoDB 2.4, `$sort` (page 670) would sort all the results in memory, and then limit the results to n results.
- Unless the `$sort` (page 670) operator can use an index or immediately precedes a `$limit` (page 667), the `$sort` (page 670) operation must fit within memory. Before MongoDB 2.4, unless the `$sort` (page 670) operator can use an index, the `sort` (page 670) operation must fit within memory.

`$sort` (page 670) produces an error if the operation consumes 10 percent or more of RAM.

## `$geoNear` (aggregation)

### `$geoNear`

New in version 2.4.

`$geoNear` (page 671) returns documents in order of nearest to farthest from a specified point and pass the documents through the aggregation `pipeline`.

---

**Important:**

- You can only use `$geoNear` (page 671) as the first stage of a pipeline.
- You must include the `distanceField` option. The `distanceField` option specifies the field that will contain the calculated distance.

- The collection must have a *geospatial index* (page 330).
- 

The `$geoNear` (page 671) operator accepts a *document* that contains the following fields. Specify all distances in the same unites as the document coordinate system:

**:field** `GeoJSON point,:term:legacy coordinate pairs <legacy coordinate pairs>` **near:**

The point for which to find the closest documents.

**field string distanceField** The output field that contains the calculated distance. To specify a field within a subdocument, use *dot notation*.

**field number limit** The maximum number of documents to return. The default value is 100. See also the `num` option.

**field number num** The `num` option provides the same function as the `limit` option. Both define the maximum number of documents to return. If both options are included, the `num` value overrides the `limit` value.

**field number maxDistance** A distance from the center point. Specify the distance in radians. MongoDB limits the results to those documents that fall within the specified distance from the center point.

**field document query** Limits the results to the documents that match the query. The query syntax is the usual MongoDB *read operation query* (page 68) syntax.

**field Boolean spherical** If `true`, MongoDB references points using a spherical surface. The default value is `false`.

**field number distanceMultiplier** The factor to multiply all distances returned by the query. For example, use the `distanceMultiplier` to convert radians, as returned by a spherical query, to kilometers by multiplying by the radius of the Earth.

**field string includeLocs** This specifies the output field that identifies the location used to calculate the distance. This option is useful when a location field contains multiple locations. To specify a field within a subdocument, use *dot notation*.

**field Boolean uniqueDocs** If this value is `true`, the query returns a matching document once, even if more than one of the document's location fields match the query. If this value is `false`, the query returns a document multiple times if the document has multiple matching location fields. See `$uniqueDocs` (page 643) for more information.

**Example** The following aggregation finds at most 5 *unique* documents with a location at most .008 from the center [40.72, -73.99] and have type equal to public:

```
db.places.aggregate([
 {
 $geoNear: {
 near: [40.724, -73.997],
 distanceField: "dist.calculated",
 maxDistance: 0.008,
 query: { type: "public" },
 includeLocs: "dist.location",
 uniqueDocs: true,
 num: 5
 }
 }
])
```

The aggregation returns the following:

```
{
 "result" : [
 {
 "_id" : 7,
 "name" : "Washington Square",
 "type" : "public",
 "location" : [
 [40.731, -73.999],
 [40.732, -73.998],
 [40.730, -73.995],
 [40.729, -73.996]
],
 "dist" : {
 "calculated" : 0.0050990195135962296,
 "location" : [40.729, -73.996]
 }
 },
 {
 "_id" : 8,
 "name" : "Sara D. Roosevelt Park",
 "type" : "public",
 "location" : [
 [40.723, -73.991],
 [40.723, -73.990],
 [40.715, -73.994],
 [40.715, -73.994]
],
 "dist" : {
 "calculated" : 0.006082762530298062,
 "location" : [40.723, -73.991]
 }
 }
],
 "ok" : 1
}
```

The matching documents in the `result` field contain two new fields:

- `dist.calculated` field that contains the calculated distance, and
- `dist.location` field that contains the location used in the calculation.

## Expression Operators

Expression operators calculate values within the [Pipeline Operators](#) (page 664).

## \$group Operators

**Group Aggregation Operators**

| Name                                  | Description                                                                                                    |
|---------------------------------------|----------------------------------------------------------------------------------------------------------------|
| <a href="#">\$addToSet (page 674)</a> | Returns an array of all the <i>unique</i> values for the selected field among for each document in that group. |
| <a href="#">\$first (page 675)</a>    | Returns the first value in a group.                                                                            |
| <a href="#">\$last (page 675)</a>     | Returns the last value in a group.                                                                             |
| <a href="#">\$max (page 675)</a>      | Returns the highest value in a group.                                                                          |
| <a href="#">\$min (page 675)</a>      | Returns the lowest value in a group.                                                                           |
| <a href="#">\$avg (page 676)</a>      | Returns an average of all the values in a group.                                                               |
| <a href="#">\$push (page 677)</a>     | Returns an array of <i>all</i> values for the selected field among for each document in that group.            |
| <a href="#">\$sum (page 678)</a>      | Returns the sum of all the values in a group.                                                                  |

**\$addToSet (aggregation)****\$addToSet**

Returns an array of all the values found in the selected field among the documents in that group. *Every unique value only appears once* in the result set. There is no ordering guarantee for the output documents.

**Example** In the [mongo \(page 942\)](#) shell, insert documents into a collection named `products` using the following operation:

```
db.products.insert([
 { "type" : "phone", "price" : 389.99, "stocked" : 270000 },
 { "type" : "phone", "price" : 376.99, "stocked" : 97000 },
 { "type" : "phone", "price" : 389.99, "stocked" : 97000 },
 { "type" : "chair", "price" : 59.99, "stocked" : 108 }
])
```

Use the following `db.collection.aggregate()` ([page 808](#)) operation in the [mongo \(page 942\)](#) shell with the [\\$addToSet \(page 674\)](#) operator:

```
db.products.aggregate({
 $group : {
 _id : "$type",
 price: { $addToSet: "$price" },
 stocked: { $addToSet: "$stocked" },
 }
})
```

This aggregation pipeline returns documents grouped on the value of the `type` field, with *sets* constructed from the unique values of the `price` and `stocked` fields in the input documents. Consider the following aggregation results:

```
{
 "_id" : "chair",
 "price" : [
 59.99
],
 "stocked" : [
 108
]
},
{
 "_id" : "phone",
 "price" : [
 376.99,
 389.99
],
}
```

```

 "stocked" : [
 97000,
 270000,
]
}

```

**\$first (aggregation)****\$first**

Returns the first value it encounters for its group.

---

**Note:** Only use [\\$first](#) (page 675) when the [\\$group](#) (page 669) follows an [\\$sort](#) (page 670) operation. Otherwise, the result of this operation is unpredictable.

---

**\$last (aggregation)****\$last**

Returns the last value it encounters for its group.

---

**Note:** Only use [\\$last](#) (page 675) when the [\\$group](#) (page 669) follows an [\\$sort](#) (page 670) operation. Otherwise, the result of this operation is unpredictable.

---

**\$max (aggregation)****\$max**

Returns the highest value among all values of the field in all documents selected by this group.

**\$min (aggregation)****\$min**

The [\\$min](#) (page 675) operator returns the lowest non-null value of a field in the documents for a [\\$group](#) (page 669) operation.

Changed in version 2.4: If some, **but not all**, documents for the [\\$min](#) (page 675) operation have either a `null` value for the field or are missing the field, the [\\$min](#) (page 675) operator only considers the non-null and the non-missing values for the field. If **all** documents for the [\\$min](#) (page 675) operation have `null` value for the field or are missing the field, the [\\$min](#) (page 675) operator returns `null` for the minimum value.

Before 2.4, if any of the documents for the [\\$min](#) (page 675) operation were missing the field, the [\\$min](#) (page 675) operator would not return any value. If any of the documents for the [\\$min](#) (page 675) had the value `null`, the [\\$min](#) (page 675) operator would return a `null`.

**Example**

The `users` collection contains the following documents:

```
{
 "_id" : "abc001", "age" : 25
}
{
 "_id" : "abe001", "age" : 35
}
{
 "_id" : "efg001", "age" : 20
}
{
 "_id" : "xyz001", "age" : 15
}
```

- To find the minimum value of the `age` field from all the documents, use the [\\$min](#) (page 675) operator:

```
db.users.aggregate([{ $group: { _id:0, minAge: { $min: "$age" } } }])
```

The operation returns the value of the `age` field in the `minAge` field:

```
{ "result" : [{ "_id" : 0, "minAge" : 15 }], "ok" : 1 }
```

- To find the minimum value of the age field for only those documents with \_id starting with the letter a, use the \$min (page 675) operator after a \$match (page 666) operation:

```
db.users.aggregate([{ $match: { _id: /^a/ } },
 { $group: { _id: 0, minAge: { $min: "$age" } } }
])
```

The operation returns the minimum value of the age field for the two documents with \_id starting with the letter a:

```
{ "result" : [{ "_id" : 0, "minAge" : 25 }], "ok" : 1 }
```

---

### Example

The users collection contains the following documents where some of the documents are either missing the age field or the age field contains null:

```
{ "_id" : "abc001", "age" : 25 }
{ "_id" : "abe001", "age" : 35 }
{ "_id" : "efg001", "age" : 20 }
{ "_id" : "xyz001", "age" : 15 }
{ "_id" : "xxx001" }
{ "_id" : "zzz001", "age" : null }
```

- The following operation finds the minimum value of the age field in all the documents:

```
db.users.aggregate([{ $group: { _id: 0, minAge: { $min: "$age" } } }])
```

Because only some documents for the \$min (page 675) operation are missing the age field or have age field equal to null, \$min (page 675) only considers the non-null and the non-missing values and the operation returns the following document:

```
{ "result" : [{ "_id" : 0, "minAge" : 15 }], "ok" : 1 }
```

- The following operation finds the minimum value of the age field for only those documents where the \_id equals "xxx001" or "zzz001":

```
db.users.aggregate([{ $match: { _id: { $in: ["xxx001", "zzz001"] } } },
 { $group: { _id: 0, minAge: { $min: "$age" } } }
])
```

The \$min (page 675) operation returns null for the minimum age since all documents for the \$min (page 675) operation have null value for the field age or are missing the field:

```
{ "result" : [{ "_id" : 0, "minAge" : null }], "ok" : 1 }
```

---

## \$avg (aggregation)

### \$avg

Returns the average of all the values of the field in all documents selected by this group.

**\$push (aggregation)****\$push**

Returns an array of all the values found in the selected field among the documents in that group. *A value may appear more than once* in the result set if more than one field in the grouped documents has that value.

**Example** The following examples use the following collection named `users` as the input for the aggregation pipeline:

```
{ "_id": 1, "user": "Jan", "age": 25, "score": 80 }
{ "_id": 2, "user": "Mel", "age": 35, "score": 70 }
{ "_id": 3, "user": "Ty", "age": 20, "score": 102 }
{ "_id": 4, "user": "Lee", "age": 25, "score": 45 }
```

**Push Values of a Single Field Into the Returned Array Field** To group by `age` and return all the `user` values for each `age`, use the [\\$push](#) (page 677) operator.

```
db.users.aggregate(
 {
 $group: {
 _id: "$age",
 users: { $push: "$user" }
 }
 }
)
```

For each `age`, the operation returns the field `users` that contains an array of all the `user` values associated with that `age`:

```
{
 "result" : [
 {
 "_id" : 20,
 "users" : [
 "Ty"
]
 },
 {
 "_id" : 35,
 "users" : [
 "Mel"
]
 },
 {
 "_id" : 25,
 "users" : [
 "Jan",
 "Lee"
]
 }
],
 "ok" : 1
}
```

**Push Documents Into the Returned Array Field** The [\\$push](#) (page 677) operator can return an array of documents.

To group by `age` and return all the `user` and associated `score` values for each age, use the [\\$push](#) (page 677) operator.

```
db.users.aggregate(
 {
 $group: {
 _id: "$age",
 users: { $push: { userid: "$user", score: "$score" } }
 }
 }
)
```

For each `age`, the operation returns the field `users` that contains an array of documents. These documents contain the fields `userid` and `score` that hold respectively the `user` value and the `score` value associated with that age:

```
{
 "result" : [
 {
 "_id" : 20,
 "users" : [
 {
 "userid" : "Ty",
 "score" : 102
 }
]
 },
 {
 "_id" : 35,
 "users" : [
 {
 "userid" : "Mel",
 "score" : 70
 }
]
 },
 {
 "_id" : 25,
 "users" : [
 {
 "userid" : "Jan",
 "score" : 80
 },
 {
 "userid" : "Lee",
 "score" : 45
 }
]
 }
],
 "ok" : 1
}
```

### \$sum (aggregation)

#### \$sum

Returns the sum of all the values for a specified field in the grouped documents, as in the second use above.

Alternately, if you specify a value as an argument, [\\$sum](#) (page 678) will increment this field by the specified value for every document in the grouping. Typically, as in the first use above, specify a value of 1 in order to

count members of the group.

**Boolean Operators** These operators accept Booleans as arguments and return Booleans as results.

The operators convert non-Booleans to Boolean values according to the BSON standards. Here, `null`, `undefined`, and `0` values become `false`, while non-zero numeric values, and all other types, such as strings, dates, objects become `true`.

## Boolean Aggregation Operators

| Name                             | Description                                                           |
|----------------------------------|-----------------------------------------------------------------------|
| <a href="#">\$and (page 679)</a> | Returns true only when <i>all</i> values in its input array are true. |
| <a href="#">\$or (page 679)</a>  | Returns true when <i>any</i> value in its input array are true.       |
| <a href="#">\$not (page 679)</a> | Returns the boolean value that is the opposite of the input value.    |

### \$and (aggregation)

#### \$and

Takes an array one or more values and returns `true` if *all* of the values in the array are `true`. Otherwise [\\$and \(page 679\)](#) returns `false`.

---

**Note:** [\\$and \(page 679\)](#) uses short-circuit logic: the operation stops evaluation after encountering the first `false` expression.

---

### \$or (aggregation)

#### \$or

Takes an array of one or more values and returns `true` if *any* of the values in the array are `true`. Otherwise [\\$or \(page 679\)](#) returns `false`.

---

**Note:** [\\$or \(page 679\)](#) uses short-circuit logic: the operation stops evaluation after encountering the first `true` expression.

---

### \$not (aggregation)

#### \$not

Returns the boolean opposite value passed to it. When passed a `true` value, [\\$not \(page 679\)](#) returns `false`; when passed a `false` value, [\\$not \(page 679\)](#) returns `true`.

**Comparison Operators** These operators perform comparisons between two values and return a Boolean, in most cases reflecting the result of the comparison.

All comparison operators take an array with a pair of values. You may compare numbers, strings, and dates. Except for [\\$cmp \(page 680\)](#), all comparison operators return a Boolean value. [\\$cmp \(page 680\)](#) returns an integer.

## Comparison Aggregation Operators

| Name                             | Description                                                                                 |
|----------------------------------|---------------------------------------------------------------------------------------------|
| <a href="#">\$cmp (page 680)</a> | Compares two values and returns the result of the comparison as an integer.                 |
| <a href="#">\$eq (page 680)</a>  | Takes two values and returns true if the values are equivalent.                             |
| <a href="#">\$gt (page 680)</a>  | Takes two values and returns true if the first is larger than the second.                   |
| <a href="#">\$gte (page 680)</a> | Takes two values and returns true if the first is larger than or equal to the second.       |
| <a href="#">\$lt (page 680)</a>  | Takes two values and returns true if the second value is larger than the first.             |
| <a href="#">\$lte (page 680)</a> | Takes two values and returns true if the second value is larger than or equal to the first. |
| <a href="#">\$ne (page 680)</a>  | Takes two values and returns true if the values are <i>not</i> equivalent.                  |

### \$cmp (aggregation)

#### \$cmp

Takes two values in an array and returns an integer. The returned value is:

- A negative number if the first value is less than the second.
- A positive number if the first value is greater than the second.
- 0 if the two values are equal.

### \$eq (aggregation)

#### \$eq

Takes two values in an array and returns a boolean. The returned value is:

- `true` when the values are equivalent.
- `false` when the values are **not** equivalent.

### \$gt (aggregation)

#### \$gt

Takes two values in an array and returns a boolean. The returned value is:

- `true` when the first value is *greater than* the second value.
- `false` when the first value is *less than or equal to* the second value.

### \$gte (aggregation)

#### \$gte

Takes two values in an array and returns a boolean. The returned value is:

- `true` when the first value is *greater than or equal* to the second value.
- `false` when the first value is *less than* the second value.

### \$lt (aggregation)

#### \$lt

Takes two values in an array and returns a boolean. The returned value is:

- `true` when the first value is *less than* the second value.
- `false` when the first value is *greater than or equal to* the second value.

### \$lte (aggregation)

#### \$lte

Takes two values in an array and returns a boolean. The returned value is:

- `true` when the first value is *less than or equal to* the second value.
- `false` when the first value is *greater than* the second value.

### \$ne (aggregation)

#### \$ne

Takes two values in an array returns a boolean. The returned value is:

- `true` when the values are **not equivalent**.
- `false` when the values are **equivalent**.

**Arithmetic Operators** Arithmetic operators support only numbers.

### Arithmetic Aggregation Operators

| Name                                  | Description                                                                            |
|---------------------------------------|----------------------------------------------------------------------------------------|
| <a href="#">\$add (page 681)</a>      | Computes the sum of an array of numbers.                                               |
| <a href="#">\$divide (page 681)</a>   | Takes two numbers and divides the first number by the second.                          |
| <a href="#">\$mod (page 681)</a>      | Takes two numbers and calculates the modulo of the first number divided by the second. |
| <a href="#">\$multiply (page 681)</a> | Computes the product of an array of numbers.                                           |
| <a href="#">\$subtract (page 681)</a> | Takes two numbers and subtracts the second number from the first.                      |

#### \$add (aggregation)

##### \$add

Takes an array of one or more numbers and adds them together, returning the sum.

#### \$divide (aggregation)

##### \$divide

Takes an array that contains a pair of numbers and returns the value of the first number divided by the second number.

#### \$mod (aggregation)

##### \$mod

Takes an array that contains a pair of numbers and returns the *remainder* of the first number divided by the second number.

##### See also:

[\\$mod \(page 632\)](#)

#### \$multiply (aggregation)

##### \$multiply

Takes an array of one or more numbers and multiplies them, returning the resulting product.

#### \$subtract (aggregation)

##### \$subtract

Takes an array that contains a pair of numbers and subtracts the second from the first, returning their difference.

**String Operators** String operators manipulate strings within projection expressions.

### String Aggregation Operators

| Name                                    | Description                                                               |
|-----------------------------------------|---------------------------------------------------------------------------|
| <a href="#">\$concat (page 681)</a>     | Concatenates two strings.                                                 |
| <a href="#">\$strcasecmp (page 684)</a> | Compares two strings and returns an integer that reflects the comparison. |
| <a href="#">\$substr (page 684)</a>     | Takes a string and returns portion of that string.                        |
| <a href="#">\$toLower (page 685)</a>    | Converts a string to lowercase.                                           |
| <a href="#">\$toUpper (page 685)</a>    | Converts a string to uppercase.                                           |

#### \$concat (aggregation)

**\$concat**

New in version 2.4.

Takes an array of strings, concatenates the strings, and returns the concatenated string. [\\$concat \(page 681\)](#) can only accept an array of strings.

Use [\\$concat \(page 681\)](#) with the following syntax:

```
{ $concat: [<string>, <string>, ...] }
```

If array element has a value of `null` or refers to a field that is missing, [\\$concat \(page 681\)](#) will return `null`.

---

**Example**

Project new concatenated values.

A collection `menu` contains the documents that stores information on menu items separately in the `section`, the `category` and the `type` fields, as in the following:

```
{ _id: 1, item: { sec: "dessert", category: "pie", type: "apple" } }
{ _id: 2, item: { sec: "dessert", category: "pie", type: "cherry" } }
{ _id: 3, item: { sec: "main", category: "pie", type: "shepherd's" } }
{ _id: 4, item: { sec: "main", category: "pie", type: "chicken pot" } }
```

The following operation uses [\\$concat \(page 681\)](#) to concatenate the `type` field from the sub-document `item`, a space, and the `category` field from the sub-document `item` to project a new `food` field:

```
db.menu.aggregate({ $project: { food:
 { $concat: ["$item.type",
 " ",
 "$item.category"]
 }
 }
)

```

The operation returns the following result set where the `food` field contains the concatenated strings:

```
{
 "result" : [
 { "_id" : 1, "food" : "apple pie" },
 { "_id" : 2, "food" : "cherry pie" },
 { "_id" : 3, "food" : "shepherd's pie" },
 { "_id" : 4, "food" : "chicken pot pie" }
],
 "ok" : 1
}
```

---

**Example**

Group by a concatenated string.

A collection `menu` contains the documents that stores information on menu items separately in the `section`, the `category` and the `type` fields, as in the following:

```
{ _id: 1, item: { sec: "dessert", category: "pie", type: "apple" } }
{ _id: 2, item: { sec: "dessert", category: "pie", type: "cherry" } }
{ _id: 3, item: { sec: "main", category: "pie", type: "shepherd's" } }
{ _id: 4, item: { sec: "main", category: "pie", type: "chicken pot" } }
```

The following aggregation uses `$concat` (page 681) to concatenate the `sec` field from the sub-document `item`, the string ":", and the `category` field from the sub-document `item` to group by the new concatenated string and perform a count:

```
db.menu.aggregate({ $group: { _id:
 { $concat: ["$item.sec",
 ": ",
 "$item.category"
]
 },
 count: { $sum: 1 }
 }
 }
)
```

The aggregation returns the following document:

```
{
 "result" : [
 { "_id" : "main: pie", "count" : 2 },
 { "_id" : "dessert: pie", "count" : 2 }
],
 "ok" : 1
}
```

---

### Example

Concatenate null or missing values.

A collection `menu` contains the documents that stores information on menu items separately in the `section`, the `category` and the `type` fields. Not all documents have the all three fields. For example, the document with `_id` equal to 5 is missing the `category` field:

```
{ _id: 1, item: { sec: "dessert", category: "pie", type: "apple" } }
{ _id: 2, item: { sec: "dessert", category: "pie", type: "cherry" } }
{ _id: 3, item: { sec: "main", category: "pie", type: "shepherd's" } }
{ _id: 4, item: { sec: "main", category: "pie", type: "chicken pot" } }
{ _id: 5, item: { sec: "beverage", type: "coffee" } }
```

The following aggregation uses the `$concat` (page 681) to concatenate the `type` field from the sub-document `item`, a space, and the `category` field from the sub-document `item`:

```
db.menu.aggregate({ $project: { food:
 { $concat: ["$item.type",
 " ",
 "$item.category"
]
 }
 }
 }
)
```

Because the document with `_id` equal to 5 is missing the `type` field in the `item` sub-document, `$concat` (page 681) returns the value `null` as the concatenated value for the document:

```
{
 "result" : [
 { "_id" : 1, "food" : "apple pie" },
 { "_id" : 2, "food" : "cherry pie" },
```

```
{ "_id" : 3, "food" : "shepherd's pie" },
{ "_id" : 4, "food" : "chicken pot pie" },
{ "_id" : 5, "food" : null }
],
"ok" : 1
}
```

To handle possible missing fields, you can use [\\$ifNull](#) (page 687) with [\\$concat](#) (page 681), as in the following example which substitutes <unknown type> if the field type is null or missing, and <unknown category> if the field category is null or is missing:

```
db.menu.aggregate({ $project: { food:
 { $concat: [{ $ifNull: ["$item.type", "<unknown type>"]
 " ",
 { $ifNull: ["$item.category", "<unknown category>"]
]
 }
 }
 }
 }
 }
```

The aggregation returns the following result set:

```
{
 "result" : [
 { "_id" : 1, "food" : "apple pie" },
 { "_id" : 2, "food" : "cherry pie" },
 { "_id" : 3, "food" : "shepherd's pie" },
 { "_id" : 4, "food" : "chicken pot pie" },
 { "_id" : 5, "food" : "coffee <unknown category>" }
],
 "ok" : 1
}
```

---

## \$strcasecmp (aggregation)

### \$strcasecmp

Takes in two strings. Returns a number. [\\$strcasecmp](#) (page 684) is positive if the first string is “greater than” the second and negative if the first string is “less than” the second. [\\$strcasecmp](#) (page 684) returns 0 if the strings are identical.

**Note:** [\\$strcasecmp](#) (page 684) may not make sense when applied to glyphs outside the Roman alphabet.

[\\$strcasecmp](#) (page 684) internally capitalizes strings before comparing them to provide a case-*insensitive* comparison. Use [\\$cmp](#) (page 680) for a case sensitive comparison.

---

## \$substr (aggregation)

### \$substr

[\\$substr](#) (page 684) takes a string and two numbers. The first number represents the number of bytes in the string to skip, and the second number specifies the number of bytes to return from the string.

**Note:** [\\$substr](#) (page 684) is not encoding aware and if used improperly may produce a result string containing an invalid UTF-8 character sequence.

---

**\$toLower (aggregation)****\$toLower**

Takes a single string and converts that string to lowercase, returning the result. All uppercase letters become lowercase.

---

**Note:** `$toLower` (page 685) may not make sense when applied to glyphs outside the Roman alphabet.

---

**\$toUpperCase (aggregation)****\$toUpperCase**

Takes a single string and converts that string to uppercase, returning the result. All lowercase letters become uppercase.

---

**Note:** `$toUpperCase` (page 685) may not make sense when applied to glyphs outside the Roman alphabet.

---

**Date Operators** Date operators take a “Date” typed value as a single argument and return a number.

**Date Aggregation Operators**

| Name                                     | Description                                                                        |
|------------------------------------------|------------------------------------------------------------------------------------|
| <a href="#">\$dayOfYear (page 685)</a>   | Converts a date to a number between 1 and 366.                                     |
| <a href="#">\$dayOfMonth (page 685)</a>  | Converts a date to a number between 1 and 31.                                      |
| <a href="#">\$dayOfWeek (page 685)</a>   | Converts a date to a number between 1 and 7.                                       |
| <a href="#">\$year (page 685)</a>        | Converts a date to the full year.                                                  |
| <a href="#">\$month (page 686)</a>       | Converts a date into a number between 1 and 12.                                    |
| <a href="#">\$week (page 686)</a>        | Converts a date into a number between 0 and 53                                     |
| <a href="#">\$hour (page 686)</a>        | Converts a date into a number between 0 and 23.                                    |
| <a href="#">\$minute (page 686)</a>      | Converts a date into a number between 0 and 59.                                    |
| <a href="#">\$second (page 686)</a>      | Converts a date into a number between 0 and 59. May be 60 to account for seconds.  |
| <a href="#">\$millisecond (page 686)</a> | Returns the millisecond portion of a date as an integer between 0 and 999,999,999. |

**\$dayOfYear (aggregation)****\$dayOfYear**

Takes a date and returns the day of the year as a number between 1 and 366.

**\$dayOfMonth (aggregation)****\$dayOfMonth**

Takes a date and returns the day of the month as a number between 1 and 31.

**\$dayOfWeek (aggregation)****\$dayOfWeek**

Takes a date and returns the day of the week as a number between 1 (Sunday) and 7 (Saturday.)

**\$year (aggregation)****\$year**

Takes a date and returns the full year.

**\$month (aggregation)****\$month**

Takes a date and returns the month as a number between 1 and 12.

**\$week (aggregation)****\$week**

Takes a date and returns the week of the year as a number between 0 and 53.

Weeks begin on Sundays, and week 1 begins with the first Sunday of the year. Days preceding the first Sunday of the year are in week 0. This behavior is the same as the “%U” operator to the `strftime` standard library function.

**\$hour (aggregation)****\$hour**

Takes a date and returns the hour between 0 and 23.

**\$minute (aggregation)****\$minute**

Takes a date and returns the minute between 0 and 59.

**\$second (aggregation)****\$second**

Takes a date and returns the second between 0 and 59, but can be 60 to account for leap seconds.

**\$millisecond (aggregation)****\$millisecond**

Takes a date and returns the millisecond portion of the date as an integer between 0 and 999.

## Conditional Expressions

### Conditional Aggregation Operators

| Name                                   | Description                                                                                                 |
|----------------------------------------|-------------------------------------------------------------------------------------------------------------|
| <a href="#">\$cond</a><br>(page 686)   | A ternary operator that evaluates one expression, and depending on the result of one following expressions. |
| <a href="#">\$ifNull</a><br>(page 687) | Evaluates an expression and returns a value.                                                                |

**\$cond (aggregation)****\$cond**

`$cond` (page 686) is a ternary operator that takes an array of three expressions, where the first expression evaluates to a Boolean value. If the first expression evaluates to `true`, then `$cond` (page 686) evaluates and returns the value of the second expression. If the first expression evaluates to `false`, then `$cond` (page 686) evaluates and returns the third expression.

Use the `$cond` (page 686) operator with the following syntax:

```
{ $cond: [<boolean-expression>, <true-case>, <false-case>] }
```

All three values in the array specified to `$cond` (page 686) must be valid MongoDB *aggregation expressions* (page 663) or document fields. Do not use JavaScript in any aggregation statements, including `$cond` (page 686).

---

### Example

The following aggregation on the `survey` collection groups by the `item_id` field and returns a `weightedCount` for each `item_id`. The `$sum` (page 678) operator uses the `$cond` (page 686) expression to add either 2 if the value stored in the `level` field is E and 1 otherwise.

```
db.survey.aggregate(
 [
 {
 $group: {
 _id: "$item_id",
 weightedCount: { $sum: { $cond: [{ $eq: ["$level", "E"] } , 2, 1] } }
 }
 }
]
)
```

---

### `$ifNull` (aggregation)

#### `$ifNull`

Takes an array with two expressions. `$ifNull` (page 687) returns the first expression if it evaluates to a non-null value. Otherwise, `$ifNull` (page 687) returns the second expression's value.

Use the `$ifNull` (page 687) operator with the following syntax:

```
{ $ifNull: [<expression>, <replacement-if-null>] }
```

Both values in the array specified to `$ifNull` (page 687) must be valid MongoDB *aggregation expressions* (page 663) or document fields. Do not use JavaScript in any aggregation statements, including `$ifNull` (page 687).

---

### Example

The following aggregation on the `offSite` collection groups by the `location` field and returns a count for each location. If the `location` field contains null, the `$ifNull` (page 687) returns "Unspecified" as the value. MongoDB assigns the returned value to `_id` in the aggregated document.

```
db.offSite.aggregate(
 [
 {
 $group: {
 _id: { $ifNull: ["$location", "Unspecified"] },
 count: { $sum: 1 }
 }
 }
]
)
```

---

## Meta-Query Operators

### Query Modification Operators

**Introduction** In addition to the *MongoDB Query Operators* (page 621), there are a number of “meta” operators that you can modify the output or behavior of a query. On the server, MongoDB treats the query and the options as a single

object. The [mongo](#) (page 942) shell and driver interfaces may provide [cursor methods](#) (page 858) that wrap these options. When possible, use these methods; otherwise, you can add these options using either of the following syntax:

```
db.collection.find({ <query> })._addSpecial(<option>)
db.collection.find({ $query: { <query> }, <option> })
```

## Operators

**Modifiers** Many of these operators have corresponding [methods in the shell](#) (page 858). These methods provide a straightforward and user-friendly interface and are the preferred way to add these options.

| Name                                     | Description                                                                                                      |
|------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| <a href="#">\$comment</a> (page 688)     | Adds a comment to the query to identify queries in the <a href="#">database profiler</a> output.                 |
| <a href="#">\$explain</a> (page 688)     | Forces MongoDB to report on query execution plans. See <a href="#">explain()</a> (page 861).                     |
| <a href="#">\$hint</a> (page 689)        | Forces MongoDB to use a specific index. See <a href="#">hint()</a> (page 866)                                    |
| <a href="#">\$maxScan</a> (page 690)     | Limits the number of documents a cursor will return for a query. See <a href="#">limit()</a> (page 867).         |
| <a href="#">\$max</a> (page 690)         | Specifies a minimum exclusive upper limit for the index to use in a query. See <a href="#">max()</a> (page 867). |
| <a href="#">\$min</a> (page 691)         | Specifies a minimum inclusive lower limit for the index to use in a query. See <a href="#">min()</a> (page 869). |
| <a href="#">\$orderby</a> (page 691)     | Returns a cursor with documents sorted according to a sort specification. See <a href="#">sort()</a> (page 872). |
| <a href="#">\$returnKey</a> (page 692)   | Forces the cursor to only return fields included in the index.                                                   |
| <a href="#">\$showDiskLoc</a> (page 692) | Modifies the documents returned to include references to the on-disk location of each document.                  |
| <a href="#">\$snapshot</a> (page 692)    | Forces the query to use the index on the <code>_id</code> field. See <a href="#">snapshot()</a> (page 872).      |
| <a href="#">\$query</a> (page 693)       | Wraps a query document.                                                                                          |

### \$comment

#### \$comment

The [\\$comment](#) (page 688) makes it possible to attach a comment to a query. Because these comments propagate to the [profile](#) (page 770) log, adding [\\$comment](#) (page 688) modifiers can make your profile data much easier to interpret and trace. Use one of the following forms:

```
db.collection.find({ <query> })._addSpecial("$comment", <comment>)
db.collection.find({ $query: { <query> }, $comment: <comment> })
```

### \$explain

#### \$explain

The [\\$explain](#) (page 688) operator provides information on the query plan. It returns a document that describes the process and indexes used to return the query. This may provide useful insight when attempting to optimize a query. For details on the output, see [cursor.explain\(\)](#) (page 861).

You can specify the [\\$explain](#) (page 688) operator in either of the following forms:

```
db.collection.find()._addSpecial("$explain", 1)
db.collection.find({ $query: {}, $explain: 1 })
```

You also can specify [\\$explain](#) (page 688) through the [explain\(\)](#) (page 861) method in the [mongo](#) (page 942) shell:

---

```
db.collection.find().explain()
```

`$explain` (page 688) runs the actual query to determine the result. Although there are some differences between running the query with `$explain` (page 688) and running without, generally, the performance will be similar between the two. So, if the query is slow, the `$explain` (page 688) operation is also slow.

Additionally, the `$explain` (page 688) operation reevaluates a set of candidate query plans, which may cause the `$explain` (page 688) operation to perform differently than a normal query. As a result, these operations generally provide an accurate account of *how* MongoDB would perform the query, but do not reflect the length of these queries.

To determine the performance of a particular index, you can use `hint()` (page 866) and in conjunction with `explain()` (page 861), as in the following example:

```
db.products.find().hint({ type: 1 }).explain()
```

When you run `explain()` (page 861) with `hint()` (page 866), the query optimizer does not reevaluate the query plans.

---

**Note:** In some situations, the `explain()` (page 861) operation may differ from the actual query plan used by MongoDB in a normal query.

The `explain()` (page 861) operation evaluates the set of query plans and reports on the winning plan for the query. In normal operations the query optimizer caches winning query plans and uses them for similar related queries in the future. As a result MongoDB may sometimes select query plans from the cache that are different from the plan displayed using `explain()` (page 861).

---

#### See also:

- [explain\(\) \(page 861\)](#)
- [Optimization Strategies for MongoDB](#) (page 160) page for information regarding optimization strategies.
- [Analyze Performance of Database Operations](#) (page 167) tutorial for information regarding the database profile.
- [Current Operation Reporting](#) (page 879)

## \$hint

### \$hint

The `$hint` (page 689) operator forces the *query optimizer* (page 45) to use a specific index to fulfill the query. Specify the index either by the index name or by document.

Use `$hint` (page 689) for testing query performance and indexing strategies. The `mongo` (page 942) shell provides a helper method `hint()` (page 866) for the `$hint` (page 689) operator.

Consider the following operation:

```
db.users.find().hint({ age: 1 })
```

This operation returns all documents in the collection named `users` using the index on the `age` field.

You can also specify a hint using either of the following forms:

```
db.users.find()._addSpecial("$hint", { age : 1 })
db.users.find({ $query: {}, $hint: { age : 1 } })
```

---

**Note:** To combine `$explain` (page 688) and `$hint` (page 689) operations when `$hint` (page 689) is part of the document, as in the following query statement:

```
db.users.find({ $query: {}, $hint: { age : 1 } })
```

You must add the `$explain` (page 688) option to the document, as in the following:

```
db.users.find({ $query: {}, $hint: { age : 1 }, $explain: 1 })
```

---

## \$maxScan

### \$maxScan

Constrains the query to only scan the specified number of documents when fulfilling the query. Use one of the following forms:

```
db.collection.find({ <query> })._addSpecial("$maxScan" , <number>)
db.collection.find({ $query: { <query> }, $maxScan: <number> })
```

Use this modifier to prevent potentially long running queries from disrupting performance by scanning through too much data.

## \$max

### \$max

Specify a `$max` (page 690) value to specify the *exclusive* upper bound for a specific index in order to constrain the results of `find()` (page 816). The `mongo` (page 942) shell provides the `max()` (page 867) wrapper method:

```
db.collection.find({ <query> }).max({ field1: <max value>, ... fieldN: <max valueN> })
```

You can also specify the option with either of the two forms:

```
db.collection.find({ <query> })._addSpecial("$max", { field1: <max value1>, ... fieldN: <max valueN> }
db.collection.find({ $query: { <query> }, $max: { field1: <max value1>, ... fieldN: <max valueN> } })
```

The `$max` (page 690) specifies the upper bound for *all* keys of a specific index *in order*.

Consider the following operations on a collection named `collection` that has an index `{ age: 1 }`:

```
db.collection.find({ <query> }).max({ age: 100 })
```

This operation limits the query to those documents where the field `age` is less than 100 using the index `{ age: 1 }`.

You can explicitly specify the corresponding index with `hint()` (page 866). Otherwise, MongoDB selects the index using the fields in the `indexBounds`; however, if multiple indexes exist on same fields with different sort orders, the selection of the index may be ambiguous.

Consider a collection named `collection` that has the following two indexes:

```
{ age: 1, type: -1 }
{ age: 1, type: 1 }
```

Without explicitly using `hint()` (page 866), MongoDB may select either index for the following operation:

```
db.collection.find().max({ age: 50, type: 'B' })
```

Use `$max` (page 690) alone or in conjunction with `$min` (page 691) to limit results to a specific range for the *same* index, as in the following example:

```
db.collection.find().min({ age: 20 }).max({ age: 25 })
```

---

**Note:** Because [max\(\)](#) (page 867) requires an index on a field, and forces the query to use this index, you may prefer the [\\$lt](#) (page 623) operator for the query if possible. Consider the following example:

```
db.collection.find({ _id: 7 }).max({ age: 25 })
```

The query uses the index on the `age` field, even if the index on `_id` may be better.

---

## \$min

### \$min

Specify a [\\$min](#) (page 691) value to specify the *inclusive* lower bound for a specific index in order to constrain the results of [find\(\)](#) (page 816). The [mongo](#) (page 942) shell provides the [min\(\)](#) (page 869) wrapper method:

```
db.collection.find({ <query> }).min({ field1: <min value>, ... fieldN: <min valueN> })
```

You can also specify the option with either of the two forms:

```
db.collection.find({ <query> })._addSpecial("$min", { field1: <min value1>, ... fieldN: <min valueN> })
db.collection.find({ $query: { <query> }, $min: { field1: <min value1>, ... fieldN: <min valueN> } })
```

The [\\$min](#) (page 691) specifies the lower bound for *all* keys of a specific index *in order*.

Consider the following operations on a collection named `collection` that has an index `{ age: 1 }`:

```
db.collection.find().min({ age: 20 })
```

These operations limit the query to those documents where the field `age` is at least 20 using the index `{ age: 1 }`.

You can explicitly specify the corresponding index with [hint\(\)](#) (page 866). Otherwise, MongoDB selects the index using the fields in the `indexBounds`; however, if multiple indexes exist on same fields with different sort orders, the selection of the index may be ambiguous.

Consider a collection named `collection` that has the following two indexes:

```
{ age: 1, type: -1 }
{ age: 1, type: 1 }
```

Without explicitly using [hint\(\)](#) (page 866), it is unclear which index the following operation will select:

```
db.collection.find().min({ age: 20, type: 'C' })
```

You can use [\\$min](#) (page 691) in conjunction with [\\$max](#) (page 690) to limit results to a specific range for the *same* index, as in the following example:

```
db.collection.find().min({ age: 20 }).max({ age: 25 })
```

---

**Note:** Because [min\(\)](#) (page 869) requires an index on a field, and forces the query to use this index, you may prefer the [\\$gte](#) (page 622) operator for the query if possible. Consider the following example:

```
db.collection.find({ _id: 7 }).min({ age: 25 })
```

The query will use the index on the `age` field, even if the index on `_id` may be better.

---

## \$orderby

### \$orderby

The [\\$orderby](#) (page 691) operator sorts the results of a query in ascending or descending order.

The [mongo](#) (page 942) shell provides the [cursor.sort\(\)](#) (page 872) method:

```
db.collection.find().sort({ age: -1 })
```

You can also specify the option in either of the following forms:

```
db.collection.find().__addSpecial("$orderby", { age : -1 })
db.collection.find({ $query: {}, $orderby: { age : -1 } })
```

These examples return all documents in the collection named `collection` sorted by the `age` field in descending order. Specify a value to [\\$orderby](#) (page 691) of negative one (e.g. `-1`, as above) to sort in descending order or a positive value (e.g. `1`) to sort in ascending order.

Unless you have an index for the specified key pattern, use [\\$orderby](#) (page 691) in conjunction with [\\$maxScan](#) (page 690) and/or [cursor.limit\(\)](#) (page 867) to avoid requiring MongoDB to perform a large in-memory sort. The [cursor.limit\(\)](#) (page 867) increases the speed and reduces the amount of memory required to return this query by way of an optimized algorithm.

### \$returnKey

#### \$returnKey

Only return the index field or fields for the results of the query. If [\\$returnKey](#) (page 692) is set to `true` and the query does not use an index to perform the read operation, the returned documents will not contain any fields. Use one of the following forms:

```
db.collection.find({ <query> }).__addSpecial("$returnKey", true)
db.collection.find({ $query: { <query> }, $returnKey: true })
```

### \$showDiskLoc

#### \$showDiskLoc

[\\$showDiskLoc](#) (page 692) option adds a field `$diskLoc` to the returned documents. The `$diskLoc` field contains the disk location information.

The [mongo](#) (page 942) shell provides the [cursor.showDiskLoc\(\)](#) (page 871) method:

```
db.collection.find().showDiskLoc()
```

You can also specify the option in either of the following forms:

```
db.collection.find({ <query> }).__addSpecial("$showDiskLoc" , true)
db.collection.find({ $query: { <query> }, $showDiskLoc: true })
```

### \$snapshot

#### \$snapshot

The [\\$snapshot](#) (page 692) operator prevents the cursor from returning a document more than once because an intervening write operation results in a move of the document.

Even in snapshot mode, objects inserted or deleted during the lifetime of the cursor may or may not be returned.

The [mongo](#) (page 942) shell provides the [cursor.snapshot\(\)](#) (page 872) method:

```
db.collection.find().snapshot()
```

You can also specify the option in either of the following forms:

```
db.collection.find()._addSpecial("$snapshot", true)
db.collection.find({ $query: {}, $snapshot: true })
```

The `$snapshot` (page 692) operator traverses the index on the `_id` field<sup>4</sup>.

**Warning:**

- You cannot use `$snapshot` (page 692) with *sharded collections*.
- Do **not** use `$snapshot` (page 692) with `$hint` (page 689) or `$orderby` (page 691) (or the corresponding `cursor_hint()` (page 866) and `cursor_sort()` (page 872) methods.)

## \$query

### \$query

The `$query` (page 693) operator provides an interface to describe queries. Consider the following operation:

```
db.collection.find({ $query: { age : 25 } })
```

This is equivalent to the more familiar `db.collection.find()` (page 816) method:

```
db.collection.find({ age : 25 })
```

These operations return only those documents in the collection named `collection` where the `age` field equals 25.

**Note:** Do not mix query forms. If you use the `$query` (page 693) format, do not append *cursor methods* (page 858) to the `find()` (page 816). To modify the query use the *meta-query operators* (page 687), such as `$explain` (page 688).

Therefore, the following two operations are equivalent:

```
db.collection.find({ $query: { age : 25 }, $explain: true })
db.collection.find({ age : 25 }).explain()
```

---

**See also:**

For more information about queries in MongoDB see *Read Operations* (page 39), *Read Operations* (page 39), `db.collection.find()` (page 816), and *Getting Started with MongoDB* (page 26).

| Sort Order | Name                              | Description                                                                      |
|------------|-----------------------------------|----------------------------------------------------------------------------------|
|            | <code>\$natural</code> (page 693) | A special sort order that orders documents using the order of documents on disk. |

## \$natural

### \$natural

Use the `$natural` (page 693) operator to use *natural order* for the results of a sort operation. Natural order refers to the order of documents in the file on disk.

The `$natural` (page 693) operator uses the following syntax to return documents in the order they exist on disk:

```
db.collection.find().sort({ $natural: 1 })
```

Use `-1` to return documents in the reverse order as they occur on disk:

---

<sup>4</sup> You can achieve the `$snapshot` (page 692) isolation behavior using any *unique* index on invariable fields.

```
db.collection.find().sort({ $natural: -1 })
```

**See also:**

[cursor.sort\(\)](#) (page 872)

## 11.1.2 Database Commands

- [User Commands](#) (page 694)
  - [Aggregation Commands](#) (page 694)
  - [Geospatial Commands](#) (page 708)
  - [Query and Write Operation Commands](#) (page 710)
- [Database Operations](#) (page 724)
  - [Authentication Commands](#) (page 724)
  - [Replication Commands](#) (page 725)
  - [Sharding Commands](#) (page 734)
  - [Instance Administration Commands](#) (page 744)
  - [Diagnostic Commands](#) (page 760)
- [Internal Commands](#) (page 799)
- [Testing Commands](#) (page 802)

All command documentation outlined below describes a command and its available parameters and provides a document template or prototype for each command. Some command documentation also includes the relevant [mongo](#) (page 942) shell helpers.

### User Commands

#### Aggregation Commands

##### Aggregation Commands

| Name                                 | Description                                                                                          |
|--------------------------------------|------------------------------------------------------------------------------------------------------|
| <a href="#">aggregate</a> (page 694) | Performs <a href="#">aggregation tasks</a> (page 279) such as group using the aggregation framework. |
| <a href="#">count</a> (page 695)     | Counts the number of documents in a collection.                                                      |
| <a href="#">distinct</a> (page 696)  | Displays the distinct values found for a specified key in a collection.                              |
| <a href="#">group</a> (page 697)     | Groups documents in a collection by the specified key and performs simple aggregation.               |
| <a href="#">mapReduce</a> (page 701) | Performs <a href="#">map-reduce</a> (page 282) aggregation for large data sets.                      |

#### [aggregate](#)

#### [aggregate](#)

New in version 2.1.0.

[aggregate](#) (page 694) implements the [aggregation framework](#). Consider the following prototype form:

```
{ aggregate: "[collection]", pipeline: [pipeline] }
```

Where [collection] specifies the name of the collection that contains the data that you wish to aggregate. The pipeline argument holds an array that contains the specification for the aggregation operation. Consider the following example.

```
db.runCommand(
{ aggregate : "article", pipeline : [
 { $project : {
```

```

 author : 1,
 tags : 1,
 } },
{ $unwind : "$tags" },
{ $group : {
 _id : "$tags",
 authors : { $addToSet : "$author" }
}
]
);

```

More typically this operation would use the [aggregate\(\)](#) (page 808) helper in the [mongo](#) (page 942) shell, and would resemble the following:

```

db.article.aggregate(
 { $project : {
 author : 1,
 tags : 1,
 } },
 { $unwind : "$tags" },
 { $group : {
 _id : "$tags",
 authors : { $addToSet : "$author" }
 }
)
;
```

Changed in version 2.4: If an error occurs, the [aggregate\(\)](#) (page 808) helper throws an exception. In previous versions, the helper returned a document with the error message and code, and `ok` status field not equal to 1, same as the [aggregate](#) (page 694) command.

For more information about the aggregation pipeline [Aggregation Pipeline](#) (page 279) and [Aggregation Reference](#) (page 306).

## count

### Definition

#### count

Counts the number of documents in a collection. Returns a document that contains this count and as well as the command status. [count](#) (page 695) has the following form:

```
{ count: <collection>, query: <query>, limit: <limit>, skip: <skip> }
```

[count](#) (page 695) has the following fields:

**field string count** The name of the collection to count.

**field document query** A query that selects which documents to count in a collection.

**field integer limit** The maximum number of matching documents to return.

**field integer skip** The number of matching documents to skip before returning results.

---

**Note:** MongoDB also provides the [count\(\)](#) (page 860) and [db.collection.count\(\)](#) (page 809) wrapper methods in the [mongo](#) (page 942) shell.

---

**Examples** The following sections provide examples of the [count](#) (page 695) command.

**Count all Documents** The following operation counts the number of all documents in the `orders` collection:

```
db.runCommand({ count: 'orders' })
```

In the result, the `n`, which represents the count, is 26, and the command status `ok` is 1:

```
{ "n" : 26, "ok" : 1 }
```

**Count Documents with Specified Field Values** The following operation returns a count of the documents in the `orders` collection where the value of the `ord_dt` field is greater than `Date('01/01/2012')`:

```
db.runCommand({ count: 'orders',
 query: { ord_dt: { $gt: new Date('01/01/2012') } }
 })
```

In the result, the `n`, which represents the count, is 13 and the command status `ok` is 1:

```
{ "n" : 13, "ok" : 1 }
```

**Skip Matching Documents** The following operation returns a count of the documents in the `orders` collection where the value of the `ord_dt` field is greater than `Date('01/01/2012')` and skip the first 10 matching documents:

```
db.runCommand({ count: 'orders',
 query: { ord_dt: { $gt: new Date('01/01/2012') } },
 skip: 10
 })
```

In the result, the `n`, which represents the count, is 3 and the command status `ok` is 1:

```
{ "n" : 3, "ok" : 1 }
```

## distinct

### Definition

#### `distinct`

Finds the distinct values for a specified field across a single collection. `distinct` (page 696) returns a document that contains an array of the distinct values. The return document also contains a subdocument with query statistics and the query plan.

When possible, the `distinct` (page 696) command uses an index to find documents and return values.

The command takes the following form:

```
{ distinct: "<collection>", key: "<field>", query: <query> }
```

The command contains the following fields:

**field string distinct** The name of the collection to query for distinct values.

**field string key** The field to collect distinct values from.

**field document query** A query specification to limit the input documents in the `distinct` analysis.

**Examples** Return an array of the distinct values of the field `ord_dt` from all documents in the `orders` collection:

```
db.runCommand ({ distinct: "orders", key: "ord_dt" })
```

Return an array of the distinct values of the field `sku` in the subdocument `item` from all documents in the `orders` collection:

```
db.runCommand ({ distinct: "orders", key: "item.sku" })
```

Return an array of the distinct values of the field `ord_dt` from the documents in the `orders` collection where the `price` is greater than 10:

```
db.runCommand ({ distinct: "orders",
 key: "ord_dt",
 query: { price: { $gt: 10 } }
})
```

---

**Note:** MongoDB also provides the shell wrapper method `db.collection.distinct()` (page 812) for the `distinct` (page 696) command. Additionally, many MongoDB *drivers* also provide a wrapper method. Refer to the specific driver documentation.

---

## group

### Definition

#### group

Groups documents in a collection by the specified key and performs simple aggregation functions, such as computing counts and sums. The command is analogous to a `SELECT <...> GROUP BY` statement in SQL. The command returns a document with the grouped records as well as the command meta-data.

The `group` (page 697) command takes the following prototype form:

```
{ group: { ns: <namespace>,
 key: <key>,
 $reduce: <reduce function>,
 $keyf: <key function>,
 cond: <query>,
 finalize: <finalize function> } }
```

The `group` (page 697) command's `group` field takes as its value a subdocument with the following fields:

**field string ns** The collection from which to perform the group by operation.

**field document key** The field or fields to group. Returns a “key object” for use as the grouping key.

**field function reduce** An aggregation function that operates on the documents during the grouping operation. These functions may return a sum or a count. The function takes two arguments: the current document and an aggregation result document for that group

**field document initial** Initializes the aggregation result document.

**field function keyf** Alternative to the `key` field. Specifies a function that creates a “key object” for use as the grouping key. Use `keyf` instead of `key` to group by calculated fields rather than existing document fields.

**field document cond** The selection criteria to determine which documents in the collection to process. If you omit the `cond` field, `group` (page 697) processes all the documents in the collection for the group operation.

**field function finalize** A function that runs each item in the result set before `group` (page 697) returns the final value. This function can either modify the result document or replace the result

document as a whole. Keep in mind that, unlike the `$keyf` and `$reduce` fields that also specify a function, this field name is `finalize`, *not* `$finalize`.

**Warning:**

- The `group` (page 697) command does not work with *sharded clusters*. Use the [aggregation framework](#) or [map-reduce](#) in *sharded environments*.
- The result set must fit within the [maximum BSON document size](#) (page 1015).
- Additionally, in version 2.2, the returned array can contain at most 20,000 elements; i.e. at most 20,000 unique groupings. For group by operations that results in more than 20,000 unique groupings, use `mapReduce` (page 701). Previous versions had a limit of 10,000 elements.
- Prior to 2.4, the `group` (page 697) command took the `mongod` (page 925) instance's JavaScript lock which blocked all other JavaScript execution.

**Note:** Changed in version 2.4.

In MongoDB 2.4, `map-reduce` operations (page 701), the `group` (page 697) command, and `$where` (page 634) operator expressions **cannot** access certain global functions or properties, such as `db`, that are available in the `mongo` (page 942) shell.

When upgrading to MongoDB 2.4, you will need to refactor your code if your `map-reduce` operations (page 701), `group` (page 697) commands, or `$where` (page 634) operator expressions include any global shell functions or properties that are no longer available, such as `db`.

The following JavaScript functions and properties **are available** to `map-reduce` operations (page 701), the `group` (page 697) command, and `$where` (page 634) operator expressions in MongoDB 2.4:

| Available Properties | Available Functions             |
|----------------------|---------------------------------|
| <code>args</code>    | <code>assert()</code>           |
| <code>MaxKey</code>  | <code>BinData()</code>          |
| <code>MinKey</code>  | <code>DBPointer()</code>        |
|                      | <code>DBRef()</code>            |
|                      | <code>doassert()</code>         |
|                      | <code>emit()</code>             |
|                      | <code>gc()</code>               |
|                      | <code>HexData()</code>          |
|                      | <code>hex_md5()</code>          |
|                      | <code>isNumber()</code>         |
|                      | <code>isObject()</code>         |
|                      | <code>ISODate()</code>          |
|                      | <code>isString()</code>         |
|                      | <code>Map()</code>              |
|                      | <code>MD5()</code>              |
|                      | <code>NumberInt()</code>        |
|                      | <code>NumberLong()</code>       |
|                      | <code>ObjectId()</code>         |
|                      | <code>print()</code>            |
|                      | <code>printjson()</code>        |
|                      | <code>printjsononeline()</code> |
|                      | <code>sleep()</code>            |
|                      | <code>Timestamp()</code>        |
|                      | <code>tojson()</code>           |
|                      | <code>tojsononeline()</code>    |
|                      | <code>tojsonObject()</code>     |
|                      | <code>UUID()</code>             |
|                      | <code>version()</code>          |

For the shell, MongoDB provides a wrapper method `db.collection.group()` (page 828). However, the `db.collection.group()` (page 828) method takes the `keyf` field and the `reduce` field whereas the `group` (page 697) command takes the `$keyf` field and the `$reduce` field.

## JavaScript in MongoDB

Although `group` (page 697) uses JavaScript, most interactions with MongoDB do not use JavaScript but use an [idiomatic driver](#) (page 95) in the language of the interacting application.

**Examples** The following are examples of the `db.collection.group()` (page 828) method. The examples assume an `orders` collection with documents of the following prototype:

```
{
 _id: ObjectId("5085a95c8fada716c89d0021"),
 ord_dt: ISODate("2012-07-01T04:00:00Z"),
 ship_dt: ISODate("2012-07-02T04:00:00Z"),
 item: { sku: "abc123",
 price: 1.99,
 uom: "pcs",
 qty: 25 }
}
```

**Group by Two Fields** The following example groups by the `ord_dt` and `item.sku` fields those documents that have `ord_dt` greater than 01/01/2012:

```
db.runCommand({ group:
 {
 ns: 'orders',
 key: { ord_dt: 1, 'item.sku': 1 },
 cond: { ord_dt: { $gt: new Date('01/01/2012') } },
 $reduce: function (curr, result) { },
 initial: { }
 }
})
```

The result is a documents that contain the `retval` field which contains the group by records, the `count` field which contains the total number of documents grouped, the `keys` field which contains the number of unique groupings (i.e. number of elements in the `retval`), and the `ok` field which contains the command status:

```
{ "retval" :
 [{ "ord_dt" : ISODate("2012-07-01T04:00:00Z"), "item.sku" : "abc123" },
 { "ord_dt" : ISODate("2012-07-01T04:00:00Z"), "item.sku" : "abc456" },
 { "ord_dt" : ISODate("2012-07-01T04:00:00Z"), "item.sku" : "bcd123" },
 { "ord_dt" : ISODate("2012-07-01T04:00:00Z"), "item.sku" : "efg456" },
 { "ord_dt" : ISODate("2012-06-01T04:00:00Z"), "item.sku" : "abc123" },
 { "ord_dt" : ISODate("2012-06-01T04:00:00Z"), "item.sku" : "efg456" },
 { "ord_dt" : ISODate("2012-06-01T04:00:00Z"), "item.sku" : "ijk123" },
 { "ord_dt" : ISODate("2012-05-01T04:00:00Z"), "item.sku" : "abc123" },
 { "ord_dt" : ISODate("2012-05-01T04:00:00Z"), "item.sku" : "abc456" },
 { "ord_dt" : ISODate("2012-06-08T04:00:00Z"), "item.sku" : "abc123" },
 { "ord_dt" : ISODate("2012-06-08T04:00:00Z"), "item.sku" : "abc456" }
],
 "count" : 13,
 "keys" : 11,
 "ok" : 1 }
```

The method call is analogous to the SQL statement:

```
SELECT ord_dt, item_sku
FROM orders
WHERE ord_dt > '01/01/2012'
GROUP BY ord_dt, item_sku
```

**Calculate the Sum** The following example groups by the `ord_dt` and `item.sku` fields those documents that have `ord_dt` greater than 01/01/2012 and calculates the sum of the `qty` field for each grouping:

```
db.runCommand({ group:
 {
 ns: 'orders',
 key: { ord_dt: 1, 'item.sku': 1 },
 cond: { ord_dt: { $gt: new Date('01/01/2012') } },
 $reduce: function (curr, result) {
 result.total += curr.item.qty;
 },
 initial: { total : 0 }
 }
})
```

The `retval` field of the returned document is an array of documents that contain the group by fields and the calculated aggregation field:

```
{ "retval" :
 [{ "ord_dt" : ISODate("2012-07-01T04:00:00Z"), "item.sku" : "abc123", "total" : 25 },
 { "ord_dt" : ISODate("2012-07-01T04:00:00Z"), "item.sku" : "abc456", "total" : 25 },
 { "ord_dt" : ISODate("2012-07-01T04:00:00Z"), "item.sku" : "bcd123", "total" : 10 },
 { "ord_dt" : ISODate("2012-07-01T04:00:00Z"), "item.sku" : "efg456", "total" : 10 },
 { "ord_dt" : ISODate("2012-06-01T04:00:00Z"), "item.sku" : "abc123", "total" : 25 },
 { "ord_dt" : ISODate("2012-06-01T04:00:00Z"), "item.sku" : "efg456", "total" : 15 },
 { "ord_dt" : ISODate("2012-06-01T04:00:00Z"), "item.sku" : "ijk123", "total" : 20 },
 { "ord_dt" : ISODate("2012-05-01T04:00:00Z"), "item.sku" : "abc123", "total" : 45 },
 { "ord_dt" : ISODate("2012-05-01T04:00:00Z"), "item.sku" : "abc456", "total" : 25 },
 { "ord_dt" : ISODate("2012-06-08T04:00:00Z"), "item.sku" : "abc123", "total" : 25 },
 { "ord_dt" : ISODate("2012-06-08T04:00:00Z"), "item.sku" : "abc456", "total" : 25 }
],
 "count" : 13,
 "keys" : 11,
 "ok" : 1 }
```

The method call is analogous to the SQL statement:

```
SELECT ord_dt, item_sku, SUM(item_qty) as total
FROM orders
WHERE ord_dt > '01/01/2012'
GROUP BY ord_dt, item_sku
```

**Calculate Sum, Count, and Average** The following example groups by the calculated `day_of_week` field, those documents that have `ord_dt` greater than 01/01/2012 and calculates the sum, count, and average of the `qty` field for each grouping:

```
db.runCommand({ group:
 {
 ns: 'orders',
 $keyf: function(doc) {
 return { day_of_week: doc.ord_dt.getDay() } ;
 },
 cond: { ord_dt: { $gt: new Date('01/01/2012') } },
 $reduce: function (curr, result) {
 result.total += curr.item.qty;
 result.count++;
 },
 initial: { total : 0, count: 0 },
 finalize: function(result) {
```

```

 var weekdays = ["Sunday", "Monday", "Tuesday",
 "Wednesday", "Thursday",
 "Friday", "Saturday"];

 result.day_of_week = weekdays[result.day_of_week];
 result.avg = Math.round(result.total / result.count);
 }

}
)

```

The `retval` field of the returned document is an array of documents that contain the group by fields and the calculated aggregation field:

```

{ "retval" :
 [{ "day_of_week" : "Sunday", "total" : 70, "count" : 4, "avg" : 18 },
 { "day_of_week" : "Friday", "total" : 110, "count" : 6, "avg" : 18 },
 { "day_of_week" : "Tuesday", "total" : 70, "count" : 3, "avg" : 23 }

],
 "count" : 13,
 "keys" : 3,
 "ok" : 1
}

```

#### See also:

[Aggregation Concepts](#) (page 279)

### mapReduce

#### mapReduce

The `mapReduce` (page 701) command allows you to run *map-reduce* aggregation operations over a collection. The `mapReduce` (page 701) command has the following prototype form:

```

db.runCommand(
{
 mapReduce: <collection>,
 map: <function>,
 reduce: <function>,
 out: <output>,
 query: <document>,
 sort: <document>,
 limit: <number>,
 finalize: <function>,
 scope: <document>,
 jsMode: <boolean>,
 verbose: <boolean>
}
)

```

Pass the name of the collection to the `mapReduce` command (i.e. `<collection>`) to use as the source documents to perform the map reduce operation. The command also accepts the following parameters:

**field collection mapReduce** The name of the collection on which you want to perform map-reduce.

**field Javascript function map** A JavaScript function that associates or “maps” a value with a key and emits the key and value pair. See [Requirements for the map Function](#) (page 703) for more information.

**field JavaScript function reduce** A JavaScript function that “reduces” to a single object all the values associated with a particular key. See [Requirements for the reduce Function](#) (page 704) for more information.

**field string out** Specifies the location of the result of the map-reduce operation. You can output to a collection, output to a collection with an action, or output inline. You may output to a collection when performing map reduce operations on the primary members of the set; on [secondary](#) members you may only use the [inline](#) output. See [out Options](#) (page 704) for more information.

**field document query** Specifies the selection criteria using [query operators](#) (page 621) for determining the documents input to the map function.

**field document sort** Sorts the *input* documents. This option is useful for optimization. For example, specify the sort key to be the same as the emit key so that there are fewer reduce operations. The sort key must be in an existing index for this collection.

**field number limit** Specifies a maximum number of documents to return from the collection.

**field Javascript function finalize** Follows the `reduce` method and modifies the output. See [Requirements for the finalize Function](#) (page 705) for more information.

**field document scope** Specifies global variables that are accessible in the `map`, `reduce` and `finalize` functions.

**field Boolean jsMode** Optional. Specifies whether to convert intermediate data into BSON format between the execution of the `map` and `reduce` functions. Defaults to `false`. If `false`: - Internally, MongoDB converts the JavaScript objects emitted by the `map` function to BSON objects. These BSON objects are then converted back to JavaScript objects when calling the `reduce` function. - The map-reduce operation places the intermediate BSON objects in temporary, on-disk storage. This allows the map-reduce operation to execute over arbitrarily large data sets. If `true`: - Internally, the JavaScript objects emitted during `map` function remain as JavaScript objects. There is no need to convert the objects for the `reduce` function, which can result in faster execution. - You can only use `jsMode` for result sets with fewer than 500,000 distinct key arguments to the mapper's `emit()` function. The `jsMode` defaults to `false`.

**field Boolean verbose** Specifies whether to include the `timing` information in the result information. The `verbose` defaults to `true` to include the `timing` information.

The following is a prototype usage of the [mapReduce](#) (page 701) command:

```
var mapFunction = function() { ... };
var reduceFunction = function(key, values) { ... };

db.runCommand(
{
 mapReduce: 'orders',
 map: mapFunction,
 reduce: reduceFunction,
 out: { merge: 'map_reduce_results', db: 'test' },
 query: { ord_date: { $gt: new Date('01/01/2012') } }
})
```

---

## JavaScript in MongoDB

Although [mapReduce](#) (page 701) uses JavaScript, most interactions with MongoDB do not use JavaScript but use an [idiomatic driver](#) (page 95) in the language of the interacting application.

---

**Note:** Changed in version 2.4.

In MongoDB 2.4, [map-reduce operations](#) (page 701), the [group](#) (page 697) command, and [\\$where](#) (page 634) operator expressions **cannot** access certain global functions or properties, such as `db`, that are available in the [mongo](#) (page 942) shell.

When upgrading to MongoDB 2.4, you will need to refactor your code if your [map-reduce operations](#) (page 701), [group](#) (page 697) commands, or [\\$where](#) (page 634) operator expressions include any global shell functions or properties that are no longer available, such as `db`.

The following JavaScript functions and properties **are available** to [map-reduce operations](#) (page 701), the [group](#) (page 697) command, and [\\$where](#) (page 634) operator expressions in MongoDB 2.4:

| Available Properties | Available Functions      |                                 |
|----------------------|--------------------------|---------------------------------|
| <code>args</code>    | <code>assert()</code>    | <code>Map()</code>              |
| <code>MaxKey</code>  | <code>BinData()</code>   | <code>MD5()</code>              |
| <code>MinKey</code>  | <code>DBPointer()</code> | <code>NumberInt()</code>        |
|                      | <code>DBRef()</code>     | <code>NumberLong()</code>       |
|                      | <code>doassert()</code>  | <code>ObjectId()</code>         |
|                      | <code>emit()</code>      | <code>print()</code>            |
|                      | <code>gc()</code>        | <code>printjson()</code>        |
|                      | <code>HexData()</code>   | <code>printjsononeline()</code> |
|                      | <code>hex_md5()</code>   | <code>sleep()</code>            |
|                      | <code>isNumber()</code>  | <code>Timestamp()</code>        |
|                      | <code>isObject()</code>  | <code>tojson()</code>           |
|                      | <code>ISODATE()</code>   | <code>tojsononeline()</code>    |
|                      | <code>isString()</code>  | <code>tojsonObject()</code>     |
|                      |                          | <code>UUID()</code>             |
|                      |                          | <code>version()</code>          |

**Requirements for the `map` Function** The `map` function has the following prototype:

```
function() {
 ...
 emit(key, value);
}
```

The `map` function exhibits the following behaviors:

- In the `map` function, reference the current document as `this` within the function.
- The `map` function should *not* access the database for any reason.
- The `map` function should be pure, or have *no* impact outside of the function (i.e. side effects.)
- The `emit(key, value)` function associates the `key` with a `value`.
  - A single `emit` can only hold half of MongoDB's [maximum BSON document size](#) (page 1015).
  - The `map` function can call `emit(key, value)` any number of times, including 0, per each input document.

The following `map` function may call `emit(key, value)` either 0 or 1 times depending on the value of the input document's `status` field:

```
function() {
 if (this.status == 'A')
 emit(this.cust_id, 1);
}
```

The following map function may call `emit(key, value)` multiple times depending on the number of elements in the input document's `items` field:

```
function() {
 this.items.forEach(function(item) { emit(item.sku, 1); });
}
```

- The `map` function can access the variables defined in the `scope` parameter.

#### Requirements for the `reduce` Function

The `reduce` function has the following prototype:

```
function(key, values) {
 ...
 return result;
}
```

The `reduce` function exhibits the following behaviors:

- The `reduce` function should *not* access the database, even to perform read operations.
- The `reduce` function should *not* affect the outside system.
- MongoDB will **not** call the `reduce` function for a key that has only a single value. The `values` argument is an array whose elements are the `value` objects that are “mapped” to the key.
- MongoDB can invoke the `reduce` function more than once for the same key. In this case, the previous output from the `reduce` function for that key will become one of the input values to the next `reduce` function invocation for that key.
- The `reduce` function can access the variables defined in the `scope` parameter.

Because it is possible to invoke the `reduce` function more than once for the same key, the following properties need to be true:

- the `type` of the return object must be **identical** to the type of the `value` emitted by the `map` function to ensure that the following operations is true:

```
reduce(key, [C, reduce(key, [A, B])]) == reduce(key, [C, A, B])
```

- the `reduce` function must be *idempotent*. Ensure that the following statement is true:

```
reduce(key, [reduce(key, valuesArray)]) == reduce(key, valuesArray)
```

- the order of the elements in the `valuesArray` should not affect the output of the `reduce` function, so that the following statement is true:

```
reduce(key, [A, B]) == reduce(key, [B, A])
```

#### `out` Options

You can specify the following options for the `out` parameter:

##### Output to a Collection

```
out: <collectionName>
```

**Output to a Collection with an Action** This option is only available when passing `out` a collection that already exists. This option is not available on secondary members of replica sets.

```
out: { <action>: <collectionName>
 [, db: <dbName>]
 [, sharded: <boolean>]
 [, nonAtomic: <boolean>] }
```

When you output to a collection with an action, the `out` has the following parameters:

- `<action>`: Specify one of the following actions:

- `replace`

Replace the contents of the `<collectionName>` if the collection with the `<collectionName>` exists.

- `merge`

Merge the new result with the existing result if the output collection already exists. If an existing document has the same key as the new result, *overwrite* that existing document.

- `reduce`

Merge the new result with the existing result if the output collection already exists. If an existing document has the same key as the new result, apply the `reduce` function to both the new and the existing documents and overwrite the existing document with the result.

- `db`:

Optional. The name of the database that you want the map-reduce operation to write its output. By default this will be the same database as the input collection.

- `sharded`:

Optional. If `true` and you have enabled sharding on output database, the map-reduce operation will shard the output collection using the `_id` field as the shard key.

- `nonAtomic`:

New in version 2.2.

Optional. Specify output operation as non-atomic and is valid *only* for `merge` and `reduce` output modes which may take minutes to execute.

If `nonAtomic` is `true`, the post-processing step will prevent MongoDB from locking the database; however, other clients will be able to read intermediate states of the output collection. Otherwise the map reduce operation must lock the database during post-processing.

**Output Inline** Perform the map-reduce operation in memory and return the result. This option is the only available option for `out` on secondary members of replica sets.

```
out: { inline: 1 }
```

The result must fit within the [maximum size of a BSON document](#) (page 1015).

**Requirements for the `finalize` Function** The `finalize` function has the following prototype:

```
function(key, reducedValue) {
 ...
 return modifiedObject;
}
```

The `finalize` function receives as its arguments a `key` value and the `reducedValue` from the `reduce` function. Be aware that:

- The `finalize` function should *not* access the database for any reason.
- The `finalize` function should be pure, or have *no* impact outside of the function (i.e. side effects.)
- The `finalize` function can access the variables defined in the `scope` parameter.

**Examples** In the [mongo](#) (page 942) shell, the `db.collection.mapReduce()` (page 837) method is a wrapper around the [mapReduce](#) (page 701) command. The following examples use the `db.collection.mapReduce()` (page 837) method:

Consider the following map-reduce operations on a collection `orders` that contains documents of the following prototype:

```
{
 _id: ObjectId("50a8240b927d5d8b5891743c"),
 cust_id: "abc123",
 ord_date: new Date("Oct 04, 2012"),
 status: 'A',
 price: 25,
 items: [{ sku: "mmm", qty: 5, price: 2.5 },
 { sku: "nnn", qty: 5, price: 2.5 }]
}
```

**Return the Total Price Per Customer** Perform the map-reduce operation on the `orders` collection to group by the `cust_id`, and calculate the sum of the `price` for each `cust_id`:

1. Define the map function to process each input document:

- In the function, `this` refers to the document that the map-reduce operation is processing.
- The function maps the `price` to the `cust_id` for each document and emits the `cust_id` and `price` pair.

```
var mapFunction1 = function() {
 emit(this.cust_id, this.price);
};
```

2. Define the corresponding reduce function with two arguments `keyCustId` and `valuesPrices`:

- The `valuesPrices` is an array whose elements are the `price` values emitted by the map function and grouped by `keyCustId`.
- The function reduces the `valuesPrice` array to the sum of its elements.

```
var reduceFunction1 = function(keyCustId, valuesPrices) {
 return Array.sum(valuesPrices);
};
```

3. Perform the map-reduce on all documents in the `orders` collection using the `mapFunction1` map function and the `reduceFunction1` reduce function.

```
db.orders.mapReduce(
 mapFunction1,
 reduceFunction1,
 { out: "map_reduce_example" }
)
```

This operation outputs the results to a collection named `map_reduce_example`. If the `map_reduce_example` collection already exists, the operation will replace the contents with the results of this map-reduce operation:

**Calculate Order and Total Quantity with Average Quantity Per Item** In this example, you will perform a map-reduce operation on the `orders` collection for all documents that have an `ord_date` value greater than 01/01/2012. The operation groups by the `item.sku` field, and calculates the number of orders and the total quantity ordered for each sku. The operation concludes by calculating the average quantity per order for each sku value:

1. Define the map function to process each input document:

- In the function, `this` refers to the document that the map-reduce operation is processing.
- For each item, the function associates the `sku` with a new object `value` that contains the `count` of 1 and the item `qty` for the order and emits the `sku` and `value` pair.

```
var mapFunction2 = function() {
 for (var idx = 0; idx < this.items.length; idx++) {
 var key = this.items[idx].sku;
 var value = {
 count: 1,
 qty: this.items[idx].qty
 };
 emit(key, value);
 }
};
```

2. Define the corresponding reduce function with two arguments `keySKU` and `countObjVals`:

- `countObjVals` is an array whose elements are the objects mapped to the grouped `keySKU` values passed by map function to the reducer function.
- The function reduces the `countObjVals` array to a single object `reducedValue` that contains the `count` and the `qty` fields.
- In `reducedVal`, the `count` field contains the sum of the `count` fields from the individual array elements, and the `qty` field contains the sum of the `qty` fields from the individual array elements.

```
var reduceFunction2 = function(keySKU, countObjVals) {
 reducedVal = { count: 0, qty: 0 };

 for (var idx = 0; idx < countObjVals.length; idx++) {
 reducedVal.count += countObjVals[idx].count;
 reducedVal.qty += countObjVals[idx].qty;
 }

 return reducedVal;
};
```

3. Define a finalize function with two arguments `key` and `reducedVal`. The function modifies the `reducedVal` object to add a computed field named `avg` and returns the modified object:

```
var finalizeFunction2 = function (key, reducedVal) {
 reducedVal.avg = reducedVal.qty/reducedVal.count;

 return reducedVal;
};
```

4. Perform the map-reduce operation on the `orders` collection using the `mapFunction2`, `reduceFunction2`, and `finalizeFunction2` functions.

```
db.orders.mapReduce(mapFunction2,
 reduceFunction2,
 {
 out: { merge: "map_reduce_example" },
 query: { ord_date:
 { $gt: new Date('01/01/2012') }
 },
 finalize: finalizeFunction2
 }
)
```

This operation uses the `query` field to select only those documents with `ord_date` greater than `new Date('01/01/2012')`. Then it output the results to a collection `map_reduce_example`. If the `map_reduce_example` collection already exists, the operation will merge the existing contents with the results of this map-reduce operation.

For more information and examples, see the [Map-Reduce](#) (page 282) page and [Perform Incremental Map-Reduce](#) (page 300).

#### See also:

- [Troubleshoot the Map Function](#) (page 302)
- [Troubleshoot the Reduce Function](#) (page 303)
- `db.collection.mapReduce()` (page 837)
- [Aggregation Concepts](#) (page 279)

For a detailed comparison of the different approaches, see [Aggregation Commands Comparison](#) (page 306).

## Geospatial Commands

|                            | Name                                 | Description                                                                                   |
|----------------------------|--------------------------------------|-----------------------------------------------------------------------------------------------|
| <b>Geospatial Commands</b> | <a href="#">geoNear</a> (page 708)   | Performs a geospatial query that returns the documents closest to a given point.              |
|                            | <a href="#">geoSearch</a> (page 709) | Performs a geospatial query that uses MongoDB's <a href="#">haystack index</a> functionality. |
|                            | <a href="#">geoWalk</a> (page 710)   | An internal command to support geospatial queries.                                            |

### geoNear

#### Definition

##### [geoNear](#)

Specifies a point for which a [geospatial](#) query returns the closest documents first. The query returns the documents from nearest to farthest. The `geoNear` (page 708) command provides an alternative to the `$near` (page 637) operator. In addition to the functionality of `$near` (page 637), `geoNear` (page 708) returns additional diagnostic information.

The `geoNear` (page 708) command can use either a [GeoJSON](#) point or [legacy coordinate pairs](#). Queries that use a `2d` index return a limit of 100 documents.

The `geoNear` (page 708) command accepts a [document](#) that contains the following fields. Specify all distances in the same units as the document coordinate system:

**field string geoNear** The collection to query.

:field GeoJSON point,:term:*legacy coordinate pairs* <*legacy coordinate pairs*> near:

The point for which to find the closest documents.

**field number limit** The maximum number of documents to return. The default value is 100. See also the num option.

**field number num** The num option provides the same function as the limit option. Both define the maximum number of documents to return. If both options are included, the num value overrides the limit value.

**field number maxDistance** A distance from the center point. Specify the distance in meters for [GeoJSON](#) data and in radians for [legacy coordinate pairs](#). MongoDB limits the results to those documents that fall within the specified distance from the center point.

**field document query** Limits the results to the documents that match the query. The query syntax is the usual MongoDB [read operation query](#) (page 68) syntax.

**field Boolean spherical** If true, MongoDB references points using a spherical surface. The default value is false.

**field number distanceMultiplier** The factor to multiply all distances returned by the query. For example, use the distanceMultiplier to convert radians, as returned by a spherical query, to kilometers by multiplying by the radius of the Earth.

**field Boolean includeLocs** If this is true, the query returns the location of the matching documents in the results. The default is false. This option is useful when a location field contains multiple locations. To specify a field within a subdocument, use [dot notation](#).

**field Boolean uniqueDocs** If this value is true, the query returns a matching document once, even if more than one of the document's location fields match the query. If this value is false, the query returns a document multiple times if the document has multiple matching location fields. See [\\$uniqueDocs](#) (page 643) for more information.

## Command Format

To query a [2dsphere](#) (page 328) index, use the following syntax:

```
db.runCommand({ geoNear : <collection> ,
 near : { type : "Point" ,
 coordinates: [<coordinates>] } ,
 spherical : true })
```

To query a [2d](#) (page 330) index, use:

```
{ geoNear : <collection> , near : [<coordinates>] }
```

## geoSearch

### geoSearch

The [geoSearch](#) (page 709) command provides an interface to MongoDB's [haystack index](#) functionality. These indexes are useful for returning results based on location coordinates *after* collecting results based on some other query (i.e. a "haystack.") Consider the following example:

```
{ geoSearch : "places" , near : [33, 33] , maxDistance : 6 , search : { type : "restaurant" } , limi
```

The above command returns all documents with a type of restaurant having a maximum distance of 6 units from the coordinates [30, 33] in the collection places up to a maximum of 30 results.

Unless specified otherwise, the [geoSearch](#) (page 709) command limits results to 50 documents.

**geoWalk****geoWalk**

[geoWalk](#) (page 710) is an internal command.

**Query and Write Operation Commands****Query and Write Operation Commands**

| Name                                        | Description                                                                         |
|---------------------------------------------|-------------------------------------------------------------------------------------|
| <a href="#">findAndModify</a><br>(page 710) | Returns and modifies a single document.                                             |
| <a href="#">text</a> (page 715)             | Performs a text search.                                                             |
| <a href="#">getLastError</a><br>(page 720)  | Returns the success status of the last operation.                                   |
| <a href="#">getPrevError</a><br>(page 721)  | Returns status document containing all errors since the last<br>(page 722) command. |
| <a href="#">resetError</a> (page 722)       | Resets the last error status.                                                       |
| <a href="#">eval</a> (page 722)             | Runs a JavaScript function on the database server.                                  |

**findAndModify****findAndModify**

The [findAndModify](#) (page 710) command atomically modifies and returns a single document. By default, the returned document does not include the modifications made on the update. To return the document with the modifications made on the update, use the `new` option.

The command has the following syntax:

```
{
 findAndModify: <string>,
 query: <document>,
 sort: <document>,
 remove: <boolean>,
 update: <document>,
 new: <boolean>,
 fields: <document>,
 upsert: <boolean>
}
```

The [findAndModify](#) (page 710) command takes the following fields:

**Fields**

- **findAndModify** (*string*) – Required. The collection against which to run the command.
- **query** (*document*) – Optional. Specifies the selection criteria for the modification. The `query` field employs the same [query selectors](#) (page 621) as used in the [find\(\)](#) (page 816) method. Although the query may match multiple documents, [findAndModify](#) (page 710) will only select one document to modify.
- **sort** (*document*) – Optional. Determines which document the operation will modify if the query selects multiple documents. [findAndModify](#) (page 710) will modify the first document in the sort order specified by this argument.
- **remove** (*boolean*) – Must specify either the `remove` or the `update` field in the [findAndModify](#) (page 710) command. When `true`, removes the selected document. The default is `false`.

- **update (document)** – Must specify either the `remove` or the `update` field in the `findAndModify` (page 710) command. The `update` field employs the same *update operators* (page 651) or `field: value` specifications to modify the selected document.
- **new (boolean)** – Optional. When `true`, returns the modified document rather than the original. The `findAndModify` (page 710) method ignores the `new` option for `remove` operations. The default is `false`.
- **fields (document)** – Optional. A subset of fields to return. The `fields` document specifies an inclusion of a field with `1`, as in the following:

```
fields: { <field1>: 1, <field2>: 1, ... }
```

See *projection* (page 72).

- **upsert (boolean)** – Optional. Used in conjunction with the `update` field. When `true`, the `findAndModify` (page 710) command creates a new document if the query returns no documents. The default is `false`.

The `findAndModify` (page 710) command returns a document, similar to the following:

```
{
 lastErrorObject: {
 updatedExisting: <boolean>,
 upserted: <boolean>,
 n: <num>,
 connectionId: <num>,
 err: <string>,
 ok: <num>
 }
 value: <document>,
 ok: <num>
}
```

The return document contains the following fields:

- The `lastErrorObject` field that returns the details of the command:
  - The `updatedExisting` field **only** appears if the command is either an `update` or an `upsert`.
  - The `upserted` field **only** appears if the command is an `upsert`.
- The `value` field that returns either:
  - the original (i.e. pre-modification) document if `new` is `false`, or
  - the modified or inserted document if `new: true`.
- The `ok` field that returns the status of the command.

---

**Note:** If the `findAndModify` (page 710) finds no matching document, then:

- for `update` or `remove` operations, `lastErrorObject` does not appear in the return document and the `value` field holds a `null`.
 

```
{ "value" : null, "ok" : 1 }
```
- for an `upsert` operation that performs an insert, when `new` is `false`, **and** includes a `sort` option, the return document has `lastErrorObject`, `value`, and `ok` fields, but the `value` field holds an empty document {}.
- for an `upsert` that performs an insert, when `new` is `false` **without** a specified `sort` the return document has `lastErrorObject`, `value`, and `ok` fields, but the `value` field holds a `null`.

Changed in version 2.2: Previously, the command returned an empty document (e.g. `{}`) in the `value` field. See [the 2.2 release notes](#) (page 1053) for more information.

---

Consider the following examples:

- The following command updates an existing document in the `people` collection where the document matches the `query` criteria:

```
db.runCommand(
 {
 findAndModify: "people",
 query: { name: "Tom", state: "active", rating: { $gt: 10 } },
 sort: { rating: 1 },
 update: { $inc: { score: 1 } }
 }
)
```

This command performs the following actions:

1. The `query` finds a document in the `people` collection where the `name` field has the value `Tom`, the `state` field has the value `active` and the `rating` field has a value `greater than` (page 622) 10.
2. The `sort` orders the results of the query in ascending order. If multiple documents meet the `query` condition, the command will select for modification the first document as ordered by this `sort`.
3. The `update` `increments` (page 651) the value of the `score` field by 1.
4. The command returns a document with the following fields:
  - The `lastErrorObject` field that contains the details of the command, including the field `updatedExisting` which is `true`, and
  - The `value` field that contains the original (i.e. pre-modification) document selected for this update:

```
{
 "lastErrorObject" : {
 "updatedExisting" : true,
 "n" : 1,
 "connectionId" : 1,
 "err" : null,
 "ok" : 1
 },
 "value" : {
 "_id" : ObjectId("50f1d54e9beb36a0f45c6452"),
 "name" : "Tom",
 "state" : "active",
 "rating" : 100,
 "score" : 5
 },
 "ok" : 1
}
```

To return the modified document in the `value` field, add the `new:true` option to the command.

If no document match the `query` condition, the command returns a document that contains `null` in the `value` field:

```
{ "value" : null, "ok" : 1 }
```

The `mongo` (page 942) shell and many *drivers* provide a `findAndModify()` (page 821) helper method. Using the shell helper, this previous operation can take the following form:

```
db.people.findAndModify({
 query: { name: "Tom", state: "active", rating: { $gt: 10 } },
 sort: { rating: 1 },
 update: { $inc: { score: 1 } }
});
```

However, the `findAndModify()` (page 821) shell helper method returns just the unmodified document, or the modified document when `new` is `true`.

```
{
 "_id" : ObjectId("50f1d54e9beb36a0f45c6452"),
 "name" : "Tom",
 "state" : "active",
 "rating" : 100,
 "score" : 5
}
```

- The following `findAndModify` (page 710) command includes the `upsert: true` option to insert a new document if no document matches the `query` condition:

```
db.runCommand(
 {
 findAndModify: "people",
 query: { name: "Gus", state: "active", rating: 100 },
 sort: { rating: 1 },
 update: { $inc: { score: 1 } },
 upsert: true
 }
)
```

If the command does **not** find a matching document, the command performs an upsert and returns a document with the following fields:

- The `lastErrorObject` field that contains the details of the command, including the field `upserted` that contains the `ObjectId` of the newly inserted document, and
- The `value` field that contains an empty document {} as the original document because the command included the `sort` option:

```
{
 "lastErrorObject" : {
 "updatedExisting" : false,
 "upserted" : ObjectId("50f2329d0092b46dae1dc98e"),
 "n" : 1,
 "connectionId" : 1,
 "err" : null,
 "ok" : 1
 },
 "value" : {

 },
 "ok" : 1
}
```

If the command did **not** include the `sort` option, the `value` field would contain `null`:

```
{
 "value" : null,
 "lastErrorObject" : {
 "updatedExisting" : false,
 "n" : 1,
 "upserted" : ObjectId("5102f7540cb5c8be998c2e99")
 },
 "ok" : 1
}
```

- The following [findAndModify](#) (page 710) command includes both `upsert: true` option and the `new:true` option to return the newly inserted document in the `value` field if a document matching the query is not found:

```
db.runCommand(
 {
 findAndModify: "people",
 query: { name: "Pascal", state: "active", rating: 25 },
 sort: { rating: 1 },
 update: { $inc: { score: 1 } },
 upsert: true,
 new: true
 }
)
```

The command returns the newly inserted document in the `value` field:

```
{
 "lastErrorObject" : {
 "updatedExisting" : false,
 "upserted" : ObjectId("50f47909444c11ac2448a5ce"),
 "n" : 1,
 "connectionId" : 1,
 "err" : null,
 "ok" : 1
 },
 "value" : {
 "_id" : ObjectId("50f47909444c11ac2448a5ce"),
 "name" : "Pascal",
 "rating" : 25,
 "score" : 1,
 "state" : "active"
 },
 "ok" : 1
}
```

When the [findAndModify](#) (page 710) command includes the `upsert: true` option **and** the query field(s) is not uniquely indexed, the method could insert a document multiple times in certain circumstances. For instance, if multiple clients issue the [findAndModify](#) (page 710) command and these commands complete the `find` phase before any one starts the `modify` phase, these commands could insert the same document.

Consider an example where no document with the name Andy exists and multiple clients issue the following command:

```
db.runCommand(
 {
 findAndModify: "people",
 query: { name: "Andy" },
 sort: { rating: 1 },
 upsert: true,
 new: true
 })
```

```

 update: { $inc: { score: 1 } },
 upsert: true
 }
)

```

If all the commands finish the `query` phase before any command starts the `modify` phase, **and** there is no unique index on the `name` field, the commands may all perform an upsert. To prevent this condition, create a [unique index](#) (page 334) on the `name` field. With the unique index in place, then the multiple `findAndModify` (page 710) commands would observe one of the following behaviors:

- Exactly one `findAndModify` (page 710) would successfully insert a new document.
- Zero or more `findAndModify` (page 710) commands would update the newly inserted document.
- Zero or more `findAndModify` (page 710) commands would fail when they attempted to insert a duplicate. If the command fails due to a unique index constraint violation, you can retry the command. Absent a delete of the document, the retry should not fail.

**Warning:** When using `findAndModify` (page 710) in a `sharded` environment, the `query` must contain the `shard key` for all operations against the shard cluster. `findAndModify` (page 710) operations issued against `mongos` (page 938) instances for non-sharded collections function normally.

---

**Note:** This command obtains a write lock on the affected database and will block other operations until it has completed; however, typically the write lock is short lived and equivalent to other similar `update()` (page 849) operations.

---

## text

### Definition

#### text

New in version 2.4.

Searches text content stored in the [text index](#) (page 332). The `text` (page 715) command is **case-insensitive**.

The `text` (page 715) command returns all documents that contain any of the terms; i.e. it performs a logical OR search. By default, the command limits the matches to the top 100 scoring documents, in descending score order, but you can specify a different limit.

The `text` (page 715) command has the following syntax:

```
db.collection.runCommand("text", { search: <string>,
 filter: <document>,
 project: <document>,
 limit: <number>,
 language: <string> })
```

The `text` (page 715) command has the following parameters:

**field string search** A string of terms that MongoDB parses and uses to query the `text` index. Enclose the string of terms in escaped double quotes to match on the phrase. For further information on the `search` field syntax, see [The search Field](#) (page 716).

**field document filter** A `query document` to further limit the results of the query using another database field. Use any valid MongoDB query in the filter document, except if the index includes an ascending or descending index field as a prefix. If the index includes an ascending or

descending index field as a prefix, the `filter` is required and the `filter` query must be an equality match.

**field document project** Limits the fields returned by the query to only those specified. By default, the `_id` field returns as part of the result set, *unless* you explicitly exclude the field in the project document.

**field number limit** The maximum number of documents to include in the response. The [text](#) (page 715) command sorts the results before applying the `limit`. The default limit is 100.

**field string language** The language that determines the list of stop words for the search and the rules for the stemmer and tokenizer. If not specified, the search uses the default language of the index. For supported languages, see [Text Search Languages](#) (page 719). Specify the language in **lowercase**.

**Returns** The [text](#) (page 715) command returns a document that contains a field `results` that contains an array of the highest scoring documents, in descending order by score. See [Output](#) (page 718) for details.

**Warning:** The complete results of the [text](#) (page 715) command must fit within the [BSON Document Size](#) (page 1015). Otherwise, the command will limit the results to fit within the [BSON Document Size](#) (page 1015). Use the `limit` and the `project` parameters with the [text](#) (page 715) command to limit the size of the result set.

---

**Note:**

- If the search string includes phrases, the search performs an AND with any other terms in the search string; e.g. search for "`\"twinkle twinkle\" little star`" searches for "twinkle twinkle" **and** ("little" **or** "star").
  - [text](#) (page 715) adds all negations to the query with the logical AND operator.
  - The [text](#) (page 715) command ignores stop words for the search language, such as the and and in English.
  - The [text](#) (page 715) command matches on the complete *stemmed* word. So if a document field contains the word blueberry, a search on the term blue will not match. However, blueberry or blueberries will match.
- 

**Note:** You cannot combine the [text](#) (page 715) command, which requires a special [text index](#) (page 332), with a query operator that requires a different type of special index. For example you cannot combine [text](#) (page 715) with the `$near` (page 637) operator.

---

**The search Field** The `search` field takes a string of terms that MongoDB parses and uses to query the `text` index. Enclose the string of terms in escaped double quotes to match on the phrase. Additionally, the [text](#) (page 715) command treats most punctuation as delimiters, except when a hyphen – negates terms.

Prefixing a word with a hyphen sign (-) negates a word:

- The negated word excludes documents that contain the negated word from the result set.
- A search string that only contains negated words returns **no** match.
- A hyphenated word, such as `pre-market`, is not a negation. The `text` command treats the hyphen as a delimiter.

**Examples** The following examples assume a collection `articles` that has a text index on the field `subject`:

```
db.articles.ensureIndex({ subject: "text" })
```

### Search for a Single Word

```
db.articles.runCommand("text", { search: "coffee" })
```

This query returns documents that contain the word `coffee`, case-insensitive, in the indexed `subject` field.

**Search for Multiple Words** The following command searches for `bake` or `coffee` or `cake`:

```
db.articles.runCommand("text", { search: "bake coffee cake" })
```

This query returns documents that contain either `bake` **or** `coffee` **or** `cake` in the indexed `subject` field.

### Search for a Phrase

```
db.articles.runCommand("text", { search: "\"bake coffee cake\"" })
```

This query returns documents that contain the phrase `bake coffee cake`.

**Exclude a Term from the Result Set** Use the hyphen (-) as a prefix to exclude documents that contain a term. Search for documents that contain the words `bake` or `coffee` but do **not** contain `cake`:

```
db.articles.runCommand("text", { search: "bake coffee -cake" })
```

**Search with Additional Query Conditions** Use the `filter` option to include additional query conditions.

Search for a single word `coffee` with an additional filter on the `about` field, but limit the results to 2 documents with the highest score and return only the `subject` field in the matching documents:

```
db.articles.runCommand("text", {
 search: "coffee",
 filter: { about: "/desserts/" },
 limit: 2,
 project: { subject: 1, _id: 0 }
})
```

- The `filter` *query document* may use any of the available [query operators](#) (page 621).
- Because the `_id` field is implicitly included, in order to return **only** the `subject` field, you must explicitly exclude (0) the `_id` field. Within the `project` document, you cannot mix inclusions (i.e. `<fieldA>: 1`) and exclusions (i.e. `<fieldB>: 0`), except for the `_id` field.

**Search a Different Language** Use the `language` option to specify Spanish as the language that determines the list of stop words and the rules for the stemmer and tokenizer:

```
db.articles.runCommand("text", {
 search: "leche",
 language: "spanish"
})
```

See [Text Search Languages](#) (page 719) for the supported languages.

---

**Important:** Specify the language in **lowercase**.

---

**Output** The following is an example document returned by the [text](#) (page 715) command:

```
{
 "queryDebugString" : "tomorrow|||||",
 "language" : "english",
 "results" : [
 {
 "score" : 1.3125,
 "obj": {
 "_id" : ObjectId("50ecef5f8abea0fda30ceab3"),
 "quote" : "tomorrow, and tomorrow, and tomorrow, creeps in this petty pace",
 "related_quotes" : [
 "is this a dagger which I see before me?",
 "the handle toward my hand?"
],
 "src" : {
 "title" : "Macbeth",
 "from" : "Act V, Scene V"
 },
 "speaker" : "macbeth"
 }
 }
],
 "stats" : {
 "nscanned" : 1,
 "nscannedObjects" : 0,
 "n" : 1,
 "nfound" : 1,
 "timeMicros" : 163
 },
 "ok" : 1
}
```

The [text](#) (page 715) command returns the following data:

**text.queryDebugString**

For internal use only.

**text.language**

The [language](#) (page 718) field returns the language used for the text search. This language determines the list of stop words and the rules for the stemmer and tokenizer.

**text.results**

The [results](#) (page 718) field returns an array of result documents that contain the information on the matching documents. The result documents are ordered by the [score](#) (page 718). Each result document contains:

**text.results.obj**

The [obj](#) (page 718) field returns the actual document from the collection that contained the stemmed term or terms.

**text.results.score**

The [score](#) (page 718) field for the document that contained the stemmed term or terms. The [score](#) (page 718) field signifies how well the document matched the stemmed term or terms. See [Control Search Results with Weights](#) (page 364) for how you can adjust the scores for the matching words.

**text.stats**

The `stats` (page 718) field returns a document that contains the query execution statistics. The `stats` (page 718) field contains:

**text.stats.nscanned**

The `nscanned` (page 719) field returns the total number of index entries scanned.

**text.stats.nscannedObjects**

The `nscannedObjects` (page 719) field returns the total number of documents scanned.

**text.stats.n**

The `n` (page 719) field returns the number of elements in the `results` (page 718) array. This number may be less than the total number of matching documents, i.e. `nfound` (page 719), if the full result exceeds the `BSON Document Size` (page 1015).

**text.stats.nfound**

The `nfound` (page 719) field returns the total number of documents that match. This number may be greater than the size of the `results` (page 718) array, i.e. `n` (page 719), if the result set exceeds the `BSON Document Size` (page 1015).

**text.stats.timeMicros**

The `timeMicros` (page 719) field returns the time in microseconds for the search.

**text.ok**

The `ok` (page 719) returns the status of the `text` (page 715) command.

**Text Search Languages** The `text index` (page 332) and the `text` (page 715) command support the following languages:

- danish
- dutch
- english
- finnish
- french
- german
- hungarian
- italian
- norwegian
- portuguese
- romanian
- russian
- spanish
- swedish
- turkish

---

**Note:** If you specify a language value of "none", then the text search has no list of stop words, and the text search does not stem or tokenize the search terms.

---

**getLastError**

**Definition****getLastError**

Returns the error status of the preceding operation on the *current connection*. Clients typically use [getLastError](#) (page 720) in combination with write operations to ensure that the write succeeds.

**field Boolean j** If `true`, wait for the next journal commit before returning, rather than waiting for a full disk flush. If [mongod](#) (page 925) does not have journaling enabled, this option has no effect. If this option is enabled for a write operation, [mongod](#) (page 925) will wait *no more* than 1/3 of the current [journalCommitInterval](#) (page 995) before writing data to the journal.

**field integer,string w** When running with replication, this is the number of servers to replicate to before returning. A `w` value of 1 indicates the primary only. A `w` value of 2 includes the primary and at least one secondary, etc. In place of a number, you may also set `w` to `majority` to indicate that the command should wait until the latest write propagates to a majority of replica set members. If using `w`, you should also use `wtimeout`. Specifying a value for `w` without also providing a `wtimeout` may cause [getLastError](#) (page 720) to block indefinitely.

**field Boolean fsync** If `true`, wait for [mongod](#) (page 925) to write this data to disk before returning. Defaults to `false`. In most cases, use the `j` option to ensure durability and consistency of the data set.

**field integer wtimeout** Milliseconds. Specify a value in milliseconds to control how long to wait for write propagation to complete. If replication does not complete in the given timeframe, the [getLastError](#) (page 720) command will return with an error status.

The following is the prototype form:

```
{ getLastError: 1 }
```

**See also:**

[Write Concern](#) (page 55), [Write Concern Reference](#) (page 96), and [Replica Acknowledged](#) (page 57).

**Output** Each `getLastError()` command returns a document containing a subset of the fields listed below.

**getLastError.ok**

`getLastError.ok` (page 720) is `true` when the [getLastError](#) (page 720) command completes successfully.

---

**Note:** A value of `true` does *not* indicate that the preceding operation did not produce an error.

---

**getLastError.err**

`getLastError.err` (page 720) is `null` unless an error occurs. When there was an error with the proceeding operation, `err` contains a textual description of the error.

**getLastError.code**

`getLastError.code` (page 720) reports the preceding operation's error code.

**getLastError.connectionId**

The identifier of the connection.

**getLastError.lastOp**

When issued against a replica set member and the preceding operation was a write or update, `getLastError.lastOp` (page 720) is the *optime* timestamp in the *oplog* of the change.

**getLastError.n**

`getLastError.n` reports the number of documents updated or removed, if the preceding operation was an update or remove operation.

**getLastError.updateExisting**

`getLastError.updateExisting` (page 720) is true when an update affects at least one document and does not result in an *upsert*.

**getLastError.upserted**

`getLastError.upserted` (page 721) is an *ObjectId* that corresponds to the upserted document if the update resulted in an insert.

**getLastError.wnote**

If set, `wnote` indicates that the preceding operation's error relates to using the `w` parameter to `getLastError` (page 720).

**See**

[Write Concern Reference](#) (page 96) for more information about `w` values.

**getLastError.wtimeout**

`getLastError.wtimeout` (page 721) is true if the `getLastError` (page 720) timed out because of the `wtimeout` setting to `getLastError` (page 720).

**getLastError.waited**

If the preceding operation specified a timeout using the `wtimeout` setting to `getLastError` (page 720), then `getLastError.waited` (page 721) reports the number of milliseconds `getLastError` (page 720) waited before timing out.

**getLastError.wtime**

`getLastError.wtime` (page 721) is the number of milliseconds spent waiting for the preceding operation to complete. If `getLastError` (page 720) timed out, `getLastError.wtime` (page 721) and `getLastError.waited` are equal.

**Examples**

**Confirm Replication to Two Replica Set Members** The following example ensures the operation has replicated to two members (the primary and one other member):

```
db.runCommand({ getLastError: 1, w: 2 })
```

**Confirm Replication to a Majority of a Replica Set** The following example ensures the write operation has replicated to a majority of the configured members of the set.

```
db.runCommand({ getLastError: 1, w: "majority" })
```

**Set a Timeout for a `getLastError` Response** Unless you specify a timeout, a `getLastError` (page 720) command may block forever if MongoDB cannot satisfy the requested write concern. To specify a timeout of 5000 milliseconds, use an invocation that resembles the following:

```
db.runCommand({ getLastError: 1, w: 2, wtimeout:5000 })
```

When `wtimeout` is 0, the `getLastError` (page 720) operation will never time out.

**getPrevError**

### **getPrevError**

The [getPrevError](#) (page 721) command returns the errors since the last [resetError](#) (page 722) command.

**See also:**

[db.getPrevError\(\)](#) (page 887)

### **resetError**

#### **resetError**

The [resetError](#) (page 722) command resets the last error status.

**See also:**

[db.resetError\(\)](#) (page 893)

### **eval**

#### **eval**

The [eval](#) (page 722) command evaluates JavaScript functions on the database server and has the following form:

```
{
 eval: <function>,
 args: [<arg1>, <arg2> ...],
 nolock: <boolean>
}
```

The command contains the following fields:

**field function eval** A JavaScript function.

**field array args** An array of arguments to pass to the JavaScript function. Omit if the function does not take arguments.

**field boolean nolock** By default, [eval](#) (page 722) takes a global write lock before evaluating the JavaScript function. As a result, [eval](#) (page 722) blocks all other read and write operations to the database while the [eval](#) (page 722) operation runs. Set `nolock` to `true` on the [eval](#) (page 722) command to prevent the [eval](#) (page 722) command from taking the global write lock before evaluating the JavaScript. `nolock` does not impact whether operations within the JavaScript code itself takes a write lock.

---

## JavaScript in MongoDB

Although [eval](#) (page 722) uses JavaScript, most interactions with MongoDB do not use JavaScript but use an *idiomatic driver* (page 95) in the language of the interacting application.

---

The following example uses [eval](#) (page 722) to perform an increment and calculate the average on the server:

```
db.runCommand({
 eval: function(name, incAmount) {
 var doc = db.myCollection.findOne({ name : name });

 doc = doc || { name : name , num : 0 , total : 0 , avg : 0 };

 doc.num++;
 doc.total += incAmount;
 doc.avg = doc.total / doc.num;
 }
}
```

```

 db.myCollection.save(doc);
 return doc;
 },
 args: ["eliot", 5]
}
);

```

The db in the function refers to the current database.

The [mongo](#) (page 942) shell provides a helper method `db.eval()` (page 884)<sup>5</sup>, so you can express the above as follows:

```

db.eval(function(name, incAmount) {
 var doc = db.myCollection.findOne({ name : name });

 doc = doc || { name : name, num : 0, total : 0, avg : 0 };

 doc.num++;
 doc.total += incAmount;
 doc.avg = doc.total / doc.num;

 db.myCollection.save(doc);
 return doc;
},
"eliot", 5);

```

If you want to use the server's interpreter, you must run `eval` (page 722). Otherwise, the [mongo](#) (page 942) shell's JavaScript interpreter evaluates functions entered directly into the shell.

If an error occurs, `eval` (page 722) throws an exception. The following invalid function uses the variable x without declaring it as an argument:

```

db.runCommand(
{
 eval: function() { return x + x; },
 args: [3]
}
)

```

The statement will result in the following exception:

```
{
 "errmsg" : "exception: JavaScript execution failed: ReferenceError: x is not defined near '{
 "code" : 16722,
 "ok" : 0
}
```

---

<sup>5</sup> The helper `db.eval()` (page 884) in the [mongo](#) (page 942) shell wraps the `eval` (page 722) command. Therefore, the helper method shares the characteristics and behavior of the underlying command with one exception: `db.eval()` (page 884) method does not support the `nolock` option.

**Warning:**

- By default, `eval` (page 722) takes a global write lock before evaluating the JavaScript function. As a result, `eval` (page 722) blocks all other read and write operations to the database while the `eval` (page 722) operation runs. Set `nolock` to `true` on the `eval` (page 722) command to prevent the `eval` (page 722) command from taking the global write lock before evaluating the JavaScript. `nolock` does not impact whether operations within the JavaScript code itself takes a write lock.
- Do not use `eval` (page 722) for long running operations as `eval` (page 722) blocks all other operations. Consider using *other server side code execution options* (page 198).
- You can not use `eval` (page 722) with `sharded` data. In general, you should avoid using `eval` (page 722) in `sharded cluster`; nevertheless, it is possible to use `eval` (page 722) with non-sharded collections and databases stored in a `sharded cluster`.
- With `authentication` (page 993) enabled, `eval` (page 722) will fail during the operation if you do not have the permission to perform a specified task.

Changed in version 2.4: You must have full admin access to run.

Changed in version 2.4: The V8 JavaScript engine, which became the default in 2.4, allows multiple JavaScript operations to execute at the same time. Prior to 2.4, `eval` (page 722) executed in a single thread.

**See also:**

*Server-side JavaScript* (page 198)

## Database Operations

### Authentication Commands

#### Authentication Commands

| Name                                   | Description                                                                                                      |
|----------------------------------------|------------------------------------------------------------------------------------------------------------------|
| <code>logout</code> (page 724)         | Terminates the current authenticated session.                                                                    |
| <code>authenticate</code> (page 725)   | Starts an authenticated session using a username and password.                                                   |
| <code>copydbgetnonce</code> (page 725) | This is an internal command to generate a one-time password for use with <code>copydb</code> (page 745) command. |
| <code>getnonce</code> (page 725)       | This is an internal command to generate a one-time password for authenticating.                                  |

#### logout

#### logout

The `logout` (page 724) command terminates the current authenticated session:

```
{ logout: 1 }
```

**Note:** If you're not logged in and using authentication, `logout` (page 724) has no effect.

Changed in version 2.4: Because MongoDB now allows users defined in one database to have privileges on another database, you must call `logout` (page 724) while using the same database context that you authenticated to.

If you authenticated to a database such as `users` or `$external`, you must issue `logout` (page 724) against this database in order to successfully log out.

---

#### Example

Use the `use <database-name>` helper in the interactive `mongo` (page 942) shell, or the following `db.getSiblingDB()` (page 888) in the interactive shell or in `mongo` (page 942) shell scripts to change the `db` object:

```
db = db.getSiblingDB('<database-name>')
```

When you have set the database context and db object, you can use the [logout](#) (page 724) to log out of database as in the following operation:

```
db.runCommand({ logout: 1 })
```

---

## **authenticate**

### **authenticate**

Clients use [authenticate](#) (page 725) to authenticate a connection. When using the shell, use the [db.auth\(\)](#) (page 876) helper as follows:

```
db.auth("username", "password")
```

---

## **See**

[db.auth\(\)](#) (page 876) and *Security Concepts* (page 237) for more information.

---

## **copydbgetnonce**

### **copydbgetnonce**

Client libraries use [copydbgetnonce](#) (page 725) to get a one-time password for use with the [copydb](#) (page 745) command.

**Note:** This command obtains a write lock on the affected database and will block other operations until it has completed; however, the write lock for this operation is short lived.

---

## **getnonce**

### **getnonce**

Client libraries use [getnonce](#) (page 725) to generate a one-time password for authentication.

## **Replication Commands**

| Name                                          | Description                                                                                                              |
|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| <a href="#">rep1SetFreeze</a> (page 726)      | Prevents the current member from seeking election as <i>primary</i> for a period of time.                                |
| <a href="#">rep1SetGetStatus</a> (page 726)   | Returns a document that reports on the status of the replica set.                                                        |
| <a href="#">rep1SetInitiate</a> (page 728)    | Initializes a new replica set.                                                                                           |
| <a href="#">rep1SetMaintenance</a> (page 729) | Enables or disables a maintenance mode, which puts a <i>secondary</i> node into a <i>RECOVERING</i> state.               |
| <a href="#">rep1SetReconfig</a> (page 729)    | Applies a new configuration to an existing replica set.                                                                  |
| <a href="#">rep1SetStepDown</a> (page 730)    | Forces the current <i>primary</i> to <i>step down</i> and become a <i>secondary</i> , forcing a new election.            |
| <a href="#">rep1SetSyncFrom</a> (page 730)    | Explicitly override the default logic for selecting a member to replicate from.                                          |
| <a href="#">resync</a> (page 731)             | Forces a <a href="#">mongod</a> (page 925) to re-synchronize from the <i>master</i> . For master-slave replication only. |
| <a href="#">applyOps</a> (page 732)           | Internal command that applies <i>oplog</i> entries to the current data set.                                              |
| <a href="#">isMaster</a> (page 732)           | Displays information about this member's role in the replica set, including whether it is the master.                    |
| <a href="#">getoptime</a> (page 734)          | Internal command to support replication, returns the optime.                                                             |

## rep1SetFreeze

### rep1SetFreeze

The [rep1SetFreeze](#) (page 726) command prevents a replica set member from seeking election for the specified number of seconds. Use this command in conjunction with the [rep1SetStepDown](#) (page 730) command to make a different node in the replica set a primary.

The [rep1SetFreeze](#) (page 726) command uses the following syntax:

```
{ rep1SetFreeze: <seconds> }
```

If you want to unfreeze a replica set member before the specified number of seconds has elapsed, you can issue the command with a seconds value of 0:

```
{ rep1SetFreeze: 0 }
```

Restarting the [mongod](#) (page 925) process also unfreezes a replica set member.

[rep1SetFreeze](#) (page 726) is an administrative command, and you must issue it against the *admin database*.

## rep1SetGetStatus

### Definition

### rep1SetGetStatus

The [rep1SetGetStatus](#) command returns the status of the replica set from the point of view of the current server. You must run the command against the *admin database*. The command has the following prototype format:

```
{ rep1SetGetStatus: 1 }
```

The value specified does not affect the output of the command. Data provided by this command derives from data included in heartbeats sent to the current instance by other members of the replica set. Because of the frequency of heartbeats, these data can be several seconds out of date.

You can also access this functionality through the `rs.status()` (page 898) helper in the `mongo` (page 942) shell.

The `mongod` (page 925) must have replication enabled and be a member of a replica set for the `replSetGetStatus` (page 726) to return successfully.

## Output

### `replSetGetStatus.set`

The `set` value is the name of the replica set, configured in the `replicaSet` (page 1000) setting. This is the same value as `_id` (page 480) in `rs.conf()` (page 896).

### `replSetGetStatus.date`

The value of the `date` field is an `ISODate` of the current time, according to the current server. Compare this to the value of the `lastHeartbeat` (page 728) to find the operational lag between the current host and the other hosts in the set.

### `replSetGetStatus.myState`

The value of `myState` (page 727) is an integer between 0 and 10 that represents the `replica state` (page 487) of the current member.

### `replSetGetStatus.members`

The `members` field holds an array that contains a document for every member in the replica set.

#### `replSetGetStatus.members.name`

The `name` field holds the name of the server.

#### `replSetGetStatus.members.self`

The `self` field is only included in the document for the current `mongod` instance in the `members` array. Its value is `true`.

#### `replSetGetStatus.members.errmsg`

This field contains the most recent error or status message received from the member. This field may be empty (e.g. "") in some cases.

#### `replSetGetStatus.members.health`

The `health` value is only present for the other members of the replica set (i.e. not the member that returns `rs.status` (page 898).) This field conveys if the member is up (i.e. 1) or down (i.e. 0.)

#### `replSetGetStatus.members.state`

The value of `state` (page 727) is an array of documents, each containing an integer between 0 and 10 that represents the `replica state` (page 487) of the corresponding member.

#### `replSetGetStatus.members.stateStr`

A string that describes `state` (page 727).

#### `replSetGetStatus.members.uptime`

The `uptime` (page 727) field holds a value that reflects the number of seconds that this member has been online.

This value does not appear for the member that returns the `rs.status()` (page 898) data.

#### `replSetGetStatus.members.optime`

A document that contains information regarding the last operation from the operation log that this member has applied.

##### `replSetGetStatus.members.optime.t`

A 32-bit timestamp of the last operation applied to this member of the replica set from the `oplog`.

##### `replSetGetStatus.members.optime.i`

An incremented field, which reflects the number of operations in since the last time stamp. This value only increases if there is more than one operation per second.

**replSetGetStatus.members.optimeDate**

An *ISODate* formatted date string that reflects the last entry from the *oplog* that this member applied. If this differs significantly from `lastHeartbeat` (page 728) this member is either experiencing “replication lag” or there have not been any new operations since the last update. Compare `members.optimeDate` between all of the members of the set.

**replSetGetStatus.members.lastHeartbeat**

The `lastHeartbeat` value provides an *ISODate* formatted date of the last heartbeat received from this member. Compare this value to the value of the `date` (page 727) field to track latency between these members.

This value does not appear for the member that returns the `rs.status()` (page 898) data.

**replSetGetStatus.members.pingMS**

The `pingMS` represents the number of milliseconds (ms) that a round-trip packet takes to travel between the remote member and the local instance.

This value does not appear for the member that returns the `rs.status()` (page 898) data.

**replSetGetStatus.syncingTo**

The `syncingTo` field is only present on the output of `rs.status()` (page 898) on *secondary* and recovering members, and holds the hostname of the member from which this instance is syncing.

**replSetInitiate****replSetInitiate**

The `replSetInitiate` (page 728) command initializes a new replica set. Use the following syntax:

```
{ replSetInitiate : <config_document> }
```

The `<config_document>` is a *document* that specifies the replica set’s configuration. For instance, here’s a config document for creating a simple 3-member replica set:

```
{
 _id : <setname>,
 members : [
 {_id : 0, host : <host0>},
 {_id : 1, host : <host1>},
 {_id : 2, host : <host2>},
]
}
```

A typical way of running this command is to assign the config document to a variable and then to pass the document to the `rs.initiate()` (page 897) helper:

```
config = {
 _id : "my_replica_set",
 members : [
 {_id : 0, host : "rs1.example.net:27017"},
 {_id : 1, host : "rs2.example.net:27017"},
 {_id : 2, host : "rs3.example.net", arbiterOnly: true},
]
}

rs.initiate(config)
```

Notice that omitting the port cause the host to use the default port of 27017. Notice also that you can specify other options in the config documents such as the `arbiterOnly` setting in this example.

**See also:**

[Replica Set Configuration](#) (page 479), [Replica Set Tutorials](#) (page 419), and [Replica Set Reconfiguration](#) (page 483).

## replSetMaintenance

### replSetMaintenance

The [replSetMaintenance](#) (page 729) admin command enables or disables the maintenance mode for a *secondary* member of a *replica set*.

The command has the following prototype form:

```
{ replSetMaintenance: <boolean> }
```

Consider the following behavior when running the [replSetMaintenance](#) (page 729) command:

- You cannot run the command on the Primary.
- You must run the command against the `admin` database.
- When enabled `replSetMaintenance: 1`, the member enters the RECOVERING state. While the secondary is RECOVERING:
  - The member is not accessible for read operations.
  - The member continues to sync its *oplog* from the Primary.

---

**Important:** On secondaries, the [compact](#) (page 752) command forces the secondary to enter RECOVERING (page 488) state. This prevents clients from reading during compaction. Once the operation finishes, the secondary returns to SECONDARY (page 487) state.

See [Replica Set Member States](#) (page 487) for more information about replica set member states. Refer to the “partial script for automating step down and compaction”<sup>6</sup> for an example of this procedure.

---

## replSetReconfig

### replSetReconfig

The [replSetReconfig](#) (page 729) command modifies the configuration of an existing replica set. You can use this command to add and remove members, and to alter the options set on existing members. Use the following syntax:

```
{ replSetReconfig: <new_config_document>, force: false }
```

You may also run the command using the shell’s `rs.reconfig()` (page 897) method.

Be aware of the following [replSetReconfig](#) (page 729) behaviors:

- You must issue this command against the `admin database` of the current primary member of the replica set.
- You can optionally force the replica set to accept the new configuration by specifying `force: true`. Use this option if the current member is not primary or if a majority of the members of the set are not accessible.

**Warning:** Forcing the [replSetReconfig](#) (page 729) command can lead to a *rollback* situation. Use with caution.

Use the `force` option to restore a replica set to new servers with different hostnames. This works even if the set members already have a copy of the data.

<sup>6</sup><https://github.com/mongodb/mongo-snippets/blob/master/js/compact-example.js>

- A majority of the set's members must be operational for the changes to propagate properly.
- This command can cause downtime as the set renegotiates primary-status. Typically this is 10-20 seconds, but could be as long as a minute or more. Therefore, you should attempt to reconfigure only during scheduled maintenance periods.
- In some cases, [rep1SetReconfig](#) (page 729) forces the current primary to step down, initiating an election for primary among the members of the replica set. When this happens, the set will drop all current connections.

---

**Note:** [rep1SetReconfig](#) (page 729) obtains a special mutually exclusive lock to prevent more than one [rep1SetReconfig](#) (page 729) operation from occurring at the same time.

---

## rep1SetStepDown

### Description

#### rep1SetStepDown

Forces the *primary* of the replica set to become a *secondary*. This initiates an *election for primary* (page 397).

**field number rep1SetStepDown** A number of seconds for the member to avoid election to primary.

If you do not specify a value for <seconds>, [rep1SetStepDown](#) (page 730) will attempt to avoid reelection to primary for 60 seconds.

**field Boolean force** New in version 2.0: Forces the *primary* to step down even if there are no secondary members within 10 seconds of the primary's latest optime.

**Warning:** [rep1SetStepDown](#) (page 730) forces all clients currently connected to the database to disconnect. This helps ensure that clients maintain an accurate view of the replica set.

New in version 2.0: If there is no *secondary* within 10 seconds of the primary, [rep1SetStepDown](#) (page 730) will not succeed to prevent long running elections.

**Example** The following example specifies that the former primary avoids reelection to primary for 120 seconds:

```
db.runCommand({ rep1SetStepDown: 120 })
```

## rep1SetSyncFrom

### Description

#### rep1SetSyncFrom

New in version 2.2.

Explicitly configures which host the current [mongod](#) (page 925) pulls *oplog* entries from. This operation is useful for testing different patterns and in situations where a set member is not replicating from the desired host.

The [rep1SetSyncFrom](#) (page 730) command has the following form:

```
{ rep1SetSyncFrom: "hostname<:port>" }
```

The [rep1SetSyncFrom](#) (page 730) command has the following field:

**field string rep1SetSyncFrom** The name and port number of the replica set member that this member should replicate from. Use the [hostname] : [port] form.

## The Target Member

The member to replicate from must be a valid source for data in the set. The member cannot be:

- The same as the [mongod](#) (page 925) on which you run [rep1SetSyncFrom](#) (page 730). In other words, a member cannot replicate from itself.
- An arbiter, because arbiters do not hold data.
- A member that does not build indexes.
- An unreachable member.
- A [mongod](#) (page 925) instance that is not a member of the same replica set.

If you attempt to replicate from a member that is more than 10 seconds behind the current member, [mongod](#) (page 925) will log a warning but will still replicate from the lagging member.

If you run [rep1SetSyncFrom](#) (page 730) during initial sync, MongoDB produces no error messages, but the sync target will not change until after the initial sync operation.

## Run from the mongo Shell

To run the command in the [mongo](#) (page 942) shell, use the following invocation:

```
db.adminCommand({ replSetSyncFrom: "hostname<:port>" })
```

You may also use the [rs.syncFrom\(\)](#) (page 899) helper in the [mongo](#) (page 942) shell in an operation with the following form:

```
rs.syncFrom("hostname<:port>")
```

---

**Note:** [replSetSyncFrom](#) (page 730) and [rs.syncFrom\(\)](#) (page 899) provide a temporary override of default behavior. [mongod](#) (page 925) will revert to the default sync behavior in the following situations:

- The [mongod](#) (page 925) instance restarts.
- The connection between the [mongod](#) (page 925) and the sync target closes.

Changed in version 2.4: The sync target falls more than 30 seconds behind another member of the replica set; the [mongod](#) (page 925) will revert to the default sync target.

---

## resync

### resync

The [resync](#) (page 731) command forces an out-of-date slave [mongod](#) (page 925) instance to re-synchronize itself. Note that this command is relevant to master-slave replication only. It does not apply to replica sets.

|                                                                                                                  |
|------------------------------------------------------------------------------------------------------------------|
| <b>Warning:</b> This command obtains a global write lock and will block other operations until it has completed. |
|------------------------------------------------------------------------------------------------------------------|

## applyOps

## Definition

### applyOps

Applies specified *oplog* entries to a [mongod](#) (page 925) instance. The [applyOps](#) (page 732) command is primarily an internal command to support *sharded clusters*.

The [applyOps](#) (page 732) command takes a document with the following fields:

**field array applyOps** The oplog entries to apply.

**field array preCondition** An array of documents that contain the conditions that must be true in order to apply the oplog entry. Each document contains a set of conditions, as described in the next table.

The *preCondition* array takes one or more documents with the following fields:

**field string ns** A *namespace*. If you use this field, [applyOps](#) (page 732) applies oplog entries only for the *collection* described by this namespace.

**param string q** Specifies the *query* that produces the results specified in the *res* field.

**param string res** The results of the query in the *q* field that must match to apply the oplog entry.

## Example

The [applyOps](#) (page 732) command has the following prototype form:

```
db.runCommand({ applyOps: [<operations>], preCondition: [{ ns: <namespace>, q: <query>, res: <result> }] })
```

**Warning:** This command obtains a global write lock and will block other operations until it has completed.

## isMaster

## Definition

### isMaster

[isMaster](#) (page 732) returns a document that describes the role of the [mongod](#) (page 925) instance.

If the instance is a member of a replica set, then [isMaster](#) (page 732) returns a subset of the replica set configuration and status including whether or not the instance is the *primary* of the replica set.

When sent to a [mongod](#) (page 925) instance that is not a member of a replica set, [isMaster](#) (page 732) returns a subset of this information.

MongoDB *drivers* and *clients* use [isMaster](#) (page 732) to determine the state of the replica set members and to discover additional members of a *replica set*.

The [db.isMaster\(\)](#) (page 890) method in the [mongo](#) (page 942) shell provides a wrapper around [isMaster](#) (page 732).

The command takes the following form:

```
{ isMaster: 1 }
```

## See also:

[db.isMaster\(\)](#) (page 890)

## Output

**All Instances** The following `isMaster` (page 732) fields are common across all roles:

**isMaster.ismaster**

A boolean value that reports when this node is writable. If `true`, then this instance is a *primary* in a *replica set*, or a *master* in a master-slave configuration, or a `mongos` (page 938) instance, or a standalone `mongod` (page 925).

This field will be `false` if the instance is a *secondary* member of a replica set or if the member is an *arbiter* of a replica set.

**isMaster.maxBsonObjectSize**

The maximum permitted size of a  *BSON* object in bytes for this `mongod` (page 925) process. If not provided, clients should assume a max size of “`4 * 1024 * 1024`”.

**isMaster.maxMessageSizeBytes**

New in version 2.4.

The maximum permitted size of a  *BSON* wire protocol message. The default value is `48000000` bytes.

**isMaster.localTime**

New in version 2.2.

Returns the local server time in UTC. This value is an *ISO date*.

**Sharded Instances** `mongos` (page 938) instances add the following field to the `isMaster` (page 732) response document:

**isMaster.msg**

Contains the value `isdbgrid` when `isMaster` (page 732) returns from a `mongos` (page 938) instance.

**Replica Sets** `isMaster` (page 732) contains these fields when returned by a member of a replica set:

**isMaster.setName**

The name of the current :replica set.

**isMaster.secondary**

A boolean value that, when `true`, indicates if the `mongod` (page 925) is a *secondary* member of a *replica set*.

**isMaster.hosts**

An array of strings in the format of “`[hostname] : [port]`” that lists all members of the *replica set* that are neither *hidden*, *passive*, nor *arbiters*.

Drivers use this array and the `isMaster.passives` (page 733) to determine which members to read from.

**isMaster.passives**

An array of strings in the format of “`[hostname] : [port]`” listing all members of the *replica set* which have a `priorities` (page 481) of 0.

This field only appears if there is at least one member with a `priorities` (page 481) of 0.

Drivers use this array and the `isMaster.hosts` (page 733) to determine which members to read from.

**isMaster.arbiters**

An array of strings in the format of “`[hostname] : [port]`” listing all members of the *replica set* that are *arbiters*.

This field only appears if there is at least one arbiter in the replica set.

**isMaster.primary**

A string in the format of “`[hostname] : [port]`” listing the current *primary* member of the replica set.

**isMaster.arbiterOnly**

A boolean value that , when true, indicates that the current instance is an *arbiter*. The `arbiterOnly` (page 733) field is only present, if the instance is an arbiter.

**isMaster.passive**

A boolean value that, when true, indicates that the current instance is *hidden*. The `passive` (page 734) field is only present for hidden members.

**isMaster.hidden**

A boolean value that, when true, indicates that the current instance is *hidden*. The `hidden` (page 734) field is only present for hidden members.

**isMaster.tags**

A document that lists any tags assigned to this member. This field is only present if there are tags assigned to the member. See *Configure Replica Set Tag Sets* (page 451) for more information.

**isMaster.me**

The [hostname] : [port] of the member that returned `isMaster` (page 732).

**getoptime**

**getoptime**

`getoptime` (page 734) is an internal command.

**See also:**

*Replication* (page 377) for more information regarding replication.

## Sharding Commands

| Name                                          | Description                                                                                                                               |
|-----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| <a href="#">flushRouterConfig (page 735)</a>  | Forces an update to the cluster metadata cached by a <code>mongos</code> (page 938).                                                      |
| <a href="#">addShard (page 736)</a>           | Adds a <i>shard</i> to a <i>sharded cluster</i> .                                                                                         |
| <a href="#">checkShardingIndex (page 736)</a> | Internal command that validates index on shard key.                                                                                       |
| <a href="#">enableSharding (page 736)</a>     | Enables sharding on a specific database.                                                                                                  |
| <a href="#">listShards (page 737)</a>         | Returns a list of configured shards.                                                                                                      |
| <a href="#">removeShard (page 737)</a>        | Starts the process of removing a shard from a sharded cluster.                                                                            |
| <a href="#">getShardMap (page 737)</a>        | Internal command that reports on the state of a sharded cluster.                                                                          |
| <a href="#">getShardVersion (page 737)</a>    | Internal command that returns the <i>config server</i> version.                                                                           |
| <a href="#">setShardVersion (page 737)</a>    | Internal command to sets the <i>config server</i> version.                                                                                |
| <a href="#">shardCollection (page 738)</a>    | Enables the sharding functionality for a collection, allowing the collection to be sharded.                                               |
| <a href="#">shardingState (page 738)</a>      | Reports whether the <code>mongod</code> (page 925) is a member of a sharded cluster.                                                      |
| <a href="#">unsetSharding (page 739)</a>      | Internal command that affects connections between instances in a MongoDB deployment.                                                      |
| <a href="#">split (page 739)</a>              | Creates a new <i>chunk</i> .                                                                                                              |
| <a href="#">splitChunk (page 741)</a>         | Internal command to split chunk. Instead use the methods <code>sh.splitFind()</code> (page 909) and <code>sh.splitAt()</code> (page 909). |
| <a href="#">splitVector (page 742)</a>        | Internal command that determines split points.                                                                                            |
| <a href="#">medianKey (page 742)</a>          | Deprecated internal command. See <code>splitVector</code> (page 742).                                                                     |
| <a href="#">moveChunk (page 742)</a>          | Internal command that migrates chunks between shards.                                                                                     |
| <a href="#">movePrimary (page 743)</a>        | Reassigns the <i>primary shard</i> when removing a shard from a sharded cluster.                                                          |
| <a href="#">isdbgrid (page 743)</a>           | Verifies that a process is a <code>mongos</code> (page 938).                                                                              |

### **flushRouterConfig**

#### **flushRouterConfig**

`flushRouterConfig` (page 735) clears the current cluster information cached by a `mongos` (page 938) instance and reloads all *sharded cluster* metadata from the *config database*.

This forces an update when the configuration database holds data that is newer than the data cached in the `mongos` (page 938) process.

**Warning:** Do not modify the config data, except as explicitly documented. A config database cannot typically tolerate manual manipulation.

`flushRouterConfig` (page 735) is an administrative command that is only available for `mongos` (page 938) instances.

New in version 1.8.2.

### **addShard**

## Definition

### addShard

Adds either a database instance or a *replica set* to a *sharded cluster*. The optimal configuration is to deploy shards across replica sets.

Run `addShard` (page 736) when connected to a `mongos` (page 938) instance. The command takes the following form when adding a single database instance as a shard:

```
{ addShard: "<hostname><:port>", maxSize: <size>, name: "<shard_name>" }
```

When adding a replica set as a shard, use the following form:

```
{ addShard: "<replica_set>/<hostname><:port>", maxSize: <size>, name: "<shard_name>" }
```

The command contains the following fields:

**field string addShard** The hostname and port of the `mongod` (page 925) instance to be added as a shard. To add a replica set as a shard, specify the name of the replica set and the hostname and port of a member of the replica set.

**field integer maxSize** The maximum size in megabytes of the shard. If you set `maxSize` to 0, MongoDB does not limit the size of the shard.

**field string name** A name for the shard. If this is not specified, MongoDB automatically provides a unique name.

The `addShard` (page 736) command stores shard configuration information in the *config database*.

Specify a `maxSize` when you have machines with different disk capacities, or if you want to limit the amount of data on some shards. The `maxSize` constraint prevents the *balancer* from migrating chunks to the shard when the value of `mem.mapped` (page 787) exceeds the value of `maxSize`.

**Examples** The following command adds the database instance running on port “27027“ on the host `mongodb0.example.net` as a shard:

```
db.runCommand({addShard: "mongodb0.example.net:27027"})
```

**Warning:** Do not use `localhost` for the hostname unless your *configuration server* is also running on `localhost`.

The following command adds a replica set as a shard:

```
db.runCommand({ addShard: "rep10/mongodb3.example.net:27327" })
```

You may specify all members in the replica set. All additional hostnames must be members of the same replica set.

### checkShardingIndex

#### checkShardingIndex

`checkShardingIndex` (page 736) is an internal command that supports the sharding functionality.

### enableSharding

#### enableSharding

The `enableSharding` (page 736) command enables sharding on a per-database level. Use the following command form:

```
{ enableSharding: "<database name>" }
```

Once you've enabled sharding in a database, you can use the [shardCollection](#) (page 738) command to begin the process of distributing data among the shards.

### **listShards**

#### **listShards**

Use the [listShards](#) (page 737) command to return a list of configured shards. The command takes the following form:

```
{ listShards: 1 }
```

### **removeShard**

#### **removeShard**

Starts the process of removing a shard from a [cluster](#). This is a multi-stage process. Begin by issuing the following command:

```
{ removeShard : "[shardName]" }
```

The balancer will then migrate chunks from the shard specified by `[shardName]`. This process happens slowly to avoid placing undue load on the overall cluster.

The command returns immediately, with the following message:

```
{ msg : "draining started successfully" , state: "started" , shard: "shardName" , ok : 1 }
```

If you run the command again, you'll see the following progress output:

```
{ msg: "draining ongoing" , state: "ongoing" , remaining: { chunks: 23 , dbs: 1 } , ok: 1 }
```

The remaining [document](#) specifies how many chunks and databases remain on the shard. Use [db.printShardingStatus\(\)](#) (page 892) to list the databases that you must move from the shard.

Each database in a sharded cluster has a primary shard. If the shard you want to remove is also the primary of one of the cluster's databases, then you must manually move the database to a new shard. This can be only after the shard is empty. See the [movePrimary](#) (page 743) command for details.

After removing all chunks and databases from the shard, you may issue the command again, to return:

```
{ msg: "remove shard completed successfully" , state: "completed" , host: "shardName" , ok : 1 }
```

### **getShardMap**

#### **getShardMap**

[getShardMap](#) (page 737) is an internal command that supports the sharding functionality.

### **getShardVersion**

#### **getShardVersion**

[getShardVersion](#) (page 737) is an internal command that supports sharding functionality.

### **setShardVersion**

#### **setShardVersion**

[setShardVersion](#) (page 737) is an internal command that supports sharding functionality.

### **shardCollection**

## Definition

### shardCollection

Enables a collection for sharding and allows MongoDB to begin distributing data among shards. You must run [enableSharding](#) (page 736) on a database before running the [shardCollection](#) (page 738) command. [shardCollection](#) (page 738) has the following form:

```
{ shardCollection: "<database>.<collection>", key: <shardkey> }
```

[shardCollection](#) (page 738) has the following fields:

**field string shardCollection** The [namespace](#) of the collection to shard in the form `<database>.<collection>`.

**field document key** The index specification document to use as the shard key. The index must exist prior to the [shardCollection](#) (page 738) command, unless the collection is empty. If the collection is empty, in which case MongoDB creates the index prior to sharding the collection. New in version 2.4: The key may be in the form `{ field : "hashed" }`, which will use the specified field as a hashed shard key.

**field Boolean unique** When `true`, the `unique` option ensures that the underlying index enforces a unique constraint. Hashed shard keys do not support unique constraints.

**field integer numInitialChunks** To support [hashed sharding](#) (page 506) added in MongoDB 2.4, `numInitialChunks` specifies the number of chunks to create when sharding an collection with a hashed shard key. MongoDB will then create and balance chunks across the cluster. The `numInitialChunks` must be less than 8192.

**Warning:** Do not run more than one [shardCollection](#) (page 738) command on the same collection at the same time.

**Shard Keys** Choosing the best shard key to effectively distribute load among your shards requires some planning. Review [Shard Keys](#) (page 506) regarding choosing a shard key.

**Hashed Shard Keys** New in version 2.4.

[Hashed shard keys](#) (page 506) use a hashed index of a single field as the shard key.

**Warning:** MongoDB provides no method to deactivate sharding for a collection after calling [shardCollection](#) (page 738). Additionally, after [shardCollection](#) (page 738), you cannot change shard keys or modify the value of any field used in your shard key index.

## See also:

[Sharding](#) (page 493), [Sharding Concepts](#) (page 498), and [Deploy a Sharded Cluster](#) (page 522).

**Example** The following operation enables sharding for the `people` collection in the `records` database and uses the `zipcode` field as the [shard key](#) (page 506):

```
db.runCommand({ shardCollection: "records.people", key: { zipcode: 1 } })
```

### shardingState

### shardingState

[shardingState](#) (page 738) is an admin command that reports if `mongod` (page 925) is a member of a [sharded cluster](#). [shardingState](#) (page 738) has the following prototype form:

```
{ shardingState: 1 }
```

For `shardingState` (page 738) to detect that a `mongod` (page 925) is a member of a sharded cluster, the `mongod` (page 925) must satisfy the following conditions:

- 1.the `mongod` (page 925) is a primary member of a replica set, and
- 2.the `mongod` (page 925) instance is a member of a sharded cluster.

If `shardingState` (page 738) detects that a `mongod` (page 925) is a member of a sharded cluster, `shardingState` (page 738) returns a document that resembles the following prototype:

```
{
 "enabled" : true,
 "configServer" : "<configdb-string>",
 "shardName" : "<string>",
 "shardHost" : "string:",
 "versions" : {
 "<database>.<collection>" : Timestamp(<...>),
 "<database>.<collection>" : Timestamp(<...>)
 },
 "ok" : 1
}
```

Otherwise, `shardingState` (page 738) will return the following document:

```
{ "note" : "from execCommand", "ok" : 0, "errmsg" : "not master" }
```

The response from `shardingState` (page 738) when used with a *config server* is:

```
{ "enabled": false, "ok": 1 }
```

---

**Note:** `mongos` (page 938) instances do not provide the `shardingState` (page 738).

---

**Warning:** This command obtains a write lock on the affected database and will block other operations until it has completed; however, the operation is typically short lived.

## unsetSharding

### unsetSharding

`unsetSharding` (page 739) is an internal command that supports sharding functionality.

## split

### Definition

#### split

Splits a *chunk* in a *sharded cluster* into two chunks. The `mongos` (page 938) instance splits and manages chunks automatically, but for exceptional circumstances the `split` (page 739) command does allow administrators to manually create splits. See *Split Chunks in a Sharded Cluster* (page 548) for information on these circumstances, and on the MongoDB shell commands that wrap `split` (page 739).

The `split` (page 739) command takes a document with the following fields:

**field string split** The name of the *collection* where the *chunk* exists. Specify the collection's full *namespace*, including the database name.

**field document find** An query statement that specifies an equality match on the shard key. The match selects the chunk that contains the specified document. You must specify only one of the following: `find`, `bounds`, or `middle`.

**field array bounds** New in version 2.4: The bounds of a chunk to split. `bounds` applies to chunks in collections partitioned using a [hashed shard key](#). The parameter's array must consist of two documents specifying the lower and upper shard-key values of the chunk. The values must match the minimum and maximum values of an existing chunk. Specify only one of the following: `find`, `bounds`, or `middle`.

**field document middle** The document to use as the split point to create two chunks. [split](#) (page 739) requires one of the following options: `find`, `bounds`, or `middle`.

**Command Formats** To create a chunk split, connect to a [mongos](#) (page 938) instance, and issue the following command to the `admin` database:

```
db.adminCommand({ split: <database>.<collection>,
 find: <document> })
```

Or:

```
db.adminCommand({ split: <database>.<collection>,
 middle: <document> })
```

Or:

```
db.adminCommand({ split: <database>.<collection>,
 bounds: [<lower>, <upper>] })
```

To create a split for a collection that uses a [hashed shard key](#), use the `bounds` parameter. Do *not* use the `middle` parameter for this purpose.

**Warning:** Be careful when splitting data in a sharded collection to create new chunks. When you shard a collection that has existing data, MongoDB automatically creates chunks to evenly distribute the collection. To split data effectively in a sharded cluster you must consider the number of documents in a chunk and the average document size to create a uniform chunk size. When chunks have irregular sizes, shards may have an equal number of chunks but have very different data sizes. Avoid creating splits that lead to a collection with differently sized chunks.

## See also:

[moveChunk](#) (page 742), [sh.moveChunk\(\)](#) (page 907), [sh.splitAt\(\)](#) (page 909), and [sh.splitFind\(\)](#) (page 909), which wrap the functionality of [split](#) (page 739).

**Examples** The following sections provide examples of the [split](#) (page 739) command.

### Split a Chunk in Half

```
db.runCommand({ split : "test.people", find : { _id : 99 } })
```

The [split](#) (page 739) command identifies the chunk in the `people` collection of the `test` database, that holds documents that match `{ _id : 99 }`. [split](#) (page 739) does not require that a match exist, in order to identify the appropriate chunk. Then the command splits it into two chunks of equal size.

**Note:** [split](#) (page 739) creates two equal chunks by range as opposed to size, and does not use the selected point as a boundary for the new chunks

**Define an Arbitrary Split Point** To define an arbitrary split point, use the following form:

```
db.runCommand({ split : "test.people", middle : { _id : 99 } })
```

The `split` (page 739) command identifies the chunk in the `people` collection of the `test` database, that would hold documents matching the query `{ _id : 99 }`. `split` (page 739) does not require that a match exist, in order to identify the appropriate chunk. Then the command splits it into two chunks, with the matching document as the lower bound of one of the split chunks.

This form is typically used when *pre-splitting* data in a collection.

**Split a Chunk Using Values of a Hashed Shard Key** This example uses the *hashed shard key* `userid` in a `people` collection of a `test` database. The following command uses an array holding two single-field documents to represent the minimum and maximum values of the hashed shard key to split the chunk:

```
db.runCommand({ split: "test.people",
 bounds : [{ userid: NumberLong("-5838464104018346494") },
 { userid: NumberLong("-5557153028469814163") }
] })
```

---

**Note:** MongoDB uses the 64-bit `NumberLong` (page 201) type to represent the hashed value.

---

Use `sh.status()` (page 910) to see the existing bounds of the shard keys.

**Metadata Lock Error** If another process in the `mongos` (page 938), such as a balancer process, changes metadata while `split` (page 739) is running, you may see a metadata lock error.

```
errmsg: "The collection's metadata lock is already taken."
```

This message indicates that the split has failed with no side effects. Retry the `split` (page 739) command.

## splitChunk

### Definition

#### splitChunk

An internal administrative command. To split chunks, use the `sh.splitFind()` (page 909) and `sh.splitAt()` (page 909) functions in the `mongo` (page 942) shell.

**Warning:** Be careful when splitting data in a sharded collection to create new chunks. When you shard a collection that has existing data, MongoDB automatically creates chunks to evenly distribute the collection. To split data effectively in a sharded cluster you must consider the number of documents in a chunk and the average document size to create a uniform chunk size. When chunks have irregular sizes, shards may have an equal number of chunks but have very different data sizes. Avoid creating splits that lead to a collection with differently sized chunks.

### See also:

`moveChunk` (page 742) and `sh.moveChunk()` (page 907).

The `splitChunk` (page 741) command takes a document with the following fields:

**field string ns** The complete *namespace* of the *chunk* to split.

**field document keyPattern** The *shard key*.

**field document min** The lower bound of the shard key for the chunk to split.

- field document max** The upper bound of the shard key for the chunk to split.
- field string from** The *shard* that owns the chunk to split.
- field document splitKeys** The split point for the chunk.
- field document shardId** The shard.

**splitVector****splitVector**

Is an internal command that supports meta-data operations in sharded clusters.

**medianKey****medianKey**

[medianKey](#) (page 742) is an internal command.

**moveChunk****Definition****moveChunk**

Internal administrative command. Moves *chunks* between *shards*. Issue the [moveChunk](#) (page 742) command via a [mongos](#) (page 938) instance while using the *admin database*. Use the following forms:

```
db.runCommand({ moveChunk : <namespace> ,
 find : <query> ,
 to : <string>,
 _secondaryThrottle : <boolean> })
```

Alternately:

```
db.runCommand({ moveChunk : <namespace> ,
 bounds : <array> ,
 to : <string>,
 _secondaryThrottle : <boolean> })
```

The [moveChunk](#) (page 742) command has the following fields:

**field string moveChunk** The *namespace* of the *collection* where the *chunk* exists. Specify the collection's full namespace, including the database name.

**field document find** An equality match on the shard key that specifies the shard-key value of the chunk to move. Specify either the *bounds* field or the *find* field but not both.

**field array bounds** The bounds of a specific chunk to move. The array must consist of two documents that specify the lower and upper shard key values of a chunk to move. Specify either the *bounds* field or the *find* field but not both. Use *bounds* to move chunks in collections partitioned using a *hashed shard key*.

**field string to** The name of the destination shard for the chunk.

**field Boolean \_secondaryThrottle** Defaults to `true`. When `true`, the balancer waits for replication to *secondaries* when it copies and deletes data during chunk migrations. For details, see [Require Replication before Chunk Migration \(Secondary Throttle\)](#) (page 550).

The value of *bounds* takes the form:

```
[{ hashedField : <minValue> } ,
 { hashedField : <maxValue> }]
```

The [chunk migration](#) (page 518) section describes how chunks move between shards on MongoDB.

**See also:**

[split](#) (page 739), [sh.moveChunk\(\)](#) (page 907), [sh.splitAt\(\)](#) (page 909), and [sh.splitFind\(\)](#) (page 909).

**Return Messages** [moveChunk](#) (page 742) returns the following error message if another metadata operation is in progress on the [chunks](#) (page 566) collection:

errmsg: "The collection's metadata lock is already taken."

If another process, such as a balancer process, changes meta data while [moveChunk](#) (page 742) is running, you may see this error. You may retry the [moveChunk](#) (page 742) operation without side effects.

---

**Note:** Only use the [moveChunk](#) (page 742) in special circumstances such as preparing your [sharded cluster](#) for an initial ingestion of data, or a large bulk import operation. In most cases allow the balancer to create and balance chunks in sharded clusters. See [Create Chunks in a Sharded Cluster](#) (page 545) for more information.

---

## movePrimary

### movePrimary

In a [sharded cluster](#), this command reassigns the database's [primary shard](#), which holds all un-sharded collections in the database. [movePrimary](#) (page 743) is an administrative command that is only available for [mongos](#) (page 938) instances. Only use [movePrimary](#) (page 743) when removing a shard from a sharded cluster.

---

**Important:** Only use [movePrimary](#) (page 743) when:

- the database does not contain any collections with data, *or*
- you have drained all sharded collections using the [removeShard](#) (page 737) command.

See [Remove Shards from an Existing Sharded Cluster](#) (page 553) for a complete procedure.

---

[movePrimary](#) (page 743) changes the primary shard for this database in the cluster metadata, and migrates all un-sharded collections to the specified shard. Use the command with the following form:

```
{ movePrimary : "test", to : "shard0001" }
```

When the command returns, the database's primary location will shift to the designated [shard](#). To fully decommission a shard, use the [removeShard](#) (page 737) command.

## isdbgrid

### isdbgrid

This command verifies that a process is a [mongos](#) (page 938).

If you issue the [isdbgrid](#) (page 743) command when connected to a [mongos](#) (page 938), the response document includes the [isdbgrid](#) field set to 1. The returned document is similar to the following:

```
{ "isdbgrid" : 1, "hostname" : "app.example.net", "ok" : 1 }
```

If you issue the [isdbgrid](#) (page 743) command when connected to a [mongod](#) (page 925), MongoDB returns an error document. The [isdbgrid](#) (page 743) command is not available to [mongod](#) (page 925). The error document, however, also includes a line that reads "isdbgrid" : 1, just as in the document returned for a [mongos](#) (page 938). The error document is similar to the following:

```
{
 "errmsg" : "no such cmd: isdbgrid",
 "bad cmd" : {
 "isdbgrid" : 1
 },
 "ok" : 0
}
```

You can instead use the [isMaster](#) (page 732) command to determine connection to a [mongos](#) (page 938). When connected to a [mongos](#) (page 938), the [isMaster](#) (page 732) command returns a document that contains the string `isdbgrid` in the `msg` field.

**See also:**

[Sharding](#) (page 493) for more information about MongoDB's sharding functionality.

## Instance Administration Commands

| Name                                               | Description                                                                            |
|----------------------------------------------------|----------------------------------------------------------------------------------------|
| <a href="#">renameCollection</a> (page 744)        | Changes the name of an existing collection.                                            |
| <a href="#">copydb</a> (page 745)                  | Copies a database from a remote host to the current host.                              |
| <a href="#">dropDatabase</a> (page 746)            | Removes the current database.                                                          |
| <a href="#">drop</a> (page 747)                    | Removes the specified collection from the database.                                    |
| <a href="#">create</a> (page 747)                  | Creates a collection and sets collection parameters.                                   |
| <a href="#">clone</a> (page 748)                   | Copies a database from a remote host to the current host.                              |
| <a href="#">cloneCollection</a> (page 748)         | Copies a collection from a remote host to the current host.                            |
| <a href="#">cloneCollectionAsCapped</a> (page 749) | Copies a non-capped collection as a new <i>capped collection</i> .                     |
| <a href="#">closeAllDatabases</a> (page 749)       | Internal command that invalidates all cursors and closes open files.                   |
| <a href="#">convertToCapped</a> (page 749)         | Converts a non-capped collection to a capped collection.                               |
| <a href="#">filemd5</a> (page 750)                 | Returns the <code>md5</code> hash for files stored using <i>GridFS</i> .               |
| <a href="#">dropIndexes</a> (page 750)             | Removes indexes from a collection.                                                     |
| <a href="#">fsync</a> (page 751)                   | Flushes pending writes to the storage layer and locks the data to allow backups.       |
| <a href="#">clean</a> (page 752)                   | Internal namespace administration command.                                             |
| <a href="#">connPoolSync</a> (page 752)            | Internal command to flush connection pool.                                             |
| <a href="#">compact</a> (page 752)                 | Defragments a collection and rebuilds the indexes.                                     |
| <a href="#">collMod</a> (page 755)                 | Add flags to collection to modify the behavior of MongoDB.                             |
| <a href="#">reIndex</a> (page 756)                 | Rebuilds all indexes on a collection.                                                  |
| <a href="#">setParameter</a> (page 756)            | Modifies configuration options.                                                        |
| <a href="#">getParameter</a> (page 757)            | Retrieves configuration options.                                                       |
| <a href="#">repairDatabase</a> (page 757)          | Repairs any errors and inconsistencies with the data storage.                          |
| <a href="#">touch</a> (page 759)                   | Loads documents and indexes from data storage to memory.                               |
| <a href="#">shutdown</a> (page 759)                | Shuts down the <a href="#">mongod</a> (page 925) or <a href="#">mongos</a> (page 938). |
| <a href="#">logRotate</a> (page 760)               | Rotates the MongoDB logs to prevent a single file from taking up much space.           |

## Administration Commands

### renameCollection

#### Definition

#### [renameCollection](#)

Changes the name of an existing collection. Specify collections to [renameCollection](#) (page 744) in the

form of a complete *namespace*, which includes the database name. Issue the `renameCollection` (page 744) command against the *admin database*. The command takes the following form:

```
{ renameCollection: "<source_namespace>", to: "<target_namespace>", dropTarget: <true|false> }
```

The command contains the following fields:

**field string renameCollection** The *namespace* of the collection to rename. The namespace is a combination of the database name and the name of the collection.

**field string to** The new namespace of the collection. If the new namespace specifies a different database, the `renameCollection` (page 744) command copies the collection to the new database and drops the source collection.

**field boolean dropTarget** If `true`, `mongod` (page 925) will drop the target of `renameCollection` (page 744) prior to renaming the collection.

`renameCollection` (page 744) is suitable for production environments; *however*:

- `renameCollection` (page 744) blocks all database activity for the duration of the operation.
- `renameCollection` (page 744) is **not** compatible with sharded collections.

**Warning:** `renameCollection` (page 744) fails if `target` is the name of an existing collection *and* you do not specify `dropTarget: true`.

If the `renameCollection` (page 744) operation does not complete the `target` collection and indexes will not be usable and will require manual intervention to clean up.

## Exceptions

**exception 10026** Raised if the source namespace does not exist.

**exception 10027** Raised if the target namespace exists and `dropTarget` is either `false` or unspecified.

**exception 15967** Raised if the target namespace is an invalid collection name.

**Shell Helper** The shell helper `db.collection.renameCollection()` (page 846) provides a simpler interface to using this command within a database. The following is equivalent to the previous example:

```
db.source-namespace.renameCollection("target")
```

**Warning:** You cannot use `renameCollection` (page 744) with sharded collections.

**Warning:** This command obtains a global write lock and will block other operations until it has completed.

## copydb

### copydb

The `copydb` (page 745) command copies a database from a remote host to the current host. `copydb` (page 745) accepts the following options:

**field string fromhost** Hostname of the source `mongod` (page 925) instance. If omitted, `copydb` (page 745) copies one database to another within a single MongoDB instance.

**field string fromdb** Name of the source database.

**field string todb** Name of the target namespace.

**field boolean slaveOk** Set `slaveOK` to `true` to allow [copydb](#) (page 745) to copy data from secondary members as well as the primary. `fromhost` must also be set.

**field string username** The username credentials on the `fromhost` MongoDB deployment.

**field string nonce** A single use shared secret generated on the remote server using the [copydbgetnonce](#) (page 725) command.

**field string key** A hash of the password used for authentication.

[copydb](#) (page 745) has the following syntax:

```
{ copydb: 1,
 fromhost: <hostname>,
 fromdb: <db>,
 todb: <db>,
 slaveOk: <bool>,
 username: <username>,
 nonce: <nonce>,
 key: <key> }
```

**Behavior** Be aware of the following properties of [copydb](#) (page 745):

- [copydb](#) (page 745) is incompatible with deployments that use [auth](#) (page 993) in combination with users who have privileges specified using the [role-based user documents](#) (page 265) introduced in 2.4. To use [copydb](#) (page 745) with access control enabled you must use the [legacy user privilege documents](#) (page 270) from v2.2 and prior.
- [copydb](#) (page 745) can run against a *secondary* or a non-*primary* member of a *replica set*. In this case, you must set the `slaveOk` option to `true`.
- [copydb](#) (page 745) does not snapshot the database. If the state of the database changes at any point during the operation, the resulting database may be inconsistent.
- You must run [copydb](#) (page 745) on the **destination server**, i.e. the host receiving the copied data.
- The destination server is not locked for the duration of the [copydb](#) (page 745) operation. This means that [copydb](#) (page 745) will occasionally yield to allow other operations to complete.
- If the remote server has authentication enabled, then you must include a username, nonce, and a key. The nonce is a one-time password that you request from the remote server using the [copydbgetnonce](#) (page 725) command. The key is a hash generated as follows:

```
hex_md5(nonce + username + hex_md5(username + ":mongo:" + pass))
```

If you need to copy a database and authenticate, it's easiest to use the shell helper:

```
db.copyDatabase(<remote_db_name>, <local_db_name>, <from_host_name>, <username>, <password>)
```

## dropDatabase **dropDatabase**

The [dropDatabase](#) (page 746) command drops a database, deleting the associated data files. [dropDatabase](#) (page 746) operates on the current database.

In the shell issue the `use <database>` command, replacing `<database>` with the name of the database you wish to delete. Then use the following command form:

```
{ dropDatabase: 1 }
```

The [mongo](#) (page 942) shell also provides the following equivalent helper method:

```
db.dropDatabase();
```

**Warning:** This command obtains a global write lock and will block other operations until it has completed.

## drop

### drop

The [drop](#) (page 747) command removes an entire collection from a database. The command has following syntax:

```
{ drop: <collection_name> }
```

The [mongo](#) (page 942) shell provides the equivalent helper method:

```
db.collection.drop();
```

Note that this command also removes any indexes associated with the dropped collection.

**Warning:** This command obtains a write lock on the affected database and will block other operations until it has completed.

## create

### Definition

#### create

Explicitly creates a collection. [create](#) (page 747) has the following form:

```
{ create: <collection_name>,
 capped: <true|false>,
 autoIndexId: <true|false>,
 size: <max_size>,
 max: <max_documents>
}
```

[create](#) (page 747) has the following fields:

**field string create** The name of the new collection.

**field Boolean capped** To create a [capped collection](#). specify `true`. If you specify `true`, you must also set a maximum size in the `size` field.

**field Boolean autoIndexId** Specify `false` to disable the automatic creation of an index on the `_id` field. Before 2.2, the default value for `autoIndexId` was `false`.

**field integer size** The maximum size for the capped collection. Once a capped collection reaches its maximum size, MongoDB overwrites older old documents with new documents. The `size` field is required for capped collections.

**field integer max** The maximum number of documents to keep in the capped collection. The `size` limit takes precedence over this limit. If a capped collection reaches its maximum size before it reaches the maximum number of documents, MongoDB removes old documents. If you use this limit, ensure that the `size` limit is sufficient to contain the documents limit.

For more information on the `autoIndexId` field in versions before 2.2, see [\\_id Fields and Indexes on Capped Collections](#) (page 1054).

The `db.createCollection()` (page 878) method wraps the `create` (page 747) command.

**Note:** The `create` (page 747) command obtains a write lock on the affected database and will block other operations until it has completed. The write lock for this operation is typically short lived. However, allocations for large capped collections may take longer.

---

**Example** To create a *capped collection* limited to 64 kilobytes, issue the command in the following form:

```
db.runCommand({ create: "collection", capped: true, size: 64 * 1024 })
```

### clone

#### clone

The `clone` (page 748) command clone a database from a remote MongoDB instance to the current host. `clone` (page 748) copies the database on the remote instance with the same name as the current database. The command takes the following form:

```
{ clone: "db1.example.net:27017" }
```

Replace `db1.example.net:27017` above with the resolvable hostname for the MongoDB instance you wish to copy from. Note the following behaviors:

- `clone` (page 748) can run against a *slave* or a non-*primary* member of a *replica set*.
- `clone` (page 748) does not snapshot the database. If any clients update the database you're copying at any point during the clone operation, the resulting database may be inconsistent.
- You must run `clone` (page 748) on the **destination server**.
- The destination server is not locked for the duration of the `clone` (page 748) operation. This means that `clone` (page 748) will occasionally yield to allow other operations to complete.

See `copydb` (page 745) for similar functionality.

**Warning:** This command obtains an intermittent *write lock* on the destination server, that can block other operations until it completes.

### cloneCollection

#### Definition

#### cloneCollection

Copies a collection from a remote `mongod` (page 925) instance to the current `mongod` (page 925) instance. `cloneCollection` (page 748) creates a collection in a database with the same name as the remote collection's database. `cloneCollection` (page 748) takes the following form:

```
{ cloneCollection: "<collection>", from: "<hostname>", query: { <query> }, copyIndexes: <true|false> }
```

**Important:** You cannot clone a collection through a `mongos` (page 938) but must connect directly to the `mongod` (page 925) instance.

`cloneCollection` (page 748) has the following fields:

**field string cloneCollection** The name of the collection to clone.

**field string from** Specify a resolvable hostname and optional port number of the remote server where the specified collection resides.

**field document query** A query that filters the documents in the remote collection that [cloneCollection](#) (page 748) will copy to the current database.

**field boolean copyIndexes** If set to `false` the indexes on the originating server are not copied with the documents in the collection. This is set to `true` by default.

### Example

```
{ cloneCollection: "users.profiles", from: "mongodb.example.net:27017", query: { active: true }, copyIndexes: false }
```

This operation copies the `profiles` collection from the `users` database on the server at `mongodb.example.net`. The operation only copies documents that satisfy the query `{ active: true }` and does not copy indexes. [cloneCollection](#) (page 748) copies indexes by default, but you can disable this behavior by setting `{ copyIndexes: false }`. The `query` and `copyIndexes` arguments are optional.

If, in the above example, the `profiles` collection exists in the `users` database, then MongoDB appends documents from the remote collection to the destination collection.

### cloneCollectionAsCapped

#### cloneCollectionAsCapped

The [cloneCollectionAsCapped](#) (page 749) command creates a new *capped collection* from an existing, non-capped collection within the same database. The operation does not affect the original non-capped collection.

The command has the following syntax:

```
{ cloneCollectionAsCapped: <existing collection>, toCollection: <capped collection>, size: <capped size> }
```

The command copies an `existing collection` and creates a new `capped collection` with a maximum size specified by the `capped size` in bytes. The name of the new capped collection must be distinct and cannot be the same as that of the original existing collection. To replace the original non-capped collection with a capped collection, use the [convertToCapped](#) (page 749) command.

During the cloning, the [cloneCollectionAsCapped](#) (page 749) command exhibit the following behavior:

- MongoDB will transverse the documents in the original collection in *natural order* as they're loaded.
- If the `capped size` specified for the new collection is smaller than the size of the original uncapped collection, then MongoDB will begin overwriting earlier documents in insertion order, which is *first in, first out* (e.g. “FIFO”).

### closeAllDatabases

#### closeAllDatabases

[closeAllDatabases](#) (page 749) is an internal command that invalidates all cursors and closes the open database files. The next operation that uses the database will reopen the file.

**Warning:** This command obtains a global write lock and will block other operations until it has completed.

### convertToCapped

#### convertToCapped

The [convertToCapped](#) (page 749) command converts an existing, non-capped collection to a *capped collection* within the same database.

The command has the following syntax:

```
{convertToCapped: <collection>, size: <capped size> }
```

[convertToCapped](#) (page 749) takes an existing collection (<collection>) and transforms it into a capped collection with a maximum size in bytes, specified to the `size` argument (<capped size>).

During the conversion process, the [convertToCapped](#) (page 749) command exhibit the following behavior:

- MongoDB transverses the documents in the original collection in *natural order* and loads the documents into a new capped collection.
- If the `capped size` specified for the capped collection is smaller than the size of the original uncapped collection, then MongoDB will overwrite documents in the capped collection based on insertion order, or *first in, first out* order.
- Internally, to convert the collection, MongoDB uses the following procedure
  - [cloneCollectionAsCapped](#) (page 749) command creates the capped collection and imports the data.
  - MongoDB drops the original collection.
  - [renameCollection](#) (page 744) renames the new capped collection to the name of the original collection.

---

**Note:** MongoDB does not support the [convertToCapped](#) (page 749) command in a sharded cluster.

---

**Warning:** The [convertToCapped](#) (page 749) will not recreate indexes from the original collection on the new collection, other than the index on the `_id` field. If you need indexes on this collection you will need to create these indexes after the conversion is complete.

**See also:**

[create](#) (page 747)

**Warning:** This command obtains a global write lock and will block other operations until it has completed.

### filemd5

#### filemd5

The [filemd5](#) (page 750) command returns the *md5* hashes for a single file stored using the *GridFS* specification. Client libraries use this command to verify that files are correctly written to MongoDB. The command takes the `files_id` of the file in question and the name of the GridFS root collection as arguments. For example:

```
{ filemd5: ObjectId("4f1f10e37671b50e4ecd2776"), root: "fs" }
```

### dropIndexes

#### dropIndexes

The [dropIndexes](#) (page 750) command drops one or all indexes from the current collection. To drop all indexes, issue the command like so:

```
{ dropIndexes: "collection", index: "*" }
```

To drop a single, issue the command by specifying the name of the index you want to drop. For example, to drop the index named `age_1`, use the following command:

```
{ dropIndexes: "collection", index: "age_1" }
```

The shell provides a useful command helper. Here's the equivalent command:

```
db.collection.dropIndex("age_1");
```

**Warning:** This command obtains a write lock on the affected database and will block other operations until it has completed.

## fsync

### fsync

The `fsync` (page 751) command forces the `mongod` (page 925) process to flush all pending writes to the storage layer. `mongod` (page 925) is always writing data to the storage layer as applications write more data to the database. MongoDB guarantees that it will write all data to disk within the `syncdelay` (page 998) interval, which is 60 seconds by default.

```
{ fsync: 1 }
```

The `fsync` (page 751) operation is synchronous by default, to run `fsync` (page 751) asynchronously, use the following form:

```
{ fsync: 1, async: true }
```

The connection will return immediately. You can check the output of `db.currentOp()` (page 879) for the status of the `fsync` (page 751) operation.

The primary use of `fsync` (page 751) is to lock the database during backup operations. This will flush all data to the data storage layer and block all write operations until you unlock the database. Consider the following command form:

```
{ fsync: 1, lock: true }
```

---

**Note:** You may continue to perform read operations on a database that has a `fsync` (page 751) lock. However, following the first write operation all subsequent read operations wait until you unlock the database.

---

To check on the current state of the `fsync` lock, use `db.currentOp()` (page 879). Use the following JavaScript function in the shell to test if the database is currently locked:

```
serverIsLocked = function () {
 var co = db.currentOp();
 if (co && co.fsyncLock) {
 return true;
 }
 return false;
}
```

After loading this function into your `mongo` (page 942) shell session you can call it as follows:

```
serverIsLocked()
```

This function will return `true` if the database is currently locked and `false` if the database is not locked. To unlock the database, make a request for an unlock using the following command:

```
db.getSiblingDB("admin").$cmd.sys.unlock.findOne();
```

New in version 1.9.0: The `db.fsyncLock()` (page 885) and `db.fsyncUnlock()` (page 886) helpers in the shell.

In the [mongo](#) (page 942) shell, you may use the `db.fsyncLock()` (page 885) and `db.fsyncUnlock()` (page 886) wrappers for the `fsync` (page 751) lock and unlock process:

```
db.fsyncLock();
db.fsyncUnlock();
```

---

**Note:** `fsync` (page 751) lock is only possible on individual shards of a sharded cluster, not on the entire sharded cluster. To backup an entire sharded cluster, please read [Sharded Cluster Backup Considerations](#) (page 137).

If your [mongod](#) (page 925) has *journaling* enabled, consider using [another method](#) (page 185) to back up your database.

---

**Note:** The database cannot be locked with `db.fsyncLock()` (page 885) while profiling is enabled. You must disable profiling before locking the database with `db.fsyncLock()` (page 885). Disable profiling using `db.setProfilingLevel()` (page 894) as follows in the [mongo](#) (page 942) shell:

---

```
db.setProfilingLevel(0)
```

### **clean**

#### **clean**

`clean` (page 752) is an internal command.

**Warning:** This command obtains a write lock on the affected database and will block other operations until it has completed.

### **connPoolSync**

#### **connPoolSync**

`connPoolSync` (page 752) is an internal command.

### **compact**

#### **Definition**

#### **compact**

New in version 2.0.

Rewrites and defragments all data in a collection, as well as all of the indexes on that collection. `compact` (page 752) has the following form:

```
{ compact: <collection name> }
```

`compact` (page 752) has the following fields:

**field string compact** The name of the collection.

**field boolean force** If `true`, `compact` (page 752) can run on the *primary* in a *replica set*. If `false`, `compact` (page 752) returns an error when run on a primary, because the command blocks all other activity. Beginning with version 2.2, `compact` (page 752) blocks activity only for the database it is compacting.

**field number paddingFactor** Describes the *record size* allocated for each document as a factor of the document size for all records compacted during the `compact` (page 752) operation. The

`paddingFactor` does not affect the padding of subsequent record allocations after `compact` (page 752) completes. For more information, see `paddingFactor` (page 753).

**field integer `paddingBytes`** Sets the padding as an absolute number of bytes for all records compacted during the `compact` (page 752) operation. After `compact` (page 752) completes, `paddingBytes` does not affect the padding of subsequent record allocations. For more information, see `paddingBytes` (page 753).

`compact` (page 752) is similar to `repairDatabase` (page 757); however, `repairDatabase` (page 757) operates on an entire database.

#### **paddingFactor** New in version 2.2.

The `paddingFactor` field takes the following range of values:

- Default: `1.0`
- Minimum: `1.0` (no padding)
- Maximum: `4.0`

If your updates increase the size of the documents, padding will increase the amount of space allocated to each document and avoid expensive document relocation operations within the data files.

You can calculate the padding size by subtracting the document size from the record size or, in terms of the `paddingFactor`, by subtracting 1 from the `paddingFactor`:

```
padding size = (paddingFactor - 1) * <document size>.
```

For example, a `paddingFactor` of `1.0` specifies a padding size of 0 whereas a `paddingFactor` of `1.2` specifies a padding size of `0.2` or 20 percent (20%) of the document size.

With the following command, you can use the `paddingFactor` option of the `compact` (page 752) command to set the record size to `1.1` of the document size, or a padding factor of 10 percent (10%):

```
db.runCommand ({ compact: '<collection>', paddingFactor: 1.1 })
```

`compact` (page 752) compacts existing documents but does not reset `paddingFactor` statistics for the collection. After the `compact` (page 752) MongoDB will use the existing `paddingFactor` when allocating new records for documents in this collection.

#### **paddingBytes** New in version 2.2.

Specifying `paddingBytes` can be useful if your documents start small but then increase in size significantly. For example, if your documents are initially 40 bytes long and you grow them by 1KB, using `paddingBytes: 1024` might be reasonable since using `paddingFactor: 4.0` would specify a record size of 160 bytes (`4.0` times the initial document size), which would only provide a padding of 120 bytes (i.e. record size of 160 bytes minus the document size).

With the following command, you can use the `paddingBytes` option of the `compact` (page 752) command to set the padding size to 100 bytes on the collection named by `<collection>`:

```
db.runCommand ({ compact: '<collection>', paddingBytes: 100 })
```

**Warning:** Always have an up-to-date backup before performing server maintenance such as the `compact` (page 752) operation.

**Behaviors** The `compact` (page 752) has the behaviors described here.

**Blocking** In MongoDB 2.2, [compact](#) (page 752) blocks activities only for its database. Prior to 2.2, the command blocked all activities.

You may view the intermediate progress either by viewing the [mongod](#) (page 925) log file or by running the [db.currentOp\(\)](#) (page 879) in another shell instance.

**Operation Termination** If you terminate the operation with the [db.killOp\(\)](#) (page 890) method or restart the server before the [compact](#) (page 752) operation has finished:

- If you have journaling enabled, the data remains consistent and usable, regardless of the state of the [compact](#) (page 752) operation. You may have to manually rebuild the indexes.
- If you do not have journaling enabled and the [mongod](#) (page 925) or [compact](#) (page 752) terminates during the operation, it is impossible to guarantee that the data is in a consistent state.
- In either case, much of the existing free space in the collection may become un-reusable. In this scenario, you should rerun the compaction to completion to restore the use of this free space.

**Disk Space** [compact](#) (page 752) generally uses less disk space than [repairDatabase](#) (page 757) and is faster. However, the [compact](#) (page 752) command is still slow and blocks other database use. Only use [compact](#) (page 752) during scheduled maintenance periods.

[compact](#) (page 752) requires up to 2 gigabytes of additional disk space while running. Unlike [repairDatabase](#) (page 757), [compact](#) (page 752) does *not* free space on the file system.

To see how the storage space changes for the collection, run the [collStats](#) (page 763) command before and after compaction.

**Size and Number of Data Files** [compact](#) (page 752) may increase the total size and number of your data files, especially when run for the first time. However, this will not increase the total collection storage space since storage size is the amount of data allocated within the database files, and not the size/number of the files on the file system.

**Replica Sets** [compact](#) (page 752) commands do not replicate to secondaries in a [replica set](#):

- Compact each member separately.
- Ideally run [compact](#) (page 752) on a secondary. See option `force:true` above for information regarding compacting the primary.

---

**Important:** On secondaries, the [compact](#) (page 752) command forces the secondary to enter [RECOVERING](#) (page 488) state. This prevents clients from reading during compaction. Once the operation finishes, the secondary returns to [SECONDARY](#) (page 487) state.

See [Replica Set Member States](#) (page 487) for more information about replica set member states. Refer to the “partial script for automating step down and compaction<sup>7</sup>” for an example of this procedure.

---

**Sharded Clusters** [compact](#) (page 752) is a command issued to a [mongod](#) (page 925). In a sharded environment, run [compact](#) (page 752) on each shard separately as a maintenance operation.

---

**Important:** You cannot issue [compact](#) (page 752) against a [mongos](#) (page 938) instance.

---

<sup>7</sup><https://github.com/mongodb/mongo-snippets/blob/master/js/compact-example.js>

**Capped Collections** It is not possible to compact *capped collections* because they don't have padding, and documents cannot grow in these collections. However, the documents of a *capped collection* are not subject to fragmentation.

## collMod

### collMod

New in version 2.2.

`collMod` (page 755) makes it possible to add flags to a collection to modify the behavior of MongoDB. Flags include `usePowerOf2Sizes` (page 755) and `index` (page 755). The command takes the following prototype form:

```
db.runCommand({ "collMod" : <collection> , "<flag>" : <value> })
```

In this command substitute `<collection>` with the name of a collection in the current database, and `<flag>` and `<value>` with the flag and value you want to set.

Use the `userFlags` (page 764) field in the in `db.collection.stats()` (page 848) output to check enabled collection flags.

### usePowerOf2Sizes

The `usePowerOf2Sizes` (page 755) flag changes the method that MongoDB uses to allocate space on disk for documents in this collection. By setting `usePowerOf2Sizes` (page 755), you ensure that MongoDB will allocate space for documents in sizes that are powers of 2 (e.g. 4, 8, 16, 32, 64, 128, 256, 512...8388608). With `usePowerOf2Sizes` (page 755) MongoDB will be able to more effectively reuse space.

---

**Note:** With `usePowerOf2Sizes` (page 755) MongoDB allocates records that have power of 2 sizes, until record sizes equal 4 megabytes. For records larger than 4 megabytes with `usePowerOf2Sizes` (page 755) set, `mongod` (page 925) will allocate records in full megabytes by rounding up to the nearest megabyte.

---

`usePowerOf2Sizes` (page 755) is useful for collections where you will be inserting and deleting large numbers of documents to ensure that MongoDB will effectively use space on disk.

### Example

To enable `usePowerOf2Sizes` (page 755) on the collection named `products`, use the following operation:

```
db.runCommand({ collMod: "products" , usePowerOf2Sizes : true })
```

To disable `usePowerOf2Sizes` (page 755) on the collection `products`, use the following operation:

```
db.runCommand({ collMod: "products" , usePowerOf2Sizes: false })
```

**Warning:** Changed in version 2.2.1: `usePowerOf2Sizes` (page 755) now supports documents larger than 8 megabytes. If you enable `usePowerOf2Sizes` (page 755) you **must** use at least version 2.2.1.

`usePowerOf2Sizes` (page 755) only affects subsequent allocations caused by document insertion or record relocation as a result of document growth, and *does not* affect existing allocations.

## index

The `index` (page 755) flag changes the expiration time of a *TTL Collection* (page 158).

Specify the key and new expiration time with a document of the form:

```
{keyPattern: <index_spec>, expireAfterSeconds: <seconds> }
```

where `<index_spec>` is an existing index in the collection and `seconds` is the number of seconds to subtract from the current time.

---

### Example

To update the expiration value for a collection named `sessions` indexed on a `lastAccess` field from 30 minutes to 60 minutes, use the following operation:

```
db.runCommand({collMod: "sessions",
 index: {keyPattern: {lastAccess:1},
 expireAfterSeconds: 3600}})
```

Which will return the document:

```
{ "expireAfterSeconds_old" : 1800, "expireAfterSeconds_new" : 3600, "ok" : 1 }
```

---

On success `collMod` (page 755) returns a document with fields `expireAfterSeconds_old` and `expireAfterSeconds_new` set to their respective values.

On failure, `collMod` (page 755) returns a document with no `expireAfterSeconds` field to update if there is no existing `expireAfterSeconds` field or cannot find index `{ **key**: 1.0 }` for ns `**namespace**` if the specified `keyPattern` does not exist.

---

## reIndex

### reIndex

The `reIndex` (page 756) command rebuilds all indexes for a specified collection. Use the following syntax:

```
{ reIndex: "collection" }
```

Normally, MongoDB compacts indexes during routine updates. For most users, the `reIndex` (page 756) command is unnecessary. However, it may be worth running if the collection size has changed significantly or if the indexes are consuming a disproportionate amount of disk space.

Call `reIndex` (page 756) using the following form:

```
db.collection.reIndex();
```

---

**Note:** For replica sets, `reIndex` (page 756) will not propagate from the *primary* to *secondaries*. `reIndex` (page 756) will only affect a single `mongod` (page 925) instance.

---

## See

[Index Creation](#) (page 335) for more information on the behavior of indexing operations in MongoDB.

---

---

## setParameter

### setParameter

`setParameter` (page 756) is an administrative command for modifying options normally set on the command line. You must issue the `setParameter` (page 756) command against the `admin database` in the form:

```
{ setParameter: 1, <option>: <value> }
```

Replace the `<option>` with one of the supported `setParameter` (page 756) options:

- [journalCommitInterval](#) (page 1006)
- [logLevel](#) (page 1006)
- [logUserIds](#) (page 1006)
- [notableScan](#) (page 1006)
- [quiet](#) (page 1007)
- [replApplyBatchSize](#) (page 1006)
- [replIndexPrefetch](#) (page 1006)
- [syncdelay](#) (page 1007)
- [traceExceptions](#) (page 1007)
- [textSearchEnabled](#) (page 1008)

**getParameter****getParameter**

[getParameter](#) (page 757) is an administrative command for retrieving the value of options normally set on the command line. Issue commands against the *admin database* as follows:

```
{ getParameter: 1, <option>: 1 }
```

The values specified for `getParameter` and `<option>` do not affect the output. The command works with the following options:

- [quiet](#)
- [notableScan](#)
- [logLevel](#)
- [syncdelay](#)

**See also:**

[setParameter](#) (page 756) for more about these parameters.

**repairDatabase**

- [Definition](#) (page 757)
- [Behavior](#) (page 758)
- [Example](#) (page 759)
- [Using repairDatabase to Reclaim Disk Space](#) (page 759)

**Definition****repairDatabase**

Checks and repairs errors and inconsistencies in data storage. [repairDatabase](#) (page 757) is analogous to a `fsck` command for file systems. Run the [repairDatabase](#) (page 757) command to ensure data integrity after the system experiences an unexpected system restart or crash, if:

1. The `mongod` (page 925) instance is not running with *journaling* enabled.

---

**Note:** When using *journaling*, there is almost never any need to run [repairDatabase](#) (page 757). In the event of an unclean shutdown, the server will be able restore the data files to a pristine state automatically.

---

2. There are *no* other intact *replica set* members with a complete data set.

**Warning:** During normal operations, only use the `repairDatabase` (page 757) command and wrappers including `db.repairDatabase()` (page 892) in the `mongo` (page 942) shell and `mongod --repair`, to compact database files and/or reclaim disk space. Be aware that these operations remove and do not save any corrupt data during the repair process.

If you are trying to repair a *replica set* member, and you have access to an intact copy of your data (e.g. a recent backup or an intact member of the *replica set*), you should restore from that intact copy, and **not use** `repairDatabase` (page 757).

`repairDatabase` (page 757) has the following fields:

**field boolean preserveClonedFilesOnFailure** When `true`, `repairDatabase` will not delete temporary files in the backup directory on error, and all new files are created with the “`backup`” instead of “`_tmp`” directory prefix. By default `repairDatabase` does not delete temporary files, and uses the “`_tmp`” naming prefix for new files.

**field boolean backupOriginalFiles** When `true`, `repairDatabase` moves old database files to the backup directory instead of deleting them before moving new files into place. New files are created with the “`backup`” instead of “`_tmp`” directory prefix. By default, `repairDatabase` leaves temporary files unchanged, and uses the “`_tmp`” naming prefix for new files.

`repairDatabase` (page 757) takes the following form:

```
{ repairDatabase: 1 }
```

You can explicitly set the options as follows:

```
{ repairDatabase: 1,
 preserveClonedFilesOnFailure: <boolean>,
 backupOriginalFiles: <boolean> }
```

**Warning:** This command obtains a global write lock and will block other operations until it has completed.

**Note:** `repairDatabase` (page 757) requires free disk space equal to the size of your current data set plus 2 gigabytes. If the volume that holds `dbpath` lacks sufficient space, you can mount a separate volume and use that for the repair. When mounting a separate volume for `repairDatabase` (page 757) you must run `repairDatabase` (page 757) from the command line and use the `--repairpath` switch to specify the folder in which to store temporary repair files.

See `mongod --repair` and `mongodump --repair` for information on these related options.

**Behavior** The `repairDatabase` (page 757) command compacts all collections in the database. It is identical to running the `compact` (page 752) command on each collection individually.

`repairDatabase` (page 757) reduces the total size of the data files on disk. It also recreates all indexes in the database.

The time requirement for `repairDatabase` (page 757) depends on the size of the data set.

You may invoke `repairDatabase` (page 757) from multiple contexts:

- Use the `mongo` (page 942) shell to run the command, as above.
- Use the `db.repairDatabase()` (page 892) in the `mongo` (page 942) shell.
- Run `mongod` (page 925) directly from your system’s shell. Make sure that `mongod` (page 925) isn’t already running, and that you invoke `mongod` (page 925) as a user that has access to MongoDB’s data files. Run as:

---

```
mongod --repair
```

To add a repair path:

```
mongod --repair --repairpath /opt/vol2/data
```

---

**Note:** `mongod --repair` (page 925) will fail if your database is not a master or primary. In most cases, you should recover a corrupt secondary using the data from an existing intact node. To run repair on a secondary/slave restart the instance in standalone mode without the `--replicaSet` or `--slave` options.

---

### Example

```
{ repairDatabase: 1 }
```

**Using `repairDatabase` to Reclaim Disk Space** You should not use `repairDatabase` (page 757) for data recovery unless you have no other option.

However, if you trust that there is no corruption and you have enough free space, then `repairDatabase` (page 757) is the appropriate and the only way to reclaim disk space.

### `touch`

#### `touch`

New in version 2.2.

The `touch` (page 759) command loads data from the data storage layer into memory. `touch` (page 759) can load the data (i.e. documents,) indexes or both documents and indexes. Use this command to ensure that a collection, and/or its indexes, are in memory before another operation. By loading the collection or indexes into memory, `mongod` (page 925) will ideally be able to perform subsequent operations more efficiently. The `touch` (page 759) command has the following prototypical form:

```
{ touch: [collection], data: [boolean], index: [boolean] }
```

By default, `data` and `index` are false, and `touch` (page 759) will perform no operation. For example, to load both the data and the index for a collection named `records`, you would use the following command in the `mongo` (page 942) shell:

```
db.runCommand({ touch: "records", data: true, index: true })
```

`touch` (page 759) will not block read and write operations on a `mongod` (page 925), and can run on `secondary` members of replica sets.

---

**Note:** Using `touch` (page 759) to control or tweak what a `mongod` (page 925) stores in memory may displace other records data in memory and hinder performance. Use with caution in production systems.

**Warning:** If you run `touch` (page 759) on a secondary, the secondary will enter a RECOVERING state to prevent clients from sending read operations during the `touch` (page 759) operation. When `touch` (page 759) finishes the secondary will automatically return to SECONDARY state. See `state` (page 727) for more information on replica set member states.

### `shutdown`

### **shutdown**

The [shutdown](#) (page 759) command cleans up all database resources and then terminates the process. You must issue the [shutdown](#) (page 759) command against the [admin database](#) in the form:

```
{ shutdown: 1 }
```

---

**Note:** Run the [shutdown](#) (page 759) against the [admin database](#). When using [shutdown](#) (page 759), the connection must originate from localhost **or** use an authenticated connection.

---

If the node you're trying to shut down is a [replica set](#) (page 377) primary, then the command will succeed only if there exists a secondary node whose oplog data is within 10 seconds of the primary. You can override this protection using the `force` option:

```
{ shutdown: 1, force: true }
```

Alternatively, the [shutdown](#) (page 759) command also supports a `timeoutSecs` argument which allows you to specify a number of seconds to wait for other members of the replica set to catch up:

```
{ shutdown: 1, timeoutSecs: 60 }
```

The equivalent [mongo](#) (page 942) shell helper syntax looks like this:

```
db.shutdownServer({timeoutSecs: 60});
```

### **logRotate**

#### **logRotate**

The [logRotate](#) (page 760) command is an administrative command that allows you to rotate the MongoDB logs to prevent a single logfile from consuming too much disk space. You must issue the [logRotate](#) (page 760) command against the [admin database](#) in the form:

```
{ logRotate: 1 }
```

---

**Note:** Your [mongod](#) (page 925) instance needs to be running with the `--logpath [file]` option.

---

You may also rotate the logs by sending a SIGUSR1 signal to the [mongod](#) (page 925) process. If your [mongod](#) (page 925) has a process ID of 2200, here's how to send the signal on Linux:

```
kill -SIGUSR1 2200
```

[logRotate](#) (page 760) renames the existing log file by appending the current timestamp to the filename. The appended timestamp has the following form:

```
<YYYY>-<mm>-<DD>T<HH>-<MM>-<SS>
```

Then [logRotate](#) (page 760) creates a new log file with the same name as originally specified by the `logpath` (page 992) setting to [mongod](#) (page 925) or [mongos](#) (page 938).

---

**Note:** New in version 2.0.3: The [logRotate](#) (page 760) command is available to [mongod](#) (page 925) instances running on Windows systems with MongoDB release 2.0.3 and higher.

---

## Diagnostic Commands

|                            | <b>Name</b>                                      | <b>Description</b>                                                                                                              |
|----------------------------|--------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| <b>Diagnostic Commands</b> | <a href="#">listDatabases</a> (page 761)         | Returns a document that lists all databases and returns basic database statistics.                                              |
|                            | <a href="#">dbHash</a> (page 761)                | Internal command to support sharding.                                                                                           |
|                            | <a href="#">driverOIDTest</a> (page 761)         | Internal command that converts an ObjectId to a string to support tests.                                                        |
|                            | <a href="#">listCommands</a> (page 762)          | Lists all database commands provided by the current <a href="#">mongod</a> (page 925) instance.                                 |
|                            | <a href="#">availableQueryOptions</a> (page 762) | Internal command that reports on the capabilities of the current MongoDB instance.                                              |
|                            | <a href="#">buildInfo</a> (page 762)             | Displays statistics about the MongoDB build.                                                                                    |
|                            | <a href="#">collStats</a> (page 763)             | Reports storage utilization statistics for a specified collection.                                                              |
|                            | <a href="#">connPoolStats</a> (page 765)         | Reports statistics on the outgoing connections from this MongoDB instance to other MongoDB instances in the deployment.         |
|                            | <a href="#">dbStats</a> (page 767)               | Reports storage utilization statistics for the specified database.                                                              |
|                            | <a href="#">cursorInfo</a> (page 769)            | Reports statistics on active cursors.                                                                                           |
|                            | <a href="#">dataSize</a> (page 769)              | Returns the data size for a range of data. For internal use.                                                                    |
|                            | <a href="#">diagLogging</a> (page 769)           | Provides a diagnostic logging. For internal use.                                                                                |
|                            | <a href="#">getCmdLineOpts</a> (page 769)        | Returns a document with the run-time arguments to the MongoDB instance and their parsed options.                                |
|                            | <a href="#">netstat</a> (page 770)               | Internal command that reports on intra-deployment connectivity. Only available for <a href="#">mongos</a> (page 938) instances. |
|                            | <a href="#">ping</a> (page 770)                  | Internal command that tests intra-deployment connectivity.                                                                      |
|                            | <a href="#">profile</a> (page 770)               | Interface for the <a href="#">database profiler</a> (page 229).                                                                 |
|                            | <a href="#">validate</a> (page 771)              | Internal command that scans for a collection's data and indexes for correctness.                                                |
|                            | <a href="#">top</a> (page 774)                   | Returns raw usage statistics for each database in the <a href="#">mongod</a> (page 925) instance.                               |
|                            | <a href="#">indexStats</a> (page 774)            | Experimental command that collects and aggregates statistics on all indexes.                                                    |
|                            | <a href="#">whatsmyuri</a> (page 779)            | Internal command that returns information on the current client.                                                                |
|                            | <a href="#">getLog</a> (page 779)                | Returns recent log messages.                                                                                                    |
|                            | <a href="#">hostInfo</a> (page 780)              | Returns data that reflects the underlying host system.                                                                          |
|                            | <a href="#">serverStatus</a> (page 782)          | Returns a collection metrics on instance-wide resource utilization and status.                                                  |
|                            | <a href="#">features</a> (page 799)              | Reports on features available in the current MongoDB instance.                                                                  |
|                            | <a href="#">isSelf</a>                           | Internal command to support testing.                                                                                            |

## listDatabases

### listDatabases

The [listDatabases](#) (page 761) command provides a list of existing databases along with basic statistics about them:

```
{ listDatabases: 1 }
```

The value (e.g. 1) does not affect the output of the command. [listDatabases](#) (page 761) returns a document for each database. Each document contains a `name` field with the database name, a `sizeOnDisk` field with the total size of the database file on disk in bytes, and an `empty` field specifying whether the database has any data.

## dbHash

### dbHash

[dbHash](#) (page 761) is an internal command.

## driverOIDTest

**driverOIDTest**

`driverOIDTest` (page 761) is an internal command.

**listCommands**

**listCommands**

The `listCommands` (page 762) command generates a list of all database commands implemented for the current `mongod` (page 925) instance.

**availableQueryOptions**

**availableQueryOptions**

`availableQueryOptions` (page 762) is an internal command that is only available on `mongos` (page 938) instances.

**buildInfo**

**buildInfo**

The `buildInfo` (page 762) command is an administrative command which returns a build summary for the current `mongod` (page 925). `buildInfo` (page 762) has the following prototype form:

```
{ buildInfo: 1 }
```

In the `mongo` (page 942) shell, call `buildInfo` (page 762) in the following form:

```
db.runCommand({ buildInfo: 1 })
```

---

**Example**

The output document of `buildInfo` (page 762) has the following form:

```
{
 "version" : "<string>",
 "gitVersion" : "<string>",
 "sysInfo" : "<string>",
 "loaderFlags" : "<string>",
 "compilerFlags" : "<string>",
 "allocator" : "<string>",
 "versionArray" : [<num>, <num>, <...>],
 "javascriptEngine" : "<string>",
 "bits" : <num>,
 "debug" : <boolean>,
 "maxBsonObjectSize" : <num>,
 "ok" : <num>
}
```

---

Consider the following documentation of the output of `buildInfo` (page 762):

**buildInfo**

The document returned by the `buildInfo` (page 762) command.

**buildInfo.gitVersion**

The commit identifier that identifies the state of the code used to build the `mongod` (page 925).

**buildInfo.sysInfo**

A string that holds information about the operating system, hostname, kernel, date, and Boost version used to compile the `mongod` (page 925).

**buildInfo.loaderFlags**

The flags passed to the loader that loads the `mongod` (page 925).

**buildInfo.compilerFlags**

The flags passed to the compiler that builds the [mongod](#) (page 925) binary.

**buildInfoallocator**

Changed in version 2.2.

The memory allocator that [mongod](#) (page 925) uses. By default this is `tcmalloc` after version 2.2, and `system` before 2.2.

**buildInfo.versionArray**

An array that conveys version information about the [mongod](#) (page 925) instance. See [version](#) for a more readable version of this string.

**buildInfo.javascriptEngine**

Changed in version 2.4.

A string that reports the JavaScript engine used in the [mongod](#) (page 925) instance. By default, this is V8 after version 2.4, and SpiderMonkey before 2.4.

**buildInfo.bits**

A number that reflects the target processor architecture of the [mongod](#) (page 925) binary.

**buildInfo.debug**

A boolean. `true` when built with debugging options.

**buildInfo.maxBsonObjectSize**

A number that reports the [Maximum BSON Document Size](#) (page 1015).

**collStats****Definition****collStats**

The [collStats](#) (page 763) command returns a variety of storage statistics for a given collection. Use the following syntax:

```
{ collStats: "collection" , scale : 1024 }
```

Specify the `collection` you want statistics for, and use the `scale` argument to scale the output. The above example will display values in kilobytes.

Examine the following example output, which uses the `db.collection.stats()` (page 848) helper in the [mongo](#) (page 942) shell.

```
> db.users.stats()
{
 "ns" : "app.users", // namespace
 "count" : 9, // number of documents
 "size" : 432, // collection size in bytes
 "avgObjSize" : 48, // average object size in bytes
 "storageSize" : 3840, // (pre)allocated space for the collection in bytes
 "numExtents" : 1, // number of extents (contiguously allocated chunks of data)
 "nindexes" : 2, // number of indexes
 "lastExtentSize" : 3840, // size of the most recently created extent in bytes
 "paddingFactor" : 1, // padding can speed up updates if documents grow
 "flags" : 1,
 "totalIndexSize" : 16384, // total index size in bytes
 "indexSizes" : {
 "_id_" : 8192, // size of specific indexes in bytes
 "username" : 8192
 }
}
```

```
 },
 "ok" : 1
 }
```

---

**Note:** The scale factor rounds values to whole numbers. This can produce unpredictable and unexpected results in some situations.

---

## Output

### collStats.ns

The namespace of the current collection, which follows the format [database].[collection].

### collStats.count

The number of objects or documents in this collection.

### collStats.size

The size of the data stored in this collection. This value does not include the size of any indexes associated with the collection, which the [totalIndexSize](#) (page 765) field reports.

The `scale` argument affects this value.

### collStats.avgObjSize

The average size of an object in the collection. The `scale` argument affects this value.

### collStats.storageSize

The total amount of storage allocated to this collection for [document](#) storage. The `scale` argument affects this value. The [storageSize](#) (page 764) does not decrease as you remove or shrink documents.

### collStats.numExtents

The total number of contiguously allocated data file regions.

### collStats.nindexes

The number of indexes on the collection. All collections have at least one index on the [\\_id](#) field.

Changed in version 2.2: Before 2.2, capped collections did not necessarily have an index on the [\\_id](#) field, and some capped collections created with pre-2.2 versions of [mongod](#) (page 925) may not have an [\\_id](#) index.

### collStats.lastExtentSize

The size of the last extent allocated. The `scale` argument affects this value.

### collStats.paddingFactor

The amount of space added to the end of each document at insert time. The document padding provides a small amount of extra space on disk to allow a document to grow slightly without needing to move the document. [mongod](#) (page 925) automatically calculates this padding factor

### collStats.flags

Changed in version 2.2: Removed in version 2.2 and replaced with the [userFlags](#) (page 764) and [systemFlags](#) (page 764) fields.

Indicates the number of flags on the current collection. In version 2.0, the only flag notes the existence of an [index](#) on the [\\_id](#) field.

### collStats.systemFlags

New in version 2.2.

Reports the flags on this collection that reflect internal server options. Typically this value is 1 and reflects the existence of an [index](#) on the [\\_id](#) field.

### collStats.userFlags

New in version 2.2.

Reports the flags on this collection set by the user. In version 2.2 the only user flag is [usePowerOf2Sizes](#) (page 755). If [usePowerOf2Sizes](#) (page 755) is enabled, [userFlags](#) (page 764) will be 1, otherwise [userFlags](#) (page 764) will be 0.

See the [collMod](#) (page 755) command for more information on setting user flags and [usePowerOf2Sizes](#) (page 755).

#### `collStats.totalIndexSize`

The total size of all indexes. The `scale` argument affects this value.

#### `collStats.indexSizes`

This field specifies the key and size of every existing index on the collection. The `scale` argument affects this value.

**Example** The following is an example of [db.collection.stats\(\)](#) (page 848) and [collStats](#) (page 763) output:

```
{
 "ns" : "<database>.<collection>",
 "count" : <number>,
 "size" : <number>,
 "avgObjSize" : <number>,
 "storageSize" : <number>,
 "numExtents" : <number>,
 "nindexes" : <number>,
 "lastExtentSize" : <number>,
 "paddingFactor" : <number>,
 "systemFlags" : <bit>,
 "userFlags" : <bit>,
 "totalIndexSize" : <number>,
 "indexSizes" : {
 "_id_" : <number>,
 "a_1" : <number>
 },
 "ok" : 1
}
```

## connPoolStats

### Definition

#### `connPoolStats`

---

**Note:** [connPoolStats](#) (page 765) only returns meaningful results for [mongos](#) (page 938) instances and for [mongod](#) (page 925) instances in sharded clusters.

The command [connPoolStats](#) (page 765) returns information regarding the number of open connections to the current database instance, including client connections and server-to-server connections for replication and clustering. The command takes the following form:

```
{ connPoolStats: 1 }
```

The value of the argument (i.e. 1) does not affect the output of the command.

---

**Note:** [connPoolStats](#) (page 765) only returns meaningful results for [mongos](#) (page 938) instances and for [mongod](#) (page 925) instances in sharded clusters.

## Output

### connPoolStats.hosts

The sub-documents of the `hosts` (page 766) *document* report connections between the `mongos` (page 938) or `mongod` (page 925) instance and each component `mongod` (page 925) of the *sharded cluster*.

#### connPoolStats.hosts.[host].available

`available` (page 766) reports the total number of connections that the `mongos` (page 938) or `mongod` (page 925) could use to connect to this `mongod` (page 925).

#### connPoolStats.hosts.[host].created

`created` (page 766) reports the number of connections that this `mongos` (page 938) or `mongod` (page 925) has ever created for this host.

### connPoolStats.replicaSets

`replicaSets` (page 766) is a *document* that contains *replica set* information for the *sharded cluster*.

#### connPoolStats.replicaSets.shard

The `shard` (page 766) *document* reports on each `shard` within the *sharded cluster*

#### connPoolStats.replicaSets.[shard].host

The `host` (page 766) field holds an array of *document* that reports on each host within the `shard` in the *replica set*.

These values derive from the *replica set status* (page 726) values.

##### connPoolStats.replicaSets.[shard].host[n].addr

`addr` (page 766) reports the address for the host in the *sharded cluster* in the format of “[hostname]:[port]”.

##### connPoolStats.replicaSets.[shard].host[n].ok

`ok` (page 766) reports false when:

- the `mongos` (page 938) or `mongod` (page 925) cannot connect to instance.
- the `mongos` (page 938) or `mongod` (page 925) received a connection exception or error.

This field is for internal use.

##### connPoolStats.replicaSets.[shard].host[n].ismaster

`ismaster` (page 766) reports true if this `host` (page 766) is the *primary* member of the *replica set*.

##### connPoolStats.replicaSets.[shard].host[n].hidden

`hidden` (page 766) reports true if this `host` (page 766) is a *hidden member* of the *replica set*.

##### connPoolStats.replicaSets.[shard].host[n].secondary

`secondary` (page 766) reports true if this `host` (page 766) is a *secondary* member of the *replica set*.

##### connPoolStats.replicaSets.[shard].host[n].pingTimeMillis

`pingTimeMillis` (page 766) reports the ping time in milliseconds from the `mongos` (page 938) or `mongod` (page 925) to this `host` (page 766).

##### connPoolStats.replicaSets.[shard].host[n].tags

New in version 2.2.

`tags` (page 766) reports the `tags` (page 482), if this member of the set has tags configured.

##### connPoolStats.replicaSets.[shard].master

`master` (page 766) reports the ordinal identifier of the host in the `host` (page 766) array that is the *primary* of the *replica set*.

**connPoolStats.replicaSets.[shard].nextSlave**

Deprecated since version 2.2.

`nextSlave` (page 766) reports the *secondary* member that the `mongos` (page 938) will use to service the next request for this *replica set*.

**connPoolStats.createdByType**

`createdByType` (page 767) *document* reports the number of each type of connection that `mongos` (page 938) or `mongod` (page 925) has created in all connection pools.

`mongos` (page 938) connect to `mongod` (page 925) instances using one of three types of connections. The following sub-document reports the total number of connections by type.

**connPoolStats.createdByType.master**

`master` (page 767) reports the total number of connections to the *primary* member in each *cluster*.

**connPoolStats.createdByType.set**

`set` (page 767) reports the total number of connections to a *replica set* member.

**connPoolStats.createdByType.sync**

`sync` (page 767) reports the total number of *config database* connections.

**connPoolStats.totalAvailable**

`totalAvailable` (page 767) reports the running total of connections from the `mongos` (page 938) or `mongod` (page 925) to all `mongod` (page 925) instances in the *sharded cluster* available for use.

**connPoolStats.totalCreated**

`totalCreated` (page 767) reports the total number of connections ever created from the `mongos` (page 938) or `mongod` (page 925) to all `mongod` (page 925) instances in the *sharded cluster*.

**connPoolStats.numDBClientConnection**

`numDBClientConnection` (page 767) reports the total number of connections from the `mongos` (page 938) or `mongod` (page 925) to all of the `mongod` (page 925) instances in the *sharded cluster*.

**connPoolStats.numAScopedConnection**

`numAScopedConnection` (page 767) reports the number of exception safe connections created from `mongos` (page 938) or `mongod` (page 925) to all `mongod` (page 925) in the *sharded cluster*. The `mongos` (page 938) or `mongod` (page 925) releases these connections after receiving a socket exception from the `mongod` (page 925).

**dbStats****Definition****dbStats**

The `dbStats` (page 767) command returns storage statistics for a given database. The command takes the following syntax:

```
{ dbStats: 1, scale: 1 }
```

The values of the options above do not affect the output of the command. The `scale` option allows you to specify how to scale byte values. For example, a `scale` value of 1024 will display the results in kilobytes rather than in bytes:

```
{ dbStats: 1, scale: 1024 }
```

---

**Note:** Because scaling rounds values to whole numbers, scaling may return unlikely or unexpected results.

The time required to run the command depends on the total size of the database. Because the command must touch all data files, the command may take several seconds to run.

In the [mongo](#) (page 942) shell, the [db.stats\(\)](#) (page 894) function provides a wrapper around [dbStats](#) (page 767).

### Output

#### dbStats.**db**

Contains the name of the database.

#### dbStats.**collections**

Contains a count of the number of collections in that database.

#### dbStats.**objects**

Contains a count of the number of objects (i.e. [documents](#)) in the database across all collections.

#### dbStats.**avgObjSize**

The average size of each document in bytes. This is the [dataSize](#) (page 768) divided by the number of documents.

#### dbStats.**dataSize**

The total size in bytes of the data held in this database including the [padding factor](#). The [scale](#) argument affects this value. The [dataSize](#) (page 768) will not decrease when [documents](#) shrink, but will decrease when you remove documents.

#### dbStats.**storageSize**

The total amount of space in bytes allocated to collections in this database for [document](#) storage. The [scale](#) argument affects this value. The [storageSize](#) (page 768) does not decrease as you remove or shrink documents.

#### dbStats.**numExtents**

Contains a count of the number of extents in the database across all collections.

#### dbStats.**indexes**

Contains a count of the total number of indexes across all collections in the database.

#### dbStats.**indexSize**

The total size in bytes of all indexes created on this database. The [scale](#) arguments affects this value.

#### dbStats.**fileSize**

The total size in bytes of the data files that hold the database. This value includes preallocated space and the [padding factor](#). The value of [fileSize](#) (page 768) only reflects the size of the data files for the database and not the namespace file.

The [scale](#) argument affects this value.

#### dbStats.**nsSizeMB**

The total size of the [namespace](#) files (i.e. that end with `.ns`) for this database. You cannot change the size of the namespace file after creating a database, but you can change the default size for all new namespace files with the [nssize](#) (page 996) runtime option.

### See also:

The [nssize](#) (page 996) option, and [Maximum Namespace File Size](#) (page 1016)

#### dbStats.**dataFileVersion**

New in version 2.4.

Document that contains information about the on-disk format of the data files for the database.

#### dbStats.dataFileVersion.**major**

New in version 2.4.

The major version number for the on-disk format of the data files for the database.

#### `dbStats.dataFileVersion.minor`

New in version 2.4.

The minor version number for the on-disk format of the data files for the database.

#### `cursorInfo`

##### `cursorInfo`

The [cursorInfo](#) (page 769) command returns information about current cursor allotment and use. Use the following form:

```
{ cursorInfo: 1 }
```

The value (e.g. 1 above,) does not affect the output of the command.

[cursorInfo](#) (page 769) returns the total number of open cursors (`totalOpen`), the size of client cursors in current use (`clientCursors_size`), and the number of timed out cursors since the last server restart (`timedOut`).

#### `dataSize`

##### `dataSize`

For internal use.

The [dataSize](#) (page 769) command returns the data size for a set of data within a certain range:

```
{ dataSize: "database.collection", keyPattern: { field: 1 }, min: { field: 10 }, max: { field: 1 }
```

This will return a document that contains the size of all matching documents. Replace `database.collection` value with database and collection from your deployment. The `keyPattern`, `min`, and `max` parameters are options.

The amount of time required to return [dataSize](#) (page 769) depends on the amount of data in the collection.

#### `diagLogging`

##### `diagLogging`

[diagLogging](#) (page 769) is an internal command.

**Warning:** This command obtains a write lock on the affected database and will block other operations until it has completed.

#### `getCmdLineOpts`

##### `getCmdLineOpts`

The [getCmdLineOpts](#) (page 769) command returns a document containing command line options used to start the given `mongod` (page 925):

```
{ getCmdLineOpts: 1 }
```

This command returns a document with two fields, `argv` and `parsed`. The `argv` field contains an array with each item from the command string used to invoke `mongod` (page 925). The document in the `parsed` field includes all runtime options, including those parsed from the command line and those specified in the configuration file, if specified.

Consider the following example output of [getCmdLineOpts](#) (page 769):

```
{
 "argv" : [
 "/usr/bin/mongod",
 "--config",
 "/etc/mongodb.conf",
 "--fork"
],
 "parsed" : {
 "bind_ip" : "127.0.0.1",
 "config" : "/etc/mongodb/mongodb.conf",
 "dbpath" : "/srv/mongodb",
 "fork" : true,
 "logappend" : "true",
 "logpath" : "/var/log/mongodb/mongod.log",
 "quiet" : "true"
 },
 "ok" : 1
}
```

<http://docs.mongodb.org/manual/administration/import-export/>

## netstat

### netstat

`netstat` (page 770) is an internal command that is only available on `mongos` (page 938) instances.

## ping

### ping

The `ping` (page 770) command is a no-op used to test whether a server is responding to commands. This command will return immediately even if the server is write-locked:

```
{ ping: 1 }
```

The value (e.g. 1 above,) does not impact the behavior of the command.

## profile

### profile

Use the `profile` (page 770) command to enable, disable, or change the query profiling level. This allows administrators to capture data regarding performance. The database profiling system can impact performance and can allow the server to write the contents of queries to the log. Your deployment should carefully consider the security implications of this. Consider the following prototype syntax:

```
{ profile: <level> }
```

The following profiling levels are available:

| Level | Setting                                       |
|-------|-----------------------------------------------|
| -1    | No change. Returns the current profile level. |
| 0     | Off. No profiling.                            |
| 1     | On. Only includes slow operations.            |
| 2     | On. Includes all operations.                  |

You may optionally set a threshold in milliseconds for profiling using the `slowms` option, as follows:

```
{ profile: 1, slowms: 200 }
```

`mongod` (page 925) writes the output of the database profiler to the `system.profile` collection.

`mongod` (page 925) records queries that take longer than the `slowms` (page 997) to the server log even when the database profiler is not active.

#### See also:

Additional documentation regarding database profiling *Database Profiling* (page 143).

#### See also:

“`db.getProfilingStatus()` (page 887)” and “`db.setProfilingLevel()` (page 894)” provide wrappers around this functionality in the `mongo` (page 942) shell.

---

**Note:** The database cannot be locked with `db.fsyncLock()` (page 885) while profiling is enabled. You must disable profiling before locking the database with `db.fsyncLock()` (page 885). Disable profiling using `db.setProfilingLevel()` (page 894) as follows in the `mongo` (page 942) shell:

```
db.setProfilingLevel(0)
```

---

**Note:** This command obtains a write lock on the affected database and will block other operations until it has completed. However, the write lock is only held while enabling or disabling the profiler. This is typically a short operation.

---

## validate

### Definition

#### `validate`

The `validate` (page 771) command checks the structures within a namespace for correctness by scanning the collection’s data and indexes. The command returns information regarding the on-disk representation of the collection.

The `validate` command can be slow, particularly on larger data sets.

The following example validates the contents of the collection named `users`.

```
{ validate: "users" }
```

You may also specify one of the following options:

- `full`: `true` provides a more thorough scan of the data.
- `scandata`: `false` skips the scan of the base collection without skipping the scan of the index.

The `mongo` (page 942) shell also provides a wrapper:

```
db.collection.validate();
```

Use one of the following forms to perform the full collection validation:

```
db.collection.validate(true)
db.runCommand({ validate: "collection", full: true })
```

**Warning:** This command is resource intensive and may have an impact on the performance of your MongoDB instance.

## Output

### validate.ns

The full namespace name of the collection. Namespaces include the database name and the collection name in the form `database.collection`.

### validate.firstExtent

The disk location of the first extent in the collection. The value of this field also includes the namespace.

### validate.lastExtent

The disk location of the last extent in the collection. The value of this field also includes the namespace.

### validate.extentCount

The number of extents in the collection.

### validate.extents

`validate` (page 771) returns one instance of this document for every extent in the collection. This sub-document is only returned when you specify the `full` option to the command.

#### validate.extents.loc

The disk location for the beginning of this extent.

#### validate.extents.xnext

The disk location for the extent following this one. “null” if this is the end of the linked list of extents.

#### validate.extents.xprev

The disk location for the extent preceding this one. “null” if this is the head of the linked list of extents.

#### validate.extents.nsdiag

The namespace this extent belongs to (should be the same as the namespace shown at the beginning of the validate listing).

#### validate.extents.size

The number of bytes in this extent.

#### validate.extents.firstRecord

The disk location of the first record in this extent.

#### validate.extents.lastRecord

The disk location of the last record in this extent.

### validate.datasize

The number of bytes in all data records. This value does not include deleted records, nor does it include extent headers, nor record headers, nor space in a file unallocated to any extent. `datasize` (page 772) includes record `padding`.

### validate.nrecords

The number of `documents` in the collection.

### validate.lastExtentSize

The size of the last new extent created in this collection. This value determines the size of the *next* extent created.

### validate.padding

A floating point value between 1 and 2.

When MongoDB creates a new record it uses the `padding factor` to determine how much additional space to add to the record. The padding factor is automatically adjusted by mongo when it notices that update operations are triggering record moves.

### validate.firstExtentDetails

The size of the first extent created in this collection. This data is similar to the data provided by the `extents` (page 772) sub-document; however, the data reflects only the first extent in the collection and is always returned.

**validate.firstExtentDetails.loc**

The disk location for the beginning of this extent.

**validate.firstExtentDetails.xnext**

The disk location for the extent following this one. “null” if this is the end of the linked list of extents, which should only be the case if there is only one extent.

**validate.firstExtentDetails.xprev**

The disk location for the extent preceding this one. This should always be “null.”

**validate.firstExtentDetails.nsdiag**

The namespace this extent belongs to (should be the same as the namespace shown at the beginning of the validate listing).

**validate.firstExtentDetails.size**

The number of bytes in this extent.

**validate.firstExtentDetails.firstRecord**

The disk location of the first record in this extent.

**validate.firstExtentDetails.lastRecord**

The disk location of the last record in this extent.

**validate.objectsFound**

The number of records actually encountered in a scan of the collection. This field should have the same value as the [nrecords](#) (page 772) field.

**validate.invalidObjects**

The number of records containing BSON documents that do not pass a validation check.

**Note:** This field is only included in the validation output when you specify the `full` option.

**validate.bytesWithHeaders**

This is similar to datasize, except that [bytesWithHeaders](#) (page 773) includes the record headers. In version 2.0, record headers are 16 bytes per document.

**Note:** This field is only included in the validation output when you specify the `full` option.

**validate.bytesWithoutHeaders**

[bytesWithoutHeaders](#) (page 773) returns data collected from a scan of all records. The value should be the same as [datasize](#) (page 772).

**Note:** This field is only included in the validation output when you specify the `full` option.

**validate.deletedCount**

The number of deleted or “free” records in the collection.

**validate.deletedSize**

The size of all deleted or “free” records in the collection.

**validate.nIndexes**

The number of indexes on the data in the collection.

**validate.keysPerIndex**

A document containing a field for each index, named after the index’s name, that contains the number of keys, or documents referenced, included in the index.

**validate.valid**

Boolean. `true`, unless [validate](#) (page 771) determines that an aspect of the collection is not valid. When

`false`, see the [errors](#) (page 774) field for more information.

### **validate.errors**

Typically empty; however, if the collection is not valid (i.e [valid](#) (page 773) is `false`), this field will contain a message describing the validation error.

### **validate.ok**

Set to `1` when the command succeeds. If the command fails the [ok](#) (page 774) field has a value of `0`.

## **top**

### **top**

The [top](#) (page 774) command is an administrative command which returns raw usage of each database, and provides amount of time, in microseconds, used and a count of operations for the following event types:

- total
- readLock
- writeLock
- queries
- getmore
- insert
- update
- remove
- commands

You must issue the [top](#) (page 774) command against the [admin database](#) in the form:

```
{ top: 1 }
```

## **indexStats**

- [Definition](#) (page 774)
- [Output](#) (page 775)
- [Example](#) (page 776)
- [Additional Resources](#) (page 779)

### **Definition**

#### **indexStats**

The [indexStats](#) (page 774) command aggregates statistics for the B-tree data structure that stores data for a MongoDB index.

**Warning:** This command is not intended for production deployments.

The command can be run *only* on a [mongod](#) (page 925) instance that uses the `--enableExperimentalIndexStatsCmd` option.

To aggregate statistics, issue the command like so:

```
db.runCommand({ indexStats: "<collection>", index: "<index name>" })
```

**Output** The `db.collection.indexStats()` (page 811) method and equivalent `indexStats` (page 774) command aggregate statistics for the B-tree data structure that stores data for a MongoDB index. The commands aggregate statistics firstly for the entire B-tree and secondly for each individual level of the B-tree. The output displays the following values.

**indexStats.index**

The `index name` (page 338).

**indexStats.version**

The index version. For more information on index version numbers, see the `v` option in `db.collection.ensureIndex()` (page 814).

**indexStats.isIdIndex**

If true, the index is the default `_id` index for the collection.

**indexStats.keyPattern**

The indexed keys.

**indexStats.storageNs**

The namespace of the index's underlying storage.

**indexStats.bucketBodyBytes**

The fixed size, in bytes, of a B-tree bucket in the index, not including the record header. All indexes for a given version have the same value for this field. MongoDB allocates fixed size buckets on disk.

**indexStats.depth**

The number of levels in the B-tree, not including the root level.

**indexStats.overall**

This section of the output displays statistics for the entire B-tree.

**indexStats.overall.numBuckets**

The number of buckets in the entire B-tree, including all levels.

**indexStats.overall.keySet**

Statistics about the number of keys in a bucket, evaluated on a per-bucket level.

**indexStats.overall.usedKeyCount**

Statistics about the number of used keys in a bucket, evaluated on a per-bucket level. Used keys are keys not marked as deleted.

**indexStats.overall.bsonRatio**

Statistics about the percentage of the bucket body that is occupied by the key objects themselves, excluding associated metadata.

For example, if you have the document `{ name: "Bob Smith" }` and an index on `{ name: 1 }`, the key object is the string `Bob Smith`.

**indexStats.overall.keyNodeRatio**

Statistics about the percentage of the bucket body that is occupied by the key node objects (the metadata and links pertaining to the keys). This does not include the key itself. In the current implementation, a key node's objects consist of: the pointer to the key data (in the same bucket), the pointer to the record the key is for, and the pointer to a child bucket.

**indexStats.overall.fillRatio**

The sum of the `bsonRatio` (page 775) and the `keyNodeRatio` (page 775). This shows how full the buckets are. This will be much higher for indexes with sequential inserts.

**indexStats.perLevel**

This section of the output displays statistics for each level of the B-tree separately, starting with the root level. This section displays a different document for each B-tree level.

**indexStats.perLevel.numBuckets**

The number of buckets at this level of the B-tree.

**indexStats.perLevel.keyCount**

Statistics about the number of keys in a bucket, evaluated on a per-bucket level.

**indexStats.perLevel.usedKeyCount**

Statistics about the number of used keys in a bucket, evaluated on a per-bucket level. Used keys are keys not marked as deleted.

**indexStats.perLevel.bsonRatio**

Statistics about the percentage of the bucket body that is occupied by the key objects themselves, excluding associated metadata.

**indexStats.perLevel.keyNodeRatio**

Statistics about the percentage of the bucket body that is occupied by the key node objects (the metadata and links pertaining to the keys).

**indexStats.perLevel.fillRatio**

The sum of the [bsonRatio](#) (page 776) and the [keyNodeRatio](#) (page 776). This shows how full the buckets are. This will be much higher in the following cases:

- For indexes with sequential inserts, such as the `_id` index when using `ObjectId` keys.
- For indexes that were recently built in the foreground with existing data.
- If you recently ran `compact` (page 752) or `--repair`.

**Example** The following is an example of `db.collection.indexStats()` (page 811) and `indexStats` (page 774) output.

```
{
 "index" : "type_1_traits_1",
 "version" : 1,
 "isIdIndex" : false,
 "keyPattern" : {
 "type" : 1,
 "traits" : 1
 },
 "storageNs" : "test.animals.$type_1_traits_1",
 "bucketBodyBytes" : 8154,
 "depth" : 2,
 "overall" : {
 "numBuckets" : 45513,
 "keyCount" : {
 "count" : NumberLong(45513),
 "mean" : 253.89602970579836,
 "stddev" : 21.784799875240708,
 "min" : 52,
 "max" : 290,
 "quantiles" : {
 "0.01" : 201.99785091648775,
 // ...
 "0.99" : 289.9999655156967
 }
 },
 "usedKeyCount" : {
 "count" : NumberLong(45513),
 // ...
 "quantiles" : {
 // ...
 }
 }
 }
}
```

```
 "0.01" : 201.99785091648775,
 // ...
 "0.99" : 289.9999655156967
 }
},
"bsonRatio" : {
 "count" : NumberLong(45513),
 // ...
 "quantiles" : {
 "0.01" : 0.4267797891997124,
 // ...
 "0.99" : 0.5945548174629648
 }
},
"keyNodeRatio" : {
 "count" : NumberLong(45513),
 // ...
 "quantiles" : {
 "0.01" : 0.3963656628236211,
 // ...
 "0.99" : 0.5690457993930765
 }
},
"fillRatio" : {
 "count" : NumberLong(45513),
 // ...
 "quantiles" : {
 "0.01" : 0.9909134214926929,
 // ...
 "0.99" : 0.9960755457453732
 }
},
},
"perLevel" : [
{
 "numBuckets" : 1,
 "keyCount" : {
 "count" : NumberLong(1),
 "mean" : 180,
 "stddev" : 0,
 "min" : 180,
 "max" : 180
 },
 "usedKeyCount" : {
 "count" : NumberLong(1),
 // ...
 "max" : 180
 },
 "bsonRatio" : {
 "count" : NumberLong(1),
 // ...
 "max" : 0.3619082658817758
 },
 "keyNodeRatio" : {
 "count" : NumberLong(1),
 // ...
 "max" : 0.35320088300220753
 },
}
```

```
 "fillRatio" : {
 "count" : NumberLong(1),
 // ...
 "max" : 0.7151091488839834
 }
 },
{
 "numBuckets" : 180,
 "keyCount" : {
 "count" : NumberLong(180),
 "mean" : 250.84444444444443,
 "stddev" : 26.30057503009355,
 "min" : 52,
 "max" : 290
 },
 "usedKeyCount" : {
 "count" : NumberLong(180),
 // ...
 "max" : 290
 },
 "bsonRatio" : {
 "count" : NumberLong(180),
 // ...
 "max" : 0.5945548197203826
 },
 "keyNodeRatio" : {
 "count" : NumberLong(180),
 // ...
 "max" : 0.5690458670591121
 },
 "fillRatio" : {
 "count" : NumberLong(180),
 // ...
 "max" : 0.9963208241353937
 }
},
{
 "numBuckets" : 45332,
 "keyCount" : {
 "count" : NumberLong(45332),
 "mean" : 253.90977675813994,
 "stddev" : 21.761620836279018,
 "min" : 167,
 "max" : 290,
 "quantiles" : {
 "0.01" : 202.0000012563603,
 // ...
 "0.99" : 289.99996486571894
 }
 },
 "usedKeyCount" : {
 "count" : NumberLong(45332),
 // ...
 "quantiles" : {
 "0.01" : 202.0000012563603,
 // ...
 "0.99" : 289.99996486571894
 }
 }
}
```

```

 },
 "bsonRatio" : {
 "count" : NumberLong(45332),
 // ...
 "quantiles" : {
 "0.01" : 0.42678446958950583,
 // ...
 "0.99" : 0.5945548175411283
 }
 },
 "keyNodeRatio" : {
 "count" : NumberLong(45332),
 // ...
 "quantiles" : {
 "0.01" : 0.39636988227885306,
 // ...
 "0.99" : 0.5690457981176729
 }
 },
 "fillRatio" : {
 "count" : NumberLong(45332),
 // ...
 "quantiles" : {
 "0.01" : 0.9909246995605362,
 // ...
 "0.99" : 0.996075546919481
 }
 }
 }
],
"ok" : 1
}
}

```

**Additional Resources** For more information on the command's limits and output, see the following:

- The equivalent `db.collection.indexStats()` (page 811) method,
- `indexStats` (page 774), and
- <https://github.com/mongodb-labs/storage-viz#readme>.

## whatsmyuri

### whatsmyuri

`whatsmyuri` (page 779) is an internal command.

## getLog

### getLog

The `getLog` (page 779) command returns a document with a `log` array that contains recent messages from the `mongod` (page 925) process log. The `getLog` (page 779) command has the following syntax:

```
{ getLog: <log> }
```

Replace `<log>` with one of the following values:

- `global` - returns the combined output of all recent log entries.

- `rs` - if the `mongod` (page 925) is part of a *replica set*, `getLog` (page 779) will return recent notices related to replica set activity.
- `startupWarnings` - will return logs that *may* contain errors or warnings from MongoDB's log from when the current process started. If `mongod` (page 925) started without warnings, this filter may return an empty array.

You may also specify an asterisk (e.g. `*`) as the `<log>` value to return a list of available log filters. The following interaction from the `mongo` (page 942) shell connected to a replica set:

```
db.adminCommand({getLog: "*" })
{ "names" : ["global", "rs", "startupWarnings"], "ok" : 1 }
```

`getLog` (page 779) returns events from a RAM cache of the `mongod` (page 925) events and *does not* read log data from the log file.

## hostInfo

### hostInfo

New in version 2.2.

**Returns** A document with information about the underlying system that the `mongod` (page 925) or `mongos` (page 938) runs on. Some of the returned fields are only included on some platforms.

You must run the `hostInfo` (page 780) command, which takes no arguments, against the `admin` database. Consider the following invocations of `hostInfo` (page 780):

```
db.hostInfo()
db.adminCommand({ "hostInfo" : 1 })
```

In the `mongo` (page 942) shell you can use `db.hostInfo()` (page 889) as a helper to access `hostInfo` (page 780). The output of `hostInfo` (page 780) on a Linux system will resemble the following:

```
{
 "system" : {
 "currentTime" : ISODate("<timestamp>"),
 "hostname" : "<hostname>",
 "cpuAddrSize" : <number>,
 "memSizeMB" : <number>,
 "numCores" : <number>,
 "cpuArch" : "<identifier>",
 "numaEnabled" : <boolean>
 },
 "os" : {
 "type" : "<string>",
 "name" : "<string>",
 "version" : "<string>"
 },
 "extra" : {
 "versionString" : "<string>",
 "libcVersion" : "<string>",
 "kernelVersion" : "<string>",
 "cpuFrequencyMHz" : "<string>",
 "cpuFeatures" : "<string>",
 "pageSize" : <number>,
 "numPages" : <number>,
 "maxOpenFiles" : <number>
 },
 "ok" : <return>
}
```

Consider the following documentation of these fields:

**hostInfo**

The document returned by the [hostInfo](#) (page 780).

**hostInfo.system**

A sub-document about the underlying environment of the system running the [mongod](#) (page 925) or [mongos](#) (page 938)

**hostInfo.system.currentTime**

A time stamp of the current system time.

**hostInfo.system.hostname**

The system name, which should correspond to the output of `hostname -f` on Linux systems.

**hostInfo.system.cpuAddrSize**

A number reflecting the architecture of the system. Either 32 or 64.

**hostInfo.system.memSizeMB**

The total amount of system memory (RAM) in megabytes.

**hostInfo.system.numCores**

The total number of available logical processor cores.

**hostInfo.system.cpuArch**

A string that represents the system architecture. Either `x86` or `x86_64`.

**hostInfo.system.numaEnabled**

A boolean value. `false` if NUMA is interleaved (i.e. disabled,) otherwise `true`.

**hostInfo.os**

A sub-document that contains information about the operating system running the [mongod](#) (page 925) and [mongos](#) (page 938).

**hostInfo.os.type**

A string representing the type of operating system, such as `Linux` or `Windows`.

**hostInfo.os.name**

If available, returns a display name for the operating system.

**hostInfo.os.version**

If available, returns the name of the distribution or operating system.

**hostInfo.extra**

A sub-document with extra information about the operating system and the underlying hardware. The content of the [extra](#) (page 781) sub-document depends on the operating system.

**hostInfo.extra.versionString**

A complete string of the operating system version and identification. On Linux and OS X systems, this contains output similar to `uname -a`.

**hostInfo.extra.libcVersion**

The release of the system libc.

[libcVersion](#) (page 781) only appears on Linux systems.

**hostInfo.extra.kernelVersion**

The release of the Linux kernel in current use.

[kernelVersion](#) (page 781) only appears on Linux systems.

**hostInfo.extra.alwaysFullSync**

[alwaysFullSync](#) (page 781) only appears on OS X systems.

`hostInfo.extra.nfsAsync`

`nfsAsync` (page 781) only appears on OS X systems.

`hostInfo.extra.cpuFrequencyMHz`

Reports the clock speed of the system's processor in megahertz.

`hostInfo.extra.cpuFeatures`

Reports the processor feature flags. On Linux systems this is the same information that <http://docs.mongodb.org/manual/proc/cpuinfo> includes in the `flags` fields.

`hostInfo.extra.pageSize`

Reports the default system page size in bytes.

`hostInfo.extra.numPages`

`numPages` (page 782) only appears on Linux systems.

`hostInfo.extra.maxOpenFiles`

Reports the current system limits on open file handles. See [UNIX ulimit Settings](#) (page 225) for more information.

`maxOpenFiles` (page 782) only appears on Linux systems.

`hostInfo.extra.scheduler`

Reports the active I/O scheduler. `scheduler` (page 782) only appears on OS X systems.

## serverStatus

### Definition

#### `serverStatus`

The `serverStatus` (page 782) command returns a document that provides an overview of the database process's state. Most monitoring applications run this command at a regular interval to collect statistics about the instance:

```
{ serverStatus: 1 }
```

The value (i.e. 1 above), does not affect the operation of the command.

Changed in version 2.4: In 2.4 you can dynamically suppress portions of the `serverStatus` (page 782) output, or include suppressed sections by adding fields to the command document as in the following examples:

```
db.runCommand({ serverStatus: 1, repl: 0, indexCounters: 0 })
db.runCommand({ serverStatus: 1, workingSet: 1, metrics: 0, locks: 0 })
```

`serverStatus` (page 782) includes all fields by default, except `workingSet` (page 795), by default.

---

**Note:** You may only dynamically include top-level fields from the `serverStatus` (page 782) document that are not included by default. You can exclude any field that `serverStatus` (page 782) includes by default.

### See also:

`db.serverStatus()` (page 893) and <http://docs.mongodb.org/manual/reference/server-status>

**Output** The `serverStatus` (page 782) command returns a collection of information that reflects the database's status. These data are useful for diagnosing and assessing the performance of your MongoDB instance. This reference catalogs each datum included in the output of this command and provides context for using this data to more effectively administer your database.

### See also:

Much of the output of `serverStatus` (page 782) is also displayed dynamically by `mongostat` (page 974). See the `mongostat` (page 974) command for more information.

For examples of the `serverStatus` (page 782) output, see <http://docs.mongodb.org/manual/reference/server-status>

**Instance Information** For an example of the instance information, see the *Instance Information section* of the <http://docs.mongodb.org/manual/reference/server-status> page.

#### `serverStatus.host`

The `host` (page 783) field contains the system's hostname. In Unix/Linux systems, this should be the same as the output of the `hostname` command.

#### `serverStatus.version`

The `version` (page 783) field contains the version of MongoDB running on the current `mongod` (page 925) or `mongos` (page 938) instance.

#### `serverStatus.process`

The `process` (page 783) field identifies which kind of MongoDB instance is running. Possible values are:

- `mongos` (page 938)
- `mongod` (page 925)

#### `serverStatus.uptime`

The value of the `uptime` (page 783) field corresponds to the number of seconds that the `mongos` (page 938) or `mongod` (page 925) process has been active.

#### `serverStatus.uptimeEstimate`

`uptimeEstimate` (page 783) provides the uptime as calculated from MongoDB's internal coarse-grained time keeping system.

#### `serverStatus.localTime`

The `localTime` (page 783) value is the current time, according to the server, in UTC specified in an ISODate format.

**locks** New in version 2.1.2: All `locks` (page 783) statuses first appeared in the 2.1.2 development release for the 2.2 series.

For an example of the `locks` output, see the `locks` section of the <http://docs.mongodb.org/manual/reference/server-status> page.

#### `serverStatus.locks`

The `locks` (page 783) document contains sub-documents that provides a granular report on MongoDB database-level lock use. All values are of the `NumberLong()` type.

Generally, fields named:

- `R` refer to the global read lock,
- `W` refer to the global write lock,
- `r` refer to the database specific read lock, and
- `w` refer to the database specific write lock.

If a document does not have any fields, it means that no locks have existed with this context since the last time the `mongod` (page 925) started.

#### `serverStatus.locks..`

A field named `.` holds the first document in `locks` (page 783) that contains information about the global lock.

`serverStatus.locks...timeLockedMicros`

The `timeLockedMicros` (page 783) document reports the amount of time in microseconds that a lock has existed in all databases in this `mongod` (page 925) instance.

`serverStatus.locks...timeLockedMicros.R`

The `R` field reports the amount of time in microseconds that any database has held the global read lock.

`serverStatus.locks...timeLockedMicros.W`

The `W` field reports the amount of time in microseconds that any database has held the global write lock.

`serverStatus.locks...timeLockedMicros.r`

The `r` field reports the amount of time in microseconds that any database has held the local read lock.

`serverStatus.locks...timeLockedMicros.w`

The `w` field reports the amount of time in microseconds that any database has held the local write lock.

`serverStatus.locks...timeAcquiringMicros`

The `timeAcquiringMicros` (page 784) document reports the amount of time in microseconds that operations have spent waiting to acquire a lock in all databases in this `mongod` (page 925) instance.

`serverStatus.locks...timeAcquiringMicros.R`

The `R` field reports the amount of time in microseconds that any database has spent waiting for the global read lock.

`serverStatus.locks...timeAcquiringMicros.W`

The `W` field reports the amount of time in microseconds that any database has spent waiting for the global write lock.

`serverStatus.locks.admin`

The `admin` (page 784) document contains two sub-documents that report data regarding lock use in the `admin database`.

`serverStatus.locks.admin.timeLockedMicros`

The `timeLockedMicros` (page 784) document reports the amount of time in microseconds that locks have existed in the context of the `admin database`.

`serverStatus.locks.admin.timeLockedMicros.r`

The `r` field reports the amount of time in microseconds that the `admin database` has held the read lock.

`serverStatus.locks.admin.timeLockedMicros.w`

The `w` field reports the amount of time in microseconds that the `admin database` has held the write lock.

`serverStatus.locks.admin.timeAcquiringMicros`

The `timeAcquiringMicros` (page 784) document reports on the amount of time in microseconds that operations have spent waiting to acquire a lock for the `admin database`.

`serverStatus.locks.admin.timeAcquiringMicros.r`

The `r` field reports the amount of time in microseconds that operations have spent waiting to acquire a read lock on the `admin database`.

`serverStatus.locks.admin.timeAcquiringMicros.w`

The `w` field reports the amount of time in microseconds that operations have spent waiting to acquire a write lock on the `admin database`.

`serverStatus.locks.local`

The `local` (page 784) document contains two sub-documents that report data regarding lock use in the `local` database. The local database contains a number of instance specific data, including the `oplog` for replication.

`serverStatus.locks.local.timeLockedMicros`

The `timeLockedMicros` (page 784) document reports on the amount of time in microseconds that locks have existed in the context of the `local` database.

`serverStatus.locks.local.timeLockedMicros.r`

The `r` field reports the amount of time in microseconds that the `local` database has held the read lock.

`serverStatus.locks.local.timeLockedMicros.w`

The `w` field reports the amount of time in microseconds that the `local` database has held the write lock.

`serverStatus.locks.local.timeAcquiringMicros`

The `timeAcquiringMicros` (page 785) document reports on the amount of time in microseconds that operations have spent waiting to acquire a lock for the `local` database.

`serverStatus.locks.local.timeAcquiringMicros.r`

The `r` field reports the amount of time in microseconds that operations have spent waiting to acquire a read lock on the `local` database.

`serverStatus.locks.local.timeAcquiringMicros.w`

The `w` field reports the amount of time in microseconds that operations have spent waiting to acquire a write lock on the `local` database.

`serverStatus.locks.<database>`

For each additional database `locks` (page 783) includes a document that reports on the lock use for this database. The names of these documents reflect the database name itself.

`serverStatus.locks.<database>.timeLockedMicros`

The `timeLockedMicros` (page 785) document reports on the amount of time in microseconds that locks have existed in the context of the `<database>` database.

`serverStatus.locks.<database>.timeLockedMicros.r`

The `r` field reports the amount of time in microseconds that the `<database>` database has held the read lock.

`serverStatus.locks.<database>.timeLockedMicros.w`

The `w` field reports the amount of time in microseconds that the `<database>` database has held the write lock.

`serverStatus.locks.<database>.timeAcquiringMicros`

The `timeAcquiringMicros` (page 785) document reports on the amount of time in microseconds that operations have spent waiting to acquire a lock for the `<database>` database.

`serverStatus.locks.<database>.timeAcquiringMicros.r`

The `r` field reports the amount of time in microseconds that operations have spent waiting to acquire a read lock on the `<database>` database.

`serverStatus.locks.<database>.timeAcquiringMicros.w`

The `w` field reports the amount of time in microseconds that operations have spent waiting to acquire a write lock on the `<database>` database.

**globalLock** For an example of the `globalLock` output, see the `globalLock` section of the <http://docs.mongodb.org/manual/reference/server-status> page.

`serverStatus.globalLock`

The `globalLock` (page 785) data structure contains information regarding the database's current lock state, historical lock status, current operation queue, and the number of active clients.

`serverStatus.globalLock.totalTime`

The value of `totalTime` (page 785) represents the time, in microseconds, since the database last started and creation of the `globalLock` (page 785). This is roughly equivalent to total server uptime.

`serverStatus.globalLock.lockTime`

The value of `lockTime` (page 785) represents the time, in microseconds, since the database last started, that the `globalLock` (page 785) has been *held*.

Consider this value in combination with the value of `totalTime` (page 785). MongoDB aggregates these values in the `ratio` (page 786) value. If the `ratio` (page 786) value is small but `totalTime` (page 785) is

high the `globalLock` (page 785) has typically been held frequently for shorter periods of time, which may be indicative of a more normal use pattern. If the `lockTime` (page 785) is higher and the `totalTime` (page 785) is smaller (relatively,) then fewer operations are responsible for a greater portion of server's use (relatively.)

`serverStatus.globalLock.ratio`

Changed in version 2.2: `ratio` (page 786) was removed. See `locks` (page 783).

The value of `ratio` (page 786) displays the relationship between `lockTime` (page 785) and `totalTime` (page 785).

Low values indicate that operations have held the `globalLock` (page 785) frequently for shorter periods of time. High values indicate that operations have held `globalLock` (page 785) infrequently for longer periods of time.

`serverStatus.globalLock.currentQueue`

The `currentQueue` (page 786) data structure value provides more granular information concerning the number of operations queued because of a lock.

`serverStatus.globalLock.currentQueue.total`

The value of `total` (page 786) provides a combined total of operations queued waiting for the lock.

A consistently small queue, particularly of shorter operations should cause no concern. Also, consider this value in light of the size of queue waiting for the read lock (e.g. `readers` (page 786)) and write lock (e.g. `writers` (page 786)) individually.

`serverStatus.globalLock.currentQueue.readers`

The value of `readers` (page 786) is the number of operations that are currently queued and waiting for the read lock. A consistently small read-queue, particularly of shorter operations should cause no concern.

`serverStatus.globalLock.currentQueue.writers`

The value of `writers` (page 786) is the number of operations that are currently queued and waiting for the write lock. A consistently small write-queue, particularly of shorter operations is no cause for concern.

## globalLock.activeClients

`serverStatus.globalLock.activeClients`

The `activeClients` (page 786) data structure provides more granular information about the number of connected clients and the operation types (e.g. read or write) performed by these clients.

Use this data to provide context for the `currentQueue` (page 786) data.

`serverStatus.globalLock.activeClients.total`

The value of `total` (page 786) is the total number of active client connections to the database. This combines clients that are performing read operations (e.g. `readers` (page 786)) and clients that are performing write operations (e.g. `writers` (page 786)).

`serverStatus.globalLock.activeClients.readers`

The value of `readers` (page 786) contains a count of the active client connections performing read operations.

`serverStatus.globalLock.activeClients.writers`

The value of `writers` (page 786) contains a count of active client connections performing write operations.

**mem** For an example of the `mem` output, see the `mem` section of the <http://docs.mongodb.org/manual/reference/server-status> page.

`serverStatus.mem`

The `mem` (page 786) data structure holds information regarding the target system architecture of `mongod` (page 925) and current memory use.

**serverStatus.mem.bits**

The value of [bits](#) (page 786) is either 64 or 32, depending on which target architecture specified during the [mongod](#) (page 925) compilation process. In most instances this is 64, and this value does not change over time.

**serverStatus.mem.resident**

The value of [resident](#) (page 787) is roughly equivalent to the amount of RAM, in megabytes (MB), currently used by the database process. In normal use this value tends to grow. In dedicated database servers this number tends to approach the total amount of system memory.

**serverStatus.mem.virtual**

[virtual](#) (page 787) displays the quantity, in megabytes (MB), of virtual memory used by the [mongod](#) (page 925) process. With [journaling](#) enabled, the value of [virtual](#) (page 787) is at least twice the value of [mapped](#) (page 787).

If [virtual](#) (page 787) value is significantly larger than [mapped](#) (page 787) (e.g. 3 or more times), this may indicate a memory leak.

**serverStatus.mem.supported**

[supported](#) (page 787) is true when the underlying system supports extended memory information. If this value is false and the system does not support extended memory information, then other [mem](#) (page 786) values may not be accessible to the database server.

**serverStatus.mem.mapped**

The value of [mapped](#) (page 787) provides the amount of mapped memory, in megabytes (MB), by the database. Because MongoDB uses memory-mapped files, this value is likely to be roughly equivalent to the total size of your database or databases.

**serverStatus.mem.mappedWithJournal**

[mappedWithJournal](#) (page 787) provides the amount of mapped memory, in megabytes (MB), including the memory used for journaling. This value will always be twice the value of [mapped](#) (page 787). This field is only included if journaling is enabled.

**connections** For an example of the `connections` output, see the *connections section* of the <http://docs.mongodb.org/manual/reference/server-status> page.

**serverStatus.connections**

The [connections](#) (page 787) sub document data regarding the current connection status and availability of the database server. Use these values to assess the current load and capacity requirements of the server.

**serverStatus.connections.current**

The value of [current](#) (page 787) corresponds to the number of connections to the database server from clients. This number includes the current shell session. Consider the value of [available](#) (page 787) to add more context to this datum.

This figure will include the current shell connection as well as any inter-node connections to support a [replica set](#) or [sharded cluster](#).

**serverStatus.connections.available**

[available](#) (page 787) provides a count of the number of unused available connections that the database can provide. Consider this value in combination with the value of [current](#) (page 787) to understand the connection load on the database, and the [UNIX ulimit Settings](#) (page 225) document for more information about system thresholds on available connections.

**serverStatus.connections.totalCreated**

[totalCreated](#) (page 787) provides a count of **all** connections created to the server. This number includes connections that have since closed.

**extra\_info** For an example of the `extra_info` output, see the *extra\_info section* of the <http://docs.mongodb.org/manual/reference/server-status> page.

**serverStatus.extra\_info**

The `extra_info` (page 788) data structure holds data collected by the `mongod` (page 925) instance about the underlying system. Your system may only report a subset of these fields.

**serverStatus.extra\_info.note**

The field `note` (page 788) reports that the data in this structure depend on the underlying platform, and has the text: “fields vary by platform.”

**serverStatus.extra\_info.heap\_usage\_bytes**

The `heap_usage_bytes` (page 788) field is only available on Unix/Linux systems, and reports the total size in bytes of heap space used by the database process.

**serverStatus.extra\_info.page\_faults**

The `page_faults` (page 788) Reports the total number of page faults that require disk operations. Page faults refer to operations that require the database server to access data which isn’t available in active memory.

The `page_faults` (page 788) counter may increase dramatically during moments of poor performance and may correlate with limited memory environments and larger data sets. Limited and sporadic page faults do not necessarily indicate an issue.

**indexCounters** For an example of the `indexCounters` output, see the *indexCounters section* of the <http://docs.mongodb.org/manual/reference/server-status> page.

**serverStatus.indexCounters**

Changed in version 2.2: Previously, data in the `indexCounters` (page 788) document reported sampled data, and were only useful in relative comparison to each other, because they could not reflect absolute index use. In 2.2 and later, these data reflect actual index use.

Changed in version 2.4: Fields previously in the `btree` sub-document of `indexCounters` (page 788) are now fields in the `indexCounters` (page 788) document.

The `indexCounters` (page 788) data structure reports information regarding the state and use of indexes in MongoDB.

**serverStatus.indexCounters.accesses**

`accesses` (page 788) reports the number of times that operations have accessed indexes. This value is the combination of the `hits` (page 788) and `misses` (page 788). Higher values indicate that your database has indexes and that queries are taking advantage of these indexes. If this number does not grow over time, this might indicate that your indexes do not effectively support your use.

**serverStatus.indexCounters.hits**

The `hits` (page 788) value reflects the number of times that an index has been accessed and `mongod` (page 925) is able to return the index from memory.

A higher value indicates effective index use. `hits` (page 788) values that represent a greater proportion of the `accesses` (page 788) value, tend to indicate more effective index configuration.

**serverStatus.indexCounters.misses**

The `misses` (page 788) value represents the number of times that an operation attempted to access an index that was not in memory. These “misses,” do not indicate a failed query or operation, but rather an inefficient use of the index. Lower values in this field indicate better index use and likely overall performance as well.

**serverStatus.indexCounters.reset**

The `reset` (page 788) value reflects the number of times that the index counters have been reset since the database last restarted. Typically this value is 0, but use this value to provide context for the data specified by other `indexCounters` (page 788) values.

**serverStatus.indexCounters.missRatio**

The [missRatio](#) (page 788) value is the ratio of [hits](#) (page 788) to [misses](#) (page 788). This value is typically 0 or approaching 0.

**backgroundFlushing** For an example of the [backgroundFlushing](#) output, see the *backgroundFlushing* section of the <http://docs.mongodb.org/manual/reference/server-status> page.

**serverStatus.backgroundFlushing**

[mongod](#) (page 925) periodically flushes writes to disk. In the default configuration, this happens every 60 seconds. The [backgroundFlushing](#) (page 789) data structure contains data regarding these operations. Consider these values if you have concerns about write performance and [journaling](#) (page 793).

**serverStatus.backgroundFlushing.flushes**

[flushes](#) (page 789) is a counter that collects the number of times the database has flushed all writes to disk. This value will grow as database runs for longer periods of time.

**serverStatus.backgroundFlushing.total\_ms**

The [total\\_ms](#) (page 789) value provides the total number of milliseconds (ms) that the [mongod](#) (page 925) processes have spent writing (i.e. flushing) data to disk. Because this is an absolute value, consider the value of [flushes](#) (page 789) and [average\\_ms](#) (page 789) to provide better context for this datum.

**serverStatus.backgroundFlushing.average\_ms**

The [average\\_ms](#) (page 789) value describes the relationship between the number of flushes and the total amount of time that the database has spent writing data to disk. The larger [flushes](#) (page 789) is, the more likely this value is likely to represent a “normal,” time; however, abnormal data can skew this value.

Use the [last\\_ms](#) (page 789) to ensure that a high average is not skewed by transient historical issue or a random write distribution.

**serverStatus.backgroundFlushing.last\_ms**

The value of the [last\\_ms](#) (page 789) field is the amount of time, in milliseconds, that the last flush operation took to complete. Use this value to verify that the current performance of the server and is in line with the historical data provided by [average\\_ms](#) (page 789) and [total\\_ms](#) (page 789).

**serverStatus.backgroundFlushing.last\_finished**

The [last\\_finished](#) (page 789) field provides a timestamp of the last completed flush operation in the [ISODate](#) format. If this value is more than a few minutes old relative to your server’s current time and accounting for differences in time zone, restarting the database may result in some data loss.

Also consider ongoing operations that might skew this value by routinely block write operations.

**cursors** For an example of the [cursors](#) output, see the *cursors* section of the <http://docs.mongodb.org/manual/reference/server-status> page.

**serverStatus.cursors**

The [cursors](#) (page 789) data structure contains data regarding cursor state and use.

**serverStatus.cursors.totalOpen**

[totalOpen](#) (page 789) provides the number of cursors that MongoDB is maintaining for clients. Because MongoDB exhausts unused cursors, typically this value small or zero. However, if there is a queue, stale tailable cursors, or a large number of operations this value may rise.

**serverStatus.cursors.clientCursors\_size**

Deprecated since version 1.x: See [totalOpen](#) (page 789) for this datum.

**serverStatus.cursors.timedOut**

[timedOut](#) (page 789) provides a counter of the total number of cursors that have timed out since the server process started. If this number is large or growing at a regular rate, this may indicate an application error.

**network** For an example of the network output, see the *network section* of the <http://docs.mongodb.org/manual/reference/server-status> page.

### serverStatus.network

The [network](#) (page 790) data structure contains data regarding MongoDB's network use.

#### serverStatus.network.bytesIn

The value of the [bytesIn](#) (page 790) field reflects the amount of network traffic, in bytes, received by this database. Use this value to ensure that network traffic sent to the [mongod](#) (page 925) process is consistent with expectations and overall inter-application traffic.

#### serverStatus.network.bytesOut

The value of the [bytesOut](#) (page 790) field reflects the amount of network traffic, in bytes, sent from this database. Use this value to ensure that network traffic sent by the [mongod](#) (page 925) process is consistent with expectations and overall inter-application traffic.

#### serverStatus.network.numRequests

The [numRequests](#) (page 790) field is a counter of the total number of distinct requests that the server has received. Use this value to provide context for the [bytesIn](#) (page 790) and [bytesOut](#) (page 790) values to ensure that MongoDB's network utilization is consistent with expectations and application use.

**repl** For an example of the repl output, see the *repl section* of the <http://docs.mongodb.org/manual/reference/server-status> page.

### serverStatus.repl

The [repl](#) (page 790) data structure contains status information for MongoDB's replication (i.e. "replica set") configuration. These values only appear when the current host has replication enabled.

See [Replication](#) (page 377) for more information on replication.

#### serverStatus.repl.setName

The [setName](#) (page 790) field contains a string with the name of the current replica set. This value reflects the `--replicaSet` command line argument, or [replicaSet](#) (page 1000) value in the configuration file.

See [Replication](#) (page 377) for more information on replication.

#### serverStatus.repl.ismaster

The value of the [ismaster](#) (page 790) field is either `true` or `false` and reflects whether the current node is the master or primary node in the replica set.

See [Replication](#) (page 377) for more information on replication.

#### serverStatus.repl.secondary

The value of the [secondary](#) (page 790) field is either `true` or `false` and reflects whether the current node is a secondary node in the replica set.

See [Replication](#) (page 377) for more information on replication.

#### serverStatus.repl.hosts

[hosts](#) (page 790) is an array that lists the other nodes in the current replica set. Each member of the replica set appears in the form of `hostname:port`.

See [Replication](#) (page 377) for more information on replication.

**opcountersRepl** For an example of the [opcountersRepl](#) output, see the *opcountersRepl section* of the <http://docs.mongodb.org/manual/reference/server-status> page.

### serverStatus.opcountersRepl

The [opcountersRepl](#) (page 790) data structure, similar to the [opcounters](#) (page 791) data structure,

provides an overview of database replication operations by type and makes it possible to analyze the load on the replica in more granular manner. These values only appear when the current host has replication enabled.

These values will differ from the [opcounters](#) (page 791) values because of how MongoDB serializes operations during replication. See [Replication](#) (page 377) for more information on replication.

These numbers will grow over time in response to database use. Analyze these values over time to track database utilization.

#### `serverStatus.opcountersRepl.insert`

`insert` (page 791) provides a counter of the total number of replicated insert operations since the [mongod](#) (page 925) instance last started.

#### `serverStatus.opcountersRepl.query`

`query` (page 791) provides a counter of the total number of replicated queries since the [mongod](#) (page 925) instance last started.

#### `serverStatus.opcountersRepl.update`

`update` (page 791) provides a counter of the total number of replicated update operations since the [mongod](#) (page 925) instance last started.

#### `serverStatus.opcountersRepl.delete`

`delete` (page 791) provides a counter of the total number of replicated delete operations since the [mongod](#) (page 925) instance last started.

#### `serverStatus.opcountersRepl.getmore`

`getmore` (page 791) provides a counter of the total number of “getmore” operations since the [mongod](#) (page 925) instance last started. This counter can be high even if the query count is low. Secondary nodes send getMore operations as part of the replication process.

#### `serverStatus.opcountersRepl.command`

`command` (page 791) provides a counter of the total number of replicated commands issued to the database since the [mongod](#) (page 925) instance last started.

**opcounters** For an example of the `opcounters` output, see the *opcounters section* of the <http://docs.mongodb.org/manual/reference/server-status> page.

#### `serverStatus.opcounters`

The [opcounters](#) (page 791) data structure provides an overview of database operations by type and makes it possible to analyze the load on the database in more granular manner.

These numbers will grow over time and in response to database use. Analyze these values over time to track database utilization.

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**Note:** The data in [opcounters](#) (page 791) treats operations that affect multiple documents, such as bulk insert or multi-update operations, as a single operation. See [document](#) (page 795) for more granular document-level operation tracking.

#### `serverStatus.opcounters.insert`

`insert` (page 791) provides a counter of the total number of insert operations since the [mongod](#) (page 925) instance last started.

#### `serverStatus.opcounters.query`

`query` (page 791) provides a counter of the total number of queries since the [mongod](#) (page 925) instance last started.

#### `serverStatus.opcounters.update`

`update` (page 791) provides a counter of the total number of update operations since the [mongod](#) (page 925) instance last started.

### serverStatus.opcounters.**delete**

[delete](#) (page 791) provides a counter of the total number of delete operations since the [mongod](#) (page 925) instance last started.

### serverStatus.opcounters.**getmore**

[getmore](#) (page 792) provides a counter of the total number of “getmore” operations since the [mongod](#) (page 925) instance last started. This counter can be high even if the query count is low. Secondary nodes send `getMore` operations as part of the replication process.

### serverStatus.opcounters.**command**

[command](#) (page 792) provides a counter of the total number of commands issued to the database since the [mongod](#) (page 925) instance last started.

**asserts** For an example of the `asserts` output, see the *asserts section* of the <http://docs.mongodb.org/manual/reference/server-status> page.

### serverStatus.asserts

The [asserts](#) (page 792) document reports the number of asserts on the database. While assert errors are typically uncommon, if there are non-zero values for the [asserts](#) (page 792), you should check the log file for the [mongod](#) (page 925) process for more information. In many cases these errors are trivial, but are worth investigating.

### serverStatus.asserts.**regular**

The [regular](#) (page 792) counter tracks the number of regular assertions raised since the server process started. Check the log file for more information about these messages.

### serverStatus.asserts.**warning**

The [warning](#) (page 792) counter tracks the number of warnings raised since the server process started. Check the log file for more information about these warnings.

### serverStatus.asserts.**msg**

The [msg](#) (page 792) counter tracks the number of message assertions raised since the server process started. Check the log file for more information about these messages.

### serverStatus.asserts.**user**

The [user](#) (page 792) counter reports the number of “user asserts” that have occurred since the last time the server process started. These are errors that user may generate, such as out of disk space or duplicate key. You can prevent these assertions by fixing a problem with your application or deployment. Check the MongoDB log for more information.

### serverStatus.asserts.**rollovers**

The [rollovers](#) (page 792) counter displays the number of times that the rollover counters have rolled over since the last time the server process started. The counters will rollover to zero after  $2^{30}$  assertions. Use this value to provide context to the other values in the [asserts](#) (page 792) data structure.

**writeBacksQueued** For an example of the `writeBacksQueued` output, see the *writeBacksQueued section* of the <http://docs.mongodb.org/manual/reference/server-status> page.

### serverStatus.writeBacksQueued

The value of [writeBacksQueued](#) (page 792) is `true` when there are operations from a [mongos](#) (page 938) instance queued for retrying. Typically this option is `false`.

#### See also:

[writeBacks](#)

## **Journaling (dur)** New in version 1.8.

For an example of the Journaling (dur) output, see the *journaling* section of the <http://docs.mongodb.org/manual/reference/server-status> page.

### serverStatus.dur

The `dur` (page 793) (for “durability”) document contains data regarding the `mongod` (page 925)‘s journaling-related operations and performance. `mongod` (page 925) must be running with journaling for these data to appear in the output of “`serverStatus` (page 782)”.

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**Note:** The data values are **not** cumulative but are reset on a regular basis as determined by the *journal group commit interval* (page 176). This interval is ~100 milliseconds (ms) by default (or 30ms if the journal file is on the same file system as your data files) and is cut by 2/3 when there is a `getLastError` (page 720) command pending. The interval is configurable using the `--journalCommitInterval` option.

#### See also:

[Journaling Mechanics](#) (page 232) for more information about journaling operations.

### serverStatus.dur.commits

The `commits` (page 793) provides the number of transactions written to the *journal* during the last *journal group commit interval* (page 176).

### serverStatus.dur.journalizedMB

The `journalizedMB` (page 793) provides the amount of data in megabytes (MB) written to *journal* during the last *journal group commit interval* (page 233).

### serverStatus.dur.writeToDataFilesMB

The `writeToDataFilesMB` (page 793) provides the amount of data in megabytes (MB) written from *journal* to the data files during the last *journal group commit interval* (page 233).

### serverStatus.dur.compression

New in version 2.0.

The `compression` (page 793) represents the compression ratio of the data written to the *journal*:

( `journaled_size_of_data / uncompressed_size_of_data` )

### serverStatus.dur.commitsInWriteLock

The `commitsInWriteLock` (page 793) provides a count of the commits that occurred while a write lock was held. Commits in a write lock indicate a MongoDB node under a heavy write load and call for further diagnosis.

### serverStatus.dur.earlyCommits

The `earlyCommits` (page 793) value reflects the number of times MongoDB requested a commit before the scheduled *journal group commit interval* (page 233). Use this value to ensure that your *journal group commit interval* (page 176) is not too long for your deployment.

### serverStatus.dur.timeMS

The `timeMS` (page 793) document provides information about the performance of the `mongod` (page 925) instance during the various phases of journaling in the last *journal group commit interval* (page 176).

### serverStatus.dur.timeMS.dt

The `dt` (page 793) value provides, in milliseconds, the amount of time over which MongoDB collected the `timeMS` (page 793) data. Use this field to provide context to the other `timeMS` (page 793) field values.

### serverStatus.dur.timeMS.prepLogBuffer

The `prepLogBuffer` (page 793) value provides, in milliseconds, the amount of time spent preparing to write to the journal. Smaller values indicate better journal performance.

`serverStatus.dur.timeMS.writeToJournal`

The `writeToJournal` (page 793) value provides, in milliseconds, the amount of time spent actually writing to the journal. File system speeds and device interfaces can affect performance.

`serverStatus.dur.timeMS.writeToDataFiles`

The `writeToDataFiles` (page 794) value provides, in milliseconds, the amount of time spent writing to data files after journaling. File system speeds and device interfaces can affect performance.

`serverStatus.dur.timeMS.remapPrivateView`

The `remapPrivateView` (page 794) value provides, in milliseconds, the amount of time spent remapping copy-on-write memory mapped views. Smaller values indicate better journal performance.

**recordStats** For an example of the `recordStats` output, see the *recordStats section* of the <http://docs.mongodb.org/manual/reference/server-status> page.

`serverStatus.recordStats`

The `recordStats` (page 794) document provides fine grained reporting on page faults on a per database level.

MongoDB uses a read lock on each database to return `recordStats` (page 794). To minimize this overhead, you can disable this section, as in the following operation:

```
db.serverStatus({ recordStats: 0 })
```

`serverStatus.recordStats.accessesNotInMemory`

`accessesNotInMemory` (page 794) reflects the number of times `mongod` (page 925) needed to access a memory page that was *not* resident in memory for *all* databases managed by this `mongod` (page 925) instance.

`serverStatus.recordStats.pageFaultExceptionsThrown`

`pageFaultExceptionsThrown` (page 794) reflects the number of page fault exceptions thrown by `mongod` (page 925) when accessing data for *all* databases managed by this `mongod` (page 925) instance.

`serverStatus.recordStats.local.accessesNotInMemory`

`accessesNotInMemory` (page 794) reflects the number of times `mongod` (page 925) needed to access a memory page that was *not* resident in memory for the `local` database.

`serverStatus.recordStats.local.pageFaultExceptionsThrown`

`pageFaultExceptionsThrown` (page 794) reflects the number of page fault exceptions thrown by `mongod` (page 925) when accessing data for the `local` database.

`serverStatus.recordStats.admin.accessesNotInMemory`

`accessesNotInMemory` (page 794) reflects the number of times `mongod` (page 925) needed to access a memory page that was *not* resident in memory for the `admin` database.

`serverStatus.recordStats.admin.pageFaultExceptionsThrown`

`pageFaultExceptionsThrown` (page 794) reflects the number of page fault exceptions thrown by `mongod` (page 925) when accessing data for the `admin` database.

`serverStatus.recordStats.<database>.accessesNotInMemory`

`accessesNotInMemory` (page 794) reflects the number of times `mongod` (page 925) needed to access a memory page that was *not* resident in memory for the `<database>` database.

`serverStatus.recordStats.<database>.pageFaultExceptionsThrown`

`pageFaultExceptionsThrown` (page 794) reflects the number of page fault exceptions thrown by `mongod` (page 925) when accessing data for the `<database>` database.

**workingSet** New in version 2.4.

---

**Note:** The `workingSet` (page 795) data is only included in the output of `serverStatus` (page 782) if explicitly enabled. To return the `workingSet` (page 795), use one of the following commands:

---

```
db.serverStatus({ workingSet: 1 })
db.runCommand({ serverStatus: 1, workingSet: 1 })
```

---

For an example of the `workingSet` output, see the `workingSet` section of the <http://docs.mongodb.org/manual/reference/server-status> page.

#### `serverStatus.workingSet`

`workingSet` (page 795) is a document that contains values useful for estimating the size of the working set, which is the amount of data that MongoDB uses actively. `workingSet` (page 795) uses an internal data structure that tracks pages accessed by `mongod` (page 925).

##### `serverStatus.workingSet.note`

`note` (page 795) is a field that holds a string warning that the `workingSet` (page 795) document is an estimate.

##### `serverStatus.workingSet.pagesInMemory`

`pagesInMemory` (page 795) contains a count of the total number of pages accessed by `mongod` (page 925) over the period displayed in `overSeconds` (page 795). The default page size is 4 kilobytes: to convert this value to the amount of data in memory multiply this value by 4 kilobytes.

If your total working set is less than the size of physical memory, over time the value of `pagesInMemory` (page 795) will reflect your data size.

Use `pagesInMemory` (page 795) in conjunction with `overSeconds` (page 795) to help estimate the actual size of the working set.

##### `serverStatus.workingSet.computationTimeMicros`

`computationTimeMicros` (page 795) reports the amount of time the `mongod` (page 925) instance used to compute the other fields in the `workingSet` (page 795) section.

Reporting on `workingSet` (page 795) may impact the performance of other operations on the `mongod` (page 925) instance because MongoDB must collect some data within the context of a lock. Ensure that automated monitoring tools consider this metric when determining the frequency of collection for `workingSet` (page 795).

##### `serverStatus.workingSet.overSeconds`

`overSeconds` (page 795) returns the amount of time elapsed between the newest and oldest pages tracked in the `pagesInMemory` (page 795) data point.

If `overSeconds` (page 795) is decreasing, or if `pagesInMemory` (page 795) equals physical RAM *and* `overSeconds` (page 795) is very small, the working set may be much *larger* than physical RAM.

When `overSeconds` (page 795) is large, MongoDB's data set is equal to or *smaller* than physical RAM.

**metrics** For an example of the metrics output, see the `metrics` section of the <http://docs.mongodb.org/manual/reference/server-status> page.

New in version 2.4.

#### `serverStatus.metrics`

The `metrics` (page 795) document holds a number of statistics that reflect the current use and state of a running `mongod` (page 925) instance.

#### `serverStatus.metrics.document`

The `document` (page 795) holds a document of that reflect document access and modification patterns and data use. Compare these values to the data in the `opcounters` (page 791) document, which track total number of operations.

serverStatus.metrics.document.**deleted**  
[deleted](#) (page 795) reports the total number of documents deleted.

serverStatus.metrics.document.**inserted**  
[inserted](#) (page 796) reports the total number of documents inserted.

serverStatus.metrics.document.**returned**  
[returned](#) (page 796) reports the total number of documents returned by queries.

serverStatus.metrics.document.**updated**  
[updated](#) (page 796) reports the total number of documents updated.

serverStatus.metrics.**getLastError**  
[getLastError](#) (page 796) is a document that reports on [getLastError](#) (page 720) use.

serverStatus.metrics.getLastError.**wtime**  
[wtime](#) (page 796) is a sub-document that reports [getLastError](#) (page 720) operation counts with a w argument greater than 1.

serverStatus.metrics.getLastError.wtime.**num**  
[num](#) (page 796) reports the total number of [getLastError](#) (page 720) operations with a specified write concern (i.e. w) that wait for one or more members of a replica set to acknowledge the write operation (i.e. a w value greater than 1.)

serverStatus.metrics.getLastError.wtime.**totalMillis**  
[totalMillis](#) (page 796) reports the total amount of time in milliseconds that the [mongod](#) (page 925) has spent performing [getLastError](#) (page 720) operations with write concern (i.e. w) that wait for one or more members of a replica set to acknowledge the write operation (i.e. a w value greater than 1.)

serverStatus.metrics.getLastError.**wtimeouts**  
[wtimeouts](#) (page 796) reports the number of times that *write concern* operations have timed out as a result of the [wtimeout](#) threshold to [getLastError](#) (page 720).

serverStatus.metrics.**operation**  
[operation](#) (page 796) is a sub-document that holds counters for several types of update and query operations that MongoDB handles using special operation types.

serverStatus.metrics.operation.**fastmod**  
[fastmod](#) (page 796) reports the number of [update](#) (page 50) operations that neither cause documents to grow nor require updates to the index. For example, this counter would record an update operation that use the [\\$inc](#) (page 651) operator to increment the value of a field that is not indexed.

serverStatus.metrics.operation.**idhack**  
[idhack](#) (page 796) reports the number of queries that contain the \_id field. For these queries, MongoDB will use default index on the \_id field and skip all query plan analysis.

serverStatus.metrics.operation.**scanAndOrder**  
[scanAndOrder](#) (page 796) reports the total number of queries that return sorted numbers that cannot perform the sort operation using an index.

serverStatus.metrics.**queryExecutor**  
[queryExecutor](#) (page 796) is a document that reports data from the query execution system.

serverStatus.metrics.queryExecutor.**scanned**  
[scanned](#) (page 796) reports the total number of index items scanned during queries and query-plan evaluation. This counter is the same as [nscanned](#) (page 864) in the output of [explain\(\)](#) (page 861).

serverStatus.metrics.**record**  
[record](#) (page 796) is a document that reports data related to record allocation in the on-disk memory files.

serverStatus.metrics.record.**moves**  
[moves](#) (page 796) reports the total number of times documents move within the on-disk representation of the

MongoDB data set. Documents move as a result of operations that increase the size of the document beyond their allocated record size.

#### `serverStatus.metrics.repl`

`repl` (page 797) holds a sub-document that reports metrics related to the replication process. `repl` (page 797) document appears on all `mongod` (page 925) instances, even those that aren't members of *replica sets*.

#### `serverStatus.metrics.repl.apply`

`apply` (page 797) holds a sub-document that reports on the application of operations from the replication *oplog*.

#### `serverStatus.metrics.repl.apply.batches`

`batches` (page 797) reports on the oplog application process on *secondaries* members of replica sets. See *Multithreaded Replication* (page 412) for more information on the oplog application processes

#### `serverStatus.metrics.repl.apply.batches.num`

`num` (page 797) reports the total number of batches applied across all databases.

#### `serverStatus.metrics.repl.apply.batches.totalMillis`

`totalMillis` (page 797) reports the total amount of time the `mongod` (page 925) has spent applying operations from the oplog.

#### `serverStatus.metrics.repl.apply.ops`

`ops` (page 797) reports the total number of *oplog* operations applied.

#### `serverStatus.metrics.repl.buffer`

MongoDB buffers oplog operations from the replication sync source buffer before applying oplog entries in a batch. `buffer` (page 797) provides a way to track the oplog buffer. See *Multithreaded Replication* (page 412) for more information on the oplog application process.

#### `serverStatus.metrics.repl.buffer.count`

`count` (page 797) reports the current number of operations in the oplog buffer.

#### `serverStatus.metrics.repl.buffer.maxSizeBytes`

`maxSizeBytes` (page 797) reports the maximum size of the buffer. This value is a constant setting in the `mongod` (page 925), and is not configurable.

#### `serverStatus.metrics.repl.buffer.sizeBytes`

`sizeBytes` (page 797) reports the current size of the contents of the oplog buffer.

#### `serverStatus.metrics.repl.network`

`network` (page 797) reports network use by the replication process.

#### `serverStatus.metrics.repl.network.bytes`

`bytes` (page 797) reports the total amount of data read from the replication sync source.

#### `serverStatus.metrics.repl.network.getmores`

`getmores` (page 797) reports on the getmore operations, which are requests for additional results from the oplog `cursor` as part of the oplog replication process.

#### `serverStatus.metrics.repl.network.getmores.num`

`num` (page 797) reports the total number of getmore operations, which are operations that request an additional set of operations from the replication sync source.

#### `serverStatus.metrics.repl.network.getmores.totalMillis`

`totalMillis` (page 797) reports the total amount of time required to collect data from getmore operations.

---

**Note:** This number can be quite large, as MongoDB will wait for more data even if the getmore operation does not initial return data.

---

#### `serverStatus.metrics.repl.network.ops`

`ops` (page 797) reports the total number of operations read from the replication source.

### serverStatus.metrics.repl.network.**readersCreated**

`readersCreated` (page 797) reports the total number of oplog query processes created. MongoDB will create a new oplog query any time an error occurs in the connection, including a timeout, or a network operation. Furthermore, `readersCreated` (page 797) will increment every time MongoDB selects a new source for replication.

### serverStatus.metrics.repl.**oplog**

`oplog` (page 798) is a document that reports on the size and use of the *oplog* by this `mongod` (page 925) instance.

#### serverStatus.metrics.repl.oplog.**insert**

`insert` (page 798) is a document that reports insert operations into the *oplog*.

##### serverStatus.metrics.repl.oplog.insert.**num**

`num` (page 798) reports the total number of items inserted into the *oplog*.

##### serverStatus.metrics.repl.oplog.insert.**totalMillis**

`totalMillis` (page 798) reports the total amount of time spent for the `mongod` (page 925) to insert data into the *oplog*.

##### serverStatus.metrics.repl.oplog.insertBytes

`insertBytes` (page 798) is the total size of documents inserted into the *oplog*.

### serverStatus.metrics.repl.**preload**

`preload` (page 798) reports on the “pre-fetch” stage, where MongoDB loads documents and indexes into RAM to improve replication throughput.

See [Multithreaded Replication](#) (page 412) for more information about the *pre-fetch* stage of the replication process.

#### serverStatus.metrics.repl.preload.**docs**

`docs` (page 798) is a sub-document that reports on the documents loaded into memory during the *pre-fetch* stage.

##### serverStatus.metrics.repl.preload.docs.**num**

`num` (page 798) reports the total number of documents loaded during the *pre-fetch* stage of replication.

##### serverStatus.metrics.repl.preload.docs.**totalMillis**

`totalMillis` (page 798) reports the total amount of time spent loading documents as part of the *pre-fetch* stage of replication.

#### serverStatus.metrics.repl.preload.indexes

`indexes` (page 798) is a sub-document that reports on the index items loaded into memory during the *pre-fetch* stage of replication.

See [Multithreaded Replication](#) (page 412) for more information about the *pre-fetch* stage of replication.

##### serverStatus.metrics.repl.preload.indexes.**num**

`num` (page 798) reports the total number of index entries loaded by members before updating documents as part of the *pre-fetch* stage of replication.

##### serverStatus.metrics.repl.preload.indexes.**totalMillis**

`totalMillis` (page 798) reports the total amount of time spent loading index entries as part of the *pre-fetch* stage of replication.

### serverStatus.metrics.**ttl**

`ttl` (page 798) is a sub-document that reports on the operation of the resource use of the `ttl` [index](#) (page 158) process.

#### serverStatus.metrics.ttl.**deletedDocuments**

`deletedDocuments` (page 798) reports the total number of documents deleted from collections with a `ttl` [index](#) (page 158).

**serverStatus.metrics.ttl.passes**

`passes` (page 798) reports the number of times the background process removes documents from collections with a *ttl index* (page 158).

**features****features**

`features` (page 799) is an internal command that returns the build-level feature settings.

**isSelf****\_isSelf**

`_isSelf` (page 799) is an internal command.

**Internal Commands****Internal Commands**

| Name                                            | Description                                                                                               |
|-------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| <code>handshake</code> (page 799)               | Internal command.                                                                                         |
| <code>_recvChunkAbort</code> (page 799)         | Internal command that supports chunk migrations in sharded clusters. Do not call directly.                |
| <code>_recvChunkCommit</code> (page 800)        | Internal command that supports chunk migrations in sharded clusters. Do not call directly.                |
| <code>_recvChunkStart</code> (page 800)         | Internal command that facilitates chunk migrations in sharded clusters.. Do not call directly.            |
| <code>_recvChunkStatus</code> (page 800)        | Internal command that returns data to support chunk migrations in sharded clusters. Do not call directly. |
| <code>_rep1SetFresh</code>                      | Internal command that supports replica set election operations.                                           |
| <code>mapreduce.shardedfinish</code> (page 800) | Internal command that supports <i>map-reduce</i> in <i>sharded cluster</i> environments.                  |
| <code>_transferMods</code> (page 800)           | Internal command that supports chunk migrations. Do not call directly.                                    |
| <code>rep1SetHeartbeat</code> (page 800)        | Internal command that supports replica set operations.                                                    |
| <code>rep1SetGetRBID</code> (page 800)          | Internal command that supports replica set operations.                                                    |
| <code>_migrateClone</code> (page 800)           | Internal command that supports chunk migration. Do not call directly.                                     |
| <code>rep1SetElect</code> (page 800)            | Internal command that supports replica set functionality.                                                 |
| <code>writeBacksQueued</code> (page 801)        | Internal command that supports chunk migrations in sharded clusters.                                      |
| <code>writebacklisten</code> (page 801)         | Internal command that supports chunk migrations in sharded clusters.                                      |

**handshake****handshake**

`handshake` (page 799) is an internal command.

**recvChunkAbort****\_recvChunkAbort**

`_recvChunkAbort` (page 799) is an internal command. Do not call directly.

**recvChunkCommit**

**\_recvChunkCommit**

[\\_recvChunkCommit](#) (page 800) is an internal command. Do not call directly.

**recvChunkStart**

**\_recvChunkStart**

[\\_recvChunkStart](#) (page 800) is an internal command. Do not call directly.

**Warning:** This command obtains a write lock on the affected database and will block other operations until it has completed.

**recvChunkStatus**

**\_recvChunkStatus**

[\\_recvChunkStatus](#) (page 800) is an internal command. Do not call directly.

**repSetFresh**

**rep1SetFresh**

[rep1SetFresh](#) (page 800) is an internal command that supports replica set functionality.

**mapreduce.shardedfinish**

**mapreduce . shardedfinish**

Provides internal functionality to support [map-reduce](#) in [sharded](#) environments.

**See also:**

“[mapReduce](#) (page 701)“

**transferMods**

**\_transferMods**

[\\_transferMods](#) (page 800) is an internal command. Do not call directly.

**repSetHeartbeat**

**rep1SetHeartbeat**

[rep1SetHeartbeat](#) (page 800) is an internal command that supports replica set functionality.

**repSetGetRBID**

**rep1SetGetRBID**

[rep1SetGetRBID](#) (page 800) is an internal command that supports replica set functionality.

**migrateClone**

**\_migrateClone**

[\\_migrateClone](#) (page 800) is an internal command. Do not call directly.

**repSetElect**

**rep1SetElect**

[rep1SetElect](#) (page 800) is an internal command that support replica set functionality.

**writeBacksQueued****writeBacksQueued**

`writeBacksQueued` (page 801) is an internal command that returns a document reporting there are operations in the write back queue for the given `mongos` (page 938) and information about the queues.

`writeBacksQueued.hasOpsQueued`

Boolean.

`hasOpsQueued` (page 801) is true if there are write Back operations queued.

`writeBacksQueued.totalOpsQueued`

Integer.

`totalOpsQueued` (page 801) reflects the number of operations queued.

`writeBacksQueued.queues`

Document.

`queues` (page 801) holds a sub-document where the fields are all write back queues. These field hold a document with two fields that reports on the state of the queue. The fields in these documents are:

`writeBacksQueued.queues.n`

`n` (page 801) reflects the size, by number of items, in the queues.

`writeBacksQueued.queues.minutesSinceLastCall`

The number of minutes since the last time the `mongos` (page 938) touched this queue.

The command document has the following prototype form:

```
{writeBacksQueued: 1}
```

To call `writeBacksQueued` (page 801) from the `mongo` (page 942) shell, use the following `db.runCommand()` (page 893) form:

```
db.runCommand({writeBacksQueued: 1})
```

Consider the following example output:

```
{
 "hasOpsQueued" : true,
 "totalOpsQueued" : 7,
 "queues" : {
 "50b4f09f6671b11ff1944089" : { "n" : 0, "minutesSinceLastCall" : 1 },
 "50b4f09fc332bf1c5aeaaf59" : { "n" : 0, "minutesSinceLastCall" : 0 },
 "50b4f09f6671b1d51df98cb6" : { "n" : 0, "minutesSinceLastCall" : 0 },
 "50b4f0c67ccf1e5c6effb72e" : { "n" : 0, "minutesSinceLastCall" : 0 },
 "50b4faf12319f193cfdec0d1" : { "n" : 0, "minutesSinceLastCall" : 4 },
 "50b4f013d2c1f8d62453017e" : { "n" : 0, "minutesSinceLastCall" : 0 },
 "50b4f0f12319f193cfdec0d1" : { "n" : 0, "minutesSinceLastCall" : 1 }
 },
 "ok" : 1
}
```

**writebacklisten****writebacklisten**

`writebacklisten` (page 801) is an internal command.

## Testing Commands

### Testing Commands

| Name                                       | Description                                                                                          |
|--------------------------------------------|------------------------------------------------------------------------------------------------------|
| <code>testDistLockWithSkew</code>          | Internal command. Do not call this directly.                                                         |
| <code>testDistLockWithSyncCluster</code>   | Internal command. Do not call this directly.                                                         |
| <code>captrunc</code> (page 802)           | Internal command. Truncates capped collections.                                                      |
| <code>emptycapped</code> (page 803)        | Internal command. Removes all documents from a capped collection.                                    |
| <code>godinsert</code> (page 803)          | Internal command for testing.                                                                        |
| <code>_hashBSONElement</code> (page 803)   | Internal command. Computes the MD5 hash of a BSON element.                                           |
| <code>_journalLatencyTest</code>           | Tests the time required to write and perform a file system sync for a file in the journal directory. |
| <code>sleep</code> (page 805)              | Internal command for testing. Forces MongoDB to block all operations.                                |
| <code>replSetTest</code> (page 805)        | Internal command for testing replica set functionality.                                              |
| <code>forceerror</code> (page 806)         | Internal command for testing. Forces a user assertion exception.                                     |
| <code>skewClockCommand</code>              | Internal command. Do not call this command directly.                                                 |
| <code>configureFailPoint</code> (page 806) | Internal command for testing. Configures failure points.                                             |

#### `testDistLockWithSkew`

##### `_testDistLockWithSkew`

`_testDistLockWithSkew` (page 802) is an internal command. Do not call directly.

---

**Note:** `_testDistLockWithSkew` (page 802) is an internal command that is not enabled by default. `_testDistLockWithSkew` (page 802) must be enabled by using `--setParameter enableTestCommands=1` on the `mongod` (page 925) command line. `_testDistLockWithSkew` (page 802) cannot be enabled during run-time.

---

#### `testDistLockWithSyncCluster`

##### `_testDistLockWithSyncCluster`

`_testDistLockWithSyncCluster` (page 802) is an internal command. Do not call directly.

---

**Note:** `_testDistLockWithSyncCluster` (page 802) is an internal command that is not enabled by default. `_testDistLockWithSyncCluster` (page 802) must be enabled by using `--setParameter enableTestCommands=1` on the `mongod` (page 925) command line. `_testDistLockWithSyncCluster` (page 802) cannot be enabled during run-time.

---

#### `captrunc`

##### Definition

##### `captrunc`

Truncates capped collections. `captrunc` (page 802) is an internal command to support testing that takes the following form:

```
{ captrunc: "<collection>", n: <integer>, inc: <true|false> }.
```

`captrunc` (page 802) has the following fields:

**field string captrunc** The name of the collection to truncate.

**field integer n** The number of documents to remove from the collection.

**field boolean inc** Specifies whether to truncate the nth document.

---

**Note:** `captrunc` (page 802) is an internal command that is not enabled by default. `captrunc` (page 802) must be enabled by using `--setParameter enableTestCommands=1` on the `mongod` (page 925) command line. `captrunc` (page 802) cannot be enabled during run-time.

---

**Examples** The following command truncates 10 older documents from the collection `records`:

```
db.runCommand({captrunc: "records", n: 10})
```

The following command truncates 100 documents and the 101st document:

```
db.runCommand({captrunc: "records", n: 100, inc: true})
```

### **emptycapped**

### **emptycapped**

The `emptycapped` command removes all documents from a capped collection. Use the following syntax:

```
{ emptycapped: "events" }
```

This command removes all records from the capped collection named `events`.

**Warning:** This command obtains a write lock on the affected database and will block other operations until it has completed.

---

**Note:** `emptycapped` (page 803) is an internal command that is not enabled by default. `emptycapped` (page 803) must be enabled by using `--setParameter enableTestCommands=1` on the `mongod` (page 925) command line. `emptycapped` (page 803) cannot be enabled during run-time.

---

### **godinsert**

### **godinsert**

`godinsert` (page 803) is an internal command for testing purposes only.

---

**Note:** This command obtains a write lock on the affected database and will block other operations until it has completed.

---



---

**Note:** `godinsert` (page 803) is an internal command that is not enabled by default. `godinsert` (page 803) must be enabled by using `--setParameter enableTestCommands=1` on the `mongod` (page 925) command line. `godinsert` (page 803) cannot be enabled during run-time.

---

## **\_hashBSONElement**

### **Description**

### **\_hashBSONElement**

New in version 2.4.

An internal command that computes the MD5 hash of a BSON element. The [\\_hashBSONElement](#) (page 803) command returns 8 bytes from the 16 byte MD5 hash.

The [\\_hashBSONElement](#) (page 803) command has the following fields:

**field BSONElement key** The BSON element to hash.

**field integer seed** A seed used when computing the hash.

---

**Note:** [\\_hashBSONElement](#) (page 803) is an internal command that is not enabled by default. [\\_hashBSONElement](#) (page 803) must be enabled by using `--setParameter enableTestCommands=1` on the [mongod](#) (page 925) command line. [\\_hashBSONElement](#) (page 803) cannot be enabled during run-time.

---

**Output** The [\\_hashBSONElement](#) (page 803) command returns a document that holds the following fields:

[\\_hashBSONElement.key](#)

The original BSON element.

[\\_hashBSONElement.seed](#)

The seed used for the hash, defaults to 0.

[\\_hashBSONElement.out](#)

The decimal result of the hash.

[\\_hashBSONElement.ok](#)

Holds the 1 if the function returns successfully, and 0 if the operation encountered an error.

**Example** Invoke a [mongod](#) (page 925) instance with test commands enabled:

```
mongod --setParameter enableTestCommands=1
```

Run the following to compute the hash of an ISODate string:

```
db.runCommand({_hashBSONElement: ISODate("2013-02-12T22:12:57.211Z")})
```

The command returns the following document:

```
{
 "key" : ISODate("2013-02-12T22:12:57.211Z"),
 "seed" : 0,
 "out" : NumberLong("-4185544074338741873"),
 "ok" : 1
}
```

Run the following to hash the same ISODate string but this time to specify a seed value:

```
db.runCommand({_hashBSONElement: ISODate("2013-02-12T22:12:57.211Z"), seed:2013})
```

The command returns the following document:

```
{
 "key" : ISODate("2013-02-12T22:12:57.211Z"),
 "seed" : 2013,
 "out" : NumberLong("7845924651247493302"),
 "ok" : 1
}
```

**journalLatencyTest****journalLatencyTest**

`journalLatencyTest` (page 805) is an administrative command that tests the length of time required to write and perform a file system sync (e.g. `fsync`) for a file in the journal directory. You must issue the `journalLatencyTest` (page 805) command against the `admin database` in the form:

```
{ journalLatencyTest: 1 }
```

The value (i.e. 1 above), does not affect the operation of the command.

---

**Note:** `journalLatencyTest` (page 805) is an internal command that is not enabled by default. `journalLatencyTest` (page 805) must be enabled by using `--setParameter enableTestCommands=1` on the `mongod` (page 925) command line. `journalLatencyTest` (page 805) cannot be enabled during run-time.

---

**sleep****Definition****sleep**

Forces the database to block all operations. This is an internal command for testing purposes.

The `sleep` (page 805) command has the following options:

**field boolean w** If true, obtains a global write lock. Otherwise obtains a read lock.

**field integer secs** The number of seconds to sleep.

**Example** The `sleep` (page 805) command takes the following prototype form:

```
{ sleep: 1, w: <true|false>, secs: <seconds> }
```

The command places the `mongod` (page 925) instance in a `write lock` state for a specified number of seconds. Without arguments, `sleep` (page 805) causes a “read lock” for 100 seconds.

**Warning:** `sleep` (page 805) claims the lock specified in the `w` argument and blocks *all* operations on the `mongod` (page 925) instance for the specified amount of time.

---

**Note:** `sleep` (page 805) is an internal command that is not enabled by default. `sleep` (page 805) must be enabled by using `--setParameter enableTestCommands=1` on the `mongod` (page 925) command line. `sleep` (page 805) cannot be enabled during run-time.

---

**rep1SetTest****rep1SetTest**

`rep1SetTest` (page 805) is internal diagnostic command used for regression tests that supports replica set functionality.

---

**Note:** `rep1SetTest` (page 805) is an internal command that is not enabled by default. `rep1SetTest` (page 805) must be enabled by using `--setParameter enableTestCommands=1` on the `mongod` (page 925) command line. `rep1SetTest` (page 805) cannot be enabled during run-time.

---

## forceerror

### forceerror

The [forceerror](#) (page 806) command is for testing purposes only. Use [forceerror](#) (page 806) to force a user assertion exception. This command always returns an `ok` value of 0.

## skewClockCommand

### \_skewClockCommand

[\\_skewClockCommand](#) (page 806) is an internal command. Do not call directly.

---

**Note:** [\\_skewClockCommand](#) (page 806) is an internal command that is not enabled by default. [\\_skewClockCommand](#) (page 806) must be enabled by using `--setParameter enableTestCommands=1` on the [mongod](#) (page 925) command line. [\\_skewClockCommand](#) (page 806) cannot be enabled during run-time.

---

## configureFailPoint

### Definition

#### configureFailPoint

Configures a failure point that you can turn on and off while MongoDB runs. [configureFailPoint](#) (page 806) is an internal command for testing purposes that takes the following form:

```
{configureFailPoint: "<failure_point>", mode: <behavior> }
```

You must issue [configureFailPoint](#) (page 806) against the [admin database](#). [configureFailPoint](#) (page 806) has the following fields:

**field string configureFailPoint** The name of the failure point.

**field document,string mode** Controls the behavior of a failure point. The possible values are `alwaysOn`, `off`, or a document in the form of `{times: n}` that specifies the number of times the failure point remains on before it deactivates. The maximum value for the number is a 32-bit signed integer.

**field document data** Passes in additional data for use in configuring the fail point. For example, to imitate a slow connection pass in a document that contains a delay time.

---

**Note:** [configureFailPoint](#) (page 806) is an internal command that is not enabled by default. [configureFailPoint](#) (page 806) must be enabled by using `--setParameter enableTestCommands=1` on the [mongod](#) (page 925) command line. [configureFailPoint](#) (page 806) cannot be enabled during run-time.

---

### Example

```
db.adminCommand({ configureFailPoint: "blocking_thread", mode: {times: 21} })
```

## 11.1.3 mongo Shell Methods

- [Collection](#) (page 807)
- [Cursor](#) (page 858)
- [Database](#) (page 874)
- [Replication](#) (page 895)
- [Sharding](#) (page 901)
- [Subprocess](#) (page 914)
- [Constructors](#) (page 915)
- [Connection](#) (page 917)
- [Native](#) (page 921)

## JavaScript in MongoDB

Although these methods use JavaScript, most interactions with MongoDB do not use JavaScript but use an *idiomatic driver* (page 95) in the language of the interacting application.

## Collection

### Collection Methods

| Name                                                         | Description                                                                                                                                                              |
|--------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>db.collection.aggregate()</code> (page 808)            | Provides access to the <i>aggregation pipeline</i> (page 279).                                                                                                           |
| <code>db.collection.count()</code> (page 809)                | Wraps <code>count</code> (page 695) to return a count of the number of documents in a collection.                                                                        |
| <code>db.collection.createIndex()</code> (page 810)          | Builds an index on a collection. Use <code>db.collection.ensureIndex</code> .                                                                                            |
| <code>db.collection.getIndexStats()</code> (page 810)        | Renders a human-readable view of the data collected by <code>indexStats</code> .                                                                                         |
| <code>db.collection.indexStats()</code> (page 811)           | Renders a human-readable view of the data collected by <code>indexStats</code> .                                                                                         |
| <code>db.collection dataSize()</code> (page 812)             | Returns the size of the collection. Wraps the <code>size</code> (page 764) field.                                                                                        |
| <code>db.collection.distinct()</code> (page 812)             | Returns an array of documents that have distinct values for the specified field.                                                                                         |
| <code>db.collection.drop()</code> (page 812)                 | Removes the specified collection from the database.                                                                                                                      |
| <code>db.collection.dropIndex()</code> (page 812)            | Removes a specified index on a collection.                                                                                                                               |
| <code>db.collection.dropIndexes()</code> (page 813)          | Removes all indexes on a collection.                                                                                                                                     |
| <code>db.collection.ensureIndex()</code> (page 814)          | Creates an index if it does not currently exist. If the index exists <code>ensureIndex</code> performs a <code>dropIndex</code> followed by a <code>createIndex</code> . |
| <code>db.collection.find()</code> (page 816)                 | Performs a query on a collection and returns a cursor object.                                                                                                            |
| <code>db.collection.findAndModify()</code> (page 821)        | Atomically modifies and returns a single document.                                                                                                                       |
| <code>db.collection.findOne()</code> (page 824)              | Performs a query and returns a single document.                                                                                                                          |
| <code>db.collection.getIndexes()</code> (page 826)           | Returns an array of documents that describe the existing indexes on a collection.                                                                                        |
| <code>db.collection.getShardDistribution()</code> (page 827) | For collections in sharded clusters, <code>db.collection.getShardDistribution</code> returns an array of shard keys and the shard key for each document.                 |
| <code>db.collection.getShardVersion()</code> (page 828)      | Internal diagnostic method for shard cluster.                                                                                                                            |
| <code>db.collection.group()</code> (page 828)                | Provides simple data aggregation function. Groups documents in a collection.                                                                                             |
| <code>db.collection.insert()</code> (page 832)               | Creates a new document in a collection.                                                                                                                                  |
| <code>db.collection.isCapped()</code> (page 837)             | Reports if a collection is a <i>capped collection</i> .                                                                                                                  |
| <code>db.collection.mapReduce()</code> (page 837)            | Performs map-reduce style data aggregation.                                                                                                                              |
| <code>db.collection.reIndex()</code> (page 844)              | Rebuilds all existing indexes on a collection.                                                                                                                           |
| <code>db.collection.remove()</code> (page 844)               | Deletes documents from a collection.                                                                                                                                     |
| <code>db.collection.renameCollection()</code> (page 846)     | Changes the name of a collection.                                                                                                                                        |
| <code>db.collection.save()</code> (page 846)                 | Provides a wrapper around an <code>insert()</code> (page 832) and <code>update()</code> (page 833).                                                                      |
| <code>db.collection.stats()</code> (page 848)                | Reports on the state of a collection. Provides a wrapper around the <code>getCollectionStatus</code> command.                                                            |
| <code>db.collection.storageSize()</code> (page 849)          | Reports the total size used by the collection in bytes. Provides a wrapper around the <code>getStorageSize</code> command.                                               |
| <code>db.collection.totalSize()</code> (page 849)            | Reports the total size of a collection, including the size of all documents.                                                                                             |
| <code>db.collection.totalIndexSize()</code> (page 849)       | Reports the total size used by the indexes on a collection. Provides a wrapper around the <code>getTotalIndexSize</code> command.                                        |

Table 11.1 – continued from p

| Name                                             | Description                                     |
|--------------------------------------------------|-------------------------------------------------|
| <code>db.collection.update()</code> (page 849)   | Modifies a document in a collection.            |
| <code>db.collection.validate()</code> (page 856) | Performs diagnostic operations on a collection. |

**db.collection.aggregate()****Definition**`db.collection.aggregate(pipeline)`

New in version 2.2.

Calculates aggregate values for the data in a collection. Always call the `aggregate()` (page 808) method on a collection object.

**param document pipeline** A sequence of data aggregation processes. See the [aggregation reference](#) (page 306) for documentation of these operators.

**Returns**

A document with two fields:

- `result` which holds an array of documents returned by the `pipeline`
- `ok` which holds the value 1, indicating success.

**Throws exception**

Changed in version 2.4: If an error occurs, the `aggregate()` (page 808) helper throws an exception. In previous versions, the helper returned a document with the error message and code, and `ok` status field not equal to 1, same as the `aggregate` (page 694) command.

**Example** Consider a collection named `articles` that contains documents of the following format:

```
{
 title : "this is my title" ,
 author : "bob" ,
 posted : new Date () ,
 pageViews : 5 ,
 tags : ["fun" , "good" , "sport"] ,
 comments : [
 { author :"joe" , text : "this is cool" } ,
 { author :"sam" , text : "this is bad" }
],
 other : { foo : 5 }
}
```

The following aggregation pivots the data to group authors by individual tags:

```
db.articles.aggregate(
 { $project : {
 author : 1,
 tags : 1,
 }
 },
 { $unwind : "$tags" },
 { $group : {
 _id : { tags : "$tags" },
 authors : { $addToSet : "$author" }
 }
 }
)
```

```

 }
 }
)
```

The aggregation pipeline begins with the collection `articles` and selects the `author` and `tags` fields using the `$project` (page 664) pipeline operator. The `$unwind` (page 668) operator produces one output document per tag. Finally, the `$group` (page 669) pipeline operator groups authors by tags.

The operation returns the following document:

```
{
 "result" : [
 {
 "_id" : { "tags" : "good" },
 "authors" : ["bob", "mike", ...]
 },
 {
 "_id" : { "tags" : "fun" },
 "authors" : ["bob", "al"]
 },
 ...
],
 "ok" : 1
}
```

The returned document contains two fields:

- `result` field, which holds an array of documents returned by the `pipeline` (page 279), and
- `ok` field, which holds the value 1, indicating success.

For more information, see [Aggregation Concepts](#) (page 279), [Aggregation Reference](#) (page 306), and [aggregate](#) (page 694).

## `db.collection.count()`

### Definition

`db.collection.count(<query>)`

Returns the count of documents that would match a `find()` (page 816) query. The `db.collection.count()` (page 809) method does not perform the `find()` (page 816) operation but instead counts and returns the number of results that match a query.

The `db.collection.count()` (page 809) method has the following parameter:

**param document query** The query selection criteria.

### See also:

[cursor.count\(\)](#) (page 860)

## Examples

**Count all Documents in a Collection** To count the number of all documents in the `orders` collection, use the following operation:

```
db.orders.count()
```

This operation is equivalent to the following:

```
db.orders.find().count()
```

**Count all Documents that Match a Query** Count the number of the documents in the `orders` collection with the field `ord_dt` greater than `new Date('01/01/2012')`:

```
db.orders.count({ ord_dt: { $gt: new Date('01/01/2012') } })
```

The query is equivalent to the following:

```
db.orders.find({ ord_dt: { $gt: new Date('01/01/2012') } }).count()
```

## db.collection.createIndex()

### Definition

`db.collection.createIndex(keys, options)`

Deprecated since version 1.8.

Creates indexes on collections.

**param document keys** For each field to index, a key-value pair with the field and the index order:  
1 for ascending or -1 for descending.

**param document options** One or more key-value pairs that specify index options. For a list of options, see [db.collection.ensureIndex\(\)](#) (page 814).

**See also:**

[Indexes](#) (page 313), [db.collection.createIndex\(\)](#) (page 810), [db.collection.dropIndex\(\)](#) (page 812), [db.collection.dropIndexes\(\)](#) (page 813), [db.collection.getIndexes\(\)](#) (page 826), [db.collection.reIndex\(\)](#) (page 844), and [db.collection.totalIndexSize\(\)](#) (page 849)

## db.collection.getIndexStats()

### Definition

`db.collection.getIndexStats(index)`

Displays a human-readable summary of aggregated statistics about an index's B-tree data structure. The information summarizes the output returned by the `indexStats` (page 774) command and `indexStats()` (page 811) method. The `getIndexStats()` (page 810) method displays the information on the screen and does not return an object.

The `getIndexStats()` (page 810) method has the following form:

```
db.<collection>.getIndexStats({ index : "<index name>" })
```

**param document index** The `index name` (page 338).

The `getIndexStats()` (page 810) method is available only when connected to a `mongod` (page 925) instance that uses the `--enableExperimentalIndexStatsCmd` option.

To view `index names` (page 338) for a collection, use the `getIndexes()` (page 826) method.

**Warning:** Do not use `getIndexStats()` (page 810) or `indexStats` (page 774) with production deployments.

**Example** The following command returns information for an index named `type_1_traits_1`:

```
db.animals.getIndexStats({index:"type_1_traits_1"})
```

The command returns the following summary. For more information on the B-tree statistics, see `indexStats` (page 774).

```
-- index "undefined" --
version 1 | key pattern { "type" : 1, "traits" : 1 } | storage namespace "test.animals.$type_1_t
2 deep, bucket body is 8154 bytes

bucket count 45513 on average 99.401 % (±0.463 %) full 49.581 % (±4.135 %) bson keys,
-- depth 0 --
bucket count 1 on average 71.511 % (±0.000 %) full 36.191 % (±0.000 %) bson keys,
-- depth 1 --
bucket count 180 on average 98.954 % (±5.874 %) full 49.732 % (±5.072 %) bson keys,
-- depth 2 --
bucket count 45332 on average 99.403 % (±0.245 %) full 49.580 % (±4.130 %) bson keys,
```

## db.collection.indexStats()

### Definition

`db.collection.indexStats(index)`

Aggregates statistics for the B-tree data structure that stores data for a MongoDB index. The `indexStats()` (page 811) method is a thin wrapper around the `indexStats` (page 774) command. The `indexStats()` (page 811) method is available only on `mongod` (page 925) instances running with the `--enableExperimentalIndexStatsCmd` option.

---

**Important:** The `indexStats()` (page 811) method is not intended for production deployments.

---

The `indexStats()` (page 811) method has the following form:

```
db.<collection>.indexStats({ index: "<index name>" })
```

The `indexStats()` (page 811) method has the following parameter:

**param document index** *The index name* (page 338).

The method takes a read lock and pages into memory all the extents, or B-tree buckets, encountered. The method might be slow for large indexes if the underlying extents are not already in physical memory. Do not run `indexStats()` (page 811) on a *replica set primary*. When run on a *secondary*, the command causes the secondary to fall behind on replication.

The method aggregates statistics for the entire B-tree and for each individual level of the B-tree. For a description of the command's output, see `indexStats` (page 774).

For more information about running `indexStats()` (page 811), see <https://github.com/mongodb-labs/storage-viz#readme>.

**db.collection.dataSize()**  
`db.collection.dataSize()`

**Returns** The size of the collection. This method provides a wrapper around the `size` (page 764) output of the `collStats` (page 763) (i.e. `db.collection.stats()` (page 848)) command.

**db.collection.distinct()**

#### Definition

**db.collection.distinct(*field, query*)**

Finds the distinct values for a specified field across a single collection and returns the results in an array.

**param string field** The field for which to return distinct values.

**param document query** A query that specifies the documents from which to retrieve the distinct values.

The `db.collection.distinct()` (page 812) method provides a wrapper around the `distinct` (page 696) command. Results must not be larger than the maximum  `BSON size` (page 1015).

When possible to use covered indexes, the `db.collection.distinct()` (page 812) method will use an index to find the documents in the query as well as to return the data.

**Examples** The following are examples of the `db.collection.distinct()` (page 812) method:

- Return an array of the distinct values of the field `ord_dt` from all documents in the `orders` collection:  
`db.orders.distinct( 'ord_dt' )`
- Return an array of the distinct values of the field `sku` in the subdocument `item` from all documents in the `orders` collection:  
`db.orders.distinct( 'item.sku' )`
- Return an array of the distinct values of the field `ord_dt` from the documents in the `orders` collection where the `price` is greater than 10:  
`db.orders.distinct( 'ord_dt', { price: { $gt: 10 } } )`

**db.collection.drop()**

**db.collection.drop()**

Call the `db.collection.drop()` (page 812) method on a collection to drop it from the database.

`db.collection.drop()` (page 812) takes no arguments and will produce an error if called with any arguments.

**db.collection.dropIndex()**

#### Definition

**db.collection.dropIndex(*index*)**

Drops or removes the specified index from a collection. The `db.collection.dropIndex()` (page 812) method provides a wrapper around the `dropIndexes` (page 750) command.

---

**Note:** You cannot drop the default index on the `_id` field.

---

The `db.collection.dropIndex()` (page 812) method takes the following parameter:

**param string,document index** Specifies the index to drop. You can specify the index either by the index name or by the index specification document.<sup>8</sup>

See *Indexing Tutorials* (page 338) for information. To view all indexes on a collection, use the `db.collection.getIndexes()` (page 826) method.

## Example

The following example uses the `db.collection.dropIndex()` (page 812) method on the collection `pets` that has the following indexes:

```
> db.pets.getIndexes()
[
 {
 "v" : 1,
 "key" : { "_id" : 1 },
 "ns" : "test.pets",
 "name" : "_id_"
 },
 {
 "v" : 1,
 "key" : { "cat" : -1 },
 "ns" : "test.pets",
 "name" : "catIdx"
 },
 {
 "v" : 1,
 "key" : { "cat" : 1, "dog" : -1 },
 "ns" : "test.pets",
 "name" : "cat_1_dog_-1"
 }
]
```

The index on the field `cat` has the user-specified name of `catIdx`<sup>9</sup>. To drop the index `catIdx`, you can use either the index name:

```
db.pets.dropIndex("catIdx")
```

or the index specification document `{ "cat" : 1 }`:

```
db.pets.dropIndex({ "cat" : 1 })
```

## db.collection.dropIndexes()

### db.collection.dropIndexes()

Drops all indexes other than the required index on the `_id` field. Only call `dropIndexes()` (page 813) as a method on a collection object.

## db.collection.ensureIndex()

---

<sup>8</sup> When using a `mongo` (page 942) shell version earlier than 2.2.2, if you specified a name during the index creation, you must use the name to drop the index.

<sup>9</sup> During index creation, if the user does **not** specify an index name, the system generates the name by concatenating the index key field and value with an underscore, e.g. `cat_1`.

**Definition**

`db.collection.ensureIndex(keys, options)`

Creates an index on the specified field if the index does not already exist.

The `ensureIndex()` (page 814) method has the following fields:

**param document keys** For ascending/descending indexes, a document that contains pairs with the name of the field or fields to index and order of the index. A `1` specifies ascending and a `-1` specifies descending. MongoDB supports several different index types including `text` (page 332), `geospatial` (page 326), and `hashed` (page 333) indexes. See *Indexing Tutorials* (page 338).

**param document options** A document that controls the creation of the index. The document contains a set of options, as described in the next table.

**Warning:** Index names, including their full namespace (i.e. `database.collection`) cannot be longer than 128 characters. See the `getIndexes()` (page 826) field `name` (page 826) for the names of existing indexes.

The `options` document has one or more of the following fields:

**param Boolean background** Builds the index in the background so that building an index does *not* block other database activities. Specify `true` to build in the background. The default value is `false`.

**param Boolean unique** Creates a unique index so that the collection will not accept insertion of documents where the index key or keys match an existing value in the index. Specify `true` to create a unique index. The default value is `false`. This option applies only to ascending/descending indexes.

**param string name** The name of the index. If unspecified, MongoDB generates an index name by concatenating the names of the indexed fields and the sort order.

**param Boolean dropDups** Creates a unique index on a field that *may* have duplicates. MongoDB indexes only the first occurrence of a key and **removes** all documents from the collection that contain subsequent occurrences of that key. Specify `true` to create unique index. The default value is `false`. This option applies only to scalar indexes.

**param Boolean sparse** If `true`, the index only references documents with the specified field. These indexes use less space but behave differently in some situations (particularly sorts). The default value is `false`. This applies only to ascending/descending indexes.

**param integer expireAfterSeconds** Specifies a value, in seconds, as a `TTL` to control how long MongoDB retains documents in this collection. See *Expire Data from Collections by Setting TTL* (page 158) for more information on this functionality. This applies only to `TTL` indexes.

**param index version v** The index version number. The default index version depends on the version of `mongod` (page 925) running when creating the index. Before version 2.0, the this value was `0`; versions 2.0 and later use version `1`, which provides a smaller and faster index format. Specify a different index version *only* in unusual situations.

**param document weights** For `text` indexes, the significance of the field relative to the other indexed fields. The document contains field and weight pairs. The weight is a number ranging from `1` to `99,999` and denotes the significance of the field relative to the other indexed fields in terms of the score. You can specify weights for some or all the indexed fields. See *Control Search Results with Weights* (page 364) to adjust the scores. The default value is `1`. This applies to `text` indexes only.

**param string default\_language** For a `text` index, the language that determines the list of stop words and the rules for the stemmer and tokenizer. See *Text Search Languages* (page 719) for

the available languages and [Specify a Language for Text Index](#) (page 362) for more information and examples. The default value is `english`. This applies to `text` indexes only.

**param string language\_override** For a `text` index, specify the name of the field in the document that contains, for that document, the language to override the default language. The default value is `language`.

## Examples

**Create an Ascending Index on a Single Field** The following example creates an ascending index on the field `orderDate`.

```
db.collection.ensureIndex({ orderDate: 1 })
```

If the `keys` document specifies more than one field, then `ensureIndex()` (page 814) creates a *compound index*.

**Create an Index on a Multiple Fields** The following example creates a compound index on the `orderDate` field (in ascending order) and the `zipcode` field (in descending order).

```
db.collection.ensureIndex({ orderDate: 1, zipcode: -1 })
```

A compound index cannot include a *hashed index* (page 333) component.

---

**Note:** The order of an index is important for supporting `sort()` (page 872) operations using the index.

---

## See also:

- The [Indexes](#) (page 313) section of this manual for full documentation of indexes and indexing in MongoDB.
- The [Create Text Index](#) (page 332) section for more information and examples on creating `text` indexes.

**Behaviors** The `ensureIndex()` (page 814) method has the behaviors described here.

- To add or change index options you must drop the index using the `dropIndex()` (page 812) method and issue another `ensureIndex()` (page 814) operation with the new options.

If you create an index with one set of options, and then issue the `ensureIndex()` (page 814) method with the same index fields and different options without first dropping the index, `ensureIndex()` (page 814) will *not* rebuild the existing index with the new options.

- If you call multiple `ensureIndex()` (page 814) methods with the same index specification at the same time, only the first operation will succeed, all other operations will have no effect.
- Non-background indexing operations will block all other operations on a database.

## See also:

In addition to the ascending/descending indexes, MongoDB provides the following index types to provide additional functionalities:

- [TTL Indexes](#) (page 334) to support expiration of data,
- [Geospatial Indexes](#) (page 327) and [Haystack Indexes](#) (page 330) to support geospatial queries, and
- [Text Indexes](#) (page 332) to support text searches.

## db.collection.find()

### Definition

```
db.collection.find(<criteria>, <projection>)
```

Selects documents in a collection and returns a [cursor](#) to the selected documents.<sup>10</sup>

**param document criteria** Specifies selection criteria using [query operators](#) (page 621). To return all documents in a collection, omit this parameter or pass an empty document ({}).

**param document projection** Specifies the fields to return using [projection operators](#) (page 646). To return all fields in the matching document, omit this parameter.

### Returns

A [cursor](#) to the documents that match the query criteria. When the [find\(\)](#) (page 816) method “returns documents,” the method is actually returning a cursor to the documents.

If the `projection` argument is specified, the matching documents contain only the `projection` fields and the `_id` field. You can optionally exclude the `_id` field.

Executing [find\(\)](#) (page 816) directly in the [mongo](#) (page 942) shell automatically iterates the cursor to display up to the first 20 documents. Type `it` to continue iteration.

To access the returned documents with a driver, use the appropriate cursor handling mechanism for the [driver language](#) (page 95).

The `projection` parameter takes a document of the following form:

```
{ field1: <boolean>, field2: <boolean> ... }
```

The `<boolean>` value can be any of the following:

- 1 or `true` to include the field. The [find\(\)](#) (page 816) method always includes the `_id` field even if the field is not explicitly stated to return in the `projection` parameter.
- 0 or `false` to exclude the field.

A `projection` *cannot* contain *both* include and exclude specifications, except for the exclusion of the `_id` field. In projections that *explicitly include* fields, the `_id` field is the only field that you can *explicitly exclude*.

### Examples

**Find All Documents in a Collection** The [find\(\)](#) (page 816) method with no parameters returns all documents from a collection and returns all fields for the documents. For example, the following operation returns all documents in the [bios collection](#) (page 111):

```
db.bios.find()
```

**Find Documents that Match Query Criteria** To find documents that match a set of selection criteria, call [find\(\)](#) with the `<criteria>` parameter. The following operation returns all the documents from the collection `products` where `qty` is greater than 25:

```
db.products.find({ qty: { $gt: 25 } })
```

<sup>10</sup> `db.collection.find()` (page 816) is a wrapper for the more formal query structure that uses the `$query` (page 693) operator.

**Query for Equality** The following operation returns documents in the *bios collection* (page 111) where `_id` equals 5:

```
db.bios.find({ _id: 5 })
```

**Query Using Operators** The following operation returns documents in the *bios collection* (page 111) where `_id` equals either 5 or `ObjectId("507c35dd8fada716c89d0013")`:

```
db.bios.find(
{
 _id: { $in: [5, ObjectId("507c35dd8fada716c89d0013")] }
}
)
```

**Query for Ranges** Combine comparison operators to specify ranges. The following operation returns documents with `field` between `value1` and `value2`:

```
db.collection.find({ field: { $gt: value1, $lt: value2 } });
```

**Query a Field that Contains an Array** If a field contains an array and your query has multiple conditional operators, the field as a whole will match if either a single array element meets the conditions or a combination of array elements meet the conditions.

Given a collection `students` that contains the following documents:

```
{ "_id" : 1, "score" : [-1, 3] }
{ "_id" : 2, "score" : [1, 5] }
{ "_id" : 3, "score" : [5, 5] }
```

The following query:

```
db.students.find({ score: { $gt: 0, $lt: 2 } })
```

Matches the following documents:

```
{ "_id" : 1, "score" : [-1, 3] }
{ "_id" : 2, "score" : [1, 5] }
```

In the document with `_id` equal to 1, the `score: [ -1, 3 ]` meets the conditions because the element `-1` meets the `$lt: 2` condition and the element `3` meets the `$gt: 0` condition.

In the document with `_id` equal to 2, the `score: [ 1, 5 ]` meets the conditions because the element `1` meets both the `$lt: 2` condition and the `$gt: 0` condition.

## Query Arrays

**Query for an Array Element** The following operation returns documents in the *bios collection* (page 111) where the array field `contribs` contains the element "UNIX":

```
db.bios.find({ contribs: "UNIX" })
```

**Query an Array of Documents** The following operation returns documents in the *bios collection* (page 111) where awards array contains a subdocument element that contains the award field equal to "Turing Award" and the year field greater than 1980:

```
db.bios.find(
{
 awards: {
 $elemMatch: {
 award: "Turing Award",
 year: { $gt: 1980 }
 }
 }
})
```

## Query Subdocuments

**Query Exact Matches on Subdocuments** The following operation returns documents in the *bios collection* (page 111) where the subdocument name is *exactly* { first: "Yukihiro", last: "Matsumoto" }, including the order:

```
db.bios.find(
{
 name: {
 first: "Yukihiro",
 last: "Matsumoto"
 }
})
```

The name field must match the sub-document exactly. The query does **not** match documents with the following name fields:

```
{
 first: "Yukihiro",
 aka: "Matz",
 last: "Matsumoto"
}

{
 last: "Matsumoto",
 first: "Yukihiro"
}
```

**Query Fields of a Subdocument** The following operation returns documents in the *bios collection* (page 111) where the subdocument name contains a field `first` with the value "Yukihiro" and a field `last` with the value "Matsumoto". The query uses *dot notation* to access fields in a subdocument:

```
db.bios.find(
{
 "name.first": "Yukihiro",
 "name.last": "Matsumoto"
})
```

The query matches the document where the `name` field contains a subdocument with the field `first` with the value `"Yukihiro"` and a field `last` with the value `"Matsumoto"`. For instance, the query would match documents with `name` fields that held either of the following values:

```
{
 first: "Yukihiro",
 aka: "Matz",
 last: "Matsumoto"
}

{
 last: "Matsumoto",
 first: "Yukihiro"
}
```

**Projections** The `projection` parameter specifies which fields to return. The parameter contains either `include` or `exclude` specifications, not both, unless the `exclude` is for the `_id` field.

**Specify the Fields to Return** The following operation returns all the documents from the `products` collection where `qty` is greater than 25 and returns only the `_id`, `item` and `qty` fields:

```
db.products.find({ qty: { $gt: 25 } }, { item: 1, qty: 1 })
```

The operation returns the following:

```
{ "_id" : 11, "item" : "pencil", "qty" : 50 }
{ "_id" : ObjectId("50634d86be4617f17bb159cd"), "item" : "bottle", "qty" : 30 }
{ "_id" : ObjectId("50634dbcbe4617f17bb159d0"), "item" : "paper", "qty" : 100 }
```

The following operation finds all documents in the `bios collection` (page 111) and returns only the `name` field, `contribs` field and `_id` field:

```
db.bios.find({ }, { name: 1, contribs: 1 })
```

**Explicitly Excluded Fields** The following operation queries the `bios collection` (page 111) and returns all fields *except* the the `first` field in the `name` subdocument and the `birth` field:

```
db.bios.find(
 { contribs: 'OOP' },
 { 'name.first': 0, birth: 0 }
)
```

**Explicitly Exclude the `_id` Field** The following operation excludes the `_id` and `qty` fields from the result set:

```
db.products.find({ qty: { $gt: 25 } }, { _id: 0, qty: 0 })
```

The documents in the result set contain all fields *except* the `_id` and `qty` fields:

```
{ "item" : "pencil", "type" : "no.2" }
{ "item" : "bottle", "type" : "blue" }
{ "item" : "paper" }
```

The following operation finds documents in the `bios collection` (page 111) and returns only the `name` field and the `contribs` field:

```
db.bios.find(
 { },
 { name: 1, contribs: 1, _id: 0 }
)
```

**On Arrays and Subdocuments** The following operation queries the [bios collection](#) (page 111) and returns the `last` field in the `name` subdocument and the first two elements in the `contribs` array:

```
db.bios.find(
 { },
 {
 _id: 0,
 'name.last': 1,
 contribs: { $slice: 2 }
 }
)
```

**Iterate the Returned Cursor** The [find\(\)](#) (page 816) method returns a [cursor](#) to the results. In the [mongo](#) (page 942) shell, if the returned cursor is not assigned to a variable using the `var` keyword, the cursor is automatically iterated up to 20 times to access up to the first 20 documents that match the query. You can use the `DBQuery.shellBatchSize` to change the number of iterations. See [Flags](#) (page 859) and [Cursor Behaviors](#) (page 43). To iterate manually, assign the returned cursor to a variable using the `var` keyword.

**With Variable Name** The following example uses the variable `myCursor` to iterate over the cursor and print the matching documents:

```
var myCursor = db.bios.find();
myCursor
```

**With `next()` Method** The following example uses the cursor method [next\(\)](#) (page 870) to access the documents:

```
var myCursor = db.bios.find();
var myDocument = myCursor.hasNext() ? myCursor.next() : null;
if (myDocument) {
 var myName = myDocument.name;
 print (tojson(myName));
}
```

To print, you can also use the `printjson()` method instead of `print(tojson())`:

```
if (myDocument) {
 var myName = myDocument.name;
 printjson(myName);
}
```

**With `forEach()` Method** The following example uses the cursor method [forEach\(\)](#) (page 866) to iterate the cursor and access the documents:

```
var myCursor = db.bios.find();
myCursor.forEach(printjson);
```

**Modify the Cursor Behavior** The [mongo](#) (page 942) shell and the [drivers](#) (page 95) provide several cursor methods that call on the *cursor* returned by the [find\(\)](#) (page 816) method to modify its behavior.

**Order Documents in the Result Set** The [sort\(\)](#) (page 872) method orders the documents in the result set. The following operation returns documents in the *bios collection* (page 111) sorted in ascending order by the *name* field:

```
db.bios.find().sort({ name: 1 })
```

[sort\(\)](#) (page 872) corresponds to the `ORDER BY` statement in SQL.

**Limit the Number of Documents to Return** The [limit\(\)](#) (page 867) method limits the number of documents in the result set. The following operation returns at most 5 documents in the *bios collection* (page 111):

```
db.bios.find().limit(5)
```

[limit\(\)](#) (page 867) corresponds to the `LIMIT` statement in SQL.

**Set the Starting Point of the Result Set** The [skip\(\)](#) (page 871) method controls the starting point of the results set. The following operation skips the first 5 documents in the *bios collection* (page 111) and returns all remaining documents:

```
db.bios.find().skip(5)
```

**Combine Cursor Methods** The following example chains cursor methods:

```
db.bios.find().sort({ name: 1 }).limit(5)
db.bios.find().limit(5).sort({ name: 1 })
```

Regardless of the order you chain the [limit\(\)](#) (page 867) and the [sort\(\)](#) (page 872), the request to the server has the structure that treats the query and the [sort\(\)](#) (page 872) modifier as a single object. Therefore, the [limit\(\)](#) (page 867) operation method is always applied after the [sort\(\)](#) (page 872) regardless of the specified order of the operations in the chain. See the [meta query operators](#) (page 687).

## db.collection.findAndModify()

### Definition

`db.collection.findAndModify( <document> )`

Atomically modifies and returns a single document. By default, the returned document does not include the modifications made on the update. To return the document with the modifications made on the update, use the `new` option. The [findAndModify\(\)](#) (page 821) method is a shell helper around the [findAndModify](#) (page 710) command.

The [findAndModify\(\)](#) (page 821) method has the following form:

```
db.collection.findAndModify({
 query: <document>,
 sort: <document>,
 remove: <boolean>,
```

```
 update: <document>,
 new: <boolean>,
 fields: <document>,
 upsert: <boolean>
 });
```

The `db.collection.findAndModify()` (page 821) method takes a document parameter with the following subdocument fields:

**param document query** The selection criteria for the modification. The `query` field employs the same *query selectors* (page 621) as used in the `db.collection.find()` (page 816) method. Although the query may match multiple documents, `findAndModify()` (page 821) will select only one document to modify.

**param document sort** Determines which document the operation modifies if the query selects multiple documents. `findAndModify()` (page 821) modifies the first document in the sort order specified by this argument.

**param Boolean remove** Must specify either the `remove` or the `update` field in the `findAndModify()` (page 821) method. Removes the document specified in the `update` field. Set this to `true` to remove the selected document. The default is `false`.

**param document update** Must specify either the `remove` or the `update` field in the `findAndModify()` (page 821) method. Performs an update of the selected document. The `update` field employs the same *update operators* (page 651) or `field: value` specifications to modify the selected document.

**param Boolean new** When `true`, returns the modified document rather than the original. The `findAndModify()` (page 821) method ignores the `new` option for `remove` operations. The default is `false`.

**param document fields** A subset of fields to return. The `fields` document specifies an inclusion of a field with `1`, as in: `fields: { <field1>: 1, <field2>: 1, ... }`. See *projection* (page 72).

**param Boolean upsert** Used in conjunction with the `update` field. When `true`, `findAndModify()` (page 821) creates a new document if the `query` returns no documents. The default is `false`.

**Return Data** The `findAndModify()` (page 821) method returns either: the pre-modification document or, if `new: true` is set, the modified document.

---

**Note:**

- If the query finds no document for `update` or `remove` operations, `findAndModify()` (page 821) returns `null`.
- If the query finds no document for an `upsert`, operation, `findAndModify()` (page 821) performs an insert. If `new` is `false`, **and** the `sort` option is **NOT** specified, the method returns `null`.

Changed in version 2.2: Previously returned an empty document `{ }`. See *the 2.2 release notes* (page 1053) for more information.

- If the query finds no document for an `upsert`, `findAndModify()` (page 821) performs an insert. If `new` is `false`, **and** a `sort` option, the method returns an empty document `{ }`.
- 

## Behaviors

**Upsert and Unique Index** When `findAndModify()` (page 821) includes the `upsert: true` option **and** the query field(s) is not uniquely indexed, the method could insert a document multiple times in certain circumstances. For instance, if multiple clients each invoke the method with the same `query` condition and these methods complete the `find` phase before any of methods perform the `modify` phase, these methods could insert the same document.

In the following example, no document with the name `Andy` exists, and multiple clients issue the following command:

```
db.people.findAndModify({
 query: { name: "Andy" },
 sort: { rating: 1 },
 update: { $inc: { score: 1 } },
 upsert: true
})
```

Then, if these clients' `findAndModify()` (page 821) methods finish the `query` phase before any command starts the `modify` phase, **and** there is no unique index on the `name` field, the commands may all perform an upsert. To prevent this condition, create a *unique index* (page 334) on the `name` field. With the unique index in place, the multiple methods would observe one of the following behaviors:

- Exactly one `findAndModify()` (page 821) would successfully insert a new document.
- Zero or more `findAndModify()` (page 821) methods would update the newly inserted document.
- Zero or more `findAndModify()` (page 821) methods would fail when they attempted to insert a duplicate. If the method fails due to a unique index constraint violation, you can retry the method. Absent a delete of the document, the retry should not fail.

**Sharded Collections** When using `findAndModify` (page 710) in a *sharded* environment, the query **must** contain the `shard key` for all operations against the shard cluster for the *sharded* collections.

`findAndModify` (page 710) operations issued against `mongos` (page 938) instances for *non-sharded* collections function normally.

## Examples

**Update** The following method updates an existing document in the `people` collection where the document matches the query criteria:

```
db.people.findAndModify({
 query: { name: "Tom", state: "active", rating: { $gt: 10 } },
 sort: { rating: 1 },
 update: { $inc: { score: 1 } }
})
```

This method performs the following actions:

1. The `query` finds a document in the `people` collection where the `name` field has the value `Tom`, the `state` field has the value `active` and the `rating` field has a value `greater than` (page 622) 10.
2. The `sort` orders the results of the query in ascending order. If multiple documents meet the `query` condition, the method will select for modification the first document as ordered by this `sort`.
3. The update `increments` (page 651) the value of the `score` field by 1.
4. The method returns the original (i.e. pre-modification) document selected for this update:

```
{
 "_id" : ObjectId("50f1e2c99beb36a0f45c6453"),
 "name" : "Tom",
```

```
 "state" : "active",
 "rating" : 100,
 "score" : 5
 }
```

To return the modified document, add the `new:true` option to the method.

If no document matched the `query` condition, the method returns `null`:

```
null
```

**Update and Insert** The following method includes the `upsert: true` option to insert a new document if no document matches the `query` condition:

```
db.people.findAndModify({
 query: { name: "Gus", state: "active", rating: 100 },
 sort: { rating: 1 },
 update: { $inc: { score: 1 } },
 upsert: true
})
```

If the method does **not** find a matching document, the method performs an upsert. Because the method included the `sort` option, it returns an empty document `{ }` as the original (pre-modification) document:

```
{ }
```

If the method did **not** include a `sort` option, the method returns `null`.

```
null
```

**Update, Insert and Return New Document** The following method includes both the `upsert: true` option and the `new:true` option to return the newly inserted document if a document matching the `query` is not found:

```
db.people.findAndModify({
 query: { name: "Pascal", state: "active", rating: 25 },
 sort: { rating: 1 },
 update: { $inc: { score: 1 } },
 upsert: true,
 new: true
})
```

The method returns the newly inserted document:

```
{
 "_id" : ObjectId("50f49ad6444c11ac2448a5d6"),
 "name" : "Pascal",
 "rating" : 25,
 "score" : 1,
 "state" : "active"
}
```

**db.collection.findOne()**

## Definition

```
db.collection.findOne(<criteria>, <projection>)
```

Returns one document that satisfies the specified query criteria. If multiple documents satisfy the query, this method returns the first document according to the *natural order* which reflects the order of documents on the disk. In *capped collections*, natural order is the same as insertion order.

**param document criteria** Specifies query selection criteria using *query operators* (page 621).

**param document projection** Specifies the fields to return using *projection operators* (page 646).

To return all fields in the matching document, omit this parameter.

### Returns

One document that satisfies the criteria specified as the first argument to this method. If you specify the projection argument, `findOne()` (page 824) returns a document that only contains the projection fields, and the `_id` field if you do not explicitly exclude the `_id` field.

Although similar to the `find()` (page 816) method, the `findOne()` (page 824) method returns a document rather than a cursor.

The projection parameter takes a document of the following form:

```
{ field1: <boolean>, field2: <boolean> ... }
```

The `<boolean>` can take the following include or exclude values:

- 1 or `true` to include. The `findOne()` (page 824) method always includes the `_id` field even if the field is not explicitly stated to return in the `projection` parameter.
- 0 or `false` to exclude.

The projection argument cannot contain both include and exclude specifications except for the exclusion of the `_id` field.

### Examples

**With Empty Query Specification** The following operation returns a single document from the *bios collection* (page 111):

```
db.bios.findOne()
```

**With a Query Specification** The following operation returns the first matching document from the *bios collection* (page 111) where either the field `first` in the subdocument `name` starts with the letter G **or** where the field `birth` is less than `new Date('01/01/1945')`:

```
db.bios.findOne(
{
 $or: [
 { 'name.first' : /^G/ },
 { birth: { $lt: new Date('01/01/1945') } }
]
})
```

**With a Projection** The projection parameter specifies which fields to return. The parameter contains either include or exclude specifications, not both, unless the exclude is for the `_id` field.

**Specify the Fields to Return** The following operation finds a document in the [bios collection](#) (page 111) and returns only the name, contribs and \_id fields:

```
db.bios.findOne(
 { },
 { name: 1, contribs: 1 }
)
```

**Return All but the Excluded Fields** The following operation returns a document in the [bios collection](#) (page 111) where the contribs field contains the element OOP and returns all fields *except* the \_id field, the first field in the name subdocument, and the birth field:

```
db.bios.findOne(
 { contribs: 'OOP' },
 { _id: 0, 'name.first': 0, birth: 0 }
)
```

**Access the findOne Result** You cannot apply the cursor methods to the result of the [findOne\(\)](#) (page 824) method. However, you can access the document directly, as in the example:

```
var myDocument = db.bios.findOne();

if (myDocument) {
 var myName = myDocument.name;

 print (tojson(myName));
}
```

#### **db.collection.getIndexes()**

**db.collection.getIndexes()**

Returns an array that holds a list of documents that identify and describe the existing indexes on the collection. You must call the [db.collection.getIndexes\(\)](#) (page 826) on a collection. For example:

```
db.collection.getIndexes()
```

Change collection to the name of the collection whose indexes you want to learn.

The [db.collection.getIndexes\(\)](#) (page 826) items consist of the following fields:

##### **system.indexes.v**

Holds the version of the index.

The index version depends on the version of [mongod](#) (page 925) that created the index. Before version 2.0 of MongoDB, the this value was 0; versions 2.0 and later use version 1.

##### **system.indexes.key**

Contains a document holding the keys held in the index, and the order of the index. Indexes may be either descending or ascending order. A value of negative one (e.g. -1) indicates an index sorted in descending order while a positive value (e.g. 1) indicates an index sorted in an ascending order.

##### **system.indexes.ns**

The namespace context for the index.

##### **system.indexes.name**

A unique name for the index comprised of the field names and orders of all keys.

```
db.collection.getShardDistribution()
db.collection.getShardDistribution()
```

#### Returns

Prints the data distribution statistics for a *sharded* collection. You must call the [getShardDistribution \(\)](#) (page 827) method on a sharded collection, as in the following example:

```
db.myShardedCollection.getShardDistribution()
```

In the following example, the collection has two shards. The output displays both the individual shard distribution information as well the total shard distribution:

```
Shard <shard-a> at <host-a>
data : <size-a> docs : <count-a> chunks : <number of chunks-a>
estimated data per chunk : <size-a>/<number of chunks-a>
estimated docs per chunk : <count-a>/<number of chunks-a>
```

```
Shard <shard-b> at <host-b>
data : <size-b> docs : <count-b> chunks : <number of chunks-b>
estimated data per chunk : <size-b>/<number of chunks-b>
estimated docs per chunk : <count-b>/<number of chunks-b>
```

#### Totals

```
data : <stats.size> docs : <stats.count> chunks : <calc total chunks>
Shard <shard-a> contains <estDataPercent-a>% data, <estDocPercent-a>% docs in cluster, avg obj
Shard <shard-b> contains <estDataPercent-b>% data, <estDocPercent-b>% docs in cluster, avg obj
```

The output information displays:

- <shard-x> is a string that holds the shard name.
- <host-x> is a string that holds the host name(s).
- <size-x> is a number that includes the size of the data, including the unit of measure (e.g. b, Mb).
- <count-x> is a number that reports the number of documents in the shard.
- <number of chunks-x> is a number that reports the number of chunks in the shard.
- <size-x>/<number of chunks-x> is a calculated value that reflects the estimated data size per chunk for the shard, including the unit of measure (e.g. b, Mb).
- <count-x>/<number of chunks-x> is a calculated value that reflects the estimated number of documents per chunk for the shard.
- <stats.size> is a value that reports the total size of the data in the sharded collection, including the unit of measure.
- <stats.count> is a value that reports the total number of documents in the sharded collection.

•<calc total chunks> is a calculated number that reports the number of chunks from all shards, for example:

```
<calc total chunks> = <number of chunks-a> + <number of chunks-b>
```

•<estDataPercent-x> is a calculated value that reflects, for each shard, the data size as the percentage of the collection's total data size, for example:

```
<estDataPercent-x> = <size-x>/<stats.size>
```

- `<estDocPercent-x>` is a calculated value that reflects, for each shard, the number of documents as the percentage of the total number of documents for the collection, for example:

```
<estDocPercent-x> = <count-x>/<stats.count>
```

- `stats.shards[ <shard-x> ].avgObjSize` is a number that reflects the average object size, including the unit of measure, for the shard.

For example, the following is a sample output for the distribution of a sharded collection:

```
Shard shard-a at shard-a/MyMachine.local:30000,MyMachine.local:30001,MyMachine.local:30002
data : 38.14Mb docs : 1000003 chunks : 2
estimated data per chunk : 19.07Mb
estimated docs per chunk : 500001

Shard shard-b at shard-b/MyMachine.local:30100,MyMachine.local:30101,MyMachine.local:30102
data : 38.14Mb docs : 999999 chunks : 3
estimated data per chunk : 12.71Mb
estimated docs per chunk : 333333

Totals
data : 76.29Mb docs : 2000002 chunks : 5
Shard shard-a contains 50% data, 50% docs in cluster, avg obj size on shard : 40b
Shard shard-b contains 49.99% data, 49.99% docs in cluster, avg obj size on shard : 40b
```

#### See also:

[Sharding](#) (page 493)

### **db.collection.getShardVersion()**

#### `db.collection.getShardVersion()`

This method returns information regarding the state of data in a *sharded cluster* that is useful when diagnosing underlying issues with a sharded cluster.

For internal and diagnostic use only.

### **db.collection.group()**

#### Definition

#### `db.collection.group({ key, reduce, initial, [keyf,] [cond,] finalize })`

Groups documents in a collection by the specified keys and performs simple aggregation functions such as computing counts and sums. The method is analogous to a `SELECT <...> GROUP BY` statement in SQL. The [group\(\)](#) (page 828) method returns an array.

The [db.collection.group\(\)](#) (page 828) accepts a single *document* that contains the following:

**field document key** The field or fields to group. Returns a “key object” for use as the grouping key.

**field function reduce** An aggregation function that operates on the documents during the grouping operation. These functions may return a sum or a count. The function takes two arguments: the current document and an aggregation result document for that group

**field document initial** Initializes the aggregation result document.

**field function keyf** Alternative to the `key` field. Specifies a function that creates a “key object” for use as the grouping key. Use `keyf` instead of `key` to group by calculated fields rather than existing document fields.

**field document cond** The selection criteria to determine which documents in the collection to process. If you omit the `cond` field, `db.collection.group()` (page 828) processes all the documents in the collection for the group operation.

**field function finalize** A function that runs each item in the result set before `db.collection.group()` (page 828) returns the final value. This function can either modify the result document or replace the result document as a whole. Keep in mind that, unlike the `$keyf` and `$reduce` fields that also specify a function, this field name is `finalize`, *not* `$finalize`.

The `db.collection.group()` (page 828) method is a shell wrapper for the `group` (page 697) command. However, the `db.collection.group()` (page 828) method takes the `keyf` field and the `reduce` field whereas the `group` (page 697) command takes the `$keyf` field and the `$reduce` field.

**Warning:**

- The `db.collection.group()` (page 828) method does not work with *sharded clusters*. Use the *aggregation framework* or *map-reduce* in sharded environments.
- The result set must fit within the *maximum BSON document size* (page 1015).
- In version 2.2, the returned array can contain at most 20,000 elements; i.e. at most 20,000 unique groupings. For group by operations that results in more than 20,000 unique groupings, use `mapReduce` (page 701). Previous versions had a limit of 10,000 elements.
- Prior to 2.4, the `db.collection.group()` (page 828) method took the `mongod` (page 925) instance's JavaScript lock, which blocked all other JavaScript execution.

**Note:** Changed in version 2.4.

In MongoDB 2.4, `map-reduce` operations (page 701), the `group` (page 697) command, and `$where` (page 634) operator expressions **cannot** access certain global functions or properties, such as `db`, that are available in the `mongo` (page 942) shell.

When upgrading to MongoDB 2.4, you will need to refactor your code if your `map-reduce` operations (page 701), `group` (page 697) commands, or `$where` (page 634) operator expressions include any global shell functions or properties that are no longer available, such as `db`.

The following JavaScript functions and properties **are available** to `map-reduce` operations (page 701), the `group` (page 697) command, and `$where` (page 634) operator expressions in MongoDB 2.4:

| Available Properties     | Available Functions                                                                                                                                              |                                                                                                                                                                                                               |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| args<br>MaxKey<br>MinKey | assert()<br>BinData()<br>DBPointer()<br>DBRef()<br>doassert()<br>emit()<br>gc()<br>HexData()<br>hex_md5()<br>isNumber()<br>isObject()<br>ISODate()<br>isString() | Map()<br>MD5()<br>NumberInt()<br>NumberLong()<br>ObjectId()<br>print()<br>printjson()<br>printjsononeline()<br>sleep()<br>Timestamp()<br>toJson()<br>tojsononeline()<br>toJsonObject()<br>UUID()<br>version() |

**Examples** The following examples assume an `orders` collection with documents of the following prototype:

```
{
 _id: ObjectId("5085a95c8fada716c89d0021"),
 ord_dt: ISODate("2012-07-01T04:00:00Z"),
 ship_dt: ISODate("2012-07-02T04:00:00Z"),
 item: { sku: "abc123",
 price: 1.99,
 uom: "pcs",
 qty: 25 }
}
```

**Group by Two Fields** The following example groups by the `ord_dt` and `item.sku` fields those documents that have `ord_dt` greater than 01/01/2011:

```
db.orders.group({
 key: { ord_dt: 1, 'item.sku': 1 },
 cond: { ord_dt: { $gt: new Date('01/01/2012') } },
 reduce: function (curr, result) { },
 initial: { }
})
```

The result is an array of documents that contain the group by fields:

```
[{ "ord_dt" : ISODate("2012-07-01T04:00:00Z"), "item.sku" : "abc123" },
 { "ord_dt" : ISODate("2012-07-01T04:00:00Z"), "item.sku" : "abc456" },
 { "ord_dt" : ISODate("2012-07-01T04:00:00Z"), "item.sku" : "bcd123" },
 { "ord_dt" : ISODate("2012-07-01T04:00:00Z"), "item.sku" : "efg456" },
 { "ord_dt" : ISODate("2012-06-01T04:00:00Z"), "item.sku" : "abc123" },
 { "ord_dt" : ISODate("2012-06-01T04:00:00Z"), "item.sku" : "efg456" },
 { "ord_dt" : ISODate("2012-06-01T04:00:00Z"), "item.sku" : "ijk123" },
 { "ord_dt" : ISODate("2012-05-01T04:00:00Z"), "item.sku" : "abc123" },
 { "ord_dt" : ISODate("2012-05-01T04:00:00Z"), "item.sku" : "abc456" },
```

```
{ "ord_dt" : ISODate("2012-06-08T04:00:00Z"), "item.sku" : "abc123" },
{ "ord_dt" : ISODate("2012-06-08T04:00:00Z"), "item.sku" : "abc456" }]
```

The method call is analogous to the SQL statement:

```
SELECT ord_dt, item_sku
FROM orders
WHERE ord_dt > '01/01/2012'
GROUP BY ord_dt, item_sku
```

**Calculate the Sum** The following example groups by the `ord_dt` and `item.sku` fields, those documents that have `ord_dt` greater than 01/01/2011 and calculates the sum of the `qty` field for each grouping:

```
db.orders.group({
 key: { ord_dt: 1, 'item.sku': 1 },
 cond: { ord_dt: { $gt: new Date('01/01/2012') } },
 reduce: function (curr, result) {
 result.total += curr.item.qty;
 },
 initial: { total : 0 }
})
```

The result is an array of documents that contain the group by fields and the calculated aggregation field:

```
[{ "ord_dt" : ISODate("2012-07-01T04:00:00Z"), "item.sku" : "abc123", "total" : 25 },
{ "ord_dt" : ISODate("2012-07-01T04:00:00Z"), "item.sku" : "abc456", "total" : 25 },
{ "ord_dt" : ISODate("2012-07-01T04:00:00Z"), "item.sku" : "bcd123", "total" : 10 },
{ "ord_dt" : ISODate("2012-07-01T04:00:00Z"), "item.sku" : "efg456", "total" : 10 },
{ "ord_dt" : ISODate("2012-06-01T04:00:00Z"), "item.sku" : "abc123", "total" : 25 },
{ "ord_dt" : ISODate("2012-06-01T04:00:00Z"), "item.sku" : "efg456", "total" : 15 },
{ "ord_dt" : ISODate("2012-06-01T04:00:00Z"), "item.sku" : "ijk123", "total" : 20 },
{ "ord_dt" : ISODate("2012-05-01T04:00:00Z"), "item.sku" : "abc123", "total" : 45 },
{ "ord_dt" : ISODate("2012-05-01T04:00:00Z"), "item.sku" : "abc456", "total" : 25 },
{ "ord_dt" : ISODate("2012-06-08T04:00:00Z"), "item.sku" : "abc123", "total" : 25 },
{ "ord_dt" : ISODate("2012-06-08T04:00:00Z"), "item.sku" : "abc456", "total" : 25 }]
```

The method call is analogous to the SQL statement:

```
SELECT ord_dt, item_sku, SUM(item_qty) as total
FROM orders
WHERE ord_dt > '01/01/2012'
GROUP BY ord_dt, item_sku
```

**Calculate Sum, Count, and Average** The following example groups by the calculated `day_of_week` field, those documents that have `ord_dt` greater than 01/01/2011 and calculates the sum, count, and average of the `qty` field for each grouping:

```
db.orders.group({
 keyf: function(doc) {
 return { day_of_week: doc.ord_dt.getDay() } ;
 },
 cond: { ord_dt: { $gt: new Date('01/01/2012') } },
 reduce: function (curr, result) {
 result.total += curr.item.qty;
 result.count++;
 },
 initial: { total : 0, count: 0 },
 finalize: function(result) {
```

```
 var weekdays = ["Sunday", "Monday", "Tuesday",
 "Wednesday", "Thursday",
 "Friday", "Saturday"];

 result.day_of_week = weekdays[result.day_of_week];
 result.avg = Math.round(result.total / result.count);

 }
}
```

The result is an array of documents that contain the group by fields and the calculated aggregation field:

```
[{ "day_of_week" : "Sunday", "total" : 70, "count" : 4, "avg" : 18 },
 { "day_of_week" : "Friday", "total" : 110, "count" : 6, "avg" : 18 },
 { "day_of_week" : "Tuesday", "total" : 70, "count" : 3, "avg" : 23 }]
```

#### See also:

[Aggregation Concepts](#) (page 279)

## db.collection.insert()

### Definition

`db.collection.insert(document)`

Inserts a document or an array of documents into a collection.

Changed in version 2.2: The `insert()` (page 832) method can accept an array of documents to perform a bulk insert of the documents into the collection.

**param document|array document** A document or array of documents to insert into the collection.

The `insert()` (page 832) method has the following behaviors:

- If the collection does not exist, then the `insert()` (page 832) method will create the collection.
- If the document does not specify an `_id` field, then MongoDB will add the `_id` field and assign a unique [`ObjectId`](#) (page 103) for the document before inserting. Most drivers create an `ObjectId` and insert the `_id` field, but the `mongod` (page 925) will create and populate the `_id` if the driver or application does not.
- If the document specifies a new field, then the `insert()` (page 832) method inserts the document with the new field. This requires no changes to the data model for the collection or the existing documents.

**Examples** The following examples show how to use the `insert()` (page 832) method to insert a document or an array of documents into either the `products` collection or the `bios` collection. If the collections do not exist, the `insert()` (page 832) method creates the collections.<sup>11</sup>

**Insert a Document without Specifying an `_id` Field** In the following examples, the document passed to the `insert()` (page 832) method does not contain the `_id` field. During the insert, `mongod` (page 925) will create the `_id` field and assign it a unique [`ObjectId`](#) (page 103) value.

The `ObjectId` values are specific to the machine and time when the operation is run. As such, your values may differ from those in the example.

---

<sup>11</sup> You can also view a list of the existing collections in the database using the `show collections` operation in the `mongo` (page 942) shell.

**products Collection** The following example inserts a document into the `products` collection:

```
db.products.insert({ item: "card", qty: 15 })
```

The inserted document includes an `_id` field with the generated `ObjectId` value:

```
{ "_id" : ObjectId("5063114bd386d8fadbd6b004"), "item" : "card", "qty" : 15 }
```

**bios Collection** The following example inserts a document into the *The bios Example Collection* (page 111):

```
db.bios.insert(
{
 name: { first: 'John', last: 'McCarthy' },
 birth: new Date('Sep 04, 1927'),
 death: new Date('Dec 24, 2011'),
 contribs: ['Lisp', 'Artificial Intelligence', 'ALGOL'],
 awards: [
 {
 award: 'Turing Award',
 year: 1971,
 by: 'ACM'
 },
 {
 award: 'Kyoto Prize',
 year: 1988,
 by: 'Inamori Foundation'
 },
 {
 award: 'National Medal of Science',
 year: 1990,
 by: 'National Science Foundation'
 }
]
})
```

To verify the inserted document, query the `bios` collection:

```
db.bios.find({ name: { first: 'John', last: 'McCarthy' } })
```

The returned document includes an `_id` field with the generated `ObjectId` value:

```
{
 "_id" : ObjectId("50a1880488d113a4ae94a94a"),
 "name" : { "first" : "John", "last" : "McCarthy" },
 "birth" : ISODate("1927-09-04T04:00:00Z"),
 "death" : ISODate("2011-12-24T05:00:00Z"),
 "contribs" : ["Lisp", "Artificial Intelligence", "ALGOL"],
 "awards" : [
 {
 "award" : "Turing Award",
 "year" : 1971,
 "by" : "ACM"
 },
 {
 "award" : "Kyoto Prize",
 "year" : 1988,
 "by" : "Inamori Foundation"
 },
]
},
```

```
 {
 "award" : "National Medal of Science",
 "year" : 1990,
 "by" : "National Science Foundation"
 }
]
}
```

---

**Note:** Most MongoDB driver clients will include the `_id` field and generate an `ObjectId` before sending the insert operation to MongoDB; however, if the client sends a document without an `_id` field, the `mongod` (page 925) will add the `_id` field and generate the `ObjectId`.

---

**Insert a Document Specifying an `_id` Field** In the following examples, the documents passed to the `insert()` (page 832) method includes the `_id` field. The value of `_id` must be unique within the collection to avoid duplicate key error.

**products Collection** This example inserts into the `products` collection a document that includes an `_id` field. The `_id` value of 10 must be a unique value for the `_id` field in the `products` collection. If the value were not unique, the insert would fail:

```
db.products.insert({ _id: 10, item: "box", qty: 20 })
```

The insert operation creates the following document in the `products` collection:

```
{ "_id" : 10, "item" : "box", "qty" : 20 }
```

**bios Collection** This example inserts into the `bios` collection a document that includes an `_id` field. The `_id` value of 1 must be a unique value for the `_id` field in the `bios` collection. Otherwise, if the value were not unique, the insert would fail:

```
db.bios.insert(
{
 _id: 1,
 name: { first: 'John', last: 'Backus' },
 birth: new Date('Dec 03, 1924'),
 death: new Date('Mar 17, 2007'),
 contribs: ['Fortran', 'ALGOL', 'Backus-Naur Form', 'FP'],
 awards: [
 {
 award: 'W.W. McDowell Award',
 year: 1967,
 by: 'IEEE Computer Society'
 },
 {
 award: 'National Medal of Science',
 year: 1975,
 by: 'National Science Foundation'
 },
 {
 award: 'Turing Award',
 year: 1977,
 by: 'ACM'
 },
 {

```

```

 award: 'Draper Prize',
 year: 1993,
 by: 'National Academy of Engineering'
 }
]
}
)
```

To confirm the insert, [query](#) (page 39) the bios collection:

```
db.bios.find({ _id: 1 })
```

The insert operation created the following document in the bios collection:

```
{
 "_id" : 1,
 "name" : { "first" : "John", "last" : "Backus" },
 "birth" : ISODate("1924-12-03T05:00:00Z"),
 "death" : ISODate("2007-03-17T04:00:00Z"),
 "contribs" : ["Fortran", "ALGOL", "Backus-Naur Form", "FP"],
 "awards" : [
 {
 "award" : "W.W. McDowell Award",
 "year" : 1967,
 "by" : "IEEE Computer Society"
 },
 {
 "award" : "National Medal of Science",
 "year" : 1975,
 "by" : "National Science Foundation"
 },
 {
 "award" : "Turing Award",
 "year" : 1977,
 "by" : "ACM"
 },
 {
 "award" : "Draper Prize",
 "year" : 1993,
 "by" : "National Academy of Engineering"
 }
]
}
```

**Insert Multiple Documents** The following examples perform a bulk insert of multiple documents by passing an array of documents to the [insert\(\)](#) (page 832) method.

**products Collection** This example inserts three documents into the products collection. The documents in the array do not need to have the same fields. For instance, the first document in the array has an `_id` field and a `type` field. Because the second and third documents do not contain an `_id` field, mongod (page 925) will create the `_id` field for the second and third documents during the insert:

```
db.products.insert([{ _id: 11, item: "pencil", qty: 50, type: "no.2" },
 { item: "pen", qty: 20 },
 { item: "eraser", qty: 25 }
])
```

The operation inserted the following three documents:

```
{ "_id" : 11, "item" : "pencil", "qty" : 50, "type" : "no.2" }
{ "_id" : ObjectId("51e0373c6f35bd826f47e9a0"), "item" : "pen", "qty" : 20 }
{ "_id" : ObjectId("51e0373c6f35bd826f47e9a1"), "item" : "eraser", "qty" : 25 }.
```

**bios Collection** This example inserts three documents in the `bios` collection. The documents in the array do not need to have the same fields. The document with `_id: 3` contains a field named `title` that does not appear in the other documents. MongoDB does not require the other documents to contain this field:

```
db.bios.insert(
 [
 {
 _id: 3,
 name: { first: 'Grace', last: 'Hopper' },
 title: 'Rear Admiral',
 birth: new Date('Dec 09, 1906'),
 death: new Date('Jan 01, 1992'),
 contribs: ['UNIVAC', 'compiler', 'FLOW-MATIC', 'COBOL'],
 awards: [
 {
 award: 'Computer Sciences Man of the Year',
 year: 1969,
 by: 'Data Processing Management Association'
 },
 {
 award: 'Distinguished Fellow',
 year: 1973,
 by: ' British Computer Society'
 },
 {
 award: 'W. W. McDowell Award',
 year: 1976,
 by: 'IEEE Computer Society'
 },
 {
 award: 'National Medal of Technology',
 year: 1991,
 by: 'United States'
 }
]
 },
 {
 _id: 4,
 name: { first: 'Kristen', last: 'Nygaard' },
 birth: new Date('Aug 27, 1926'),
 death: new Date('Aug 10, 2002'),
 contribs: ['OOP', 'Simula'],
 awards: [
 {
 award: 'Rosing Prize',
 year: 1999,
 by: 'Norwegian Data Association'
 },
 {
 award: 'Turing Award',
 year: 2001,
 by: 'ACM'
 },
]
 }
]
)
```

```

 {
 award: 'IEEE John von Neumann Medal',
 year: 2001,
 by: 'IEEE'
 }
]
},
{
 _id: 5,
 name: { first: 'Ole-Johan', last: 'Dahl' },
 birth: new Date('Oct 12, 1931'),
 death: new Date('Jun 29, 2002'),
 contribs: ['OOP', 'Simula'],
 awards: [
 {
 award: 'Rosing Prize',
 year: 1999,
 by: 'Norwegian Data Association'
 },
 {
 award: 'Turing Award',
 year: 2001,
 by: 'ACM'
 },
 {
 award: 'IEEE John von Neumann Medal',
 year: 2001,
 by: 'IEEE'
 }
]
}
]
)

```

**db.collection.isCapped()**`db.collection.isCapped()`

**Returns** Returns `true` if the collection is a *capped collection*, otherwise returns `false`.

**See also:**

*Capped Collections* (page 156)

**db.collection.mapReduce()**

`db.collection.mapReduce (map, reduce, {<out>, <query>, <sort>, <limit>, <finalize>, <scope>, <jsMode>, <verbose>})`

The `db.collection.mapReduce()` (page 837) method provides a wrapper around the `mapReduce` (page 701) command.

```

db.collection.mapReduce(
 <map>,
 <reduce>,
 {
 out: <collection>,
 query: <document>,
 sort: <document>,
 limit: <number>,

```

```
 finalize: <function>,
 scope: <document>,
 jsMode: <boolean>,
 verbose: <boolean>
 }
)
```

`db.collection.mapReduce()` (page 837) takes the following parameters:

**field Javascript function map** A JavaScript function that associates or “maps” a value with a key and emits the key and value pair. See [Requirements for the map Function](#) (page 839) for more information.

**field JavaScript function reduce** A JavaScript function that “reduces” to a single object all the values associated with a particular key. See [Requirements for the reduce Function](#) (page 840) for more information.

**field document argument document** Arguments document that specifies any additional parameters to `db.collection.mapReduce()` (page 837).

The following table describes additional arguments that `db.collection.mapReduce()` (page 837) can accept.

**field string out** Specifies the location of the result of the map-reduce operation. You can output to a collection, output to a collection with an action, or output inline. You may output to a collection when performing map reduce operations on the primary members of the set; on `secondary` members you may only use the `inline` output. See [out Options](#) (page 840) for more information.

**field document query** Specifies the selection criteria using [query operators](#) (page 621) for determining the documents input to the map function.

**field document sort** Sorts the `input` documents. This option is useful for optimization. For example, specify the sort key to be the same as the emit key so that there are fewer reduce operations. The sort key must be in an existing index for this collection.

**field number limit** Specifies a maximum number of documents to return from the collection.

**field Javascript function finalize** Follows the `reduce` method and modifies the output. See [Requirements for the finalize Function](#) (page 841) for more information.

**field document scope** Specifies global variables that are accessible in the map, reduce and finalize functions.

**field Boolean jsMode** Optional. Specifies whether to convert intermediate data into BSON format between the execution of the map and reduce functions. Defaults to false. If `false`: - Internally, MongoDB converts the JavaScript objects emitted by the map function to BSON objects. These BSON objects are then converted back to JavaScript objects when calling the reduce function. - The map-reduce operation places the intermediate BSON objects in temporary, on-disk storage. This allows the map-reduce operation to execute over arbitrarily large data sets. If `true`: - Internally, the JavaScript objects emitted during map function remain as JavaScript objects. There is no need to convert the objects for the reduce function, which can result in faster execution. - You can only use `jsMode` for result sets with fewer than 500,000 distinct key arguments to the mapper’s `emit()` function. The `jsMode` defaults to false.

**field Boolean verbose** Specifies whether to include the `timing` information in the result information. The `verbose` defaults to `true` to include the `timing` information.

---

**Note:** Changed in version 2.4.

In MongoDB 2.4, `map-reduce` operations (page 701), the `group` (page 697) command, and `$where`

(page 634) operator expressions **cannot** access certain global functions or properties, such as `db`, that are available in the `mongo` (page 942) shell.

When upgrading to MongoDB 2.4, you will need to refactor your code if your `map-reduce operations` (page 701), `group` (page 697) commands, or `$where` (page 634) operator expressions include any global shell functions or properties that are no longer available, such as `db`.

The following JavaScript functions and properties **are available** to `map-reduce operations` (page 701), the `group` (page 697) command, and `$where` (page 634) operator expressions in MongoDB 2.4:

| Available Properties                                            | Available Functions                                                                                                                                                                                                                                                                                                                       |
|-----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>args</code><br><code>MaxKey</code><br><code>MinKey</code> | <code>assert()</code><br><code>BinData()</code><br><code>DBPointer()</code><br><code>DBRef()</code><br><code>doassert()</code><br><code>emit()</code><br><code>gc()</code><br><code>HexData()</code><br><code>hex_md5()</code><br><code>isNumber()</code><br><code>isObject()</code><br><code>ISODate()</code><br><code>isString()</code> |

**Requirements for the `map` Function** The `map` function has the following prototype:

```
function() {
 ...
 emit(key, value);
}
```

The `map` function exhibits the following behaviors:

- In the `map` function, reference the current document as `this` within the function.
- The `map` function should *not* access the database for any reason.
- The `map` function should be pure, or have *no* impact outside of the function (i.e. side effects.)
- The `emit(key, value)` function associates the `key` with a `value`.
  - A single `emit` can only hold half of MongoDB's `maximum BSON document size` (page 1015).
  - The `map` function can call `emit(key, value)` any number of times, including 0, per each input document.

The following `map` function may call `emit(key, value)` either 0 or 1 times depending on the value of the input document's `status` field:

```
function() {
 if (this.status == 'A')
```

```
 emit(this.cust_id, 1);
 }
```

The following map function may call `emit(key, value)` multiple times depending on the number of elements in the input document's `items` field:

```
function() {
 this.items.forEach(function(item) { emit(item.sku, 1); });
}
```

- The `map` function can access the variables defined in the `scope` parameter.

### Requirements for the `reduce` Function

The `reduce` function has the following prototype:

```
function(key, values) {
 ...
 return result;
}
```

The `reduce` function exhibits the following behaviors:

- The `reduce` function should *not* access the database, even to perform read operations.
- The `reduce` function should *not* affect the outside system.
- MongoDB will **not** call the `reduce` function for a key that has only a single value. The `values` argument is an array whose elements are the `value` objects that are “mapped” to the key.
- MongoDB can invoke the `reduce` function more than once for the same key. In this case, the previous output from the `reduce` function for that key will become one of the input values to the next `reduce` function invocation for that key.
- The `reduce` function can access the variables defined in the `scope` parameter.

Because it is possible to invoke the `reduce` function more than once for the same key, the following properties need to be true:

- the *type* of the return object must be **identical** to the type of the `value` emitted by the `map` function to ensure that the following operations is true:

```
reduce(key, [C, reduce(key, [A, B])]) == reduce(key, [C, A, B])
```

- the `reduce` function must be *idempotent*. Ensure that the following statement is true:

```
reduce(key, [reduce(key, valuesArray)]) == reduce(key, valuesArray)
```

- the order of the elements in the `valuesArray` should not affect the output of the `reduce` function, so that the following statement is true:

```
reduce(key, [A, B]) == reduce(key, [B, A])
```

### `out` Options

You can specify the following options for the `out` parameter:

#### Output to a Collection

```
out: <collectionName>
```

**Output to a Collection with an Action** This option is only available when passing `out` a collection that already exists. This option is not available on secondary members of replica sets.

```
out: { <action>: <collectionName>
 [, db: <dbName>]
 [, sharded: <boolean>]
 [, nonAtomic: <boolean>] }
```

When you output to a collection with an action, the `out` has the following parameters:

- `<action>`: Specify one of the following actions:

- `replace`

Replace the contents of the `<collectionName>` if the collection with the `<collectionName>` exists.

- `merge`

Merge the new result with the existing result if the output collection already exists. If an existing document has the same key as the new result, *overwrite* that existing document.

- `reduce`

Merge the new result with the existing result if the output collection already exists. If an existing document has the same key as the new result, apply the `reduce` function to both the new and the existing documents and overwrite the existing document with the result.

- `db`:

Optional. The name of the database that you want the map-reduce operation to write its output. By default this will be the same database as the input collection.

- `sharded`:

Optional. If `true` and you have enabled sharding on output database, the map-reduce operation will shard the output collection using the `_id` field as the shard key.

- `nonAtomic`:

New in version 2.2.

Optional. Specify output operation as non-atomic and is valid *only* for `merge` and `reduce` output modes which may take minutes to execute.

If `nonAtomic` is `true`, the post-processing step will prevent MongoDB from locking the database; however, other clients will be able to read intermediate states of the output collection. Otherwise the map reduce operation must lock the database during post-processing.

**Output Inline** Perform the map-reduce operation in memory and return the result. This option is the only available option for `out` on secondary members of replica sets.

```
out: { inline: 1 }
```

The result must fit within the [maximum size of a BSON document](#) (page 1015).

**Requirements for the `finalize` Function** The `finalize` function has the following prototype:

```
function(key, reducedValue) {
 ...
 return modifiedObject;
}
```

The `finalize` function receives as its arguments a `key` value and the `reducedValue` from the `reduce` function. Be aware that:

- The `finalize` function should *not* access the database for any reason.
- The `finalize` function should be pure, or have *no* impact outside of the function (i.e. side effects.)
- The `finalize` function can access the variables defined in the `scope` parameter.

**Map-Reduce Examples** Consider the following map-reduce operations on a collection `orders` that contains documents of the following prototype:

```
{
 _id: ObjectId("50a8240b927d5d8b5891743c"),
 cust_id: "abc123",
 ord_date: new Date("Oct 04, 2012"),
 status: 'A',
 price: 25,
 items: [{ sku: "mmm", qty: 5, price: 2.5 },
 { sku: "nnn", qty: 5, price: 2.5 }]
}
```

**Return the Total Price Per Customer** Perform the map-reduce operation on the `orders` collection to group by the `cust_id`, and calculate the sum of the `price` for each `cust_id`:

1. Define the map function to process each input document:

- In the function, `this` refers to the document that the map-reduce operation is processing.
- The function maps the `price` to the `cust_id` for each document and emits the `cust_id` and `price` pair.

```
var mapFunction1 = function() {
 emit(this.cust_id, this.price);
};
```

2. Define the corresponding reduce function with two arguments `keyCustId` and `valuesPrices`:

- The `valuesPrices` is an array whose elements are the `price` values emitted by the map function and grouped by `keyCustId`.
- The function reduces the `valuesPrice` array to the sum of its elements.

```
var reduceFunction1 = function(keyCustId, valuesPrices) {
 return Array.sum(valuesPrices);
};
```

3. Perform the map-reduce on all documents in the `orders` collection using the `mapFunction1` map function and the `reduceFunction1` reduce function.

```
db.orders.mapReduce(
 mapFunction1,
 reduceFunction1,
 { out: "map_reduce_example" })
```

This operation outputs the results to a collection named `map_reduce_example`. If the `map_reduce_example` collection already exists, the operation will replace the contents with the results of this map-reduce operation:

**Calculate Order and Total Quantity with Average Quantity Per Item** In this example, you will perform a map-reduce operation on the `orders` collection for all documents that have an `ord_date` value greater than 01/01/2012. The operation groups by the `item.sku` field, and calculates the number of orders and the total quantity ordered for each `sku`. The operation concludes by calculating the average quantity per order for each `sku` value:

1. Define the map function to process each input document:

- In the function, `this` refers to the document that the map-reduce operation is processing.
- For each item, the function associates the `sku` with a new object value that contains the `count` of 1 and the item `qty` for the order and emits the `sku` and `value` pair.

```
var mapFunction2 = function() {
 for (var idx = 0; idx < this.items.length; idx++) {
 var key = this.items[idx].sku;
 var value = {
 count: 1,
 qty: this.items[idx].qty
 };
 emit(key, value);
 }
};
```

2. Define the corresponding reduce function with two arguments `keySKU` and `countObjVals`:

- `countObjVals` is an array whose elements are the objects mapped to the grouped `keySKU` values passed by map function to the reducer function.
- The function reduces the `countObjVals` array to a single object `reducedValue` that contains the `count` and the `qty` fields.
- In `reducedVal`, the `count` field contains the sum of the `count` fields from the individual array elements, and the `qty` field contains the sum of the `qty` fields from the individual array elements.

```
var reduceFunction2 = function(keySKU, countObjVals) {
 reducedVal = { count: 0, qty: 0 };

 for (var idx = 0; idx < countObjVals.length; idx++) {
 reducedVal.count += countObjVals[idx].count;
 reducedVal.qty += countObjVals[idx].qty;
 }

 return reducedVal;
};
```

3. Define a finalize function with two arguments `key` and `reducedVal`. The function modifies the `reducedVal` object to add a computed field named `avg` and returns the modified object:

```
var finalizeFunction2 = function (key, reducedVal) {

 reducedVal.avg = reducedVal.qty/reducedVal.count;

 return reducedVal;
};
```

4. Perform the map-reduce operation on the `orders` collection using the `mapFunction2`, `reduceFunction2`, and `finalizeFunction2` functions.

```
db.orders.mapReduce(mapFunction2,
 reduceFunction2,
 {
 out: { merge: "map_reduce_example" },
 query: { ord_date:
 { $gt: new Date('01/01/2012') }
 },
 finalize: finalizeFunction2
 }
)
```

This operation uses the `query` field to select only those documents with `ord_date` greater than `new Date('01/01/2012')`. Then it output the results to a collection `map_reduce_example`. If the `map_reduce_example` collection already exists, the operation will merge the existing contents with the results of this map-reduce operation.

For more information and examples, see the [Map-Reduce](#) (page 282) page and [Perform Incremental Map-Reduce](#) (page 300).

**See also:**

- [Troubleshoot the Map Function](#) (page 302)
- [Troubleshoot the Reduce Function](#) (page 303)
- [mapReduce](#) (page 701) command
- [Aggregation Concepts](#) (page 279)

**db.collection.reIndex()**

`db.collection.reIndex()`

This method drops all indexes and recreates them. This operation may be expensive for collections that have a large amount of data and/or a large number of indexes.

Call this method, which takes no arguments, on a collection object. For example:

```
db.collection.reIndex()
```

Change `collection` to the name of the collection that you want to rebuild the index.

---

**See**

[Index Creation](#) (page 335) for more information on the behavior of indexing operations in MongoDB.

---

**db.collection.remove()**

**Definition**

`db.collection.remove(query, justOne)`

Removes documents from a collection.

The `remove()` (page 844) method has the following parameters:

**param document query** Specifies deletion criteria using [query operators](#) (page 621). To delete all documents in a collection, omit this parameter or pass an empty document (`{}`).

**param boolean justOne** To limit the deletion to just one document, set to `true`. The default value is `false`.

---

**Note:** You cannot use the `remove()` (page 844) method with a *capped collection*.

---

**Examples** The following are examples of the `remove()` (page 844) method.

**Remove All Documents from a Collection** To remove all documents in a collection, call the `remove()` (page 844) method with no parameters: The following operation deletes all documents from the *bios collection* (page 111):

```
db.bios.remove()
```

---

**Note:** This operation is not equivalent to the `drop()` (page 812) method.

To remove all documents from a collection, it may be more efficient to use the `drop()` (page 812) method to drop the entire collection, including the indexes, and then recreate the collection and rebuild the indexes.

---

**Remove All Documents that Match a Condition** To remove the documents that match a deletion criteria, call the `remove()` (page 844) method with the `<query>` parameter:

The following operation deletes all documents from the *bios collection* (page 111) where the subdocument name contains a field `first` whose value starts with G:

```
db.bios.remove({ 'name.first' : /^G/ })
```

The following operation removes all the documents from the collection `products` where `qty` is greater than 20:

```
db.products.remove({ qty: { $gt: 20 } })
```

**Remove a Single Document that Matches a Condition** To remove the first document that match a deletion criteria, call the `remove()` (page 844) method with the `query` criteria and the `justOne` parameter set to `true` or 1.

The following operation deletes a single document from the *bios collection* (page 111) where the `turing` field equals true:

```
db.bios.remove({ turing: true }, 1)
```

The following operation removes the first document from the collection `products` where `qty` is greater than 20:

```
db.products.remove({ qty: { $gt: 20 } }, true)
```

**Capped Collection** You cannot use the `remove()` (page 844) method with a *capped collection*.

**Isolation** If the `<query>` argument to the `remove()` (page 844) method matches multiple documents in the collection, the delete operation may interleave with other write operations to that collection. For an unsharded collection, you have the option to override this behavior with the `$isolated` (page 663) isolation operator, effectively isolating the delete operation and blocking other write operations during the delete. To isolate the query, include `$isolated: 1` in the `<query>` parameter as in the following examples:

```
db.bios.remove({ turing: true, $isolated: 1 })
```

```
db.products.remove({ qty: { $gt: 20 }, $isolated: 1 })
```

## db.collection.renameCollection()

### Definition

`db.collection.renameCollection(target, string)`

Renames a collection. Provides a wrapper for the [renameCollection](#) (page 744) *database command*.

**param string target** The new name of the collection. Enclose the string in quotes.

**param boolean dropTarget** If `true`, `mongod` (page 925) drops the `target` of [renameCollection](#) (page 744) prior to renaming the collection.

**Example** Call the `db.collection.renameCollection()` (page 846) method on a collection object. For example:

```
db.rrecord.renameCollection("record")
```

This operation will rename the `rrecord` collection to `record`. If the target name (i.e. `record`) is the name of an existing collection, then the operation will fail.

**Limitations** The method has the following limitations:

- `db.collection.renameCollection()` (page 846) cannot move a collection between databases. Use [renameCollection](#) (page 744) for these rename operations.
- `db.collection.renameCollection()` (page 846) cannot operation on sharded collections.

The `db.collection.renameCollection()` (page 846) method operates within a collection by changing the metadata associated with a given collection.

Refer to the documentation [renameCollection](#) (page 744) for additional warnings and messages.

**Warning:** The `db.collection.renameCollection()` (page 846) method and [renameCollection](#) (page 744) command will invalidate open cursors which interrupts queries that are currently returning data.

## db.collection.save()

### Definition

`db.collection.save(document)`

Updates an existing document or inserts a new document, depending on its `document` parameter.

The `save()` (page 846) method takes the following parameter:

**param document document** A document to save to the collection.

If the document does **not** contain an `_id` field, then the `save()` (page 846) method performs an insert. During the operation, `mongod` (page 925) will add to the document the `_id` field and assign it a unique `ObjectId` (page 103).

If the document contains an `_id` field, then the `save()` (page 846) method performs an upsert, querying the collection on the `_id` field. If a document does not exist with the specified `_id` value, the `save()` (page 846) method performs an insert. If a document exists with the specified `_id` value, the `save()` (page 846) method performs an update that replaces **all** fields in the existing document with the fields from the document.

**Examples** The following are examples of the `save()` (page 846) method. The following examples show how to use the `save()` (page 846) method to insert or update a document into either the `products` collection or the `bios` collection.

**Save a New Document without Specifying an `_id` Field** In the following examples, the parameter to the `save()` (page 846) method is a document without an `_id` field. This means the `save()` (page 846) method performs an insert. During the insert, `mongod` (page 925) will create the `_id` field with a unique `ObjectId` (page 103) value.

The `ObjectId` values are specific to the machine and time when the operation is run. As such, your values may differ from those in the example.

**products Collection** This example inserts into the `products` collection a document with the `item` field set to `book` and `qty` field set to `40`:

```
db.products.save({ item: "book", qty: 40 })
```

The inserted document includes an `_id` field with the generated `ObjectId` value:

```
{ "_id" : ObjectId("50691737d386d8fadbd6b01d"), "item" : "book", "qty" : 40 }
```

**bios Collection** This example inserts a new document into the *The bios Example Collection* (page 111):

```
db.bios.save(
{
 name: { first: 'Guido', last: 'van Rossum' },
 birth: new Date('Jan 31, 1956'),
 contribs: ['Python'],
 awards: [
 {
 award: 'Award for the Advancement of Free Software',
 year: 2001,
 by: 'Free Software Foundation'
 },
 {
 award: 'NLUUG Award',
 year: 2003,
 by: 'NLUUG'
 }
]
})
```

The inserted document includes an `_id` field with the generated `ObjectId` value.

---

**Note:** Most MongoDB driver clients will include the `_id` field and generate an `ObjectId` before sending the insert operation to MongoDB; however, if the client sends a document without an `_id` field, the `mongod` (page 925) will add the `_id` field and generate the `ObjectId`.

**Save a New Document Specifying an `_id` Field** The following examples pass the `save()` (page 846) method a document *with* an `_id` field. Because the `_id` field holds a value that *does not* exist in the collection, the operations insert new documents. The results of these operations are identical to an *update operation with the upsert flag* (page 50) set to `true` or `1`.

**products Collection** This example creates a new document with the `_id` field set to `100`, the `item` field set to `water`, and the `qty` field set to `30`:

```
db.products.save({ _id: 100, item: "water", qty: 30 })
```

The operation results in the following new document in the `products` collection:

```
{ "_id" : 100, "item" : "water", "qty" : 30 }
```

**bios Collection** This example creates a new document in the *The bios Example Collection* (page 111). The `save()` (page 846) method inserts the document because the `bios` collection has **no** document with the `_id` field equal to 10:

```
db.bios.save(
{
 _id: 10,
 name: { first: 'Yukihiro', aka: 'Matz', last: 'Matsumoto' },
 birth: new Date('Apr 14, 1965'),
 contribs: ['Ruby'],
 awards: [
 {
 award: 'Award for the Advancement of Free Software',
 year: '2011',
 by: 'Free Software Foundation'
 }
]
})
```

**Replace an Existing Document** The following example passes the `save()` (page 846) method a document *with* an `_id` field. Because the `_id` field holds a value that *does* exist in the collection, the operation performs an update to replace the existing document.

**products Collection** This example replaces the fields and values of the following document that currently exists in the `products` collection:

```
{ "_id" : 100, "item" : "water", "qty" : 30 }
```

To replace the document's data, pass the `save()` (page 846) method a document that contains the `_id` field set to 100 and the new fields and values:

```
db.products.save({ _id : 100, item : "juice" })
```

The operation replaces the existing document with the following:

```
{ "_id" : 100, "item" : "juice" }
```

## **db.collection.stats()**

### **Definition**

```
db.collection.stats(scale)
```

Returns statistics about the collection. The method includes the following parameter:

**param number scale** The scale used in the output to display the sizes of items. By default, output displays sizes in bytes. To display kilobytes rather than bytes, specify a `scale` value of 1024.

**Returns** A *document* containing statistics that reflect the state of the specified collection.

The `stats()` (page 848) method provides a wrapper around the database command `collStats` (page 763).

**Example** The following operation returns stats on the people collection:

```
db.people.stats()
```

**See also:**

[collStats](#) (page 763) for an overview of the output of this command.

**db.collection.storageSize()**  
**db.collection.storageSize()**

**Returns** The total amount of storage allocated to this collection for document storage. Provides a wrapper around the [storageSize](#) (page 764) field of the [collStats](#) (page 763) (i.e. [db.collection.stats\(\)](#) (page 848)) output.

**db.collection.totalSize()**  
**db.collection.totalSize()**

**Returns** The total size of the data in the collection plus the size of every indexes on the collection.

**db.collection.totalIndexSize()**  
**db.collection.totalIndexSize()**

**Returns** The total size of all indexes for the collection. This method provides a wrapper around the [totalIndexSize](#) (page 765) output of the [collStats](#) (page 763) (i.e. [db.collection.stats\(\)](#) (page 848)) operation.

**db.collection.update()**

**Definition**

**db.collection.update(query, update, options)**

Modifies an existing document or documents in a collection. By default, the [update\(\)](#) (page 849) method updates a **single** document. If the `multi` option is set to `true`, the method updates all documents that match the query criteria.

Changed in version 2.2: The [update\(\)](#) (page 849) method has the following form:

```
db.collection.update(
 <query>,
 <update>,
 {
 upsert: <Boolean>,
 multi: <Boolean>,
 }
)
```

Prior to version 2.2, the [update\(\)](#) (page 849) method has the following form:

```
db.collection.update(<query>, <update>, <upsert>, <multi>)
```

The [update\(\)](#) (page 849) method takes the following parameters:

**param document query** The selection criteria for the update. Use the same [query selectors](#) (page 621) as used in the [find\(\)](#) (page 816) method.

**param document update** The modifications to apply. For details see [Update Parameter](#) (page 850) after this table.

**param document,Boolean upsert** If set to `true`, creates a new document when no document matches the query criteria. The default value is `false`, which does *not* insert a new document when no match is found. The syntax for this parameter depends on the MongoDB version. See [Upset Parameter](#) (page 850).

**param document,Boolean multi** If set to `true`, updates multiple documents that meet the query criteria. If set to `false`, updates one document. The default value is `false`. For additional information, see [Multi Parameter](#) (page 850).

The [update \(\)](#) (page 849) method either updates specific fields in the existing document or replaces the document. The method updates specific fields if the `<update>` parameter contains only [update operator](#) (page 651) expressions, such as a `$set` (page 655) operator expression. Otherwise the method replaces the existing document.

To update fields in subdocuments, use [dot notation](#).

The [update \(\)](#) (page 849) method can modify the name of a field using the `$rename` (page 652) operator.

**Update Parameter** If the `<update>` document contains [update operator](#) (page 651) expressions, such those using the `$set` (page 655) operator, then:

- The `<update>` document must contain *only* [update operator](#) (page 651) expressions.
- The [update \(\)](#) (page 849) method updates only the corresponding fields in the document. For an example, see [Update Specific Fields](#) (page 851).

If the `<update>` document contains *only* `field:value` expressions, then:

- The [update \(\)](#) (page 849) method *replaces* the matching document with the `<update>` document. The [update \(\)](#) (page 849) method *does not* replace the `_id` value. For an example, see [Replace All Fields](#) (page 852).
- [update \(\)](#) (page 849) *cannot* update multiple documents.

**Upset Parameter** In MongoDB versions 2.2 and later, the `upsert` parameter has the following form:

```
upsert : true|false
```

Prior to version 2.2, the `upsert` parameter is a positional Boolean. To enable, specify `true` as the third parameter to [update \(\)](#) (page 849).

If `upsert` is set to `true` and if no document matches the query criteria, [update \(\)](#) (page 849) inserts a *single* document. The `upsert` creates the new document with either:

- The fields and values of the `<update>` parameter, or
- The fields and values of the both the `<query>` and `<update>` parameters. The `upsert` creates a document with data from both `<query>` and `<update>` if the `<update>` parameter contains *only* [update operator](#) (page 651) expressions.

For examples, see [Insert a New Document if No Match Exists \(Upset\)](#) (page 852).

**Multi Parameter** In MongoDB versions 2.2 and later, the `multi` parameter has the following form:

```
multi : true|false
```

Prior to version 2.2, the `multi` parameter is a positional Boolean. To enable the multiple updates, specify `true` as the fourth parameter to [update \(\)](#) (page 849).

If `multi` is set to `true`, the `update()` (page 849) method updates all documents that meet the `<query>` criteria. The `multi` update operation may interleave with other write operations. For unsharded collections, you can override this behavior with the `$isolated` (page 663) isolation operator, which isolates the update operation and blocks other write operations during the update.

For an example, see [Update Multiple Documents](#) (page 854).

**Examples** The following examples use the **MongoDB version 2.2 interface** to specify options in the document form.

**Update Specific Fields** To update specific fields in a document, use [update operators](#) (page 651) in the `<update>` parameter. For example, given a `books` collection with the following document:

```
{ "_id" : 11, "item" : "Divine Comedy", "stock" : 2 }
```

The following operation uses the `$set` (page 655) and `$inc` (page 651) operators to add a `price` field and to increment `stock` by 5.

```
db.books.update({ item: "Divine Comedy" },
 {
 $set: { price: 18 },
 $inc: { stock: 5 }
 })
```

The updated document is now the following:

```
{ "_id" : 11, "item" : "Divine Comedy", "price" : 18, "stock" : 7 }
```

**Update Specific Fields in Subdocuments** Use [dot notation](#) to update values in subdocuments. The following example, which uses the `bios` collection (page 111), queries for the document with `_id` equal to 1 and updates the value of the field `middle` in the subdocument name:

```
db.bios.update({ _id: 1 }, { $set: { "name.middle": "Warner" } })
```

**Add New Fields** If the `<update>` parameter contains fields not currently in the document, the `update()` (page 849) method adds the new fields to the document. The following operation adds two new fields: `mbranch` and `aka`. The operation adds `aka` in the subdocument name:

```
db.bios.update(
 { _id: 3 },
 { $set: {
 mbranch: "Navy",
 "name.aka": "Amazing Grace"
 }
}
```

**Remove Fields** The following operation uses the `$unset` (page 655) operator to remove the `birth` field from the document that has `_id` equal to 3:

```
db.bios.update({ _id: 3 }, { $unset: { birth: 1 } })
```

**Replace All Fields** Given the following document in the `books` collection:

```
{
 "_id" : 22,
 "item" : "The Banquet",
 "author" : "Dante",
 "price" : 20,
 "stock" : 4
}
```

The following operation passes an `<update>` document that contains only field and value pairs, which means the document replaces all the fields in the original document. The operation *does not* replace the `_id` value. The operation contains the same value for the `item` field in both the `<query>` and `<update>` documents, which means the field does not change:

```
db.books.update({ item: "The Banquet" },
 { item: "The Banquet", price: 19 , stock: 3 }
)
```

The operation creates the following new document. The operation removed the `author` field and changed the values of the `price` and `stock` fields:

```
{
 "_id" : 22,
 "item" : "The Banquet",
 "price" : 19,
 "stock" : 3
}
```

In the next example, which uses the [bios collection](#) (page 111), the operation changes all values for the document *including the value used to locate the document*. The operation locates a document by querying for `name` set to `{ first: "John", last: "McCarthy" }` and then issues a replacement document that includes the `name` field set to `{ first: "Ken", last: "Iverson" }`.

```
db.bios.update(
 { name: { first: "John", last: "McCarthy" } },
 {
 name: { first: "Ken", last: "Iverson" },
 birth: new Date("Dec 17, 1941"),
 died: new Date("Oct 19, 2004"),
 contribs: ["APL", "J"],
 awards: [
 { award: "Turing Award",
 year: 1979,
 by: "ACM" },
 { award: "Harry H. Goode Memorial Award",
 year: 1975,
 by: "IEEE Computer Society" },
 { award: "IBM Fellow",
 year: 1970,
 by: "IBM" }
]
 }
)
```

**Insert a New Document if No Match Exists (Upsert)** The following command sets the `upsert` option to `true`<sup>12</sup> so that `update()` (page 849) creates a new document in the `books` collection if no document matches the `<query>` parameter:

```
db.books.update({ item: "The New Life" },
 { item: "The New Life",
 author: "Dante",
 price: 15 },
 { upsert: true }
)
```

If no document matches the `<query>` parameter, the `upsert` inserts a document with the fields and values of the `<update>` parameter and a new unique `ObjectId` for the `_id` field:

```
{
 "_id" : ObjectId("51e5990c95098ed69d4a89f2"),
 "author" : "Dante",
 "item" : "The New Life",
 "price" : 15
}
```

In the next example, the `<update>` parameter includes only *update operators* (page 651). If no document matches the `<query>` parameter, the `upsert` inserts a document with the fields and values of the both the `<query>` and `<update>` parameters:

```
db.bios.update(
 {
 _id: 7,
 name: { first: "Ken", last: "Thompson" }
 },
 {
 $set: {
 birth: new Date("Feb 04, 1943"),
 contribs: ["UNIX", "C", "B", "UTF-8"],
 awards: [
 {
 award: "Turing Award",
 year: 1983,
 by: "ACM"
 },
 {
 award: "IEEE Richard W. Hamming Medal",
 year: 1990,
 by: "IEEE"
 },
 {
 award: "National Medal of Technology",
 year: 1998,
 by: "United States"
 },
 {
 award: "Tsutomu Kanai Award",
 year: 1999,
 by: "IEEE"
 },
 {
 award: "Japan Prize",
 }
]
 }
 }
)
```

<sup>12</sup> Prior to version 2.2, in the `mongo` (page 942) shell, you would specify the `upsert` and the `multi` options in the `update()` (page 849) method as positional boolean options. See `update()` (page 849) for details.

```
 year: 2011,
 by: "The Japan Prize Foundation"
 }
]
}
},
{ upsert: true
)
```

**Update Multiple Documents** To update multiple documents, set the `multi` option to `true`<sup>13</sup>. The following example queries the `bios` collection (page 111) for all documents where `awards.award` is set to Turing. The update sets the `turing` field to `true`:

```
db.bios.update(
 { "awards.award": "Turing" },
 { $set: { turing: true } },
 { multi: true }
)
```

**Combine the Upsert and Multi Parameters** Given a `books` collection that includes the following documents:

```
{
 "_id" : 11,
 "author" : "Dante",
 "item" : "Divine Comedy",
 "price" : 18 }
{
 "_id" : 22,
 "author" : "Dante",
 "item" : "The Banquet",
 "price" : 19 }
{
 "_id" : 33,
 "author" : "Dante",
 "item" : "Monarchia",
 "price" : 14
}
```

The following command uses the `multi` parameter to update all documents where `author` is "Dante" and uses the `upsert` parameter to create a new document if no such documents are found<sup>14</sup>:

```
db.books.update({ author: "Dante" },
 { $set: { born: "Florence", died: "Ravenna" } },
 { upsert: true, multi: true }
)
```

The operation results in the following:

```
{
 "_id" : 11,
 "author" : "Dante",
 "born" : "Florence",
```

<sup>13</sup> Prior to version 2.2, in the `mongo` (page 942) shell, you would specify the `upsert` and the `multi` options in the `update()` (page 849) method as positional boolean options. See `update()` (page 849) for details.

<sup>14</sup> Prior to version 2.2, in the `mongo` (page 942) shell, you would specify the `upsert` and the `multi` options in the `update()` (page 849) method as positional boolean options. See `update()` (page 849) for details.

```

 "died" : "Ravenna",
 "item" : "Divine Comedy",
 "price" : 18
}
{
 "_id" : 22,
 "author" : "Dante",
 "born" : "Florence",
 "died" : "Ravenna",
 "item" : "The Banquet",
 "price" : 19
}
{
 "_id" : 33,
 "author" : "Dante",
 "born" : "Florence",
 "died" : "Ravenna",
 "item" : "Monarchia",
 "price" : 14
}

```

## Update Arrays

**Update an Element by Position** If the update operation requires an update of an element in an array field, the `update()` (page 849) method can perform the update using the position of the element and *dot notation*. Arrays in MongoDB are zero-based.

The following operation queries the *bios collection* (page 111) for the first document with `_id` field equal to 1 and updates the second element in the `contribs` array:

```
db.bios.update(
 { _id: 1 },
 { $set: { "contribs.1": "ALGOL 58" } }
)
```

**Update an Element if Position is Unknown** If the position in the array is not known, the `update()` (page 849) method can perform the update using the `$` (page 656) positional operator. The array field must appear in the `<query>` parameter in order to determine which array element to update.

The following operation queries the *bios collection* (page 111) for the first document where the `_id` field equals 3 and the `contribs` array contains an element equal to `compiler`. If found, the `update()` (page 849) method updates the first matching element in the array to `A compiler` in the document:

```
db.bios.update(
 { _id: 3, "contribs": "compiler" },
 { $set: { "contribs.$": "A compiler" } }
)
```

**Update a Document Element** The `update()` (page 849) method can perform the update of an array that contains subdocuments by using the positional operator (i.e. `$` (page 656)) and the *dot notation*.

The following operation queries the *bios collection* (page 111) for the first document where the `_id` field equals 6 and the `awards` array contains a subdocument element with the `by` field equal to ACM. If found, the `update()` (page 849) method updates the `by` field in the first matching subdocument:

```
db.bios.update(
 { _id: 6, "awards.by": "ACM" } ,
 { $set: { "awards.$.by": "Association for Computing Machinery" } }
)
```

**Add an Element** The following operation queries the *bios collection* (page 111) for the first document that has an `_id` field equal to 1 and adds a new element to the `awards` field:

```
db.bios.update(
 { _id: 1 },
 {
 $push: { awards: { award: "IBM Fellow", year: 1963, by: "IBM" } }
 }
)
```

In the next example, the `$set` (page 655) operator uses *dot notation* (page 94) to access the `middle` field in the `name` subdocument. The `$push` (page 659) operator adds another document as element to the field `awards`.

Consider the following operation:

```
db.bios.update(
 { _id: 1 },
 {
 $set: { "name.middle": "Warner" },
 $push: { awards: {
 award: "IBM Fellow",
 year: "1963",
 by: "IBM"
 }
 }
)
```

This `update()` (page 849) operation:

- Modifies the field name whose value is another document. Specifically, the `$set` (page 655) operator updates the `middle` field in the `name` subdocument. The document uses *dot notation* (page 94) to access a field in a subdocument.
- Adds an element to the field `awards`, whose value is an array. Specifically, the `$push` (page 659) operator adds another document as element to the field `awards`.

## db.collection.validate()

### Description

`db.collection.validate(full)`

Validates a collection. The method scans a collection's data structures for correctness and returns a single *document* that describes the relationship between the logical collection and the physical representation of the data.

The `validate()` (page 856) method has the following parameter:

**param Boolean full** Specify `true` to enable a full validation and to return full statistics. MongoDB disables full validation by default because it is a potentially resource-intensive operation.

The `validate()` (page 856) method output provides an in-depth view of how the collection uses storage. Be aware that this command is potentially resource intensive and may impact the performance of your MongoDB instance.

The `validate()` (page 856) method is a wrapper around the `validate` (page 771) *database command*.

**See also:**

`validate` (page 771)

## Cursor

### Cursor Methods

| Name                                                | Description                                                                                                                                                                          |
|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>cursor.addOption()</code><br>(page 858)       | Adds special wire protocol flags that modify the behavior of the query. <sup>7</sup>                                                                                                 |
| <code>cursor batchSize()</code><br>(page 859)       | Controls the number of documents MongoDB will return to the client in a single network message.                                                                                      |
| <code>cursor.count()</code><br>(page 860)           | Returns a count of the documents in a cursor.                                                                                                                                        |
| <code>cursor.explain()</code><br>(page 861)         | Reports on the query execution plan, including index use, for a cursor.                                                                                                              |
| <code>cursor.forEach()</code><br>(page 866)         | Applies a JavaScript function for every document in a cursor.                                                                                                                        |
| <code>cursor.hasNext()</code><br>(page 866)         | Returns true if the cursor has documents and can be iterated.                                                                                                                        |
| <code>cursor.hint()</code><br>(page 866)            | Forces MongoDB to use a specific index for a query.                                                                                                                                  |
| <code>cursor.limit()</code><br>(page 867)           | Constrains the size of a cursor's result set.                                                                                                                                        |
| <code>cursor.map()</code><br>(page 867)             | Applies a function to each document in a cursor and collects the return values in an array.                                                                                          |
| <code>cursor.max()</code><br>(page 867)             | Specifies an exclusive upper index bound for a cursor. For use with <code>cursor.hint()</code> (page 866)                                                                            |
| <code>cursor.min()</code><br>(page 869)             | Specifies an inclusive lower index bound for a cursor. For use with <code>cursor.hint()</code> (page 866)                                                                            |
| <code>cursor.next()</code><br>(page 870)            | Returns the next document in a cursor.                                                                                                                                               |
| <code>cursor objsLeftInBatch()</code><br>(page 871) | Returns the number of documents left in the current cursor batch.                                                                                                                    |
| <code>cursor.readPref()</code><br>(page 871)        | Specifies a <i>read preference</i> to a cursor to control how the client directs queries to a <i>replica set</i> .                                                                   |
| <code>cursor.showDiskLoc()</code><br>(page 871)     | Returns a cursor with modified documents that include the on-disk location of the document.                                                                                          |
| <code>cursor.size()</code><br>(page 871)            | Returns a count of the documents in the cursor after applying <code>skip()</code> (page 871) and <code>limit()</code> (page 867) methods.                                            |
| <code>cursor.skip()</code><br>(page 871)            | Returns a cursor that begins returning results only after passing or skipping a number of documents.                                                                                 |
| <code>cursor.snapshot()</code><br>(page 872)        | Forces the cursor to use the index on the <code>_id</code> field. Ensures that the cursor returns each document, with regards to the value of the <code>_id</code> field, only once. |
| <code>cursor.sort()</code><br>(page 872)            | Returns results ordered according to a sort specification.                                                                                                                           |
| <code>cursor.toArray()</code><br>(page 874)         | Returns an array that contains all documents returned by the cursor.                                                                                                                 |

### `cursor.addOption()`

#### Definition

`cursor.addOption(flag)`

Adds OP\_QUERY wire protocol flags, such as the `tailable` flag, to change the behavior of queries.

The `cursor.addOption()` (page 858) method has the following parameter:

**param flag flag** OP\_QUERY wire protocol flag. See [MongoDB wire protocol](#)<sup>15</sup> for more information on MongoDB Wire Protocols and the OP\_QUERY flags. For the `mongo` (page 942) shell, you can use [cursor flags](#) (page 859). For the driver-specific list, see your [driver documentation](#) (page 95).

**Flags** The `mongo` (page 942) shell provides several additional cursor flags to modify the behavior of the cursor.

```
DBQuery.Option.tailable
DBQuery.Option.slaveOk
DBQuery.Option.oplogReplay
DBQuery.Option.noTimeout
DBQuery.Option.awaitData
DBQuery.Option.exhaust
DBQuery.Option.partial
```

For a description of the flags, see [MongoDB wire protocol](#)<sup>16</sup>.

**Example** The following example adds the `DBQuery.Option.tailable` flag and the `DBQuery.Option.awaitData` flag to ensure that the query returns a tailable cursor. The sequence creates a cursor that will wait for few seconds after returning the full result set so that it can capture and return additional data added during the query:

```
var t = db.myCappedCollection;
var cursor = t.find().addOption(DBQuery.Option.tailable).
 addOption(DBQuery.Option.awaitData)
```

**Warning:** Adding incorrect wire protocol flags can cause problems and/or extra server load.

## cursor.batchSize()

### Definition

`cursor.batchSize(size)`

Specifies the number of documents to return in each batch of the response from the MongoDB instance. In most cases, modifying the batch size will not affect the user or the application, as the `mongo` (page 942) shell and most [drivers](#) (page 95) return results as if MongoDB returned a single batch.

The `batchSize()` (page 859) method takes the following parameter:

**param integer size** The number of documents to return per batch. Do **not** use a batch size of 1.

---

**Note:** Specifying 1 or a negative number is analogous to using the `limit()` (page 867) method.

<sup>15</sup><http://docs.mongodb.org/meta-driver/latest/legacy/mongodb-wire-protocol/?pageVersion=106#op-query>

<sup>16</sup><http://docs.mongodb.org/meta-driver/latest/legacy/mongodb-wire-protocol/?pageVersion=106#op-query>

**Example** The following example sets the batch size for the results of a query (i.e. `find()` (page 816)) to 10. The `batchSize()` (page 859) method does not change the output in the `mongo` (page 942) shell, which, by default, iterates over the first 20 documents.

```
db.inventory.find().batchSize(10)
```

```
cursor.count()
```

### Definition

`cursor.count()`

Counts the number of documents referenced by a cursor. Append the `count()` (page 860) method to a `find()` (page 816) query to return the number of matching documents. The operation does not perform the query but instead counts the results that would be returned by the query.

The `count()` (page 860) method has the following prototype form:

```
db.collection.find().count()
```

The `count()` (page 860) method has the following parameter:

**param Boolean applySkipLimit** Specifies whether to consider the effects of the `cursor.skip()` (page 871) and `cursor.limit()` (page 867) methods in the count. By default, the `count()` (page 860) method ignores the effects of the `cursor.skip()` (page 871) and `cursor.limit()` (page 867). Set `applySkipLimit` to `true` to consider the effect of these methods.

### See also:

`cursor.size()` (page 871)

MongoDB also provides the shell wrapper `db.collection.count()` (page 809) for the `db.collection.find().count()` construct.

**Examples** The following are examples of the `count()` (page 860) method.

---

### Example

Count the number of all documents in the `orders` collection:

```
db.orders.find().count()
```

---

### Example

Count the number of the documents in the `orders` collection with the field `ord_dt` greater than `new Date('01/01/2012')`:

```
db.orders.find({ ord_dt: { $gt: new Date('01/01/2012') } }).count()
```

---

### Example

Count the number of the documents in the `orders` collection with the field `ord_dt` greater than `new Date('01/01/2012')` *taking into account* the effect of the `limit(5)`:

```
db.orders.find({ ord_dt: { $gt: new Date('01/01/2012') } }).limit(5).count(true)
```

---

## `cursor.explain()`

### Definition

`cursor.explain(verbose)`

Provides information on the query plan. The query plan is the plan the server uses to find the matches for a query. This information may be useful when optimizing a query. The `explain()` (page 861) method returns a document that describes the process used to return the query results.

The `explain()` (page 861) method has the following form:

```
db.collection.find().explain()
```

The `explain()` (page 861) method has the following parameter:

**param Boolean verbose** Specifies the level of detail to include in the output. If `true` or `1`, includes the `allPlans` and `oldPlan` fields in the output.

For an explanation of output, see *Explain on Queries on Sharded Collections* (page 863) and *Core Explain Output Fields* (page 863).

The `explain()` (page 861) method runs the actual query to determine the result. Although there are some differences between running the query with `explain()` (page 861) and running without, generally, the performance will be similar between the two. So, if the query is slow, the `explain()` (page 861) operation is also slow.

Additionally, the `explain()` (page 861) operation reevaluates a set of candidate query plans, which may cause the `explain()` (page 861) operation to perform differently than a normal query. As a result, these operations generally provide an accurate account of *how* MongoDB would perform the query, but do not reflect the length of these queries.

To determine the performance of a particular index, you can use `hint()` (page 866) and in conjunction with `explain()` (page 861), as in the following example:

```
db.products.find().hint({ type: 1 }).explain()
```

When you run `explain()` (page 861) with `hint()` (page 866), the query optimizer does not reevaluate the query plans.

---

**Note:** In some situations, the `explain()` (page 861) operation may differ from the actual query plan used by MongoDB in a normal query. The `explain()` (page 861) operation evaluates the set of query plans and reports on the winning plan for the query. In normal operations the query optimizer caches winning query plans and uses them for similar related queries in the future. As a result MongoDB may sometimes select query plans from the cache that are different from the plan displayed using `explain()` (page 861).

---

### See also:

- [\\$explain \(page 688\)](#)
- [Optimization Strategies for MongoDB](#) (page 160) page for information regarding optimization strategies.
- [Analyze Performance of Database Operations](#) (page 167) tutorial for information regarding the database profile.
- [Current Operation Reporting](#) (page 879)

## Explain Results

**Explain on Queries on Unsharded Collections** For queries on unsharded collections, `explain()` (page 861) returns the following core information.

```
{
 "cursor" : "<Cursor Type and Index>",
 "isMultiKey" : <boolean>,
 "n" : <num>,
 "nscannedObjects" : <num>,
 "nscanned" : <num>,
 "nscannedObjectsAllPlans" : <num>,
 "nscannedAllPlans" : <num>,
 "scanAndOrder" : <boolean>,
 "indexOnly" : <boolean>,
 "nYields" : <num>,
 "nChunkSkips" : <num>,
 "millis" : <num>,
 "indexBounds" : { <index bounds> },
 "allPlans" : [
 { "cursor" : "<Cursor Type and Index>",
 "n" : <num>,
 "nscannedObjects" : <num>,
 "nscanned" : <num>,
 "indexBounds" : { <index bounds> }
 },
 ...
],
 "oldPlan" : {
 "cursor" : "<Cursor Type and Index>",
 "indexBounds" : { <index bounds> }
 }
 "server" : "<host:port>",
}
```

For details on the fields, see [Core Explain Output Fields](#) (page 863).

**Explain on \$or Queries** Queries with `$or` (page 625) operator execute each clause of the `$or` (page 625) expression in parallel and can use separate indexes on the individual clauses. If the query uses indexes on any or all of the query's clause, `explain()` (page 861) contains `output` (page 863) for each clause as well as the cumulative data for the entire query:

```
{
 "clauses" : [
 {
 <core explain output>
 },
 {
 <core explain output>
 },
 ...
],
 "n" : <num>,
 "nscannedObjects" : <num>,
 "nscanned" : <num>,
 "nscannedObjectsAllPlans" : <num>,
 "nscannedAllPlans" : <num>,
 "millis" : <num>,
 "server" : "<host:port>"
}
```

For details on the fields, see [\\$or Query Output Fields](#) (page 865) and [Core Explain Output Fields](#) (page 863).

**Explain on Queries on Sharded Collections** For queries on sharded collections, `explain()` (page 861) returns information for each shard the query accesses. For queries on unsharded collections, see [Core Explain Output Fields](#) (page 863).

For queries on a sharded collection, the output contains the [Core Explain Output Fields](#) (page 863) for each accessed shard and [cumulative shard information](#) (page 865):

```
{
 "clusteredType" : "<Shard Access Type>",
 "shards" : [
 {
 "<shard1>" : [
 {
 "<core explain output>"
 }
],
 "<shard2>" : [
 {
 "<core explain output>"
 }
],
 ...
 },
 "millisShardTotal" : <num>,
 "millisShardAvg" : <num>,
 "numQueries" : <num>,
 "numShards" : <num>,
 "cursor" : "<Cursor Type and Index>",
 "n" : <num>,
 "nChunkSkips" : <num>,
 "nYields" : <num>,
 "nscanned" : <num>,
 "nscannedAllPlans" : <num>,
 "nscannedObjects" : <num>,
 "nscannedObjectsAllPlans" : <num>,
 "millis" : <num>
 }
}
```

For details on these fields, see [Core Explain Output Fields](#) (page 863) for each accessed shard and [Sharded Collections Output Fields](#) (page 865).

## Explain Output Fields

**Core Explain Output Fields** This section explains output for queries on collections that are *not sharded*. For queries on sharded collections, see [Explain on Queries on Sharded Collections](#) (page 863).

### `explain.cursor`

`cursor` (page 863) is a string that reports the type of cursor used by the query operation:

- `BasicCursor` indicates a full collection scan.
- `BtreeCursor` indicates that the query used an index. The cursor includes name of the index. When a query uses an index, the output of `explain()` (page 861) includes `indexBounds` (page 865) details.
- `GeoSearchCursor` indicates that the query used a geospatial index.

For `BtreeCursor` cursors, MongoDB will append the name of the index to the cursor string. Additionally, depending on how the query uses an index, MongoDB may append one or both of the following strings to the cursor string:

- `reverse` indicates that query transverses the index from the highest values to the lowest values (e.g. “right to left”.)
- `multi` indicates that the query performed multiple look-ups. Otherwise, the query uses the index to determine a range of possible matches.

### `explain.isMultiKey`

`isMultiKey` (page 864) is a boolean. When `true`, the query uses a *multikey index* (page 324), where one of the fields in the index holds an array.

### `explain.n`

`n` (page 864) is a number that reflects the number of documents that match the query selection criteria.

### `explain.nscannedObjects`

Specifies the total number of documents scanned during the query. The `nscannedObjects` (page 864) may be lower than `nscanned` (page 864), such as if the index `covers` (page 368) a query. See `indexOnly` (page 864). Additionally, the `nscannedObjects` (page 864) may be lower than `nscanned` (page 864) in the case of multikey index on an array field with duplicate documents.

### `explain.nscanned`

Specifies the total number of documents or index entries scanned during the database operation. You want `n` (page 864) and `nscanned` (page 864) to be close in value as possible. The `nscanned` (page 864) value may be higher than the `nscannedObjects` (page 864) value, such as if the index `covers` (page 368) a query. See `indexOnly` (page 864).

### `explain.nscannedObjectsAllPlans`

New in version 2.2.

`nscannedObjectsAllPlans` (page 864) is a number that reflects the total number of documents scanned for all query plans during the database operation.

### `explain.nscannedAllPlans`

New in version 2.2.

`nscannedAllPlans` (page 864) is a number that reflects the total number of documents or index entries scanned for all query plans during the database operation.

### `explain.scanAndOrder`

`scanAndOrder` (page 864) is a boolean that is `true` when the query **cannot** use the order of documents in the index for returning sorted results: MongoDB must sort the documents after it receives the documents from a cursor.

If `scanAndOrder` (page 864) is `false`, MongoDB *can* use the order of the documents in an index to return sorted results.

### `explain.indexOnly`

`indexOnly` (page 864) is a boolean value that returns `true` when the query is `covered` (page 368) by the index indicated in the `cursor` (page 863) field. When an index covers a query, MongoDB can both match the `query conditions` (page 68) **and** return the results using only the index because:

- all the fields in the `query` (page 68) are part of that index, **and**
- all the fields returned in the results set are in the same index.

### `explain.nYields`

`nYields` (page 864) is a number that reflects the number of times this query yielded the read lock to allow waiting writes execute.

**explain.nChunkSkips**

`nChunkSkips` (page 864) is a number that reflects the number of documents skipped because of active chunk migrations in a sharded system. Typically this will be zero. A number greater than zero is ok, but indicates a little bit of inefficiency.

**explain.millis**

`millis` (page 865) is a number that reflects the time in milliseconds to complete the query.

**explain.indexBounds**

`indexBounds` (page 865) is a document that contains the lower and upper index key bounds. This field resembles one of the following:

```
"indexBounds" : {
 "start" : { <index key1> : <value>, ... },
 "end" : { <index key1> : <value>, ... }
},
"indexBounds" : { "<field>" : [[<lower bound>, <upper bound>]],
 ...
}
```

**explain.allPlans**

`allPlans` (page 865) is an array that holds the list of plans the query optimizer runs in order to select the index for the query. Displays only when the `<verbose>` parameter to `explain()` (page 861) is `true` or `1`.

**explain.oldPlan**

New in version 2.2.

`oldPlan` (page 865) is a document value that contains the previous plan selected by the query optimizer for the query. Displays only when the `<verbose>` parameter to `explain()` (page 861) is `true` or `1`.

**explain.server**

New in version 2.2.

`server` (page 865) is a string that reports the MongoDB server.

**\$or Query Output Fields****explain.clauses**

`clauses` (page 865) is an array that holds the *Core Explain Output Fields* (page 863) information for each clause of the `$or` (page 625) expression. `clauses` (page 865) is only included when the clauses in the `$or` (page 625) expression use indexes.

**Sharded Collections Output Fields****explain.clusteredType**

`clusteredType` (page 865) is a string that reports the access pattern for shards. The value is:

- `ParallelSort`, if the `mongos` (page 938) queries shards in parallel.
- `SerialServer`, if the `mongos` (page 938) queries shards sequentially.

**explain.shards**

`shards` (page 865) contains fields for each shard in the cluster accessed during the query. Each field holds the *Core Explain Output Fields* (page 863) for that shard.

**explain.millisShardTotal**

`millisShardTotal` (page 865) is a number that reports the total time in milliseconds for the query to run on the shards.

**explain.millisShardAvg**

`millisShardAvg` (page 865) is a number that reports the average time in millisecond for the query to run on each shard.

**explain.numQueries**

`numQueries` (page 866) is a number that reports the total number of queries executed.

**explain.numShards**

`numShards` (page 866) is a number that reports the total number of shards queried.

**cursor.forEach()**

**Description**

**cursor.forEach(function)**

Iterates the cursor to apply a JavaScript function to each document from the cursor.

The `forEach()` (page 866) method has the following prototype form:

```
db.collection.find().forEach(<function>)
```

The `forEach()` (page 866) method has the following parameter:

**param JavaScript function** A JavaScript function to apply to each document from the cursor. The `<function>` signature includes a single argument that is passed the current document to process.

**Example** The following example invokes the `forEach()` (page 866) method on the cursor returned by `find()` (page 816) to print the name of each user in the collection:

```
db.users.find().forEach(function(myDoc) { print("user: " + myDoc.name); });
```

**See also:**

`cursor.map()` (page 867) for similar functionality.

**cursor.hasNext()**

**cursor.hasNext()**

**Returns** Boolean.

`cursor.hasNext()` (page 866) returns `true` if the cursor returned by the `db.collection.find()` (page 816) query can iterate further to return more documents.

**cursor\_hint()**

**Definition**

**cursor\_hint(index)**

Call this method on a query to override MongoDB's default index selection and query optimization process. Use `db.collection.getIndexes()` (page 826) to return the list of current indexes on a collection.

The `cursor_hint()` (page 866) method has the following parameter:

**param string,document index** The index to "hint" or force MongoDB to use when performing the query. Specify the index either by the index name or by the index specification document.

---

**See**

[Indexing Tutorials](#) (page 338) for information.

---

**Example** The following example returns all documents in the collection named `users` using the index on the `age` field.

```
db.users.find().hint({ age: 1 })
```

You can also specify the index using the index name:

```
db.users.find().hint("age_1")
```

**See also:**

[\\$hint](#) (page 689)

**cursor.limit()**

**cursor.limit()**

Use the `limit()` (page 867) method on a cursor to specify the maximum number of documents the cursor will return. `limit()` (page 867) is analogous to the `LIMIT` statement in a SQL database.

---

**Note:** You must apply `limit()` (page 867) to the cursor before retrieving any documents from the database.

---

Use `limit()` (page 867) to maximize performance and prevent MongoDB from returning more results than required for processing.

A `limit()` (page 867) value of 0 (e.g. “`.limit(0)` (page 867)”) is equivalent to setting no limit.

**cursor.map()**

**cursor.map(function)**

Applies `function` to each document visited by the cursor and collects the return values from successive application into an array.

The `cursor.map()` (page 867) method has the following parameter:

**param function function** A function to apply to each document visited by the cursor.

**Example**

```
db.users.find().map(function(u) { return u.name; });
```

**See also:**

[cursor.forEach\(\)](#) (page 866) for similar functionality.

**cursor.max()**

**Definition**

**cursor.max()**

Specifies the *exclusive* upper bound for a specific index in order to constrain the results of `find()` (page 816). `max()` (page 867) provides a way to specify an upper bound on compound key indexes.

The `max()` (page 867) method has the following parameter:

**param document indexBounds** The exclusive upper bound for the index keys.

The `indexBounds` parameter has the following prototype form:

```
{ field1: <max value>, field2: <max value2> ... fieldN:<max valueN>}
```

The fields correspond to *all* the keys of a particular index *in order*. You can explicitly specify the particular index with the `hint()` (page 866) method. Otherwise, `mongod` (page 925) selects the index using the fields in the `indexBounds`; however, if multiple indexes exist on same fields with different sort orders, the selection of the index may be ambiguous.

**See also:**

`min()` (page 869).

---

**Note:** `max()` (page 867) is a shell wrapper around the query modifier `$max` (page 690).

---

## Behavior

- Because `max()` (page 867) requires an index on a field, and forces the query to use this index, you may prefer the `$lt` (page 623) operator for the query if possible. Consider the following example:

```
db.products.find({ _id: 7 }).max({ price: 1.39 })
```

The query will use the index on the `price` field, even if the index on `_id` may be better.

- `max()` (page 867) exists primarily to support the `mongos` (page 938) (sharding) process.
- If you use `max()` (page 867) with `min()` (page 869) to specify a range, the index bounds specified in `min()` (page 869) and `max()` (page 867) must both refer to the keys of the same index.

**Example** This example assumes a collection named `products` that holds the following documents:

```
{ "_id" : 6, "item" : "apple", "type" : "cortland", "price" : 1.29 }
{ "_id" : 2, "item" : "apple", "type" : "fuji", "price" : 1.99 }
{ "_id" : 1, "item" : "apple", "type" : "honey crisp", "price" : 1.99 }
{ "_id" : 3, "item" : "apple", "type" : "jonagold", "price" : 1.29 }
{ "_id" : 4, "item" : "apple", "type" : "jonathan", "price" : 1.29 }
{ "_id" : 5, "item" : "apple", "type" : "mcintosh", "price" : 1.29 }
{ "_id" : 7, "item" : "orange", "type" : "cara cara", "price" : 2.99 }
{ "_id" : 10, "item" : "orange", "type" : "navel", "price" : 1.39 }
{ "_id" : 9, "item" : "orange", "type" : "satsuma", "price" : 1.99 }
{ "_id" : 8, "item" : "orange", "type" : "valencia", "price" : 0.99 }
```

The collection has the following indexes:

```
{ "_id" : 1 }
{ "item" : 1, "type" : 1 }
{ "item" : 1, "type" : -1 }
{ "price" : 1 }
```

- Using the ordering of `{ item: 1, type: 1 }` index, `max()` (page 867) limits the query to the documents that are below the bound of `item` equal to `apple` and `type` equal to `jonagold`:

```
db.products.find().max({ item: 'apple', type: 'jonagold' }).hint({ item: 1, type: 1 })
```

The query returns the following documents:

```
{ "_id" : 6, "item" : "apple", "type" : "cortland", "price" : 1.29 }
{ "_id" : 2, "item" : "apple", "type" : "fuji", "price" : 1.99 }
{ "_id" : 1, "item" : "apple", "type" : "honey crisp", "price" : 1.99 }
```

If the query did not explicitly specify the index with the `hint()` (page 866) method, it is ambiguous as to whether `mongod` (page 925) would select the `{ item: 1, type: 1 }` index ordering or the `{ item: 1, type: -1 }` index ordering.

- Using the ordering of the index `{ price: 1 },max()` (page 867) limits the query to the documents that are below the index key bound of `price` equal to `1.99` and `min()` (page 869) limits the query to the documents that are at or above the index key bound of `price` equal to `1.39`:

```
db.products.find().min({ price: 1.39 }).max({ price: 1.99 }).hint({ price: 1 })
```

The query returns the following documents:

```
{ "_id" : 6, "item" : "apple", "type" : "cortland", "price" : 1.29 }
{ "_id" : 4, "item" : "apple", "type" : "jonathan", "price" : 1.29 }
{ "_id" : 5, "item" : "apple", "type" : "mcintosh", "price" : 1.29 }
{ "_id" : 3, "item" : "apple", "type" : "jonagold", "price" : 1.29 }
{ "_id" : 10, "item" : "orange", "type" : "navel", "price" : 1.39 }
```

## `cursor.min()`

### Definition

`cursor.min()`

Specifies the *inclusive* lower bound for a specific index in order to constrain the results of `find()` (page 816). `min()` (page 869) provides a way to specify lower bounds on compound key indexes.

The `min()` (page 869) has the following parameter:

**param document indexBounds** The inclusive lower bound for the index keys.

The `indexBounds` parameter has the following prototype form:

```
{ field1: <min value>, field2: <min value2>, fieldN:<min valueN> }
```

The fields correspond to *all* the keys of a particular index *in order*. You can explicitly specify the particular index with the `hint()` (page 866) method. Otherwise, MongoDB selects the index using the fields in the `indexBounds`; however, if multiple indexes exist on same fields with different sort orders, the selection of the index may be ambiguous.

### See also:

`max()` (page 867).

---

**Note:** `min()` (page 869) is a shell wrapper around the query modifier `$min` (page 691).

---

## Behaviors

- Because `min()` (page 869) requires an index on a field, and forces the query to use this index, you may prefer the `$gte` (page 622) operator for the query if possible. Consider the following example:

```
db.products.find({ _id: 7 }).min({ price: 1.39 })
```

The query will use the index on the `price` field, even if the index on `_id` may be better.

- `min()` (page 869) exists primarily to support the `mongos` (page 938) process.

- If you use `min()` (page 869) with `max()` (page 867) to specify a range, the index bounds specified in `min()` (page 869) and `max()` (page 867) must both refer to the keys of the same index.

**Example** This example assumes a collection named `products` that holds the following documents:

```
{ "_id" : 6, "item" : "apple", "type" : "cortland", "price" : 1.29 }
{ "_id" : 2, "item" : "apple", "type" : "fuji", "price" : 1.99 }
{ "_id" : 1, "item" : "apple", "type" : "honey crisp", "price" : 1.99 }
{ "_id" : 3, "item" : "apple", "type" : "jonagold", "price" : 1.29 }
{ "_id" : 4, "item" : "apple", "type" : "jonathan", "price" : 1.29 }
{ "_id" : 5, "item" : "apple", "type" : "mcintosh", "price" : 1.29 }
{ "_id" : 7, "item" : "orange", "type" : "cara cara", "price" : 2.99 }
{ "_id" : 10, "item" : "orange", "type" : "navel", "price" : 1.39 }
{ "_id" : 9, "item" : "orange", "type" : "satsuma", "price" : 1.99 }
{ "_id" : 8, "item" : "orange", "type" : "valencia", "price" : 0.99 }
```

The collection has the following indexes:

```
{ "_id" : 1 }
{ "item" : 1, "type" : 1 }
{ "item" : 1, "type" : -1 }
{ "price" : 1 }
```

- Using the ordering of the `{ item: 1, type: 1 }` index, `min()` (page 869) limits the query to the documents that are at or above the index key bound of `item` equal to `apple` and `type` equal to `jonagold`, as in the following:

```
db.products.find().min({ item: 'apple', type: 'jonagold' }).hint({ item: 1, type: 1 })
```

The query returns the following documents:

```
{ "_id" : 3, "item" : "apple", "type" : "jonagold", "price" : 1.29 }
{ "_id" : 4, "item" : "apple", "type" : "jonathan", "price" : 1.29 }
{ "_id" : 5, "item" : "apple", "type" : "mcintosh", "price" : 1.29 }
{ "_id" : 7, "item" : "orange", "type" : "cara cara", "price" : 2.99 }
{ "_id" : 10, "item" : "orange", "type" : "navel", "price" : 1.39 }
{ "_id" : 9, "item" : "orange", "type" : "satsuma", "price" : 1.99 }
{ "_id" : 8, "item" : "orange", "type" : "valencia", "price" : 0.99 }
```

If the query did not explicitly specify the index with the `hint()` (page 866) method, it is ambiguous as to whether `mongod` (page 925) would select the `{ item: 1, type: 1 }` index ordering or the `{ item: 1, type: -1 }` index ordering.

- Using the ordering of the index `{ price: 1 }`, `min()` (page 869) limits the query to the documents that are at or above the index key bound of `price` equal to `1.39` and `max()` (page 867) limits the query to the documents that are below the index key bound of `price` equal to `1.99`:

```
db.products.find().min({ price: 1.39 }).max({ price: 1.99 }).hint({ price: 1 })
```

The query returns the following documents:

```
{ "_id" : 6, "item" : "apple", "type" : "cortland", "price" : 1.29 }
{ "_id" : 4, "item" : "apple", "type" : "jonathan", "price" : 1.29 }
{ "_id" : 5, "item" : "apple", "type" : "mcintosh", "price" : 1.29 }
{ "_id" : 3, "item" : "apple", "type" : "jonagold", "price" : 1.29 }
{ "_id" : 10, "item" : "orange", "type" : "navel", "price" : 1.39 }
```

**cursor.next()**

---

`cursor.next()`

**Returns** The next document in the cursor returned by the `db.collection.find()` (page 816) method. See `cursor.hasNext()` (page 866) related functionality.

**cursor objsLeftInBatch()**

`cursor.objectsLeftInBatch()`

`cursor.objectsLeftInBatch()` (page 871) returns the number of documents remaining in the current batch.

The MongoDB instance returns response in batches. To retrieve all the documents from a cursor may require multiple batch responses from the MongoDB instance. When there are no more documents remaining in the current batch, the cursor will retrieve another batch to get more documents until the cursor exhausts.

**cursor.readPref()**

#### Definition

`cursor.readPref(mode, tagSet)`

Append `readPref()` (page 871) to a cursor to control how the client routes the query to members of the replica set.

**param string mode** One of the following *read preference* modes: `primary` (page 489), `primaryPreferred` (page 489), `secondary` (page 489), `secondaryPreferred` (page 489), or `nearest` (page 490)

**param array tagSet** A tag set used to specify custom read preference modes. For details, see *Tag Sets* (page 407).

---

**Note:** You must apply `readPref()` (page 871) to the cursor before retrieving any documents from the database.

---

**cursor.showDiskLoc()**

`cursor.showDiskLoc()`

**Returns** A modified cursor object that contains documents with appended information that describes the on-disk location of the document.

#### See also:

`$showDiskLoc` (page 692) for related functionality.

**cursor.size()**

`cursor.size()`

**Returns** A count of the number of documents that match the `db.collection.find()` (page 816) query after applying any `cursor.skip()` (page 871) and `cursor.limit()` (page 867) methods.

**cursor.skip()**

`cursor.skip()`

Call the `cursor.skip()` (page 871) method on a cursor to control where MongoDB begins returning results. This approach may be useful in implementing “paged” results.

---

**Note:** You must apply `cursor.skip()` (page 871) to the cursor before retrieving any documents from the database.

---

Consider the following JavaScript function as an example of the sort function:

```
function printStudents(pageNumber, nPerPage) {
 print("Page: " + pageNumber);
 db.students.find().skip((pageNumber-1)*nPerPage).limit(nPerPage).forEach(function(student) {
```

The `cursor.skip()` (page 871) method is often expensive because it requires the server to walk from the beginning of the collection or index to get the offset or skip position before beginning to return result. As offset (e.g. `pageNumber` above) increases, `cursor.skip()` (page 871) will become slower and more CPU intensive. With larger collections, `cursor.skip()` (page 871) may become IO bound.

Consider using range-based pagination for these kinds of tasks. That is, query for a range of objects, using logic within the application to determine the pagination rather than the database itself. This approach features better index utilization, if you do not need to easily jump to a specific page.

### **cursor.snapshot()**

`cursor.snapshot()`

Append the `snapshot()` (page 872) method to a cursor to toggle the “snapshot” mode. This ensures that the query will not return a document multiple times, even if intervening write operations result in a move of the document due to the growth in document size.

#### **Warning:**

- You must apply `snapshot()` (page 872) to the cursor before retrieving any documents from the database.
- You can only use `snapshot()` (page 872) with **unsharded** collections.

The `snapshot()` (page 872) does not guarantee isolation from insertion or deletions.

The `snapshot()` (page 872) traverses the index on the `_id` field. As such, `snapshot()` (page 872) **cannot** be used with `sort()` (page 872) or `hint()` (page 866).

Queries with results of less than 1 megabyte are effectively implicitly snapshotted.

### **cursor.sort()**

#### **Definition**

`cursor.sort(sort)`

Controls the order that the query returns matching documents. For each field in the sort document, if the field’s corresponding value is positive, then `sort()` (page 872) returns query results in ascending order for that attribute. If the field’s corresponding value is negative, then `sort()` (page 872) returns query results in descending order.

The `sort()` (page 872) method has the following parameter:

**param document sort** A document that defines the sort order of the result set.

The `sort` parameter contains field and value pairs, in the following form:

```
{ field: value }
```

- `field` is the field by which to sort documents.
- `value` is either 1 for ascending or -1 for descending.

---

**Note:** You must apply `limit()` (page 867) to the cursor before retrieving any documents from the database.

---

**Examples** The following query returns all documents in `collection` sorted by the `age` field in descending order.

```
db.collection.find().sort({ age: -1 });
```

The following query specifies the sort order using the fields from a sub-document `name`. The query sorts first by the `last` field and then by the `first` field. The query sorts both fields in ascending order:

```
db.bios.find().sort({ 'name.last': 1, 'name.first': 1 });
```

**Limit Results** Unless you have an index for the specified key pattern, use `sort()` (page 872) in conjunction with `limit()` (page 867) to avoid requiring MongoDB to perform a large, in-memory sort. `limit()` (page 867) increases the speed and reduces the amount of memory required to return this query by way of an optimized algorithm.

**Warning:** The sort function requires that the entire sort be able to complete within 32 megabytes. When the sort option consumes more than 32 megabytes, MongoDB will return an error. Use `limit()` (page 867), or create an index on the field that you're sorting to avoid this error.

**Return Natural Order** The `$natural` (page 693) parameter returns items according to their order on disk. Consider the following query:

```
db.collection.find().sort({ $natural: -1 });
```

This will return documents in the reverse of the order on disk. Typically, the order of documents on disks reflects insertion order, *except* when documents move internal because of document growth due to update operations.

When comparing values of different `BSON` types, MongoDB uses the following comparison order, from lowest to highest:

1. MinKey (internal type)
2. Null
3. Numbers (ints, longs, doubles)
4. Symbol, String
5. Object
6. Array
7. BinData
8. ObjectId
9. Boolean
10. Date, Timestamp
11. Regular Expression
12. MaxKey (internal type)

---

**Note:** MongoDB treats some types as equivalent for comparison purposes. For instance, numeric types undergo conversion before comparison.

---

**cursor.toArray()****cursor.toArray()**

The [toArray\(\)](#) (page 874) method returns an array that contains all the documents from a cursor. The method iterates completely the cursor, loading all the documents into RAM and exhausting the cursor.

**Returns** An array of documents.

Consider the following example that applies [toArray\(\)](#) (page 874) to the cursor returned from the [find\(\)](#) (page 816) method:

```
var allProductsArray = db.products.find().toArray();

if (allProductsArray.length > 0) { printjson(allProductsArray[0]); }
```

The variable `allProductsArray` holds the array of documents returned by [toArray\(\)](#) (page 874).

## Database

### Database Methods

| Name                                             | Description                                                                                                         |
|--------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| <code>db.addUser()</code> (page 875)             | Adds a user to a database, and allows administrators to configure the user's privileges.                            |
| <code>db.auth()</code> (page 876)                | Authenticates a user to a database.                                                                                 |
| <code>db.changeUserPassword()</code> (page 877)  | Changes an existing user's password.                                                                                |
| <code>db.cloneCollection()</code> (page 877)     | Copies data directly between MongoDB instances. Wraps <code>cloneCollection()</code> .                              |
| <code>db.cloneDatabase()</code> (page 877)       | Copies a database from a remote host to the current host. Wraps <code>cloneDatabase()</code> .                      |
| <code>db.commandHelp()</code> (page 878)         | Returns help information for a <a href="#">database command</a> .                                                   |
| <code>db.copyDatabase()</code> (page 878)        | Copies a database to another database on the current host. Wraps <code>copyDatabase()</code> .                      |
| <code>db.createCollection()</code> (page 878)    | Creates a new collection. Commonly used to create a capped collection.                                              |
| <code>db.currentOp()</code> (page 879)           | Reports the current in-progress operations.                                                                         |
| <code>db.dropDatabase()</code> (page 884)        | Removes the current database.                                                                                       |
| <code>db.eval()</code> (page 884)                | Passes a JavaScript function to the <a href="#">mongod</a> (page 925) instance for server-side execution.           |
| <code>db.fsyncLock()</code> (page 885)           | Flushes writes to disk and locks the database to prevent write operations and reads.                                |
| <code>db.fsyncUnlock()</code> (page 886)         | Allows writes to continue on a database locked with <code>db.fsyncLock()</code> .                                   |
| <code>db.getCollection()</code> (page 886)       | Returns a collection object. Used to access collections with names that are not valid as identifiers.               |
| <code>db.getCollectionNames()</code> (page 886)  | Lists all collections in the current database.                                                                      |
| <code>db.getLastErrorMessage()</code> (page 886) | Checks and returns the status of the last operation. Wraps <code>getLastError()</code> .                            |
| <code>db.getLastErrorObj()</code> (page 886)     | Returns the status document for the last operation. Wraps <code>getLastError()</code> .                             |
| <code>db.getMongo()</code> (page 887)            | Returns the <a href="#">Mongo</a> (page 919) connection object for the current connection.                          |
| <code>db.getName()</code> (page 887)             | Returns the name of the current database.                                                                           |
| <code>db.getPrevErrorMessage()</code> (page 887) | Returns a status document containing all errors since the last error reset. Wraps <code>getPreviousError()</code> . |
| <code>db.getProfilingLevel()</code> (page 887)   | Returns the current profiling level for database operations.                                                        |
| <code>db.getProfilingStatus()</code> (page 887)  | Returns a document that reflects the current profiling level and the profiling stage.                               |
| <code>db.getReplicationInfo()</code> (page 887)  | Returns a document with replication statistics.                                                                     |
| <code>db.getSiblingDB()</code> (page 888)        | Provides access to the specified database.                                                                          |
| <code>db.help()</code> (page 889)                | Displays descriptions of common <code>db</code> object methods.                                                     |
| <code>db.hostInfo()</code> (page 889)            | Returns a document with information about the system MongoDB runs on.                                               |
| <code>db.isMaster()</code> (page 890)            | Returns a document that reports the state of the replica set.                                                       |
| <code>db.killOp()</code> (page 890)              | Terminates a specified operation.                                                                                   |
| <code>db.listCommands()</code> (page 890)        | Displays a list of common database commands.                                                                        |
| <code>db.loadServerScripts()</code> (page 890)   | Loads all scripts in the <code>system.js</code> collection for the current database into memory.                    |
| <code>db.logout()</code> (page 891)              | Ends an authenticated session.                                                                                      |

Table 11.2 – continued from previous page

| Name                                                   | Description                                                                                      |
|--------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| <code>db.printCollectionStats()</code> (page 891)      | Prints statistics from every collection. Wraps <code>db.collection.stats</code> .                |
| <code>db.printReplicationInfo()</code> (page 891)      | Prints a report of the status of the replica set from the perspective of the primary.            |
| <code>db.printShardingStatus()</code> (page 892)       | Prints a report of the sharding configuration and the chunk ranges.                              |
| <code>db.printSlaveReplicationInfo()</code> (page 892) | Prints a report of the status of the replica set from the perspective of the secondary.          |
| <code>db.removeUser()</code> (page 892)                | Removes a user from a database.                                                                  |
| <code>db.repairDatabase()</code> (page 892)            | Runs a repair routine on the current database.                                                   |
| <code>db.resetError()</code> (page 893)                | Resets the error message returned by <code>db.getPrevError()</code> (page 887).                  |
| <code>db.runCommand()</code> (page 893)                | Runs a <i>database command</i> (page 694).                                                       |
| <code>db.serverBuildInfo()</code> (page 893)           | Returns a document that displays the compilation parameters for the <code>mongod</code> process. |
| <code>db.serverStatus()</code> (page 893)              | Returns a document that provides an overview of the state of the database.                       |
| <code>db.setProfilingLevel()</code> (page 894)         | Modifies the current level of database profiling.                                                |
| <code>db.shutdownServer()</code> (page 894)            | Shuts down the current <code>mongod</code> (page 925) or <code>mongos</code> (page 938) process. |
| <code>db.stats()</code> (page 894)                     | Returns a document that reports on the state of the current database.                            |
| <code>db.version()</code> (page 895)                   | Returns the version of the <code>mongod</code> (page 925) instance.                              |

## db.addUser()

### Definition

`db.addUser(document)`

Use `db.addUser()` (page 875) to add privilege documents to the `system.users` (page 270) collection in a database, which creates database credentials in MongoDB.

Changed in version 2.4: The schema of `system.users` (page 270) changed in 2.4 to accommodate a more *sophisticated privilege model* (page 265). In 2.4 `db.addUser()` (page 875) supports both forms of privilege documents.

In MongoDB 2.4 you must pass `db.addUser()` (page 875) a document that contains a well-formed `system.users` (page 270) document. In MongoDB 2.2 pass arguments to `db.addUser()` (page 875) that describe *user credentials* (page 876). A 2.4 privilege document has a subset of the following fields:

**field string user** The username for a new database user.

**field array roles** An array of user roles.

**field hash pwd** A shared secret used to authenticate the user. The `pwd` field and the `userSource` field are mutually exclusive. The document cannot contain both.

**field string userSource** The database that contains the credentials for the user. The `userSource` field and the `pwd` field are mutually exclusive. The document cannot contain both.

**field document otherDBRoles** Roles this user has on other databases.

See `system.users Privilege Documents` (page 270) for documentation of the 2.4 privilege documents.

**Examples** The following are prototype `db.addUser()` (page 875) operations:

```
db.addUser({ user: "<user>", pwd: "<password>", roles: [<roles>] })
```

This operation creates a `system.users` (page 270) document with a password using the `pwd` (page 270) field.

In the following prototype, rather than specify a password directly, you can delegate the credential to another database using the `userSource` (page 271) field:

```
db.addUser({ user: "<user>", userSource: "<database>", roles: [<roles>] })
```

To create and add a 2.4-style privilege document to `system.users` (page 270) to grant `readWrite` (page 266) privileges to a user named “author” with privileges, use the following operation:

```
db.addUser({ user: "author", pwd: "pass", roles: ["readWrite"] })
```

If you want to store user credentials in a single `users` database, you can use *delegated credentials* (page 272), as in the following example:

```
db.addUser({ user: "author", userSource: "users", roles: ["readWrite"] })
```

### See also:

[Add a User to a Database](#) (page 257), [User Privilege Roles in MongoDB](#) (page 265), and [system.users Privilege Documents](#) (page 270).

**Legacy Privilege Documents** To create legacy (2.2. and earlier) privilege documents, `db.addUser()` (page 875) accepts the following parameters:

**param string user** The username.

**param string password** The corresponding password.

**param boolean readOnly** Defaults to `false`. Grants users a restricted privilege set that only allows the user to read the this database.

The command takes the following form:

```
db.addUser("<username>", "<password>", <read-only>)
```

---

### Example

To create and add a legacy (2.2. and earlier) privilege document with a user named `guest` and the password `pass` that has only `readOnly` privileges, use the following operation:

```
db.addUser("guest", "pass", true)
```

---

**Note:** The `mongo` (page 942) shell excludes all `db.addUser()` (page 875) operations from the saved history.

---

Deprecated since version 2.4: The `roles` parameter replaces the `readOnly` parameter for `db.addUser()` (page 875). 2.4 also adds the `otherDBRoles` (page 271) and `userSource` (page 271) fields to documents in the `system.users` (page 270) collection.

## db.auth()

### Definition

`db.auth(username, password)`

Allows a user to authenticate to the database from within the shell.

**param string username** Specifies an existing username with access privileges for this database.

**param string password** Specifies the corresponding password.

Alternatively, you can use `mongo --username` and `--password` to specify authentication credentials.

---

**Note:** The `mongo` (page 942) shell excludes all `db.auth()` (page 876) operations from the saved history.

---

**db.changeUserPassword()****Definition****db.changeUserPassword(*username, password*)**

Allows an administrator to update a user's password from within the shell.

**param string username** Specifies an existing username with access privileges for this database.**param string password** Specifies the corresponding password.**Throws exception** If an error occurs, the [db.changeUserPassword\(\) \(page 877\)](#) helper throws an exception with the error message and code.**Example****Example**

The following operation changes the reporting user's password to SOhSS3TbYhxusooLiW8ypJPxmt1oOfL:

```
db = db.getSiblingDB('records')
db.changeUserPassword("reporting", "SOhSS3TbYhxusooLiW8ypJPxmt1oOfL")
```

**db.cloneCollection()****Definition****db.cloneCollection(*from, collection, query*)**Copies data directly between MongoDB instances. The [db.cloneCollection\(\) \(page 877\)](#) wraps the [cloneCollection \(page 748\)](#) database command and accepts the following arguments:**param string from** Host name of the MongoDB instance that holds the collection to copy.**param string collection** The collection in the MongoDB instance that you want to copy.**db.cloneCollection()** (page 877) will only copy the collection with this name from *database* of the same name as the current database the remote MongoDB instance. If you want to copy a collection from a different database name you must use the [cloneCollection \(page 748\)](#) directly.**param document query** A standard query document that limits the documents copied as part of the [db.cloneCollection\(\) \(page 877\)](#) operation. All [query selectors \(page 621\)](#) available to the [find\(\) \(page 816\)](#) are available here.**db.cloneCollection() (page 877)** does not allow you to clone a collection through a [mongos \(page 938\)](#). You must connect directly to the [mongod \(page 925\)](#) instance.**db.cloneDatabase()****Definition****db.cloneDatabase("hostname")**

Copies a remote database to the current database. The command assumes that the remote database has the same name as the current database.

**param string hostname** The hostname of the database to copy.This method provides a wrapper around the MongoDB [database command “clone \(page 748\).”](#) The [copydb \(page 745\)](#) database command provides related functionality.

**Example** To clone a database named `importdb` on a host named `hostname`, issue the following:

```
use importdb
db.cloneDatabase("hostname")
```

New databases are implicitly created, so the current host does not need to have a database named `importdb` for this command to succeed.

### **db.commandHelp()**

#### **Description**

`db.commandHelp(command)`

Displays help text for the specified *database command*. See the [Database Commands](#) (page 694).

The `db.commandHelp()` (page 878) method has the following parameter:

**param string command** The name of a *database command*.

### **db.copyDatabase()**

#### **Definition**

`db.copyDatabase(origin, destination, hostname)`

Copies a single logical *database* from a remote MongoDB instance to the local database. `db.copyDatabase()` (page 878) wraps the `copydb` (page 745) database command, and takes the following arguments:

**param string origin** The name of the database on the origin system.

**param string destination** The name of the database to copy the origin database into.

**param string hostname** The hostname of the origin database host. Omit the hostname to copy from one name to another on the same server.

`db.copyDatabase()` (page 878) implicitly creates the destination databases if it does not exist. If you do not specify the `hostname` argument, MongoDB assumes the origin and destination databases are on the *local* instance.

The `clone` (page 748) database command provides related functionality.

**Example** To copy a database named `records` into a database named `archive_records`, use the following invocation of `db.copyDatabase()` (page 878):

```
db.copyDatabase('records', 'archive_records')
```

### **db.createCollection()**

#### **Definition**

`db.createCollection(name, options)`

Creates a new collection explicitly.

Because MongoDB creates a collection implicitly when the collection is first referenced in a command, this method is used primarily for creating new *capped collections*. This is also used to pre-allocate space for an ordinary collection.

The `db.createCollection()` (page 878) has the following prototype form:

```
db.createCollection(name, {capped: <Boolean>, autoIndexId: <Boolean>, size: <number>, max: <number>})
```

The [db.createCollection\(\)](#) (page 878) method has the following parameters:

**param string name** The name of the collection to create.

**param document options** Configuration options for creating a capped collection or for preallocating space in a new collection.

The options document creates a capped collection or preallocates space in a new ordinary collection. The options document contains the following fields:

**field Boolean capped** Enables a *capped collection*. To create a capped collection, specify `true`. If you specify `true`, you must also set a maximum size in the `size` field.

**field Boolean autoIndexID** If `capped` is `true`, specify `false` to disable the automatic creation of an index on the `_id` field. Before 2.2, the default value for `autoIndexID` was `false`. See [\\_id Fields and Indexes on Capped Collections](#) (page 1054) for more information.

**field number size** Specifies a maximum size in bytes for a capped collection. The `size` field is required for capped collections. If `capped` is `false`, you can use this field to preallocate space for an ordinary collection.

**field number max** The maximum number of documents allowed in the capped collection. The `size` limit takes precedence over this limit. If a capped collection reaches its maximum `size` before it reaches the maximum number of documents, MongoDB removes old documents. If you prefer to use this limit, ensure that the `size` limit, which is required, is sufficient to contain the documents limit.

**Example** The following example creates a capped collection. Capped collections have maximum size or document counts that prevent them from growing beyond maximum thresholds. All capped collections must specify a maximum size and may also specify a maximum document count. MongoDB removes older documents if a collection reaches the maximum size limit before it reaches the maximum document count. Consider the following example:

```
db.createCollection("log", { capped : true, size : 5242880, max : 5000 })
```

This command creates a collection named `log` with a maximum size of 5 megabytes and a maximum of 5000 documents.

The following command simply pre-allocates a 2-gigabyte, uncapped collection named `people`:

```
db.createCollection("people", { size: 2147483648 })
```

This command provides a wrapper around the database command [create](#) (page 747). See [Capped Collections](#) (page 156) for more information about capped collections.

## db.currentOp()

### Definition

```
db.currentOp()
```

**Returns** A *document* that reports in-progress operations for the database instance.

The [db.currentOp\(\)](#) (page 879) method can take no arguments or take the `true` argument, which returns a more verbose output, including idle connections and system operations. The following example uses the `true` argument:

```
db.currentOp(true)
```

`db.currentOp()` (page 879) is available only for users with administrative privileges.

You can use `db.killOp()` (page 890) in conjunction with the `opid` (page 881) field to terminate a currently running operation. The following JavaScript operations for the `mongo` (page 942) shell filter the output of specific types of operations:

- Return all pending write operations:

```
db.currentOp().inprog.forEach(
 function(d){
 if(d.waitingForLock && d.lockType != "read")
 printjson(d)
 })
```

- Return the active write operation:

```
db.currentOp().inprog.forEach(
 function(d){
 if(d.active && d.lockType == "write")
 printjson(d)
 })
```

- Return all active read operations:

```
db.currentOp().inprog.forEach(
 function(d){
 if(d.active && d.lockType == "read")
 printjson(d)
 })
```

**Warning:** Terminate running operations with extreme caution. Only use `db.killOp()` (page 890) to terminate operations initiated by clients and *do not* terminate internal database operations.

**Example** The following is an example of `db.currentOp()` (page 879) output. If you specify the `true` argument, `db.currentOp()` (page 879) returns more verbose output.

```
{
 "inprog": [
 {
 "opid" : 3434473,
 "active" : <boolean>,
 "secs_running" : 0,
 "op" : "<operation>",
 "ns" : "<database>.<collection>",
 "query" : {
 },
 "client" : "<host>:<outgoing>",
 "desc" : "conn57683",
 "threadId" : "0x7f04a637b700",
 "connectionId" : 57683,
 "locks" : {
 "^" : "w",
 "^local" : "W",
 "^<database>" : "W"
 },
 "waitingForLock" : false,
```

```

 "msg": "<string>",
 "numYields" : 0,
 "progress" : {
 "done" : <number>,
 "total" : <number>
 }
 },
 "lockStats" : {
 "timeLockedMicros" : {
 "R" : NumberLong(),
 "W" : NumberLong(),
 "r" : NumberLong(),
 "w" : NumberLong()
 },
 "timeAcquiringMicros" : {
 "R" : NumberLong(),
 "W" : NumberLong(),
 "r" : NumberLong(),
 "w" : NumberLong()
 }
 }
},
]
}

```

#### **Output** Changed in version 2.2.

The `db.currentOp()` (page 879) returns a document with an array named `inprog`. The `inprog` array contains a document for each in-progress operation. The fields that appear for a given operation depend on the kind of operation and its state.

##### `currentOp.opid`

Holds an identifier for the operation. You can pass this value to `db.killOp()` (page 890) in the `mongo` (page 942) shell to terminate the operation.

##### `currentOp.active`

A boolean value, that is `true` if the operation has started or `false` if the operation is queued and waiting for a lock to run. `active` (page 881) may be `true` even if the operation has yielded to another operation.

##### `currentOpsecs_running`

The duration of the operation in seconds. MongoDB calculates this value by subtracting the current time from the start time of the operation.

If the operation is not running, (i.e. if `active` (page 881) is `false`,) this field may not appear in the output of `db.currentOp()` (page 879).

##### `currentOp.op`

A string that identifies the type of operation. The possible values are:

- `insert`
- `query`
- `update`
- `remove`
- `getmore`
- `command`

**currentOp.ns**

The [namespace](#) the operation targets. MongoDB forms namespaces using the name of the [database](#) and the name of the [collection](#).

**currentOp.query**

A document containing the current operation's query. The document is empty for operations that do not have queries: `getmore`, `insert`, and `command`.

**currentOp.client**

The IP address (or hostname) and the ephemeral port of the client connection where the operation originates. If your `inprog` array has operations from many different clients, use this string to relate operations to clients.

For some commands, including `findAndModify` (page 710) and `db.eval()` (page 884), the client will be `0.0.0.0:0`, rather than an actual client.

**currentOp.desc**

A description of the client. This string includes the [connectionId](#) (page 882).

**currentOp.threadId**

An identifier for the thread that services the operation and its connection.

**currentOp.connectionId**

An identifier for the connection where the operation originated.

**currentOp.locks**

New in version 2.2.

The [locks](#) (page 882) document reports on the kinds of locks the operation currently holds. The following kinds of locks are possible:

**currentOp.locks.^**

`^` (page 882) reports on the use of the global lock for the [mongod](#) (page 925) instance. All operations must hold the global lock for some phases of operation.

**currentOp.locks.^local**

`^local` (page 882) reports on the lock for the `local` database. MongoDB uses the `local` database for a number of operations, but the most frequent use of the `local` database is for the [oplog](#) used in replication.

**currentOp.locks.^<database>**

`locks.^<database>` (page 882) reports on the lock state for the database that this operation targets.

`locks` (page 882) replaces `lockType` in earlier versions.

**currentOp.lockType**

Changed in version 2.2: The [locks](#) (page 882) replaced the `lockType` (page 882) field in 2.2.

Identifies the type of lock the operation currently holds. The possible values are:

- `read`
- `write`

**currentOp.waitingForLock**

Returns a boolean value. `waitingForLock` (page 882) is `true` if the operation is waiting for a lock and `false` if the operation has the required lock.

**currentOp.msg**

The [msg](#) (page 882) provides a message that describes the status and progress of the operation. In the case of indexing or mapReduce operations, the field reports the completion percentage.

**currentOp.progress**

Reports on the progress of mapReduce or indexing operations. The [progress](#) (page 882) fields corresponds

to the completion percentage in the `msg` (page 882) field. The `progress` (page 882) specifies the following information:

`currentOp.progress.done`

Reports the number completed.

`currentOp.progress.total`

Reports the total number.

`currentOp.killed`

Returns `true` if `mongod` (page 925) instance is in the process of killing the operation.

`currentOp.numYields`

`numYields` (page 883) is a counter that reports the number of times the operation has yielded to allow other operations to complete.

Typically, operations yield when they need access to data that MongoDB has not yet fully read into memory. This allows other operations that have data in memory to complete quickly while MongoDB reads in data for the yielding operation.

`currentOp.lockStats`

New in version 2.2.

The `lockStats` (page 883) document reflects the amount of time the operation has spent both acquiring and holding locks. `lockStats` (page 883) reports data on a per-lock type, with the following possible lock types:

- `R` represents the global read lock,
- `W` represents the global write lock,
- `r` represents the database specific read lock, and
- `w` represents the database specific write lock.

`currentOp.timeLockedMicros`

The `timeLockedMicros` (page 883) document reports the amount of time the operation has spent holding a specific lock.

For operations that require more than one lock, like those that lock the `local` database to update the `oplog`, then the values in this document can be longer than this value may be longer than the total length of the operation (i.e. `secs_running` (page 881).)

`currentOp.timeLockedMicros.R`

Reports the amount of time in microseconds the operation has held the global read lock.

`currentOp.timeLockedMicros.W`

Reports the amount of time in microseconds the operation has held the global write lock.

`currentOp.timeLockedMicros.r`

Reports the amount of time in microseconds the operation has held the database specific read lock.

`currentOp.timeLockedMicros.w`

Reports the amount of time in microseconds the operation has held the database specific write lock.

`currentOp.timeAcquiringMicros`

The `timeAcquiringMicros` (page 883) document reports the amount of time the operation has spent waiting to acquire a specific lock.

`currentOp.timeAcquiringMicros.R`

Reports the mount of time in microseconds the operation has waited for the global read lock.

`currentOp.timeAcquiringMicros.w`

Reports the mount of time in microseconds the operation has waited for the global write lock.

`currentOp.timeAcquiringMicros.r`

Reports the mount of time in microseconds the operation has waited for the database specific read lock.

`currentOp.timeAcquiringMicros.w`

Reports the mount of time in microseconds the operation has waited for the database specific write lock.

## **db.dropDatabase()**

`db.dropDatabase()`

Removes the current database. Does not change the current database, so the insertion of any documents in this database will allocate a fresh set of data files.

## **db.eval()**

### **Definition**

`db.eval(function, arguments)`

Provides the ability to run JavaScript code on the MongoDB server.

The helper `db.eval()` (page 884) in the `mongo` (page 942) shell wraps the `eval` (page 722) command. Therefore, the helper method shares the characteristics and behavior of the underlying command with *one exception*: `db.eval()` (page 884) method does not support the `nolock` option.

The method accepts the following parameters:

**param JavaScript function function** A JavaScript function to execute.

**param list arguments** A list of arguments to pass to the JavaScript function. Omit if the function does not take arguments.

The JavaScript function need not take any arguments, as in the first example, or may optionally take arguments as in the second:

```
function () {
 // ...
}
```

```
function (arg1, arg2) {
 // ...
}
```

**Examples** The following is an example of the `db.eval()` (page 884) method:

```
db.eval(function(name, incAmount) {
 var doc = db.myCollection.findOne({ name : name });

 doc = doc || { name : name , num : 0 , total : 0 , avg : 0 };

 doc.num++;
 doc.total += incAmount;
 doc.avg = doc.total / doc.num;

 db.myCollection.save(doc);
```

```

 return doc;
 },
 "eliot", 5);

```

- The `db` in the function refers to the current database.
- "eliot" is the argument passed to the function, and corresponds to the `name` argument.
- 5 is an argument to the function and corresponds to the `incAmount` field.

If you want to use the server's interpreter, you must run `db.eval()` (page 884). Otherwise, the `mongo` (page 942) shell's JavaScript interpreter evaluates functions entered directly into the shell.

If an error occurs, `db.eval()` (page 884) throws an exception. The following is an example of an invalid function that uses the variable `x` without declaring it as an argument:

```
db.eval(function() { return x + x; }, 3);
```

The statement results in the following exception:

```
{
 "errmsg" : "exception: JavaScript execution failed: ReferenceError: x is not defined near '{ return',
 "code" : 16722,
 "ok" : 0
}
```

#### Warning:

- By default, `db.eval()` (page 884) takes a global write lock before evaluating the JavaScript function. As a result, `db.eval()` (page 884) blocks all other read and write operations to the database while the `db.eval()` (page 884) operation runs. Set `nolock` to `true` on the `eval` (page 722) command to prevent the `eval` (page 722) command from taking the global write lock before evaluating the JavaScript. `nolock` does not impact whether operations within the JavaScript code itself takes a write lock.
- Do not use `db.eval()` (page 884) for long running operations as `db.eval()` (page 884) blocks all other operations. Consider using *other server side code execution options* (page 198).
- You can not use `db.eval()` (page 884) with `sharded` data. In general, you should avoid using `db.eval()` (page 884) in `sharded cluster`; nevertheless, it is possible to use `db.eval()` (page 884) with non-sharded collections and databases stored in a `sharded cluster`.
- With `authentication` (page 993) enabled, `db.eval()` (page 884) will fail during the operation if you do not have the permission to perform a specified task.

Changed in version 2.4: You must have full admin access to run.

Changed in version 2.4: The V8 JavaScript engine, which became the default in 2.4, allows multiple JavaScript operations to execute at the same time. Prior to 2.4, `db.eval()` (page 884) executed in a single thread.

#### See also:

*Server-side JavaScript* (page 198)

#### `db.fsyncLock()`

`db.fsyncLock()`

Forces the `mongod` (page 925) to flush pending all write operations to the disk and locks the *entire* `mongod` (page 925) instance to prevent additional writes until the user releases the lock with the `db.fsyncUnlock()` (page 886) command. `db.fsyncLock()` (page 885) is an administrative command.

This command provides a simple wrapper around a `fsync` (page 751) database command with the following syntax:

```
{ fsync: 1, lock: true }
```

This function locks the database and create a window for *backup operations* (page 136).

---

**Note:** The database cannot be locked with `db.fsyncLock()` (page 885) while profiling is enabled. You must disable profiling before locking the database with `db.fsyncLock()` (page 885). Disable profiling using `db.setProfilingLevel()` (page 894) as follows in the `mongo` (page 942) shell:

```
db.setProfilingLevel(0)
```

### **db.fsyncUnlock()**

#### **db.fsyncUnlock()**

Unlocks a `mongod` (page 925) instance to allow writes and reverses the operation of a `db.fsyncLock()` (page 885) operation. Typically you will use `db.fsyncUnlock()` (page 886) following a database *backup operation* (page 136).

`db.fsyncUnlock()` (page 886) is an administrative command.

### **db.getCollection()**

#### **Description**

##### **db.getCollection(name)**

Returns a collection name. This is useful for a collection whose name might interact with the shell itself, such names that begin with `_` or that mirror the *database commands* (page 694).

The `db.getCollection()` (page 886) method has the following parameter:

**param string name** The name of the collection.

### **db.getCollectionNames()**

#### **db.getCollectionNames()**

**Returns** An array containing all collections in the existing database.

### **db.getLastErrorMessage()**

#### **db.getLastErrorMessage()**

**Returns** The last error message string.

Sets the level of *write concern* for confirming the success of write operations.

---

#### **See**

`getLastError` (page 720) and *Write Concern Reference* (page 96) for all options, *Write Concern* (page 55) for a conceptual overview, *Write Operations* (page 50) for information about all write operations in MongoDB,

.

---

### **db.getLastErrorMessage()**

#### **db.getLastErrorMessage()**

**Returns** A full *document* with status information.

**See also:**

[Write Concern](#) (page 55), [Write Concern Reference](#) (page 96), and [Replica Acknowledged](#) (page 57).

**db.getMongo()**  
**db.getMongo()**

**Returns** The current database connection.

`db.getMongo()` (page 887) runs when the shell initiates. Use this command to test that the `mongo` (page 942) shell has a connection to the proper database instance.

**db.getName()**  
**db.getName()**

**Returns** the current database name.

**db.getPrevError()**  
**db.getPrevError()**

**Returns** A status document, containing the errors.

Deprecated since version 1.6.

This output reports all errors since the last time the database received a `resetError` (page 722) (also `db.resetError()` (page 893)) command.

This method provides a wrapper around the `getPrevError` (page 721) command.

**db.getProfilingLevel()**  
**db.getProfilingLevel()**

This method provides a wrapper around the database command “`profile` (page 770)” and returns the current profiling level.

Deprecated since version 1.8.4: Use `db.getProfilingStatus()` (page 887) for related functionality.

**db.getProfilingStatus()**  
**db.getProfilingStatus()**

**Returns** The current `profile` (page 770) level and `slowms` (page 997) setting.

**db.getReplicationInfo()**

**Definition**

**db.getReplicationInfo()**

**Returns** A document with the status of the replica status, using data polled from the “`oplog`”. Use this output when diagnosing issues with replication.

## Output

`db.getReplicationInfo.logSizeMB`

Returns the total size of the *oplog* in megabytes. This refers to the total amount of space allocated to the oplog rather than the current size of operations stored in the oplog.

`db.getReplicationInfo.usedMB`

Returns the total amount of space used by the *oplog* in megabytes. This refers to the total amount of space currently used by operations stored in the oplog rather than the total amount of space allocated.

`db.getReplicationInfo.errmsg`

Returns an error message if there are no entries in the oplog.

`db.getReplicationInfo.oplogMainRowCount`

Only present when there are no entries in the oplog. Reports a the number of items or rows in the *oplog* (e.g. 0).

`db.getReplicationInfo.timeDiff`

Returns the difference between the first and last operation in the *oplog*, represented in seconds.

Only present if there are entries in the oplog.

`db.getReplicationInfo.timeDiffHours`

Returns the difference between the first and last operation in the *oplog*, rounded and represented in hours.

Only present if there are entries in the oplog.

`db.getReplicationInfo.tFirst`

Returns a time stamp for the first (i.e. earliest) operation in the *oplog*. Compare this value to the last write operation issued against the server.

Only present if there are entries in the oplog.

`db.getReplicationInfo.tLast`

Returns a time stamp for the last (i.e. latest) operation in the *oplog*. Compare this value to the last write operation issued against the server.

Only present if there are entries in the oplog.

`db.getReplicationInfo.now`

Returns a time stamp that reflects reflecting the current time. The shell process generates this value, and the datum may differ slightly from the server time if you're connecting from a remote host as a result. Equivalent to `Date()` (page 916).

Only present if there are entries in the oplog.

## `db.getSiblingDB()`

### Definition

`db.getSiblingDB(<database>)`

**param string database** The name of a MongoDB database.

**Returns** A database object.

Used to return another database without modifying the `db` variable in the shell environment.

**Example** You can use `db.getSiblingDB()` (page 888) as an alternative to the `use <database>` helper. This is particularly useful when writing scripts using the `mongo` (page 942) shell where the `use` helper is not available. Consider the following sequence of operations:

---

```
db = db.getSiblingDB('users')
db.active.count()
```

This operation sets the db object to point to the database named users, and then returns a [count](#) (page 809) of the collection named active. You can create multiple db objects, that refer to different databases, as in the following sequence of operations:

```
users = db.getSiblingDB('users')
records = db.getSiblingDB('records')

users.active.count()
users.active.findOne()

records.requests.count()
records.requests.findOne()
```

This operation creates two db objects referring to different databases (i.e. users and records,) and then returns a [count](#) (page 809) and an [example document](#) (page 824) from one collection in that database (i.e. active and requests respectively.)

### **db.help()**

```
db.help()
```

**Returns** Text output listing common methods on the db object.

### **db.hostInfo()**

```
db.hostInfo()
```

New in version 2.2.

**Returns** A document with information about the underlying system that the mongod (page 925) or mongos (page 938) runs on. Some of the returned fields are only included on some platforms.

`db.hostInfo()` (page 889) provides a helper in the mongo (page 942) shell around the `hostInfo` (page 780) The output of `db.hostInfo()` (page 889) on a Linux system will resemble the following:

```
{
 "system" : {
 "currentTime" : ISODate("<timestamp>"),
 "hostname" : "<hostname>",
 "cpuAddrSize" : <number>,
 "memSizeMB" : <number>,
 "numCores" : <number>,
 "cpuArch" : "<identifier>",
 "numaEnabled" : <boolean>
 },
 "os" : {
 "type" : "<string>",
 "name" : "<string>",
 "version" : "<string>"
 },
 "extra" : {
 "versionString" : "<string>",
 "libcVersion" : "<string>",
 "kernelVersion" : "<string>",
 "cpuFrequencyMHz" : "<string>",
 "cpuFeatures" : "<string>",
 "pageSize" : <number>,
 }
}
```

```
 "numPages" : <number>,
 "maxOpenFiles" : <number>
 },
 "ok" : <return>
}
```

See [hostInfo](#) (page 781) for full documentation of the output of [db.hostInfo\(\)](#) (page 889).

### **db.isMaster()**

**db.isMaster()**

**Returns** A document that describes the role of the [mongod](#) (page 925) instance.

If the [mongod](#) (page 925) is a member of a *replica set*, then the [ismaster](#) (page 733) and [secondary](#) (page 733) fields report if the instance is the [primary](#) or if it is a [secondary](#) member of the replica set.

---

#### See

[isMaster](#) (page 732) for the complete documentation of the output of [db.isMaster\(\)](#) (page 890).

---

### **db.killOp()**

#### Description

**db.killOp(opid)**

Terminates an operation as specified by the operation ID. To find operations and their corresponding IDs, see [db.currentOp\(\)](#) (page 879).

The [db.killOp\(\)](#) (page 890) method has the following parameter:

**param number opid** An operation ID.

**Warning:** Terminate running operations with extreme caution. Only use [db.killOp\(\)](#) (page 890) to terminate operations initiated by clients and *do not* terminate internal database operations.

### **db.listCommands()**

**db.listCommands()**

Provides a list of all database commands. See the [Database Commands](#) (page 694) document for a more extensive index of these options.

### **db.loadServerScripts()**

**db.loadServerScripts()**

[db.loadServerScripts\(\)](#) (page 890) loads all scripts in the `system.js` collection for the current database into the [mongo](#) (page 942) shell session.

Documents in the `system.js` collection have the following prototype form:

```
{ _id : "<name>" , value : <function> } }
```

The documents in the `system.js` collection provide functions that your applications can use in any JavaScript context with MongoDB in this database. These contexts include [\\$where](#) (page 634) clauses and [mapReduce](#) (page 701) operations.

**db.logout()****db.logout()**

Ends the current authentication session. This function has no effect if the current session is not authenticated.

---

**Note:** If you're not logged in and using authentication, `db.logout()` (page 891) has no effect.

Changed in version 2.4: Because MongoDB now allows users defined in one database to have privileges on another database, you must call `db.logout()` (page 891) while using the same database context that you authenticated to.

If you authenticated to a database such as `users` or `$external`, you must issue `db.logout()` (page 891) against this database in order to successfully log out.

---

**Example**

Use the `use <database-name>` helper in the interactive `mongo` (page 942) shell, or the following `db.getSiblingDB()` (page 888) in the interactive shell or in `mongo` (page 942) shell scripts to change the `db` object:

```
db = db.getSiblingDB('<database-name>')
```

When you have set the database context and `db` object, you can use the `db.logout()` (page 891) to log out of database as in the following operation:

```
db.logout()
```

---

`db.logout()` (page 891) function provides a wrapper around the database command `logout` (page 724).

**db.printCollectionStats()****db.printCollectionStats()**

Provides a wrapper around the `db.collection.stats()` (page 848) method. Returns statistics from every collection separated by three hyphen characters.

---

**Note:** The `db.printCollectionStats()` (page 891) in the `mongo` (page 942) shell does **not** return `JSON`. Use `db.printCollectionStats()` (page 891) for manual inspection, and `db.collection.stats()` (page 848) in scripts.

**See also:**

`collStats` (page 763)

**db.printReplicationInfo()****db.printReplicationInfo()**

Provides a formatted report of the status of a *replica set* from the perspective of the *primary* set member. See the `replSetGetStatus` (page 726) for more information regarding the contents of this output.

---

**Note:** The `db.printReplicationInfo()` (page 891) in the `mongo` (page 942) shell does **not** return `JSON`. Use `db.printReplicationInfo()` (page 891) for manual inspection, and `rs.status()` (page 898) in scripts.

**db.printShardingStatus()**

### Definition

`db.printShardingStatus()`

Prints a formatted report of the sharding configuration and the information regarding existing chunks in a *sharded cluster*.

Only use `db.printShardingStatus()` (page 892) when connected to a `mongos` (page 938) instance.

The `db.printShardingStatus()` (page 892) method has the following parameter:

**param Boolean verbose** If `true`, the method displays details of the document distribution across chunks when you have 20 or more chunks.

See `sh.status()` (page 910) for details of the output.

---

**Note:** The `db.printShardingStatus()` (page 892) in the `mongo` (page 942) shell does **not** return `JSON`. Use `db.printShardingStatus()` (page 892) for manual inspection, and `Config Database` (page 564) in scripts.

---

### See also:

`sh.status()` (page 910)

**db.printSlaveReplicationInfo()**

`db.printSlaveReplicationInfo()`

Provides a formatted report of the status of a *replica set* from the perspective of the *secondary* set member. See the `replSetGetStatus` (page 726) for more information regarding the contents of this output.

---

**Note:** The `db.printSlaveReplicationInfo()` (page 892) in the `mongo` (page 942) shell does **not** return `JSON`. Use `db.printSlaveReplicationInfo()` (page 892) for manual inspection, and `rs.status()` (page 898) in scripts.

---

**db.removeUser()**

### Definition

`db.removeUser(username)`

Removes the specified username from the database.

The `db.removeUser()` (page 892) method has the following parameter:

**param string username** The database username.

**db.repairDatabase()**

`db.repairDatabase()`

**Warning:** During normal operations, only use the `repairDatabase` (page 757) command and wrappers including `db.repairDatabase()` (page 892) in the `mongo` (page 942) shell and `mongod --repair`, to compact database files and/or reclaim disk space. Be aware that these operations remove and do not save any corrupt data during the repair process.

If you are trying to repair a *replica set* member, and you have access to an intact copy of your data (e.g. a recent backup or an intact member of the *replica set*), you should restore from that intact copy, and **not** use `repairDatabase` (page 757).

---

**Note:** When using `journaling`, there is almost never any need to run `repairDatabase` (page 757). In the event of an unclean shutdown, the server will be able to restore the data files to a pristine state automatically.

---

---

`db.repairDatabase()` (page 892) provides a wrapper around the database command `repairDatabase` (page 757), and has the same effect as the run-time option `mongod --repair` option, limited to *only* the current database. See `repairDatabase` (page 757) for full documentation.

**db.resetError()****db.resetError()**

Deprecated since version 1.6.

Resets the error message returned by `db.getPrevError` (page 887) or `getPrevError` (page 721). Provides a wrapper around the `resetError` (page 722) command.

**db.runCommand()****Definition****db.runCommand(command)**

Provides a helper to run specified *database commands* (page 694). This is the preferred method to issue database commands, as it provides a consistent interface between the shell and drivers.

**param document,string command** “A *database command*, specified either in *document* form or as a string. If specified as a string, `db.runCommand()` (page 893) transforms the string into a document.”

**db.serverBuildInfo()****db.serverBuildInfo()**

Provides a wrapper around the `buildInfo` (page 762) *database command*. `buildInfo` (page 762) returns a document that contains an overview of parameters used to compile this `mongod` (page 925) instance.

**db.serverStatus()****db.serverStatus()**

Returns a *document* that provides an overview of the database process’s state.

This command provides a wrapper around the database command `serverStatus` (page 782).

Changed in version 2.4: In 2.4 you can dynamically suppress portions of the `db.serverStatus()` (page 893) output, or include suppressed sections in a document passed to the `db.serverStatus()` (page 893) method, as in the following example:

```
db.serverStatus({ repl: 0, indexCounters: 0, locks: 0 })
db.serverStatus({ workingSet: 1, metrics: 0, locks: 0 })
```

`db.serverStatus()` (page 893) includes all fields by default, except `workingSet` (page 795), by default.

---

**Note:** You may only dynamically include top-level fields from the `serverStatus` (page 782) document that are not included by default. You can exclude any field that `db.serverStatus()` (page 893) includes by default.

**See also:**

`serverStatus` (page 782) for complete documentation of the output of this function.

**db.setProfilingLevel()**

## Definition

`db.setProfilingLevel (level, slowms)`

Modifies the current [database profiler](#) level used by the database profiling system to capture data about performance. The method provides a wrapper around the [database command profile](#) (page 770).

**param integer level** Specifies a profiling level, which is either 0 for no profiling, 1 for only slow operations, or 2 for all operations.

**param integer slowms** Sets the threshold in milliseconds for the profile to consider a query or operation to be slow.

The level chosen can affect performance. It also can allow the server to write the contents of queries to the log, which might have information security implications for your deployment.

Configure the `slowms` (page 997) option to set the threshold for the profiler to consider a query “slow.” Specify this value in milliseconds to override the default.

`mongod` (page 925) writes the output of the database profiler to the `system.profile` collection.

`mongod` (page 925) prints information about queries that take longer than the `slowms` (page 997) to the log even when the database profiler is not active.

---

**Note:** The database cannot be locked with `db.fsyncLock()` (page 885) while profiling is enabled. You must disable profiling before locking the database with `db.fsyncLock()` (page 885). Disable profiling using `db.setProfilingLevel()` (page 894) as follows in the `mongo` (page 942) shell:

---

```
db.setProfilingLevel(0)
```

## db.shutdownServer()

`db.shutdownServer()`

Shuts down the current `mongod` (page 925) or `mongos` (page 938) process cleanly and safely.

This operation fails when the current database *is not* the [admin database](#).

This command provides a wrapper around the `shutdown` (page 759).

## db.stats()

### Description

`db.stats (scale)`

Returns statistics that reflect the use state of a single [database](#).

The `db.stats()` (page 894) method has the following parameter:

**param number scale** The scale at which to deliver results. Unless specified, this command returns all data in bytes.

**Returns** A [document](#) with statistics reflecting the database system’s state. For an explanation of the output, see `dbStats` (page 767).

The `db.stats()` (page 894) method is a wrapper around the `dbStats` (page 767) database command.

**Example** The following example converts the returned values to kilobytes:

```
db.stats(1024)
```

---

**Note:** The scale factor rounds values to whole numbers. This can produce unpredictable and unexpected results in some situations.

---

**db.version()****db.version()**

**Returns** The version of the [mongod](#) (page 925) or [mongos](#) (page 938) instance.

**Replication****Replication Methods**

| Name                                        | Description                                                                                                                                                                                                 |
|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <a href="#">rs.add()</a><br>(page 895)      | Adds a member to a replica set.                                                                                                                                                                             |
| <a href="#">rs.addArb()</a><br>(page 896)   | Adds an <i>arbiter</i> to a replica set.                                                                                                                                                                    |
| <a href="#">rs.conf()</a><br>(page 896)     | Returns the replica set configuration document.                                                                                                                                                             |
| <a href="#">rs.freeze()</a><br>(page 897)   | Prevents the current member from seeking election as primary for a period of time.                                                                                                                          |
| <a href="#">rs.help()</a><br>(page 897)     | Returns basic help text for <i>replica set</i> functions.                                                                                                                                                   |
| <a href="#">rs.initiate()</a><br>(page 897) | Initializes a new replica set.                                                                                                                                                                              |
| <a href="#">rs.reconfig()</a><br>(page 897) | Re-configures a replica set by applying a new replica set configuration object.                                                                                                                             |
| <a href="#">rs.remove()</a><br>(page 898)   | Remove a member from a replica set.                                                                                                                                                                         |
| <a href="#">rs.slaveOk()</a><br>(page 898)  | Sets the <code>slaveOk</code> property for the current connection. Deprecated. Use <a href="#">readPref()</a> (page 871) and <a href="#">Mongo.setReadPref()</a> (page 919) to set <i>read preference</i> . |
| <a href="#">rs.status()</a><br>(page 898)   | Returns a document with information about the state of the replica set.                                                                                                                                     |
| <a href="#">rs.stepDown()</a><br>(page 899) | Causes the current <i>primary</i> to become a secondary which forces an <i>election</i> .                                                                                                                   |
| <a href="#">rs.syncFrom()</a><br>(page 899) | Sets the member that this replica set member will sync from, overriding the default sync target selection logic.                                                                                            |

**rs.add()****Definition****rs.add(host, arbiterOnly)**

Adds a member to a *replica set*.

**param string,document host** The new member to add to the replica set. If a string, specifies the hostname and optionally the port number for the new member. If a document, specifies a replica set members document, as found in the [members](#) (page 480) array. To view a replica set's members array, run [rs.conf\(\)](#) (page 896).

**param boolean arbiterOnly** Applies only if the <host> value is a string. If `true`, the added host is an arbiter.”

You may specify new hosts in one of two ways:

- 1.as a “hostname” with an optional port number to use the default configuration as in the [Add a Member to an Existing Replica Set](#) (page 435) example.
- 2.as a configuration *document*, as in the [Configure and Add a Member](#) (page 435) example.

This function will disconnect the shell briefly and forces a reconnection as the replica set renegotiates which member will be *primary*. As a result, the shell will display an error even if this command succeeds.

`rs.add()` (page 895) provides a wrapper around some of the functionality of the “[rep1SetReconfig](#) (page 729)” *database command* and the corresponding shell helper `rs.reconfig()` (page 897). See the [Replica Set Configuration](#) (page 479) document for full documentation of all replica set configuration options.

**Example** To add a `mongod` (page 925) accessible on the default port 27017 running on the host `mongodb3.example.net`, use the following `rs.add()` (page 895) invocation:

```
rs.add('mongodb3.example.net:27017')
```

If `mongodb3.example.net` is an arbiter, use the following form:

```
rs.add('mongodb3.example.net:27017', true)
```

To add `mongodb3.example.net` as a *secondary-only* (page 386) member of set, use the following form of `rs.add()` (page 895):

```
rs.add({ "_id": 3, "host": "mongodb3.example.net:27017", "priority": 0 })
```

Replace, 3 with the next unused `_id` value in the replica set. See `rs.conf()` (page 896) to see the existing `_id` values in the replica set configuration document.

See the [Replica Set Configuration](#) (page 479) and [Replica Set Tutorials](#) (page 419) documents for more information.

## rs.addArb()

### Description

`rs.addArb(host)`

Adds a new *arbiter* to an existing replica set.

The `rs.addArb()` (page 896) method takes the following parameter:

**param string host** Specifies the hostname and optionally the port number of the arbiter member to add to replica set.

This function briefly disconnects the shell and forces a reconnection as the replica set renegotiates which member will be *primary*. As a result, the shell displays an error even if this command succeeds.

## rs.conf()

`rs.conf()`

**Returns** a *document* that contains the current *replica set* configuration document.

See [Replica Set Configuration](#) (page 479) for more information on the replica set configuration document.

`rs.config()`

`rs.config()` (page 896) is an alias of `rs.conf()` (page 896).

**rs.freeze()****Description****rs.freeze (seconds)**

Makes the current *replica set* member ineligible to become *primary* for the period specified.

The `rs.freeze ()` (page 897) method has the following parameter:

**param number seconds** The duration the member is ineligible to become primary.

`rs.freeze ()` (page 897) provides a wrapper around the *database command* `replSetFreeze` (page 726).

**rs.help()****rs.help ()**

Returns a basic help text for all of the *replication* (page 377) related shell functions.

**rs.initiate()****Description****rs.initiate (configuration)**

Initiates a *replica set*. Optionally takes a configuration argument in the form of a *document* that holds the configuration of a replica set.

The `rs.initiate ()` (page 897) method has the following parameter:

**param document configuration** A *document* that specifies *configuration settings* (page 479) for the new replica set. If a configuration is not specified, MongoDB uses a default configuration.

The `rs.initiate ()` (page 897) method provides a wrapper around the “`replSetInitiate` (page 728)” *database command*.

**Replica Set Configuration** See *Member Configuration Tutorials* (page 438) and *Replica Set Configuration* (page 479) for examples of replica set configuration and invitation objects.

**rs.reconfig()****Definition****rs.reconfig (configuration, force)**

Initializes a new *replica set* configuration. Disconnects the shell briefly and forces a reconnection as the replica set renegotiates which member will be *primary*. As a result, the shell will display an error even if this command succeeds.

**param document configuration** A *document* that specifies the configuration of a replica set.

**param document force** “If set as { force: true }, this forces the replica set to accept the new configuration even if a majority of the members are not accessible. Use with caution, as this can lead to term:*rollback* situations.”

`rs.reconfig ()` (page 897) overwrites the existing replica set configuration. Retrieve the current configuration object with `rs.conf ()` (page 896), modify the configuration as needed and then use `rs.reconfig ()` (page 897) to submit the modified configuration object.

`rs.reconfig ()` (page 897) provides a wrapper around the “`replSetReconfig` (page 729)” *database command*.

**Examples** To reconfigure a replica set, use the following sequence of operations:

```
conf = rs.conf()

// modify conf to change configuration

rs.reconfig(conf)
```

If you want to force the reconfiguration if a majority of the set is not connected to the current member, or you are issuing the command against a secondary, use the following form:

```
conf = rs.conf()

// modify conf to change configuration

rs.reconfig(conf, { force: true })
```

**Warning:** Forcing a `rs.reconfig()` (page 897) can lead to `rollback` situations and other difficult to recover from situations. Exercise caution when using this option.

### See also:

[Replica Set Configuration](#) (page 479) and [Replica Set Tutorials](#) (page 419).

## rs.remove()

### Definition

`rs.remove(hostname)`

Removes the member described by the `hostname` parameter from the current *replica set*. This function will disconnect the shell briefly and forces a reconnection as the *replica set* renegotiates which member will be *primary*. As a result, the shell will display an error even if this command succeeds.

The `rs.remove()` (page 898) method has the following parameter:

**param string hostname** The hostname of a system in the replica set.

---

**Note:** Before running the `rs.remove()` (page 898) operation, you must *shut down* the replica set member that you're removing.

Changed in version 2.2: This procedure is no longer required when using `rs.remove()` (page 898), but it remains good practice.

---

## rs.slaveOk()

`rs.slaveOk()`

Provides a shorthand for the following operation:

```
db.getMongo().setSlaveOk()
```

This allows the current connection to allow read operations to run on *secondary* members. See the `readPref()` (page 871) method for more fine-grained control over *read preference* (page 405) in the `mongo` (page 942) shell.

## rs.status()

`rs.status()`

**Returns** A *document* with status information.

This output reflects the current status of the replica set, using data derived from the heartbeat packets sent by the other members of the replica set.

This method provides a wrapper around the [rep1SetGetStatus](#) (page 726) *database command*.

## rs.stepDown()

### Description

**rs.stepDown(seconds)**

Forces the current *replica set* member to step down as *primary* and then attempt to avoid election as primary for the designated number of seconds. Produces an error if the current member is not the primary.

The [rs.stepDown\(\)](#) (page 899) method has the following parameter:

**param number seconds** The duration of time that the stepped-down member attempts to avoid re-election as primary. If this parameter is not specified, the method uses the default value of 60 seconds.

This function disconnects the shell briefly and forces a reconnection as the replica set renegotiates which member will be primary. As a result, the shell will display an error even if this command succeeds.

[rs.stepDown\(\)](#) (page 899) provides a wrapper around the *database command* [rep1SetStepDown](#) (page 730).

## rs.syncFrom()

**rs.syncFrom()**

New in version 2.2.

Provides a wrapper around the [rep1SetSyncFrom](#) (page 730), which allows administrators to configure the member of a replica set that the current member will pull data from. Specify the name of the member you want to replicate from in the form of [hostname] : [port].

See [rep1SetSyncFrom](#) (page 730) for more details.



## Sharding

### Sharding Methods

| Name                                                                         | Description                                                                                                                                                                          |
|------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>sh._adminCommand</code><br>(page 902)                                  | Runs a <i>database command</i> against the admin database, like <code>db.runCommand()</code> (page 893), but can confirm that it is issued against a <code>mongos</code> (page 938). |
| <code>sh._checkFullName()</code><br>(page 902)                               | Tests a namespace to determine if its well formed.                                                                                                                                   |
| <code>sh._checkMongos()</code><br>(page 902)                                 | Tests to see if the <code>mongo</code> (page 942) shell is connected to a <code>mongos</code> (page 938) instance.                                                                   |
| <code>sh._lastMigration()</code><br>(page 902)                               | Reports on the last <i>chunk</i> migration.                                                                                                                                          |
| <code>sh.addShard()</code><br>(page 903)                                     | Adds a <i>shard</i> to a sharded cluster.                                                                                                                                            |
| <code>sh.addShardTag()</code><br>(page 904)                                  | Associates a shard with a tag, to support <i>tag aware sharding</i> (page 557).                                                                                                      |
| <code>sh.addTagRange()</code><br>(page 904)                                  | Associates range of shard keys with a shard tag, to support <i>tag aware sharding</i> (page 557).                                                                                    |
| <code>sh.disableBalancing</code><br>(page 905)                               | Disable balancing on a single collection in a sharded database. Does not affect balancing of other collections in a sharded cluster.                                                 |
| <code>sh.enableBalancing</code><br>(page 905)                                | Activates the sharded collection balancer process if previously disabled using <code>sh.disableBalancing()</code> (page 905).                                                        |
| <code>sh.enableSharding()</code><br>(page 905)                               | Enables sharding on a specific database.                                                                                                                                             |
| <code>sh.getBalancerHost</code><br>(page 906)                                | Returns the name of a <code>mongos</code> (page 938) that's responsible for the balancer process.                                                                                    |
| <code>sh.getBalancerState</code><br>(page 906)                               | Returns a boolean to report if the <i>balancer</i> is currently enabled.                                                                                                             |
| <code>sh.help()</code> (page 906)                                            | Returns help text for the <code>sh</code> methods.                                                                                                                                   |
| <code>sh.isBalancerRunning</code><br>(page 907)                              | Returns a boolean to report if the balancer process is currently migrating chunks.                                                                                                   |
| <code>sh.moveChunk()</code><br>(page 907)                                    | Migrates a <i>chunk</i> in a <i>sharded cluster</i> .                                                                                                                                |
| <code>sh.removeShardTag()</code><br>(page 908)                               | Removes the association between a shard and a shard tag shard tag.                                                                                                                   |
| <code>sh.setBalancerState</code><br>(page 908)                               | Enables or disables the <i>balancer</i> which migrates <i>chunks</i> between <i>shards</i> .                                                                                         |
| <code>sh.shardCollection</code><br>(page 908)                                | Enables sharding for a collection.                                                                                                                                                   |
| <code>sh.splitAt()</code><br>(page 909)                                      | Divides an existing <i>chunk</i> into two chunks using a specific value of the <i>shard key</i> as the dividing point.                                                               |
| <code>sh.splitFind()</code><br>(page 909)                                    | Divides an existing <i>chunk</i> that contains a document matching a query into two approximately equal chunks.                                                                      |
| <code>sh.startBalancer()</code><br>(page 910)                                | Enables the <i>balancer</i> and waits for balancing to start.                                                                                                                        |
| <code>sh.status()</code><br>(page 910)                                       | Reports on the status of a <i>sharded cluster</i> , as <code>db.printShardingStatus()</code> (page 892).                                                                             |
| <code>sh.stopBalancer()</code><br>(page 912)                                 | Disables the <i>balancer</i> and waits for any in progress balancing rounds to complete.                                                                                             |
| <code>sh.waitForBalancer</code><br>(page 913)                                | Internal. Waits for the balancer state to change.                                                                                                                                    |
| <code>sh.waitForBalancer</code><br>(page 913)                                | Internal. Waits until the balancer stops running.                                                                                                                                    |
| <code>sh.waitForBlock</code><br><b>11.1. MongoDB Interface</b><br>(page 914) | Internal. Waits for a specified distributed <i>sharded cluster</i> lock.                                                                                                             |
| <code>sh.waitForPingChange</code><br>(page 914)                              | Internal. Waits for a change in ping state from one of the <code>mongos</code> (page 938) in the sharded cluster.                                                                    |

## sh.\_adminCommand()

### Definition

`sh._adminCommand(command, checkMongos)`

Runs a database command against the admin database of a [mongos](#) (page 938) instance.

**param string command** A database command to run against the `admin` database.

**param boolean checkMongos** Require verification that the shell is connected to a [mongos](#) (page 938) instance.

**See also:**

[db.runCommand\(\)](#) (page 893)

## sh.\_checkFullName()

### Definition

`sh._checkFullName(namespace)`

Verifies that a `namespace` name is well formed. If the namespace is well formed, the `sh._checkFullName()` (page 902) method exits *with no message*.

**Throws** If the namespace is not well formed, `sh._checkFullName()` (page 902) throws: “name needs to be fully qualified <db>. <collection>”

The `sh._checkFullName()` (page 902) method has the following parameter:

**param string namespace** The `namespace` of a collection. The namespace is the combination of the database name and the collection name. Enclose the namespace in quotation marks.

## sh.\_checkMongos()

`sh._checkMongos()`

**Returns** nothing

**Throws** “not connected to a mongos”

The `sh._checkMongos()` (page 902) method throws an error message if the [mongo](#) (page 942) shell is not connected to a [mongos](#) (page 938) instance. Otherwise it exits (no return document or return code).

## sh.\_lastMigration()

### Definition

`sh._lastMigration(namespace)`

Returns information on the last migration performed on the specified database or collection.

The `sh._lastMigration()` (page 902) method has the following parameter:

**param string namespace** The `namespace` of a database or collection within the current database.

**Output** The `sh._lastMigration()` (page 902) method returns a document with details about the last migration performed on the database or collection. The document contains the following output:

`sh._lastMigration._id`

The id of the migration task.

**sh.\_lastMigration.server**

The name of the server.

**sh.\_lastMigration.clientAddr**

The IP address and port number of the server.

**sh.\_lastMigration.time**

The time of the last migration, formatted as *ISODate*.

**sh.\_lastMigration.what**

The specific type of migration.

**sh.\_lastMigration.ns**

The complete *namespace* of the collection affected by the migration.

**sh.\_lastMigration.details**

A document containing details about the migrated chunk. The document includes min and max sub-documents with the bounds of the migrated chunk.

**sh.addShard()****Definition****sh.addShard(host)**

Adds a database instance or replica set to a *sharded cluster*. The optimal configuration is to deploy shards across *replica sets*. This method must be run on a *mongos* (page 938) instance.

The `sh.addShard()` (page 903) method has the following parameter:

**param string host** The hostname of either a standalone database instance or of a replica set. Include the port number if the instance is running on a non-standard port. Include the replica set name if the instance is a replica set, as explained below.

The `sh.addShard()` (page 903) method has the following prototype form:

```
sh.addShard("<host>")
```

The `host` parameter can be in any of the following forms:

```
[hostname]
[hostname]:[port]
[replica-set-name]/[hostname]
[replica-set-name]/[hostname]:port
```

**Warning:** Do not use `localhost` for the hostname unless your *configuration server* is also running on `localhost`.

The `sh.addShard()` (page 903) method is a helper for the `addShard` (page 736) command. The `addShard` (page 736) command has additional options which are not available with this helper.

**Example** To add a shard on a replica set, specify the name of the replica set and the hostname of at least one member of the replica set, as a seed. If you specify additional hostnames, all must be members of the same replica set.

The following example adds a replica set named `rep10` and specifies one member of the replica set:

```
sh.addShard("rep10/mongodb3.example.net:27327")
```

**sh.addShardTag()**

## Definition

`sh.addShardTag(shard, tag)`

New in version 2.2.

Associates a shard with a tag or identifier. MongoDB uses these identifiers to direct *chunks* that fall within a tagged range to specific shards. `sh.addTagRange()` (page 904) associates chunk ranges with tag ranges.

**param string shard** The name of the shard to which to give a specific tag.

**param string tag** The name of the tag to add to the shard.

Always issue `sh.addShardTag()` (page 904) when connected to a `mongos` (page 938) instance.

**Example** The following example adds three tags, NYC, LAX, and NRT, to three shards:

```
sh.addShardTag("shard0000", "NYC")
sh.addShardTag("shard0001", "LAX")
sh.addShardTag("shard0002", "NRT")
```

**See also:**

`sh.addTagRange()` (page 904) and `sh.removeShardTag()` (page 908).

## sh.addTagRange()

### Definition

`sh.addTagRange(namespace, minimum, maximum, tag)`

New in version 2.2.

Attaches a range of shard key values to a shard tag created using the `sh.addShardTag()` (page 904) method. `sh.addTagRange()` (page 904) takes the following arguments:

**param string namespace** The *namespace* of the sharded collection to tag.

**param document minimum** The minimum value of the *shard key* range to include in the tag. Specify the minimum value in the form of `<fieldname>:<value>`. This value must be of the same BSON type or types as the shard key.

**param document maximum** The maximum value of the shard key range to include in the tag. Specify the maximum value in the form of `<fieldname>:<value>`. This value must be of the same BSON type or types as the shard key.

**param string tag** The name of the tag to attach the range specified by the `minimum` and `maximum` arguments to.

Use `sh.addShardTag()` (page 904) to ensure that the balancer migrates documents that exist within the specified range to a specific shard or set of shards.

Always issue `sh.addTagRange()` (page 904) when connected to a `mongos` (page 938) instance.

---

**Note:** If you add a tag range to a collection using `sh.addTagRange()` (page 904) and then later drop the collection or its database, MongoDB does not remove the tag association. If you later create a new collection with the same name, the old tag association will apply to the new collection.

---

**Example** Given a shard key of `{state: 1, zip: 1}`, the following operation creates a tag range covering zip codes in New York State:

```
sh.addTagRange("exampledb.collection",
 { state: "NY", zip: MinKey },
 { state: "NY", zip: MaxKey },
 "NY"
)
```

## sh.disableBalancing()

### Description

`sh.disableBalancing(namespace)`

Disables the balancer for the specified sharded collection. This does not affect the balancing of *chunks* for other sharded collections in the same cluster.

The `sh.disableBalancing()` (page 905) method has the following parameter:

**param string namespace** The *namespace* of the collection.

For more information on the balancing process, see [Manage Sharded Cluster Balancer](#) (page 551) and [Sharded Collection Balancing](#) (page 516).

## sh.enableBalancing()

### Description

`sh.enableBalancing(collection)`

Enables the balancer for the specified sharded collection.

The `sh.enableBalancing()` (page 905) method has the following parameter:

**param string collection** The *namespace* of the collection.

---

**Important:** `sh.enableBalancing()` (page 905) does not *start* balancing. Rather, it allows balancing of this collection the next time the balancer runs.

---

For more information on the balancing process, see [Manage Sharded Cluster Balancer](#) (page 551) and [Sharded Collection Balancing](#) (page 516).

## sh.enableSharding()

### Definition

`sh.enableSharding(database)`

Enables sharding on the specified database. This does not automatically shard any collections but makes it possible to begin sharding collections using `sh.shardCollection()` (page 908).

The `sh.enableSharding()` (page 905) method has the following parameter:

**param string database** The name of the database shard. Enclose the name in quotation marks.

### See also:

`sh.shardCollection()` (page 908)

**sh.getBalancerHost()**

**sh.getBalancerHost()**

**Returns** String in form *hostname:port*

[sh.getBalancerHost \(\)](#) (page 906) returns the name of the server that is running the balancer.

**See also:**

- [sh.enableBalancing \(\)](#) (page 905)
- [sh.disableBalancing \(\)](#) (page 905)
- [sh.getBalancerState \(\)](#) (page 906)
- [sh.isBalancerRunning \(\)](#) (page 907)
- [sh.setBalancerState \(\)](#) (page 908)
- [sh.startBalancer \(\)](#) (page 910)
- [sh.stopBalancer \(\)](#) (page 912)
- [sh.waitForBalancer \(\)](#) (page 913)
- [sh.waitForBalancerOff \(\)](#) (page 913)

**sh.getBalancerState()**

**sh.getBalancerState()**

**Returns** boolean

[sh.getBalancerState \(\)](#) (page 906) returns true when the *balancer* is enabled and false if the balancer is disabled. This does not reflect the current state of balancing operations: use [sh.isBalancerRunning \(\)](#) (page 907) to check the balancer's current state.

**See also:**

- [sh.enableBalancing \(\)](#) (page 905)
- [sh.disableBalancing \(\)](#) (page 905)
- [sh.getBalancerHost \(\)](#) (page 906)
- [sh.isBalancerRunning \(\)](#) (page 907)
- [sh.setBalancerState \(\)](#) (page 908)
- [sh.startBalancer \(\)](#) (page 910)
- [sh.stopBalancer \(\)](#) (page 912)
- [sh.waitForBalancer \(\)](#) (page 913)
- [sh.waitForBalancerOff \(\)](#) (page 913)

**sh.help()**

**sh.help()**

**Returns** a basic help text for all sharding related shell functions.

**sh.isBalancerRunning()**  
**sh.isBalancerRunning()**

**Returns** boolean

Returns true if the *balancer* process is currently running and migrating chunks and false if the balancer process is not running. Use [sh.getBalancerState\(\)](#) (page 906) to determine if the balancer is enabled or disabled.

**See also:**

- [sh.enableBalancing\(\)](#) (page 905)
- [sh.disableBalancing\(\)](#) (page 905)
- [sh.getBalancerHost\(\)](#) (page 906)
- [sh.getBalancerState\(\)](#) (page 906)
- [sh.setBalancerState\(\)](#) (page 908)
- [sh.startBalancer\(\)](#) (page 910)
- [sh.stopBalancer\(\)](#) (page 912)
- [sh.waitForBalancer\(\)](#) (page 913)
- [sh.waitForBalancerOff\(\)](#) (page 913)

**sh.moveChunk()**

#### Definition

**sh.moveChunk(namespace, query, destination)**

Moves the *chunk* that contains the document specified by the *query* to the *destination shard*. [sh.moveChunk\(\)](#) (page 907) provides a wrapper around the [moveChunk](#) (page 742) database command and takes the following arguments:

- param string namespace** The *namespace* of the sharded collection that contains the chunk to migrate.
- param document query** An equality match on the shard key that selects the chunk to move.
- param string destination** The name of the shard to move.

---

**Important:** In most circumstances, allow the *balancer* to automatically migrate *chunks*, and avoid calling [sh.moveChunk\(\)](#) (page 907) directly.

**See also:**

[moveChunk](#) (page 742), [sh.splitAt\(\)](#) (page 909), [sh.splitFind\(\)](#) (page 909), [Sharding](#) (page 493), and [chunk migration](#) (page 518).

**Example** Given the *people* collection in the *records* database, the following operation finds the chunk that contains the documents with the *zipcode* field set to 53187 and then moves that chunk to the shard named *shard0019*:

```
sh.moveChunk("records.people", { zipcode: 53187 }, "shard0019")
```

**sh.removeShardTag()**

## Definition

`sh.removeShardTag(shard, tag)`

New in version 2.2.

Removes the association between a tag and a shard. Always issue `sh.removeShardTag()` (page 908) when connected to a `mongos` (page 938) instance.

**param string shard** The name of the shard from which to remove a tag.

**param string tag** The name of the tag to remove from the shard.

See also:

`sh.addShardTag()` (page 904), `sh.addTagRange()` (page 904)

## `sh.setBalancerState()`

### Description

`sh.setBalancerState(state)`

Enables or disables the *balancer*. Use `sh.getBalancerState()` (page 906) to determine if the balancer is currently enabled or disabled and `sh.isBalancerRunning()` (page 907) to check its current state.

The `sh.getBalancerState()` (page 906) method has the following parameter:

**param Boolean state** Set this to `true` to enable the balancer and `false` to disable it.

See also:

- `sh.enableBalancing()` (page 905)
- `sh.disableBalancing()` (page 905)
- `sh.getBalancerHost()` (page 906)
- `sh.getBalancerState()` (page 906)
- `sh.isBalancerRunning()` (page 907)
- `sh.startBalancer()` (page 910)
- `sh.stopBalancer()` (page 912)
- `sh.waitForBalancer()` (page 913)
- `sh.waitForBalancerOff()` (page 913)

## `sh.shardCollection()`

### Definition

`sh.shardCollection(namespace, key, unique)`

Shards a collection using the key as a the *shard key*. `sh.shardCollection()` (page 908) takes the following arguments:

**param string namespace** The *namespace* of the collection to shard.

**param document key** A *document* that specifies the *shard key* to use to *partition* and distribute objects among the shards. A shard key may be one field or multiple fields. A shard key with multiple fields is called a “compound shard key.”

**param Boolean unique** When true, ensures that the underlying index enforces a unique constraint. *Hashed shard keys* do not support unique constraints.

New in version 2.4: Use the form `{field: "hashed"}` to create a *hashed shard key*. Hashed shard keys may not be compound indexes.

**Warning:** MongoDB provides no method to deactivate sharding for a collection after calling `shardCollection` (page 738). Additionally, after `shardCollection` (page 738), you cannot change shard keys or modify the value of any field used in your shard key index.

#### See also:

`shardCollection` (page 738) for additional options, *Sharding* (page 493) and *Sharding Introduction* (page 493) for an overview of sharding, *Deploy a Sharded Cluster* (page 522) for a tutorial, and *Shard Keys* (page 506) for choosing a shard key.

**Example** Given the `people` collection in the `records` database, the following command shards the collection by the `zipcode` field:

```
sh.shardCollection("records.people", { zipcode: 1 })
```

### sh.splitAt()

#### Definition

`sh.splitAt(namespace, query)`

Splits the chunk containing the document specified by the query as if that document were at the “middle” of the collection, even if the specified document is not the actual median of the collection.

**param string namespace** The namespace (i.e. `<database>.<collection>`) of the sharded collection that contains the chunk to split.

**param document query** A query to identify a document in a specific chunk. Typically specify the *shard key* for a document as the query.

Use this command to manually split chunks unevenly. Use the “`sh.splitFind()` (page 909)” function to split a chunk at the actual median.

In most circumstances, you should leave chunk splitting to the automated processes within MongoDB. However, when initially deploying a *sharded cluster* it is necessary to perform some measure of *pre-splitting* using manual methods including `sh.splitAt()` (page 909).

### sh.splitFind()

#### Definition

`sh.splitFind(namespace, query)`

Splits the chunk containing the document specified by the query at its median point, creating two roughly equal chunks. Use `sh.splitAt()` (page 909) to split a collection in a specific point.

In most circumstances, you should leave chunk splitting to the automated processes. However, when initially deploying a *sharded cluster* it is necessary to perform some measure of *pre-splitting* using manual methods including `sh.splitFind()` (page 909).

**param string namespace** The namespace (i.e. `<database>.<collection>`) of the sharded collection that contains the chunk to split.

**param document query** A query to identify a document in a specific chunk. Typically specify the *shard key* for a document as the query.

## sh.startBalancer()

### Definition

`sh.startBalancer(timeout, interval)`

Enables the balancer in a sharded cluster and waits for balancing to initiate.

**param integer timeout** Milliseconds to wait.

**param integer interval** Milliseconds to sleep each cycle of waiting.

### See also:

- `sh.enableBalancing()` (page 905)
- `sh.disableBalancing()` (page 905)
- `sh.getBalancerHost()` (page 906)
- `sh.getBalancerState()` (page 906)
- `sh.isBalancerRunning()` (page 907)
- `sh.setBalancerState()` (page 908)
- `sh.stopBalancer()` (page 912)
- `sh.waitForBalancer()` (page 913)
- `sh.waitForBalancerOff()` (page 913)

## sh.status()

### Definition

`sh.status()`

Prints a formatted report of the sharding configuration and the information regarding existing chunks in a *sharded cluster*. The default behavior suppresses the detailed chunk information if the total number of chunks is greater than or equal to 20.

The `sh.status()` (page 910) method has the following parameter:

**param Boolean verbose** If `true`, the method displays details of the document distribution across chunks when you have 20 or more chunks.

### See also:

`db.printShardingStatus()` (page 892)

**Output Examples** The *Sharding Version* (page 911) section displays information on the *config database*:

```
--- Sharding Status ---
sharding version: {
 "_id" : <num>,
 "version" : <num>,
 "minCompatibleVersion" : <num>,
 "currentVersion" : <num>,
 "clusterId" : <ObjectId>
}
```

The *Shards* (page 912) section lists information on the shard(s). For each shard, the section displays the name, host, and the associated tags, if any.

```

shards:
{ "_id" : <shard name1>,
 "host" : <string>,
 "tags" : [<string> ...]
}
{ "_id" : <shard name2>,
 "host" : <string>,
 "tags" : [<string> ...]
}
...

```

The [Databases](#) (page 912) section lists information on the database(s). For each database, the section displays the name, whether the database has sharding enabled, and the [primary shard](#) for the database.

```

databases:
{ "_id" : <dbname1>,
 "partitioned" : <boolean>,
 "primary" : <string>
}
{ "_id" : <dbname2>,
 "partitioned" : <boolean>,
 "primary" : <string>
}
...

```

The [Sharded Collection](#) (page 912) section provides information on the sharding details for sharded collection(s). For each sharded collection, the section displays the shard key, the number of chunks per shard(s), the distribution of documents across chunks <sup>17</sup>, and the tag information, if any, for shard key range(s).

```

<dbname>.<collection>
 shard key: { <shard key> : <1 or hashed> }
 chunks:
 <shard name1> <number of chunks>
 <shard name2> <number of chunks>
 ...
 { <shard key>: <min range1> } -->> { <shard key> : <max range1> } on : <shard name> <last modified>
 { <shard key>: <min range2> } -->> { <shard key> : <max range2> } on : <shard name> <last modified>
 ...
 tag: <tag1> { <shard key> : <min rangel> } -->> { <shard key> : <max range1> }
 ...

```

## Output Fields

### Sharding Version

`sh.status.sharding-version._id`

The `_id` (page 911) is an identifier for the version details.

`sh.status.sharding-version.version`

The `version` (page 911) is the version of the [config server](#) for the sharded cluster.

`sh.status.sharding-version.minCompatibleVersion`

The `minCompatibleVersion` (page 911) is the minimum compatible version of the config server.

`sh.status.sharding-version.currentVersion`

The `currentVersion` (page 911) is the current version of the config server.

<sup>17</sup> The sharded collection section, by default, displays the chunk information if the total number of chunks is less than 20. To display the information when you have 20 or more chunks, call the `sh.status()` (page 910) methods with the `verbose` parameter set to `true`, i.e. `sh.status(true)`.

`sh.status.sharding-version.clusterId`

The `clusterId` (page 912) is the identification for the sharded cluster.

## Shards

`sh.status.shards._id`

The `_id` (page 912) displays the name of the shard.

`sh.status.shards.host`

The `host` (page 912) displays the host location of the shard.

`sh.status.shards.tags`

The `tags` (page 912) displays all the tags for the shard. The field only displays if the shard has tags.

## Databases

`sh.status.databases._id`

The `_id` (page 912) displays the name of the database.

`sh.status.databases.partitioned`

The `partitioned` (page 912) displays whether the database has sharding enabled. If `true`, the database has sharding enabled.

`sh.status.databases.primary`

The `primary` (page 912) displays the *primary shard* for the database.

## Sharded Collection

`sh.status.databases.shard-key`

The `shard-key` (page 912) displays the shard key specification document.

`sh.status.databases.chunks`

The `chunks` (page 912) lists all the shards and the number of chunks that reside on each shard.

`sh.status.databases.chunk-details`

The `chunk-details` (page 912) lists the details of the chunks <sup>1</sup>:

- The range of shard key values that define the chunk,
- The shard where the chunk resides, and
- The last modified timestamp for the chunk.

`sh.status.databases.tag`

The `tag` (page 912) lists the details of the tags associated with a range of shard key values.

## `sh.stopBalancer()`

### Definition

`sh.stopBalancer(timeout, interval)`

Disables the balancer in a sharded cluster and waits for balancing to complete.

**param integer timeout** Milliseconds to wait.

**param integer interval** Milliseconds to sleep each cycle of waiting.

See also:

- `sh.enableBalancing()` (page 905)
- `sh.disableBalancing()` (page 905)
- `sh.getBalancerHost()` (page 906)

- `sh.getBalancerState()` (page 906)
- `sh.isBalancerRunning()` (page 907)
- `sh.setBalancerState()` (page 908)
- `sh.startBalancer()` (page 910)
- `sh.waitForBalancer()` (page 913)
- `sh.waitForBalancerOff()` (page 913)

## **sh.waitForBalancer()**

### **Definition**

`sh.waitForBalancer(wait, timeout, interval)`

Waits for a change in the state of the balancer. `sh.waitForBalancer()` (page 913) is an internal method, which takes the following arguments:

- param Boolean wait** Set to `true` to ensure the balancer is now active. The default is `false`, which waits until balancing stops and becomes inactive.
- param integer timeout** Milliseconds to wait.
- param integer interval** Milliseconds to sleep.

## **sh.waitForBalancerOff()**

### **Definition**

`sh.waitForBalancerOff(timeout, interval)`

Internal method that waits until the balancer is not running.

- param integer timeout** Milliseconds to wait.
- param integer interval** Milliseconds to sleep.

### **See also:**

- `sh.enableBalancing()` (page 905)
- `sh.disableBalancing()` (page 905)
- `sh.getBalancerHost()` (page 906)
- `sh.getBalancerState()` (page 906)
- `sh.isBalancerRunning()` (page 907)
- `sh.setBalancerState()` (page 908)
- `sh.startBalancer()` (page 910)
- `sh.stopBalancer()` (page 912)
- `sh.waitForBalancer()` (page 913)

## **sh.waitForDLock()**

**Definition****sh.waitForDLock (lockname, wait, timeout, interval)**

Waits until the specified distributed lock changes state. [sh.waitForDLock \(\)](#) (page 914) is an internal method that takes the following arguments:

**param string lockname** The name of the distributed lock.

**param Boolean wait** Set to `true` to ensure the balancer is now active. Set to `false` to wait until balancing stops and becomes inactive.

**param integer timeout** Milliseconds to wait.

**param integer interval** Milliseconds to sleep in each waiting cycle.

**sh.waitForPingChange()****Definition****sh.waitForPingChange (activePings, timeout, interval)**

[sh.waitForPingChange \(\)](#) (page 914) waits for a change in ping state of one of the `activepings`, and only returns when the specified ping changes state.

**param array activePings** An array of active pings from the [mongos](#) (page 568) collection.

**param integer timeout** Number of milliseconds to wait for a change in ping state.

**param integer interval** Number of milliseconds to sleep in each waiting cycle.

**Subprocess****Subprocess Methods**

| Name                                                     | Description       |
|----------------------------------------------------------|-------------------|
| <a href="#">clearRawMongoProgramOutput ()</a> (page 914) | For internal use. |
| <a href="#">rawMongoProgramOutput ()</a> (page 914)      | For internal use. |
| <a href="#">run ()</a>                                   | For internal use. |
| <a href="#">runMongoProgram ()</a> (page 915)            | For internal use. |
| <a href="#">runProgram ()</a> (page 915)                 | For internal use. |
| <a href="#">startMongoProgram ()</a>                     | For internal use. |
| <a href="#">stopMongoProgram ()</a> (page 915)           | For internal use. |
| <a href="#">stopMongoProgramByPid ()</a> (page 915)      | For internal use. |
| <a href="#">stopMongod ()</a> (page 915)                 | For internal use. |
| <a href="#">waitMongoProgramOnPort ()</a> (page 915)     | For internal use. |
| <a href="#">waitProgram ()</a> (page 915)                | For internal use. |

**clearRawMongoProgramOutput()****clearRawMongoProgramOutput ()**

For internal use.

**rawMongoProgramOutput()****rawMongoProgramOutput ()**

For internal use.

---

**run()**  
**run()**  
 For internal use.

**runMongoProgram()**  
**runMongoProgram()**  
 For internal use.

**runProgram()**  
**runProgram()**  
 For internal use.

**startMongoProgram()**  
**\_startMongoProgram()**  
 For internal use.

**stopMongoProgram()**  
**stopMongoProgram()**  
 For internal use.

**stopMongoProgramByPid()**  
**stopMongoProgramByPid()**  
 For internal use.

**stopMongod()**  
**stopMongod()**  
 For internal use.

**waitMongoProgramOnPort()**  
**waitForMongoProgramOnPort()**  
 For internal use.

**waitProgram()**  
**waitForProgram()**  
 For internal use.

## Constructors

### Object Constructors and Methods

| Name                                            | Description                                                                                  |
|-------------------------------------------------|----------------------------------------------------------------------------------------------|
| <code>Date()</code> (page 916)                  | Creates a date object. By default creates a date object including the current date.          |
| <code>UUID()</code> (page 916)                  | Converts a 32-byte hexadecimal string to the UUID BSON subtype.                              |
| <code>ObjectId.getTimestamp()</code> (page 916) | Returns the timestamp portion of an <code>ObjectId</code> .                                  |
| <code>ObjectId.toString()</code> (page 916)     | Displays the string representation of an <code>ObjectId</code> .                             |
| <code>ObjectId.valueOf()</code> (page 917)      | Displays the <code>str</code> attribute of an <code>ObjectId</code> as a hexadecimal string. |

**Date()**

`Date()`

**Returns** Current date, as a string.

**UUID()**

**Definition**

`UUID(<string>)`

Generates a BSON UUID object.

**param string hex** Specify a 32-byte hexadecimal string to convert to the UUID BSON subtype.

**Returns** A BSON UUID object.

**Example** Create a 32 byte hexadecimal string:

```
var myuuid = '0123456789abcdefeffedcba9876543210'
```

Convert it to the BSON UUID subtype:

```
UUID(myuuid)
BinData(3, "ASNFZ4mrze/+3LqYdlQyEA==")
```

**ObjectId.getTimestamp()**

`ObjectId.getTimestamp()`

**Returns** The timestamp portion of the `ObjectId()` (page 104) object as a Date.

In the following example, call the `getTimestamp()` (page 916) method on an ObjectId (e.g. `ObjectId("507c7f79bcf86cd7994f6c0e")`):

```
ObjectId("507c7f79bcf86cd7994f6c0e").getTimestamp()
```

This will return the following output:

```
ISODate("2012-10-15T21:26:17Z")
```

**ObjectId.toString()**

`ObjectId.toString()`

**Returns** The string representation of the `ObjectId()` (page 104) object. This value has the format of `ObjectId(...)`.

Changed in version 2.2: In previous versions `ObjectId.toString()` (page 916) returns the value of the ObjectId as a hexadecimal string.

In the following example, call the `toString()` (page 916) method on an ObjectId (e.g. `ObjectId("507c7f79bcf86cd7994f6c0e")`):

```
ObjectId("507c7f79bcf86cd7994f6c0e").toString()
```

This will return the following string:

```
ObjectId("507c7f79bcf86cd7994f6c0e")
```

You can confirm the type of this object using the following operation:

```
typeof ObjectId("507c7f79bcf86cd7994f6c0e").toString()
```

### ObjectId.valueOf()

ObjectId.**valueOf**()

**Returns** The value of the [ObjectId\(\)](#) (page 104) object as a lowercase hexadecimal string. This value is the `str` attribute of the `ObjectId()` object.

Changed in version 2.2: In previous versions `ObjectId.valueOf()` (page 917) returns the `ObjectId()` object.

In the following example, call the `valueOf()` (page 917) method on an `ObjectId` (e.g. `ObjectId("507c7f79bcf86cd7994f6c0e")`):

```
ObjectId("507c7f79bcf86cd7994f6c0e").valueOf()
```

This will return the following string:

```
507c7f79bcf86cd7994f6c0e
```

You can confirm the type of this object using the following operation:

```
typeof ObjectId("507c7f79bcf86cd7994f6c0e").valueOf()
```

## Connection

### Connection Methods

| Name                                              | Description                                                                        |
|---------------------------------------------------|------------------------------------------------------------------------------------|
| <code>Mongo.getDB()</code> (page 917)             | Returns a database object.                                                         |
| <code>Mongo.getReadPrefMode()</code> (page 918)   | Returns the current read preference mode for the MongoDB connection.               |
| <code>Mongo.getReadPrefTagSet()</code> (page 918) | Returns the read preference tag set for the MongoDB connection.                    |
| <code>Mongo.setReadPref()</code> (page 919)       | Sets the <i>read preference</i> for the MongoDB connection.                        |
| <code>Mongo.setSlaveOk()</code> (page 919)        | Allows operations on the current connection to read from <i>secondary</i> members. |
| <code>Mongo()</code> (page 919)                   | Creates a new connection object.                                                   |
| <code>connect()</code>                            | Connects to a MongoDB instance and to a specified database on that instance.       |

### Mongo.getDB()

#### Description

`Mongo.getDB(<database>)`

Provides access to database objects from the `mongo` (page 942) shell or from a JavaScript file.

The `Mongo.getDB()` (page 917) method has the following parameter:

**param string database** The name of the database to access.

**Example** The following example instantiates a new connection to the MongoDB instance running on the localhost interface and returns a reference to "myDatabase":

```
db = new Mongo().getDB("myDatabase");
```

**See also:**

[Mongo\(\)](#) (page 919) and [connect\(\)](#) (page 920)

### **Mongo.getReadPrefMode()**

[Mongo.getReadPrefMode\(\)](#)

**Returns** The current *read preference* mode for the [Mongo\(\)](#) (page 887) connection object.

See [Read Preference](#) (page 405) for an introduction to read preferences in MongoDB. Use [getReadPrefMode\(\)](#) (page 918) to return the current read preference mode, as in the following example:

```
db.getMongo().getReadPrefMode()
```

Use the following operation to return and print the current read preference mode:

```
print(db.getMongo().getReadPrefMode());
```

This operation will return one of the following read preference modes:

- [primary](#) (page 489)
- [primaryPreferred](#) (page 489)
- [secondary](#) (page 489)
- [secondaryPreferred](#) (page 489)
- [nearest](#) (page 490)

**See also:**

[Read Preference](#) (page 405), [readPref\(\)](#) (page 871), [setReadPref\(\)](#) (page 919), and [getReadPrefTagSet\(\)](#) (page 918).

### **Mongo.getReadPrefTagSet()**

[Mongo.getReadPrefTagSet\(\)](#)

**Returns** The current *read preference* tag set for the [Mongo\(\)](#) (page 887) connection object.

See [Read Preference](#) (page 405) for an introduction to read preferences and tag sets in MongoDB. Use [getReadPrefTagSet\(\)](#) (page 918) to return the current read preference tag set, as in the following example:

```
db.getMongo().getReadPrefTagSet()
```

Use the following operation to return and print the current read preference tag set:

```
printjson(db.getMongo().getReadPrefTagSet());
```

**See also:**

[Read Preference](#) (page 405), [readPref\(\)](#) (page 871), [setReadPref\(\)](#) (page 919), and [getReadPrefTagSet\(\)](#) (page 918).

### **Mongo.setReadPref()**

**Definition**

`Mongo.setReadPref(mode, tagSet)`

Call the `setReadPref()` (page 919) method on a `Mongo` (page 887) connection object to control how the client will route all queries to members of the replica set.

**param string mode** One of the following *read preference* modes: `primary` (page 489), `primaryPreferred` (page 489), `secondary` (page 489), `secondaryPreferred` (page 489), or `nearest` (page 490).

**param array tagSet** A tag set used to specify custom read preference modes. For details, see *Tag Sets* (page 407).

**Examples** To set a read preference mode in the `mongo` (page 942) shell, use the following operation:

```
db.getMongo().setReadPref('primaryPreferred')
```

To set a read preference that uses a tag set, specify an array of tag sets as the second argument to `Mongo.setReadPref()` (page 919), as in the following:

```
db.getMongo().setReadPref('primaryPreferred', [{ "dc": "east" }])
```

You can specify multiple tag sets, in order of preference, as in the following:

```
db.getMongo().setReadPref('secondaryPreferred',
 [{ "dc": "east", "use": "production" },
 { "dc": "east", "use": "reporting" },
 { "dc": "east" },
 {}]
)
```

If the replica set cannot satisfy the first tag set, the client will attempt to use the second read preference. Each tag set can contain zero or more field/value tag pairs, with an “empty” document acting as a wildcard which matches a replica set member with any tag set or no tag set.

---

**Note:** You must call `Mongo.setReadPref()` (page 919) on the connection object before retrieving documents using that connection to use that read preference.

---

**mongo.setSlaveOk()**

`Mongo.setSlaveOk()`

For the current session, this command permits read operations from non-master (i.e. `slave` or `secondary`) instances. Practically, use this method in the following form:

```
db.getMongo().setSlaveOk()
```

Indicates that “*eventually consistent*” read operations are acceptable for the current application. This function provides the same functionality as `rs.slaveOk()` (page 898).

See the `readPref()` (page 871) method for more fine-grained control over *read preference* (page 405) in the `mongo` (page 942) shell.

**Mongo()****Description**

### **Mongo** (*host*)

JavaScript constructor to instantiate a database connection from the [mongo](#) (page 942) shell or from a JavaScript file.

The [Mongo \(\)](#) (page 919) method has the following parameter:

**param string host** The host, either in the form of <host> or <host><:port>.

**Instantiation Options** Use the constructor without a parameter to instantiate a connection to the localhost interface on the default port.

Pass the <host> parameter to the constructor to instantiate a connection to the <host> and the default port.

Pass the <host><:port> parameter to the constructor to instantiate a connection to the <host> and the <port>.

**See also:**

[Mongo.getDB \(\)](#) (page 917) and [db.getMongo \(\)](#) (page 887).

### **connect()**

#### **connect (<hostname><:port>/<database>)**

The `connect ()` method creates a connection to a MongoDB instance. However, use the [Mongo \(\)](#) (page 919) object and its [getDB \(\)](#) (page 917) method in most cases.

`connect ()` accepts a string <hostname><:port>/<database> parameter to connect to the MongoDB instance on the <hostname><:port> and return the reference to the database <database>.

The following example instantiates a new connection to the MongoDB instance running on the localhost interface and returns a reference to `myDatabase`:

```
db = connect("localhost:27017/myDatabase")
```

**See also:**

[Mongo.getDB \(\)](#) (page 917)

## Native

### Native Methods

| Name                                     | Description                                                                                                    |
|------------------------------------------|----------------------------------------------------------------------------------------------------------------|
| <code>cat()</code>                       | Returns the contents of the specified file.                                                                    |
| <code>version()</code>                   | Returns the current version of the <code>mongo</code> (page 942) shell instance.                               |
| <code>cd()</code>                        | Changes the current working directory to the specified path.                                                   |
| <code>copyDbpath()</code><br>(page 922)  | Copies a local <code>dbpath</code> (page 993). For internal use.                                               |
| <code>resetDbpath()</code><br>(page 922) | Removes a local <code>dbpath</code> (page 993). For internal use.                                              |
| <code>fuzzFile()</code> (page 922)       | For internal use to support testing.                                                                           |
| <code>getHostName()</code><br>(page 922) | Returns the hostname of the system running the <code>mongo</code> (page 942) shell.                            |
| <code>getMemInfo()</code><br>(page 922)  | Returns a document that reports the amount of memory used by the shell.                                        |
| <code>hostname()</code>                  | Returns the hostname of the system running the shell.                                                          |
| <code>_isWindows()</code><br>(page 922)  | Returns <code>true</code> if the shell runs on a Windows system; <code>false</code> if a Unix or Linux system. |
| <code>listFiles()</code> (page 922)      | Returns an array of documents that give the name and size of each object in the directory.                     |
| <code>load()</code>                      | Loads and runs a JavaScript file in the shell.                                                                 |
| <code>ls()</code>                        | Returns a list of the files in the current directory.                                                          |
| <code>md5sumFile()</code><br>(page 923)  | The <code>md5</code> hash of the specified file.                                                               |
| <code>mkdir()</code>                     | Creates a directory at the specified path.                                                                     |
| <code>pwd()</code>                       | Returns the current directory.                                                                                 |
| <code>quit()</code>                      | Exits the current shell session.                                                                               |
| <code>_rand()</code> (page 924)          | Returns a random number between 0 and 1.                                                                       |
| <code>removeFile()</code><br>(page 924)  | Removes the specified file from the local file system.                                                         |
| <code>_srand()</code> (page 924)         | For internal use.                                                                                              |

### `cat()`

#### Definition

`cat (filename)`

Returns the contents of the specified file. The method returns with output relative to the current shell session and does not impact the server.

**param string filename** Specify a path and file name on the local file system.

### `version()`

`version()`

**Returns** The version of the `mongo` (page 942) shell as a string.

Changed in version 2.4: In previous versions of the shell, `version()` would print the version instead of returning a string.

### `cd()`

**Definition**

`cd (path)`

**param string path** A path on the file system local to the [mongo](#) (page 942) shell context.

`cd ()` changes the directory context of the [mongo](#) (page 942) shell and has no effect on the MongoDB server.

`copyDbpath()`

`copyDbpath ()`

For internal use.

`resetDbpath()`

`resetDbpath ()`

For internal use.

`fuzzFile()`

**Description**

`fuzzFile (filename)`

For internal use.

**param string filename** A filename or path to a local file.

`getHostName()`

`getHostName ()`

**Returns** The hostname of the system running the [mongo](#) (page 942) shell process.

`getMemInfo()`

`getMemInfo ()`

Returns a document with two fields that report the amount of memory used by the JavaScript shell process. The fields returned are *resident* and *virtual*.

`hostname()`

`hostname ()`

**Returns** The hostname of the system running the [mongo](#) (page 942) shell process.

`_isWindows()`

`_isWindows ()`

**Returns** boolean.

Returns “true” if the [mongo](#) (page 942) shell is running on a system that is Windows, or “false” if the shell is running on a Unix or Linux systems.

`listFiles()`

`listFiles ()`

Returns an array, containing one document per object in the directory. This function operates in the context of the [mongo](#) (page 942) process. The included fields are:

**name**

Returns a string which contains the name of the object.

**isDirectory**

Returns true or false if the object is a directory.

**size**

Returns the size of the object in bytes. This field is only present for files.

**load()****Definition****load (file)**

Loads and runs a JavaScript file into the current shell environment.

The `load()` method has the following parameter:

**param string filename** Specifies the path of a JavaScript file to execute.

Specify filenames with relative or absolute paths. When using relative path names, confirm the current directory using the `pwd()` method.

After executing a file with `load()`, you may reference any functions or variables defined the file from the `mongo` (page 942) shell environment.

**Example** Consider the following examples of the `load()` method:

```
load("scripts/myjstest.js")
load("/data/db/scripts/myjstest.js")
```

**ls()****ls()**

Returns a list of the files in the current directory.

This function returns with output relative to the current shell session, and does not impact the server.

**md5sumFile()****Description****md5sumFile (filename)**

Returns a `md5` hash of the specified file.

The `md5sumFile()` (page 923) method has the following parameter:

**param string filename** A file name.

---

**Note:** The specified filename must refer to a file located on the system running the `mongo` (page 942) shell.

**mkdir()**

### Description

**mkdir** (*path*)

Creates a directory at the specified path. This method creates the entire path specified if the enclosing directory or directories do not already exist.

This method is equivalent to **mkdir -p** with BSD or GNU utilities.

The `mkdir()` method has the following parameter:

**param string path** A path on the local filesystem.

**pwd()**

**pwd()**

Returns the current directory.

This function returns with output relative to the current shell session, and does not impact the server.

**quit()**

**quit()**

Exits the current shell session.

**rand()**

**\_rand()**

**Returns** A random number between 0 and 1.

This function provides functionality similar to the `Math.rand()` function from the standard library.

**removeFile()**

### Description

**removeFile** (*filename*)

Removes the specified file from the local file system.

The `removeFile()` (page 924) method has the following parameter:

**param string filename** A filename or path to a local file.

**\_srand()**

**\_srand()**

For internal use.

## 11.2 Architecture and Components

### 11.2.1 MongoDB Package Components

#### Core Processes

The core components in the MongoDB package are: `mongod` (page 925), the core database process; `mongos` (page 938) the controller and query router for *sharded clusters*; and `mongo` (page 942) the interactive MongoDB Shell.

**mongod**

**Synopsis** `mongod` (page 925) is the primary daemon process for the MongoDB system. It handles data requests, manages data format, and performs background management operations.

This document provides a complete overview of all command line options for `mongod` (page 925). These options are primarily useful for testing purposes. In common operation, use the *configuration file options* (page 990) to control the behavior of your database, which is fully capable of all operations described below.

**Options****mongod****Core Options****mongod**

command line option!–help, -h

**--help, -h**

Returns a basic help and usage text.

command line option!–version

**--version**

Returns the version of the `mongod` (page 925) daemon.

command line option!–config <filename>, -f <filename>

**--config <filename>, -f <filename>**

Specifies a configuration file, that you can use to specify runtime-configurations. While the options are equivalent and accessible via the other command line arguments, the configuration file is the preferred method for runtime configuration of mongod. See the *Configuration File Options* (page 990) document for more information about these options.

---

**Note:** Ensure the configuration file uses ASCII encoding. `mongod` (page 925) does not support configuration files with non-ASCII encoding, including UTF-8.

---

command line option!–verbose, -v

**--verbose, -v**

Increases the amount of internal reporting returned on standard output or in the log file specified by `--logpath` (page 939). Use the `-v` form to control the level of verbosity by including the option multiple times, (e.g. `-vvvvv.`)

command line option!–quiet

**--quiet**

Runs the `mongod` (page 925) instance in a quiet mode that attempts to limit the amount of output. This option suppresses:

- output from *database commands*, including `drop` (page 747), `dropIndexes` (page 750), `diagLogging` (page 769), `validate` (page 771), and `clean` (page 752).
- replication activity.
- connection accepted events.
- connection closed events.

command line option!–port <port>

**--port <port>**

Specifies a TCP port for the [mongod](#) (page 925) to listen for client connections. By default [mongod](#) (page 925) listens for connections on port 27017.

UNIX-like systems require root privileges to use ports with numbers lower than 1024.

command line option!–bind\_ip <ip address>

**--bind\_ip <ip address>**

The IP address that the [mongod](#) (page 925) process will bind to and listen for connections. By default [mongod](#) (page 925) listens for connections all interfaces. You may attach [mongod](#) (page 925) to any interface; however, when attaching [mongod](#) (page 925) to a publicly accessible interface ensure that you have implemented proper authentication and/or firewall restrictions to protect the integrity of your database.

command line option!–maxConns <number>

**--maxConns <number>**

Specifies the maximum number of simultaneous connections that [mongod](#) (page 925) will accept. This setting will have no effect if it is higher than your operating system's configured maximum connection tracking threshold.

---

**Note:** You cannot set [maxConns](#) (page 992) to a value higher than 20000.

---

command line option!–objcheck

**--objcheck**

Forces the [mongod](#) (page 925) to validate all requests from clients upon receipt to ensure that clients never insert invalid documents into the database. For objects with a high degree of sub-document nesting, [--objcheck](#) (page 983) can have a small impact on performance. You can set [--noobjcheck](#) (page 959) to disable object checking at run-time.

Changed in version 2.4: MongoDB enables [--objcheck](#) (page 983) by default, to prevent any client from inserting malformed or invalid BSON into a MongoDB database.

command line option!–noobjcheck

**--noobjcheck**

New in version 2.4.

Disables the default document validation that MongoDB performs on all incoming BSON documents.

command line option!–logpath <path>

**--logpath <path>**

Specify a path for the log file that will hold all diagnostic logging information.

Unless specified, [mongod](#) (page 925) will output all log information to the standard output. Additionally, unless you also specify [--logappend](#) (page 939), the logfile will be overwritten when the process restarts.

---

**Note:** The behavior of the logging system may change in the near future in response to the [SERVER-4499](#)<sup>18</sup> case.

---

command line option!–logappend

**--logappend**

When specified, this option ensures that [mongod](#) (page 925) appends new entries to the end of the logfile rather than overwriting the content of the log when the process restarts.

command line option!–syslog

<sup>18</sup><https://jira.mongodb.org/browse/SERVER-4499>

**--syslog**

New in version 2.1.0.

Sends all logging output to the host's *syslog* system rather than to standard output or a log file as with [--logpath](#) (page 939).

---

**Important:** You cannot use [--syslog](#) (page 939) with [--logpath](#) (page 939).

---

command line option!–pidfilepath <path>

**--pidfilepath** <path>

Specify a file location to hold the “*PID*” or process ID of the [mongod](#) (page 925) process. Useful for tracking the [mongod](#) (page 925) process in combination with the [mongod --fork](#) option.

Without a specified [--pidfilepath](#) (page 940) option, [mongos](#) (page 938) creates no PID file.

command line option!–keyFile <file>

**--keyFile** <file>

Specify the path to a key file to store authentication information. This option is only useful for the connection between replica set members.

**See also:**

[Replica Set Security](#) (page 238) and [Replica Set Tutorials](#) (page 419).

command line option!–nounixsocket

**--nounixsocket**

Disables listening on the UNIX socket. [mongod](#) (page 925) always listens on the UNIX socket, unless [--nounixsocket](#) (page 940) is set, [--bind\\_ip](#) (page 938) is *not* set, or [--bind\\_ip](#) (page 938) does *not* specify 127.0.0.1.

command line option!–unixSocketPrefix <path>

**--unixSocketPrefix** <path>

Specifies a path for the UNIX socket. Unless this option has a value [mongod](#) (page 925) creates a socket with `http://docs.mongodb.org/manualtmp` as a prefix.

MongoDB will *always* create and listen on a UNIX socket, unless [--nounixsocket](#) (page 940) is set, [--bind\\_ip](#) (page 938) is *not* set, or [--bind\\_ip](#) (page 938) does *not* specify 127.0.0.1.

command line option!–fork

**--fork**

Enables a *daemon* mode for [mongod](#) (page 925) that runs the process to the background. This is the normal mode of operation, in production and production-like environments, but may *not* be desirable for testing.

command line option!–auth

**--auth**

Enables database authentication for users connecting from remote hosts. Configure users via the [mongo shell](#) (page 942). If no users exist, the localhost interface will continue to have access to the database until you create the first user.

See the [Security and Authentication](#) (page 237) page for more information regarding this functionality.

command line option!–cpu

**--cpu**

Forces [mongod](#) (page 925) to report the percentage of CPU time in write lock. [mongod](#) (page 925) generates output every four seconds. MongoDB writes this data to standard output or the logfile if using the [logpath](#) (page 992) option.

command line option!–dbpath <path>

**--dbpath** <path>

Specify a directory for the [mongod](#) (page 925) instance to store its data. Typical locations include: /srv/mongodb, /var/lib/mongodb or http://docs.mongodb.org/manual/loopt/mongodb

Unless specified, [mongod](#) (page 925) will look for data files in the default /data/db directory. (Windows systems use the \data\db directory.) If you installed using a package management system. Check the /etc/mongodb.conf file provided by your packages to see the configuration of the [dbpath](#) (page 993).

command line option!–diaglog <value>

**--diaglog** <value>

Creates a very verbose, [diagnostic log](#) for troubleshooting and recording various errors. MongoDB writes these log files in the [dbpath](#) (page 993) directory in a series of files that begin with the string diaglog and end with the initiation time of the logging as a hex string.

The specified value configures the level of verbosity. Possible values, and their impact are as follows.

| Value | Setting                             |
|-------|-------------------------------------|
| 0     | off. No logging.                    |
| 1     | Log write operations.               |
| 2     | Log read operations.                |
| 3     | Log both read and write operations. |
| 7     | Log write and some read operations. |

You can use the [mongosniff](#) (page 982) tool to replay this output for investigation. Given a typical diaglog file, located at /data/db/diaglog.4f76a58c, you might use a command in the following form to read these files:

```
mongosniff --source DIAGLOG /data/db/diaglog.4f76a58c
```

[--diaglog](#) (page 928) is for internal use and not intended for most users.

**Warning:** Setting the diagnostic level to 0 will cause [mongod](#) (page 925) to stop writing data to the [diagnostic log](#) file. However, the [mongod](#) (page 925) instance will continue to keep the file open, even if it is no longer writing data to the file. If you want to rename, move, or delete the diagnostic log you must cleanly shut down the [mongod](#) (page 925) instance before doing so.

command line option!–directoryperdb

**--directoryperdb**

Alters the storage pattern of the data directory to store each database's files in a distinct folder. This option will create directories within the [--dbpath](#) (page 958) named for each directory.

Use this option in conjunction with your file system and device configuration so that MongoDB will store data on a number of distinct disk devices to increase write throughput or disk capacity.

**Warning:** If you have an existing `mongod` (page 925) instance and `dbpath` (page 993), and you want to enable `--directoryperdb` (page 958), you **must** migrate your existing databases to directories before setting `--directoryperdb` (page 958) to access those databases.

### Example

Given a `dbpath` (page 993) directory with the following items:

```
journal
mongod.lock
local.0
local.1
local.ns
test.0
test.1
test.ns
```

To enable `--directoryperdb` (page 958) you would need to modify the `dbpath` (page 993) to resemble the following:

```
journal
mongod.lock
local/local.0
local/local.1
local/local.ns
test/test.0
test/test.1
test/test.ns
```

command line option!–journal

#### **--journal**

Enables operation journaling to ensure write durability and data consistency. `mongod` (page 925) enables journaling by default on 64-bit builds of versions after 2.0.

command line option!–journalOptions <arguments>

#### **--journalOptions** <arguments>

Provides functionality for testing. Not for general use, and may affect database integrity.

command line option!–journalCommitInterval <value>

#### **--journalCommitInterval** <value>

Specifies the maximum amount of time for `mongod` (page 925) to allow between journal operations. Possible values are between 2 and 300 milliseconds. Lower values increase the durability of the journal, at the expense of disk performance.

The default journal commit interval is 100 milliseconds if a single block device (e.g. physical volume, RAID device, or LVM volume) contains both the journal and the data files.

If different block devices provide the journal and data files the default journal commit interval is 30 milliseconds.

To force `mongod` (page 925) to commit to the journal more frequently, you can specify `j:true`. When a write operation with `j:true` is pending, `mongod` (page 925) will reduce `journalCommitInterval` (page 995) to a third of the set value.

command line option!–ipv6

#### **--ipv6**

Specify this option to enable IPv6 support. This will allow clients to connect to `mongod` (page 925) using IPv6

nets. [mongod](#) (page 925) disables IPv6 support by default in [mongod](#) (page 925) and all utilities. command line option!–jsonp

### **--jsonp**

Permits *JSONP* access via an HTTP interface. Consider the security implications of allowing this activity before enabling this option.

command line option!–noauth

### **--noauth**

Disable authentication. Currently the default. Exists for future compatibility and clarity.

command line option!–nohttpinterface

### **--nohttpinterface**

Disables the HTTP interface.

---

**Note:** In MongoDB Enterprise, the HTTP Console does not support Kerberos Authentication.

---

command line option!–nojournal

### **--nojournal**

Disables the durability journaling. By default, [mongod](#) (page 925) enables journaling in 64-bit versions after v2.0.

command line option!–noprealloc

### **--noprealloc**

Disables the preallocation of data files. This will shorten the start up time in some cases, but can cause significant performance penalties during normal operations.

command line option!–noscripting

### **--noscripting**

Disables the scripting engine.

command line option!–notablescan

### **--notablescan**

Forbids operations that require a table scan.

command line option!–nssize <value>

### **--nssize <value>**

Specifies the default size for namespace files (i.e .ns). This option has no impact on the size of existing namespace files. The maximum size is 2047 megabytes.

The default value is 16 megabytes; this provides for approximately 24,000 namespaces. Each collection, as well as each index, counts as a namespace.

command line option!–profile <level>

### **--profile <level>**

Changes the level of database profiling, which inserts information about operation performance into output of [mongod](#) (page 925) or the log file. The following levels are available:

| Level | Setting                            |
|-------|------------------------------------|
| 0     | Off. No profiling.                 |
| 1     | On. Only includes slow operations. |
| 2     | On. Includes all operations.       |

Profiling is off by default. Database profiling can impact database performance. Enable this option only after careful consideration.

command line option!–quota

**--quota**

Enables a maximum limit for the number data files each database can have. When running with [--quota](#) (page 931), there are a maximum of 8 data files per database. Adjust the quota with the [--quotaFiles](#) (page 931) option.

command line option!–quotaFiles <number>

**--quotaFiles** <number>

Modify limit on the number of data files per database. This option requires the [--quota](#) (page 931) setting. The default value for [--quotaFiles](#) (page 931) is 8.

command line option!–rest

**--rest**

Enables the simple [REST API](#).

command line option!–repair

**--repair**

Runs a repair routine on all databases. This is equivalent to shutting down and running the [repairDatabase](#) (page 757) database command on all databases.

**Warning:** During normal operations, only use the [repairDatabase](#) (page 757) command and wrappers including `db.repairDatabase()` (page 892) in the [mongo](#) (page 942) shell and `mongod --repair`, to compact database files and/or reclaim disk space. Be aware that these operations remove and do not save any corrupt data during the repair process.

If you are trying to repair a [replica set](#) member, and you have access to an intact copy of your data (e.g. a recent backup or an intact member of the [replica set](#)), you should restore from that intact copy, and **not** use [repairDatabase](#) (page 757).

---

**Note:** When using [journaling](#), there is almost never any need to run [repairDatabase](#) (page 757). In the event of an unclean shutdown, the server will be able to restore the data files to a pristine state automatically.

---

Changed in version 2.1.2.

If you run the repair option *and* have data in a journal file, `mongod` (page 925) will refuse to start. In these cases you should start `mongod` (page 925) without the [--repair](#) (page 954) option to allow `mongod` (page 925) to recover data from the journal. This will complete more quickly and will result in a more consistent and complete data set.

To continue the repair operation despite the journal files, shut down `mongod` (page 925) cleanly and restart with the [--repair](#) (page 954) option.

---

**Note:** [--repair](#) (page 954) copies data from the source data files into new data files in the [repairpath](#) (page 997), and then replaces the original data files with the repaired data files. If [repairpath](#) (page 997) is on the same device as [dbpath](#) (page 993), you *may* interrupt a `mongod` (page 925) running [--repair](#) (page 954) without affecting the integrity of the data set.

---

command line option!–repairpath <path>

**--repairpath** <path>

Specifies the root directory containing MongoDB data files, to use for the [--repair](#) (page 954) operation. Defaults to a `_tmp` directory within the [dbpath](#) (page 993).

command line option!–setParameter <options>

### --setParameter <options>

New in version 2.4.

Specifies an option to configure on startup. Specify multiple options with multiple [--setParameter](#) (page 939) options. See [mongod Parameters](#) (page 1005) for full documentation of these parameters. The [setParameter](#) (page 756) database command provides access to many of these parameters. [--setParameter](#) (page 939) supports the following options:

- [enableLocalhostAuthBypass](#) (page 1005)
- [enableTestCommands](#) (page 1005)
- [journalCommitInterval](#) (page 1006)
- [logLevel](#) (page 1006)
- [logUserIds](#) (page 1006)
- [notableScan](#) (page 1006)
- [quiet](#) (page 1007)
- [replApplyBatchSize](#) (page 1006)
- [replIndexPrefetch](#) (page 1006)
- [supportCompatibilityForPrivilegeDocuments](#) (page 1007)
- [syncdelay](#) (page 1007)
- [textSearchEnabled](#) (page 1008)
- [traceExceptions](#) (page 1007)

command line option!–slowms <value>

### --slowms <value>

Defines the value of “slow,” for the [--profile](#) (page 930) option. The database logs all slow queries to the log, even when the profiler is not turned on. When the database profiler is on, [mongod](#) (page 925) the profiler writes to the `system.profile` collection. See the [profile](#) (page 770) command for more information on the database profiler.

command line option!–smallfiles

### --smallfiles

Enables a mode where MongoDB uses a smaller default file size. Specifically, [--smallfiles](#) (page 932) reduces the initial size for data files and limits them to 512 megabytes. [--smallfiles](#) (page 932) also reduces the size of each [journal](#) files from 1 gigabyte to 128 megabytes.

Use [--smallfiles](#) (page 932) if you have a large number of databases that each holds a small quantity of data. [--smallfiles](#) (page 932) can lead your [mongod](#) (page 925) to create a large number of files, which may affect performance for larger databases.

command line option!–shutdown

### --shutdown

Used in [control scripts](#), the [--shutdown](#) (page 932) will cleanly and safely terminate the [mongod](#) (page 925) process. When invoking [mongod](#) (page 925) with this option you must set the [--dbpath](#) (page 958) option either directly or by way of the [configuration file](#) (page 990) and the [--config](#) (page 938) option.

The [--shutdown](#) (page 932) option is available only on Linux systems.

command line option!–syncdelay <value>

**--syncdelay <value>**

`mongod` (page 925) writes data very quickly to the journal, and lazily to the data files. `--syncdelay` (page 932) controls how much time can pass before MongoDB flushes data to the *database files* via an `fsync` operation. The default setting is 60 seconds. In almost every situation you should not set this value and use the default setting.

The `serverStatus` (page 782) command reports the background flush thread's status via the `backgroundFlushing` (page 789) field.

`syncdelay` (page 998) has no effect on the `journal` (page 995) files or *journaling* (page 232).

**Warning:** If you set `--syncdelay` (page 932) to 0, MongoDB will not sync the memory mapped files to disk. Do not set this value on production systems.

command line option!–sysinfo

**--sysinfo**

Returns diagnostic system information and then exits. The information provides the page size, the number of physical pages, and the number of available physical pages.

command line option!–upgrade

**--upgrade**

Upgrades the on-disk data format of the files specified by the `--dbpath` (page 958) to the latest version, if needed.

This option only affects the operation of `mongod` (page 925) if the data files are in an old format.

---

**Note:** In most cases you should **not** set this value, so you can exercise the most control over your upgrade process. See the MongoDB release notes<sup>19</sup> (on the download page) for more information about the upgrade process.

command line option!–traceExceptions

**--traceExceptions**

For internal diagnostic use only.

**Replication Options** command line option!–replicaSet <setname>

**--replicaSet <setname>**

Use this option to configure replication with replica sets. Specify a replica set name as an argument to this set. All hosts in the replica set must have the same set name.

---

**Important:** If your application connects to more than one replica set, each set should have a distinct name. Some drivers group replica set connections by replica set name.

**See also:**

[Replication](#) (page 377), [Replica Set Tutorials](#) (page 419), and [Replica Set Configuration](#) (page 479)

command line option!–oplogSize <value>

**--oplogSize <value>**

Specifies a maximum size in megabytes for the replication operation log (e.g. `oplog`.) By `mongod` (page 925) creates an `oplog` based on the maximum amount of space available. For 64-bit systems, the op log is typically 5% of available disk space.

---

<sup>19</sup><http://www.mongodb.org/downloads>

Once the [mongod](#) (page 925) has created the oplog for the first time, changing [--oplogSize](#) (page 933) will not affect the size of the oplog.

command line option!–fastsync

### **--fastsync**

In the context of [replica set](#) replication, set this option if you have seeded this member with a snapshot of the [dbpath](#) of another member of the set. Otherwise the [mongod](#) (page 925) will attempt to perform an initial sync, as though the member were a new member.

**Warning:** If the data is not perfectly synchronized *and* [mongod](#) (page 925) starts with [fastsync](#) (page 1000), then the secondary or slave will be permanently out of sync with the primary, which may cause significant consistency problems.

command line option!–replIndexPrefetch

### **--replIndexPrefetch**

New in version 2.2.

You must use [--replIndexPrefetch](#) (page 934) in conjunction with [rep1Set](#) (page 1000). The default value is `all` and available options are:

- `none`
- `all`
- `_id_only`

By default [secondary](#) members of a [replica set](#) will load all indexes related to an operation into memory before applying operations from the oplog. You can modify this behavior so that the secondaries will only load the `_id` index. Specify `_id_only` or `none` to prevent the [mongod](#) (page 925) from loading *any* index into memory.

**Master-Slave Replication** These options provide access to conventional master-slave database replication. While this functionality remains accessible in MongoDB, replica sets are the preferred configuration for database replication.

command line option!–master

### **--master**

Configures [mongod](#) (page 925) to run as a replication *master*.

command line option!–slave

### **--slave**

Configures [mongod](#) (page 925) to run as a replication *slave*.

command line option!–source <host><:port>

### **--source** <host><:port>

For use with the [--slave](#) (page 934) option, the [--source](#) option designates the server that this instance will replicate.

command line option!–only <arg>

### **--only** <arg>

For use with the [--slave](#) (page 934) option, the [--only](#) option specifies only a single [database](#) to replicate.

command line option!–slavedelay <value>

### **--slavedelay** <value>

For use with the [--slave](#) (page 934) option, the [--slavedelay](#) option configures a “delay” in seconds, for this slave to wait to apply operations from the [master](#) node.

command line option!–autoresync

**--autoresync**

For use with the `--slave` (page 934) option. When set, `--autoresync` (page 934) option allows this slave to automatically resync if it is more than 10 seconds behind the master. This setting may be problematic if the `--oplogSize` (page 933) specifies a too small oplog. If the *oplog* is not large enough to store the difference in changes between the master's current state and the state of the slave, this instance will forcibly resync itself unnecessarily. When you set the `autoresync` (page 1001) option to `false`, the slave will not attempt an automatic resync more than once in a ten minute period.

**Sharding Cluster Options** command line option!–configsvr**--configsvr**

Declares that this `mongod` (page 925) instance serves as the *config database* of a sharded cluster. When running with this option, clients will not be able to write data to any database other than `config` and `admin`. The default port for a `mongod` (page 925) with this option is 27019 and the default `--dbpath` (page 958) directory is `/data/configdb`, unless specified.

Changed in version 2.2: `--configsvr` (page 935) also sets `--smallfiles` (page 932).

Changed in version 2.4: `--configsvr` (page 935) creates a local *oplog*.

Do not use `--configsvr` (page 935) with `--repSet` (page 933) or `--shardsvr` (page 935). Config servers cannot be a shard server or part of a *replica set*.

## command line option!–shardsvr

**--shardsvr**

Configures this `mongod` (page 925) instance as a shard in a partitioned cluster. The default port for these instances is 27018. The only effect of `--shardsvr` (page 935) is to change the port number.

## command line option!–moveParanoia

**--moveParanoia**

New in version 2.4.

During chunk migrations, `--moveParanoia` (page 935) forces the `mongod` (page 925) instances to save all documents migrated from this shard in the `moveChunk` directory of the `dbpath` (page 993). MongoDB does not delete data from this directory.

Prior to 2.4, `--moveParanoia` (page 935) was the default behavior of MongoDB.

**SSL Options****See**

[Connect to MongoDB with SSL](#) (page 249) for full documentation of MongoDB's support.

## command line option!–sslOnNormalPorts

**--sslOnNormalPorts**

New in version 2.2.

**Note:** The [default distribution of MongoDB<sup>20</sup>](#) does **not** contain support for SSL. To use SSL you can either compile MongoDB with SSL support or use MongoDB Enterprise. See [Connect to MongoDB with SSL](#) (page 249) for more information about SSL and MongoDB.

Enables SSL for `mongod` (page 925). With `--sslOnNormalPorts` (page 935), a `mongod` (page 925) requires SSL encryption for all connections on the default MongoDB port, or the port specified by `--port` (page 980). By default, `--sslOnNormalPorts` (page 935) is disabled.

<sup>20</sup><http://www.mongodb.org/downloads>

command line option!–sslPEMKeyFile <filename>

**–sslPEMKeyFile** <filename>

New in version 2.2.

---

**Note:** The [default distribution of MongoDB<sup>21</sup>](#) does **not** contain support for SSL. To use SSL you can either compile MongoDB with SSL support or use MongoDB Enterprise. See [Connect to MongoDB with SSL](#) (page 249) for more information about SSL and MongoDB.

---

Specifies the .pem file that contains both the SSL certificate and key. Specify the file name of the .pem file using relative or absolute paths

When using [–sslOnNormalPorts](#) (page 935), you must specify [–sslPEMKeyFile](#) (page 936).

command line option!–sslPEMKeyPassword <value>

**–sslPEMKeyPassword** <value>

New in version 2.2.

---

**Note:** The [default distribution of MongoDB<sup>22</sup>](#) does **not** contain support for SSL. To use SSL you can either compile MongoDB with SSL support or use MongoDB Enterprise. See [Connect to MongoDB with SSL](#) (page 249) for more information about SSL and MongoDB.

---

Specifies the password to de-crypt the certificate-key file (i.e. [–sslPEMKeyFile](#) (page 936)). Only use [–sslPEMKeyPassword](#) (page 936) if the certificate-key file is encrypted. In all cases, [mongod](#) (page 925) will redact the password from all logging and reporting output.

Changed in version 2.4: [–sslPEMKeyPassword](#) (page 936) is only needed when the private key is encrypted. In earlier versions [mongod](#) (page 925) would require [–sslPEMKeyPassword](#) (page 936) whenever using [–sslOnNormalPorts](#) (page 935), even when the private key was not encrypted.

command line option!–sslCAFile <filename>

**–sslCAFile** <filename>

New in version 2.4.

---

**Note:** The [default distribution of MongoDB<sup>23</sup>](#) does **not** contain support for SSL. To use SSL you can either compile MongoDB with SSL support or use MongoDB Enterprise. See [Connect to MongoDB with SSL](#) (page 249) for more information about SSL and MongoDB.

---

Specifies the .pem file that contains the root certificate chain from the Certificate Authority. Specify the file name of the .pem file using relative or absolute paths

command line option!–sslCRLFile <filename>

**–sslCRLFile** <filename>

New in version 2.4.

---

**Note:** The [default distribution of MongoDB<sup>24</sup>](#) does **not** contain support for SSL. To use SSL you can either compile MongoDB with SSL support or use MongoDB Enterprise. See [Connect to MongoDB with SSL](#) (page 249) for more information about SSL and MongoDB.

---

Specifies the .pem file that contains the Certificate Revocation List. Specify the file name of the .pem file using relative or absolute paths

---

<sup>21</sup><http://www.mongodb.org/downloads>

<sup>22</sup><http://www.mongodb.org/downloads>

<sup>23</sup><http://www.mongodb.org/downloads>

<sup>24</sup><http://www.mongodb.org/downloads>

command line option!–sslWeakCertificateValidation

#### **--sslWeakCertificateValidation**

New in version 2.4.

---

**Note:** The [default distribution of MongoDB<sup>25</sup>](#) does **not** contain support for SSL. To use SSL you can either compile MongoDB with SSL support or use MongoDB Enterprise. See [Connect to MongoDB with SSL](#) (page 249) for more information about SSL and MongoDB.

---

Disables the requirement for SSL certificate validation, that [--sslCAFile](#) (page 936) enables. With [--sslWeakCertificateValidation](#) (page 937), [mongod](#) (page 925) will accept connections if the client does not present a certificate when establishing the connection.

If the client presents a certificate and [mongod](#) (page 925) has [--sslWeakCertificateValidation](#) (page 937) enabled, [mongod](#) (page 925) will validate the certificate using the root certificate chain specified by [--sslCAFile](#) (page 936), and reject clients with invalid certificates.

Use [--sslWeakCertificateValidation](#) (page 937) if you have a mixed deployment that includes clients that do not or cannot present certificates to [mongod](#) (page 925).

command line option!–sslFIPSMode

#### **--sslFIPSMode**

New in version 2.4.

---

**Note:** The [default distribution of MongoDB<sup>26</sup>](#) does **not** contain support for SSL. To use SSL you can either compile MongoDB with SSL support or use MongoDB Enterprise. See [Connect to MongoDB with SSL](#) (page 249) for more information about SSL and MongoDB.

---

When specified, [mongod](#) (page 925) will use the FIPS mode of the installed OpenSSL library. Your system must have a FIPS compliant OpenSSL library to use [--sslFIPSMode](#) (page 937).

**Usage** In common usage, the invocation of [mongod](#) (page 925) will resemble the following in the context of an initialization or control script:

```
mongod --config /etc/mongodb.conf
```

See the [Configuration File Options](#) (page 990) for more information on how to configure [mongod](#) (page 925) using the configuration file.

## **mongos**

**Synopsis** [mongos](#) (page 938) for “MongoDB Shard,” is a routing service for MongoDB shard configurations that processes queries from the application layer, and determines the location of this data in the [sharded cluster](#), in order to complete these operations. From the perspective of the application, a [mongos](#) (page 938) instance behaves identically to any other MongoDB instance.

---

**Note:** Changed in version 2.1.

Some aggregation operations using the [aggregate](#) (page 694) will cause [mongos](#) (page 938) instances to require more CPU resources than in previous versions. This modified performance profile may dictate alternate architecture decisions if you use the [aggregation framework](#) extensively in a sharded environment.

---

<sup>25</sup><http://www.mongodb.org/downloads>

<sup>26</sup><http://www.mongodb.org/downloads>

**See also:**

*Sharding* (page 493) and *Sharding Introduction* (page 493).

**Options**

**mongos**

**mongos**

command line option!–help, -h

**--help, -h**

Returns a basic help and usage text.

command line option!–version

**--version**

Returns the version of the [mongod](#) (page 925) daemon.

command line option!–config <filename>, -f <filename>

**--config <filename>, -f <filename>**

Specifies a configuration file, that you can use to specify runtime-configurations. While the options are equivalent and accessible via the other command line arguments, the configuration file is the preferred method for runtime configuration of mongod. See the [Configuration File Options](#) (page 990) document for more information about these options.

Not all configuration options for [mongod](#) (page 925) make sense in the context of [mongos](#) (page 938).

---

**Note:** Ensure the configuration file uses ASCII encoding. [mongod](#) (page 925) does not support configuration files with non-ASCII encoding, including UTF-8.

---

command line option!–verbose, -v

**--verbose, -v**

Increases the amount of internal reporting returned on standard output or in the log file specified by [--logpath](#) (page 939). Use the –v form to control the level of verbosity by including the option multiple times, (e.g. –vvvvv.)

command line option!–quiet

**--quiet**

Runs the [mongos](#) (page 938) instance in a quiet mode that attempts to limit the amount of output.

command line option!–port <port>

**--port <port>**

Specifies a TCP port for the [mongos](#) (page 938) to listen for client connections. By default [mongos](#) (page 938) listens for connections on port 27017.

UNIX-like systems require root access to access ports with numbers lower than 1024.

command line option!–bind\_ip <ip address>

**--bind\_ip <ip address>**

The IP address that the [mongos](#) (page 938) process will bind to and listen for connections. By default [mongos](#) (page 938) listens for connections all interfaces. You may attach [mongos](#) (page 938) to any interface; however, when attaching [mongos](#) (page 938) to a publicly accessible interface ensure that you have implemented proper authentication and/or firewall restrictions to protect the integrity of your database.

command line option!–maxConns <number>

**--maxConns <number>**

Specifies the maximum number of simultaneous connections that [mongos](#) (page 938) will accept. This setting will have no effect if the value of this setting is higher than your operating system's configured maximum connection tracking threshold.

This is particularly useful for [mongos](#) (page 938) if you have a client that creates a number of collections but allows them to timeout rather than close the collections. When you set [maxConns](#) (page 992), ensure the value is slightly higher than the size of the connection pool or the total number of connections to prevent erroneous connection spikes from propagating to the members of a [sharded cluster](#).

---

**Note:** You cannot set [maxConns](#) (page 992) to a value higher than 20000.

---

command line option!–objcheck

**--objcheck**

Forces the [mongos](#) (page 938) to validate all requests from clients upon receipt to ensure that invalid objects are never inserted into the database. This option has a performance impact, and is not enabled by default.

command line option!–logpath <path>

**--logpath <path>**

Specify a path for the log file that will hold all diagnostic logging information.

Unless specified, [mongos](#) (page 938) will output all log information to the standard output. Additionally, unless you also specify [--logappend](#) (page 939), the logfile will be overwritten when the process restarts.

command line option!–logappend

**--logappend**

Specify to ensure that [mongos](#) (page 938) appends additional logging data to the end of the logfile rather than overwriting the content of the log when the process restarts.

command line option!–setParameter <options>

**--setParameter <options>**

New in version 2.4.

Specifies an option to configure on startup. Specify multiple options with multiple [--setParameter](#) (page 939) options. See [mongod Parameters](#) (page 1005) for full documentation of these parameters. The [setParameter](#) (page 756) database command provides access to many of these parameters. [--setParameter](#) (page 939) supports the following options:

- [enableLocalhostAuthBypass](#) (page 1005)
- [enableTestCommands](#) (page 1005)
- [logLevel](#) (page 1006)
- [logUserIds](#) (page 1006)
- [notableScan](#) (page 1006)
- [quiet](#) (page 1007)
- [supportCompatibilityForPrivilegeDocuments](#) (page 1007)
- [syncdelay](#) (page 1007)
- [textSearchEnabled](#) (page 1008)

command line option!–syslog

**--syslog**

New in version 2.1.0.

Sends all logging output to the host's [syslog](#) system rather than to standard output or a log file as with [--logpath](#) (page 939).

---

**Important:** You cannot use [--syslog](#) (page 939) with [--logpath](#) (page 939).

---

command line option!–pidfilepath <path>

**--pidfilepath** <path>

Specify a file location to hold the [PID](#) or process ID of the [mongos](#) (page 938) process. Useful for tracking the [mongos](#) (page 938) process in combination with the [mongos --fork](#) option.

Without a specified [--pidfilepath](#) (page 940) option, [mongos](#) (page 938) creates no PID file.

command line option!–keyFile <file>

**--keyFile** <file>

Specify the path to a key file to store authentication information. This option is only useful for the connection between [mongos](#) (page 938) instances and components of the [sharded cluster](#).

**See also:**

[Sharded Cluster Security](#) (page 509)

command line option!–nounixsocket

**--nounixsocket**

Disables listening on the UNIX socket. [mongos](#) (page 938) always listens on the UNIX socket, unless [--nounixsocket](#) (page 940) is set, [--bind\\_ip](#) (page 938) is *not* set, or [--bind\\_ip](#) (page 938) does *not* specify 127.0.0.1.

command line option!–unixSocketPrefix <path>

**--unixSocketPrefix** <path>

Specifies a path for the UNIX socket. Unless this option has a value [mongos](#) (page 938) creates a socket with <http://docs.mongodb.org/manualtmp> as a prefix.

MongoDB will *always* create and listen on a UNIX socket, unless [--nounixsocket](#) (page 940) is set, [--bind\\_ip](#) (page 938) is *not* set, or [--bind\\_ip](#) (page 938) specifies 127.0.0.1.

command line option!–fork

**--fork**

Enables a [daemon](#) mode for [mongos](#) (page 938) which forces the process to the background. This is the normal mode of operation, in production and production-like environments, but may *not* be desirable for testing.

command line option!–configdb <config1>,<config2><:port>,<config3>

**--configdb** <config1>,<config2><:port>,<config3>

Set this option to specify a configuration database (i.e. [config database](#)) for the [sharded cluster](#). You must specify either 1 configuration server or 3 configuration servers, in a comma separated list.

---

**Note:** [mongos](#) (page 938) instances read from the first [config server](#) in the list provided. All [mongos](#) (page 938) instances **must** specify the hosts to the [--configdb](#) (page 940) setting in the same order.

If your configuration databases reside in more than one data center, order the hosts in the [--configdb](#) (page 940) argument so that the config database that is closest to the majority of your [mongos](#) (page 938) instances is first servers in the list.

**Warning:** Never remove a config server from the [--configdb](#) (page 940) parameter, even if the config server or servers are not available, or offline.

command line option!–test

**--test**

This option is for internal testing use only, and runs unit tests without starting a [mongos](#) (page 938) instance.

command line option!–upgrade

**--upgrade**

This option updates the meta data format used by the [config database](#).

command line option!–chunkSize <value>

**--chunkSize** <value>

The value of the [–chunkSize](#) (page 941) determines the size of each *chunk*, *in megabytes*, of data distributed around the [sharded cluster](#). The default value is 64 megabytes, which is the ideal size for chunks in most deployments: larger chunk size can lead to uneven data distribution, smaller chunk size often leads to inefficient movement of chunks between nodes. However, in some circumstances it may be necessary to set a different chunk size.

This option *only* sets the chunk size when initializing the cluster for the first time. If you modify the run-time option later, the new value will have no effect. See the [Modify Chunk Size in a Sharded Cluster](#) (page 547) procedure if you need to change the chunk size on an existing sharded cluster.

command line option!–ipv6

**--ipv6**

Enables IPv6 support to allow clients to connect to [mongos](#) (page 938) using IPv6 networks. MongoDB disables IPv6 support by default in [mongod](#) (page 925) and all utilities.

command line option!–jsonp

**--jsonp**

Permits [JSONP](#) access via an HTTP interface. Consider the security implications of allowing this activity before enabling this option.

command line option!–noscrypting

**--noscrypting**

Disables the scripting engine.

command line option!–nohttpinterface

**--nohttpinterface**

New in version 2.1.2.

Disables the HTTP interface.

command line option!–localThreshold

**--localThreshold**

New in version 2.2.

[–localThreshold](#) (page 941) affects the logic that [mongos](#) (page 938) uses when selecting [replica set](#) members to pass read operations to from clients. Specify a value to [–localThreshold](#) (page 941) in milliseconds. The default value is 15, which corresponds to the default value in all of the client [drivers](#) (page 95).

When [mongos](#) (page 938) receives a request that permits reads to [secondary](#) members, the [mongos](#) (page 938) will:

- find the member of the set with the lowest ping time.
- construct a list of replica set members that is within a ping time of 15 milliseconds of the nearest suitable member of the set.

If you specify a value for `--localThreshold` (page 941), `mongos` (page 938) will construct the list of replica members that are within the latency allowed by this value.

- The `mongos` (page 938) will select a member to read from at random from this list.

The ping time used for a set member compared by the `--localThreshold` (page 941) setting is a moving average of recent ping times, calculated, at most, every 10 seconds. As a result, some queries may reach members above the threshold until the `mongos` (page 938) recalculates the average.

See the *Member Selection* (page 408) section of the *read preference* (page 405) documentation for more information.

command line option!`--noAutoSplit`

### **--noAutoSplit**

New in version 2.0.7.

`--noAutoSplit` (page 942) prevents `mongos` (page 938) from automatically inserting metadata splits in a *sharded collection*. If set on all `mongos` (page 938), this will prevent MongoDB from creating new chunks as the data in a collection grows.

Because any `mongos` (page 938) in a cluster can create a split, to totally disable splitting in a cluster you must set `--noAutoSplit` (page 942) on all `mongos` (page 938).

**Warning:** With `--noAutoSplit` (page 942) enabled, the data in your sharded cluster may become imbalanced over time. Enable with caution.

---

## SSL Options

---

See

*Connect to MongoDB with SSL* (page 249) for full documentation of MongoDB's support.

---

command line option!`--authenticationDatabase <dbname>`

### **--authenticationDatabase <dbname>**

New in version 2.4.

Specifies the database that holds the user's (e.g `--username`) credentials.

By default, `mongos` (page 938) assumes that the database specified to the `--db` (page 958) argument holds the user's credentials, unless you specify `--authenticationDatabase` (page 980).

See `userSource` (page 271), `system.users Privilege Documents` (page 270) and *User Privilege Roles in MongoDB* (page 265) for more information about delegated authentication in MongoDB.

command line option!`--authenticationMechanism <name>`

### **--authenticationMechanism <name>**

New in version 2.4.

Specifies the authentication mechanism. By default, the authentication mechanism is MONGODB-CR, which is the MongoDB challenge/response authentication mechanism. In MongoDB Enterprise, `mongos` (page 938) also includes support for GSSAPI to handle Kerberos authentication.

See *Deploy MongoDB with Kerberos Authentication* (page 259) for more information about Kerberos authentication.

`mongo`

## Description

**mongo**

`mongo` (page 942) is an interactive JavaScript shell interface to MongoDB, which provides a powerful interface for systems administrators as well as a way for developers to test queries and operations directly with the database. `mongo` (page 942) also provides a fully functional JavaScript environment for use with a MongoDB. This document addresses the basic invocation of the `mongo` (page 942) shell and an overview of its usage.

**Interface****Options****mongo**

command line option!–shell

**--shell**

Enables the shell interface after evaluating a *JavaScript* file. If you invoke the `mongo` (page 942) command and specify a JavaScript file as an argument, or use `--eval` (page 943) to specify JavaScript on the command line, the `--shell` (page 943) option provides the user with a shell prompt after the file finishes executing.

command line option!–nodb

**--nodb**

Prevents the shell from connecting to any database instances. Later, to connect to a database within the shell, see *Opening New Connections* (page 202).

command line option!–norc

**--norc**

Prevents the shell from sourcing and evaluating `~/.mongorc.js` on start up.

command line option!–quiet

**--quiet**

Silences output from the shell during the connection process.

command line option!–port <port>

**--port** <port>

Specifies the port where the `mongod` (page 925) or `mongos` (page 938) instance is listening. Unless specified `mongo` (page 942) connects to `mongod` (page 925) instances on port 27017, which is the default `mongod` (page 925) port.

command line option!–host <hostname>

**--host** <hostname>

specifies the host where the `mongod` (page 925) or `mongos` (page 938) is running to connect to as <hostname>. By default `mongo` (page 942) will attempt to connect to a MongoDB process running on the localhost.

command line option!–eval <javascript>

**--eval** <javascript>

Evaluates a JavaScript expression specified as an argument to this option. `mongo` (page 942) does not load its own environment when evaluating code: as a result many options of the shell environment are not available.

command line option!–username <username>, -u <username>

**--username** <username>, **-u** <username>

Specifies a username to authenticate to the MongoDB instance. Use in conjunction with the `--password` (page 980) option to supply a password. If you specify a username and password but the default database or the specified database do not require authentication, `mongo` (page 942) will exit with an exception.

command line option!–password <password>, -p <password>

**--password <password>, -p <password>**

Specifies a password to authenticate to the MongoDB instance. Use in conjunction with the [--username](#) (page 980) option to supply a username. If you specify a [--username](#) (page 980) and do not pass an argument to the [--password](#) (page 980) option, [mongo](#) (page 942) will prompt for a password interactively, if the [mongod](#) (page 925) or [mongos](#) (page 938) requires authentication.

If you chose not to provide an argument so that [mongo](#) (page 942) will prompt for a password, [--password](#) (page 980) must be the last option.

command line option!–authenticationDatabase <dbname>

**--authenticationDatabase <dbname>**

New in version 2.4.

Specifies the database that holds the user's (e.g [--username](#)) credentials.

By default, [mongo](#) (page 942) assumes that the database name specified in the [db address](#) (page 945) holds the user's credentials, unless you specify [--authenticationDatabase](#) (page 980).

See [userSource](#) (page 271), [system.users Privilege Documents](#) (page 270) and [User Privilege Roles in MongoDB](#) (page 265) for more information about delegated authentication in MongoDB.

command line option!–authenticationMechanism <name>

**--authenticationMechanism <name>**

New in version 2.4.

Specifies the authentication mechanism. By default, the authentication mechanism is MONGODB-CR, which is the MongoDB challenge/response authentication mechanism. In MongoDB Enterprise, [mongo](#) (page 942) also includes support for GSSAPI to handle Kerberos authentication.

See [Deploy MongoDB with Kerberos Authentication](#) (page 259) for more information about Kerberos authentication.

command line option!–ssl

**--ssl**

Enable connection to a [mongod](#) (page 925) or [mongos](#) (page 938) that has SSL encryption.

command line option!–sslPEMKeyFile <filename>

**--sslPEMKeyFile <filename>**

New in version 2.4.

---

**Note:** The [default distribution of MongoDB<sup>27</sup>](#) does **not** contain support for SSL. To use SSL you can either compile MongoDB with SSL support or use MongoDB Enterprise. See [Connect to MongoDB with SSL](#) (page 249) for more information about SSL and MongoDB.

---

Specifies the .pem file that contains both the SSL certificate and key. Specify the file name of the .pem file using relative or absolute paths

Required when using the [--ssl](#) (page 975) option if the [mongod](#) (page 925) or [mongos](#) (page 938) has [sslCAFile](#) (page 1004) enabled *without* [sslWeakCertificateValidation](#) (page 1004).

command line option!–sslPEMKeyPassword <value>

**--sslPEMKeyPassword <value>**

New in version 2.4.

---

**Note:** The [default distribution of MongoDB<sup>28</sup>](#) does **not** contain support for SSL. To use SSL you can ei-

<sup>27</sup><http://www.mongodb.org/downloads>

---

ther compile MongoDB with SSL support or use MongoDB Enterprise. See [Connect to MongoDB with SSL](#) (page 249) for more information about SSL and MongoDB.

---

Specifies the password to decrypt the root certificate chain specified by `--sslPEMKeyFile` (page 936).

Only required if the certificate-key file is encrypted.

command line option!–sslCAFile <filename>

**--sslCAFile** <filename>

New in version 2.4.

---

**Note:** The default distribution of MongoDB<sup>29</sup> does **not** contain support for SSL. To use SSL you can either compile MongoDB with SSL support or use MongoDB Enterprise. See [Connect to MongoDB with SSL](#) (page 249) for more information about SSL and MongoDB.

---

Specifies the .pem file that contains the certificate from the Certificate Authority. Specify the file name of the .pem file using relative or absolute paths

command line option!–help, -h

**--help, -h**

Returns a basic help and usage text.

command line option!–version

**--version**

Returns the version of the shell.

command line option!–verbose

**--verbose**

Increases the verbosity of the output of the shell during the connection process.

command line option!–ipv6

**--ipv6**

Enables IPv6 support that allows [mongo](#) (page 942) to connect to the MongoDB instance using an IPv6 network.

All MongoDB programs and processes, including [mongo](#) (page 942), disable IPv6 support by default.

**<db address>**

Specifies the “database address” of the database to connect to. For example:

```
mongo admin
```

The above command will connect the [mongo](#) (page 942) shell to the [admin database](#) on the local machine. You may specify a remote database instance, with the resolvable hostname or IP address. Separate the database name from the hostname using a `http://docs.mongodb.org/manual` character. See the following examples:

```
mongo mongo1.example.net
```

```
mongo mongo1/admin
```

```
mongo 10.8.8.10/test
```

**<file.js>**

Specifies a JavaScript file to run and then exit. Generally this should be the last option specified.

---

## Optional

<sup>28</sup><http://www.mongodb.org/downloads>

<sup>29</sup><http://www.mongodb.org/downloads>

To specify a JavaScript file to execute *and* allow `mongo` (page 942) to prompt you for a password using `--password` (page 980), pass the filename as the first parameter with `--username` (page 980) and `--password` (page 980)s the last options as in the following:

```
mongo file.js --username username --password
```

---

Use the `--shell` (page 943) option to return to a shell after the file finishes running.

### Files `~/ .dbshell`

`mongo` (page 942) maintains a history of commands in the `.dbshell` file.

---

**Note:** `mongo` (page 942) does not record interaction related to authentication in the history file, including `authenticate` (page 725) and `db.addUser()` (page 875).

---

**Warning:** Versions of Windows `mongo.exe` earlier than 2.2.0 will save the `.dbshell` file in the `mongo.exe` working directory.

### `~/.mongorc.js`

`mongo` (page 942) will read the `.mongorc.js` file from the home directory of the user invoking `mongo` (page 942). In the file, users can define variables, customize the `mongo` (page 942) shell prompt, or update information that they would like updated every time they launch a shell. If you use the shell to evaluate a JavaScript file or expression either on the command line with `--eval` (page 943) or by specifying `a.js file to mongo` (page 945), `mongo` (page 942) will read the `.mongorc.js` file *after* the JavaScript has finished processing.

Specify the `--norc` (page 943) option to disable reading `.mongorc.js`.

`http://docs.mongodb.org/manual/tmp/mongo_edit<time_t>.js`

Created by `mongo` (page 942) when editing a file. If the file exists `mongo` (page 942) will append an integer from 1 to 10 to the time value to attempt to create a unique file.

`%TEMP%mongo_edit<time_t>.js`

Created by `mongo.exe` on Windows when editing a file. If the file exists `mongo` (page 942) will append an integer from 1 to 10 to the time value to attempt to create a unique file.

## Environment

### `EDITOR`

Specifies the path to an editor to use with the `edit` shell command. A JavaScript variable `EDITOR` will override the value of `EDITOR` (page 946).

### `HOME`

Specifies the path to the home directory where `mongo` (page 942) will read the `.mongorc.js` file and write the `.dbshell` file.

### `HOMEDRIVE`

On Windows systems, `HOMEDRIVE` (page 946) specifies the path the directory where `mongo` (page 942) will read the `.mongorc.js` file and write the `.dbshell` file.

### `HOMEPATH`

Specifies the Windows path to the home directory where `mongo` (page 942) will read the `.mongorc.js` file and write the `.dbshell` file.

**Keyboard Shortcuts** The [mongo](#) (page 942) shell supports the following keyboard shortcuts:<sup>30</sup>

| Keybinding                      | Function                                                           |
|---------------------------------|--------------------------------------------------------------------|
| Up arrow                        | Retrieve previous command from history                             |
| Down-arrow                      | Retrieve next command from history                                 |
| Home                            | Go to beginning of the line                                        |
| End                             | Go to end of the line                                              |
| Tab                             | Autocomplete method/command                                        |
| Left-arrow                      | Go backward one character                                          |
| Right-arrow                     | Go forward one character                                           |
| Ctrl-left-arrow                 | Go backward one word                                               |
| Ctrl-right-arrow                | Go forward one word                                                |
| Meta-left-arrow                 | Go backward one word                                               |
| Meta-right-arrow                | Go forward one word                                                |
| Ctrl-A                          | Go to the beginning of the line                                    |
| Ctrl-B                          | Go backward one character                                          |
| Ctrl-C                          | Exit the <a href="#">mongo</a> (page 942) shell                    |
| Ctrl-D                          | Delete a char (or exit the <a href="#">mongo</a> (page 942) shell) |
| Ctrl-E                          | Go to the end of the line                                          |
| Ctrl-F                          | Go forward one character                                           |
| Ctrl-G                          | Abort                                                              |
| Ctrl-J                          | Accept/evaluate the line                                           |
| Ctrl-K                          | Kill/erase the line                                                |
| Ctrl-L or type <code>cls</code> | Clear the screen                                                   |
| Ctrl-M                          | Accept/evaluate the line                                           |
| Ctrl-N                          | Retrieve next command from history                                 |
| Ctrl-P                          | Retrieve previous command from history                             |
| Ctrl-R                          | Reverse-search command history                                     |
| Ctrl-S                          | Forward-search command history                                     |
| Ctrl-T                          | Transpose characters                                               |
| Ctrl-U                          | Perform Unix line-discard                                          |
| Ctrl-W                          | Perform Unix word-rubout                                           |
| Ctrl-Y                          | Yank                                                               |
| Ctrl-Z                          | Suspend (job control works in linux)                               |
| Ctrl-H                          | Backward-delete a character                                        |
| Ctrl-I                          | Complete, same as Tab                                              |
| Meta-B                          | Go backward one word                                               |
| Meta-C                          | Capitalize word                                                    |
| Meta-D                          | Kill word                                                          |
| Meta-F                          | Go forward one word                                                |
| Meta-L                          | Change word to lowercase                                           |
| Meta-U                          | Change word to uppercase                                           |
| Meta-Y                          | Yank-pop                                                           |
| Meta-Backspace                  | Backward-kill word                                                 |
| Meta-<                          | Retrieve the first command in command history                      |
| Meta->                          | Retrieve the last command in command history                       |

**Use** Typically users invoke the shell with the [mongo](#) (page 942) command at the system prompt. Consider the following examples for other scenarios.

<sup>30</sup> MongoDB accommodates multiple keybinding. Since 2.0, [mongo](#) (page 942) includes support for basic emacs keybindings.

To connect to a database on a remote host using authentication and a non-standard port, use the following form:

```
mongo --username <user> --password <pass> --host <host> --port 28015
```

Alternatively, consider the following short form:

```
mongo -u <user> -p <pass> --host <host> --port 28015
```

Replace `<user>`, `<pass>`, and `<host>` with the appropriate values for your situation and substitute or omit the `--port` (page 980) as needed.

To execute a JavaScript file without evaluating the `~/.mongorc.js` file before starting a shell session, use the following form:

```
mongo --shell --norc alternate-environment.js
```

To execute a JavaScript file with authentication, with password prompted rather than provided on the command-line, use the following form:

```
mongo script-file.js -u <user> -p
```

To print return a query as `JSON`, from the system prompt using the `--eval` option, use the following form:

```
mongo --eval 'db.collection.find().forEach(printjson)'
```

Use single quotes (e.g. `'`) to enclose the JavaScript, as well as the additional JavaScript required to generate this output.

## Windows Services

The `mongod.exe` (page 948) and `mongos.exe` (page 950) describe the options available for configuring MongoDB when running as a Windows Service. The `mongod.exe` (page 948) and `mongos.exe` (page 950) binaries provide a superset of the `mongod` (page 925) and `mongos` (page 938) options.

### `mongod.exe`

**Synopsis** `mongod.exe` (page 948) is the build of the MongoDB daemon (i.e. `mongod` (page 925)) for the Windows platform. `mongod.exe` (page 948) has all of the features of `mongod` (page 925) on Unix-like platforms and is completely compatible with the other builds of `mongod` (page 925). In addition, `mongod.exe` (page 948) provides several options for interacting with the Windows platform itself.

This document only references options that are unique to `mongod.exe` (page 948). All `mongod` (page 925) options are available. See the `mongod` (page 925) and the *Configuration File Options* (page 990) documents for more information regarding `mongod.exe` (page 948).

To install and use `mongod.exe` (page 948), read the *Install MongoDB on Windows* (page 16) document.

### Options

#### `mongod.exe`

#### `mongod.exe`

command line option!–install

#### `--install`

Installs `mongod.exe` (page 948) as a Windows Service and exits.

command line option!–remove

**--remove**

Removes the `mongod.exe` (page 948) Windows Service. If `mongod.exe` (page 948) is running, this operation will stop and then remove the service.

---

**Note:** `--remove` (page 950) requires the `--serviceName` (page 950) if you configured a non-default `--serviceName` (page 950) during the `--install` (page 950) operation.

---

command line option!–reinstall

**--reinstall**

Removes `mongod.exe` (page 948) and reinstalls `mongod.exe` (page 948) as a Windows Service.

command line option!–serviceName <name>

**--serviceName** <name>

*Default:* “MongoDB”

Set the service name of `mongod.exe` (page 948) when running as a Windows Service. Use this name with the `net start <name>` and `net stop <name>` operations.

You must use `--serviceName` (page 950) in conjunction with either the `--install` (page 950) or `--remove` (page 950) install option.

command line option!–serviceDisplayName <name>

**--serviceDisplayName** <name>

*Default:* “Mongo DB”

Sets the name listed for MongoDB on the Services administrative application.

command line option!–serviceDescription <description>

**--serviceDescription** <description>

*Default:* “MongoDB Server”

Sets the `mongod.exe` (page 948) service description.

You must use `--serviceDescription` (page 950) in conjunction with the `--install` (page 950) option.

---

**Note:** For descriptions that contain spaces, you must enclose the description in quotes.

---

command line option!–serviceUser <user>

**--serviceUser** <user>

Runs the `mongod.exe` (page 948) service in the context of a certain user. This user must have “Log on as a service” privileges.

You must use `--serviceUser` (page 950) in conjunction with the `--install` (page 950) option.

command line option!–servicePassword <password>

**--servicePassword** <password>

Sets the password for <user> for `mongod.exe` (page 948) when running with the `--serviceUser` (page 950) option.

You must use `--servicePassword` (page 951) in conjunction with the `--install` (page 950) option.

**mongos.exe**

**Synopsis** `mongos.exe` (page 950) is the build of the MongoDB Shard (i.e. `mongos` (page 938)) for the Windows platform. `mongos.exe` (page 950) has all of the features of `mongos` (page 938) on Unix-like platforms and is

completely compatible with the other builds of [mongos](#) (page 938). In addition, [mongos.exe](#) (page 950) provides several options for interacting with the Windows platform itself.

This document only references options that are unique to [mongos.exe](#) (page 950). All [mongos](#) (page 938) options are available. See the [mongos](#) (page 937) and the [Configuration File Options](#) (page 990) documents for more information regarding [mongos.exe](#) (page 950).

To install and use [mongos.exe](#) (page 950), read the [Install MongoDB on Windows](#) (page 16) document.

### Options

[mongos.exe](#)

[mongos.exe](#)

command line option!–install

#### **--install**

Installs [mongos.exe](#) (page 950) as a Windows Service and exits.

command line option!–remove

#### **--remove**

Removes the [mongos.exe](#) (page 950) Windows Service. If [mongos.exe](#) (page 950) is running, this operation will stop and then remove the service.

---

**Note:** [--remove](#) (page 950) requires the [--serviceName](#) (page 950) if you configured a non-default [--serviceName](#) (page 950) during the [--install](#) (page 950) operation.

---

command line option!–reinstall

#### **--reinstall**

Removes [mongos.exe](#) (page 950) and reinstalls [mongos.exe](#) (page 950) as a Windows Service.

command line option!–serviceName <name>

#### **--serviceName** <name>

*Default:* “MongoS”

Set the service name of [mongos.exe](#) (page 950) when running as a Windows Service. Use this name with the `net start <name>` and `net stop <name>` operations.

You must use [--serviceName](#) (page 950) in conjunction with either the [--install](#) (page 950) or [--remove](#) (page 950) install option.

command line option!–serviceDisplayName <name>

#### **--serviceDisplayName** <name>

*Default:* “Mongo DB Router”

Sets the name listed for MongoDB on the Services administrative application.

command line option!–serviceDescription <description>

#### **--serviceDescription** <description>

*Default:* “Mongo DB Sharding Router”

Sets the [mongos.exe](#) (page 950) service description.

You must use [--serviceDescription](#) (page 950) in conjunction with the [--install](#) (page 950) option.

---

**Note:** For descriptions that contain spaces, you must enclose the description in quotes.

---

command line option!–serviceUser <user>

**--serviceUser** <user>

Runs the `mongos.exe` (page 950) service in the context of a certain user. This user must have “Log on as a service” privileges.

You must use `--serviceUser` (page 950) in conjunction with the `--install` (page 950) option.

## command line option!–servicePassword &lt;password&gt;

**--servicePassword** <password>

Sets the password for <user> for `mongos.exe` (page 950) when running with the `--serviceUser` (page 950) option.

You must use `--servicePassword` (page 951) in conjunction with the `--install` (page 950) option.

## Binary Import and Export Tools

`mongodump` (page 951) provides a method for creating  *BSON* dump files from the `mongod` (page 925) instances, while `mongorestore` (page 956) makes it possible to restore these dumps. `bsondump` (page 961) converts *BSON* dump files into  *JSON*. The `mongooplog` (page 962) utility provides the ability to stream *oplog* entries outside of normal replication.

### `mongodump`

- [Synopsis](#) (page 951)
- [Options](#) (page 951)
- [Behavior](#) (page 955)
- [Required User Privileges](#) (page 955)
- [Usage](#) (page 955)

**Synopsis** `mongodump` (page 951) is a utility for creating a binary export of the contents of a database. Consider using this utility as part an effective  *backup strategy* (page 136). Use `mongodump` (page 951) in conjunction with `mongorestore` (page 956) to restore databases.

`mongodump` (page 951) can read data from either `mongod` (page 925) or `mongos` (page 938) instances, in addition to reading directly from MongoDB data files without an active `mongod` (page 925).

---

**Important:** `mongodump` (page 951) does *not* create output for the `local` database.

---

**Note:** The format of data created by `mongodump` (page 951) tool from the 2.2 distribution or later is different and incompatible with earlier versions of `mongod` (page 925).

---

**See also:**

`mongorestore` (page 956), *Backup a Sharded Cluster with Database Dumps* (page 190) and *Backup Strategies for MongoDB Systems* (page 136).

### Options

#### `mongodump`

command line option!–help

**--help**

Returns a basic help and usage text.

command line option!–verbose, -v

**--verbose, -v**

Increases the amount of internal reporting returned on the command line. Increase the verbosity with the `-v` form by including the option multiple times, (e.g. `-vvvvv`.)

command line option!–version

**--version**

Returns the version of the [mongodump](#) (page 951) utility and exits.

command line option!–host <hostname><:port>

**--host <hostname><:port>**

Specifies a resolvable hostname for the [mongod](#) (page 925) that you wish to use to create the database dump. By default [mongodump](#) (page 951) will attempt to connect to a MongoDB process running on the localhost port number 27017.

Optionally, specify a port number to connect a MongoDB instance running on a port other than 27017.

To connect to a replica set, use the `--host` argument with a setname, followed by a slash and a comma-separated list of host names and port numbers. The [mongodump](#) (page 951) utility will, given the seed of at least one connected set member, connect to the primary member of that set. This option would resemble:

```
mongodump --host repl0/mongo0.example.net,mongo0.example.net:27018,mongo1.example.net,mongo2.example.net
```

You can always connect directly to a single MongoDB instance by specifying the host and port number directly.

command line option!–port <port>

**--port <port>**

Specifies the port number, if the MongoDB instance is not running on the standard port. (i.e. 27017) You may also specify a port number using the `--host` option.

command line option!–ipv6

**--ipv6**

Enables IPv6 support that allows [mongodump](#) (page 951) to connect to the MongoDB instance using an IPv6 network. All MongoDB programs and processes, including [mongodump](#) (page 951), disable IPv6 support by default.

command line option!–ssl

**--ssl**

New in version 2.4: MongoDB added support for SSL connections to [mongod](#) (page 925) instances in [mongodump](#).

---

**Note:** SSL support in [mongodump](#) is not compiled into the default distribution of MongoDB. See [Connect to MongoDB with SSL](#) (page 249) for more information on SSL and MongoDB.

Additionally, [mongodump](#) does not support connections to [mongod](#) (page 925) instances that require client certificate validation.

---

Allows [mongodump](#) (page 951) to connect to [mongod](#) (page 925) instance over an SSL connection.

command line option!–username <username>, -u <username>

**--username <username>, -u <username>**

Specifies a username to authenticate to the MongoDB instance, if your database requires authentication. Use in conjunction with the `--password` option to supply a password.

command line option!–password <password>, -p <password>

**--password** <password>, **-p** <password>

Specifies a password to authenticate to the MongoDB instance. Use in conjunction with the **--username** option to supply a username.

If you specify a **--username** and do not pass an argument to **--password** (page 980), [mongodump](#) (page 951) will prompt for a password interactively. If you do not specify a password on the command line, **--password** (page 980) must be the last argument specified.

command line option!–authenticationDatabase <dbname>

**--authenticationDatabase** <dbname>

New in version 2.4.

Specifies the database that holds the user’s (e.g **--username**) credentials.

By default, [mongodump](#) (page 951) assumes that the database specified to the **--db** (page 958) argument holds the user’s credentials, unless you specify **--authenticationDatabase** (page 980).

See [userSource](#) (page 271), [system.users Privilege Documents](#) (page 270) and [User Privilege Roles in MongoDB](#) (page 265) for more information about delegated authentication in MongoDB.

command line option!–authenticationMechanism <name>

**--authenticationMechanism** <name>

New in version 2.4.

Specifies the authentication mechanism. By default, the authentication mechanism is MONGODB-CR, which is the MongoDB challenge/response authentication mechanism. In MongoDB Enterprise, [mongodump](#) (page 951) also includes support for GSSAPI to handle Kerberos authentication.

See [Deploy MongoDB with Kerberos Authentication](#) (page 259) for more information about Kerberos authentication.

command line option!–dbpath <path>

**--dbpath** <path>

Specifies the directory of the MongoDB data files. If used, the **--dbpath** (page 958) option enables [mongodump](#) (page 951) to attach directly to local data files and copy the data without the [mongod](#) (page 925). To run with **--dbpath** (page 958), [mongodump](#) (page 951) needs to restrict access to the data directory: as a result, no [mongod](#) (page 925) can access the same path while the process runs.

command line option!–directoryperdb

**--directoryperdb**

Use the **--directoryperdb** (page 958) in conjunction with the corresponding option to [mongod](#) (page 925). This option allows [mongodump](#) (page 951) to read data files organized with each database located in a distinct directory. This option is only relevant when specifying the **--dbpath** (page 958) option.

command line option!–journal

**--journal**

Allows [mongodump](#) (page 951) operations to use the durability [journal](#) to ensure that the export is in a consistent state. This option is only relevant when specifying the **--dbpath** (page 958) option.

command line option!–db <db>, -d <db>

**--db** <db>, **-d** <db>

Use the **--db** (page 958) option to specify a database for [mongodump](#) (page 951) to backup. If you do not specify a DB, [mongodump](#) (page 951) copies all databases in this instance into the dump files. Use this option to backup or copy a smaller subset of your data.

command line option!–collection <collection>, -c <collection>

### **--collection** <collection>, **-c** <collection>

Use the [--collection](#) (page 958) option to specify a collection for [mongodump](#) (page 951) to backup. If you do not specify a collection, this option copies all collections in the specified database or instance to the dump files. Use this option to backup or copy a smaller subset of your data.

command line option! **--out** <path>, **-o** <path>

### **--out** <path>, **-o** <path>

Specifies a directory where [mongodump](#) (page 951) saves the output of the database dump. By default, [mongodump](#) (page 951) saves output files in a directory named `dump` in the current working directory.

To send the database dump to standard output, specify “`-`” instead of a path. Write to standard output if you want process the output before saving it, such as to use `gzip` to compress the dump. When writing standard output, [mongodump](#) (page 951) does not write the metadata that writes in a `<dbname>.metadata.json` file when writing to files directly.

command line option! **--query** <json>, **-q** <json>

### **--query** <json>, **-q** <json>

Provides a query to limit (optionally) the documents included in the output of [mongodump](#) (page 951).

command line option! **--oplog**

### **--oplog**

Use this option to ensure that [mongodump](#) (page 951) creates a dump of the database that includes an *oplog*, to create a point-in-time snapshot of the state of a [mongod](#) (page 925) instance. To restore to a specific point-in-time backup, use the output created with this option in conjunction with [mongorestore](#) `--oplogReplay`.

Without [--oplog](#) (page 954), if there are write operations during the dump operation, the dump will not reflect a single moment in time. Changes made to the database during the update process can affect the output of the backup.

[--oplog](#) (page 954) has no effect when running [mongodump](#) (page 951) against a [mongos](#) (page 938) instance to dump the entire contents of a sharded cluster. However, you can use [--oplog](#) (page 954) to dump individual shards.

---

**Note:** [--oplog](#) (page 954) only works against nodes that maintain an *oplog*. This includes all members of a replica set, as well as *master* nodes in master/slave replication deployments.

---

command line option! **--repair**

### **--repair**

Use this option to run a repair option in addition to dumping the database. The repair option attempts to repair a database that may be in an inconsistent state as a result of an improper shutdown or [mongod](#) (page 925) crash.

---

**Note:** The [--repair](#) (page 954) option uses aggressive data-recovery algorithms that may produce a large amount of duplication.

---

command line option! **--forceTableScan**

### **--forceTableScan**

Forces [mongodump](#) (page 951) to scan the data store directly: typically, [mongodump](#) (page 951) saves entries as they appear in the index of the `_id` field. Use [--forceTableScan](#) (page 973) to skip the index and scan the data directly. Typically there are two cases where this behavior is preferable to the default:

1. If you have key sizes over 800 bytes that would not be present in the `_id` index.
2. Your database uses a custom `_id` field.

When you run with `--forceTableScan` (page 973), `mongodump` (page 951) does not use `$snapshot` (page 692). As a result, the dump produced by `mongodump` (page 951) can reflect the state of the database at many different points in time.

### Tip

Use `--forceTableScan` (page 973) with extreme caution and consideration.

**Behavior** When running `mongodump` (page 951) against a `mongos` (page 938) instance where the *sharded cluster* consists of *replica sets*, the *read preference* of the operation will prefer reads from *secondary* members of the set.

**Warning:** Changed in version 2.2: When used in combination with `fsync` (page 751) or `db.fsyncLock()` (page 885), `mongod` (page 925) may block some reads, including those from `mongodump` (page 951), when queued write operation waits behind the `fsync` (page 751) lock.

### Required User Privileges

#### Tip

User privileges changed in MongoDB 2.4.

The user must have appropriate privileges to read data from database holding collections in order to use `mongodump` (page 951). Consider the following *required privileges* (page 265) for the following `mongodump` (page 951) operations:

| Task                                                                 | Required Privileges                                                                                                                            |
|----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| All collections in a database except <code>system.users</code> .     | <code>read</code> (page 265). <sup>31</sup>                                                                                                    |
| All collections in a database, including <code>system.users</code> . | <code>read</code> (page 265) <sup>1</sup> and <code>userAdmin</code> (page 267).                                                               |
| All databases. <sup>32</sup>                                         | <code>readAnyDatabase</code> (page 269), <code>userAdminAnyDatabase</code> (page 269), and <code>clusterAdmin</code> (page 267). <sup>33</sup> |

See *User Privilege Roles in MongoDB* (page 265) and *system.users Privilege Documents* (page 270) for more information on user roles.

**Usage** See the *Backup and Restore with MongoDB Tools* (page 181) for a larger overview of `mongodump` (page 951) usage. Also see the `mongorestore` (page 956) document for an overview of the `mongorestore` (page 956), which provides the related inverse functionality.

The following command creates a dump file that contains only the collection named `collection` in the database named `test`. In this case the database is running on the local interface on port 27017:

```
mongodump --collection collection --db test
```

In the next example, `mongodump` (page 951) creates a backup of the database instance stored in the `/srv/mongodb` directory on the local machine. This requires that no `mongod` (page 925) instance is using the `/srv/mongodb` directory.

```
mongodump --dbpath /srv/mongodb
```

<sup>31</sup> You may provision `readWrite` (page 266) instead of `read` (page 265).

<sup>32</sup> If any database runs with profiling enabled, `mongodump` (page 951) may need the `dbAdminAnyDatabase` (page 269) privilege to dump the `system.profile` collection.

<sup>33</sup> `clusterAdmin` (page 267) provides the ability to run the `listDatabases` (page 761) command, to list all existing databases.

In the final example, `mongodump` (page 951) creates a database dump located at <http://docs.mongodb.org/manual/pt/backup/mongodump-2011-10-24>, from a database running on port 37017 on the host `mongodb1.example.net` and authenticating using the username `user` and the password `pass`, as follows:

```
mongodump --host mongodb1.example.net --port 37017 --username user --password pass --out /opt/backup
```

### `mongorestore`

**Synopsis** The `mongorestore` (page 956) program writes data from a binary database dump created by `mongodump` (page 951) to a MongoDB instance. `mongorestore` (page 956) can create a new database or add data to an existing database.

`mongorestore` (page 956) can write data to either `mongod` or `mongos` (page 938) instances, in addition to writing directly to MongoDB data files without an active `mongod` (page 925).

If you restore to an existing database, `mongorestore` (page 956) will only insert into the existing database, and does not perform updates of any kind. If existing documents have the same value `_id` field in the target database and collection, `mongorestore` (page 956) will *not* overwrite those documents.

Remember the following properties of `mongorestore` (page 956) behavior:

- `mongorestore` (page 956) recreates indexes recorded by `mongodump` (page 951).
- all operations are inserts, not updates.
- `mongorestore` (page 956) does not wait for a response from a `mongod` (page 925) to ensure that the MongoDB process has received or recorded the operation.

The `mongod` (page 925) will record any errors to its log that occur during a restore operation, but `mongorestore` (page 956) will not receive errors.

---

**Note:** The format of data created by `mongodump` (page 951) tool from the 2.2 distribution or later is different and incompatible with earlier versions of `mongod` (page 925).

---

### Options

#### `mongorestore`

#### `mongorestore`

command line option!–help

#### `--help`

Returns a basic help and usage text.

command line option!–verbose, -v

#### `--verbose`, `-v`

Increases the amount of internal reporting returned on the command line. Increase the verbosity with the `-v` form by including the option multiple times (e.g. `-vvvvv`).

command line option!–version

#### `--version`

Returns the version of the `mongorestore` (page 956) tool.

command line option!–host <hostname><:port>

#### `--host` <hostname><:port>

Specifies a resolvable hostname for the `mongod` (page 925) to which you want to restore the database. By

default `mongorestore` (page 956) will attempt to connect to a MongoDB process running on the localhost port number 27017. For an example of `--host` (page 979), see *Restore a Database with mongorestore* (page 183).

Optionally, specify a port number to connect a MongoDB instance running on a port other than 27017.

To connect to a replica set, you can specify the replica set seed name, and a seed list of set members, in the following format:

```
<replica_set_name>/<hostname1><:port>,<hostname2><:port>,...
```

command line option!–port <port>

**--port** <port>

Specifies the port number, if the MongoDB instance is not running on the standard port (i.e. 27017). You may also specify a port number using the `--host` (page 979) command. For an example of `--port` (page 980), see *Restore a Database with mongorestore* (page 183).

command line option!–ipv6

**--ipv6**

Enables IPv6 support that allows `mongorestore` (page 956) to connect to the MongoDB instance using an IPv6 network. All MongoDB programs and processes, including `mongorestore` (page 956), disable IPv6 support by default.

command line option!–ssl

**--ssl**

New in version 2.4: MongoDB added support for SSL connections to `mongod` (page 925) instances in `mongorestore`.

---

**Note:** SSL support in `mongorestore` is not compiled into the default distribution of MongoDB. See *Connect to MongoDB with SSL* (page 249) for more information on SSL and MongoDB.

Additionally, `mongorestore` does not support connections to `mongod` (page 925) instances that require client certificate validation.

---

Allows `mongorestore` (page 956) to connect to `mongod` (page 925) instance over an SSL connection.

command line option!–username <username>, -u <username>

**--username** <username>, **-u** <username>

Specifies a username to authenticate to the MongoDB instance, if your database requires authentication. Use in conjunction with the `--password` (page 980) option to supply a password. For an example of `--username` (page 980), see *Restore a Database with mongorestore* (page 183).

command line option!–password <password>, -p <password>

**--password** <password>, **-p** <password>

Specifies a password to authenticate to the MongoDB instance. Use in conjunction with the `--username` (page 980) option to supply a username. For an example of `--password` (page 980), see *Restore a Database with mongorestore* (page 183).

If you specify a `--username` (page 980) and do not pass an argument to `--password` (page 980), `mongorestore` (page 956) will prompt for a password interactively. If you do not specify a password on the command line, `--password` (page 980) must be the last argument specified.

command line option!–authenticationDatabase <dbname>

**--authenticationDatabase** <dbname>

New in version 2.4.

Specifies the database that holds the user's (e.g `--username`) credentials.

By default, `mongorestore` (page 956) assumes that the database specified to the `--db` (page 958) argument holds the user's credentials, unless you specify `--authenticationDatabase` (page 980).

See `userSource` (page 271), `system.users Privilege Documents` (page 270) and `User Privilege Roles in MongoDB` (page 265) for more information about delegated authentication in MongoDB.

command line option! `--authenticationMechanism <name>`

**`--authenticationMechanism <name>`**

New in version 2.4.

Specifies the authentication mechanism. By default, the authentication mechanism is MONGODB-CR, which is the MongoDB challenge/response authentication mechanism. In MongoDB Enterprise, `mongorestore` (page 956) also includes support for GSSAPI to handle Kerberos authentication.

See `Deploy MongoDB with Kerberos Authentication` (page 259) for more information about Kerberos authentication.

command line option! `--dbpath <path>`

**`--dbpath <path>`**

Specifies the directory of the MongoDB data files. If used, the `--dbpath` (page 958) option enables `mongorestore` (page 956) to attach directly to local data files and insert the data without the `mongod` (page 925). To run with `--dbpath` (page 958), `mongorestore` (page 956) needs to lock access to the data directory: as a result, no `mongod` (page 925) can access the same path while the process runs. For an example of `--dbpath` (page 958), see `Restore Without a Running mongod` (page 183).

command line option! `--directoryperdb`

**`--directoryperdb`**

Use the `--directoryperdb` (page 958) in conjunction with the corresponding option to `mongod` (page 925), which allows `mongorestore` (page 956) to import data into MongoDB instances that have every database's files saved in discrete directories on the disk. This option is only relevant when specifying the `--dbpath` (page 958) option.

command line option! `--journal`

**`--journal`**

Allows `mongorestore` (page 956) write to the durability `journal` to ensure that the data files will remain in a consistent state during the write process. This option is only relevant when specifying the `--dbpath` (page 958) option. For an example of `--journal` (page 958), see `Restore Without a Running mongod` (page 183).

command line option! `--db <db>, -d <db>`

**`--db <db>, -d <db>`**

Use the `--db` (page 958) option to specify a database for `mongorestore` (page 956) to restore data *into*. If the database doesn't exist, `mongorestore` (page 956) will create the specified database. If you do not specify a `<db>`, `mongorestore` (page 956) creates new databases that correspond to the databases where data originated and data may be overwritten. Use this option to restore data into a MongoDB instance that already has data.

`--db` (page 958) does *not* control which `BSON` files `mongorestore` (page 956) restores. You must use the `mongorestore` (page 956) `path option` (page 960) to limit that restored data.

command line option! `--collection <collection>, -c <collection>`

**`--collection <collection>, -c <collection>`**

Use the `--collection` (page 958) option to specify a collection for `mongorestore` (page 956) to restore. If you do not specify a `<collection>`, `mongorestore` (page 956) imports all collections created. Existing

data may be overwritten. Use this option to restore data into a MongoDB instance that already has data, or to restore only some data in the specified imported data set.

command line option!–objcheck

**--objcheck**

Forces the [mongorestore](#) (page 956) to validate all requests from clients upon receipt to ensure that clients never insert invalid documents into the database. For objects with a high degree of sub-document nesting, [--objcheck](#) (page 983) can have a small impact on performance. You can set [--noobjcheck](#) (page 959) to disable object checking at run-time.

Changed in version 2.4: MongoDB enables [--objcheck](#) (page 983) by default, to prevent any client from inserting malformed or invalid BSON into a MongoDB database.

command line option!–noobjcheck

**--noobjcheck**

New in version 2.4.

Disables the default document validation that MongoDB performs on all incoming BSON documents.

command line option!–filter '<JSON>'

**--filter ' <JSON> '**

Limits the documents that [mongorestore](#) (page 956) imports to only those documents that match the JSON document specified as '`<JSON>`'. Be sure to include the document in single quotes to avoid interaction with your system's shell environment. For an example of [--filter](#) (page 959), see *Restore a Subset of data from a Binary Database Dump* (page 183).

command line option!–drop

**--drop**

Modifies the restoration procedure to drop every collection from the target database before restoring the collection from the dumped backup.

command line option!–oplogReplay

**--oplogReplay**

Replays the [oplog](#) after restoring the dump to ensure that the current state of the database reflects the point-in-time backup captured with the “`mongodump --oplog`” command. For an example of [--oplogReplay](#) (page 959), see *Restore Point in Time Oplog Backup* (page 183).

command line option!–keepIndexVersion

**--keepIndexVersion**

Prevents [mongorestore](#) (page 956) from upgrading the index to the latest version during the restoration process.

command line option!–w <number of replicas per write>

**--w <number of replicas per write>**

New in version 2.2.

Specifies the [write concern](#) for each write operation that [mongorestore](#) (page 956) writes to the target database. By default, [mongorestore](#) (page 956) does not wait for a response for [write acknowledgment](#) (page 55).

command line option!–noOptionsRestore

**--noOptionsRestore**

New in version 2.2.

Prevents [mongorestore](#) (page 956) from setting the collection options, such as those specified by the [collMod](#) (page 755) [database command](#), on restored collections.

command line option!–noIndexRestore

**--noIndexRestore**

New in version 2.2.

Prevents [mongorestore](#) (page 956) from restoring and building indexes as specified in the corresponding [mongodump](#) (page 951) output.

command line option!–oplogLimit <timestamp>

**--oplogLimit** <timestamp>

New in version 2.2.

Prevents [mongorestore](#) (page 956) from applying *oplog* entries newer than the <timestamp>. Specify <timestamp> values in the form of <time\_t>:<ordinal>, where <time\_t> is the seconds since the UNIX epoch, and <ordinal> represents a counter of operations in the oplog that occurred in the specified second.

You must use [--oplogLimit](#) (page 960) in conjunction with the [--oplogReplay](#) (page 959) option.

**<path>**

The final argument of the [mongorestore](#) (page 956) command is a directory path. This argument specifies the location of the database dump from which to restore.

**Usage** See [Backup and Restore with MongoDB Tools](#) (page 181) for a larger overview of [mongorestore](#) (page 956) usage. Also see the [mongodump](#) (page 951) document for an overview of the [mongodump](#) (page 951), which provides the related inverse functionality.

Consider the following example:

```
mongorestore --collection people --db accounts dump/accounts/people.bson
```

Here, [mongorestore](#) (page 956) reads the database dump in the dump/ sub-directory of the current directory, and restores *only* the documents in the collection named people from the database named accounts. [mongorestore](#) (page 956) restores data to the instance running on the localhost interface on port 27017.

In the next example, [mongorestore](#) (page 956) restores a backup of the database instance located in dump to a database instance stored in the /srv/mongodb on the local machine. This requires that there are no active [mongod](#) (page 925) instances attached to /srv/mongodb data directory.

```
mongorestore --dbpath /srv/mongodb
```

In the final example, [mongorestore](#) (page 956) restores a database dump located at <http://docs.mongodb.org/manual/pt/backup/mongodump-2011-10-24>, to a database running on port 37017 on the host mongodb1.example.net. The [mongorestore](#) (page 956) command authenticates to the MongoDB instance using the username user and the password pass, as follows:

```
mongorestore --host mongodb1.example.net --port 37017 --username user --password pass /opt/backup/mo
```

## bsondump

**Synopsis** The [bsondump](#) (page 961) converts *BSON* files into human-readable formats, including *JSON*. For example, [bsondump](#) (page 961) is useful for reading the output files generated by [mongodump](#) (page 951).

**Important:** [bsondump](#) (page 961) is a diagnostic tool for inspecting BSON files, not a tool for data ingestion or other application use.

**Options**

**bsondump**  
**bsondump**

command line option!–help

**--help**

Returns a basic help and usage text.

command line option!–verbose, -v

**--verbose, -v**

Increases the amount of internal reporting returned on the command line. Increase the verbosity with the `-v` form by including the option multiple times, (e.g. `-vvvvv`.)

command line option!–version

**--version**

Returns the version of the [bsondump](#) (page 961) utility.

command line option!–objcheck

**--objcheck**

Validates each [BSON](#) object before outputting it in [JSON](#) format. By default, [bsondump](#) (page 961) enables `--objcheck` (page 983). For objects with a high degree of sub-document nesting, `--objcheck` (page 983) can have a small impact on performance. You can set `--noobjcheck` (page 959) to disable object checking.

Changed in version 2.4: MongoDB enables `--objcheck` (page 983) by default, to prevent any client from inserting malformed or invalid BSON into a MongoDB database.

command line option!–noobjcheck

**--noobjcheck**

New in version 2.4.

Disables the default document validation that [bsondump](#) (page 961) performs on all BSON documents.

command line option!–filter '`<JSON>`'

**--filter ' <JSON> '**

Limits the documents that [bsondump](#) (page 961) exports to only those documents that match the [JSON document](#) specified as '`<JSON>`'. Be sure to include the document in single quotes to avoid interaction with your system's shell environment.

command line option!–type `<=json|=debug>`

**--type** `<=json|=debug>`

Changes the operation of [bsondump](#) (page 961) from outputting "[JSON](#)" (the default) to a debugging format.

**<bsonfilename>**

The final argument to [bsondump](#) (page 961) is a document containing [BSON](#). This data is typically generated by [mongodump](#) (page 951) or by MongoDB in a [rollback](#) operation.

**Usage** By default, [bsondump](#) (page 961) outputs data to standard output. To create corresponding [JSON](#) files, you will need to use the shell redirect. See the following command:

```
bsondump collection.bson > collection.json
```

Use the following command (at the system shell) to produce debugging output for a [BSON](#) file:

```
bsondump --type=debug collection.bson
```

## `mongooplog`

New in version 2.2.

**Synopsis** `mongooplog` (page 962) is a simple tool that polls operations from the *replication oplog* of a remote server, and applies them to the local server. This capability supports certain classes of real-time migrations that require that the source server remain online and in operation throughout the migration process.

Typically this command will take the following form:

```
mongooplog --from mongodb0.example.net --host mongodb1.example.net
```

This command copies oplog entries from the `mongod` (page 925) instance running on the host `mongodb0.example.net` and duplicates operations to the host `mongodb1.example.net`. If you do not need to keep the `--from` host running during the migration, consider using `mongodump` (page 951) and `mongorestore` (page 956) or another *backup* (page 136) operation, which may be better suited to your operation.

---

**Note:** If the `mongod` (page 925) instance specified by the `--from` argument is running with `authentication` (page 993), then `mongooplog` (page 962) will not be able to copy oplog entries.

---

### See also:

`mongodump` (page 951), `mongorestore` (page 956), *Backup Strategies for MongoDB Systems* (page 136), *Replica Set Oplog* (page 410).

### Options

#### `mongooplog`

command line option!–help

#### `--help`

Returns a basic help and usage text.

command line option!–verbose, -v

#### `--verbose, -v`

Increases the amount of internal reporting returned on the command line. Increase the verbosity with the `-v` form by including the option multiple times, (e.g. `-vvvvv`.)

command line option!–version

#### `--version`

Returns the version of the `mongooplog` (page 962) utility.

command line option!–host <hostname><:port>, -h

#### `--host <hostname><:port>, -h`

Specifies a resolvable hostname for the `mongod` (page 925) instance to which `mongooplog` (page 962) will apply *oplog* operations retrieved from the serve specified by the `--from` option.

`mongooplog` (page 962) assumes that all target `mongod` (page 925) instances are accessible by way of port 27017. You may, optionally, declare an alternate port number as part of the hostname argument.

You can always connect directly to a single `mongod` (page 925) instance by specifying the host and port number directly.

To connect to a replica set, you can specify the replica set seed name, and a seed list of set members, in the following format:

---

```
<replica_set_name>/<hostname1><:port>,<hostname2:><port>,...
```

command line option!–port

**--port**

Specifies the port number of the [mongod](#) (page 925) instance where [mongooplog](#) (page 962) will apply [oplog](#) entries. Only specify this option if the MongoDB instance that you wish to connect to is not running on the standard port. (i.e. 27017) You may also specify a port number using the [--host](#) command.

command line option!–ipv6

**--ipv6**

Enables IPv6 support that allows [mongooplog](#) (page 962) to connect to the MongoDB instance using an IPv6 network. All MongoDB programs and processes, including [mongooplog](#) (page 962), disable IPv6 support by default.

command line option!–ssl

**--ssl**

New in version 2.4: MongoDB added support for SSL connections to [mongod](#) (page 925) instances in [mongooplog](#).

---

**Note:** SSL support in [mongooplog](#) is not compiled into the default distribution of MongoDB. See [Connect to MongoDB with SSL](#) (page 249) for more information on SSL and MongoDB.

Additionally, [mongooplog](#) does not support connections to [mongod](#) (page 925) instances that require client certificate validation.

---

Allows [mongooplog](#) (page 962) to connect to [mongod](#) (page 925) instance over an SSL connection.

command line option!–username <username>, -u <username>

**--username** <username>, **-u** <username>

Specifies a username to authenticate to the MongoDB instance, if your database requires authentication. Use in conjunction with the [--password](#) option to supply a password.

command line option!–password <password>, -p <password>

**--password** <password>, **-p** <password>

Specifies a password to authenticate to the MongoDB instance. Use in conjunction with the [--username](#) option to supply a username.

If you specify a [--username](#) and do not pass an argument to [--password](#) (page 980), [mongooplog](#) (page 962) will prompt for a password interactively. If you do not specify a password on the command line, [--password](#) (page 980) must be the last option.

command line option!–authenticationDatabase <dbname>

**--authenticationDatabase** <dbname>

New in version 2.4.

Specifies the database that holds the user's (e.g [--username](#)) credentials.

By default, [mongooplog](#) (page 962) assumes that the database specified to the [--db](#) (page 958) argument holds the user's credentials, unless you specify [--authenticationDatabase](#) (page 980).

See [userSource](#) (page 271), [system.users Privilege Documents](#) (page 270) and [User Privilege Roles in MongoDB](#) (page 265) for more information about delegated authentication in MongoDB.

command line option!–authenticationMechanism <name>

**--authenticationMechanism** <name>

New in version 2.4.

Specifies the authentication mechanism. By default, the authentication mechanism is MONGODB-CR, which is the MongoDB challenge/response authentication mechanism. In MongoDB Enterprise, [mongooplog](#) (page 962) also includes support for GSSAPI to handle Kerberos authentication.

See [Deploy MongoDB with Kerberos Authentication](#) (page 259) for more information about Kerberos authentication.

command line option!–dbpath <path>

**--dbpath <path>**

Specifies a directory, containing MongoDB data files, to which [mongooplog](#) (page 962) will apply operations from the *oplog* of the database specified with the --from option. When used, the --dbpath (page 958) option enables [mongo](#) (page 942) to attach directly to local data files and write data without a running [mongod](#) (page 925) instance. To run with --dbpath (page 958), [mongooplog](#) (page 962) needs to restrict access to the data directory: as a result, no [mongod](#) (page 925) can be access the same path while the process runs.

command line option!–directoryperdb

**--directoryperdb**

Use the --directoryperdb (page 958) in conjunction with the corresponding option to [mongod](#) (page 925). This option allows [mongooplog](#) (page 962) to write to data files organized with each database located in a distinct directory. This option is only relevant when specifying the --dbpath (page 958) option.

command line option!–journal

**--journal**

Allows [mongooplog](#) (page 962) operations to use the durability *journal* to ensure that the data files will remain in a consistent state during the writing process. This option is only relevant when specifying the --dbpath (page 958) option.

command line option!–seconds <number>, -s <number>

**--seconds <number>, -s <number>**

Specify a number of seconds of operations for [mongooplog](#) (page 962) to pull from the *remote host*. Unless specified the default value is 86400 seconds, or 24 hours.

command line option!–from <host[:port]>

**--from <host[:port]>**

Specify the host for [mongooplog](#) (page 962) to retrieve *oplog* operations from. [mongooplog](#) (page 962) requires this option.

Unless you specify the --host option, [mongooplog](#) (page 962) will apply the operations collected with this option to the oplog of the [mongod](#) (page 925) instance running on the localhost interface connected to port 27017.

command line option!–oplogs <namespace>

**--oplogs <namespace>**

Specify a namespace in the --from host where the oplog resides. The default value is `local.oplog.rs`, which is the where *replica set* members store their operation log. However, if you've copied *oplog* entries into another database or collection, use this option to copy oplog entries stored in another location.

*Namespaces* take the form of [database]. [collection].

**Usage** Consider the following prototype [mongooplog](#) (page 962) command:

```
mongooplog --from mongodb0.example.net --host mongodb1.example.net
```

Here, entries from the *oplog* of the [mongod](#) (page 925) running on port 27017. This only pull entries from the last 24 hours.

Use the `--seconds` argument to capture a greater or smaller amount of time. Consider the following example:

```
mongooplog --from mongo0.example.net --seconds 172800
```

In this operation, `mongooplog` (page 962) captures 2 full days of operations. To migrate 12 hours of `oplog` entries, use the following form:

```
mongooplog --from mongo0.example.net --seconds 43200
```

For the previous two examples, `mongooplog` (page 962) migrates entries to the `mongod` (page 925) process running on the localhost interface connected to the 27017 port. `mongooplog` (page 962) can also operate directly on MongoDB's data files if no `mongod` (page 925) is running on the *target* host. Consider the following example:

```
mongooplog --from mongo0.example.net --dbpath /srv/mongodb --journal
```

Here, `mongooplog` (page 962) imports `oplog` operations from the `mongod` (page 925) host connected to port 27017. This migrates operations to the MongoDB data files stored in the `/srv/mongodb` directory. Additionally `mongooplog` (page 962) will use the durability `journal` to ensure that the data files remain in a consistent state.

## Data Import and Export Tools

`mongoimport` (page 965) provides a method for taking data in `JSON`, `CSV`, or `TSV` and importing it into a `mongod` (page 925) instance. `mongoexport` (page 969) provides a method to export data from a `mongod` (page 925) instance into `JSON`, `CSV`, or `TSV`.

---

**Note:** The conversion between BSON and other formats lacks full type fidelity. Therefore you cannot use `mongoimport` (page 965) and `mongoexport` (page 969) for round-trip import and export operations.

---

### `mongoimport`

**Synopsis** The `mongoimport` (page 965) tool provides a route to import content from a `JSON`, `CSV`, or `TSV` export created by `mongoexport` (page 969), or potentially, another third-party export tool. See the *Import and Export MongoDB Data* (page 149) document for a more in depth usage overview, and the `mongoexport` (page 969) document for more information regarding `mongoexport` (page 969), which provides the inverse “importing” capability.

---

**Note:** Do not use `mongoimport` (page 965) and `mongoexport` (page 969) for full instance, production backups because they will not reliably capture data type information. Use `mongodump` (page 951) and `mongorestore` (page 956) as described in *Backup Strategies for MongoDB Systems* (page 136) for this kind of functionality.

---

#### Options

`mongoimport`  
`mongoimport`

command line option!–help

**--help**

Returns a basic help and usage text.

command line option!–verbose, -v

**--verbose**, **-v**

Increases the amount of internal reporting returned on the command line. Increase the verbosity with the `-v` form by including the option multiple times, (e.g. `-vvvvv`.)

command line option!–version

### --version

Returns the version of the [mongoimport](#) (page 965) program.

command line option!–host <hostname><:port>, -h

### --host <hostname><:port>, -h

Specifies a resolvable hostname for the [mongod](#) (page 925) to which you want to restore the database. By default [mongoimport](#) (page 965) will attempt to connect to a MongoDB process running on the localhost port numbered 27017.

Optionally, specify a port number to connect a MongoDB instance running on a port other than 27017.

To connect to a replica set, use the [--host](#) (page 979) argument with a setname, followed by a slash and a comma-separated list of host and port names. [mongoimport](#) (page 965) will, given the seed of at least one connected set member, connect to the [primary](#) of that set. This option would resemble:

```
--host rep10/mongo0.example.net,mongo0.example.net:27018,mongo1.example.net,mongo2.example.net
```

You can always connect directly to a single MongoDB instance by specifying the host and port number directly.

command line option!–port <port>

### --port <port>

Specifies the port number, if the MongoDB instance is not running on the standard port. (i.e. 27017) You may also specify a port number using the [mongoimport --host](#) command.

command line option!–ipv6

### --ipv6

Enables IPv6 support that allows [mongoimport](#) (page 965) to connect to the MongoDB instance using an IPv6 network. All MongoDB programs and processes, including [mongoimport](#) (page 965), disable IPv6 support by default.

command line option!–ssl

### --ssl

New in version 2.4: MongoDB added support for SSL connections to [mongod](#) (page 925) instances in [mongoimport](#).

---

**Note:** SSL support in [mongoimport](#) is not compiled into the default distribution of MongoDB. See [Connect to MongoDB with SSL](#) (page 249) for more information on SSL and MongoDB.

Additionally, [mongoimport](#) does not support connections to [mongod](#) (page 925) instances that require client certificate validation.

---

Allows [mongoimport](#) (page 965) to connect to [mongod](#) (page 925) instance over an SSL connection.

command line option!–username <username>, -u <username>

### --username <username>, -u <username>

Specifies a username to authenticate to the MongoDB instance, if your database requires authentication. Use in conjunction with the [mongoimport --password](#) option to supply a password.

command line option!–password <password>, -p <password>

### --password <password>, -p <password>

Specifies a password to authenticate to the MongoDB instance. Use in conjunction with the [mongoimport --username](#) option to supply a username.

If you specify a [--username](#) and do not pass an argument to [--password](#) (page 980), [mongoimport](#) (page 965) will prompt for a password interactively. If you do not specify a password on the command line, [--password](#) (page 980) must be the last option.

command line option!–authenticationDatabase <dbname>

**--authenticationDatabase** <dbname>

New in version 2.4.

Specifies the database that holds the user’s (e.g. `--username`) credentials.

By default, `mongoimport` (page 965) assumes that the database specified to the `--db` (page 958) argument holds the user’s credentials, unless you specify `--authenticationDatabase` (page 980).

See `userSource` (page 271), `system.users Privilege Documents` (page 270) and `User Privilege Roles in MongoDB` (page 265) for more information about delegated authentication in MongoDB.

command line option!–authenticationMechanism <name>

**--authenticationMechanism** <name>

New in version 2.4.

Specifies the authentication mechanism. By default, the authentication mechanism is MONGODB-CR, which is the MongoDB challenge/response authentication mechanism. In MongoDB Enterprise, `mongoimport` (page 965) also includes support for GSSAPI to handle Kerberos authentication.

See `Deploy MongoDB with Kerberos Authentication` (page 259) for more information about Kerberos authentication.

command line option!–dbpath <path>

**--dbpath** <path>

Specifies the directory of the MongoDB data files. If used, the `--dbpath` option enables `mongoimport` (page 965) to attach directly to local data files and insert the data without the `mongod` (page 925). To run with `--dbpath`, `mongoimport` (page 965) needs to lock access to the data directory: as a result, no `mongod` (page 925) can access the same path while the process runs.

command line option!–directoryperdb

**--directoryperdb**

Use the `--directoryperdb` (page 958) in conjunction with the corresponding option to `mongod` (page 925), which allows `mongoimport` (page 965) to import data into MongoDB instances that have every database’s files saved in discrete directories on the disk. This option is only relevant when specifying the `--dbpath` (page 958) option.

command line option!–journal

**--journal**

Allows `mongoexport` (page 969) write to the durability `journal` to ensure that the data files will remain in a consistent state during the write process. This option is only relevant when specifying the `--dbpath` (page 958) option.

command line option!–db <db>, -d <db>

**--db** <db>, **-d** <db>

Use the `--db` (page 958) option to specify a database for `mongoimport` (page 965) to import data.

command line option!–collection <collection>, -c <collection>

**--collection** <collection>, **-c** <collection>

Use the `--collection` (page 958) option to specify a collection for `mongoimport` (page 965) to import.

command line option!–fields <field1<,field2>>, -f <field1[,field2]>

**--fields** <field1<,field2>>, **-f** <field1[,field2]>

Specify a comma separated list of field names when importing `csv` or `tsv` files that do not have field names in the first (i.e. header) line of the file.

command line option!–fieldFile <filename>

**--fieldFile** <filename>

As an alternative to [--fields](#) (page 967) the [--fieldFile](#) (page 968) option allows you to specify a file (e.g. <file>) to that holds a list of field names if your [csv](#) or [tsv](#) file does not include field names in the first (i.e. header) line of the file. Place one field per line.

command line option!–ignoreBlanks

**--ignoreBlanks**

In [csv](#) and [tsv](#) exports, ignore empty fields. If not specified, [mongoimport](#) (page 965) creates fields without values in imported documents.

command line option!–type <json|csv|tsv>

**--type** <json|csv|tsv>

Declare the type of export format to import. The default format is [JSON](#), but it's possible to import [csv](#) and [tsv](#) files.

command line option!–file <filename>

**--file** <filename>

Specify the location of a file containing the data to import. [mongoimport](#) (page 965) will read data from standard input (e.g. “stdin.”) if you do not specify a file.

command line option!–drop

**--drop**

Modifies the import process so that the target instance drops every collection before importing the collection from the input.

command line option!–headerline

**--headerline**

If using “[--type csv](#)” or “[--type tsv](#),” use the first line as field names. Otherwise, [mongoimport](#) (page 965) will import the first line as a distinct document.

command line option!–upsert

**--upsert**

Modifies the import process to update existing objects in the database if they match an imported object, while inserting all other objects.

If you do not specify a field or fields using the [--upsertFields](#) (page 968) [mongoimport](#) (page 965) will upsert on the basis of the `_id` field.

command line option!–upsertFields <field1[,field2]>

**--upsertFields** <field1[,field2]>

Specifies a list of fields for the query portion of the [upsert](#). Use this option if the `_id` fields in the existing documents don't match the field in the document, but another field or field combination can uniquely identify documents as a basis for performing upsert operations.

To ensure adequate performance, indexes should exist for this field or fields.

command line option!–stopOnError

**--stopOnError**

New in version 2.2.

Forces [mongoimport](#) (page 965) to halt the import operation at the first error rather than continuing the operation despite errors.

command line option!–jsonArray

**-- jsonArray**

Changed in version 2.2: The limit on document size increased from 4MB to 16MB.

Accept import of data expressed with multiple MongoDB documents within a single *JSON* array.

Use in conjunction with *mongoexport* *--jsonArray* to import data written as a single *JSON* array. Limited to imports of 16 MB or smaller.

**Usage** In this example, *mongoimport* (page 965) imports the *csv* formatted data in the <http://docs.mongodb.org/manual/pt/backups/contacts.csv> into the collection *contacts* in the *users* database on the MongoDB instance running on the localhost port numbered 27017.

```
mongoimport --db users --collection contacts --type csv --file /opt/backups/contacts.csv
```

In the following example, *mongoimport* (page 965) imports the data in the *JSON* formatted file *contacts.json* into the collection *contacts* on the MongoDB instance running on the localhost port number 27017. Journaling is explicitly enabled.

```
mongoimport --collection contacts --file contacts.json
```

In the next example, *mongoimport* (page 965) takes data passed to it on standard input (i.e. with a | pipe.) and imports it into the collection *contacts* in the *sales* database is the MongoDB datafiles located at /srv/mongodb/. if the import process encounters an error, the *mongoimport* (page 965) will halt because of the *--stopOnError* option.

```
mongoimport --db sales --collection contacts --stopOnError --dbpath /srv/mongodb/
```

In the final example, *mongoimport* (page 965) imports data from the file <http://docs.mongodb.org/manual/pt/backups/mdb1-examplenet.json> into the collection *contacts* within the database *marketing* on a remote MongoDB database. This *mongoimport* (page 965) accesses the *mongod* (page 925) instance running on the host *mongodb1.example.net* over port 37017, which requires the username *user* and the password *pass*.

```
mongoimport --host mongodb1.example.net --port 37017 --username user --password pass --collection contacts
```

**mongoexport**

**Synopsis** *mongoexport* (page 969) is a utility that produces a JSON or CSV export of data stored in a MongoDB instance. See the *Import and Export MongoDB Data* (page 149) document for a more in depth usage overview, and the *mongoimport* (page 965) document for more information regarding the *mongoimport* (page 965) utility, which provides the inverse “importing” capability.

---

**Note:** Do not use *mongoimport* (page 965) and *mongoexport* (page 969) for full-scale backups because they may not reliably capture data type information. Use *mongodump* (page 951) and *mongorestore* (page 956) as described in *Backup Strategies for MongoDB Systems* (page 136) for this kind of functionality.

---

**Options****mongoexport****mongoexport**

command line option!–help

**--help**

Returns a basic help and usage text.

command line option!–verbose, -v

**--verbose, -v**

Increases the amount of internal reporting returned on the command line. Increase the verbosity with the `-v` form by including the option multiple times, (e.g. `-vvvvv.`)

command line option!–version

**--version**

Returns the version of the [mongoexport](#) (page 969) utility.

command line option!–host <hostname><:port>

**--host <hostname><:port>**

Specifies a resolvable hostname for the [mongod](#) (page 925) from which you want to export data. By default [mongoexport](#) (page 969) attempts to connect to a MongoDB process running on the localhost port number 27017.

Optionally, specify a port number to connect a MongoDB instance running on a port other than 27017.

To connect to a replica set, you can specify the replica set seed name, and a seed list of set members, in the following format:

<replica\_set\_name>/<hostname1><:port>,<hostname2>:<port>,...

command line option!–port <port>

**--port <port>**

Specifies the port number, if the MongoDB instance is not running on the standard port. (i.e. 27017) You may also specify a port number using the [mongoexport](#) `--host` command.

command line option!–ipv6

**--ipv6**

Enables IPv6 support that allows [mongoexport](#) (page 969) to connect to the MongoDB instance using an IPv6 network. All MongoDB programs and processes, including [mongoexport](#) (page 969), disable IPv6 support by default.

command line option!–ssl

**--ssl**

New in version 2.4: MongoDB added support for SSL connections to [mongod](#) (page 925) instances in mongo-export.

---

**Note:** SSL support in mongoexport is not compiled into the default distribution of MongoDB. See [Connect to MongoDB with SSL](#) (page 249) for more information on SSL and MongoDB.

Additionally, mongoexport does not support connections to [mongod](#) (page 925) instances that require client certificate validation.

---

Allows [mongoexport](#) (page 969) to connect to [mongod](#) (page 925) instance over an SSL connection.

command line option!–username <username>, -u <username>

**--username <username>, -u <username>**

Specifies a username to authenticate to the MongoDB instance, if your database requires authentication. Use in conjunction with the [mongoexport](#) `--password` option to supply a password.

command line option!–password <password>, -p <password>

**--password <password>, -p <password>**

Specifies a password to authenticate to the MongoDB instance. Use in conjunction with the `--username` option to supply a username.

If you specify a `--username` and do not pass an argument to `--password` (page 980), `mongoexport` (page 969) will prompt for a password interactively. If you do not specify a password on the command line, `--password` (page 980) must be the last argument specified.

command line option! `--authenticationDatabase <dbname>`

**`--authenticationDatabase <dbname>`**

New in version 2.4.

Specifies the database that holds the user's (e.g `--username`) credentials.

By default, `mongoexport` (page 969) assumes that the database specified to the `--db` (page 958) argument holds the user's credentials, unless you specify `--authenticationDatabase` (page 980).

See `userSource` (page 271), `system.users Privilege Documents` (page 270) and `User Privilege Roles in MongoDB` (page 265) for more information about delegated authentication in MongoDB.

command line option! `--authenticationMechanism <name>`

**`--authenticationMechanism <name>`**

New in version 2.4.

Specifies the authentication mechanism. By default, the authentication mechanism is MONGODB-CR, which is the MongoDB challenge/response authentication mechanism. In MongoDB Enterprise, `mongoexport` (page 969) also includes support for GSSAPI to handle Kerberos authentication.

See `Deploy MongoDB with Kerberos Authentication` (page 259) for more information about Kerberos authentication.

command line option! `--dbpath <path>`

**`--dbpath <path>`**

Specifies the directory of the MongoDB data files. If used, the `--dbpath` option enables `mongoexport` (page 969) to attach directly to local data files and insert the data without the `mongod` (page 925). To run with `--dbpath`, `mongoexport` (page 969) needs to lock access to the data directory: as a result, no `mongod` (page 925) can access the same path while the process runs.

command line option! `--directoryperdb`

**`--directoryperdb`**

Use the `--directoryperdb` (page 958) in conjunction with the corresponding option to `mongod` (page 925), which allows `mongoexport` (page 969) to export data from MongoDB instances that have every database's files saved in discrete directories on the disk. This option is only relevant when specifying the `--dbpath` (page 958) option.

command line option! `--journal`

**`--journal`**

Allows `mongoexport` (page 969) operations to access the durability `journal` to ensure that the export is in a consistent state. This option is only relevant when specifying the `--dbpath` (page 958) option.

command line option! `--db <db>, -d <db>`

**`--db <db>, -d <db>`**

Use the `--db` (page 958) option to specify the name of the database that contains the collection you want to export.

command line option! `--collection <collection>, -c <collection>`

**`--collection <collection>, -c <collection>`**

Use the `--collection` (page 958) option to specify the collection that you want `mongoexport` (page 969) to export.

command line option! `--fields <field1[,field2]>, -f <field1[,field2]>`

**--fields** <field1[,field2]>, **-f** <field1[,field2]>

Specify a field or fields to *include* in the export. Use a comma separated list of fields to specify multiple fields.

For **--csv** output formats, [mongoexport](#) (page 969) includes only the specified field(s), and the specified field(s) can be a field within a sub-document.

For **JSON** output formats, [mongoexport](#) (page 969) includes only the specified field(s) **and** the `_id` field, and if the specified field(s) is a field within a sub-document, the [mongoexport](#) (page 969) includes the sub-document with all its fields, not just the specified field within the document.

command line option!–fieldFile <file>

**--fieldFile** <file>

As an alternative to **--fields**, the **--fieldFile** option allows you to specify in a file the field or fields to *include* in the export and is **only valid** with the **--csv** option. The file must have only one field per line, and the line(s) must end with the LF character (0x0A).

[mongoexport](#) (page 969) includes only the specified field(s). The specified field(s) can be a field within a sub-document.

command line option!–query <JSON>, -q <JSON>

**--query** <JSON>, **-q** <JSON>

Provides a **JSON document** as a query that optionally limits the documents returned in the export.

---

### Example

Given a collection named `records` in the database `test` with the following documents:

```
{ "_id" : ObjectId("51f0188846a64a1ed98fde7c"), "a" : 1 }
{ "_id" : ObjectId("520e61b0c6646578e3661b59"), "a" : 1, "b" : 2 }
{ "_id" : ObjectId("520e642bb7fa4ea22d6b1871"), "a" : 2, "b" : 3, "c" : 5 }
{ "_id" : ObjectId("520e6431b7fa4ea22d6b1872"), "a" : 3, "b" : 3, "c" : 6 }
{ "_id" : ObjectId("520e6445b7fa4ea22d6b1873"), "a" : 5, "b" : 6, "c" : 8 }
```

The following [mongoexport](#) (page 969) uses the **-q** option to export only the documents with the field `a` greater than or equal to (`$gte` (page 622)) to 3:

```
mongoexport -d test -c records -q "{ a: { $gte: 3 } }" --out exportdir/myRecords.json
```

The resulting file contains the following documents:

```
{ "_id" : { "$oid" : "520e6431b7fa4ea22d6b1872" }, "a" : 3, "b" : 3, "c" : 6 }
{ "_id" : { "$oid" : "520e6445b7fa4ea22d6b1873" }, "a" : 5, "b" : 6, "c" : 8 }
```

---

command line option!–csv

**--csv**

Changes the export format to a comma separated values (CSV) format. By default [mongoexport](#) (page 969) writes data using one **JSON** document for every MongoDB document.

If you specify **--csv** (page 972), then you must also use either the **--fields** (page 967) or the **--fieldFile** (page 968) option to declare the fields to export from the collection.

command line option!–jsonArray

**--jsonArray**

Modifies the output of [mongoexport](#) (page 969) to write the entire contents of the export as a single **JSON** array. By default [mongoexport](#) (page 969) writes data using one JSON document for every MongoDB document.

command line option!–slaveOk, -k

**--slaveOk, -k**

Allows [mongoexport](#) (page 969) to read data from secondary or slave nodes when using [mongoexport](#) (page 969) with a replica set. This option is only available if connected to a [mongod](#) (page 925) or [mongos](#) (page 938) and is not available when used with the “`mongoexport --dbpath`” option.

This is the default behavior.

command line option!–out <file>, -o <file>

**--out <file>, -o <file>**

Specify a file to write the export to. If you do not specify a file name, the [mongoexport](#) (page 969) writes data to standard output (e.g. `stdout`).

command line option!–forceTableScan

**--forceTableScan**

New in version 2.2.

Forces [mongoexport](#) (page 969) to scan the data store directly: typically, [mongoexport](#) (page 969) saves entries as they appear in the index of the `_id` field. Use [--forceTableScan](#) (page 973) to skip the index and scan the data directly. Typically there are two cases where this behavior is preferable to the default:

- 1.If you have key sizes over 800 bytes that would not be present in the `_id` index.
- 2.Your database uses a custom `_id` field.

When you run with [--forceTableScan](#) (page 973), [mongoexport](#) (page 969) does not use `$snapshot` (page 692). As a result, the export produced by [mongoexport](#) (page 969) can reflect the state of the database at many different points in time.

**Warning:** Use [--forceTableScan](#) (page 973) with extreme caution and consideration.

**Usage** In the following example, [mongoexport](#) (page 969) exports the collection `contacts` from the `users` database from the [mongod](#) (page 925) instance running on the localhost port number 27017. This command writes the export data in [CSV](#) format into a file located at `http://docs.mongodb.org/manual/backup/backups/contacts.csv`. The `fields.txt` file contains a line-separated list of fields to export.

```
mongoexport --db users --collection contacts --csv --fieldFile fields.txt --out /opt/backups/contacts
```

The next example creates an export of the collection `contacts` from the MongoDB instance running on the localhost port number 27017, with journaling explicitly enabled. This writes the export to the `contacts.json` file in [JSON](#) format.

```
mongoexport --db sales --collection contacts --out contacts.json --journal
```

The following example exports the collection `contacts` from the `sales` database located in the MongoDB data files located at `/srv/mongodb/`. This operation writes the export to standard output in [JSON](#) format.

```
mongoexport --db sales --collection contacts --dbpath /srv/mongodb/
```

**Warning:** The above example will only succeed if there is no [mongod](#) (page 925) connected to the data files located in the `/srv/mongodb/` directory.

The final example exports the collection `contacts` from the database `marketing`. This data resides on the MongoDB instance located on the host `mongodb1.example.net` running on port 37017, which requires the username `user` and the password `pass`.

```
mongoexport --host mongodb1.example.net --port 37017 --username user --password pass --collection co
```

### Diagnostic Tools

[mongostat](#) (page 974), [mongotop](#) (page 979), and [mongosniff](#) (page 982) provide diagnostic information related to the current operation of a [mongod](#) (page 925) instance.

---

**Note:** Because [mongosniff](#) (page 982) depends on *libpcap*, most distributions of MongoDB do *not* include [mongosniff](#) (page 982).

---

#### [mongostat](#)

**Synopsis** The [mongostat](#) (page 974) utility provides a quick overview of the status of a currently running [mongod](#) (page 925) or [mongos](#) (page 938) instance. [mongostat](#) (page 974) is functionally similar to the UNIX/Linux file system utility `vmstat`, but provides data regarding [mongod](#) (page 925) and [mongos](#) (page 938) instances.

**See also:**

For more information about monitoring MongoDB, see [Monitoring for MongoDB](#) (page 138).

For more background on various other MongoDB status outputs see:

- [serverStatus](#) (page 782)
- [replicaSetGetStatus](#) (page 726)
- [dbStats](#) (page 767)
- [collStats](#) (page 763)

For an additional utility that provides MongoDB metrics see [mongotop](#) (page 979).

[mongostat](#) (page 974) connects to the [mongod](#) (page 925) instance running on the local host interface on TCP port 27017; however, [mongostat](#) (page 974) can connect to any accessible remote [mongod](#) (page 925) instance.

#### Options

##### [mongostat](#)

##### [mongostat](#)

command line option!–help

##### **--help**

Returns a basic help and usage text.

command line option!–verbose, -v

##### **--verbose, -v**

Increases the amount of internal reporting returned on the command line. Increase the verbosity with the `-v` form by including the option multiple times, (e.g. `-vvvvv`.)

command line option!–version

##### **--version**

Returns the version of the [mongostat](#) (page 974) utility.

command line option!–host <hostname><:port>

**--host** <hostname><:port>

Specifies a resolvable hostname for the [mongod](#) (page 925) from which you want to export data. By default [mongostat](#) (page 974) attempts to connect to a MongoDB instance running on the localhost port number 27017.

Optionally, specify a port number to connect a MongoDB instance running on a port other than 27017.

To connect to a replica set, you can specify the replica set seed name, and a seed list of set members, in the following format:

```
<replica_set_name>/<hostname1><:port>,<hostname2>:<port>,...
```

command line option!–port <port>

**--port** <port>

Specifies the port number, if the MongoDB instance is not running on the standard port. (i.e. 27017) You may also specify a port number using the [mongostat](#) --host command.

command line option!–ipv6

**--ipv6**

Enables IPv6 support that allows [mongostat](#) (page 974) to connect to the MongoDB instance using an IPv6 network. All MongoDB programs and processes, including [mongostat](#) (page 974), disable IPv6 support by default.

command line option!–ssl

**--ssl**

New in version 2.4: MongoDB added support for SSL connections to [mongod](#) (page 925) instances in mongostat.

---

**Note:** SSL support in mongostat is not compiled into the default distribution of MongoDB. See [Connect to MongoDB with SSL](#) (page 249) for more information on SSL and MongoDB.

Additionally, mongostat does not support connections to [mongod](#) (page 925) instances that require client certificate validation.

---

Allows [mongostat](#) (page 974) to connect to [mongod](#) (page 925) instance over an SSL connection.

command line option!–username <username>, -u <username>

**--username** <username>, **-u** <username>

Specifies a username to authenticate to the MongoDB instance, if your database requires authentication. Use in conjunction with the [mongostat](#) --password option to supply a password.

---

**Important:** This user must have sufficient credentials to run the [serverStatus](#) (page 782) command, which is the [clusterAdmin](#) (page 267) role. See [User Privilege Roles in MongoDB](#) (page 265) and [system.users Privilege Documents](#) (page 270) for more information.

---

command line option!–password <password>, -p <password>

**--password** <password>, **-p** <password>

Specifies a password to authenticate to the MongoDB instance. Use in conjunction with the [mongostat](#) --username option to supply a username.

If you specify a --username (page 980), and do not pass an argument to --password (page 980), [mongostat](#) (page 974) will prompt for a password interactively. If you do not specify a password on the command line, --password (page 980) must be the last argument specified.

command line option!–authenticationDatabase <dbname>

### --authenticationDatabase <dbname>

New in version 2.4.

Specifies the database that holds the user's (e.g. --username) credentials.

By default, [mongostat](#) (page 974) assumes that the database specified to the --db (page 958) argument holds the user's credentials, unless you specify --authenticationDatabase (page 980).

See [userSource](#) (page 271), [system.users Privilege Documents](#) (page 270) and [User Privilege Roles in MongoDB](#) (page 265) for more information about delegated authentication in MongoDB.

command line option!–authenticationMechanism <name>

### --authenticationMechanism <name>

New in version 2.4.

Specifies the authentication mechanism. By default, the authentication mechanism is MONGODB-CR, which is the MongoDB challenge/response authentication mechanism. In MongoDB Enterprise, [mongostat](#) (page 974) also includes support for GSSAPI to handle Kerberos authentication.

See [Deploy MongoDB with Kerberos Authentication](#) (page 259) for more information about Kerberos authentication.

command line option!–noheaders

### --noheaders

Disables the output of column or field names.

command line option!–rowcount <number>, -n <number>

### --rowcount <number>, -n <number>

Controls the number of rows to output. Use in conjunction with the sleeptime argument to control the duration of a [mongostat](#) (page 974) operation.

Unless --rowcount (page 976) is specified, [mongostat](#) (page 974) will return an infinite number of rows (e.g. value of 0.)

command line option!–http

### --http

Configures [mongostat](#) (page 974) to collect data using the HTTP interface rather than a raw database connection.

command line option!–discover

### --discover

With this option [mongostat](#) (page 974) discovers and reports on statistics from all members of a [replica set](#) or [sharded cluster](#). When connected to any member of a replica set, --discover (page 976) all non-hidden members of the replica set. When connected to a [mongos](#) (page 938), [mongostat](#) (page 974) will return data from all shards in the cluster. If a replica set provides a shard in the sharded cluster, [mongostat](#) (page 974) will report on non-hidden members of that replica set.

The [mongostat](#) --host option is not required but potentially useful in this case.

command line option!–all

### --all

Configures [mongostat](#) (page 974) to return all optional [fields](#) (page 977).

### <sleeptime>

The final argument is the length of time, in seconds, that [mongostat](#) (page 974) waits in between calls. By default [mongostat](#) (page 974) returns one call every second.

`mongostat` (page 974) returns values that reflect the operations over a 1 second period. For values of `<sleepetime>` greater than 1, `mongostat` (page 974) averages data to reflect average operations per second.

**Fields** `mongostat` (page 974) returns values that reflect the operations over a 1 second period. When **mongostat** `<sleepetime>` has a value greater than 1, `mongostat` (page 974) averages the statistics to reflect average operations per second.

`mongostat` (page 974) outputs the following fields:

#### **inserts**

The number of objects inserted into the database per second. If followed by an asterisk (e.g. \*), the datum refers to a replicated operation.

#### **query**

The number of query operations per second.

#### **update**

The number of update operations per second.

#### **delete**

The number of delete operations per second.

#### **getmore**

The number of get more (i.e. cursor batch) operations per second.

#### **command**

The number of commands per second. On `slave` and `secondary` systems, `mongostat` (page 974) presents two values separated by a pipe character (e.g. |), in the form of `local|replicated` commands.

#### **flushes**

The number of `fsync` operations per second.

#### **mapped**

The total amount of data mapped in megabytes. This is the total data size at the time of the last `mongostat` (page 974) call.

#### **size**

The amount of (virtual) memory in megabytes used by the process at the time of the last `mongostat` (page 974) call.

#### **res**

The amount of (resident) memory in megabytes used by the process at the time of the last `mongostat` (page 974) call.

#### **faults**

Changed in version 2.1.

The number of page faults per second.

Before version 2.1 this value was only provided for MongoDB instances running on Linux hosts.

#### **locked**

The percent of time in a global write lock.

Changed in version 2.2: The `locked db` field replaces the `locked %` field to more appropriate data regarding the database specific locks in version 2.2.

#### **locked db**

New in version 2.2.

The percent of time in the per-database context-specific lock. [mongostat](#) (page 974) will report the database that has spent the most time since the last [mongostat](#) (page 974) call with a write lock.

This value represents the amount of time that the listed database spent in a locked state *combined* with the time that the [mongod](#) (page 925) spent in the global lock. Because of this, and the sampling method, you may see some values greater than 100%.

### **idx miss**

The percent of index access attempts that required a page fault to load a btree node. This is a sampled value.

### **qr**

The length of the queue of clients waiting to read data from the MongoDB instance.

### **qw**

The length of the queue of clients waiting to write data from the MongoDB instance.

### **ar**

The number of active clients performing read operations.

### **aw**

The number of active clients performing write operations.

### **netIn**

The amount of network traffic, in *bytes*, received by the MongoDB instance.

This includes traffic from [mongostat](#) (page 974) itself.

### **netOut**

The amount of network traffic, in *bytes*, sent by the MongoDB instance.

This includes traffic from [mongostat](#) (page 974) itself.

### **conn**

The total number of open connections.

### **set**

The name, if applicable, of the replica set.

### **repl**

The replication status of the member.

| Value | Replication Type          |
|-------|---------------------------|
| M     | <a href="#">master</a>    |
| SEC   | <a href="#">secondary</a> |
| REC   | recovering                |
| UNK   | unknown                   |
| SLV   | <a href="#">slave</a>     |

**Usage** In the first example, [mongostat](#) (page 974) will return data every second for 20 seconds. [mongostat](#) (page 974) collects data from the [mongod](#) (page 925) instance running on the localhost interface on port 27017. All of the following invocations produce identical behavior:

```
mongostat --rowcount 20 1
mongostat --rowcount 20
mongostat -n 20 1
mongostat -n 20
```

In the next example, [mongostat](#) (page 974) returns data every 5 minutes (or 300 seconds) for as long as the program runs. [mongostat](#) (page 974) collects data from the [mongod](#) (page 925) instance running on the localhost interface on port 27017. Both of the following invocations produce identical behavior.

---

```
mongostat --rowcount 0 300
mongostat -n 0 300
mongostat 300
```

In the following example, [mongostat](#) (page 974) returns data every 5 minutes for an hour (12 times.) [mongostat](#) (page 974) collects data from the [mongod](#) (page 925) instance running on the localhost interface on port 27017. Both of the following invocations produce identical behavior.

```
mongostat --rowcount 12 300
mongostat -n 12 300
```

In many cases, using the `--discover` will help provide a more complete snapshot of the state of an entire group of machines. If a [mongos](#) (page 938) process connected to a [sharded cluster](#) is running on port 27017 of the local machine, you can use the following form to return statistics from all members of the cluster:

```
mongostat --discover
```

## [mongotop](#)

**Synopsis** [mongotop](#) (page 979) provides a method to track the amount of time a MongoDB instance spends reading and writing data. [mongotop](#) (page 979) provides statistics on a per-collection level. By default, [mongotop](#) (page 979) returns values every second.

### See also:

For more information about monitoring MongoDB, see [Monitoring for MongoDB](#) (page 138).

For additional background on various other MongoDB status outputs see:

- [serverStatus](#) (page 782)
- [replicaSetGetStatus](#) (page 726)
- [dbStats](#) (page 767)
- [collStats](#) (page 763)

For an additional utility that provides MongoDB metrics see [mongostat](#) (page 974).

## Options

[mongotop](#)  
[mongotop](#)

command line option!–help

### **--help**

Returns a basic help and usage text.

command line option!–verbose, -v

### **--verbose, -v**

Increases the amount of internal reporting returned on the command line. Increase the verbosity with the `-v` form by including the option multiple times, (e.g. `-vvvvv`.)

command line option!–version

### **--version**

Print the version of the [mongotop](#) (page 979) utility and exit.

command line option!–host <hostname><:port>

**--host <hostname><:port>**

Specifies a resolvable hostname for the mongod from which you want to export data. By default [mongotop](#) (page 979) attempts to connect to a MongoDB process running on the localhost port number 27017.

Optionally, specify a port number to connect a MongoDB instance running on a port other than 27017.

To connect to a replica set, you can specify the replica set seed name, and a seed list of set members, in the following format:

```
<replica_set_name>/<hostname1><:port>,<hostname2:><port>,...
```

command line option!–port <port>

**--port <port>**

Specifies the port number, if the MongoDB instance is not running on the standard port. (i.e. 27017) You may also specify a port number using the [mongotop --host](#) command.

command line option!–ipv6

**--ipv6**

Enables IPv6 support that allows [mongotop](#) (page 979) to connect to the MongoDB instance using an IPv6 network. All MongoDB programs and processes, including [mongotop](#) (page 979), disable IPv6 support by default.

command line option!–username <username>, -u <username>

**--username <username>, -u <username>**

Specifies a username to authenticate to the MongoDB instance, if your database requires authentication. Use in conjunction with the [mongotop](#) option to supply a password.

command line option!–password <password>, -p <password>

**--password <password>, -p <password>**

Specifies a password to authenticate to the MongoDB instance. Use in conjunction with the [--username](#) option to supply a username.

If you specify a [--username](#) and do not pass an argument to [--password](#) (page 980), [mongotop](#) (page 979) will prompt for a password interactively. If you do not specify a password on the command line, [--password](#) (page 980) must be the last argument specified.

command line option!–authenticationDatabase <dbname>

**--authenticationDatabase <dbname>**

New in version 2.4.

Specifies the database that holds the user's (e.g [--username](#)) credentials.

By default, [mongotop](#) (page 979) assumes that the database specified to the [--db](#) (page 958) argument holds the user's credentials, unless you specify [--authenticationDatabase](#) (page 980).

See [userSource](#) (page 271), [system.users Privilege Documents](#) (page 270) and [User Privilege Roles in MongoDB](#) (page 265) for more information about delegated authentication in MongoDB.

command line option!–authenticationMechanism <name>

**--authenticationMechanism <name>**

New in version 2.4.

Specifies the authentication mechanism. By default, the authentication mechanism is MONGODB-CR, which is the MongoDB challenge/response authentication mechanism. In MongoDB Enterprise, [mongotop](#) (page 979) also includes support for GSSAPI to handle Kerberos authentication.

See [Deploy MongoDB with Kerberos Authentication](#) (page 259) for more information about Kerberos authentication.

command line option!–locks

#### **--locks**

New in version 2.2.

Toggles the mode of [mongotop](#) (page 979) to report on use of per-database *locks* (page 783). These data are useful for measuring concurrent operations and lock percentage.

#### **<sleeptime>**

The final argument is the length of time, in seconds, that [mongotop](#) (page 979) waits in between calls. By default [mongotop](#) (page 979) returns data every second.

**Fields** [mongotop](#) (page 979) returns time values specified in milliseconds (ms.)

[mongotop](#) (page 979) only reports active namespaces or databases, depending on the [--locks](#) (page 981) option. If you don't see a database or collection, it has received no recent activity. You can issue a simple operation in the [mongo](#) (page 942) shell to generate activity to affect the output of [mongotop](#) (page 979).

#### **mongotop.ns**

Contains the database namespace, which combines the database name and collection.

Changed in version 2.2: If you use the [--locks](#) (page 981), the [ns](#) (page 981) field does not appear in the [mongotop](#) (page 979) output.

#### **mongotop.db**

New in version 2.2.

Contains the name of the database. The database named . refers to the global lock, rather than a specific database.

This field does not appear unless you have invoked [mongotop](#) (page 979) with the [--locks](#) (page 981) option.

#### **mongotop.total**

Provides the total amount of time that this [mongod](#) (page 925) spent operating on this namespace.

#### **mongotop.read**

Provides the amount of time that this [mongod](#) (page 925) spent performing read operations on this namespace.

#### **mongotop.write**

Provides the amount of time that this [mongod](#) (page 925) spent performing write operations on this namespace.

#### **mongotop.<timestamp>**

Provides a time stamp for the returned data.

**Use** By default [mongotop](#) (page 979) connects to the MongoDB instance running on the localhost port 27017. However, [mongotop](#) (page 979) can optionally connect to remote [mongod](#) (page 925) instances. See the [mongotop options](#) (page 979) for more information.

To force [mongotop](#) (page 979) to return less frequently specify a number, in seconds at the end of the command. In this example, [mongotop](#) (page 979) will return every 15 seconds.

```
mongotop 15
```

This command produces the following output:

```
connected to: 127.0.0.1
```

|                        | ns | total | read | write |                     |
|------------------------|----|-------|------|-------|---------------------|
| test.system.namespaces |    | 0ms   | 0ms  | 0ms   | 2012-08-13T15:45:40 |
| local.system.replset   |    | 0ms   | 0ms  | 0ms   |                     |

|                        |       |      |       |                     |
|------------------------|-------|------|-------|---------------------|
| local.system.indexes   | 0ms   | 0ms  | 0ms   |                     |
| admin.system.indexes   | 0ms   | 0ms  | 0ms   |                     |
| admin.                 | 0ms   | 0ms  | 0ms   |                     |
| ns                     | total | read | write | 2012-08-13T15:45:55 |
| test.system.namespaces | 0ms   | 0ms  | 0ms   |                     |
| local.system.replset   | 0ms   | 0ms  | 0ms   |                     |
| local.system.indexes   | 0ms   | 0ms  | 0ms   |                     |
| admin.system.indexes   | 0ms   | 0ms  | 0ms   |                     |
| admin.                 | 0ms   | 0ms  | 0ms   |                     |

To return a [mongotop](#) (page 979) report every 5 minutes, use the following command:

```
mongotop 300
```

To report the use of per-database locks, use `mongotop --locks`, which produces the following output:

```
$ mongotop --locks
connected to: 127.0.0.1
```

|       |       |      |       |                     |
|-------|-------|------|-------|---------------------|
| db    | total | read | write | 2012-08-13T16:33:34 |
| local | 0ms   | 0ms  | 0ms   |                     |
| admin | 0ms   | 0ms  | 0ms   |                     |
| .     | 0ms   | 0ms  | 0ms   |                     |

### [mongosniff](#)

**Synopsis** [mongosniff](#) (page 982) provides a low-level operation tracing/sniffing view into database activity in real time. Think of [mongosniff](#) (page 982) as a MongoDB-specific analogue of `tcpdump` for TCP/IP network traffic. Typically, [mongosniff](#) (page 982) is most frequently used in driver development.

**Note:** [mongosniff](#) (page 982) requires `libpcap` and is only available for Unix-like systems. Furthermore, the version distributed with the MongoDB binaries is dynamically linked against aversion 0.9 of `libpcap`. If your system has a different version of `libpcap`, you will need to compile [mongosniff](#) (page 982) yourself or create a symbolic link pointing to `libpcap.so.0.9` to your local version of `libpcap`. Use an operation that resembles the following:

```
ln -s /usr/lib/libpcap.so.1.1.1 /usr/lib/libpcap.so.0.9
```

Change the path's and name of the shared library as needed.

---

As an alternative to [mongosniff](#) (page 982), Wireshark, a popular network sniffing tool is capable of inspecting and parsing the MongoDB wire protocol.

#### Options

**mongosniff**  
**mongosniff**

command line option!-help

**--help**

Returns a basic help and usage text.

command line option!-forward <host><:port>

**--forward <host><:port>**

Declares a host to forward all parsed requests that the [mongosniff](#) (page 982) intercepts to another [mongod](#) (page 925) instance and issue those operations on that database instance.

Specify the target host name and port in the <host><:port> format.

To connect to a replica set, you can specify the replica set seed name, and a seed list of set members, in the following format:

```
<replica_set_name>/<hostname1><:port>,<hostname2><:port>,...
```

command line option!–source <NET [interface]>, <FILE [filename]>, <DIAGLOG [filename]>

**--source <NET [interface]>, <FILE [filename]>, <DIAGLOG [filename]>**

Specifies source material to inspect. Use --source NET [interface] to inspect traffic from a network interface (e.g. eth0 or lo.) Use --source FILE [filename] to read captured packets in [pcap](#) format.

You may use the --source DIAGLOG [filename] option to read the output files produced by the [--diaglog](#) option.

command line option!–objcheck

**--objcheck**

Modifies the behavior to *only* display invalid BSON objects and nothing else. Use this option for troubleshooting driver development. This option has some performance impact on the performance of [mongosniff](#) (page 982).

**<port>**

Specifies alternate ports to sniff for traffic. By default, [mongosniff](#) (page 982) watches for MongoDB traffic on port 27017. Append multiple port numbers to the end of [mongosniff](#) (page 982) to monitor traffic on multiple ports.

**Usage** Use the following command to connect to a [mongod](#) (page 925) or [mongos](#) (page 938) running on port 27017 and 27018 on the localhost interface:

```
mongosniff --source NET lo 27017 27018
```

Use the following command to only log invalid *BSON* objects for the [mongod](#) (page 925) or [mongos](#) (page 938) running on the localhost interface and port 27018, for driver development and troubleshooting:

```
mongosniff --objcheck --source NET lo 27018
```

**Build mongosniff** To build [mongosniff](#) yourself, Linux users can use the following procedure:

1. Obtain prerequisites using your operating systems package management software. Dependencies include:

- libpcap - to capture network packets.
- git - to download the MongoDB source code.
- scons and a C++ compiler - to build [mongosniff](#) (page 982).

2. Download a copy of the MongoDB source code using git:

```
git clone git://github.com/mongodb/mongo.git
```

3. Issue the following sequence of commands to change to the mongo/ directory and build [mongosniff](#) (page 982):

```
cd mongo
scons mongosniff
```

---

**Note:** If you run `scons mongosniff` before installing libpcap you must run `scons clean` before you can build `mongosniff` (page 982).

---

### **mongoperf**

**Synopsis** `mongoperf` (page 984) is a utility to check disk I/O performance independently of MongoDB.

It times tests of random disk I/O and presents the results. You can use `mongoperf` (page 984) for any case apart from MongoDB. The `mmf` (page 985) true mode is completely generic. In that mode it is somewhat analogous to tools such as `bonnie++`<sup>34</sup> (albeit `mongoperf` is simpler).

Specify options to `mongoperf` (page 984) using a JavaScript document.

**See also:**

- `bonnie`<sup>35</sup>
- `bonnie++`<sup>36</sup>
- Output from an example run<sup>37</sup>
- Checking Disk Performance with the `mongoperf` Utility<sup>38</sup>

### Options

#### **mongoperf**

#### **mongoperf**

command line option!–help

#### **--help**

Displays the options to `mongoperf` (page 984). Specify options to `mongoperf` (page 984) with a JSON document described in the *Configuration Fields* (page 985) section.

#### **<jsonconfig>**

`mongoperf` (page 984) accepts configuration options in the form of a file that holds a *JSON* document. You must stream the content of this file into `mongoperf` (page 984), as in the following operation:

```
mongoperf < config
```

In this example `config` is the name of a file that holds a JSON document that resembles the following example:

```
{
 nThreads:<n>,
 fileSizeMB:<n>,
 sleepMicros:<n>,
 mmf:<bool>,
 r:<bool>,
 w:<bool>,
 recSizeKB:<n>,
 syncDelay:<n>
}
```

See the *Configuration Fields* (page 985) section for documentation of each of these fields.

---

<sup>34</sup><http://sourceforge.net/projects/bonnie/>

<sup>35</sup><http://www.textuality.com/bonnie/>

<sup>36</sup><http://sourceforge.net/projects/bonnie/>

<sup>37</sup><https://gist.github.com/1694664>

<sup>38</sup><http://blog.mongodb.org/post/40769806981/checking-disk-performance-with-the-mongoperf-utility>

## Configuration Fields

### `mongoperf.nThreads`

*Type:* Integer.

*Default:* 1

Defines the number of threads `mongoperf` (page 984) will use in the test. To saturate your system's storage system you will need multiple threads. Consider setting `nThreads` (page 985) to 16.

### `mongoperf.fileSizeMB`

*Type:* Integer.

*Default:* 1 megabyte (i.e.  $1024^2$  bytes)

Test file size.

### `mongoperf.sleepMicros`

*Type:* Integer.

*Default:* 0

`mongoperf` (page 984) will pause for the number of specified `sleepMicros` (page 985) divided by the `nThreads` (page 985) between each operation.

### `mongoperf.mmf`

*Type:* Boolean.

*Default:* false

Set `mmf` (page 985) to true to use memory mapped files for the tests.

Generally:

- when `mmf` (page 985) is false, `mongoperf` (page 984) tests direct, physical, I/O, without caching. Use a large file size to test heavy random I/O load and to avoid I/O coalescing.
- when `mmf` (page 985) is true, `mongoperf` (page 984) runs tests of the caching system, and can use normal file system cache. Use `mmf` (page 985) in this mode to test file system cache behavior with memory mapped files.

### `mongoperf.r`

*Type:* Boolean.

*Default:* false

Set `r` (page 985) to true to perform reads as part of the tests.

Either `r` (page 985) or `w` (page 985) must be true.

### `mongoperf.w`

*Type:* Boolean.

*Default:* false

Set `w` (page 985) to true to perform writes as part of the tests.

Either `r` (page 985) or `w` (page 985) must be true.

### `mongoperf.recSizeKB`

New in version 2.4.

*Type:* Integer.

*Default:* 4 kb

The size of each write operation.

### `mongoperf.syncDelay`

Type: Integer.

Default: 0

Seconds between disk flushes. `mongoperf.syncDelay` (page 985) is similar to `--syncdelay` for `mongod` (page 925).

The `syncDelay` (page 985) controls how frequently `mongoperf` (page 984) performs an asynchronous disk flush of the memory mapped file used for testing. By default, `mongod` (page 925) performs this operation every 60 seconds. Use `syncDelay` (page 985) to test basic system performance of this type of operation.

Only use `syncDelay` (page 985) in conjunction with `mmf` (page 985) set to `true`.

The default value of 0 disables this.

### Use

```
mongoperf < jsonconfigfile
```

Replace `jsonconfigfile` with the path to the `mongoperf` (page 984) configuration. You may also invoke `mongoperf` (page 984) in the following form:

```
echo "{nThreads:16,fileSizeMB:1000,r:true}" | ./mongoperf
```

In this operation:

- `mongoperf` (page 984) tests direct physical random read io's, using 16 concurrent reader threads.
- `mongoperf` (page 984) uses a 1 gigabyte test file.

Consider using `iostat`, as invoked in the following example to monitor I/O performance during the test.

```
iostat -xm 2
```

## GridFS

`mongofiles` (page 986) provides a command-line interact to a MongoDB *GridFS* storage system.

### `mongofiles`

#### `mongofiles`

**Synopsis** The `mongofiles` (page 986) utility makes it possible to manipulate files stored in your MongoDB instance in *GridFS* objects from the command line. It is particularly useful as it provides an interface between objects stored in your file system and GridFS.

All `mongofiles` (page 986) commands have the following form:

```
mongofiles <options> <commands> <filename>
```

The components of the `mongofiles` (page 986) command are:

1. *Options* (page 987). You may use one or more of these options to control the behavior of `mongofiles` (page 986).
2. *Commands* (page 989). Use one of these commands to determine the action of `mongofiles` (page 986).
3. A filename which is either: the name of a file on your local's file system, or a GridFS object.

`mongofiles` (page 986), like `mongodump` (page 951), `mongoexport` (page 969), `mongoimport` (page 965), and `mongorestore` (page 956), can access data stored in a MongoDB data directory without requiring a running `mongod` (page 925) instance, if no other `mongod` (page 925) is running.

---

**Important:** For *replica sets*, `mongofiles` (page 986) can only read from the set's '*primary*'.

---

## Options

### **mongofiles**

command line option!–help

#### **--help**

Returns a basic help and usage text.

command line option!–verbose, -v

#### **--verbose, -v**

Increases the amount of internal reporting returned on the command line. Increase the verbosity with the `-v` form by including the option multiple times, (e.g. `-vvvvv`.)

command line option!–version

#### **--version**

Returns the version of the `mongofiles` (page 986) utility.

command line option!–host <hostname><:port>

#### **--host <hostname><:port>**

Specifies a resolvable hostname for the `mongod` (page 925) that holds your GridFS system. By default `mongofiles` (page 986) attempts to connect to a MongoDB process running on the localhost port number 27017.

Optionally, specify a port number to connect a MongoDB instance running on a port other than 27017.

command line option!–port <port>

#### **--port <port>**

Specifies the port number, if the MongoDB instance is not running on the standard port. (i.e. 27017) You may also specify a port number using the `mongofiles --host` command.

command line option!–ipv6

#### **--ipv6**

Enables IPv6 support that allows `mongofiles` (page 986) to connect to the MongoDB instance using an IPv6 network. All MongoDB programs and processes, including `mongofiles` (page 986), disable IPv6 support by default.

command line option!–ssl

#### **--ssl**

New in version 2.4: MongoDB added support for SSL connections to `mongod` (page 925) instances in `mongofiles`.

---

**Note:** SSL support in `mongofiles` is not compiled into the default distribution of MongoDB. See [Connect to MongoDB with SSL](#) (page 249) for more information on SSL and MongoDB.

Additionally, `mongofiles` does not support connections to `mongod` (page 925) instances that require client certificate validation.

---

Allows `mongofiles` (page 986) to connect to `mongod` (page 925) instance over an SSL connection.

command line option!–username <username>, -u <username>

**--username** <username>, **-u** <username>

Specifies a username to authenticate to the MongoDB instance, if your database requires authentication. Use in conjunction with the [mongofiles](#) [--password](#) option to supply a password.

command line option!–password <password>, -p <password>

**--password** <password>, **-p** <password>

Specifies a password to authenticate to the MongoDB instance. Use in conjunction with the [mongofiles](#) [--username](#) option to supply a username.

If you specify a [--username](#) and do not pass an argument to [--password](#) (page 980), [mongofiles](#) (page 986) will prompt for a password interactively. If you do not specify a password on the command line, [--password](#) (page 980) must be the last argument specified.

command line option!–authenticationDatabase <dbname>

**--authenticationDatabase** <dbname>

New in version 2.4.

Specifies the database that holds the user’s (e.g [--username](#)) credentials.

By default, [mongofiles](#) (page 986) assumes that the database specified to the [--db](#) (page 958) argument holds the user’s credentials, unless you specify [--authenticationDatabase](#) (page 980).

See [userSource](#) (page 271), [system.users Privilege Documents](#) (page 270) and [User Privilege Roles in MongoDB](#) (page 265) for more information about delegated authentication in MongoDB.

command line option!–authenticationMechanism <name>

**--authenticationMechanism** <name>

New in version 2.4.

Specifies the authentication mechanism. By default, the authentication mechanism is MONGODB-CR, which is the MongoDB challenge/response authentication mechanism. In MongoDB Enterprise, [mongofiles](#) (page 986) also includes support for GSSAPI to handle Kerberos authentication.

See [Deploy MongoDB with Kerberos Authentication](#) (page 259) for more information about Kerberos authentication.

command line option!–dbpath <path>

**--dbpath** <path>

Specifies the directory of the MongoDB data files. If used, the [--dbpath](#) (page 958) option enables [mongofiles](#) (page 986) to attach directly to local data files interact with the GridFS data without the [mongod](#) (page 925). To run with [--dbpath](#) (page 958), [mongofiles](#) (page 986) needs to lock access to the data directory: as a result, no [mongod](#) (page 925) can access the same path while the process runs.

command line option!–directoryperdb

**--directoryperdb**

Use the [--directoryperdb](#) (page 958) in conjunction with the corresponding option to [mongod](#) (page 925), which allows [mongofiles](#) (page 986) when running with the [--dbpath](#) (page 958) option and MongoDB uses an on-disk format where every database has a distinct directory. This option is only relevant when specifying the [--dbpath](#) (page 958) option.

command line option!–journal

**--journal**

Allows [mongofiles](#) (page 986) operations to use the durability [journal](#) when running with [--dbpath](#) (page 958) to ensure that the database maintains a recoverable state. This forces [mongofiles](#) (page 986) to record all data on disk regularly.

command line option!–db <db>, -d <db>

**--db** <db>, **-d** <db>

Use the [--db](#) (page 958) option to specify the MongoDB database that stores or will store the GridFS files.

command line option!–collection <collection>, -c <collection>

**--collection** <collection>, **-c** <collection>

This option has no use in this context and a future release may remove it. See SERVER-4931<sup>39</sup> for more information.

command line option!–local <filename>, -l <filename>

**--local** <filename>, **-l** <filename>

Specifies the local filesystem name of a file for get and put operations.

In the **mongofiles put** and **mongofiles get** commands the required <filename> modifier refers to the name the object will have in GridFS. [mongofiles](#) (page 986) assumes that this reflects the file’s name on the local file system. This setting overrides this default.

command line option!–type < MIME >, t < MIME >

**--type** < MIME >, **t** < MIME >

Provides the ability to specify a [MIME](#) type to describe the file inserted into GridFS storage. [mongofiles](#) (page 986) omits this option in the default operation.

Use only with **mongofiles put** operations.

command line option!–replace, -r

**--replace**, **-r**

Alters the behavior of **mongofiles put** to replace existing GridFS objects with the specified local file, rather than adding an additional object with the same name.

In the default operation, files will not be overwritten by a **mongofiles put** option.

## Commands

**list** <prefix>

Lists the files in the GridFS store. The characters specified after **list** (e.g. <prefix>) optionally limit the list of returned items to files that begin with that string of characters.

**search** <string>

Lists the files in the GridFS store with names that match any portion of <string>.

**put** <filename>

Copy the specified file from the local file system into GridFS storage.

Here, <filename> refers to the name the object will have in GridFS, and [mongofiles](#) (page 986) assumes that this reflects the name the file has on the local file system. If the local filename is different use the [mongofiles --local](#) option.

**get** <filename>

Copy the specified file from GridFS storage to the local file system.

Here, <filename> refers to the name the object will have in GridFS, and [mongofiles](#) (page 986) assumes that this reflects the name the file has on the local file system. If the local filename is different use the [mongofiles --local](#) option.

**delete** <filename>

Delete the specified file from GridFS storage.

<sup>39</sup><https://jira.mongodb.org/browse/SERVER-4931>

**Examples** To return a list of all files in a [GridFS](#) collection in the `records` database, use the following invocation at the system shell:

```
mongofiles -d records list
```

This `mongofiles` (page 986) instance will connect to the `mongod` (page 925) instance running on the 27017 localhost interface to specify the same operation on a different port or hostname, and issue a command that resembles one of the following:

```
mongofiles --port 37017 -d records list
mongofiles --hostname db1.example.net -d records list
mongofiles --hostname db1.example.net --port 37017 -d records list
```

Modify any of the following commands as needed if you're connecting the `mongod` (page 925) instances on different ports or hosts.

To upload a file named `32-corinth.lp` to the GridFS collection in the `records` database, you can use the following command:

```
mongofiles -d records put 32-corinth.lp
```

To delete the `32-corinth.lp` file from this GridFS collection in the `records` database, you can use the following command:

```
mongofiles -d records delete 32-corinth.lp
```

To search for files in the GridFS collection in the `records` database that have the string `corinth` in their names, you can use following command:

```
mongofiles -d records search corinth
```

To list all files in the GridFS collection in the `records` database that begin with the string `32`, you can use the following command:

```
mongofiles -d records list 32
```

To fetch the file from the GridFS collection in the `records` database named `32-corinth.lp`, you can use the following command:

```
mongofiles -d records get 32-corinth.lp
```

## Run Time Configuration

### Configuration File Options

**Synopsis** Administrators and users can control `mongod` (page 925) or `mongos` (page 938) instances at runtime either directly from [mongod's command line arguments](#) (page 925) or using a configuration file.

While both methods are functionally equivalent and all settings are similar, the configuration file method is preferable. If you installed from a package and have started MongoDB using your system's [control script](#), you're already using a configuration file.

To start `mongod` (page 925) or `mongos` (page 938) using a config file, use one of the following forms:

```
mongod --config /etc/mongodb.conf
mongod -f /etc/mongodb.conf
mongos --config /srv/mongodb/mongos.conf
mongos -f /srv/mongodb/mongos.conf
```

Declare all settings in this file using the following form:

```
<setting> = <value>
```

New in version 2.0: *Before* version 2.0, Boolean (i.e. `true`|`false`) or “flag” parameters, register as true, if they appear in the configuration file, regardless of their value.

---

**Note:** Ensure the configuration file uses ASCII encoding. [mongod](#) (page 925) does not support configuration files with non-ASCII encoding, including UTF-8.

---

## Settings

### **verbose**

*Default:* `false`

Increases the amount of internal reporting returned on standard output or in the log file generated by [logpath](#) (page 992). To enable [verbose](#) (page 991) or to enable increased verbosity with [vvvv](#) (page 991), set these options as in the following example:

```
verbose = true
vvvv = true
```

MongoDB has the following levels of verbosity:

**v**

*Default:* `false`

Alternate form of [verbose](#) (page 991).

**vv**

*Default:* `false`

Additional increase in verbosity of output and logging.

**vvv**

*Default:* `false`

Additional increase in verbosity of output and logging.

**vvvv**

*Default:* `false`

Additional increase in verbosity of output and logging.

**vvvvv**

*Default:* `false`

Additional increase in verbosity of output and logging.

### **port**

*Default:* `27017`

Specifies a TCP port for the [mongod](#) (page 925) or [mongos](#) (page 938) instance to listen for client connections. UNIX-like systems require root access for ports with numbers lower than 1024.

### **bind\_ip**

*Default:* All interfaces.

Set this option to configure the [mongod](#) (page 925) or [mongos](#) (page 938) process to bind to and listen for connections from applications on this address. You may attach [mongod](#) (page 925) or [mongos](#) (page 938) instances to any interface; however, if you attach the process to a publicly accessible interface, implement proper authentication or firewall restrictions to protect the integrity of your database.

You may concatenate a list of comma separated values to bind [mongod](#) (page 925) to multiple IP addresses.

### **maxConns**

*Default:* depends on system (i.e. ulimit and file descriptor) limits. Unless set, MongoDB will not limit its own connections.

Specifies a value to set the maximum number of simultaneous connections that [mongod](#) (page 925) or [mongos](#) (page 938) will accept. This setting has no effect if it is higher than your operating system's configured maximum connection tracking threshold.

This is particularly useful for [mongos](#) (page 938) if you have a client that creates a number of collections but allows them to timeout rather than close the collections. When you set [maxConns](#) (page 992), ensure the value is slightly higher than the size of the connection pool or the total number of connections to prevent erroneous connection spikes from propagating to the members of a [shard](#) cluster.

---

**Note:** You cannot set [maxConns](#) (page 992) to a value higher than 20000.

---

### **objcheck**

*Default:* true

Changed in version 2.4: The default setting for [objcheck](#) (page 992) became true in 2.4. In earlier versions [objcheck](#) (page 992) was false by default.

Forces the [mongod](#) (page 925) to validate all requests from clients upon receipt to ensure that clients never insert invalid documents into the database. For objects with a high degree of sub-document nesting, [objcheck](#) (page 992) can have a small impact on performance. You can set [noobjcheck](#) (page 992) to disable object checking at run-time.

### **noobjcheck**

New in version 2.4.

*Default:* false

Disables the default object validation that MongoDB performs on all incoming BSON documents.

### **logpath**

*Default:* None. (i.e. `http://docs.mongodb.org/manualdev/stdout`)

Specify the path to a file name for the log file that will hold all diagnostic logging information.

Unless specified, [mongod](#) (page 925) will output all log information to the standard output. Unless [logappend](#) (page 992) is true, the logfile will be overwritten when the process restarts.

---

**Note:** Currently, MongoDB will overwrite the contents of the log file if the [logappend](#) (page 992) is not used. This behavior may change in the future depending on the outcome of SERVER-4499<sup>40</sup>.

---

### **logappend**

*Default:* false

Set to true to add new entries to the end of the logfile rather than overwriting the content of the log when the process restarts.

If this setting is not specified, then MongoDB will overwrite the existing logfile upon start up.

---

**Note:** The behavior of the logging system may change in the near future in response to the SERVER-4499<sup>41</sup> case.

---

### **syslog**

New in version 2.2.

<sup>40</sup><https://jira.mongodb.org/browse/SERVER-4499>

<sup>41</sup><https://jira.mongodb.org/browse/SERVER-4499>

---

Sends all logging output to the host's [syslog](#) system rather than to standard output or a log file as with [logpath](#) (page 992).

---

**Important:** You cannot use [syslog](#) (page 992) with [logpath](#) (page 992).

---

**pidfilepath**

*Default:* None.

Specify a file location to hold the [PID](#) or process ID of the [mongod](#) (page 925) process. Useful for tracking the [mongod](#) (page 925) process in combination with the [fork](#) (page 993) setting.

Without a specified [pidfilepath](#) (page 993), [mongos](#) (page 938) creates no PID file.

Without this option, [mongod](#) (page 925) creates no PID file.

**keyFile**

*Default:* None.

Specify the path to a key file to store authentication information. This option is only useful for the connection between replica set members.

**See also:**

[Replica Set Security](#) (page 238)

**nounixsocket**

*Default:* false

Set to true to disable listening on the UNIX socket.

MongoDB always creates and listens on the UNIX socket, unless [nounixsocket](#) (page 993) is set, or [bind\\_ip](#) (page 991) is not set, or [bind\\_ip](#) (page 991) does not specify 127.0.0.1.

**unixSocketPrefix**

*Default:* http://docs.mongodb.org/manualtmp

Specifies a path for the UNIX socket. Unless this option has a value [mongod](#) (page 925) creates a socket with http://docs.mongodb.org/manualtmp as a prefix.

MongoDB will always create and listen on a UNIX socket, unless [nounixsocket](#) (page 993) is set, [bind\\_ip](#) (page 991) is not set, or [bind\\_ip](#) (page 991) does not specify 127.0.0.1.

**fork**

*Default:* false

Set to true to enable a [daemon](#) mode for [mongod](#) (page 925) that runs the process in the background.

**auth**

*Default:* false

Set to true to enable database authentication for users connecting from remote hosts. Configure users via the [mongo shell](#) (page 942). If no users exist, the localhost interface will continue to have access to the database until you create the first user.

**cpu**

*Default:* false

Set to true to force [mongod](#) (page 925) to report every four seconds CPU utilization and the amount of time that the processor waits for I/O operations to complete (i.e. I/O wait.) MongoDB writes this data to standard output, or the logfile if using the [logpath](#) (page 992) option.

**dbpath**

*Default:* /data/db/

Set this value to designate a directory for the [mongod](#) (page 925) instance to store its data. Typical locations include: /srv/mongodb, /var/lib/mongodb or <http://docs.mongodb.org/manual/pt/2.4/mongodbs.html>

Unless specified, [mongod](#) (page 925) will look for data files in the default /data/db directory. (Windows systems use the \data\db directory.) If you installed using a package management system. Check the /etc/mongodb.conf file provided by your packages to see the configuration of the [dbpath](#) (page 993).

### **diaglog**

*Default:* 0

Creates a very verbose *diagnostic log* for troubleshooting and recording various errors. MongoDB writes these log files in the [dbpath](#) (page 993) directory and names them diaglog.<time in hex>, where <time-in-hex> is the initiation time of logging as a hexadecimal string.

The value of this setting configures the level of verbosity. Possible values, and their impact are as follows.

| Value | Setting                             |
|-------|-------------------------------------|
| 0     | Off. No logging.                    |
| 1     | Log write operations.               |
| 2     | Log read operations.                |
| 3     | Log both read and write operations. |
| 7     | Log write and some read operations. |

You can use the [mongosniff](#) (page 982) tool to replay this output for investigation. Given a typical diaglog file, located at /data/db/diaglog.4f76a58c, you might use a command in the following form to read these files:

```
mongosniff --source DIAGLOG /data/db/diaglog.4f76a58c
```

[diaglog](#) (page 994) is for internal use and not intended for most users.

**Warning:** Setting the diagnostic level to 0 will cause [mongod](#) (page 925) to stop writing data to the *diagnostic log* file. However, the [mongod](#) (page 925) instance will continue to keep the file open, even if it is no longer writing data to the file. If you want to rename, move, or delete the diagnostic log you must cleanly shut down the [mongod](#) (page 925) instance before doing so.

### **directoryperdb**

*Default:* false

Set to true to modify the storage pattern of the data directory to store each database's files in a distinct folder. This option will create directories within the [dbpath](#) (page 993) named for each directory.

Use this option in conjunction with your file system and device configuration so that MongoDB will store data on a number of distinct disk devices to increase write throughput or disk capacity.

**Warning:** If you have an existing `mongod` (page 925) instance and `dbpath` (page 993), and you want to enable `directoryperdb` (page 994), you **must** migrate your existing databases to directories before setting `directoryperdb` (page 994) to access those databases.

#### Example

Given a `dbpath` (page 993) directory with the following items:

```
journal
mongod.lock
local.0
local.1
local.ns
test.0
test.1
test.ns
```

To enable `directoryperdb` (page 994) you would need to modify the `dbpath` (page 993) to resemble the following:

```
journal
mongod.lock
local/local.0
local/local.1
local/local.ns
test/test.0
test/test.1
test/test.ns
```

### `journal`

*Default:* (on 64-bit systems) true

*Default:* (on 32-bit systems) false

Set to true to enable operation journaling to ensure write durability and data consistency.

Set to false to prevent the overhead of journaling in situations where durability is not required. To reduce the impact of the journaling on disk usage, you can leave `journal` (page 995) enabled, and set `smallfiles` (page 998) to true to reduce the size of the data and journal files.

---

**Note:** You must use `nojournal` (page 996) to disable journaling on 64-bit systems.

---

### `journalCommitInterval`

*Default:* 100 or 30

Set this value to specify the maximum amount of time for `mongod` (page 925) to allow between journal operations. Lower values increase the durability of the journal, at the possible expense of disk performance.

The default journal commit interval is 100 milliseconds if a single block device (e.g. physical volume, RAID device, or LVM volume) contains both the journal and the data files.

If different block devices provide the journal and data files the default journal commit interval is 30 milliseconds.

This option accepts values between 2 and 300 milliseconds.

To force `mongod` (page 925) to commit to the journal more frequently, you can specify `j:true`. When a write operation with `j:true` is pending, `mongod` (page 925) will reduce `journalCommitInterval` (page 995) to a third of the set value.

**ipv6**

*Default:* false

Set to `true` to IPv6 support to allow clients to connect to [mongod](#) (page 925) using IPv6 networks. [mongod](#) (page 925) disables IPv6 support by default in [mongod](#) (page 925) and all utilities.

**jsonp**

*Default:* false

Set to `true` to permit [JSONP](#) access via an HTTP interface. Consider the security implications of allowing this activity before setting this option.

**noauth**

*Default:* true

Disable authentication. Currently the default. Exists for future compatibility and clarity.

For consistency use the [auth](#) (page 993) option.

**nohttpinterface**

*Default:* false

Set to `true` to disable the HTTP interface. This command will override the [rest](#) (page 997) and disable the HTTP interface if you specify both.

---

**Note:** In MongoDB Enterprise, the HTTP Console does not support Kerberos Authentication.

---

Changed in version 2.1.2: The [nohttpinterface](#) (page 996) option is not available for [mongos](#) (page 938) instances before 2.1.2

**nojournal**

*Default:* (on 64-bit systems) false

*Default:* (on 32-bit systems) true

Set `nojournal = true` to disable durability journaling. By default, [mongod](#) (page 925) enables journaling in 64-bit versions after v2.0.

---

**Note:** You must use [journal](#) (page 995) to enable journaling on 32-bit systems.

---

**noprealloc**

*Default:* false

Set `noprealloc = true` to disable the preallocation of data files. This will shorten the start up time in some cases, but can cause significant performance penalties during normal operations.

**noscripting**

*Default:* false

Set `noscripting = true` to disable the scripting engine.

**notablescan**

*Default:* false

Set `notablescan = true` to forbid operations that require a table scan.

**nssize**

*Default:* 16

Specify this value in megabytes. The maximum size is 2047 megabytes.

Use this setting to control the default size for all newly created namespace files (i.e `.ns`). This option has no impact on the size of existing namespace files.

See [Limits on namespaces](#) (page 1015).

#### **profile**

*Default:* 0

Modify this value to changes the level of database profiling, which inserts information about operation performance into output of [mongod](#) (page 925) or the log file if specified by [logpath](#) (page 992). The following levels are available:

| Level | Setting                            |
|-------|------------------------------------|
| 0     | Off. No profiling.                 |
| 1     | On. Only includes slow operations. |
| 2     | On. Includes all operations.       |

By default, [mongod](#) (page 925) disables profiling. Database profiling can impact database performance because the profiler must record and process all database operations. Enable this option only after careful consideration.

#### **quota**

*Default:* false

Set to true to enable a maximum limit for the number data files each database can have. The default quota is 8 data files, when quota is true. Adjust the quota size with the with the [quotaFiles](#) (page 997) setting.

#### **quotaFiles**

*Default:* 8

Modify limit on the number of data files per database. This option requires the [quota](#) (page 997) setting.

#### **rest**

*Default:* false

Set to true to enable a simple [REST](#) interface.

#### **repair**

*Default:* false

Set to true to run a repair routine on all databases following start up. In general you should set this option on the command line and *not* in the [configuration file](#) (page 145) or in a [control script](#).

Use the `mongod --repair` option to access this functionality.

---

**Note:** Because [mongod](#) (page 925) rewrites all of the database files during the repair routine, if you do not run [repair](#) (page 997) under the same user account as [mongod](#) (page 925) usually runs, you will need to run chown on your database files to correct the permissions before starting [mongod](#) (page 925) again.

---

#### **repairpath**

*Default:* A \_tmp directory in the [dbpath](#) (page 993).

Specify the path to the directory containing MongoDB data files, to use in conjunction with the [repair](#) (page 997) setting or `mongod --repair` operation. Defaults to a \_tmp directory within the [dbpath](#) (page 993).

#### **slowms**

*Default:* 100

Specify values in milliseconds.

Sets the threshold for [mongod](#) (page 925) to consider a query “slow” for the database profiler. The database logs all slow queries to the log, even when the profiler is not turned on. When the database profiler is on, [mongod](#) (page 925) the profiler writes to the `system.profile` collection.

**See also:**

[profile](#) (page 997)

### **smallfiles**

*Default:* false

Set to `true` to modify MongoDB to use a smaller default data file size. Specifically, [smallfiles](#) (page 998) reduces the initial size for data files and limits them to 512 megabytes. The [smallfiles](#) (page 998) setting also reduces the size of each [journal](#) files from 1 gigabyte to 128 megabytes.

Use the [smallfiles](#) (page 998) setting if you have a large number of databases that each hold a small quantity of data. The [smallfiles](#) (page 998) setting can lead [mongod](#) (page 925) to create many files, which may affect performance for larger databases.

### **syncdelay**

*Default:* 60

[mongod](#) (page 925) writes data very quickly to the journal, and lazily to the data files. [syncdelay](#) (page 998) controls how much time can pass before MongoDB flushes data to the *database files* via an [fsync](#) operation. The default setting is 60 seconds. In almost every situation you should not set this value and use the default setting.

The [serverStatus](#) (page 782) command reports the background flush thread's status via the [backgroundFlushing](#) (page 789) field.

[syncdelay](#) (page 998) has no effect on the [journal](#) (page 995) files or [journaling](#) (page 232).

**Warning:** If you set [syncdelay](#) (page 998) to 0, MongoDB will not sync the memory mapped files to disk. Do not set this value on production systems.

### **sysinfo**

*Default:* false

When set to `true`, [mongod](#) (page 925) returns diagnostic system information regarding the page size, the number of physical pages, and the number of available physical pages to standard output.

More typically, run this operation by way of the `mongod --sysinfo` command. When running with the [sysinfo](#) (page 998), only [mongod](#) (page 925) only outputs the page information and no database process will start.

### **upgrade**

*Default:* false

When set to `true` this option upgrades the on-disk data format of the files specified by the [dbpath](#) (page 993) to the latest version, if needed.

This option only affects the operation of [mongod](#) (page 925) if the data files are in an old format.

When specified for a [mongos](#) (page 938) instance, this option updates the meta data format used by the [config database](#).

**Note:** In most cases you should **not** set this value, so you can exercise the most control over your upgrade process. See the MongoDB release notes<sup>42</sup> (on the download page) for more information about the upgrade process.

---

### **traceExceptions**

*Default:* false

For internal diagnostic use only.

---

<sup>42</sup><http://www.mongodb.org/downloads>

**quiet**

*Default:* false

Runs the [mongod](#) (page 925) or [mongos](#) (page 938) instance in a quiet mode that attempts to limit the amount of output. This option suppresses:

- output from *database commands*, including [drop](#) (page 747), [dropIndexes](#) (page 750), [diagLogging](#) (page 769), [validate](#) (page 771), and [clean](#) (page 752).
- replication activity.
- connection accepted events.
- connection closed events.

**Note:** For production systems this option is **not** recommended as it may make tracking problems during particular connections much more difficult.

**setParameter**

New in version 2.4.

Specifies an option to configure on startup. Specify multiple options with multiple [setParameter](#) (page 999) options. See [mongod Parameters](#) (page 1005) for full documentation of these parameters. The [setParameter](#) (page 756) database command provides access to many of these parameters.

Declare all [setParameter](#) (page 756) settings in this file using the following form:

```
setParameter = <parameter>=<value>
```

For [mongod](#) (page 925) the following options are available using [setParameter](#) (page 999):

- [enableLocalhostAuthBypass](#) (page 1005)
- [enableTestCommands](#) (page 1005)
- [journalCommitInterval](#) (page 1006)
- [logLevel](#) (page 1006)
- [logUserIds](#) (page 1006)
- [notableScan](#) (page 1006)
- [quiet](#) (page 1007)
- [replApplyBatchSize](#) (page 1006)
- [replIndexPrefetch](#) (page 1006)
- [supportCompatibilityForPrivilegeDocuments](#) (page 1007)
- [syncdelay](#) (page 1007)
- [textSearchEnabled](#) (page 1008)
- [traceExceptions](#) (page 1007)

For [mongos](#) (page 938) the following options are available using [setParameter](#) (page 999):

- [enableLocalhostAuthBypass](#) (page 1005)
- [enableTestCommands](#) (page 1005)
- [logLevel](#) (page 1006)
- [logUserIds](#) (page 1006)

- [notableScan](#) (page 1006)
- [quiet](#) (page 1007)
- [supportCompatibilityForPrivilegeDocuments](#) (page 1007)
- [syncDelay](#) (page 1007)
- [textSearchEnabled](#) (page 1008)

## Replication Options

### **replicaSet**

*Default:* <none>

*Form:* <setname>

Use this setting to configure replication with replica sets. Specify a replica set name as an argument to this set. All hosts must have the same set name.

**See also:**

[Replication](#) (page 377), [Replica Set Deployment Tutorials](#) (page 420), and [Replica Set Configuration](#) (page 479)

### **oplogSize**

Specifies a maximum size in megabytes for the replication operation log (e.g. [oplog](#).) [mongod](#) (page 925) creates an oplog based on the maximum amount of space available. For 64-bit systems, the oplog is typically 5% of available disk space.

Once the [mongod](#) (page 925) has created the oplog for the first time, changing [oplogSize](#) (page 1000) will not affect the size of the oplog.

### **fastSync**

*Default:* false

In the context of [replica set](#) replication, set this option to true if you have seeded this member with a snapshot of the [dbpath](#) of another member of the set. Otherwise the [mongod](#) (page 925) will attempt to perform an initial sync, as though the member were a new member.

**Warning:** If the data is not perfectly synchronized and [mongod](#) (page 925) starts with [fastSync](#) (page 1000), then the secondary or slave will be permanently out of sync with the primary, which may cause significant consistency problems.

### **replicaIndexPrefetch**

New in version 2.2.

*Default:* all

*Values:* all, none, and \_id\_only

You can only use [replicaIndexPrefetch](#) (page 1000) in conjunction with [replicaSet](#) (page 1000).

By default [secondary](#) members of a [replica set](#) will load all indexes related to an operation into memory before applying operations from the oplog. You can modify this behavior so that the secondaries will only load the \_id index. Specify \_id\_only or none to prevent the [mongod](#) (page 925) from loading any index into memory.

## Master/Slave Replication

### **master**

*Default:* false

Set to true to configure the current instance to act as [master](#) instance in a replication configuration.

**slave**

*Default:* false

Set to `true` to configure the current instance to act as `slave` instance in a replication configuration.

**source**

*Default:* <>

*Form:* <host><:port>

Used with the `slave` (page 1001) setting to specify the `master` instance from which this `slave` instance will replicate

**only**

*Default:* <>

Used with the `slave` (page 1001) option, `only` (page 1001) specifies only a single `database` to replicate.

**slaveDelay**

*Default:* 0

Used with the `slave` (page 1001) setting, `slaveDelay` (page 1001) configures a “delay” in seconds, for this slave to wait to apply operations from the `master` instance.

**autoresync**

*Default:* false

Used with the `slave` (page 1001) setting, set `autoresync` (page 1001) to `true` to force the `slave` to automatically resync if it is more than 10 seconds behind the master. This setting may be problematic if the `oplogSize` (page 1000) of the `oplog` is too small. If the `oplog` is not large enough to store the difference in changes between the master’s current state and the state of the slave, this instance will forcibly resync itself unnecessarily. When you set the `autoresync` (page 1001) option to `false`, the slave will not attempt an automatic resync more than once in a ten minute period.

**Sharded Cluster Options****configsvr**

*Default:* false

Set this value to `true` to configure this `mongod` (page 925) instance to operate as the `config database` of a shard cluster. When running with this option, clients will not be able to write data to any database other than `config` and `admin`. The default port for a `mongod` (page 925) with this option is 27019 and the default `dbpath` (page 993) directory is `/data/configdb`, unless specified.

Changed in version 2.2: `configsvr` (page 1001) also sets `smallfiles` (page 998).

Changed in version 2.4: `configsvr` (page 1001) creates a local `oplog`.

Do not use `configsvr` (page 1001) with `replicaSet` (page 1000) or `shardsvr` (page 1001). Config servers cannot be a shard server or part of a `replica set`.

default port for `mongod` (page 925) with this option is 27019 and `mongod` (page 925) writes all data files to the `http://docs.mongodb.org/manual/configdb` sub-directory of the `dbpath` (page 993) directory.

**shardsvr**

*Default:* false

Set this value to `true` to configure this `mongod` (page 925) instance as a shard in a partitioned cluster. The default port for these instances is 27018. The only effect of `shardsvr` (page 1001) is to change the port number.

**configdb**

*Default:* None.

*Format:* <config1>, <config2><:port>, <config3>

Set this option to specify a configuration database (i.e. [config database](#)) for the [sharded cluster](#). You must specify either 1 configuration server or 3 configuration servers, in a comma separated list.

This setting only affects [mongos](#) (page 938) processes.

**Note:** [mongos](#) (page 938) instances read from the first [config server](#) in the list provided. All [mongos](#) (page 938) instances **must** specify the hosts to the [configdb](#) (page 1001) setting in the same order.

If your configuration databases reside in more than one data center, order the hosts in the [configdb](#) (page 1001) setting so that the config database that is closest to the majority of your [mongos](#) (page 938) instances is first servers in the list.

**Warning:** Never remove a config server from the [configdb](#) (page 1001) parameter, even if the config server or servers are not available, or offline.

### **test**

*Default:* false

Only runs unit tests and does not start a [mongos](#) (page 938) instance.

This setting only affects [mongos](#) (page 938) processes and is for internal testing use only.

### **chunkSize**

*Default:* 64

The value of this option determines the size of each [chunk](#) of data distributed around the [sharded cluster](#). The default value is 64 megabytes. Larger chunks may lead to an uneven distribution of data, while smaller chunks may lead to frequent and unnecessary migrations. However, in some circumstances it may be necessary to set a different chunk size.

This setting only affects [mongos](#) (page 938) processes. Furthermore, [chunkSize](#) (page 1002) *only* sets the chunk size when initializing the cluster for the first time. If you modify the run-time option later, the new value will have no effect. See the [Modify Chunk Size in a Sharded Cluster](#) (page 547) procedure if you need to change the chunk size on an existing sharded cluster.

### **localThreshold**

New in version 2.2.

[localThreshold](#) (page 1002) affects the logic that [mongos](#) (page 938) uses when selecting [replica set](#) members to pass reads operations to from clients. Specify a value to [localThreshold](#) (page 1002) in milliseconds. The default value is 15, which corresponds to the default value in all of the client [drivers](#) (page 95).

This setting only affects [mongos](#) (page 938) processes.

When [mongos](#) (page 938) receives a request that permits reads to [secondary](#) members, the [mongos](#) (page 938) will:

- find the member of the set with the lowest ping time.
- construct a list of replica set members that is within a ping time of 15 milliseconds of the nearest suitable member of the set.

If you specify a value for [localThreshold](#) (page 1002), [mongos](#) (page 938) will construct the list of replica members that are within the latency allowed by this value.

- The [mongos](#) (page 938) will select a member to read from at random from this list.

The ping time used for a set member compared by the [localThreshold](#) (page 1002) setting is a moving average of recent ping times, calculated, at most, every 10 seconds. As a result, some queries may reach members above the threshold until the [mongos](#) (page 938) recalculates the average.

See the [Member Selection](#) (page 408) section of the [read preference](#) (page 405) documentation for more information.

#### **noAutoSplit**

`noAutoSplit` (page 1003) is for internal use and is only available on [mongos](#) (page 938) instances.

New in version 2.0.7.

`noAutoSplit` (page 1003) prevents [mongos](#) (page 938) from automatically inserting metadata splits in a *sharded collection*. If set on all [mongos](#) (page 938), this will prevent MongoDB from creating new chunks as the data in a collection grows.

Because any [mongos](#) (page 938) in a cluster can create a split, to totally disable splitting in a cluster you must set `noAutoSplit` (page 1003) on all [mongos](#) (page 938).

**Warning:** With `noAutoSplit` (page 1003) enabled, the data in your sharded cluster may become imbalanced over time. Enable with caution.

#### **moveParanoia**

New in version 2.4.

During chunk migrations, `moveParanoia` (page 1003) forces the [mongod](#) (page 925) instances to save all documents migrated from this shard in the `moveChunk` directory of the [dbpath](#) (page 993). MongoDB does not delete data from this directory.

Prior to 2.4, `moveParanoia` (page 1003) was the default behavior of MongoDB.

### SSL Options

#### **sslOnNormalPorts**

New in version 2.2.

---

**Note:** The [default distribution of MongoDB](#)<sup>43</sup> does **not** contain support for SSL. To use SSL you can either compile MongoDB with SSL support or use MongoDB Enterprise. See [Connect to MongoDB with SSL](#) (page 249) for more information about SSL and MongoDB.

---

Enables SSL for [mongod](#) (page 925) or [mongos](#) (page 938). With `sslOnNormalPorts` (page 1003), a [mongod](#) (page 925) or [mongos](#) (page 938) requires SSL encryption for all connections on the default MongoDB port, or the port specified by [port](#) (page 991). By default, `sslOnNormalPorts` (page 1003) is disabled.

#### **sslPEMKeyFile**

New in version 2.2.

---

**Note:** The [default distribution of MongoDB](#)<sup>44</sup> does **not** contain support for SSL. To use SSL you can either compile MongoDB with SSL support or use MongoDB Enterprise. See [Connect to MongoDB with SSL](#) (page 249) for more information about SSL and MongoDB.

---

Specifies the .pem file that contains both the SSL certificate and key. Specify the file name of the .pem file using relative or absolute paths

When using `sslOnNormalPorts` (page 1003), you must specify `sslPEMKeyFile` (page 1003).

#### **sslPEMKeyPassword**

New in version 2.2.

---

**Note:** The [default distribution of MongoDB](#)<sup>45</sup> does **not** contain support for SSL. To use SSL you can ei-

<sup>43</sup><http://www.mongodb.org/downloads>

<sup>44</sup><http://www.mongodb.org/downloads>

ther compile MongoDB with SSL support or use MongoDB Enterprise. See [Connect to MongoDB with SSL](#) (page 249) for more information about SSL and MongoDB.

---

Specifies the password to de-crypt the certificate-key file (i.e. `sslPEMKeyFile` (page 1003)). Only use `sslPEMKeyPassword` (page 1003) if the certificate-key file is encrypted. In all cases, `mongod` (page 925) or `mongos` (page 938) will redact the password from all logging and reporting output.

Changed in version 2.4: `sslPEMKeyPassword` (page 1003) is only needed when the private key is encrypted. In earlier versions `mongod` (page 925) or `mongos` (page 938) would require `sslPEMKeyPassword` (page 1003) whenever using `sslOnNormalPorts` (page 1003), even when the private key was not encrypted.

### **sslCAFile**

New in version 2.4.

---

**Note:** The [default distribution of MongoDB<sup>46</sup>](#) does **not** contain support for SSL. To use SSL you can either compile MongoDB with SSL support or use MongoDB Enterprise. See [Connect to MongoDB with SSL](#) (page 249) for more information about SSL and MongoDB.

---

Specifies the .pem file that contains the root certificate chain from the Certificate Authority. Specify the file name of the .pem file using relative or absolute paths

### **sslCRLFile**

New in version 2.4.

---

**Note:** The [default distribution of MongoDB<sup>47</sup>](#) does **not** contain support for SSL. To use SSL you can either compile MongoDB with SSL support or use MongoDB Enterprise. See [Connect to MongoDB with SSL](#) (page 249) for more information about SSL and MongoDB.

---

Specifies the .pem file that contains the Certificate Revocation List. Specify the file name of the .pem file using relative or absolute paths

### **sslWeakCertificateValidation**

New in version 2.4.

---

**Note:** The [default distribution of MongoDB<sup>48</sup>](#) does **not** contain support for SSL. To use SSL you can either compile MongoDB with SSL support or use MongoDB Enterprise. See [Connect to MongoDB with SSL](#) (page 249) for more information about SSL and MongoDB.

---

Disables the requirement for SSL certificate validation, that `sslCAFile` (page 1004) enables. With `sslWeakCertificateValidation` (page 1004), `mongod` (page 925) or `mongos` (page 938) will accept connections if the client does not present a certificate when establishing the connection.

If the client presents a certificate and `mongod` (page 925) or `mongos` (page 938) has `sslWeakCertificateValidation` (page 1004) enabled, `mongod` (page 925) or `mongos` (page 938) will validate the certificate using the root certificate chain specified by `sslCAFile` (page 1004), and reject clients with invalid certificates.

Use `sslWeakCertificateValidation` (page 1004) if you have a mixed deployment that includes clients that do not or cannot present certificates to `mongod` (page 925) or `mongos` (page 938).

### **sslFIPSMode**

New in version 2.4.

---

<sup>45</sup><http://www.mongodb.org/downloads>

<sup>46</sup><http://www.mongodb.org/downloads>

<sup>47</sup><http://www.mongodb.org/downloads>

<sup>48</sup><http://www.mongodb.org/downloads>

**Note:** The default distribution of MongoDB<sup>49</sup> does **not** contain support for SSL. To use SSL you can either compile MongoDB with SSL support or use MongoDB Enterprise. See [Connect to MongoDB with SSL](#) (page 249) for more information about SSL and MongoDB.

When specified, `mongod` (page 925) or `mongos` (page 938) will use the FIPS mode of the installed OpenSSL library. Your system must have a FIPS compliant OpenSSL library to use `sslFIPSMode` (page 1004).

## **mongod** Parameters

Changed in version 2.4.

**Synopsis** MongoDB provides a number of configuration options that are accessible via the `--setParameter` option to `mongod` (page 925). This document documents all of these options.

For additional run time configuration options, see [Configuration File Options](#) (page 990) and [Manual Page for mongod](#) (page 925).

### Parameters

#### **enablelocalhostAuthBypass**

New in version 2.4.

Specify 0 to disable localhost authentication bypass. Enabled by default.

`enablelocalhostAuthBypass` (page 1005) is not available using `setParameter` (page 756) database command. Use the `setParameter` (page 999) option in the configuration file or the `--setParameter` option on the command line.

#### **enableTestCommands**

New in version 2.4.

`enableTestCommands` (page 1005) enables a set of internal commands useful for internal testing operations. `enableTestCommands` (page 1005) is only available when starting `mongod` (page 925) and you cannot use `setParameter` (page 756) to modify this parameter. Consider the following `mongod` (page 925) innovation, which sets `enableTestCommands` (page 1005):

```
mongod --setParameter enableTestCommands=1
```

`enableTestCommands` (page 1005) provides access to the following internal commands:

- [captrunc](#) (page 802)
- [configureFailPoint](#) (page 806)
- [emptycapped](#) (page 803)
- [godinsert](#) (page 803)
- [\\_hashBSNElement](#) (page 803)
- [journalLatencyTest](#) (page 805)
- [replSetTest](#) (page 805)
- [\\_skewClockCommand](#) (page 806)
- [sleep](#) (page 805)
- [\\_testDistLockWithSkew](#) (page 802)

<sup>49</sup><http://www.mongodb.org/downloads>

- `_testDistLockWithSyncCluster` (page 802)

#### **journalCommitInterval**

Specify an integer between 1 and 500 signifying the number of milliseconds (ms) between journal commits.

Consider the following example which sets the `journalCommitInterval` (page 1006) to 200 ms:

```
use admin
db.runCommand({ setParameter: 1, journalCommitInterval: 200 })
```

**See also:**

`journalCommitInterval` (page 995).

#### **logUserIds**

New in version 2.4.

Specify 1 to enable logging of userids.

Disabled by default.

#### **logLevel**

Specify an integer between 0 and 5 signifying the verbosity of the logging, where 5 is the most verbose.

Consider the following example which sets the `logLevel` (page 1006) to 2:

```
use admin
db.runCommand({ setParameter: 1, logLevel: 2 })
```

**See also:**

`verbose` (page 991).

#### **notableScan**

Specify whether queries must use indexes. If 1, queries that perform a table scan instead of using an index will fail.

Consider the following example which sets `notableScan` (page 1006) to true:

```
use admin
db.runCommand({ setParameter: 1, notableScan: 1 })
```

**See also:**

`notableScan` (page 996)

#### **replIndexPrefetch**

New in version 2.2.

Use `replIndexPrefetch` (page 1006) in conjunction with `replSet` (page 1000). The default value is all and available options are:

- none
- all
- \_id\_only

By default `secondary` members of a `replica set` will load all indexes related to an operation into memory before applying operations from the oplog. You can modify this behavior so that the secondaries will only load the `_id` index. Specify `_id_only` or `none` to prevent the `mongod` (page 925) from loading *any* index into memory.

#### **replApplyBatchSize**

New in version 2.4.

Specify the number of oplog entries to apply as a single batch. `replApplyBatchSize` (page 1006) must be an integer between 1 and 1024. This option only applies to replica set members when they are in the `secondary` state.

Batch sizes must be 1 for members with `slaveDelay` (page 1001) configured.

#### **saslHostName**

New in version 2.4.

`saslHostName` (page 1007) overrides MongoDB's default hostname detection for the purpose of configuring SASL and Kerberos authentication.

`saslHostName` (page 1007) does not affect the hostname of the `mongod` (page 925) or `mongos` (page 938) instance for any purpose beyond the configuration of SASL and Kerberos.

You can only set `saslHostName` (page 1007) during start-up, and cannot change this setting using the `setParameter` (page 756) database command.

---

**Note:** `saslHostName` (page 1007) supports Kerberos authentication and is only included in MongoDB Enterprise. See *Deploy MongoDB with Kerberos Authentication* (page 259) for more information.

---

#### **supportCompatibilityFormPrivilegeDocuments**

New in version 2.4.

`supportCompatibilityFormPrivilegeDocuments` (page 1007) is not available using `setParameter` (page 756) database command. Use the `setParameter` (page 999) option in the configuration file or the `--setParameter` option on the command line.

#### **syncdelay**

Specify the interval in seconds between `fsync` operations where `mongod` (page 925) flushes its working memory to disk. By default, `mongod` (page 925) flushes memory to disk every 60 seconds. In almost every situation you should not set this value and use the default setting.

Consider the following example which sets the `syncdelay` to 60 seconds:

```
db = db.getSiblingDB("admin")
db.runCommand({ setParameter: 1, syncdelay: 60 })
```

#### **See also:**

[syncdelay](#) (page 998) and [journalCommitInterval](#) (page 1006).

#### **traceExceptions**

New in version 2.2.

Configures `mongod` (page 925) log full stack traces on assertions or errors. If 1, `mongod` (page 925) will log full stack traces on assertions or errors.

Consider the following example which sets the `traceExceptions` to true:

```
use admin
db.runCommand({ setParameter: 1, traceExceptions: true })
```

#### **See also:**

[traceExceptions](#) (page 998)

#### **quiet**

Sets quiet logging mode. If 1, `mongod` (page 925) will go into a quiet logging mode which will not log the following events/activities:

- connection events;

- the `drop` (page 747) command, the `dropIndexes` (page 750) command, the `diagLogging` (page 769) command, the `validate` (page 771) command, and the `clean` (page 752) command; and
- replication synchronization activities.

Consider the following example which sets the `quiet` to 1:

```
db = db.getSiblingDB("admin")
db.runCommand({ setParameter: 1, quiet: 1 })
```

### See also:

`quiet` (page 998)

## `textSearchEnabled`

New in version 2.4.

### Warning:

- Do **not** enable or use text search on production systems.
- Text indexes have significant storage requirements and performance costs. See *Storage Requirements and Performance Costs* (page 332) for more information.

Enables the `text search` (page 333) feature. You must enable the feature before creating or accessing a text index.

```
mongod --setParameter textSearchEnabled=true
```

If the flag is not enabled, you cannot create *new* `text` indexes, and you cannot perform text searches. However, MongoDB will continue to maintain existing `text` indexes.

## `releaseConnectionsAfterResponse`

New in version 2.2.4: and 2.4.2

Changes the behavior of the connection pool that `mongos` (page 938) uses to connect to the shards. As a result, each `mongos` (page 938) should need to maintain fewer connections to each shard. When enabled, the `mongos` (page 938) will release a connection into the thread pool *after* each read operation or command.

**Warning:** For applications that do not use the `default` (page 55), `jounaled` (page 57), or `replica acknowledged` (page 57) write concern modes of the driver, `releaseConnectionsAfterResponse` (page 1008) will affect the meaning of `getLastError` (page 720).

If an application allows read operations in between write operations and `getLastError` (page 720) calls, the resulting `getLastError` (page 720) will **not** report on the success of the proceeding write operation. Use with caution.

To enable, use the following command while connected to a `mongos` (page 938):

```
use admin
db.runCommand({ setParameter: 1, releaseConnectionsAfterResponse: true })
```

Alternately, you may start the `mongos` (page 938) instance with the following run-time option:

```
mongos --setParameter releaseConnectionsAfterResponse=true
```

To change this policy for the entire cluster, you must set `releaseConnectionsAfterResponse` (page 1008) on each `mongos` (page 938) instance in the cluster.

## 11.3 General Reference

### 11.3.1 Exit Codes and Statuses

MongoDB will return one of the following codes and statuses when exiting. Use this guide to interpret logs and when troubleshooting issues with [mongod](#) (page 925) and [mongos](#) (page 938) instances.

- 0**  
Returned by MongoDB applications upon successful exit.
- 2**  
The specified options are in error or are incompatible with other options.
- 3**  
Returned by [mongod](#) (page 925) if there is a mismatch between hostnames specified on the command line and in the [local.sources](#) (page 486) collection. [mongod](#) (page 925) may also return this status if [oplog](#) collection in the [local](#) database is not readable.
- 4**  
The version of the database is different from the version supported by the [mongod](#) (page 925) (or [mongod.exe](#) (page 948)) instance. The instance exits cleanly. Restart [mongod](#) (page 925) with the [--upgrade](#) option to upgrade the database to the version supported by this [mongod](#) (page 925) instance.
- 5**  
Returned by [mongod](#) (page 925) if a [moveChunk](#) (page 742) operation fails to confirm a commit.
- 12**  
Returned by the [mongod.exe](#) (page 948) process on Windows when it receives a Control-C, Close, Break or Shutdown event.
- 14**  
Returned by MongoDB applications which encounter an unrecoverable error, an uncaught exception or uncaught signal. The system exits without performing a clean shut down.
- 20**  
*Message:* ERROR: wsastartup failed <reason>  
Returned by MongoDB applications on Windows following an error in the WSAStartup function.  
*Message:* NT Service Error  
Returned by MongoDB applications for Windows due to failures installing, starting or removing the NT Service for the application.
- 45**  
Returned when a MongoDB application cannot open a file or cannot obtain a lock on a file.
- 47**  
MongoDB applications exit cleanly following a large clock skew (32768 milliseconds) event.
- 48**  
[mongod](#) (page 925) exits cleanly if the server socket closes. The server socket is on port 27017 by default, or as specified to the [--port](#) run-time option.
- 49**  
Returned by [mongod.exe](#) (page 948) or [mongos.exe](#) (page 950) on Windows when either receives a shutdown message from the *Windows Service Control Manager*.

100

Returned by [mongod](#) (page 925) when the process throws an uncaught exception.

### 11.3.2 Connection String URI Format

This document describes the URI format for defining connections between applications and MongoDB instances in the official MongoDB [drivers](#) (page 95).

#### Standard Connection String Format

This section describes the standard format of the MongoDB connection URI used to connect to a MongoDB database server. The format is the same for all official MongoDB drivers. For a list of drivers and links to driver documentation, see [MongoDB Drivers and Client Libraries](#) (page 95).

The following is the standard URI connection scheme:

```
mongodb://[username:password@]host1[:port1][,host2[:port2],...[,hostN[:portN]]][/[database][?options]]
```

The components of this string are:

1. `mongodb://`

A required prefix to identify that this is a string in the standard connection format.

2. `username:password@`

Optional. If specified, the client will attempt to log in to the specific database using these credentials after connecting to the [mongod](#) (page 925) instance.

3. `host1`

This the only required part of the URI. It identifies a server address to connect to. It identifies either a hostname, IP address, or UNIX domain socket.

4. `:port1`

Optional. The default value is `:27017` if not specified.

5. `hostX`

Optional. You can specify as many hosts as necessary. You would specify multiple hosts, for example, for connections to replica sets.

6. `:portX`

Optional. The default value is `:27017` if not specified.

7. `/database`

Optional. The name of the database to authenticate if the connection string includes authentication credentials in the form of `username:password@`. If `/database` is not specified and the connection string includes credentials, the driver will authenticate to the `admin` database.

8. `?options`

Connection specific options. See [Connection String Options](#) (page 1011) for a full description of these options.

If the connection string does not specify a database/ you must specify a slash (i.e. `http://docs.mongodb.org/manual`) between the last `hostN` and the question mark that begins the string of options.

---

## Example

To describe a connection to a replica set named `test`, with the following `mongod` (page 925) hosts:

- `db1.example.net` on port 27017 and
- `db2.example.net` on port 2500.

You would use a connection string that resembles the following:

```
mongodb://db1.example.net,db2.example.net:2500/?replicaSet=test
```

---

## Connection String Options

This section lists all connection options used in the *Standard Connection String Format* (page 1010). The options are not case-sensitive.

Connection options are pairs in the following form: `name=value`. Separate options with the ampersand (i.e. `&`) character. In the following example, a connection uses the `replicaSet` and `connectTimeoutMS` options:

```
mongodb://db1.example.net,db2.example.net:2500/?replicaSet=test&connectTimeoutMS=300000
```

---

### Semi-colon separator for connection string arguments

To provide backwards compatibility, drivers currently accept semi-colons (i.e. `;`) as option separators.

---

## Replica Set Option

### `replicaSet`

Specifies the name of the *replica set*, if the `mongod` (page 925) is a member of a replica set.

When connecting to a replica set it is important to give a seed list of at least two `mongod` (page 925) instances.

If you only provide the connection point of a single `mongod` (page 925) instance, and omit the `replicaSet` (page 1011), the client will create a *standalone* connection.

## Connection Options

### `ssl`

`true`: Initiate the connection with SSL.

`false`: Initiate the connection without SSL.

The default value is `false`.

---

**Note:** The `ssl` (page 1011) option is not supported by all drivers. See your `driver` (page 95) documentation and the *Connect to MongoDB with SSL* (page 249) document.

---

### `connectTimeoutMS`

The time in milliseconds to attempt a connection before timing out. The default is never to timeout, though different drivers might vary. See the `driver` (page 95) documentation.

### `socketTimeoutMS`

The time in milliseconds to attempt a send or receive on a socket before the attempt times out. The default is never to timeout, though different drivers might vary. See the `driver` (page 95) documentation.

## Connection Pool Options

Most drivers implement some kind of connection pooling handle this for you behind the scenes. Some drivers do not support connection pools. See your [driver](#) (page 95) documentation for more information on the connection pooling implementation. These options allow applications to configure the connection pool when connecting to the MongoDB deployment.

### **maxPoolSize**

The maximum number of connections in the connection pool. The default value is 100.

### **minPoolSize**

The minimum number of connections in the connection pool. The default value is 0.

---

**Note:** The [minPoolSize](#) (page 1012) option is not supported by all drivers. For information on your driver, see the [drivers](#) (page 95) documentation.

---

### **maxIdleTimeMS**

The maximum number of milliseconds that a connection can remain idle in the pool before being removed and closed.

This option is not supported by all drivers.

### **waitForQueueMultiple**

A number that the driver multiples the [maxPoolSize](#) (page 1012) value to, to provide the maximum number of threads allowed to wait for a connection to become available from the pool. For default values, see the [MongoDB Drivers and Client Libraries](#) (page 95) documentation.

### **waitForQueueTimeoutMS**

The maximum time in milliseconds that a thread can wait for a connection to become available. For default values, see the [MongoDB Drivers and Client Libraries](#) (page 95) documentation.

## Write Concern Options

[Write concern](#) (page 55) describes the kind of assurances that the program:*mongod* and the driver provide to the application regarding the success and durability of the write operation. For a full explanation of write concern and write operations in general see the: [Write Operations](#) (page 50):

### **w**

Defines the level and kind of write concern, that the driver uses when calling [getLastError](#) (page 720). This option can take either a number or a string as a value.

**option number -1** The driver will *not* acknowledge write operations and will suppress all network or socket errors.

**option number 0** The driver will *not* acknowledge write operations but will pass or handle any network and socket errors that it receives to the client. If you disable write concern but enable the [getLastError](#) (page 720) command's `w` option, `w` overrides the `w` option.

**option number 1** Provides basic acknowledgment of write operations. By specifying 1, you require that a standalone *mongod* (page 925) instance, or the primary for [replica sets](#), acknowledge all write operations. For drivers released after the [default write concern change](#) (page 1089), this is the default write concern setting.

**option string majority** For replica sets, if you specify the special `majority` value to [w](#) (page 1012) option, write operations will only return successfully after a majority of the configured replica set members have acknowledged the write operation.

**option number n** For replica sets, if you specify a number *n* greater than 1, operations with this write concern return only after *n* members of the set have acknowledged the write. If you set *n* to a number that is greater than the number of available set members or members that hold data, MongoDB will wait, potentially indefinitely, for these members to become available.

**option string tags** For replica sets, you can specify a *tag set* (page 451) to require that all members of the set that have these tags configured return confirmation of the write operation. See *Replica Set Tag Set Configuration* (page 451) for more information.

#### wtimeoutMS

The time in milliseconds to wait for replication to succeed, as specified in the *w* (page 1012) option, before timing out. When *wtimeoutMS* is 0, write operations will never time out.

#### journal

Controls whether write operations will wait until the *mongod* (page 925) acknowledges the write operations and commits the data to the on disk *journal*.

**option Boolean true** Enables journal commit acknowledgment write concern. Equivalent to specifying the *getLastError* (page 720) command with the *j* option enabled.

**option Boolean false** Does not require that *mongod* (page 925) commit write operations to the journal before acknowledging the write operation. This is the default option for the *journal* (page 1013) parameter.

If you set *journal* (page 1013) to *true*, and specify a *w* (page 1012) value less than 1, *journal* (page 1013) prevails.

If you set *journal* (page 1013) to *true*, and the *mongod* (page 925) does not have journaling enabled, as with *nojournal* (page 996), then *getLastError* (page 720) will provide basic receipt acknowledgment (i.e. *w:1*), and will include a *jnote* field in its return document.

### Read Preference Options

*Read preferences* (page 405) describe the behavior of read operations with regards to *replica sets*. These parameters allow you to specify read preferences on a per-connection basis in the connection string:

#### readPreference

Specifies the *replica set* read preference for this connection. This setting overrides any *slaveOk* value. The read preference values are the following:

- *primary* (page 489)
- *primaryPreferred* (page 489)
- *secondary* (page 489)
- *secondaryPreferred* (page 489)
- *nearest* (page 490)

For descriptions of each value, see *Read Preference Modes* (page 489).

The default value is *primary* (page 489), which sends all read operations to the replica set's *primary*.

#### readPreferenceTags

Specifies a tag set as a comma-separated list of colon-separated key-value pairs. For example:

*dc:ny,rack:1*

To specify a *list* of tag sets, use multiple *readPreferenceTags*. The following specifies two tag sets and an empty tag set:

```
readPreferenceTags=dc:ny,rack:1&readPreferenceTags=dc:ny&readPreferenceTags=
```

Order matters when using multiple `readPreferenceTags`.

### Miscellaneous Configuration

#### `uuidRepresentation`

**option standard** The standard binary representation.

**option csharpLegacy** The default representation for the C# driver.

**option javaLegacy** The default representation for the Java driver.

**option pythonLegacy** The default representation for the Python driver.

For the default, see the [drivers](#) (page 95) documentation for your driver.

---

**Note:** Not all drivers support the `uuidRepresentation` (page 1014) option. For information on your driver, see the [drivers](#) (page 95) documentation.

---

### Examples

The following provide example URI strings for common connection targets.

#### Database Server Running Locally

The following connects to a database server running locally on the default port:

```
mongodb://localhost
```

#### admin Database

The following connects and logs in to the `admin` database as user `sysop` with the password `moon`:

```
mongodb://sysop:moon@localhost
```

#### records Database

The following connects and logs in to the `records` database as user `sysop` with the password `moon`:

```
mongodb://sysop:moon@localhost/records
```

#### UNIX Domain Socket

The following connects to a UNIX domain socket:

```
mongodb:///tmp/mongodb-27017.sock
```

---

**Note:** Not all drivers support UNIX domain sockets. For information on your driver, see the [drivers](#) (page 95) documentation.

---

### Replica Set with Members on Different Machines

The following connects to a *replica set* with two members, one on db1.example.net and the other on db2.example.net:

```
mongodb://db1.example.net,db2.example.com
```

### Replica Set with Members on localhost

The following connects to a replica set with three members running on localhost on ports 27017, 27018, and 27019:

```
mongodb://localhost,localhost:27018,localhost:27019
```

### Replica Set with Read Distribution

The following connects to a replica set with three members and distributes reads to the *secondaries*:

```
mongodb://example1.com,example2.com,example3.com/?readPreference=secondary
```

### Replica Set with a High Level of Write Concern

The following connects to a replica set with write concern configured to wait for replication to succeed on at least two members, with a two-second timeout.

```
mongodb://example1.com,example2.com,example3.com/?w=2&wtimeoutMS=2000
```

## 11.3.3 MongoDB Limits and Thresholds

This document provides a collection of hard and soft limitations of the MongoDB system.

### BSON Documents

#### BSON Document Size

The maximum BSON document size is 16 megabytes.

The maximum document size helps ensure that a single document cannot use excessive amount of RAM or, during transmission, excessive amount of bandwidth. To store documents larger than the maximum size, MongoDB provides the GridFS API. See [mongofiles](#) (page 986) and the documentation for your *driver* (page 95) for more information about GridFS.

#### Nested Depth for BSON Documents

Changed in version 2.2.

MongoDB supports no more than 100 levels of nesting for *BSON documents*.

### Namespaces

#### Namespace Length

Each namespace, including database and collection name, must be shorter than 123 bytes.

### Number of Namespaces

The limitation on the number of namespaces is the size of the namespace file divided by 628.

A 16 megabyte namespace file can support approximately 24,000 namespaces. Each index also counts as a namespace.

### Size of Namespace File

Namespace files can be no larger than 2047 megabytes.

By default namespace files are 16 megabytes. You can configure the size using the `nssize` (page 996) option.

## Indexes

### Index Key

The total size of an indexed value must be *less than* 1024 bytes. MongoDB will not add that value to an index if it is longer than 1024 bytes.

### Number of Indexes per Collection

A single collection can have *no more* than 64 indexes.

### Index Name Length

The names of indexes, including their namespace (i.e database and collection name) cannot be longer than 125 characters. The default index name is the concatenation of the field names and index directions.

You can explicitly specify an index name to the `ensureIndex()` (page 814) helper if the default index name is too long.

### Number of Indexed Fields in a Compound Index

There can be no more than 31 fields in a compound index.

### Queries cannot use both text and Geospatial Indexes

that requires a different type of special index. For example you cannot combine `text` (page 715) with the `$near` (page 637) operator.

### See also:

The unique indexes limit in *Sharding Operational Restrictions* (page 1017).

## Capped Collections

### Maximum Number of Documents in a Capped Collection

Changed in version 2.4.

If you specify a maximum number of documents for a capped collection using the `max` parameter to `create` (page 747), the limit must be less than  $2^{32}$  documents. If you do not specify a maximum number of documents when creating a capped collection, there is no limit on the number of documents.

## Replica Sets

### Number of Members of a Replica Set

Replica sets can have no more than 12 members.

### Number of Voting Members of a Replica Set

Only 7 members of a replica set can have votes at any given time. See can vote *Non-Voting Members* (page 400) for more information

## Sharded Clusters

Sharded clusters have the restrictions and thresholds described here.

### Sharding Operational Restrictions

#### Operations Unavailable in Sharded Environments

The [group](#) (page 697) does not work with sharding. Use [mapReduce](#) (page 701) or [aggregate](#) (page 694) instead.

`db.eval()` (page 884) is incompatible with sharded collections. You may use `db.eval()` (page 884) with un-sharded collections in a shard cluster.

`$where` (page 634) does not permit references to the `db` object from the `$where` (page 634) function. This is uncommon in un-sharded collections.

The `$isolated` (page 663) update modifier does not work in sharded environments.

`$snapshot` (page 692) queries do not work in sharded environments.

#### Sharding Existing Collection Data Size

For existing collections that hold documents, MongoDB supports enabling sharding on *any* collections that contains less than 256 gigabytes of data. MongoDB *may* be able to shard collections with as many as 400 gigabytes depending on the distribution of document sizes. The precise size of the limitation is a function of the chunk size and the data size.

---

**Important:** Sharded collections may have *any* size, after successfully enabling sharding.

---

#### Single Document Modification Operations in Sharded Collections

All single `update()` (page 849) and `remove()` (page 844) operations must include the `shard key` or the `_id` field in the query specification. `update()` (page 849) or `remove()` (page 844) operations that affect a single document in a sharded collection without the `shard key` or the `_id` field return an error.

#### Unique Indexes in Sharded Collections

MongoDB does not support unique indexes across shards, except when the unique index contains the full shard key as a prefix of the index. In these situations MongoDB will enforce uniqueness across the full key, not a single field.

---

**See**

[Enforce Unique Keys for Sharded Collections](#) (page 558) for an alternate approach.

---

## Shard Key Limitations

### Shard Key Size

A shard key cannot exceed 512 bytes.

### Shard Key is Immutable

You cannot change a shard key after sharding the collection. If you must change a shard key:

- Dump all data from MongoDB into an external format.
- Drop the original sharded collection.
- Configure sharding using the new shard key.
- [Pre-split](#) (page 545) the shard key range to ensure initial even distribution.

- Restore the dumped data into MongoDB.

#### **Shard Key Value in a Document is Immutable**

After you insert a document into a sharded collection, you cannot change the document's value for the field or fields that comprise the shard key. The [update \(\)](#) (page 849) operation will not modify the value of a shard key in an existing document.

#### **Monotonically Increasing Shard Keys Can Limit Insert Throughput**

For clusters with high insert volumes, a shard keys with monotonically increasing and decreasing keys can affect insert throughput. If you use the `_id` field that holds default as the shard key, be aware that the default value of the `_id` field, [ObjectID](#) values, this shard key will be monotonically increasing because ObjectID values increment as time-stamps.

When inserting documents with monotonically increasing shard keys, all inserts belong to the same [chunk](#) on a single [shard](#). The system will eventually divide the chunk range that receives all write operations and migrate its contents to distribute data more evenly. However, at any moment the cluster can only direct insert operations only to a single shard, which creates an insert throughput bottleneck.

If the operations on the cluster are predominately read operations and updates, this limitation may not affect the cluster.

To avoid this constraint, use a [hashed shard key](#) (page 506) or select a field that does not increase or decrease monotonically.

Changed in version 2.4: [Hashed shard keys](#) (page 506) and [hashed indexes](#) (page 333) store hashes of keys with ascending values.

## **Operations**

### **Sorted Documents**

MongoDB will only return sorted results on fields without an index *if* the sort operation uses less than 32 megabytes of memory.

### **Aggregation Sort Operation**

`$sort` (page 670) produces an error if the operation consumes 10 percent or more of RAM.

### **2d Geospatial queries cannot use the \$or operator**

---

#### **See**

[\\$or](#) (page 625) and [2d Index Internals](#) (page 330).

---

Spherical Polygons must fit within a hemisphere.

Any geometry specified with [GeoJSON](#) to [\\$geoIntersects](#) (page 637) or [\\$geoWithin](#) (page 635) queries, **must** fit within a single hemisphere. MongoDB interprets geometries larger than half of the sphere as queries for the smaller of the complementary geometries.

### **Combination Limit with Multiple \$in Expressions**

When using two or more [\\$in](#) (page 623) expressions, the product of the number of **distinct** elements in the [\\$in](#) (page 623) arrays must be less than 4000000. Otherwise, MongoDB will throw an exception of "combinatorial limit of \$in partitioning of result set exceeded".

## **Naming Restrictions**

### **Database Name Case Sensitivity**

Database names are case sensitive even if the underlying file system is case insensitive. MongoDB does not

permit database names that differ only by the case of the characters.

#### **Restrictions on Database Names for Windows**

Changed in version 2.2: [Restrictions on Database Names for Windows](#) (page 1054).

For MongoDB deployments running on Windows, MongoDB will not permit database names that include any of the following characters:

```
/ \ . " * <> : | ?
```

Also, database names cannot contain the null byte.

#### **Restrictions on Database Names for Unix and Linux Systems**

For MongoDB deployments running on Unix and Linux systems, MongoDB will not permit database names that include any of the following characters:

```
/ \ . "
```

Also, database names cannot contain the null byte.

#### **Length of Database Names**

Database names cannot be empty and must have fewer than 64 characters.

#### **Restriction on Collection Names**

New in version 2.2.

Collection names should begin with an underscore or a letter character, and *cannot*:

- contain the \$.
- be an empty string (e.g. "").
- contain the null character.
- begin with the system. prefix. (Reserved for internal use.)

In the [mongo](#) (page 942) shell, use `db.getCollection()` (page 886) to specify collection names that might interact with the shell or are not valid JavaScript.

#### **Restrictions on Field Names**

Field names cannot contain dots (i.e. .), dollar signs (i.e. \$), or null characters. See [Dollar Sign Operator Escaping](#) (page 589) for an alternate approach.

### **11.3.4 Glossary**

**\$cmd** A special virtual *collection* that exposes MongoDB's *database commands*. To use database commands, see [Issue Commands](#) (page 164).

**\_id** A field required in every MongoDB *document*. The \_id field must have a unique value. You can think of the \_id field as the document's *primary key*. If you create a new document without an \_id field, MongoDB automatically creates the field and assigns a unique BSON *ObjectId*.

**accumulator** An *expression* in the *aggregation framework* that maintains state between documents in the aggregation *pipeline*. For a list of accumulator operations, see `$group` (page 669).

**admin database** A privileged database. Users must have access to the admin database to run certain administrative commands. For a list of administrative commands, see [Instance Administration Commands](#) (page 744).

**aggregation** Any of a variety of operations that reduces and summarizes large sets of data. MongoDB's `aggregate()` (page 808) and `mapReduce()` (page 837) methods are two examples of aggregation operations. For more information, see [Aggregation Concepts](#) (page 279).

**aggregation framework** The set of MongoDB operators that let you calculate aggregate values without having to use [map-reduce](#). For a list of operators, see [Aggregation Reference](#) (page 306).

**arbiter** A member of a [replica set](#) that exists solely to vote in [elections](#). Arbiters do not replicate data. See [Replica Set Arbiter](#) (page 389).

**B-tree** A data structure commonly used by database management systems to store indexes. MongoDB uses B-trees for its indexes.

**balancer** An internal MongoDB process that runs in the context of a [sharded cluster](#) and manages the migration of [chunks](#). Administrators must disable the balancer for all maintenance operations on a sharded cluster. See [Sharded Collection Balancing](#) (page 516).

**BSON** A serialization format used to store documents and make remote procedure calls in MongoDB. “BSON” is a portmanteau of the words “binary” and “JSON”. Think of BSON as a binary representation of JSON (JavaScript Object Notation) documents.

**See also:**

[Documents](#) (page 92), [BSON Types](#) (page 105) and [Data Type Fidelity](#) (page 150)

**BSON types** The set of types supported by the [BSON](#) serialization format. For a list of BSON types, see [BSON Types](#) (page 105).

**CAP Theorem** Given three properties of computing systems, consistency, availability, and partition tolerance, a distributed computing system can provide any two of these features, but never all three.

**capped collection** A fixed-sized [collection](#) that automatically overwrites its oldest entries when it reaches its maximum size. The MongoDB [oplog](#) that is used in [replication](#) is a capped collection. See [Capped Collections](#) (page 156).

**checksum** A calculated value used to ensure data integrity. The [md5](#) algorithm is sometimes used as a checksum.

**chunk** A contiguous range of [shard key](#) values within a particular [shard](#). Chunk ranges are inclusive of the lower boundary and exclusive of the upper boundary. MongoDB splits chunks when they grow beyond the configured chunk size, which by default is 64 megabytes. MongoDB migrates chunks when a shard contains too many chunks of a collection relative to other shards. See [Data Partitioning](#) (page 495) and [Sharding Mechanics](#) (page 515).

**client** The application layer that uses a database for data persistence and storage. [Drivers](#) provide the interface level between the application layer and the database server.

**cluster** See [sharded cluster](#).

**collection** A grouping of MongoDB [documents](#). A collection is the equivalent of an [RDBMS](#) table. A collection exists within a single [database](#). Collections do not enforce a schema. Documents within a collection can have different fields. Typically, all documents in a collection have a similar or related purpose. See [What is a namespace in MongoDB?](#) (page 585).

**compound index** An [index](#) consisting of two or more keys. See [Compound Indexes](#) (page 322).

**config database** An internal database that holds the metadata associated with a [sharded cluster](#). Applications and administrators should not modify the config database in the course of normal operation. See [Config Database](#) (page 564).

**config server** A [mongod](#) (page 925) instance that stores all the metadata associated with a [sharded cluster](#). A production sharded cluster requires three config servers, each on a separate machine. See [Config Servers](#) (page 502).

**control script** A simple shell script, typically located in the `/etc/rc.d` or `/etc/init.d` directory, and used by the system’s initialization process to start, restart or stop a [daemon](#) process.

**CRUD** An acronym for the fundamental operations of a database: Create, Read, Update, and Delete. See [MongoDB CRUD Operations](#) (page 35).

**CSV** A text-based data format consisting of comma-separated values. This format is commonly used to exchange data between relational databases since the format is well-suited to tabular data. You can import CSV files using [mongoimport](#) (page 965).

**cursor** A pointer to the result set of a [query](#). Clients can iterate through a cursor to retrieve results. By default, cursors timeout after 10 minutes of inactivity. See [Cursors](#) (page 43).

**daemon** The conventional name for a background, non-interactive process.

**data-center awareness** A property that allows clients to address members in a system based on their locations. [Replica sets](#) implement data-center awareness using [tagging](#). See [Data Center Awareness](#) (page 153).

**database** A physical container for [collections](#). Each database gets its own set of files on the file system. A single MongoDB server typically has multiple databases.

**database command** A MongoDB operation, other than an insert, update, remove, or query. For a list of database commands, see [Database Commands](#) (page 694). To use database commands, see [Issue Commands](#) (page 164).

**database profiler** A tool that, when enabled, keeps a record on all long-running operations in a database’s `system.profile` collection. The profiler is most often used to diagnose slow queries. See [Database Profiling](#) (page 143).

**datum** A set of values used to define measurements on the earth. MongoDB uses the [WGS84](#) datum in certain [geospatial](#) calculations. See [Geospatial Indexes and Queries](#) (page 326).

**dbpath** The location of MongoDB’s data file storage. See [dbpath](#) (page 993).

**delayed member** A [replica set](#) member that cannot become primary and applies operations at a specified delay. The delay is useful for protecting data from human error (i.e. unintentionally deleted databases) or updates that have unforeseen effects on the production database. See [Delayed Replica Set Members](#) (page 387).

**diagnostic log** A verbose log of operations stored in the [dbpath](#). See [diaglog](#) (page 994).

**document** A record in a MongoDB [collection](#) and the basic unit of data in MongoDB. Documents are analogous to [JSON](#) objects but exist in the database in a more type-rich format known as [BSON](#). See [Documents](#) (page 92).

**dot notation** MongoDB uses the dot notation to access the elements of an array and to access the fields of a subdocument. See [Dot Notation](#) (page 94).

**draining** The process of removing or “shedding” [chunks](#) from one [shard](#) to another. Administrators must drain shards before removing them from the cluster. See [Remove Shards from an Existing Sharded Cluster](#) (page 553).

**driver** A client library for interacting with MongoDB in a particular language. See [MongoDB Drivers and Client Libraries](#) (page 95).

**election** The process by which members of a [replica set](#) select a [primary](#) on startup and in the event of a failure. See [Replica Set Elections](#) (page 397).

**eventual consistency** A property of a distributed system that allows changes to the system to propagate gradually. In a database system, this means that readable members are not required to reflect the latest writes at all times. In MongoDB, reads to a primary have [strict consistency](#); reads to secondaries have [eventual consistency](#).

**expression** In the context of [aggregation framework](#), expressions are the stateless transformations that operate on the data that passes through a [pipeline](#). See [Aggregation Concepts](#) (page 279).

**failover** The process that allows a [secondary](#) member of a [replica set](#) to become [primary](#) in the event of a failure. See [Replica Set High Availability](#) (page 396).

**field** A name-value pair in a [document](#). A document has zero or more fields. Fields are analogous to columns in relational databases.

**firewall** A system level networking filter that restricts access based on, among other things, IP address. Firewalls form a part of an effective network security strategy. See [Firewalls](#) (page 240).

**fsync** A system call that flushes all dirty, in-memory pages to disk. MongoDB calls `fsync()` on its database files at least every 60 seconds. See [fsync](#) (page 751).

**geohash** A geohash value is a binary representation of the location on a coordinate grid. See [Calculation of Geohash Values for 2d Indexes](#) (page 331).

**GeoJSON** A *geospatial* data interchange format based on JavaScript Object Notation ([JSON](#)). GeoJSON is used in [geospatial queries](#) (page 326). For supported GeoJSON objects, see [Location Data](#) (page 326). For the GeoJSON format specification, see <http://geojson.org/geojson-spec.html>.

**geospatial** Data that relates to geographical location. In MongoDB, you may store, index, and query data according to geographical parameters. See [Geospatial Indexes and Queries](#) (page 326).

**GridFS** A convention for storing large files in a MongoDB database. All of the official MongoDB drivers support this convention, as does the `mongofiles` (page 986) program. See [GridFS](#) (page 154).

**hashed shard key** A special type of *shard key* that uses a hash of the value in the shard key field to distribute documents among members of the *sharded cluster*. See [Hashed Index](#) (page 333).

**haystack index** A *geospatial* index that enhances searches by creating “buckets” of objects grouped by a second criterion. See [Haystack Indexes](#) (page 330).

**hidden member** A *replica set* member that cannot become *primary* and are invisible to client applications. See [Hidden Replica Set Members](#) (page 387).

**idempotent** The quality of an operation to produce the same result given the same input, whether run once or run multiple times.

**index** A data structure that optimizes queries. See [Index Concepts](#) (page 318).

**initial sync** The *replica set* operation that replicates data from an existing replica set member to a new or restored replica set member. See [Initial Sync](#) (page 412).

**IPv6** A revision to the IP (Internet Protocol) standard that provides a significantly larger address space to more effectively support the number of hosts on the contemporary Internet.

**ISODate** The international date format used by `mongo` (page 942) to display dates. The format is: YYYY-MM-DD HH:MM.SS.millis.

**JavaScript** A popular scripting language originally designed for web browsers. The MongoDB shell and certain server-side functions use a JavaScript interpreter. See [Server-side JavaScript](#) (page 198) for more information.

**journal** A sequential, binary transaction log used to bring the database into a consistent state in the event of a hard shutdown. Journaling writes data first to the journal and then to the core data files. MongoDB enables journaling by default for 64-bit builds of MongoDB version 2.0 and newer. Journal files are pre-allocated and exist as files in the data directory. See [Journaling Mechanics](#) (page 232).

**JSON** JavaScript Object Notation. A human-readable, plain text format for expressing structured data with support in many programming languages. For more information, see <http://www.json.org>. Certain MongoDB tools render an approximation of MongoDB [BSON](#) documents in JSON format. See [MongoDB Extended JSON](#) (page 108).

**JSON document** A [JSON](#) document is a collection of fields and values in a structured format. For sample JSON documents, see <http://json.org/example.html>.

**JSONP** [JSON](#) with Padding. Refers to a method of injecting JSON into applications. **Presents potential security concerns.**

**legacy coordinate pairs** The format used for *geospatial* data prior to MongoDB version 2.4. This format stores geospatial data as points on a planar coordinate system (e.g. [ x, y ]). See *Geospatial Indexes and Queries* (page 326).

**LineString** A LineString is defined by an array of two or more positions. A closed LineString with four or more positions is called a LinearRing, as described in the GeoJSON LineString specification: <http://geojson.org/geojson-spec.html#linestring>. To use a LineString in MongoDB, see *Store GeoJSON Objects* (page 328).

**LVM** Logical volume manager. LVM is a program that abstracts disk images from physical devices and provides a number of raw disk manipulation and snapshot capabilities useful for system management. For information on LVM and MongoDB, see *Backup and Restore Using LVM on a Linux System* (page 185).

**map-reduce** A data processing and aggregation paradigm consisting of a “map” phase that selects data and a “reduce” phase that transforms the data. In MongoDB, you can run arbitrary aggregations over data using map-reduce. For map-reduce implementation, see *Map-Reduce* (page 282). For all approaches to aggregation, see *Aggregation Concepts* (page 279).

**mapping type** A Structure in programming languages that associate keys with values, where keys may nest other pairs of keys and values (e.g. dictionaries, hashes, maps, and associative arrays). The properties of these structures depend on the language specification and implementation. Generally the order of keys in mapping types is arbitrary and not guaranteed.

**master** The database that receives all writes in a conventional master-slave replication. In MongoDB, *replica sets* replace master-slave replication for most use cases. For more information on master-slave replication, see *Master Slave Replication* (page 413).

**md5** A hashing algorithm used to efficiently provide reproducible unique strings to identify and *checksum* data. MongoDB uses md5 to identify chunks of data for *GridFS*. See *filemd5* (page 750).

**MIME** Multipurpose Internet Mail Extensions. A standard set of type and encoding definitions used to declare the encoding and type of data in multiple data storage, transmission, and email contexts. The *mongofiles* (page 986) tool provides an option to specify a MIME type to describe a file inserted into *GridFS* storage.

**mongo** The MongoDB shell. The *mongo* (page 942) process starts the MongoDB shell as a daemon connected to either a *mongod* (page 925) or *mongos* (page 938) instance. The shell has a JavaScript interface. See *mongo* (page 942) and *mongo Shell Methods* (page 806).

**mongod** The MongoDB database server. The *mongod* (page 925) process starts the MongoDB server as a daemon. The MongoDB server manages data requests and formats and manages background operations. See *mongod* (page 925).

**MongoDB** An open-source document-based database system. “MongoDB” derives from the word “humongous” because of the database’s ability to scale up with ease and hold very large amounts of data. MongoDB stores *documents* in *collections* within databases.

**mongos** The routing and load balancing process that acts an interface between an application and a MongoDB *sharded cluster*. See *mongos* (page 937).

**namespace** The canonical name for a collection or index in MongoDB. The namespace is a combination of the database name and the name of the collection or index, like so: [database-name].[collection-or-index-name]. All documents belong to a namespace. See *What is a namespace in MongoDB?* (page 585).

**natural order** The order that a database stores documents on disk. Typically, the order of documents on disks reflects insertion order, except when a document moves internally because an update operation increases its size. In *capped collections*, documents do not move internally, and therefore insertion order and natural order are identical in capped collections. MongoDB returns documents in forward natural order for a *find()* (page 816) query with no parameters. MongoDB returns documents in reverse natural order for a *find()* (page 816) query *sorted* (page 872) with a parameter of `$natural:-1`. See `$natural` (page 693).

**ObjectId** A special 12-byte [BSON](#) type that guarantees uniqueness within the [collection](#). The ObjectId is generated based on timestamp, machine ID, process ID, and a process-local incremental counter. MongoDB uses ObjectId values as the default values for `_id` fields.

**operator** A keyword beginning with a \$ used to express an update, complex query, or data transformation. For example, `$gt` is the query language's "greater than" operator. For available operators, see [Operators](#) (page 621).

**oplog** A [capped collection](#) that stores an ordered history of logical writes to a MongoDB database. The oplog is the basic mechanism enabling [replication](#) in MongoDB. See [Replica Set Oplog](#) (page 410).

**ordered query plan** A query plan that returns results in the order consistent with the `sort()` (page 872) order. See [Query Plans](#) (page 45).

**padding** The extra space allocated to document on the disk to prevent moving a document when it grows as the result of `update()` (page 849) operations. See [Padding Factor](#) (page 65).

**padding factor** An automatically-calibrated constant used to determine how much extra space MongoDB should allocate per document container on disk. A padding factor of 1 means that MongoDB will allocate only the amount of space needed for the document. A padding factor of 2 means that MongoDB will allocate twice the amount of space required by the document. See [Padding Factor](#) (page 65).

**page fault** The event that occurs when a process requests stored data (i.e. a page) from memory that the operating system has moved to disk. See [What are page faults?](#) (page 610).

**partition** A distributed system architecture that splits data into ranges. [Sharding](#) uses partitioning. See [Data Partitioning](#) (page 495).

**passive member** A member of a [replica set](#) that cannot become primary because its [priority](#) (page 481) is 0. See [Priority 0 Replica Set Members](#) (page 386).

**pcap** A packet-capture format used by [mongosniff](#) (page 982) to record packets captured from network interfaces and display them as human-readable MongoDB operations. See [Options](#) (page 982).

**PID** A process identifier. UNIX-like systems assign a unique-integer PID to each running process. You can use a PID to inspect a running process and send signals to it. See [/proc File System](#) (page 227).

**pipe** A communication channel in UNIX-like systems allowing independent processes to send and receive data. In the UNIX shell, piped operations allow users to direct the output of one command into the input of another.

**pipeline** A series of operations in an [aggregation](#) process. See [Aggregation Concepts](#) (page 279).

**Point** A single coordinate pair as described in the GeoJSON Point specification: <http://geojson.org/geojson-spec.html#point>. To use a Point in MongoDB, see [Store GeoJSON Objects](#) (page 328).

**Polygon** An array of [LinearRing](#) coordinate arrays, as described in the GeoJSON Polygon specification: <http://geojson.org/geojson-spec.html#polygon>. For Polygons with multiple rings, the first must be the exterior ring and any others must be interior rings or holes.

MongoDB does not permit the exterior ring to self-intersect. Interior rings must be fully contained within the outer loop and cannot intersect or overlap with each other. See [Store GeoJSON Objects](#) (page 328).

**powerOf2Sizes** A per-collection setting that changes and normalizes the way MongoDB allocates space for each [document](#), in an effort to maximize storage reuse and to reduce fragmentation. This is the default for [TTL Collections](#) (page 158). See [collMod](#) (page 755) and [usePowerOf2Sizes](#) (page 755).

**pre-splitting** An operation performed before inserting data that divides the range of possible shard key values into chunks to facilitate easy insertion and high write throughput. In some cases pre-splitting expedites the initial distribution of documents in [sharded cluster](#) by manually dividing the collection rather than waiting for the MongoDB [balancer](#) to do so. See [Create Chunks in a Sharded Cluster](#) (page 545).

**primary** In a [replica set](#), the primary member is the current [master](#) instance, which receives all write operations. See [Primary](#) (page ??).

**primary key** A record's unique immutable identifier. In an [RDBMS](#), the primary key is typically an integer stored in each row's `id` field. In MongoDB, the `_id` field holds a document's primary key which is usually a BSON [ObjectId](#).

**primary shard** The [shard](#) that holds all the un-sharded collections. See [Primary Shard](#) (page 501).

**priority** A configurable value that helps determine which members in a [replica set](#) are most likely to become [primary](#). See [priority](#) (page 481).

**projection** A document given to a [query](#) that specifies which fields MongoDB returns in the result set. See [Limit Fields to Return from a Query](#) (page 72). For a list of projection operators, see [Projection Operators](#) (page 646).

**query** A read request. MongoDB uses a [JSON](#)-like query language that includes a variety of [query operators](#) with names that begin with a \$ character. In the [mongo](#) (page 942) shell, you can issue queries using the `find()` (page 816) and `findOne()` (page 824) methods. See [Read Operations](#) (page 39).

**query optimizer** A process that generates query plans. For each query, the optimizer generates a plan that matches the query to the index that will return results as efficiently as possible. The optimizer reuses the query plan each time the query runs. If a collection changes significantly, the optimizer creates a new query plan. See [Query Plans](#) (page 45).

**RDBMS** Relational Database Management System. A database management system based on the relational model, typically using [SQL](#) as the query language.

**read lock** In the context of a reader-writer lock, a lock that while held allows concurrent readers but no writers. See [What type of locking does MongoDB use?](#) (page 596).

**read preference** A setting that determines how clients direct read operations. Read preference affects all replica sets, including shards. By default, MongoDB directs reads to [primaries](#) for [strict consistency](#). However, you may also direct reads to secondaries for [eventually consistent](#) reads. See [Read Preference](#) (page 405).

**record size** The space allocated for a document including the padding. For more information on padding, see [Padding Factor](#) (page 65) and [compact](#) (page 752).

**recovering** A [replica set](#) member status indicating that a member is not ready to begin normal activities of a secondary or primary. Recovering members are unavailable for reads.

**replica pairs** The precursor to the MongoDB [replica sets](#).

Deprecated since version 1.6.

**replica set** A cluster of MongoDB servers that implements master-slave replication and automated failover. MongoDB's recommended replication strategy. See [Replication](#) (page 377).

**replication** A feature allowing multiple database servers to share the same data, thereby ensuring redundancy and facilitating load balancing. See [Replication](#) (page 377).

**replication lag** The length of time between the last operation in the [primary's oplog](#) and the last operation applied to a particular [secondary](#). In general, you want to keep replication lag as small as possible. See [Replication Lag](#) (page 463).

**resident memory** The subset of an application's memory currently stored in physical RAM. Resident memory is a subset of [virtual memory](#), which includes memory mapped to physical RAM and to disk.

**REST** An API design pattern centered around the idea of resources and the [CRUD](#) operations that apply to them. Typically REST is implemented over HTTP. MongoDB provides a simple HTTP REST interface that allows HTTP clients to run commands against the server. See [REST Interface](#) (page 139) and [REST API](#) (page 241).

**rollback** A process that reverts writes operations to ensure the consistency of all replica set members. See [Rollbacks During Replica Set Failover](#) (page 401).

**secondary** A [replica set](#) member that replicates the contents of the master database. Secondary members may handle read requests, but only the [primary](#) members can handle write operations. See [Secondaries](#) (page ??).

**secondary index** A database [index](#) that improves query performance by minimizing the amount of work that the query engine must perform to fulfill a query. See [Indexes](#) (page 313).

**set name** The arbitrary name given to a replica set. All members of a replica set must have the same name specified with the [rep1Set](#) (page 1000) setting or the `--rep1Set` option.

**shard** A single [mongod](#) (page 925) instance or [replica set](#) that stores some portion of a [sharded cluster](#)'s total data set. In production, all shards should be replica sets. See [Shards](#) (page 499).

**shard key** The field MongoDB uses to distribute documents among members of a [sharded cluster](#). See [Shard Keys](#) (page 506).

**sharded cluster** The set of nodes comprising a [sharded](#) MongoDB deployment. A sharded cluster consists of three config processes, one or more replica sets, and one or more [mongos](#) (page 938) routing processes. See [Sharded Cluster Components](#) (page 499).

**sharding** A database architecture that partitions data by key ranges and distributes the data among two or more database instances. Sharding enables horizontal scaling. See [Sharding](#) (page 493).

**shell helper** A method in the [mongo](#) shell that provides a more concise syntax for a [database command](#) (page 694). Shell helpers improve the general interactive experience. See [mongo Shell Methods](#) (page 806).

**single-master replication** A [replication](#) topology where only a single database instance accepts writes. Single-master replication ensures consistency and is the replication topology employed by MongoDB. See [Replica Set Primary](#) (page 382).

**slave** A read-only database that replicates operations from a [master](#) database in conventional master/slave replication. In MongoDB, [replica sets](#) replace master/slave replication for most use cases. However, for information on master/slave replication, see [Master Slave Replication](#) (page 413).

**split** The division between [chunks](#) in a [sharded cluster](#). See [Chunk Splits in a Sharded Cluster](#) (page 519).

**SQL** Structured Query Language (SQL) is a common special-purpose programming language used for interaction with a relational database, including access control, insertions, updates, queries, and deletions. There are some similar elements in the basic SQL syntax supported by different database vendors, but most implementations have their own dialects, data types, and interpretations of proposed SQL standards. Complex SQL is generally not directly portable between major [RDBMS](#) products. SQL is often used as metonym for relational databases.

**SSD** Solid State Disk. A high-performance disk drive that uses solid state electronics for persistence, as opposed to the rotating platters and movable read/write heads used by traditional mechanical hard drives.

**standalone** An instance of [mongod](#) (page 925) that is running as a single server and not as part of a [replica set](#). To convert a standalone into a replica set, see [Convert a Standalone to a Replica Set](#) (page 432).

**strict consistency** A property of a distributed system requiring that all members always reflect the latest changes to the system. In a database system, this means that any system that can provide data must reflect the latest writes at all times. In MongoDB, reads from a primary have [strict consistency](#); reads from secondary members have [eventual consistency](#).

**sync** The [replica set](#) operation where members replicate data from the [primary](#). Sync first occurs when MongoDB creates or restores a member, which is called [initial sync](#). Sync then occurs continually to keep the member updated with changes to the replica set's data. See [Replica Set Data Synchronization](#) (page 412).

**syslog** On UNIX-like systems, a logging process that provides a uniform standard for servers and processes to submit logging information. MongoDB provides an option to send output to the host's syslog system. See [syslog](#) (page 992).

**tag** A label applied to a replica set member or shard and used by clients to issue data-center-aware operations. For more information on using tags with replica sets and with shards, see the following sections of this manual: [Tag Sets](#) (page 407) and [Behavior and Operations](#) (page 557).

**TSV** A text-based data format consisting of tab-separated values. This format is commonly used to exchange data between relational databases, since the format is well-suited to tabular data. You can import TSV files using [mongoimport](#) (page 965).

**TTL** Stands for “time to live” and represents an expiration time or period for a given piece of information to remain in a cache or other temporary storage before the system deletes it or ages it out. MongoDB has a TTL collection feature. See [Expire Data from Collections by Setting TTL](#) (page 158).

**unique index** An index that enforces uniqueness for a particular field across a single collection. See [Unique Indexes](#) (page 334).

**unordered query plan** A query plan that returns results in an order inconsistent with the [sort\(\)](#) (page 872) order. See [Query Plans](#) (page 45).

**upsert** An operation that will either update the first document matched by a query or insert a new document if none matches. The new document will have the fields implied by the operation. You perform upserts with the [update\(\)](#) (page 849) operation. See [Upsert Parameter](#) (page 850).

**virtual memory** An application’s working memory, typically residing on both disk and in physical RAM.

**WGS84** The default [datum](#) MongoDB uses to calculate geometry over an Earth-like sphere. MongoDB uses the WGS84 datum for [geospatial](#) queries on [GeoJSON](#) objects. See the “EPSG:4326: WGS 84” specification: <http://spatialreference.org/ref/epsg/4326/>.

**working set** The data that MongoDB uses most often. This data is preferably held in RAM, solid-state drive (SSD), or other fast media. See [What is the working set?](#) (page 611).

**write concern** Specifies whether a write operation has succeeded. Write concern allows your application to detect insertion errors or unavailable [mongod](#) (page 925) instances. For [replica sets](#), you can configure write concern to confirm replication to a specified number of members. See [Write Concern](#) (page 55).

**write lock** A lock on the database for a given writer. When a process writes to the database, it takes an exclusive write lock to prevent other processes from writing or reading. For more information on locks, see [FAQ: Concurrency](#) (page 596).

**writeBacks** The process within the sharding system that ensures that writes issued to a [shard](#) that is not responsible for the relevant chunk get applied to the proper shard. For related information, see [What does writebacklisten in the log mean?](#) (page 603) and [writeBacksQueued](#) (page 792).

#### See also:

The [genindex](#) may provide useful insight into the reference material in this manual.



---

## Release Notes

---

Always install the latest, stable version of MongoDB. See [MongoDB Version Numbers](#) (page 1090) for more information.

See the following release notes for an account of the changes in major versions. Release notes also include instructions for upgrade.

### 12.1 Current Stable Release

(2.4-series)

#### 12.1.1 Release Notes for MongoDB 2.4

See the **full index of this page** for a complete list of changes included in 2.4.

- Platform Support (page 1031)
- Upgrade Process (page 1031)
- Changes (page 1039)
  - Major Features (page 1039)
  - Security Improvements (page 1040)
  - Administration Changes (page 1040)
  - Indexing Changes (page 1042)
  - Interface Changes (page 1042)
- Additional Resources (page 1049)

MongoDB 2.4 was released on March 19, 2013.

#### What's New in MongoDB 2.4

MongoDB 2.4 represents hundreds of improvements and features driven by user requests. MongoDB 2.4 builds on the momentum of 2.2 by introducing new features that enable greater developer productivity, easier operations, improved performance and enhanced security. MongoDB 2.4 is available for download on [MongoDB.org](#)<sup>1</sup>.

---

<sup>1</sup><http://www.mongodb.org/downloads>

## Developer Productivity

- Aggregation Framework refinements include an overhaul of the underlying engine introduced in MongoDB 2.2 making it easier to leverage real-time, in-place analytics. MongoDB 2.4 includes significant performance improvements, additional support for binary data, support for `$geoWithin` (page 635) and `$near` (page 637) geospatial queries, improved string concatenation with the new `$concat` (page 681) operator, and improved date calculation semantics.
- Geospatial enhancements support new use cases with support for polygon intersection queries (with `$geoIntersects` (page 637)), support for `GeoJSON`, and an improved spherical model. Learn more about *geospatial improvements in 2* (page 1039).
- Text Search provides a simplified, integrated approach to incorporating search functionality into apps with support for language specific stemming and stop words in 15 languages and real time indexes. Text search is beta for 2.4 and is not recommended for production use. Learn more about `text search` (page 1039).
- New update semantics for arrays with the `$push` (page 659) update operator. Applications can now use `$slice` (page 661) to maintain fixed size arrays, and use `$sort` (page 661) to maintain sorted arrays. Learn more about *capped arrays* (page 1043).
- New `$setOnInsert` (page 654) update operator supports specifying fields to add only on insert and `upsert` operations.

## Ease of Operations

- Hashed indexes and shard keys provide simple, even distribution for reads and writes. Learn more about *hashed indexes and shard keys* (page 1039).
- New `serverStatus` (page 782) metrics including a working set analysis tool makes capacity planning easier for operations teams. Learn more about the new `serverStatus metrics` (page 1041) including the `working set analyzer` (page 794).
- More control for operators with the ability to terminate indexing operations with automatic resource cleanup.

## Improved Performance

- V8 JavaScript engine offers better performance and concurrency with JavaScript based actions including those using the `$where` (page 634) query operator as well as `mapReduce` (page 701) and `eval` (page 722). Learn more about *MongoDB on V8* (page 1043), and *JavaScript Changes in MongoDB 2.4* (page 1043).
- Improvements to `count` (page 695) provide dramatically faster count operations. Counting is now up to 20 times faster for low cardinality index based counts.
- Significant optimizations to `$elemMatch` (page 645) when using a multi-key index.

## More Robust Security

- Role-Based privileges allow organizations to assign more granular security policies for server, database and cluster administration. Learn more about *role based access control in MongoDB* (page 265).
- Kerberos authentication mechanism in MongoDB Enterprise.

## MongoDB Enterprise

MongoDB Enterprise is a commercial edition of MongoDB that includes enterprise-grade capabilities, such as advanced security features, management tools, software integrations and certifications. Available as part of the MongoDB Enterprise Subscription, this edition includes the most comprehensive SLA and a commercial license. Continue reading for more information on [MongoDB Enterprise](#)<sup>2</sup>

## Learning More

These features represent only a small portion of the improvements made in MongoDB 2.4. For more details see the [MongoDB 2.4 release notes](#) (page 1029) and Jira for a complete list of all cases closed for MongoDB 2.4 sorted by user votes<sup>3</sup>

## Platform Support

For OS X, MongoDB 2.4 only supports OS X versions 10.6 (Snow Leopard) and later. There are no other platform support changes in MongoDB 2.4. See the [downloads page](#)<sup>4</sup> for more information on platform support.

## Upgrade Process

### Upgrade MongoDB to 2.4

In the general case, the upgrade from MongoDB 2.2 to 2.4 is a binary-compatible “drop-in” upgrade: shut down the `mongod` (page 925) instances and replace them with `mongod` (page 925) instances running 2.4. **However**, before you attempt any upgrade please familiarize yourself with the content of this document, particularly the procedure for [upgrading sharded clusters](#) (page 1032) and the considerations for [reverting to 2.2 after running 2.4](#) (page 1036).

#### Content

- [Upgrade Recommendations and Checklist](#) (page 1031)
- [Upgrade Standalone mongod Instance to MongoDB 2.4](#) (page 1032)
- [Upgrade a Replica Set from MongoDB 2.2 to MongoDB 2.4](#) (page 1032)
- [Upgrade a Sharded Cluster from MongoDB 2.2 to MongoDB 2.4](#) (page 1032)
- [Rolling Upgrade Limitation for 2.2.0 Deployments Running with auth Enabled](#) (page 1036)
- [Upgrade from 2.3 to 2.4](#) (page 1036)
- [Downgrade MongoDB from 2.4 to Previous Versions](#) (page 1036)

**Upgrade Recommendations and Checklist** When upgrading, consider the following:

- For all deployments using authentication, upgrade the drivers (i.e. client libraries), before upgrading the `mongod` (page 925) instance or instances.
- To upgrade to 2.4 sharded clusters *must* upgrade following the [meta-data upgrade procedure](#) (page 1032).
- If you’re using 2.2.0 and running with `auth` (page 993) enabled, you will need to upgrade first to 2.2.1 and then upgrade to 2.4. See [Rolling Upgrade Limitation for 2.2.0 Deployments Running with auth Enabled](#) (page 1036).

<sup>2</sup><http://www.mongodb.com/products/mongodb-enterprise>

<sup>3</sup><https://jira.mongodb.org/secure/IssueNavigator.jspa?reset=true&jqlQuery=project+%3D+SERVER+AND+fixVersion+in+%28%222.3.2%22,%222.3.1%22,%222.3.0%22,%222.4.0-rc1%22,%222.4.0-rc2%22,%222.4.0-rc3%22%29+ORDER+BY+votes+DESC,+status+DESC,+priority+DESC>

<sup>4</sup><http://www.mongodb.org/downloads/>

- If you have `system.users` (page 270) documents (i.e. for `auth` (page 993)) that you created before 2.4 you *must* ensure that there are no duplicate values for the `user` field in the `system.users` (page 270) collection in *any* database. If you *do* have documents with duplicate user fields, you must remove them before upgrading.

See *Compatibility Change: User Uniqueness Enforced* (page 1040) for more information.

### Upgrade Standalone `mongod` Instance to MongoDB 2.4

1. Download binaries of the latest release in the 2.4 series from the [MongoDB Download Page](#)<sup>5</sup>. See *Install MongoDB* (page 3) for more information.
2. Shutdown your `mongod` (page 925) instance. Replace the existing binary with the 2.4 `mongod` (page 925) binary and restart `mongod` (page 925).

**Upgrade a Replica Set from MongoDB 2.2 to MongoDB 2.4** You can upgrade to 2.4 by performing a “rolling” upgrade of the set by upgrading the members individually while the other members are available to minimize downtime. Use the following procedure:

1. Upgrade the `secondary` members of the set one at a time by shutting down the `mongod` (page 925) and replacing the 2.2 binary with the 2.4 binary. After upgrading a `mongod` (page 925) instance, wait for the member to recover to `SECONDARY` state before upgrading the next instance. To check the member’s state, issue `rs.status()` (page 898) in the `mongo` (page 942) shell.
2. Use the `mongo` (page 942) shell method `rs.stepDown()` (page 899) to step down the `primary` to allow the normal `failover` (page 396) procedure. `rs.stepDown()` (page 899) expedites the failover procedure and is preferable to shutting down the primary directly.

Once the primary has stepped down and another member has assumed `PRIMARY` state, as observed in the output of `rs.status()` (page 898), shut down the previous primary and replace `mongod` (page 925) binary with the 2.4 binary and start the new process.

---

**Note:** Replica set failover is not instant but will render the set unavailable to read or accept writes until the failover process completes. Typically this takes 10 seconds or more. You may wish to plan the upgrade during a predefined maintenance window.

---

### Upgrade a Sharded Cluster from MongoDB 2.2 to MongoDB 2.4

---

**Important:** Only upgrade sharded clusters to 2.4 if **all** members of the cluster are currently running instances of 2.2. The only supported upgrade path for sharded clusters running 2.0 is via 2.2.

---

Upgrading a `sharded cluster` from MongoDB version 2.2 to 2.4 (or 2.3) requires that you run a 2.4 `mongos` (page 938) with the `--upgrade` option, described in this procedure. The upgrade process does not require downtime.

The upgrade to MongoDB 2.4 adds epochs to the meta-data for all collections and chunks in the existing cluster. MongoDB 2.2 processes are capable of handling epochs, even though 2.2 did not require them.

This procedure applies only to upgrades from version 2.2. Earlier versions of MongoDB do not correctly handle epochs.

---

<sup>5</sup><http://www.mongodb.org/downloads>

**Warning:**

- Before you start the upgrade, ensure that the amount of free space on the filesystem for the [config database](#) (page 564) is 4 to 5 times the amount of space currently used by the [config database](#) (page 564) data files. Additionally, ensure that all indexes in the [config database](#) (page 564) are `{v:1}` indexes. If a critical index is a `{v:0}` index, chunk splits can fail due to known issues with the `{v:0}` format. `{v:0}` indexes are present on clusters created with MongoDB 2.0 or earlier.  
The duration of the metadata upgrade depends on the network latency between the node performing the upgrade and the three config servers. Ensure low latency between the upgrade process and the config servers.
- While the upgrade is in progress, you cannot make changes to the collection meta-data. For example, during the upgrade, do **not** perform:
  - `sh.enableSharding()` (page 905),
  - `sh.shardCollection()` (page 908),
  - `sh.addShard()` (page 903),
  - `db.createCollection()` (page 878),
  - `db.collection.drop()` (page 812),
  - `db.dropDatabase()` (page 884),
  - any operation that creates a database, or
  - any other operation that modifies the cluster meta-data in any way. See [Sharding Reference](#) (page 563) for a complete list of sharding commands. Note, however, that not all commands on the [Sharding Reference](#) (page 563) page modifies the cluster meta-data.
- Once you upgrade to 2.4 and complete the upgrade procedure **do not** use 2.0 `mongod` (page 925) and `mongos` (page 938) processes in your cluster. 2.0 process may re-introduce old meta-data formats into cluster meta-data.

**Note:** The upgraded config database will require more storage space than before, to make backup and working copies of the `config.chunks` (page 566) and `config.collections` (page 567) collections. As always, if storage requirements increase, the `mongod` (page 925) might need to pre-allocate additional data files. See [What tools can I use to investigate storage use in MongoDB?](#) (page 611) for more information.

**Meta-Data Upgrade Procedure** Changes to the meta-data format for sharded clusters, stored in the [config database](#) (page 564), require a special meta-data upgrade procedure when moving to 2.4.

Do not perform operations that modify meta-data while performing this procedure. See [Upgrade a Sharded Cluster from MongoDB 2.2 to MongoDB 2.4](#) (page 1032) for examples of prohibited operations.

1. Before you start the upgrade, ensure that the amount of free space on the filesystem for the [config database](#) (page 564) is 4 to 5 times the amount of space currently used by the [config database](#) (page 564) data files. Additionally, ensure that all indexes in the [config database](#) (page 564) are `{v:1}` indexes. If a critical index is a `{v:0}` index, chunk splits can fail due to known issues with the `{v:0}` format. `{v:0}` indexes are present on clusters created with MongoDB 2.0 or earlier.

The duration of the metadata upgrade depends on the network latency between the node performing the upgrade and the three config servers. Ensure low latency between the upgrade process and the config servers.

To check the version of your indexes, use `db.collection.getIndexes()` (page 826).

If any index **on the config database** is `{v:0}`, you should rebuild those indexes by connecting to the `mongos` (page 938) and either: rebuild all indexes using the `db.collection.reIndex()` (page 844) method, or drop and rebuild specific indexes using `db.collection.dropIndex()` (page 812) and then `db.collection.ensureIndex()` (page 814). If you need to upgrade the `_id` index to `{v:1}` use `db.collection.reIndex()` (page 844).

You may have `{v:0}` indexes on other databases in the cluster.

2. Turn off the `balancer` (page 516) in the `sharded cluster`, as described in [Disable the Balancer](#) (page 552).

---

**Optional**

For additional security during the upgrade, you can make a backup of the config database using [mongodump](#) (page 951) or other backup tools.

---

3. Ensure there are no version 2.0 [mongod](#) (page 925) or [mongos](#) (page 938) processes still active in the sharded cluster. The automated upgrade process checks for 2.0 processes, but network availability can prevent a definitive check. Wait 5 minutes after stopping or upgrading version 2.0 [mongos](#) (page 938) processes to confirm that none are still active.
4. Start a single 2.4 [mongos](#) (page 938) process with [configdb](#) (page 1001) pointing to the sharded cluster's [config servers](#) (page 502) and with the `--upgrade` option. The upgrade process happens before the process becomes a daemon (i.e. before `--fork`.)

You can upgrade an existing [mongos](#) (page 938) instance to 2.4 or you can start a new *mongos* instance that can reach all config servers if you need to avoid reconfiguring a production [mongos](#) (page 938).

Start the [mongos](#) (page 938) with a command that resembles the following:

```
mongos --configdb <config servers> --upgrade
```

Without the `--upgrade` option 2.4 [mongos](#) (page 938) processes will fail to start until the upgrade process is complete.

The upgrade will prevent any chunk moves or splits from occurring during the upgrade process. If there are very many sharded collections or there are stale locks held by other failed processes, acquiring the locks for all collections can take seconds or minutes. See the log for progress updates.

5. When the [mongos](#) (page 938) process starts successfully, the upgrade is complete. If the [mongos](#) (page 938) process fails to start, check the log for more information.

If the [mongos](#) (page 938) terminates or loses its connection to the config servers during the upgrade, you may always safely retry the upgrade.

However, if the upgrade failed during the short critical section, the [mongos](#) (page 938) will exit and report that the upgrade will require manual intervention. To continue the upgrade process, you must follow the [Resync after an Interruption of the Critical Section](#) (page 1035) procedure.

---

**Optional**

If the [mongos](#) (page 938) logs show the upgrade waiting for the upgrade lock, a previous upgrade process may still be active or may have ended abnormally. After 15 minutes of no remote activity [mongos](#) (page 938) will force the upgrade lock. If you can verify that there are no running upgrade processes, you may connect to a 2.2 [mongos](#) (page 938) process and force the lock manually:

```
mongo <mongos.example.net>
```

```
db.getMongo().getCollection("config.locks").findOne({ _id : "configUpgrade" })
```

If the process specified in the `process` field of this document is *verifiably* offline, run the following operation to force the lock.

```
db.getMongo().getCollection("config.locks").update({ _id : "configUpgrade" }, { $set : { state :
```

It is always more safe to wait for the [mongos](#) (page 938) to verify that the lock is inactive, if you have any doubts about the activity of another upgrade operation. In addition to the `configUpgrade`, the [mongos](#) (page 938) may need to wait for specific collection locks. Do not force the specific collection locks.

---

6. Upgrade and restart other [mongos](#) (page 938) processes in the sharded cluster, *without* the `--upgrade` option. See [Complete Sharded Cluster Upgrade](#) (page 1036) for more information.
7. [Re-enable the balancer](#) (page 552). You can now perform operations that modify cluster meta-data.

Once you have upgraded, *do not* introduce version 2.0 MongoDB processes into the sharded cluster. This can reintroduce old meta-data formats into the config servers. The meta-data change made by this upgrade process will help prevent errors caused by cross-version incompatibilities in future versions of MongoDB.

**Resync after an Interruption of the Critical Section** During the short critical section of the upgrade that applies changes to the meta-data, it is unlikely but possible that a network interruption can prevent all three config servers from verifying or modifying data. If this occurs, the [config servers](#) (page 502) must be re-synced, and there may be problems starting new [mongos](#) (page 938) processes. The [sharded cluster](#) will remain accessible, but avoid all cluster meta-data changes until you resync the config servers. Operations that change meta-data include: adding shards, dropping databases, and dropping collections.

---

**Note:** Only perform the following procedure *if* something (e.g. network, power, etc.) interrupts the upgrade process during the short critical section of the upgrade. Remember, you may always safely attempt the [meta data upgrade procedure](#) (page 1033).

---

To resync the config servers:

1. Turn off the [balancer](#) (page 516) in the sharded cluster and stop all meta-data operations. If you are in the middle of an upgrade process ([Upgrade a Sharded Cluster from MongoDB 2.2 to MongoDB 2.4](#) (page 1032)), you have already disabled the balancer.
2. Shut down two of the three config servers, preferably the last two listed in the [configdb](#) (page 1001) string. For example, if your [configdb](#) (page 1001) string is `configA:27019,configB:27019,configC:27019`, shut down configB and configC. Shutting down the last two config servers ensures that most [mongos](#) (page 938) instances will have uninterrupted access to cluster meta-data.
3. [mongodump](#) (page 951) the data files of the active config server (configA).
4. Move the data files of the deactivated config servers (configB and configC) to a backup location.
5. Create new, empty [data directories](#).
6. Restart the disabled config servers with `--dbpath` pointing to the now-empty data directory and `--port` pointing to an alternate port (e.g. 27020).
7. Use [mongorestore](#) (page 956) to repopulate the data files on the disabled documents from the active config server (configA) to the restarted config servers on the new port (configB:27020, configC:27020). These config servers are now re-synced.
8. Restart the restored config servers on the old port, resetting the port back to the old settings (configB:27019 and configC:27019).
9. In some cases connection pooling may cause spurious failures, as the [mongos](#) (page 938) disables old connections only after attempted use. 2.4 fixes this problem, but to avoid this issue in version 2.2, you can restart all [mongos](#) (page 938) instances (one-by-one, to avoid downtime) and use the [rs.stepDown\(\)](#) (page 899) method before restarting each of the shard [replica set primaries](#).
10. The sharded cluster is now fully resynced; however before you attempt the upgrade process again, you must manually reset the upgrade state using a version 2.2 [mongos](#) (page 938). Begin by connecting to the 2.2 [mongos](#) (page 938) with the [mongo](#) (page 942) shell:

```
mongo <mongos.example.net>
```

Then, use the following operation to reset the upgrade process:

```
db.getMongo().getCollection("config.version").update({ _id : 1 }, { $unset : { upgradeState : 1 }}
```

11. Finally retry the upgrade process, as in [Upgrade a Sharded Cluster from MongoDB 2.2 to MongoDB 2.4](#) (page 1032).

**Complete Sharded Cluster Upgrade** After you have successfully completed the meta-data upgrade process described in [Meta-Data Upgrade Procedure](#) (page 1033), and the 2.4 `mongos` (page 938) instance starts, you can upgrade the other processes in your MongoDB deployment.

While the balancer is still disabled, upgrade the components of your sharded cluster in the following order:

- Upgrade all `mongos` (page 938) instances in the cluster, in any order.
- Upgrade all 3 `mongod` (page 925) config server instances, upgrading the *first* system in the `mongos --configdb` argument *last*.
- Upgrade each shard, one at a time, upgrading the `mongod` (page 925) secondaries before running `replSetStepDown` (page 730) and upgrading the primary of each shard.

When this process is complete, you can now [re-enable the balancer](#) (page 552).

**Rolling Upgrade Limitation for 2.2.0 Deployments Running with auth Enabled** MongoDB *cannot* support deployments that mix 2.2.0 and 2.4.0, or greater, components. MongoDB version 2.2.1 and later processes *can* exist in mixed deployments with 2.4-series processes. Therefore you cannot perform a rolling upgrade from MongoDB 2.2.0 to MongoDB 2.4.0. To upgrade a cluster with 2.2.0 components, use one of the following procedures.

1. Perform a rolling upgrade of all 2.2.0 processes to the latest 2.2-series release (e.g. 2.2.3) so that there are no processes in the deployment that predate 2.2.1. When there are no 2.2.0 processes in the deployment, perform a rolling upgrade to 2.4.0.
2. Stop all processes in the cluster. Upgrade all processes to a 2.4-series release of MongoDB, and start all processes at the same time.

**Upgrade from 2.3 to 2.4** If you used a `mongod` (page 925) from the 2.3 or 2.4-rc (release candidate) series, you can safely transition these databases to 2.4.0 or later; *however*, if you created `2dsphere` or `text` indexes using a `mongod` (page 925) before v2.4-rc2, you will need to rebuild these indexes. For example:

```
db.records.dropIndex({ loc: "2dsphere" })
db.records.dropIndex("records_text")

db.records.ensureIndex({ loc: "2dsphere" })
db.records.ensureIndex({ records: "text" })
```

**Downgrade MongoDB from 2.4 to Previous Versions** For some cases the on-disk format of data files used by 2.4 and 2.2 `mongod` (page 925) is compatible, and you can upgrade and downgrade if needed. However, several new features in 2.4 are incompatible with previous versions:

- `2dsphere` indexes are incompatible with 2.2 and earlier `mongod` (page 925) instances.
- `text` indexes are incompatible with 2.2 and earlier `mongod` (page 925) instances.
- using a hashed index as a shard key are incompatible with 2.2 and earlier `mongos` (page 938) instances.
- hashed indexes are incompatible with 2.0 and earlier `mongod` (page 925) instances.

---

**Important:** Collections sharded using hashed shard keys, should **not** use 2.2 `mongod` (page 925) instances, which cannot correctly support cluster operations for these collections.

If you completed the *meta-data upgrade for a sharded cluster* (page 1032), you can safely downgrade to 2.2 MongoDB processes. **Do not** use 2.0 processes after completing the upgrade procedure.

---

**Note:** In sharded clusters, once you have completed the *meta-data upgrade procedure* (page 1032), you cannot use 2.0 `mongod` (page 925) or `mongos` (page 938) instances in the same cluster.

If you complete the meta-data upgrade, you can have a mixed cluster that has both 2.2 and 2.4 `mongod` (page 925) and `mongos` (page 938) instances, if needed. However, **do not** create `2dsphere` or `text` indexes in a cluster that has 2.2 components.

---

**Considerations and Compatibility** If you upgrade to MongoDB 2.4, and then need to run MongoDB 2.2 with the same data files, consider the following limitations.

- If you use a hashed index as the shard key index, which is only possible under 2.4 you will not be able to query data in this sharded collection. Furthermore, a 2.2 `mongos` (page 938) cannot properly route an insert operation for a collections sharded using a hashed index for the shard key index: any data that you insert using a 2.2 `mongos` (page 938), will not arrive on the correct shard and will not be reachable by future queries.
- If you *never* create an `2dsphere` or `text` index, you can move between a 2.4 and 2.2 `mongod` (page 925) for a given data set; however, after you create the first `2dsphere` or `text` index with a 2.4 `mongod` (page 925) you will need to run a 2.2 `mongod` (page 925) with the `--upgrade` option and drop any `2dsphere` or `text` index.

## Upgrade and Downgrade Procedures

**Basic Downgrade and Upgrade** Except as described below, moving between 2.2 and 2.4 is a drop-in replacement:

- stop the existing `mongod` (page 925), using the `--shutdown` option as follows:

```
mongod --dbpath /var/mongod/data --shutdown
```

Replace `/var/mongod/data` with your MongoDB `dbpath` (page 993).

- start the new `mongod` (page 925) processes with the same `dbpath` (page 993) setting, for example:

```
mongod --dbpath /var/mongod/data
```

Replace `/var/mongod/data` with your MongoDB `dbpath` (page 993).

**Downgrade to 2.2 After Creating a `2dsphere` or `text` Index** If you have created `2dsphere` or `text` indexes while running a 2.4 `mongod` (page 925) instance, you can downgrade at any time, by starting the 2.2 `mongod` (page 925) with the `--upgrade` option as follows:

```
mongod --dbpath /var/mongod/data/ --upgrade
```

Then, you will need to drop any existing `2dsphere` or `text` indexes using `db.collection.dropIndex()` (page 812), for example:

```
db.records.dropIndex({ loc: "2dsphere" })
db.records.dropIndex("records_text")
```

**Warning:** `--upgrade` will run `repairDatabase` (page 757) on any database where you have created a `2dsphere` or `text` index, which will rebuild *all* indexes.

**Troubleshooting Upgrade/Downgrade Operations** If you do not use `--upgrade`, when you attempt to start a 2.2 `mongod` (page 925) and you have created a `2dsphere` or `text` index, `mongod` (page 925) will return the following message:

```
'need to upgrade database index_plugin_upgrade with pdfile version 4.6, new version: 4.5 Not upgradin
```

While running 2.4, to check the data file version of a MongoDB database, use the following operation in the shell:

```
db.getSiblingDB('<datbasename>').stats().dataFileVersion
```

The major data file<sup>6</sup> version for both 2.2 and 2.4 is 4, the minor data file version for 2.2 is 5 and the minor data file version for 2.4 is 6 **after** you create a `2dsphere` or `text` index.

### Compatibility and Index Type Changes in MongoDB 2.4

In 2.4 MongoDB includes two new features related to indexes that users upgrading to version 2.4 must consider, particularly with regard to possible downgrade paths. For more information on downgrades, see *Downgrade MongoDB from 2.4 to Previous Versions* (page 1036).

**New Index Types** In 2.4 MongoDB adds two new index types: `2dsphere` and `text`. These index types do not exist in 2.2, and for each database, creating a `2dsphere` or `text` index, will upgrade the data-file version and make that database incompatible with 2.2.

If you intend to downgrade, you should always drop all `2dsphere` and `text` indexes before moving to 2.2.

You can use the *downgrade procedure* (page 1036) to downgrade these databases and run 2.2 if needed, however this will run a full database repair (as with `repairDatabase` (page 757),) for all affected databases.

**Index Type Validation** In MongoDB 2.2 and earlier you could specify invalid index types that did not exist. In these situations, MongoDB would create an ascending (e.g. 1) index. Invalid indexes include index types specified by strings that do not refer to an existing index type, and all numbers other than 1 and -1.<sup>7</sup>

In 2.4, creating any invalid index will result in an error. Furthermore, you cannot create a `2dsphere` or `text` index on a collection if its containing database has any invalid index types.<sup>1</sup>

---

### Example

If you attempt to add an invalid index in MongoDB 2.4, as in the following:

```
db.coll.ensureIndex({ field: "1" })
```

MongoDB will return the following error document:

```
{
 "err" : "Unknown index plugin '1' in index { field: \"1\" }"
 "code": 16734,
 "n": <number>,
 "connectionId": <number>,
```

<sup>6</sup> The data file version (i.e. `pdfile version`) is independent and unrelated to the release version of MongoDB.

<sup>7</sup> In 2.4, indexes that specify a type of "1" or "-1" (the strings "1" and "-1") will continue to exist, despite a warning on start-up. **However**, a *secondary* in a replica set cannot complete an initial sync from a primary that has a "1" or "-1" index. Avoid all indexes with invalid types.

```
"ok": 1
}
```

See [Upgrade MongoDB to 2.4](#) (page 1031) for full upgrade instructions.

## Changes

### Major Features

**Text Search** MongoDB 2.4 adds text search of content in MongoDB databases as a beta feature. With the new [text index](#) (page 332), and supporting, [text](#) (page 715) command you can search for text using boolean queries in data stored in MongoDB, using an index that updates in real-time and is always consistent with the data set. See [Text Indexes](#) (page 332) for more information about `text` index and text search in MongoDB.

---

**Note:** You cannot combine the [text](#) (page 715) command, which requires a special [text index](#) (page 332), with a query operator that requires a different type of special index. For example you cannot combine [text](#) (page 715) with the [\\$near](#) (page 637) operator.

---

**New Geospatial Indexes with GeoJSON and Improved Spherical Geometry** MongoDB adds the new `2dsphere` geospatial index in addition to the existing `2d` index. The `2dsphere` index supports improved spherical queries and supports the following GeoJSON<sup>8</sup> objects:

- Point
- LineString
- Polygon

The `2dsphere` index supports all current geospatial [query operators](#) (page 635) and introduces the following new query operator for queries on GeoJSON data:

- [\\$geoWithin](#) (page 635) operator
- [\\$geoIntersects](#) (page 637) operator

The operators use the new [\\$geometry](#) (page 639) parameter.

The [\\$within](#) (page 636) operator no longer requires a geospatial index. Additionally, 2.4 deprecates the [\\$within](#) (page 636) operator. Use [\\$geoWithin](#) (page 635) operator instead.

For more information on geospatial indexes in 2.4, see:

- [Geospatial Indexes and Queries](#) (page 326)
- [2d Index Internals](#) (page 330)

**New Hashed Index and Sharding with a Hashed Shard Key** To support an easy to configure and evenly distributed shard key, version 2.4 adds a new “hashed” index type that indexes documents using hashes of field values.

See [Hashed Index](#) (page 333) for documentation of hashed indexes, and [Hashed Shard Keys](#) (page 506) for documentation of hash-based sharding.

---

<sup>8</sup><http://geojson.org/geojson-spec.html>

### Security Improvements

#### New Modular Authentication System with Support for Kerberos

---

**Note:** Kerberos authentication is only present in MongoDB Enterprise Edition<sup>9</sup>. To download and install MongoDB Enterprise, see [Install MongoDB Enterprise](#) (page 20).

---

In 2.4 the MongoDB Enterprise now supports authentication via a Kerberos mechanism. See [Deploy MongoDB with Kerberos Authentication](#) (page 259) for more information.

Also consider the following documents that address authenticating to MongoDB using Kerberos:

- [Authenticate to MongoDB using Kerberos and the Java Driver](#)<sup>10</sup>
  - [Authenticate to MongoDB using Kerberos and the C# Driver](#)<sup>11</sup>
- 

### See

[MongoDB Security Practices and Procedures](#) (page 235).

---

**SASL Library Change** In 2.4.4, MongoDB Enterprise uses Cyrus SASL. Earlier 2.4 Enterprise versions use GNU SASL (libgsasl). To upgrade to 2.4.4 MongoDB Enterprise or greater, you **must** install all package dependencies related to this change, including the appropriate Cyrus SASL GSSAPI library. See [Install MongoDB Enterprise](#) (page 20) for details of the dependencies.

**Role Based Access Control and New Privilege Documents** MongoDB 2.4 introduces a role based access control system that provides more granular privileges to MongoDB users. See [User Privilege Roles in MongoDB](#) (page 265) for more information.

To support the new access control system, 2.4 also introduces a new format for documents in a database's `system.users` (page 270) collection. See [system.users Privilege Documents](#) (page 270) for more information.

Use `supportCompatibilityForPrivilegeDocuments` (page 1007) to disable the legacy privilege documents, which MongoDB continues to support in 2.4.

**Enhanced SSL Support** In 2.4, MongoDB instances can optionally require clients to provide SSL certificates signed by a Certificate Authority. You must use the MongoDB distribution that supports SSL, and your client driver must support SSL. See [Connect to MongoDB with SSL](#) (page 249) for more information.

**Compatibility Change: User Uniqueness Enforced** 2.4 now enforces uniqueness of the `user` field in user privilege documents (i.e. in the `system.users` (page 270) collection.) Previous versions of MongoDB did not enforce this requirement, and existing databases may have duplicates.

### Administration Changes

**--setParameter Option Available on the mongos and mongod Command Line** You can now use `--setParameter` on the command line and `setParameter` (page 999) in the configuration file. For `mongod` (page 925) the following options are available using `setParameter` (page 999):

- [enableLocalhostAuthBypass](#) (page 1005)
- [enableTestCommands](#) (page 1005)

---

<sup>9</sup><http://www.mongodb.com/products/mongodb-enterprise>

<sup>10</sup><http://docs.mongodb.org/ecosystem/tutorial/authenticate-with-java-driver/>

<sup>11</sup><http://docs.mongodb.org/ecosystem/tutorial/authenticate-with-csharp-driver/>

- [journalCommitInterval](#) (page 1006)
- [logLevel](#) (page 1006)
- [logUserIds](#) (page 1006)
- [notableScan](#) (page 1006)
- [quiet](#) (page 1007)
- [replApplyBatchSize](#) (page 1006)
- [replIndexPrefetch](#) (page 1006)
- [supportCompatibilityForPrivilegeDocuments](#) (page 1007)
- [syncdelay](#) (page 1007)
- [textSearchEnabled](#) (page 1008)
- [traceExceptions](#) (page 1007)

For `mongos` (page 938) the following options are available using `setParameter` (page 999):

- [enablelocalhostAuthBypass](#) (page 1005)
- [enableTestCommands](#) (page 1005)
- [logLevel](#) (page 1006)
- [logUserIds](#) (page 1006)
- [notableScan](#) (page 1006)
- [quiet](#) (page 1007)
- [supportCompatibilityForPrivilegeDocuments](#) (page 1007)
- [syncdelay](#) (page 1007)
- [textSearchEnabled](#) (page 1008)

See `mongod Parameters` (page 1005) for full documentation of available parameters and their use.

**Changes to `serverStatus` Output Including Additional Metrics** In 2.4 MongoDB adds a number of counters and system metrics to the output of the `serverStatus` (page 782) command, including:

- a *working set estimator* (page 794).
- operation counters, in `document` (page 795) and `operation` (page 796).
- record allocation, in `record` (page 796).
- thorough metrics of the replication process, in `rep1` (page 797).
- metrics on the *ttl index* (page 158) documentation.

Additionally, in 2.4, the `serverStatus` (page 782) command can dynamically construct the `serverStatus` (page 782) document by excluding any top-level sections included by default, or including any top-level section not included by default (e.g. `workingSet` (page 795).)

See `db.serverStatus()` (page 893) and `serverStatus` (page 782) for more information.

**Increased Chunk Migration Write Concern** By default, all insert and delete operations that occur as part of a *chunk* migration in a *sharded cluster* will have an increased write concern, to ensure that at least one secondary acknowledges each insert and deletion operation. This change slows the potential speed of a chunk migration, but increases reliability and ensures that a large number of chunk migrations *cannot* affect the availability of a sharded cluster.

**BSON Document Validation Enabled by Default for mongod and mongorestore** Starting in 2.4, MongoDB enables basic *BSON* object validation for *mongod* (page 925) and *mongorestore* (page 956) when writing to MongoDB data files. This prevents any client from inserting invalid or malformed BSON into a MongoDB database. For objects with a high degree of sub-document nesting this validation may have a small performance impact. *objcheck* (page 992), which was previously disabled by default, provides this validation.

## Indexing Changes

**Support for Multiple Concurrent Index Builds** A single *mongod* (page 925) instance can build multiple indexes in the background at the same time. See *building indexes in the background* (page 336) for more information on background index builds. Foreground index builds hold a database lock and must proceed one at a time.

**db.killOp()** Can Now Kill Foreground Index Builds The *db.killOp()* (page 890) method will now terminate a foreground index build, in addition to the other operations supported in previous versions.

**Improved Validation of Index Types** Before 2.4, *mongod* (page 925) would create an ascending scalar index (e.g. `{ a : 1 }`) when users attempted to create an index of a type that did not exist. Creating an index of an invalid index type will generate an error in 2.4.

See *Compatibility and Index Type Changes in MongoDB 2.4* (page 1038) for more information.

## Interface Changes

**\$setOnInsert – New Update Operator** To set fields *only* when an *upsert* (page 849) performs an insert, use the *\$setOnInsert* (page 654) operator with the *upsert* (page 849).

---

### Example

A collection named `coll` has no documents with `_id` equal to 1.

The following *upsert* (page 849) operation inserts a document and applies the *\$setOnInsert* (page 654) operator to set the fields `x` and `y`:

```
db.coll.update({ _id: 1 },
 { $setOnInsert: { x: 25, y: 30 } },
 { upsert: true })
```

The newly-inserted document has the field `x` set to 25 and the field `y` set to 30:

```
{ "_id" : 1, "x" : 25, "y" : 30 }
```

---

**Note:** The *\$setOnInsert* (page 654) operator performs no operation for *upserts* (page 849) that only perform an update and for *updates* (page 849) when the *upsert* option is `false`.

---

**Limit Number of Elements in an Array** In 2.4, by using the `$push` (page 659) operator with the `$each` (page 660), the `$sort` (page 661), and the `$slice` (page 661) modifiers, you can add multiple elements to an array, sort and limit the number of elements in the modified array to maintain an array with a fixed number of elements.

See *Limit Number of Elements in an Array after an Update* (page 89) for an example where an update maintains the top three scores for a student.

#### See also:

The following pages provide additional information and examples:

- `$push` (page 659) operator
- `$each` (page 660) modifier
- `$sort` (page 661) modifier
- `$slice` (page 661) modifier

### JavaScript Engine Changed to V8

**JavaScript Changes in MongoDB 2.4** Consider the following impacts of *JavaScript Engine Changed to V8* (page 1043) in MongoDB 2.4:

**Improved Concurrency** Previously, MongoDB operations that required the JavaScript interpreter had to acquire a lock, and a single `mongod` (page 925) could only run a single JavaScript operation at a time. The switch to V8 improves concurrency by permitting multiple JavaScript operations to run at the same time.

**Modernized JavaScript Implementation (ES5)** The 5th edition of `ECMAScript`<sup>12</sup>, abbreviated as ES5, adds many new language features, including:

- standardized `JSON`<sup>13</sup>,
- `strict mode`<sup>14</sup>,
- `function.bind()`<sup>15</sup>,
- `array extensions`<sup>16</sup>, and
- getters and setters.

With V8, MongoDB supports the ES5 implementation of Javascript with the following exceptions.

---

**Note:** The following features do not work as expected on documents **returned from MongoDB queries**:

- `Object.seal()` throws an exception on documents returned from MongoDB queries.
- `Object.freeze()` throws an exception on documents returned from MongoDB queries.
- `Object.preventExtensions()` incorrectly allows the addition of new properties on documents returned from MongoDB queries.
- enumerable properties, when added to documents returned from MongoDB queries, are not saved during write operations.

<sup>12</sup><http://www.ecma-international.org/publications/standards/Ecma-262.htm>

<sup>13</sup><http://www.ecma-international.org/ecma-262/5.1/#sec-15.12.1>

<sup>14</sup><http://www.ecma-international.org/ecma-262/5.1/#sec-4.2.2>

<sup>15</sup><http://www.ecma-international.org/ecma-262/5.1/#sec-15.3.4.5>

<sup>16</sup><http://www.ecma-international.org/ecma-262/5.1/#sec-15.4.4.16>

See SERVER-8216<sup>17</sup>, SERVER-8223<sup>18</sup>, SERVER-8215<sup>19</sup>, and SERVER-8214<sup>20</sup> for more information.

For objects that have not been returned from MongoDB queries, the features work as expected.

---

**Removed Non-Standard SpiderMonkey Features** V8 does **not** support the following *non-standard* SpiderMonkey<sup>21</sup> JavaScript extensions, previously supported by MongoDB's use of SpiderMonkey as its JavaScript engine.

**E4X Extensions** V8 does not support the *non-standard* E4X<sup>22</sup> extensions. E4X provides a native XML<sup>23</sup> object to the JavaScript language and adds the syntax for embedding literal XML documents in JavaScript code.

You need to use alternative XML processing if you used any of the following constructors/methods:

- XML ()
- Namespace ()
- QName ()
- XMMList ()
- isXMLName ()

**Destructuring Assignment** V8 does not support the non-standard destructuring assignments. Destructuring assignment “extract[s] data from arrays or objects using a syntax that mirrors the construction of array and object literals.” - Mozilla docs<sup>24</sup>

---

### Example

The following destructuring assignment is **invalid** with V8 and throws a SyntaxError:

```
original = [4, 8, 15];
var [b, ,c] = a; // <== destructuring assignment
print(b) // 4
print(c) // 15
```

---

**Iterator(), StopIteration(), and Generators** V8 does not support Iterator(), StopIteration(), and generators<sup>25</sup>.

**InternalError()** V8 does not support InternalError(). Use Error() instead.

**for each...in Construct** V8 does not support the use of for each...in<sup>26</sup> construct. Use for (var x in y) construct instead.

---

### Example

<sup>17</sup><https://jira.mongodb.org/browse/SERVER-8216>

<sup>18</sup><https://jira.mongodb.org/browse/SERVER-8223>

<sup>19</sup><https://jira.mongodb.org/browse/SERVER-8215>

<sup>20</sup><https://jira.mongodb.org/browse/SERVER-8214>

<sup>21</sup><https://developer.mozilla.org/en-US/docs/SpiderMonkey>

<sup>22</sup><https://developer.mozilla.org/en-US/docs/E4X>

<sup>23</sup>[https://developer.mozilla.org/en-US/docs/E4X/Processing\\_XML\\_with\\_E4X](https://developer.mozilla.org/en-US/docs/E4X/Processing_XML_with_E4X)

<sup>24</sup>[https://developer.mozilla.org/en-US/docs/JavaScript/New\\_in\\_JavaScript/1.7#Destructuring\\_assignment\\_\(Merge\\_into\\_own\\_page.2Fsection\)](https://developer.mozilla.org/en-US/docs/JavaScript/New_in_JavaScript/1.7#Destructuring_assignment_(Merge_into_own_page.2Fsection))

<sup>25</sup>[https://developer.mozilla.org/en-US/docs/JavaScript/Guide/Iterators\\_and\\_Generators](https://developer.mozilla.org/en-US/docs/JavaScript/Guide/Iterators_and_Generators)

<sup>26</sup>[https://developer.mozilla.org/en-US/docs/JavaScript/Reference/Statements/for\\_each...in](https://developer.mozilla.org/en-US/docs/JavaScript/Reference/Statements/for_each...in)

The following `for each (var x in y)` construct is **invalid** with V8:

```
var o = { name: 'MongoDB', version: 2.4 };

for each (var value in o) {
 print(value);
}
```

Instead, in version 2.4, you can use the `for (var x in y)` construct:

```
var o = { name: 'MongoDB', version: 2.4 };

for (var prop in o) {
 var value = o[prop];
 print(value);
}
```

You can also use the array *instance* method `forEach()` with the ES5 method `Object.keys()`:

```
Object.keys(o).forEach(function (key) {
 var value = o[key];
 print(value);
});
```

---

**Array Comprehension** V8 does not support [Array comprehensions](#)<sup>27</sup>.

Use other methods such as the Array instance methods `map()`, `filter()`, or `forEach()`.

## Example

With V8, the following array comprehension is **invalid**:

```
var a = { w: 1, x: 2, y: 3, z: 4 }

var arr = [i * i for each (i in a) if (i > 2)]
printjson(arr)
```

Instead, you can implement using the Array *instance* method `forEach()` and the ES5 method `Object.keys()`:

```
var a = { w: 1, x: 2, y: 3, z: 4 }

var arr = [];
Object.keys(a).forEach(function (key) {
 var val = a[key];
 if (val > 2) arr.push(val * val);
})
printjson(arr)
```

**Note:** The new logic uses the Array *instance* method `forEach()` and not the *generic* method `Array.forEach()`; V8 does **not** support Array *generic* methods. See [Array Generic Methods](#) (page 1047) for more information.

---

<sup>27</sup>[https://developer.mozilla.org/en-US/docs/JavaScript/Guide/Predefined\\_Core\\_Objects#Array\\_comprehensions](https://developer.mozilla.org/en-US/docs/JavaScript/Guide/Predefined_Core_Objects#Array_comprehensions)

**Multiple Catch Blocks** V8 does not support multiple `catch` blocks and will throw a `SyntaxError`.

---

### Example

The following multiple catch blocks is **invalid** with V8 and will throw "SyntaxError: Unexpected token if":

```
try {
 something()
} catch (err if err instanceof SomeError) {
 print('some error')
} catch (err) {
 print('standard error')
}
```

---

**Conditional Function Definition** V8 will produce different outcomes than SpiderMonkey with conditional function definitions<sup>28</sup>.

---

### Example

The following conditional function definition produces different outcomes in SpiderMonkey versus V8:

```
function test () {
 if (false) {
 function go () {};
 }
 print(typeof go)
}
```

With SpiderMonkey, the conditional function outputs `undefined`, whereas with V8, the conditional function outputs `function`.

If your code defines functions this way, it is highly recommended that you refactor the code. The following example refactors the conditional function definition to work in both SpiderMonkey and V8.

```
function test () {
 var go;
 if (false) {
 go = function () {}
 }
 print(typeof go)
}
```

The refactored code outputs `undefined` in both SpiderMonkey and V8.

---

**Note:** ECMAScript prohibits conditional function definitions. To force V8 to throw an Error, enable strict mode<sup>29</sup>.

```
function test () {
 'use strict';

 if (false) {
 function go () {}
 }
}
```

<sup>28</sup><https://developer.mozilla.org/en-US/docs/JavaScript/Guide/Functions>

<sup>29</sup><http://www.nczonline.net/blog/2012/03/13/its-time-to-start-using-javascript-strict-mode/>

The JavaScript code throws the following syntax error:

```
SyntaxError: In strict mode code, functions can only be declared at top level or immediately within a
```

---

**String Generic Methods** V8 does not support [String generics<sup>30</sup>](#). String generics are a set of methods on the `String` class that mirror instance methods.

### Example

The following use of the generic method `String.toLowerCase()` is **invalid** with V8:

```
var name = 'MongoDB';

var lower = String.toLowerCase(name);
```

With V8, use the `String` instance method `toLowerCase()` available through an *instance* of the `String` class instead:

```
var name = 'MongoDB';

var lower = name.toLowerCase();
print(name + ' becomes ' + lower);
```

---

With V8, use the `String` *instance* methods instead of following *generic* methods:

|                                     |                                  |                                         |
|-------------------------------------|----------------------------------|-----------------------------------------|
| <code>String.charAt()</code>        | <code>String.quote()</code>      | <code>String.toLocaleLowerCase()</code> |
| <code>String.charCodeAt()</code>    | <code>String.replace()</code>    | <code>String.toLocaleUpperCase()</code> |
| <code>String.concat()</code>        | <code>String.search()</code>     | <code>String.toLowerCase()</code>       |
| <code>String.endsWith()</code>      | <code>String.slice()</code>      | <code>String.toUpperCase()</code>       |
| <code>String.indexOf()</code>       | <code>String.split()</code>      | <code>String.trim()</code>              |
| <code>String.lastIndexOf()</code>   | <code>String.startsWith()</code> | <code>String.trimLeft()</code>          |
| <code>String.localeCompare()</code> | <code>String.substr()</code>     | <code>String.trimRight()</code>         |
| <code>String.match()</code>         | <code>String.substring()</code>  |                                         |

**Array Generic Methods** V8 does not support [Array generic methods<sup>31</sup>](#). Array generics are a set of methods on the `Array` class that mirror instance methods.

### Example

The following use of the generic method `Array.every()` is **invalid** with V8:

```
var arr = [4, 8, 15, 16, 23, 42];

function isEven (val) {
 return 0 === val % 2;
}

var allEven = Array.every(arr, isEven);
print(allEven);
```

With V8, use the `Array` instance method `every()` available through an *instance* of the `Array` class instead:

<sup>30</sup>[https://developer.mozilla.org/en-US/docs/JavaScript/Reference/Global\\_Objects/String#String\\_generic\\_methods](https://developer.mozilla.org/en-US/docs/JavaScript/Reference/Global_Objects/String#String_generic_methods)

<sup>31</sup>[https://developer.mozilla.org/en-US/docs/JavaScript/Reference/Global\\_Objects/Array#Array\\_generic\\_methods](https://developer.mozilla.org/en-US/docs/JavaScript/Reference/Global_Objects/Array#Array_generic_methods)

```
var allEven = arr.every(isEven);
print(allEven);
```

With V8, use the `Array instance` methods instead of the following *generic* methods:

|                              |                                  |                              |
|------------------------------|----------------------------------|------------------------------|
| <code>Array.concat()</code>  | <code>Array.lastIndexOf()</code> | <code>Array.slice()</code>   |
| <code>Array.every()</code>   | <code>Array.map()</code>         | <code>Array.some()</code>    |
| <code>Array.filter()</code>  | <code>Array.pop()</code>         | <code>Array.sort()</code>    |
| <code>Array.forEach()</code> | <code>Array.push()</code>        | <code>Array.splice()</code>  |
| <code>Array.indexOf()</code> | <code>Array.reverse()</code>     | <code>Array.unshift()</code> |
| <code>Array.join()</code>    | <code>Array.shift()</code>       |                              |

**Array Instance Method `toSource()`** V8 does not support the `Array instance` method `toSource()`<sup>32</sup>. Use the `Array instance` method `toString()` instead.

**`uneval()`** V8 does not support the non-standard method `uneval()`. Use the standardized `JSON.stringify()`<sup>33</sup> method instead.

In 2.4 the default JavaScript engine in the `mongo` (page 942) shell `mongod` (page 925) is now V8. This change affects all JavaScript behavior including the `mapReduce` (page 701), `group` (page 697), and `eval` (page 722) commands, as well as the `$where` (page 634) query operator.

Use the new `interpreterVersion()` method in the `mongo` (page 942) shell and the `javascriptEngine` (page 763) field in the output of `db.serverBuildInfo()` (page 893) to determine which JavaScript engine a MongoDB binary uses.

The primary impacts of the change from the previous JavaScript engine, SpiderMonkey, to V8 are:

- improved concurrency for JavaScript operations,
- modernized JavaScript implementation, and
- removed non-standard SpiderMonkey features.

See *JavaScript Changes in MongoDB 2.4* (page 1043) for more information about all changes .

**Additional Limitations for Map-Reduce and `$where` Operations** In MongoDB 2.4, `map-reduce operations` (page 701), the `group` (page 697) command, and `$where` (page 634) operator expressions **cannot** access certain global functions or properties, such as `db`, that are available in the `mongo` (page 942) shell.

When upgrading to MongoDB 2.4, you will need to refactor your code if your `map-reduce operations` (page 701), `group` (page 697) commands, or `$where` (page 634) operator expressions include any global shell functions or properties that are no longer available, such as `db`.

The following JavaScript functions and properties **are available** to `map-reduce operations` (page 701), the `group` (page 697) command, and `$where` (page 634) operator expressions in MongoDB 2.4:

<sup>32</sup>[https://developer.mozilla.org/en-US/docs/JavaScript/Reference/Global\\_Objects/Array/toSource](https://developer.mozilla.org/en-US/docs/JavaScript/Reference/Global_Objects/Array/toSource)

<sup>33</sup>[https://developer.mozilla.org/en-US/docs/JavaScript/Reference/Global\\_Objects/JSON/stringify](https://developer.mozilla.org/en-US/docs/JavaScript/Reference/Global_Objects/JSON/stringify)

| Available Properties     | Available Functions                                                                                                                                              |                                                                                                                                                                                                               |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| args<br>MaxKey<br>MinKey | assert()<br>BinData()<br>DBPointer()<br>DBRef()<br>doassert()<br>emit()<br>gc()<br>HexData()<br>hex_md5()<br>isNumber()<br>isObject()<br>ISODate()<br>isString() | Map()<br>MD5()<br>NumberInt()<br>NumberLong()<br>ObjectId()<br>print()<br>printjson()<br>printjsononeline()<br>sleep()<br>Timestamp()<br>tojson()<br>tojsononeline()<br>tojsonObject()<br>UUID()<br>version() |

**Improvements to the Aggregation Framework** MongoDB 2.4 introduces a number of additional functionality and improved performance for the [Aggregation Framework](#) (page 279). Consider the following additions in 2.4:

- `$match` (page 666) queries now support the `$geoWithin` (page 635) operator for bounded geospatial queries.
- The new `$geoNear` (page 671) pipeline stage to support geospatial queries.
- `$min` (page 675) operator only considers non-null and existing field values. If all the values for a field are `null` or are missing, the operator returns `null` for the minimum value.
- For sort operations where the `$sort` (page 670) stage immediately precedes a `$limit` (page 667) in the pipeline, the MongoDB can perform a more efficient sort that does not require keeping the entire result set in memory.
- The new `$millisecond` (page 686) operator returns the millisecond portion of a date.
- The new `$concat` (page 681) operator concatenates array of strings.

## Additional Resources

- [MongoDB Downloads](#)<sup>34</sup>.
- [What's New in MongoDB 2.4](#) (page 1029).
- All JIRA issues resolved in 2.4<sup>35</sup>.
- All Backwards incompatible changes<sup>36</sup>.
- All Third Party License Notices<sup>37</sup>.

<sup>34</sup><http://mongodb.org/downloads>

<sup>35</sup><https://jira.mongodb.org/secure/IssueNavigator.jspa?reset=true&jqlQuery=project+%3D+SERVER+AND+fixVersion+in+%28%222.3.2%22,%222.3.1%22,%222.4.0-rc1%22,%222.4.0-rc2%22,%222.4.0-rc3%22%29>

<sup>36</sup><https://jira.mongodb.org/secure/IssueNavigator.jspa?reset=true&jqlQuery=project+%3D+SERVER+AND+fixVersion+in+%28%222.3.2%22%2C%222.3.1%22%2C%222.4.0-rc1%22%2C%222.4.0-rc2%22%2C%222.4.0-rc3%22%29+AND+%22Backward+Breaking%22+in+%28+Rarely+%2C+sometimes%2C+yet+never%29>

<sup>37</sup><https://github.com/mongodb/mongo/blob/v2.4/distsrc/THIRD-PARTY-NOTICES>

See <http://docs.mongodb.org/manual/release-notes/2.4-changes> for an overview of all changes in 2.4.

## 12.2 Previous Stable Releases

### 12.2.1 Release Notes for MongoDB 2.2

See the [full index of this page](#) for a complete list of changes included in 2.2.

- [Upgrading](#) (page 1050)
- [Changes](#) (page 1051)
- [Licensing Changes](#) (page 1059)
- [Resources](#) (page 1059)

#### Upgrading

MongoDB 2.2 is a production release series and succeeds the 2.0 production release series.

MongoDB 2.0 data files are compatible with 2.2-series binaries without any special migration process. However, always perform the upgrade process for replica sets and sharded clusters using the procedures that follow.

Always upgrade to the latest point release in the 2.2 point release. Currently the latest release of MongoDB is 2.4.6.

#### Synopsis

- [mongod](#) (page 925), 2.2 is a drop-in replacement for 2.0 and 1.8.
  - Check your [driver](#) (page 95) documentation for information regarding required compatibility upgrades, and always run the recent release of your driver.
- Typically, only users running with authentication, will need to upgrade drivers before continuing with the upgrade to 2.2.
- For all deployments using authentication, upgrade the drivers (i.e. client libraries), before upgrading the [mongod](#) (page 925) instance or instances.
  - For all upgrades of sharded clusters:
    - turn off the balancer during the upgrade process. See the [Disable the Balancer](#) (page 552) section for more information.
    - upgrade all [mongos](#) (page 938) instances before upgrading any [mongod](#) (page 925) instances.

Other than the above restrictions, 2.2 processes can interoperate with 2.0 and 1.8 tools and processes. You can safely upgrade the [mongod](#) (page 925) and [mongos](#) (page 938) components of a deployment one by one while the deployment is otherwise operational. Be sure to read the detailed upgrade procedures below before upgrading production systems.

#### Upgrading a Standalone mongod

1. Download binaries of the latest release in the 2.2 series from the [MongoDB Download Page](#)<sup>38</sup>.

<sup>38</sup><http://downloads.mongodb.org/>

2. Shutdown your `mongod` (page 925) instance. Replace the existing binary with the 2.2 `mongod` (page 925) binary and restart MongoDB.

## Upgrading a Replica Set

You can upgrade to 2.2 by performing a “rolling” upgrade of the set by upgrading the members individually while the other members are available to minimize downtime. Use the following procedure:

1. Upgrade the `secondary` members of the set one at a time by shutting down the `mongod` (page 925) and replacing the 2.0 binary with the 2.2 binary. After upgrading a `mongod` (page 925) instance, wait for the member to recover to `SECONDARY` state before upgrading the next instance. To check the member’s state, issue `rs.status()` (page 898) in the `mongo` (page 942) shell.
2. Use the `mongo` (page 942) shell method `rs.stepDown()` (page 899) to step down the `primary` to allow the normal `failover` (page 396) procedure. `rs.stepDown()` (page 899) expedites the failover procedure and is preferable to shutting down the primary directly.

Once the primary has stepped down and another member has assumed `PRIMARY` state, as observed in the output of `rs.status()` (page 898), shut down the previous primary and replace `mongod` (page 925) binary with the 2.2 binary and start the new process.

---

**Note:** Replica set failover is not instant but will render the set unavailable to read or accept writes until the failover process completes. Typically this takes 10 seconds or more. You may wish to plan the upgrade during a predefined maintenance window.

---

## Upgrading a Sharded Cluster

Use the following procedure to upgrade a sharded cluster:

- *Disable the balancer* (page 552).
- Upgrade all `mongos` (page 938) instances *first*, in any order.
- Upgrade all of the `mongod` (page 925) config server instances using the `stand alone` (page 1050) procedure. To keep the cluster online, be sure that at all times at least one config server is up.
- Upgrade each shard’s replica set, using the *upgrade procedure for replica sets* (page 1051) detailed above.
- re-enable the balancer.

---

**Note:** Balancing is not currently supported in *mixed* 2.0.x and 2.2.0 deployments. Thus you will want to reach a consistent version for all shards within a reasonable period of time, e.g. same-day. See SERVER-6902<sup>39</sup> for more information.

---

## Changes

### Major Features

**Aggregation Framework** The aggregation framework makes it possible to do aggregation operations without needing to use `map-reduce`. The `aggregate` (page 694) command exposes the aggregation framework, and the `aggregate()` (page 808) helper in the `mongo` (page 942) shell provides an interface to these operations. Consider the following resources for background on the aggregation framework and its use:

<sup>39</sup><https://jira.mongodb.org/browse/SERVER-6902>

- Documentation: [Aggregation Concepts](#) (page 279)
- Reference: [Aggregation Reference](#) (page 306)
- Examples: [Aggregation Examples](#) (page 290)

**TTL Collections** TTL collections remove expired data from a collection, using a special index and a background thread that deletes expired documents every minute. These collections are useful as an alternative to [capped collections](#) in some cases, such as for data warehousing and caching cases, including: machine generated event data, logs, and session information that needs to persist in a database for only a limited period of time.

For more information, see the [Expire Data from Collections by Setting TTL](#) (page 158) tutorial.

**Concurrency Improvements** MongoDB 2.2 increases the server's capacity for concurrent operations with the following improvements:

1. DB Level Locking<sup>40</sup>
2. Improved Yielding on Page Faults<sup>41</sup>
3. Improved Page Fault Detection on Windows<sup>42</sup>

To reflect these changes, MongoDB now provides changed and improved reporting for concurrency and use, see [locks](#) (page 783) and [recordStats](#) (page 794) in [server status](#) (page 782) and see [db.currentOp\(\)](#) (page 879), [mongotop](#) (page 979), and [mongostat](#) (page 974).

**Improved Data Center Awareness with Tag Aware Sharding** MongoDB 2.2 adds additional support for geographic distribution or other custom partitioning for sharded collections in [clusters](#). By using this “tag aware” sharding, you can automatically ensure that data in a sharded database system is always on specific shards. For example, with tag aware sharding, you can ensure that data is closest to the application servers that use that data most frequently.

Shard tagging controls data location, and is complementary but separate from replica set tagging, which controls [read preference](#) (page 405) and [write concern](#) (page 55). For example, shard tagging can pin all “USA” data to one or more logical shards, while replica set tagging can control which [mongod](#) (page 925) instances (e.g. “production” or “reporting”) the application uses to service requests.

See the documentation for the following helpers in the [mongo](#) (page 942) shell that support tagged sharding configuration:

- [sh.addShardTag\(\)](#) (page 904)
- [sh.addTagRange\(\)](#) (page 904)
- [sh.removeShardTag\(\)](#) (page 908)

Also, see [Tag Aware Sharding](#) (page 557) and [Manage Shard Tags](#) (page 536).

**Fully Supported Read Preference Semantics** All MongoDB clients and drivers now support full [read preferences](#) (page 405), including consistent support for a full range of [read preference modes](#) (page 489) and [tag sets](#) (page 407). This support extends to the [mongos](#) (page 938) and applies identically to single replica sets and to the replica sets for each shard in a [sharded cluster](#).

Additional read preference support now exists in the [mongo](#) (page 942) shell using the [readPref\(\)](#) (page 871) cursor method.

<sup>40</sup><https://jira.mongodb.org/browse/SERVER-4328>

<sup>41</sup><https://jira.mongodb.org/browse/SERVER-3357>

<sup>42</sup><https://jira.mongodb.org/browse/SERVER-4538>

## Compatibility Changes

**Authentication Changes** MongoDB 2.2 provides more reliable and robust support for authentication clients, including drivers and [mongos](#) (page 938) instances.

If your cluster runs with authentication:

- For all drivers, use the latest release of your driver and check its release notes.
- In sharded environments, to ensure that your cluster remains available during the upgrade process you **must** use the [upgrade procedure for sharded clusters](#) (page 1051).

**findAndModify Returns Null Value for Upserts that Perform Inserts** In version 2.2, for [upsert](#) that perform inserts with the new option set to `false`, [findAndModify](#) (page 710) commands will now return the following output:

```
{ 'ok': 1.0, 'value': null }
```

In the [mongo](#) (page 942) shell, upsert [findAndModify](#) (page 710) operations that perform inserts (with `new` set to `false`) only output a `null` value.

In version 2.0 these operations would return an empty document, e.g. `{ }.`

See: [SERVER-6226](#)<sup>43</sup> for more information.

**mongodump 2.2 Output Incompatible with Pre-2.2 mongorestore** If you use the [mongodump](#) (page 951) tool from the 2.2 distribution to create a dump of a database, you must use a 2.2 (or later) version of [mongorestore](#) (page 956) to restore that dump.

See: [SERVER-6961](#)<sup>44</sup> for more information.

**ObjectId().toString() Returns String Literal ObjectId("...")** In version 2.2, the [toString\(\)](#) (page 916) method returns the string representation of the [ObjectId\(\)](#) (page 104) object and has the format `ObjectId("...")`.

Consider the following example that calls the [toString\(\)](#) (page 916) method on the `ObjectId("507c7f79bcf86cd7994f6c0e")` object:

```
ObjectId("507c7f79bcf86cd7994f6c0e").toString()
```

The method now returns the *string* `ObjectId("507c7f79bcf86cd7994f6c0e")`.

Previously, in version 2.0, the method would return the *hexadecimal string* `507c7f79bcf86cd7994f6c0e`.

If compatibility between versions 2.0 and 2.2 is required, use [ObjectId\(\).str](#) (page 104), which holds the hexadecimal string value in both versions.

**ObjectId().valueOf() Returns hexadecimal string** In version 2.2, the [valueOf\(\)](#) (page 917) method returns the value of the [ObjectId\(\)](#) (page 104) object as a lowercase hexadecimal string.

Consider the following example that calls the [valueOf\(\)](#) (page 917) method on the `ObjectId("507c7f79bcf86cd7994f6c0e")` object:

```
ObjectId("507c7f79bcf86cd7994f6c0e").valueOf()
```

<sup>43</sup><https://jira.mongodb.org/browse/SERVER-6226>

<sup>44</sup><https://jira.mongodb.org/browse/SERVER-6961>

The method now returns the *hexadecimal string* `507c7f79bcf86cd7994f6c0e`.

Previously, in version 2.0, the method would return the *object* `ObjectId("507c7f79bcf86cd7994f6c0e")`.

If compatibility between versions 2.0 and 2.2 is required, use `ObjectId().str` (page 104) attribute, which holds the hexadecimal string value in both versions.

### Behavioral Changes

**Restrictions on Collection Names** In version 2.2, collection names cannot:

- contain the `$`.
- be an empty string (i.e. `" "`).

This change does not affect collections created with now illegal names in earlier versions of MongoDB.

These new restrictions are in addition to the existing restrictions on collection names which are:

- A collection name should begin with a letter or an underscore.
- A collection name cannot contain the null character.
- Begin with the `system.` prefix. MongoDB reserves `system.` for system collections, such as the `system.indexes` collection.
- The maximum size of a collection name is 128 characters, including the name of the database. However, for maximum flexibility, collections should have names less than 80 characters.

Collections names may have any other valid UTF-8 string.

See the [SERVER-4442<sup>45</sup>](#) and the [Are there any restrictions on the names of Collections?](#) (page 592) FAQ item.

**Restrictions on Database Names for Windows** Database names running on Windows can no longer contain the following characters:

`/ \ . " * < > : | ?`

The names of the data files include the database name. If you attempt to upgrade a database instance with one or more of these characters, `mongod` (page 925) will refuse to start.

Change the name of these databases before upgrading. See [SERVER-4584<sup>46</sup>](#) and [SERVER-6729<sup>47</sup>](#) for more information.

**\_id Fields and Indexes on Capped Collections** All *capped collections* now have an `_id` field by default, *if* they exist outside of the `local` database, and now have indexes on the `_id` field. This change only affects capped collections created with 2.2 instances and does not affect existing capped collections.

See: [SERVER-5516<sup>48</sup>](#) for more information.

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<sup>45</sup><https://jira.mongodb.org/browse/SERVER-4442>

<sup>46</sup><https://jira.mongodb.org/browse/SERVER-4584>

<sup>47</sup><https://jira.mongodb.org/browse/SERVER-6729>

<sup>48</sup><https://jira.mongodb.org/browse/SERVER-5516>

**New \$elemMatch Projection Operator** The `$elemMatch` (page 648) operator allows applications to narrow the data returned from queries so that the query operation will only return the first matching element in an array. See the `$elemMatch (projection)` (page 648) documentation and the SERVER-2238<sup>49</sup> and SERVER-828<sup>50</sup> issues for more information.

## Windows Specific Changes

**Windows XP is Not Supported** As of 2.2, MongoDB does not support Windows XP. Please upgrade to a more recent version of Windows to use the latest releases of MongoDB. See SERVER-5648<sup>51</sup> for more information.

**Service Support for mongos.exe** You may now run `mongos.exe` (page 950) instances as a Windows Service. See the `mongos.exe` (page 949) reference and *MongoDB as a Windows Service* (page 19) and SERVER-1589<sup>52</sup> for more information.

**Log Rotate Command Support** MongoDB for Windows now supports log rotation by way of the `logRotate` (page 760) database command. See SERVER-2612<sup>53</sup> for more information.

**New Build Using SlimReadWrite Locks for Windows Concurrency** Labeled “2008+” on the Downloads Page<sup>54</sup>, this build for 64-bit versions of Windows Server 2008 R2 and for Windows 7 or newer, offers increased performance over the standard 64-bit Windows build of MongoDB. See SERVER-3844<sup>55</sup> for more information.

## Tool Improvements

**Index Definitions Handled by mongodump and mongorestore** When you specify the `--collection` option to `mongodump` (page 951), `mongodump` (page 951) will now backup the definitions for all indexes that exist on the source database. When you attempt to restore this backup with `mongorestore` (page 956), the target `mongod` (page 925) will rebuild all indexes. See SERVER-808<sup>56</sup> for more information.

`mongorestore` (page 956) now includes the `--noIndexRestore` option to provide the preceding behavior. Use `--noIndexRestore` to prevent `mongorestore` (page 956) from building previous indexes.

**mongooplog for Replaying Ologs** The `mongooplog` (page 962) tool makes it possible to pull `oplog` entries from `mongod` (page 925) instance and apply them to another `mongod` (page 925) instance. You can use `mongooplog` (page 962) to achieve point-in-time backup of a MongoDB data set. See the SERVER-3873<sup>57</sup> case and the `mongooplog` (page 962) documentation.

**Authentication Support for mongotop and mongostat** `mongotop` (page 979) and `mongostat` (page 974) now contain support for username/password authentication. See SERVER-3875<sup>58</sup> and SERVER-3871<sup>59</sup> for more information regarding this change. Also consider the documentation of the following options for additional information:

<sup>49</sup><https://jira.mongodb.org/browse/SERVER-2238>

<sup>50</sup><https://jira.mongodb.org/browse/SERVER-828>

<sup>51</sup><https://jira.mongodb.org/browse/SERVER-5648>

<sup>52</sup><https://jira.mongodb.org/browse/SERVER-1589>

<sup>53</sup><https://jira.mongodb.org/browse/SERVER-2612>

<sup>54</sup><http://www.mongodb.org/downloads>

<sup>55</sup><https://jira.mongodb.org/browse/SERVER-3844>

<sup>56</sup><https://jira.mongodb.org/browse/SERVER-808>

<sup>57</sup><https://jira.mongodb.org/browse/SERVER-3873>

<sup>58</sup><https://jira.mongodb.org/browse/SERVER-3875>

<sup>59</sup><https://jira.mongodb.org/browse/SERVER-3871>

- `mongotop --username`
- `mongotop --password`
- `mongostat --username`
- `mongostat --password`

**Write Concern Support for `mongoimport` and `mongorestore`** `mongoimport` (page 965) now provides an option to halt the import if the operation encounters an error, such as a network interruption, a duplicate key exception, or a write error. The `--stopOnError` option will produce an error rather than silently continue importing data. See SERVER-3937<sup>60</sup> for more information.

In `mongorestore` (page 956), the `--w` option provides support for configurable write concern.

**`mongodump` Support for Reading from Secondaries** You can now run `mongodump` (page 951) when connected to a `secondary` member of a *replica set*. See SERVER-3854<sup>61</sup> for more information.

**`mongoimport` Support for full 16MB Documents** Previously, `mongoimport` (page 965) would only import documents that were less than 4 megabytes in size. This issue is now corrected, and you may use `mongoimport` (page 965) to import documents that are at least 16 megabytes in size. See SERVER-4593<sup>62</sup> for more information.

**`Timestamp()` Extended JSON format** MongoDB extended JSON now includes a new `Timestamp()` type to represent the `Timestamp` type that MongoDB uses for timestamps in the *oplog* among other contexts.

This permits tools like `mongooplog` (page 962) and `mongodump` (page 951) to query for specific timestamps. Consider the following `mongodump` (page 951) operation:

```
mongodump --db local --collection oplog.rs --query '{"ts":{"$gt":{"$timestamp" : {"t": 1344969612000,
```

See SERVER-3483<sup>63</sup> for more information.

## Shell Improvements

**Improved Shell User Interface** 2.2 includes a number of changes that improve the overall quality and consistency of the user interface for the `mongo` (page 942) shell:

- Full Unicode support.
- Bash-like line editing features. See SERVER-4312<sup>64</sup> for more information.
- Multi-line command support in shell history. See SERVER-3470<sup>65</sup> for more information.
- Windows support for the `edit` command. See SERVER-3998<sup>66</sup> for more information.

**Helper to load Server-Side Functions** The `db.loadServerScripts()` (page 890) loads the contents of the current database's `system.js` collection into the current `mongo` (page 942) shell session. See SERVER-1651<sup>67</sup> for more information.

<sup>60</sup><https://jira.mongodb.org/browse/SERVER-3937>

<sup>61</sup><https://jira.mongodb.org/browse/SERVER-3854>

<sup>62</sup><https://jira.mongodb.org/browse/SERVER-4593>

<sup>63</sup><https://jira.mongodb.org/browse/SERVER-3483>

<sup>64</sup><https://jira.mongodb.org/browse/SERVER-4312>

<sup>65</sup><https://jira.mongodb.org/browse/SERVER-3470>

<sup>66</sup><https://jira.mongodb.org/browse/SERVER-3998>

<sup>67</sup><https://jira.mongodb.org/browse/SERVER-1651>

**Support for Bulk Inserts** If you pass an array of `documents` to the `insert()` (page 832) method, the `mongo` (page 942) shell will now perform a bulk insert operation. See SERVER-3819<sup>68</sup> and SERVER-2395<sup>69</sup> for more information.

---

**Note:** For bulk inserts on sharded clusters, the `getLastError` (page 720) command alone is insufficient to verify success. Applications should must verify the success of bulk inserts in application logic.

---

## Operations

**Support for Logging to Syslog** See the SERVER-2957<sup>70</sup> case and the documentation of the `syslog` (page 992) run-time option or the `mongod --syslog` and `mongos --syslog` command line-options.

**touch Command** Added the `touch` (page 759) command to read the data and/or indexes from a collection into memory. See: SERVER-2023<sup>71</sup> and `touch` (page 759) for more information.

**indexCounters No Longer Report Sampled Data** `indexCounters` now report actual counters that reflect index use and state. In previous versions, these data were sampled. See SERVER-5784<sup>72</sup> and `indexCounters` for more information.

**Padding Specifiable on compact Command** See the documentation of the `compact` (page 752) and the SERVER-4018<sup>73</sup> issue for more information.

**Added Build Flag to Use System Libraries** The Boost library, version 1.49, is now embedded in the MongoDB code base.

If you want to build MongoDB binaries using system Boost libraries, you can pass `scons` using the `--use-system-boost` flag, as follows:

```
scons --use-system-boost
```

When building MongoDB, you can also pass `scons` a flag to compile MongoDB using only system libraries rather than the included versions of the libraries. For example:

```
scons --use-system-all
```

See the SERVER-3829<sup>74</sup> and SERVER-5172<sup>75</sup> issues for more information.

**Memory Allocator Changed to TCMalloc** To improve performance, MongoDB 2.2 uses the TCMalloc memory allocator from Google Perftools. For more information about this change see the SERVER-188<sup>76</sup> and SERVER-4683<sup>77</sup>. For more information about TCMalloc, see the documentation of TCMalloc<sup>78</sup> itself.

<sup>68</sup><https://jira.mongodb.org/browse/SERVER-3819>

<sup>69</sup><https://jira.mongodb.org/browse/SERVER-2395>

<sup>70</sup><https://jira.mongodb.org/browse/SERVER-2957>

<sup>71</sup><https://jira.mongodb.org/browse/SERVER-2023>

<sup>72</sup><https://jira.mongodb.org/browse/SERVER-5784>

<sup>73</sup><https://jira.mongodb.org/browse/SERVER-4018>

<sup>74</sup><https://jira.mongodb.org/browse/SERVER-3829>

<sup>75</sup><https://jira.mongodb.org/browse/SERVER-5172>

<sup>76</sup><https://jira.mongodb.org/browse/SERVER-188>

<sup>77</sup><https://jira.mongodb.org/browse/SERVER-4683>

<sup>78</sup><http://goog-perftools.sourceforge.net/doc/tcmalloc.html>

## Replication

**Improved Logging for Replica Set Lag** When *secondary* members of a replica set fall behind in replication, `mongod` (page 925) now provides better reporting in the log. This makes it possible to track replication in general and identify what process may produce errors or halt replication. See SERVER-3575<sup>79</sup> for more information.

**Replica Set Members can Sync from Specific Members** The new `replSetSyncFrom` (page 730) command and new `rs.syncFrom()` (page 899) helper in the `mongo` (page 942) shell make it possible for you to manually configure from which member of the set a replica will poll *oplog* entries. Use these commands to override the default selection logic if needed. Always exercise caution with `replSetSyncFrom` (page 730) when overriding the default behavior.

**Replica Set Members will not Sync from Members Without Indexes Unless `buildIndexes: false`** To prevent inconsistency between members of replica sets, if the member of a replica set has `buildIndexes` (page 481) set to `true`, other members of the replica set will *not* sync from this member, unless they also have `buildIndexes` (page 481) set to `true`. See SERVER-4160<sup>80</sup> for more information.

**New Option To Configure Index Pre-Fetching during Replication** By default, when replicating options, `secondaries` will pre-fetch *Indexes* (page 313) associated with a query to improve replication throughput in most cases. The `replIndexPrefetch` (page 1000) setting and `--replIndexPrefetch` option allow administrators to disable this feature or allow the `mongod` (page 925) to pre-fetch only the index on the `_id` field. See SERVER-6718<sup>81</sup> for more information.

## Map Reduce Improvements

In 2.2 Map Reduce received the following improvements:

- Improved support for sharded MapReduce<sup>82</sup>, and
- MapReduce will retry jobs following a config error<sup>83</sup>.

## Sharding Improvements

**Index on Shard Keys Can Now Be a Compound Index** If your shard key uses the prefix of an existing index, then you do not need to maintain a separate index for your shard key in addition to your existing index. This index, however, cannot be a multi-key index. See the *Shard Key Indexes* (page 520) documentation and SERVER-1506<sup>84</sup> for more information.

**Migration Thresholds Modified** The *migration thresholds* (page 517) have changed in 2.2 to permit more even distribution of *chunks* in collections that have smaller quantities of data. See the *Migration Thresholds* (page 517) documentation for more information.

<sup>79</sup><https://jira.mongodb.org/browse/SERVER-3575>

<sup>80</sup><https://jira.mongodb.org/browse/SERVER-4160>

<sup>81</sup><https://jira.mongodb.org/browse/SERVER-6718>

<sup>82</sup><https://jira.mongodb.org/browse/SERVER-4521>

<sup>83</sup><https://jira.mongodb.org/browse/SERVER-4158>

<sup>84</sup><https://jira.mongodb.org/browse/SERVER-1506>

## Licensing Changes

Added License notice for Google Perftools (TCMalloc Utility). See the [License Notice<sup>85</sup>](#) and the [SERVER-4683<sup>86</sup>](#) for more information.

## Resources

- [MongoDB Downloads<sup>87</sup>](#).
- [All JIRA issues resolved in 2.2<sup>88</sup>](#).
- [All backwards incompatible changes<sup>89</sup>](#).
- [All third party license notices<sup>90</sup>](#).
- [What's New in MongoDB 2.2 Online Conference<sup>91</sup>](#).

## 12.2.2 Release Notes for MongoDB 2.0

See the [full index of this page](#) for a complete list of changes included in 2.0.

- [Upgrading](#) (page 1059)
- [Changes](#) (page 1060)
- [Resources](#) (page 1065)

## Upgrading

Although the major version number has changed, MongoDB 2.0 is a standard, incremental production release and works as a drop-in replacement for MongoDB 1.8.

### Preparation

Read through all release notes before upgrading, and ensure that no changes will affect your deployment.

If you create new indexes in 2.0, then downgrading to 1.8 is possible but you must reindex the new collections.

[mongoimport](#) (page 965) and [mongoexport](#) (page 969) now correctly adhere to the CSV spec for handling CSV input/output. This may break existing import/export workflows that relied on the previous behavior. For more information see [SERVER-1097<sup>92</sup>](#).

[Journaling<sup>93</sup>](#) is **enabled by default** in 2.0 for 64-bit builds. If you still prefer to run without journaling, start [mongod](#) (page 925) with the `--nojournal` run-time option. Otherwise, MongoDB creates journal files during startup. The first time you start [mongod](#) (page 925) with journaling, you will see a delay as [mongod](#) (page 925) creates new files. In addition, you may see reduced write throughput.

<sup>85</sup><https://github.com/mongodb/mongo/blob/v2.2/distsrc/THIRD-PARTY-NOTICES#L231>

<sup>86</sup><https://jira.mongodb.org/browse/SERVER-4683>

<sup>87</sup><http://mongodb.org/downloads>

<sup>88</sup><https://jira.mongodb.org/secure/IssueNavigator.jspa?reset=true&jqlQuery=project+%3D+SERVER+AND+fixVersion+in+%28%222.1.0%22%2C%222.1.1%22%2C%222.2.0-rc1%22%2C%222.2.0-rc2%22%29+ORDER+BY+component+ASC%2C+key+DESC>

<sup>89</sup><https://jira.mongodb.org/secure/IssueNavigator.jspa?requestId=11225>

<sup>90</sup><https://github.com/mongodb/mongo/blob/v2.2/distsrc/THIRD-PARTY-NOTICES>

<sup>91</sup><http://www.mongodb.com/events/webinar/mongodb-online-conference-sept>

<sup>92</sup><https://jira.mongodb.org/browse/SERVER-1097>

<sup>93</sup><http://www.mongodb.org/display/DOCS/Journaling>

2.0 `mongod` (page 925) instances are interoperable with 1.8 `mongod` (page 925) instances; however, for best results, upgrade your deployments using the following procedures:

### Upgrading a Standalone `mongod`

1. Download the v2.0.x binaries from the MongoDB Download Page<sup>94</sup>.
2. Shutdown your `mongod` (page 925) instance. Replace the existing binary with the 2.0.x `mongod` (page 925) binary and restart MongoDB.

### Upgrading a Replica Set

1. Upgrade the *secondary* members of the set one at a time by shutting down the `mongod` (page 925) and replacing the 1.8 binary with the 2.0.x binary from the MongoDB Download Page<sup>95</sup>.
2. To avoid losing the last few updates on failover you can temporarily halt your application (failover should take less than 10 seconds), or you can set *write concern* (page 55) in your application code to confirm that each update reaches multiple servers.
3. Use the `rs.stepDown()` (page 899) to step down the primary to allow the normal *failover* (page 396) procedure.  
`rs.stepDown()` (page 899) and `replSetStepDown` (page 730) provide for shorter and more consistent failover procedures than simply shutting down the primary directly.

When the primary has stepped down, shut down its instance and upgrade by replacing the `mongod` (page 925) binary with the 2.0.x binary.

### Upgrading a Sharded Cluster

1. Upgrade all *config server* instances *first*, in any order. Since config servers use two-phase commit, *shard* configuration metadata updates will halt until all are up and running.
2. Upgrade `mongos` (page 938) routers in any order.

## Changes

### Compact Command

A `compact` (page 752) command is now available for compacting a single collection and its indexes. Previously, the only way to compact was to repair the entire database.

### Concurrency Improvements

When going to disk, the server will yield the write lock when writing data that is not likely to be in memory. The initial implementation of this feature now exists:

See SERVER-2563<sup>96</sup> for more information.

The specific operations yield in 2.0 are:

---

<sup>94</sup><http://downloads.mongodb.org/>

<sup>95</sup><http://downloads.mongodb.org/>

<sup>96</sup><https://jira.mongodb.org/browse/SERVER-2563>

- Updates by `_id`
- Removes
- Long cursor iterations

## Default Stack Size

MongoDB 2.0 reduces the default stack size. This change can reduce total memory usage when there are many (e.g., 1000+) client connections, as there is a thread per connection. While portions of a thread's stack can be swapped out if unused, some operating systems do this slowly enough that it might be an issue. The default stack size is lesser of the system setting or 1MB.

## Index Performance Enhancements

v2.0 includes significant improvements to the [index](#) (page 345). Indexes are often 25% smaller and 25% faster (depends on the use case). When upgrading from previous versions, the benefits of the new index type are realized only if you create a new index or re-index an old one.

Dates are now signed, and the max index key size has increased slightly from 819 to 1024 bytes.

All operations that create a new index will result in a 2.0 index by default. For example:

- Reindexing results on an older-version index results in a 2.0 index. However, reindexing on a secondary does *not* work in versions prior to 2.0. Do not reindex on a secondary. For a workaround, see [SERVER-3866](#)<sup>97</sup>.
- The `repairDatabase` command converts indexes to a 2.0 indexes.

To convert all indexes for a given collection to the [2.0 type](#) (page 1061), invoke the `compact` (page 752) command.

Once you create new indexes, downgrading to 1.8.x will require a re-index of any indexes created using 2.0. See [Build Old Style Indexes](#) (page 345).

## Sharding Authentication

Applications can now use authentication with *sharded clusters*.

## Replica Sets

**Hidden Nodes in Sharded Clusters** In 2.0, `mongos` (page 938) instances can now determine when a member of a replica set becomes “hidden” without requiring a restart. In 1.8, `mongos` (page 938) if you reconfigured a member as hidden, you *had* to restart `mongos` (page 938) to prevent queries from reaching the hidden member.

**Priorities** Each *replica set* member can now have a priority value consisting of a floating-point from 0 to 1000, inclusive. Priorities let you control which member of the set you prefer to have as *primary* the member with the highest priority that can see a majority of the set will be elected primary.

For example, suppose you have a replica set with three members, A, B, and C, and suppose that their priorities are set as follows:

- A’s priority is 2.
- B’s priority is 3.

<sup>97</sup><https://jira.mongodb.org/browse/SERVER-3866>

- C’s priority is 1.

During normal operation, the set will always chose B as primary. If B becomes unavailable, the set will elect A as primary.

For more information, see the [priority](#) (page 481) documentation.

**Data-Center Awareness** You can now “tag” *replica set* members to indicate their location. You can use these tags to design custom *write rules* (page 55) across data centers, racks, specific servers, or any other architecture choice.

For example, an administrator can define rules such as “very important write” or `customerData` or “audit-trail” to replicate to certain servers, racks, data centers, etc. Then in the application code, the developer would say:

```
db.foo.insert(doc, {w : "very important write"})
```

which would succeed if it fulfilled the conditions the DBA defined for “very important write”.

For more information, see [Tagging](#)<sup>98</sup>.

Drivers may also support tag-aware reads. Instead of specifying `slaveOk`, you specify `slaveOk` with tags indicating which data-centers to read from. For details, see the [MongoDB Drivers and Client Libraries](#) (page 95) documentation.

**w : majority** You can also set `w` to `majority` to ensure that the write propagates to a majority of nodes, effectively committing it. The value for “majority” will automatically adjust as you add or remove nodes from the set.

For more information, see [Write Concern](#) (page 55).

**Reconfiguration with a Minority Up** If the majority of servers in a set has been permanently lost, you can now force a reconfiguration of the set to bring it back online.

For more information see [Reconfigure a Replica Set with Unavailable Members](#) (page 455).

**Primary Checks for a Caught up Secondary before Stepping Down** To minimize time without a *primary*, the `rs.stepDown()` (page 899) method will now fail if the primary does not see a *secondary* within 10 seconds of its latest optime. You can force the primary to step down anyway, but by default it will return an error message.

See also [Force a Member to Become Primary](#) (page 448).

**Extended Shutdown on the Primary to Minimize Interruption** When you call the `shutdown` (page 759) command, the *primary* will refuse to shut down unless there is a *secondary* whose optime is within 10 seconds of the primary. If such a secondary isn’t available, the primary will step down and wait up to a minute for the secondary to be fully caught up before shutting down.

Note that to get this behavior, you must issue the `shutdown` (page 759) command explicitly; sending a signal to the process will not trigger this behavior.

You can also force the primary to shut down, even without an up-to-date secondary available.

**Maintenance Mode** When `repair` or `compact` (page 752) runs on a *secondary*, the secondary will automatically drop into “recovering” mode until the operation finishes. This prevents clients from trying to read from it while it’s busy.

<sup>98</sup><http://www.mongodb.org/display/DOCS/Data+Center+Awareness#DataCenterAwareness-Tagging%28version2.0%29>

## Geospatial Features

**Multi-Location Documents** Indexing is now supported on documents which have multiple location objects, embedded either inline or in nested sub-documents. Additional command options are also supported, allowing results to return with not only distance but the location used to generate the distance.

For more information, see [Multi-location Documents](#)<sup>99</sup>.

**Polygon searches** Polygonal `$within` (page 636) queries are also now supported for simple polygon shapes. For details, see the `$within` (page 636) operator documentation.

## Journaling Enhancements

- Journaling is now enabled by default for 64-bit platforms. Use the `--nojournal` command line option to disable it.
- The journal is now compressed for faster commits to disk.
- A new `--journalCommitInterval` run-time option exists for specifying your own group commit interval. The default settings do not change.
- A new `{ getLastError: { j: true } }` (page 720) option is available to wait for the group commit. The group commit will happen sooner when a client is waiting on `{ j: true }`. If journaling is disabled, `{ j: true }` is a no-op.

## New ContinueOnError Option for Bulk Insert

Set the `continueOnError` option for bulk inserts, in the [driver](#) (page 95), so that bulk insert will continue to insert any remaining documents even if an insert fails, as is the case with duplicate key exceptions or network interruptions. The `getLastError` (page 720) command will report whether any inserts have failed, not just the last one. If multiple errors occur, the client will only receive the most recent `getLastError` (page 720) results.

See [OP\\_INSERT](#)<sup>100</sup>.

---

**Note:** For bulk inserts on sharded clusters, the `getLastError` (page 720) command alone is insufficient to verify success. Applications should must verify the success of bulk inserts in application logic.

---

## Map Reduce

**Output to a Sharded Collection** Using the new `sharded` flag, it is possible to send the result of a map/reduce to a sharded collection. Combined with the `reduce` or `merge` flags, it is possible to keep adding data to very large collections from map/reduce jobs.

For more information, see [MapReduce Output Options](#)<sup>101</sup> and [mapReduce](#) (page 701).

**Performance Improvements** Map/reduce performance will benefit from the following:

- Larger in-memory buffer sizes, reducing the amount of disk I/O needed during a job
- Larger javascript heap size, allowing for larger objects and less GC

---

<sup>99</sup><http://www.mongodb.org/display/DOCS/Geospatial+Indexing#GeospatialIndexing-MultilocationDocuments>

<sup>100</sup><http://www.mongodb.org/display/DOCS/Mongo+Wire+Protocol#MongoWireProtocol-OPINSERT>

<sup>101</sup><http://www.mongodb.org/display/DOCS/MapReduce#MapReduce-Outputoptions>

- Supports pure JavaScript execution with the `jsMode` flag. See [mapReduce](#) (page 701).

### New Querying Features

**Additional regex options: s** Allows the dot (.) to match all characters including new lines. This is in addition to the currently supported `i`, `m` and `x`. See [Regular Expressions](#)<sup>102</sup> and [\\$regex](#) (page 633).

**\$and** A special boolean `$and` (page 626) query operator is now available.

### Command Output Changes

The output of the [validate](#) (page 771) command and the documents in the `system.profile` collection have both been enhanced to return information as BSON objects with keys for each value rather than as free-form strings.

### Shell Features

**Custom Prompt** You can define a custom prompt for the [mongo](#) (page 942) shell. You can change the prompt at any time by setting the `prompt` variable to a string or a custom JavaScript function returning a string. For examples, see [Custom Prompt](#)<sup>103</sup>.

**Default Shell Init Script** On startup, the shell will check for a `.mongorc.js` file in the user's home directory. The shell will execute this file after connecting to the database and before displaying the prompt.

If you would like the shell not to run the `.mongorc.js` file automatically, start the shell with `--norc`.

For more information, see [mongo](#) (page 942).

### Most Commands Require Authentication

In 2.0, when running with authentication (e.g. [auth](#) (page 993)) *all* database commands require authentication, *except* the following commands.

- [isMaster](#) (page 732)
- [authenticate](#) (page 725)
- [getnonce](#) (page 725)
- [buildInfo](#) (page 762)
- [ping](#) (page 770)
- [isdbgrid](#) (page 743)

<sup>102</sup><http://www.mongodb.org/display/DOCS/Advanced+Queries#AdvancedQueries-RegularExpressions>

<sup>103</sup><http://www.mongodb.org/display/DOCS/Overview++The+MongoDB+Interactive+Shell#Overview-TheMongoDBInteractiveShell-CustomPrompt>

## Resources

- MongoDB Downloads<sup>104</sup>
- All JIRA Issues resolved in 2.0<sup>105</sup>
- All Backward Incompatible Changes<sup>106</sup>

### 12.2.3 Release Notes for MongoDB 1.8

See the [full index of this page](#) for a complete list of changes included in 1.8.

- [Upgrading](#) (page 1065)
- [Changes](#) (page 1068)
- [Resources](#) (page 1071)

## Upgrading

MongoDB 1.8 is a standard, incremental production release and works as a drop-in replacement for MongoDB 1.6, except:

- *Replica set* members should be upgraded in a particular order, as described in [Upgrading a Replica Set](#) (page 1066).
- The `mapReduce` (page 701) command has changed in 1.8, causing incompatibility with previous releases. `mapReduce` (page 701) no longer generates temporary collections (thus, `keepTemp` has been removed). Now, you must always supply a value for `out`. See the `out` field options in the [mapReduce](#) (page 701) document. If you use MapReduce, this also likely means you need a recent version of your client driver.

## Preparation

Read through all release notes before upgrading and ensure that no changes will affect your deployment.

### Upgrading a Standalone `mongod`

1. Download the v1.8.x binaries from the MongoDB Download Page<sup>107</sup>.
2. Shutdown your `mongod` (page 925) instance.
3. Replace the existing binary with the 1.8.x `mongod` (page 925) binary.
4. Restart MongoDB.

<sup>104</sup><http://mongodb.org/downloads>

<sup>105</sup><https://jira.mongodb.org/secure/IssueNavigator.jspa?mode=hide&requestId=11002>

<sup>106</sup><https://jira.mongodb.org/secure/IssueNavigator.jspa?requestId=11023>

<sup>107</sup><http://downloads.mongodb.org/>

## Upgrading a Replica Set

1.8.x *secondaries* can replicate from 1.6.x *primaries*.

1.6.x secondaries **cannot** replicate from 1.8.x primaries.

Thus, to upgrade a *replica set* you must replace all of your secondaries first, then the primary.

For example, suppose you have a replica set with a primary, an *arbiter* and several secondaries. To upgrade the set, do the following:

1. For the arbiter:

- (a) Shut down the arbiter.
- (b) Restart it with the 1.8.x binary from the [MongoDB Download Page](#)<sup>108</sup>.

2. Change your config (optional) to prevent election of a new primary.

It is possible that, when you start shutting down members of the set, a new primary will be elected. To prevent this, you can give all of the secondaries a priority of 0 before upgrading, and then change them back afterwards. To do so:

- (a) Record your current config. Run `rs.config()` (page 896) and paste the results into a text file.
- (b) Update your config so that all secondaries have priority 0. For example:

```
config = rs.conf()
{
 "_id" : "foo",
 "version" : 3,
 "members" : [
 {
 "_id" : 0,
 "host" : "ubuntu:27017"
 },
 {
 "_id" : 1,
 "host" : "ubuntu:27018"
 },
 {
 "_id" : 2,
 "host" : "ubuntu:27019",
 "arbiterOnly" : true
 },
 {
 "_id" : 3,
 "host" : "ubuntu:27020"
 },
 {
 "_id" : 4,
 "host" : "ubuntu:27021"
 },
]
}
config.version++
3
rs.isMaster()
{
 "setName" : "foo",
```

---

<sup>108</sup><http://downloads.mongodb.org/>

```

 "ismaster" : false,
 "secondary" : true,
 "hosts" : [
 "ubuntu:27017",
 "ubuntu:27018"
],
 "arbiters" : [
 "ubuntu:27019"
],
 "primary" : "ubuntu:27018",
 "ok" : 1
}
// for each secondary
config.members[0].priority = 0
config.members[3].priority = 0
config.members[4].priority = 0
rs.reconfig(config)

```

3. For each secondary:
  - (a) Shut down the secondary.
  - (b) Restart it with the 1.8.x binary from the [MongoDB Download Page](#)<sup>109</sup>.
4. If you changed the config, change it back to its original state:

```

config = rs.conf()
config.version++
config.members[0].priority = 1
config.members[3].priority = 1
config.members[4].priority = 1
rs.reconfig(config)

```

5. Shut down the primary (the final 1.6 server), and then restart it with the 1.8.x binary from the [MongoDB Download Page](#)<sup>110</sup>.

## Upgrading a Sharded Cluster

1. Turn off the balancer:
 

```
mongo <a_mongos_hostname>
use config
db.settings.update({_id:"balancer"}, {$set : {stopped:true}}, true)
```
2. For each *shard*:
  - If the shard is a *replica set*, follow the directions above for [Upgrading a Replica Set](#) (page 1066).
  - If the shard is a single *mongod* (page 925) process, shut it down and then restart it with the 1.8.x binary from the [MongoDB Download Page](#)<sup>111</sup>.
3. For each *mongos* (page 938):
  - (a) Shut down the *mongos* (page 938) process.
  - (b) Restart it with the 1.8.x binary from the [MongoDB Download Page](#)<sup>112</sup>.

<sup>109</sup><http://downloads.mongodb.org/>

<sup>110</sup><http://downloads.mongodb.org/>

<sup>111</sup><http://downloads.mongodb.org/>

<sup>112</sup><http://downloads.mongodb.org/>

4. For each config server:
  - (a) Shut down the config server process.
  - (b) Restart it with the 1.8.x binary from the [MongoDB Download Page](#)<sup>113</sup>.
5. Turn on the balancer:

```
use config
db.settings.update({_id:"balancer"}, {$set : {stopped:false}})
```

## Returning to 1.6

If for any reason you must move back to 1.6, follow the steps above in reverse. Please be careful that you have not inserted any documents larger than 4MB while running on 1.8 (where the max size has increased to 16MB). If you have you will get errors when the server tries to read those documents.

**Journaling** Returning to 1.6 after using 1.8 *Journaling* (page 232) works fine, as journaling does not change anything about the data file format. Suppose you are running 1.8.x with journaling enabled and you decide to switch back to 1.6. There are two scenarios:

- If you shut down cleanly with 1.8.x, just restart with the 1.6 mongod binary.
- If 1.8.x shut down uncleanly, start 1.8.x up again and let the journal files run to fix any damage (incomplete writes) that may have existed at the crash. Then shut down 1.8.x cleanly and restart with the 1.6 mongod binary.

## Changes

### Journaling

MongoDB now supports write-ahead *Journaling Mechanics* (page 232) to facilitate fast crash recovery and durability in the storage engine. With journaling enabled, a [mongod](#) (page 925) can be quickly restarted following a crash without needing to repair the [collections](#). The aggregation framework makes it possible to do aggregation

### Sparse and Covered Indexes

*Sparse Indexes* (page 335) are indexes that only include documents that contain the fields specified in the index. Documents missing the field will not appear in the index at all. This can significantly reduce index size for indexes of fields that contain only a subset of documents within a [collection](#).

*Covered Indexes* (page 368) enable MongoDB to answer queries entirely from the index when the query only selects fields that the index contains.

### Incremental MapReduce Support

The [mapReduce](#) (page 701) command supports new options that enable incrementally updating existing [collections](#). Previously, a MapReduce job could output either to a temporary collection or to a named permanent collection, which it would overwrite with new data.

You now have several options for the output of your MapReduce jobs:

---

<sup>113</sup><http://downloads.mongodb.org/>

- You can merge MapReduce output into an existing collection. Output from the Reduce phase will replace existing keys in the output collection if it already exists. Other keys will remain in the collection.
- You can now re-reduce your output with the contents of an existing collection. Each key output by the reduce phase will be reduced with the existing document in the output collection.
- You can replace the existing output collection with the new results of the MapReduce job (equivalent to setting a permanent output collection in previous releases)
- You can compute MapReduce inline and return results to the caller without persisting the results of the job. This is similar to the temporary collections generated in previous releases, except results are limited to 8MB.

For more information, see the `out` field options in the [mapReduce](#) (page 701) document.

## Additional Changes and Enhancements

### 1.8.1

- Sharding migrate fix when moving larger chunks.
- Durability fix with background indexing.
- Fixed mongos concurrency issue with many incoming connections.

### 1.8.0

- All changes from 1.7.x series.

### 1.7.6

- Bug fixes.

### 1.7.5

- [Journaling](#) (page 232).
- Extent allocation improvements.
- Improved [replica set](#) connectivity for [mongos](#) (page 938).
- [getLastError](#) (page 720) improvements for [sharding](#).

### 1.7.4

- [mongos](#) (page 938) routes `slaveOk` queries to `secondaries` in [replica sets](#).
- New [mapReduce](#) (page 701) output options.
- [Sparse Indexes](#) (page 335).

### 1.7.3

- Initial [covered index](#) (page 368) support.
- Distinct can use data from indexes when possible.
- [mapReduce](#) (page 701) can merge or reduce results into an existing collection.
- [mongod](#) (page 925) tracks and [mongostat](#) (page 974) displays network usage. See [mongostat](#) (page 974).

- Sharding stability improvements.

### 1.7.2

- `$rename` (page 652) operator allows renaming of fields in a document.
- `db.eval()` (page 884) not to block.
- Geo queries with sharding.
- `mongostat --discover` option
- Chunk splitting enhancements.
- Replica sets network enhancements for servers behind a nat.

### 1.7.1

- Many sharding performance enhancements.
- Better support for `$elemMatch` (page 648) on primitives in embedded arrays.
- Query optimizer enhancements on range queries.
- Window service enhancements.
- Replica set setup improvements.
- `$pull` (page 658) works on primitives in arrays.

### 1.7.0

- Sharding performance improvements for heavy insert loads.
- Slave delay support for replica sets.
- `getLastErrorDefaults` (page 483) for replica sets.
- Auto completion in the shell.
- Spherical distance for geo search.
- All fixes from 1.6.1 and 1.6.2.

#### Release Announcement Forum Pages

- 1.8.1<sup>114</sup>, 1.8.0<sup>115</sup>
- 1.7.6<sup>116</sup>, 1.7.5<sup>117</sup>, 1.7.4<sup>118</sup>, 1.7.3<sup>119</sup>, 1.7.2<sup>120</sup>, 1.7.1<sup>121</sup>, 1.7.0<sup>122</sup>

<sup>114</sup><https://groups.google.com/forum/?fromgroups#!topic/mongodb-user/v09MbhEm62Y>

<sup>115</sup><https://groups.google.com/forum/?fromgroups#!topic/mongodb-user/JeHQOnam6Qk>

<sup>116</sup><https://groups.google.com/forum/?fromgroups#!topic/mongodb-user/3t6GNZ1qGYc>

<sup>117</sup><https://groups.google.com/forum/?fromgroups#!topic/mongodb-user/S5R0Tx9wkEg>

<sup>118</sup><https://groups.google.com/forum/?fromgroups#!topic/mongodb-user/9Om3Vuw-y9c>

<sup>119</sup><https://groups.google.com/forum/?fromgroups#!topic/mongodb-user/DfNUrbmflI>

<sup>120</sup><https://groups.google.com/forum/?fromgroups#!topic/mongodb-user/df7mwK6Xixo>

<sup>121</sup><https://groups.google.com/forum/?fromgroups#!topic/mongodb-user/HUR9zYtTpA8>

<sup>122</sup><https://groups.google.com/forum/?fromgroups#!topic/mongodb-user/TUnJCg9161A>

## Resources

- MongoDB Downloads<sup>123</sup>
- All JIRA Issues resolved in 1.8<sup>124</sup>

### 12.2.4 Release Notes for MongoDB 1.6

See the [full index of this page](#) for a complete list of changes included in 1.6.

- [Upgrading](#) (page 1071)
- [Sharding](#) (page 1071)
- [Replica Sets](#) (page 1071)
- [Other Improvements](#) (page 1072)
- [Installation](#) (page 1072)
- [1.6.x Release Notes](#) (page 1072)
- [1.5.x Release Notes](#) (page 1072)

## Upgrading

MongoDB 1.6 is a drop-in replacement for 1.4. To upgrade, simply shutdown [mongod](#) (page 925) then restart with the new binaries.

*Please note that you should upgrade to the latest version of whichever driver you're using. Certain drivers, including the Ruby driver, will require the upgrade, and all the drivers will provide extra features for connecting to replica sets.*

## Sharding

[Sharding](#) (page 493) is now production-ready, making MongoDB horizontally scalable, with no single point of failure. A single instance of [mongod](#) (page 925) can now be upgraded to a distributed cluster with zero downtime when the need arises.

- [Sharding](#) (page 493)
- [Deploy a Sharded Cluster](#) (page 522)
- [Convert a Replica Set to a Replicated Sharded Cluster](#) (page 530)

## Replica Sets

[Replica sets](#) (page 377), which provide automated failover among a cluster of n nodes, are also now available.

Please note that replica pairs are now deprecated; we strongly recommend that replica pair users upgrade to replica sets.

- [Replication](#) (page 377)
- [Deploy a Replica Set](#) (page 420)
- [Convert a Standalone to a Replica Set](#) (page 432)

<sup>123</sup><http://mongodb.org/downloads>

<sup>124</sup><https://jira.mongodb.org/secure/IssueNavigator.jspa?mode=hide&requestId=10172>

## Other Improvements

- The `w` option (and `writeConcern`) forces writes to be propagated to `n` servers before returning success (this works especially well with replica sets)
- [`\$or` queries](#) (page 625)
- Improved concurrency
- [`\$slice`](#) (page 650) operator for returning subsets of arrays
- 64 indexes per collection (formerly 40 indexes per collection)
- 64-bit integers can now be represented in the shell using `NumberLong`
- The [`findAndModify`](#) (page 710) command now supports upserts. It also allows you to specify fields to return
- `$showDiskLoc` option to see disk location of a document
- Support for IPv6 and UNIX domain sockets

## Installation

- Windows service improvements
- The C++ client is a separate tarball from the binaries

## 1.6.x Release Notes

- [1.6.5<sup>125</sup>](#)

## 1.5.x Release Notes

- [1.5.8<sup>126</sup>](#)
- [1.5.7<sup>127</sup>](#)
- [1.5.6<sup>128</sup>](#)
- [1.5.5<sup>129</sup>](#)
- [1.5.4<sup>130</sup>](#)
- [1.5.3<sup>131</sup>](#)
- [1.5.2<sup>132</sup>](#)
- [1.5.1<sup>133</sup>](#)
- [1.5.0<sup>134</sup>](#)

<sup>125</sup>[https://groups.google.com/forum/?fromgroups#!topic/mongodb-user/06\\_QCC05Fpk](https://groups.google.com/forum/?fromgroups#!topic/mongodb-user/06_QCC05Fpk)

<sup>126</sup><https://groups.google.com/forum/?fromgroups#!topic/mongodb-user/uJF1QN6Thk>

<sup>127</sup><https://groups.google.com/forum/?fromgroups#!topic/mongodb-user/OYvz40RWs90>

<sup>128</sup>[https://groups.google.com/forum/?fromgroups#!topic/mongodb-user/4l0N2U\\_H0cQ](https://groups.google.com/forum/?fromgroups#!topic/mongodb-user/4l0N2U_H0cQ)

<sup>129</sup><https://groups.google.com/forum/?fromgroups#!topic/mongodb-user/oO749nvTARY>

<sup>130</sup>[https://groups.google.com/forum/?fromgroups#!topic/mongodb-user/380V\\_Ec\\_q1c](https://groups.google.com/forum/?fromgroups#!topic/mongodb-user/380V_Ec_q1c)

<sup>131</sup><https://groups.google.com/forum/?hl=en&fromgroups#!topic/mongodb-user/hsUQL9CxTQw>

<sup>132</sup><https://groups.google.com/forum/?fromgroups#!topic/mongodb-user/94EE3HVidAA>

<sup>133</sup><https://groups.google.com/forum/?fromgroups#!topic/mongodb-user/7SBPQ2RSfdM>

<sup>134</sup><https://groups.google.com/forum/?fromgroups#!topic/mongodb-user/VAhJcjDGTy0>

You can see a full list of all changes on [JIRA](#)<sup>135</sup>.

Thank you everyone for your support and suggestions!

## 12.2.5 Release Notes for MongoDB 1.4

See the `full index of this page` for a complete list of changes included in 1.4.

- [Upgrading \(page 1073\)](#)
- [Core Server Enhancements \(page 1073\)](#)
- [Replication and Sharding \(page 1073\)](#)
- [Deployment and Production \(page 1073\)](#)
- [Query Language Improvements \(page 1074\)](#)
- [Geo \(page 1074\)](#)

### Upgrading

We're pleased to announce the 1.4 release of MongoDB. 1.4 is a drop-in replacement for 1.2. To upgrade you just need to shutdown `mongod` (page 925), then restart with the new binaries. (Users upgrading from release 1.0 should review the [1.2 release notes](#) (page 1074), in particular the instructions for upgrading the DB format.)

Release 1.4 includes the following improvements over release 1.2:

### Core Server Enhancements

- [\*concurrency\* \(page 596\) improvements](#)
- indexing memory improvements
- [\*background index creation\* \(page 336\)](#)
- better detection of regular expressions so the index can be used in more cases

### Replication and Sharding

- better handling for restarting slaves offline for a while
- fast new slaves from snapshots (`--fastsync`)
- configurable slave delay (`--slavedelay`)
- replication handles clock skew on master
- [`\$inc` \(page 651\) replication fixes](#)
- sharding alpha 3 - notably 2-phase commit on config servers

### Deployment and Production

- [\*configure “slow threshold” for profiling\* \(page 167\)](#)
- ability to do [`fsync + lock`](#) (page 751) for backing up raw files

<sup>135</sup><https://jira.mongodb.org/secure/IssueNavigator.jspa?mode=hide&requestId=10107>

- option for separate directory per db (`--directoryperdb`)
- `http://localhost:28017/_status` to get `serverStatus` via http
- REST interface is off by default for security (`--rest` to enable)
- can rotate logs with a db command, `logRotate` (page 760)
- enhancements to `serverStatus` (page 782) command (`db.serverStatus()`) - counters and `replication lag` (page 463) stats
- new `mongostat` (page 974) tool

## Query Language Improvements

- `$all` (page 645) with regex
- `$not` (page 627)
- partial matching of array elements `$elemMatch` (page 648)
- `$` operator for updating arrays
- `$addToSet` (page 657)
- `$unset` (page 655)
- `$pull` (page 658) supports object matching
- `$set` (page 655) with array indexes

## Geo

- `2d geospatial search` (page 330)
- geo `$center` (page 640) and `$box` (page 641) searches

## 12.2.6 Release Notes for MongoDB 1.2.x

See the [full index of this page](#) for a complete list of changes included in 1.2.

- New Features (page 1074)
- DB Upgrade Required (page 1075)
- Replication Changes (page 1075)
- mongoimport (page 1075)
- field filter changing (page 1075)

## New Features

- More indexes per collection
- Faster index creation
- Map/Reduce
- Stored JavaScript functions
- Configurable fsync time

- Several small features and fixes

## DB Upgrade Required

There are some changes that will require doing an upgrade if your previous version is  $\leq 1.0.x$ . If you're already using a version  $\geq 1.1.x$  then these changes aren't required. There are 2 ways to do it:

- --upgrade
  - stop your `mongod` (page 925) process
  - run `./mongod --upgrade`
  - start `mongod` (page 925) again
- use a slave
  - start a slave on a different port and data directory
  - when its synced, shut down the master, and start the new slave on the regular port.

Ask in the forums or IRC for more help.

## Replication Changes

- There have been minor changes in replication. If you are upgrading a master/slave setup from  $\leq 1.1.2$  you have to update the slave first.

## `mongoimport`

- `mongoimport json` has been removed and is replaced with `mongoimport` (page 965) that can do json/csv/tsv

## field filter changing

- We've changed the semantics of the field filter a little bit. Previously only objects with those fields would be returned. Now the field filter only changes the output, not which objects are returned. If you need that behavior, you can use `$exists` (page 629)

## 12.3 Current Development Series

### 12.3.1 Release Notes for MongoDB 2.6 (Development Series 2.5.x)

MongoDB 2.6 is currently in development, as part of the 2.5 development release series. While 2.5-series releases are currently available, these versions of MongoDB, including the 2.6 release candidate builds, are for **testing only and not for production use**.

This document will eventually contain the full release notes for MongoDB 2.6; before its release this document covers the 2.5 development series as a work-in-progress.

See the [full index of this page](#) for a complete list of changes included in 2.6 (Development Series 2.5.x).

- [Downloading](#) (page 1076)
- [Changes](#) (page 1076)
  - [SNMP Enterprise Identifier Changed](#) (page 1076)
  - [Default bind\\_ip for RPM and DEB Packages](#) (page 1076)
  - [Aggregation Pipeline Changes](#) (page 1077)
  - [Update Improvements](#) (page 1081)
  - [Sharding Improvements](#) (page 1082)
  - [Support for Auditing](#) (page 1083)
  - [isMaster Comand includes Wire Protocol Versions](#) (page 1083)
  - [SASL Library Change](#) (page 1084)
  - [LDAP Support for Authentication](#) (page 1084)
  - [x.509 Authentication](#) (page 1085)
  - [Limit for maxConns Removed](#) (page 1088)
  - [Background Index Builds Replicate to Secondaries](#) (page 1088)
  - [mongod Automatically Continues in Progress Index Builds Following Restart](#) (page 1088)
  - [Global mongorc.js File](#) (page 1088)
  - [Geospatial Enhancements](#) (page 1089)

## Downloading

You can download the 2.6 release candidate on the [downloads page](#)<sup>136</sup> in the *Development Release (Unstable)* section. There are no distribution packages for development releases, but you can use the binaries provided for testing purposes. See [Install MongoDB on Linux](#) (page 11), [Install MongoDB on Windows](#) (page 16), or [Install MongoDB on OS X](#) (page 13) for the basic installation process.

## Changes

**Important:** The MongoDB 2.5-series, which will become MongoDB 2.6, is for testing and development **only**. All identifiers, names, interfaces are subject to change. Do **not** use a MongoDB 2.5 release in production situations.

---

### SNMP Enterprise Identifier Changed

In 2.5.1, the IANA enterprise identifier for MongoDB changed from 37601 to 34601. Users of SNMP monitoring must modify their SNMP configuration (i.e. MIB) accordingly.

### Default bind\_ip for RPM and DEB Packages

In the packages provided by 10gen for MongoDB in RPM (Red Hat, CentOS, Fedora Linux, and derivatives) and DEB (Debian, Ubuntu, and derivatives,) the default [bind\\_ip](#) (page 991) value attaches MongoDB components to the localhost interface *only*. These packages set this default in the default configuration file (i.e. `/etc/mongod.conf`.)

If you use one of these packages and have *not* modified the default `/etc/mongod.conf` file, you will need to set [bind\\_ip](#) (page 991) before or during the upgrade.

There is no default [bind\\_ip](#) setting in any other 10gen distributions of MongoDB.

---

<sup>136</sup><http://www.mongodb.org/downloads>

## Aggregation Pipeline Changes

### \$out Stage to Write Data to a Collection

#### \$out

In an aggregation pipeline you may specify the name of a collection to a [\\$out](#) (page 1077) stage, which will write all documents in the aggregation pipeline to that collection.

---

**Important:** The input collection for the aggregation may be sharded; however, you may not specify a sharded collection to [\\$out](#) (page 1077).

---

[\\$out](#) (page 1077) will create a new collection if one does not already exist in the current database. This collection is not visible until the aggregation completes. If the aggregation fails, MongoDB will not create any collection.

If the output collection already exists, when the aggregation completes *successfully*, the [\\$out](#) (page 1077) atomically replaces the output collection with the new results collection. [\\$out](#) (page 1077) does not change any indexes that existed on the previous collection.

---

**Important:** The pipeline will fail to complete if the documents produced by the pipeline would violate any unique indexes, including the index on the `_id` field, that existed on the original output collection.

---

You may *only* specify [\\$out](#) (page 1077) at the end of a pipeline.

With [\\$out](#) (page 1077), the aggregation framework can return result sets of any size.

#### Example

The following operation will insert all documents in `records` collection into a collection named `users`. The inserted documents will *only* have the `_id`, `uid`, and `email` fields from the source documents:

```
db.records.aggregate({ $project: { uid: 1, email: 1 } },
 { $out: "users" })
```

---

**Aggregation Operation May Return a Cursor** The [aggregate](#) (page 694) may now return a cursor rather than a result document. Specify the `cursor` operation and an initial batch size as options to the [aggregate](#) (page 694) command to return a cursor object. In 2.5.2, the `temporary mongo` (page 942) shell helper `db.collection.aggregateCursor()` provides access to this capability.

By returning a cursor, aggregation pipelines can return result sets of any size. In previous versions, the result of an aggregation operation could be no larger than 16 megabytes.

The following command will return an aggregation cursor:

```
db.runCommand(
 { aggregate: "records",
 pipeline: [
 { $project: { name: { $toUpperCase: "$_id" }, _id: 0 } },
 { $sort: { name: 1 } }
],
 cursor: {}
 }
)
```

In the `mongo` (page 942) shell, you may use the `aggregateCursor()` method:

```
db.records.aggregateCursor(
 [
```

```
 { $project : { name: { $toUpperCase: "$_id" }, _id: 0 } },
 { $sort : { name: 1 } }
]
}
```

Cursors returned from the aggregation command are equivalent to cursors returned from `find()` (page 816) queries in every way.

You may specify an initial batch size using the following form:

```
db.runCommand(
 { aggregate: "records",
 pipeline: [
 { $project : { name: { $toUpperCase: "$_id" }, _id: 0 } },
 { $sort : { name : 1 } }
],
 cursor: { batchSize: 10 }
 }
)
```

The `{batchSize: 10}` document specifies the size of the *initial* batch size only. Specify subsequent batch sizes to `OP_GET_MORE`<sup>137</sup> operations as with other MongoDB cursors.

### Improved Sorting

New in version 2.5.2.

The `$sort` (page 670) and `$group` (page 669) stages now use a more efficient sorting system within the `mongod` (page 925) process. This improves performance for sorting operations that cannot rely on an index or that exceed the maximum memory use limit, see `Aggregation Sort Operation` (page 1018) for more information.

For large sort operations these “external sort” operations can write data to the `_tmp` directory in the `dbpath` (page 993) directory. To enable external sort use the new `allowDiskUsage` argument to the `aggregate` (page 694), as in the following prototype:

```
{
 aggregate: "<collection>",
 pipeline: [<pipeline>],
 allowDiskUsage: <boolean>
}
```

You can run this pipeline operation, using the following command:

```
db.runCommand(
 { aggregate: "records",
 pipeline: [
 { $project : { name: { $toUpperCase: "$_id" }, _id: 0 } },
 { $sort : { name : 1 } }
],
 cursor: { batchSize: 10 },
 allowDiskUsage: true
 }
)
```

### `$redact` Stage to Provide Filtering for Field-Level Access Control

#### `$redact`

New in version 2.5.2.

<sup>137</sup><http://docs.mongodb.org/meta-driver/latest/legacy/mongodb-wire-protocol/#wire-op-get-more>

---

Provides a method to restrict the content of a returned document on a per-field level.

---

### Example

Given a collection with the following document in a `test` collection:

```
{ a: {
 level: 1,
 b: {
 level: 5,
 c: {
 level: 1,
 message: "Hello"
 }
 },
 d: "World."
}
```

Consider the following aggregation operation:

```
db.test.aggregate(
 { $match: {} },
 { $redact: { $cond: [{ $lt: ['$level', 3] },,
 "$$CONTINUE",
 "$$PRUNE"]
 }
}
```

This operation evaluates every field at every level for all documents in the `test` collection, and uses the `$cond` (page 686) expression and the variables `$$CONTINUE` and `$$PRUNE` to specify the redaction of document parts in the aggregation pipeline.

---

**Important:** `$$CONTINUE` will become `$$DESCEND` in 2.5.3.

Specifically, if the field `level` is less than 3, (i.e. `{ $lt: [ '$level', 3 ] }`) `$redact` (page 1078) continues (i.e. `$$CONTINUE`) evaluating the fields and sub-documents at this level of the input document. If the value of `level` is greater than 3, then `$redact` (page 1078) removes all data at this level of the document.

The result of this aggregation operation is as follows:

```
{ a: {
 level: 1,
 d: "World."
}
```

You may also specify `$$KEEP` as a variable to `$cond` (page 686), which returns the entire sub-document without transversing, as `$$CONTINUE`.

---

### See

`$cond` (page 686).

---



---

**Set Expression Operations in `$project`** In 2.5.2, the `$project` (page 664) aggregation pipeline stage now supports the following set expressions:

**Important:** Set operators take arrays as their arguments and treat these arrays as sets. Except for [\\$setDifference](#) (page 1080), the set operators ignore duplicate entries in an input array and produce arrays containing unique entries.

---

#### **\$setIsSubset**

Takes two arrays and returns `true` when the first array is a subset of the second and `false` otherwise.

#### **\$setEquals**

Takes two arrays and returns `true` when they contain the same elements, and `false` otherwise.

#### **\$setDifference**

Takes two arrays and returns an array containing the elements that only exist in the first array. [\\$setDifference](#) (page 1080) may produce arrays containing duplicate items in 2.5.2 if the input array contains duplicate items.

#### **\$setIntersection**

Takes any number of arrays and returns an array that contains the elements that appear in every input array.

#### **\$setUnion**

Takes any number of arrays and returns an array that containing the elements that appear in any input array.

#### **\$all**

Takes a single array and returns `true` if all its values are `true` and `false` otherwise.

[\\$all](#) (page 1080) will become `$allElementsTrue` in 2.5.3.

#### **\$any**

Takes a single expression that returns an array and returns `true` if any of its values are `true` and `false` otherwise.

[\\$any](#) (page 1080) will become `$anyElementTrue` in 2.5.3.

### **\$map and \$let Expressions in Aggregation Pipeline Stages**

---

#### **Tip**

For [\\$let](#) (page 1080) and [\\$map](#) (page 1080), the aggregation framework introduces variables. To specify a variable, use the name of the variable prefixed by 2 dollar signs (i.e. `$$<name>`).

---

#### **\$let**

[\\$let](#) (page 1080) binds variables for use in sub-expressions. For example:

```
{ $project: { $let: { vars: { tally: 75, count: 50 } },
 in: { remaining: { $subtract: ["$$tally", "$$count"] } } } }
```

Would return a document with the following:

```
{ remaining: 25 }
```

[\\$let](#) (page 1080) is available the in [\\$project](#) (page 664), [\\$group](#) (page 669), and [\\$redact](#) (page 1078) pipeline stages.

#### **\$map**

[\\$map](#) (page 1080) applies a sub-expression to each item in an array and returns an array with the result of the sub-expression

[\\$map](#) (page 1080) is available the in [\\$project](#) (page 664), [\\$group](#) (page 669), and [\\$redact](#) (page 1078) pipeline stages.

Given an input document that resembles the following:

```
{ skews: [1, 1, 2, 3, 5, 8] }
```

And the following `$project` (page 664) statement:

```
{ $project: { adjustments: { $map: { input: "$skews",
 as: "adj",
 in: { $add: ["$$adj", 12] } } } } }
```

The `$map` (page 1080) would transform the input document into the following output document:

```
{ adjustments: [13, 13, 14, 15, 17, 20] }
```

**\$literal Expression for Aggregation Pipeline Stages** The new `$literal` (page 1081) operator allows users to explicitly specify documents in aggregation operations that the pipeline stage would otherwise interpret directly. For example, use `$literal` (page 1081) to project fields with dollar signs (e.g. `$`) in their values.

### `$literal`

Wraps an expression to prevent the aggregation pipeline from interpreting an object directly.

Consider the following example:

```
db.runCommand({ aggregate: "records",
 pipeline: [{ $project: { costsOneDollar:
 { $eq: ["$price", { $literal: "$1.00" }] } } }] })
```

This projects documents with a field named `costsOneDollar` that holds a boolean value if the value of the field is the string `$1.00`.

## Update Improvements

MongoDB 2.5.2 includes a new subsystem which provides more reliable and extensible update operations. 2.5.2 introduces two new changes to the update language:

### `$mul` Update Operator

#### `$mul`

The new `$mul` (page 1081) allows you to multiply the value of a field by the specified amount. If the field does not exist in a document, `$mul` (page 1081) sets field to the specified amount. Consider the following prototype:

---

#### Example

Given a collection named `records` with the following documents:

```
{ _id: 1, a: 1, b: 4 }
{ _id: 2, a: 1, b: 3 }
{ _id: 3, a: 1 }
```

Consider the following update operation:

```
db.records.update({ a: 1 },
 { $mul: { b: 5 } },
 { multi: true })
```

Following this operation, the collection would resemble the following:

```
{ _id: 1, a: 1, b: 20 }
{ _id: 2, a: 1, b: 15 }
{ _id: 3, a: 1, b: 5 }
```

---

**xor operation for \$bit Operator** The [\\$bit](#) (page 663) now supports bitwise updates using a logical `xor` operation. See the documentation of [\\$bit](#) (page 663) for more information on bitwise updates. Consider the following operation:

```
db.collection.update({ field: NumberInt(1) }, { $bit: { field: { xor: NumberInt(5) } } });
```

### Sharding Improvements

#### Support for Removing Orphan Data From Shards

New in version 2.5.2.

The new [cleanupOrphaned](#) (page 1082) is available to remove orphaned data from a sharded cluster. Orphaned data are those documents in a collection that exist on shards that belong to another shard in the cluster. Orphaned data are the result of failed migrations or incomplete migration cleanup due to abnormal shutdown.

##### **cleanupOrphaned**

[cleanupOrphaned](#) (page 1082) removes documents from *one* orphaned chunk range on shard and runs directly on the shard's [mongod](#) (page 925) instance, and requires the [clusterAdmin](#) (page 267) for systems running with [auth](#) (page 993). You do **not** need to disable the [balancer](#) to run [cleanupOrphaned](#) (page 1082).

In the common case, [cleanupOrphaned](#) (page 1082) takes the following form:

```
{ cleanupOrphaned: <namespace>, startingFromKey: { } }
```

The `startingFromKey` field specifies the lowest value of the [shard key](#) to begin searching for orphaned data. The empty document (i.e. `{ }`) is equivalent to the minimum value for the shard key (i.e. `$minValue`).

The [cleanupOrphaned](#) (page 1082) command returns a document that contains a field named `stoppedAtKey` that you can use to construct a loop, as in the following example in the [mongo](#) (page 942) shell:

```
use admin

var nextKey = {};

while (
 nextKey = db.runCommand({ cleanupOrphaned : "test.user", startingFromKey : nextKey }).stop
) { printjson(nextKey); }
```

This loop removes all orphaned data on the shard.

#### Ability to Merge Co-located Contiguous Chunks

New in version 2.5.2.

The [mergeChunks](#) (page 1082) provides the ability for users to combine contiguous chunks located on a single shard. This makes it possible to combine chunks in situations where document removal leaves a sharded collection with too many empty chunks.

##### **mergeChunks**

Combines two contiguous chunks located on the same shard. The [mergeChunks](#) (page 1082) takes the following form:

```
{ mergeChunks: <namespace>, bounds: [<minKey>, <maxKey>] }
```

The `bounds` option specified to [mergeChunks](#) (page 1082) *must* be the boundaries of existing chunks in the collections. See the output of [sh.status\(\)](#) (page 910) to see the current shard boundaries.

**Important:** Both chunks **must** reside on the same shard.

---

**Tip**

In 2.5.2, [mergeChunks](#) (page 1082) has the following restrictions, which are subject to change in future releases:

- [mergeChunks](#) (page 1082) will only merge two chunks.
  - one chunk **must** not hold any documents (i.e. an “empty chunk”).
- 

**Support for Auditing**

New in version 2.5.2.

MongoDB adds features to audit server and client activity for [mongod](#) (page 925) and [mongos](#) (page 938) instances.

**Important:** Auditing, like all new features in 2.5.2, is in ongoing development. Specifically the interface, output format, audited events and the structure of audited events will change significantly in the in the 2.5 series before the release of 2.6.

---

To enable auditing, start [mongod](#) (page 925) or [mongos](#) (page 938) with the following argument:

```
--setParameter auditLogPath=<option>
```

The value of <option> is one of the following:

- a path. This may be the same as the [logpath](#) (page 992) for MongoDB’s process log. If you specify the same log file, then the path specification must be *exactly* the same as the [logpath](#) (page 992) specification.
  - the string :[console](#) to output audit log messages to standard output.
  - the string :[syslog](#) to output audit log messages to the system’s syslog facility.
- 

**Tip**

As of 2.5.2 auditing does not support filtering of audit events.

---

**[isMaster](#) Comand includes Wire Protocol Versions**

New in version 2.5.2.

In order to support changes to the wire protocol both now and in the future, the output of [isMaster](#) (page 732) now contains two new fields that report the earliest version of the wire protocol that this [mongod](#) (page 925) instance supports and the highest version of the wire protocol that this [mongo](#) (page 942) instance supports.

**[isMaster](#).maxWireVersion**

The latest version of the wire protocol that this [mongod](#) (page 925) or [mongos](#) (page 938) instance is capable of using to communicate with clients.

**[isMaster](#).minWireVersion**

The earliest version of the wire protocol that this [mongod](#) (page 925) or [mongos](#) (page 938) instance is capable of using to communicate with clients.

## SASL Library Change

MongoDB Enterprise uses Cyrus SASL instead of GNU SASL (libgsasl). This change has the following SASL2 and Cyrus SASL library and GSSAPI plugin dependencies:

For Debian or Ubuntu, install the following:

```
sudo apt-get install cyrus-sasl2-dbg cyrus-sasl2-mit-dbg libsasl2-2 libsasl2-dev libsasl2-modules lib
```

For CentOS, Red Hat Enterprise Linux, and Amazon AMI, install the following:

```
sudo yum install cyrus-sasl cyrus-sasl-lib cyrus-sasl-devel cyrus-sasl-gssapi
```

For SUSE, install the following:

```
sudo zypper install cyrus-sasl cyrus-sasl-devel cyrus-sasl-gssapi
```

## LDAP Support for Authentication

MongoDB Enterprise provides support for proxy authentication of users. This change allows administrators to configure a MongoDB cluster to authenticate users via Linux PAM or by proxying authentication requests to a specified LDAP service.

**Warning:** Because this change uses SASL PLAIN mechanism to transmit the user password to the MongoDB server, you should, in general, use only on a trusted channel (VPN, SSL, trusted wired network).

**Configuration** LDAP support for user authentication requires proper configuration of the saslauthd daemon process as well as introduces a new server parameter, saslauthdPath. saslauthdPath is the path to the Unix Domain Socket of the saslauthd instance to use for proxy authentication.

**saslauthd Configuration** On systems that configure saslauthd with a /etc/sysconfig/saslauthd file, such as Red Hat Enterprise Linux, Fedora, CentOS, Amazon Linux AMI, set the mechanism MECH to ldap:

```
MECH=ldap
```

On systems that configure saslauthd with a /etc/default/saslauthd file, set the mechanisms option to ldap:

```
MECHANISMS="ldap"
```

To use with *ActiveDirectory*, start saslauthd with the following configuration options:

```
ldap_servers: <ldap uri, e.g. ldaps://ad.example.net>
ldap_use_sasl: yes
ldap_mech: DIGEST-MD5
ldap_auth_method: fastbind
```

To connect to an OpenLDAP server, use a test saslauthd.conf with the following content:

```
ldap_servers: <ldap uri, e.g. ldaps://ad.example.net>
ldap_search_base: ou=Users,dc=example,dc=com
ldap_filter: (uid=%u)
```

To use this sample OpenLDAP configuration, create users with a uid attribute (login name) and place under the Users organizational unit (ou).

To test the saslauthd configuration, use `testsaslauthd` utility, as in the following example:

```
testsaslauthd -u testuser -p testpassword -s mongod -f /var/run/saslauthd/mux
```

For more information on saslauthd configuration, see <http://www.openldap.org/doc/admin24/guide.html#Configuringsaslauthd>.

**MongoDB Server Configuration** Configure the MongoDB server with the `authenticationMechanisms` parameter and the `saslauthdPath` parameters using either the command line option `--setParameter` or the *configuration file* (page 990):

- If `saslauthd` has a socket path of `/<some>/<path>/saslauthd`, set the `saslauthdPath` parameter to `/<some>/<path>/saslauthd/mux` and the `authenticationMechanisms` parameter to `PLAIN`, as in the following command line example:

```
mongod --setParameter saslauthdPath=/<some>/<path>/saslauthd/mux --setParameter authenticationMechanisms=PLAIN
```

Or to set the configuration in the *configuration file* (page 990), add the parameters:

```
setParameter=saslauthdPath=/<some>/<path>/saslauthd/mux
setParameter=authenticationMechanisms=PLAIN
```

- Otherwise, set the `saslauthdPath` to the empty string `""` to use the library's default value and the `authenticationMechanisms` parameter to `PLAIN`, as in the following command line example:

```
mongod --setParameter saslauthdPath="" --setParameter authenticationMechanisms=PLAIN
```

Or to set the configuration in the *configuration file* (page 990), add the parameters:

```
setParameter=saslauthdPath=""
setParameter=authenticationMechanisms=PLAIN
```

**Authenticate in the mongo Shell** To use this authentication mechanism in the `mongo` (page 942) shell, you **must** pass `digestPassword: false` to `db.auth()` (page 876) when authenticating on the `$external` database, since the server must receive an undigested password to forward on to `saslauthd`, as in the following example:

```
use $external
db.auth(
{
 mechanism: "PLAIN",
 user: "application/reporting@EXAMPLE.NET",
 pwd: "someInterestingPwd",
 digestPassword: false
})
```

## x.509 Authentication

MongoDB introduces x.509 certificate authentication for use with a secure *SSL connection* (page 249).

---

**Important:** To use SSL, you must either use MongoDB Enterprise or build MongoDB locally using `scons` with the `--ssl` option.

---

The x.509 authentication allows clients to authenticate to servers with certificates instead of with username and password.

The x.509 authentication also allows sharded cluster members and replica set members to use x.509 certificates to verify their membership to the cluster or the replica set instead of using key files. The membership authentication is an internal process.

**x.509 Certificate** The x.509 certificate for client authentication and the x.509 certificate for internal authentication have different properties.

The client certificate must have the following properties:

- A single Certificate Authority (CA) must issue the certificates for both the client and the server.
- Client certificates must contain the following fields:

```
keyUsage = digitalSignature
extendedKeyUsage = clientAuth
```

The member certificate, used for internal authentication to verify membership to the sharded cluster or a replica set, must have the following properties:

- A single Certificate Authority (CA) must issue all the x.509 certificates for the members of a sharded cluster or a replica set.
- The member certificate's `subject`, which contains the Distinguished Name (DN), must match the `subject` of the certificate on the server, *starting from and including* the Organizational Unit (OU) of the certificate on the server.

**New Protocol and Parameters** The change for x.509 authentication introduces a new MONGODB-X509 protocol. For internal authentication for membership, the change also introduces the `--clusterAuthMode`, `--sslClusterFile` and the `--sslClusterPassword` options.

Use the `--clusterAuthMode` option to enable internal x.509 authentication for membership. The `--clusterAuthMode` option can have one of the following values:

| Value                    | Description                                                                                                                     |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| <code>keyfile</code>     | Default value. Use keyfile for authentication.                                                                                  |
| <code>sendKeyfile</code> | For rolling upgrade purposes. Send the keyfile for authentication but can accept either keyfile or x.509 certificate.           |
| <code>sendX509</code>    | For rolling upgrade purposes. Send the x.509 certificate for authentication but can accept either keyfile or x.509 certificate. |
| <code>x509</code>        | Recommended. Send the x.509 certificate for authentication and accept <b>only</b> x.509 certificate.                            |

For the `--sslClusterFile` option, specify the full path to the x.509 certificate and key PEM file for the cluster or set member. If the key is encrypted, specify the password with the `--sslClusterPassword` option.

**Configure MongoDB Server to Use x.509** Configure the MongoDB server from the command line, as in the following <sup>[138](#)</sup>:

```
mongod --sslOnNormalPorts --sslPEMKeyFile <path to sslCertificate and key PEM file> --sslCAFile <path
```

You may also specify these options in the *configuration file* (page 990):

```
sslOnNormalPorts = true
sslPEMKeyFile = <path to sslCertificate and key PEM file>
sslCAFile = <path to the root CA PEM file>
```

---

<sup>138</sup> Include any additional options, SSL or otherwise, that are required for your specific configuration.

To specify the x.509 certificate for internal cluster member authentication, append the additional SSL options `--clusterAuthMode` and `--sslClusterFile`, as in the following example for a member of a replica set 2:

```
mongod --replSet <name> --sslOnNormalPorts --sslPEMKeyFile <path to sslCertificate and key PEM file>
```

**Authenticate with a x.509 Certificate** To authenticate with a client certificate, you must first add a MongoDB user that corresponds to the client certificate. See [Add x.509 Certificate subject as a User](#) (page 1087).

To authenticate, use the `db.auth()` (page 876) method in the `$external` database. For the `mechanism` field, specify "MONGODB-X509", and for the `user` field, specify the user, or the `subject`, that corresponds to the client certificate.

For example, if using the `mongo` (page 942) shell,

1. Connect `mongo` (page 942) shell to the `mongod` (page 925) set up for SSL:

```
mongo --ssl --sslPEMKeyFile <path to CA signed client PEM file>
```

2. To perform the authentication, use the `db.auth()` (page 876) method in the `$external` database.

```
db.getSiblingDB("$external").auth(
 {
 mechanism: "MONGODB-X509",
 user: "CN=myName,OU=myOrgUnit,O=myOrg,L=myLocality,ST=myState"
 }
)
```

**Add x.509 Certificate subject as a User** To authenticate with a client certificate, you must first add the value of the `subject` from the client certificate as a MongoDB user.

1. You can retrieve the `subject` from the client certificate with the following command:

```
openssl x509 -in <pathToClient PEM> -inform PEM -subject -nameopt RFC2253
```

The command returns the `subject` string as well as certificate:

```
subject= CN=myName,OU=myOrgUnit,O=myOrg,L=myLocality,ST=myState,C=myCountry
-----BEGIN CERTIFICATE-----
...
-----END CERTIFICATE-----
```

2. Add the value of the `subject`, omitting the spaces, from the certificate as a user. For example, in the `mongo` (page 942) shell, to add the user to the `test` database:

```
use test
db.addUser({
 user: "CN=myName,OU=myOrgUnit,O=myOrg,L=myLocality,ST=myState,C=myCountry",
 userSource: '$external',
 roles: ['readAnyDatabase', 'readWriteAnyDatabase']
})
```

See [Add a User to a Database](#) (page 257) for details on adding a user with roles using [privilege documents](#) (page 270).

**Upgrade Clusters to x.509 Authentication** To upgrade clusters that are currently using keyfile authentication to x.509 authentication, use a rolling upgrade process:

1. For each node of a cluster, set `--clusterAuthMode` to `sendKeyFile`. With this setting, each node continues to use its keyfile to authenticate itself as a member. However, each node can now accept either a keyfile or the x.509 certificate from other members to authenticate those members. Upgrade all nodes of the cluster to this setting.
2. Then, for each node of a cluster, set `--clusterAuthMode` to `sendX509` and set `--sslClusterFile` to the appropriate path of the node's certificate.<sup>139</sup> With this setting, each node uses its x.509 certificate to authenticate itself as a member. However, each node continues to accept either a keyfile or the x.509 certificate from other members to authenticate those members. Upgrade all nodes of the cluster to this setting.
3. Optional but recommended. Finally, for each node of the cluster, set `--clusterAuthMode` to `x509` to only use the x.509 certificate for authentication.

### Limit for `maxConns` Removed

Starting in MongoDB 2.5.0, there is no longer any upward limit for the `maxConns` (page 992), or `mongod --maxConns` and `mongos --maxConns` options. Previous versions capped the maximum possible `maxConns` (page 992) setting at 20,000 connections.

### Background Index Builds Replicate to Secondaries

Starting in MongoDB 2.5.0, if you initiate a *background index build* (page 336) on a *primary*, the secondaries will replicate the index build in the background. In previous versions of MongoDB, secondaries built all indexes in the foreground, even if the primary built an index in the background.

For all index builds, secondaries will not begin building indexes until the primary has successfully completed the index build.

### `mongod` Automatically Continues in Progress Index Builds Following Restart

If your `mongod` (page 925) instance was building an index when it shutdown or terminated, `mongod` (page 925) will now continue building the index when the `mongod` (page 925) restarts. Previously, the index build *had* to finish building before `mongod` (page 925) shutdown.

To disable this behavior the 2.5 series adds a new run time option, `noIndexBuildRetry` (page 1088) (or via, `--noIndexBuildRetry` on the command line,) for `mongod` (page 925). `noIndexBuildRetry` (page 1088) prevents `mongod` (page 925) from continuing rebuilding indexes that did not finished building when the `mongod` (page 925) last shut down.

#### `noIndexBuildRetry`

By default, `mongod` (page 925) will attempt to rebuild indexes upon start-up *if* `mongod` (page 925) shuts down or stops in the middle of an index build. When enabled, this option prevents this behavior.

### Global `mongorc.js` File

If the file `mongorc.js` exists in the `/etc` directory (or `%ProgramData%\MongoDB` directory on Windows), the `mongo` (page 942) shell evaluates the contents of this file on start-up. Then, the `mongo` (page 942) shell evaluates the user's `.mongorc.js` file if the file exists in the user's `HOME` directory.

The `--norc` (page 943) option for `mongo` (page 942) suppresses only the user's `.mongorc.js` file.

---

**Important:** The `mongorc.js` in `/etc` directory must have read permission for the user running the shell.

<sup>139</sup> If the key is encrypted, set the `--sslClusterPassword` to the password to decrypt the key.

## Geospatial Enhancements

New in version 2.5.2.

MongoDB added support for the following GeoJSON<sup>140</sup> object types for use with *2dsphere indexes* (page 328):

- MultiPoint<sup>141</sup>
- MultiLineString<sup>142</sup>
- MultiPolygon<sup>143</sup>
- GeometryCollection<sup>144</sup>

## 12.4 Other MongoDB Release Notes

### 12.4.1 Default Write Concern Change

These release notes outline a change to all driver interfaces released in November 2012. See release notes for specific drivers for additional information.

#### Changes

As of the releases listed below, there are two major changes to all drivers:

1. All drivers will add a new top-level connection class that will increase consistency for all MongoDB client interfaces.

This change is non-backward breaking: existing connection classes will remain in all drivers for a time, and will continue to operate as expected. However, those previous connection classes are now deprecated as of these releases, and will eventually be removed from the driver interfaces.

The new top-level connection class is named `MongoClient`, or similar depending on how host languages handle namespacing.

2. The default write concern on the new `MongoClient` class will be to acknowledge all write operations <sup>145</sup>. This will allow your application to receive acknowledgment of all write operations.

See the documentation of *Write Concern* (page 55) for more information about write concern in MongoDB.

Please migrate to the new `MongoClient` class expeditiously.

<sup>140</sup><http://geojson.org/geojson-spec.html>

<sup>141</sup><http://geojson.org/geojson-spec.html#id5>

<sup>142</sup><http://geojson.org/geojson-spec.html#id6>

<sup>143</sup><http://geojson.org/geojson-spec.html#id7>

<sup>144</sup><http://geojson.org/geojson-spec.html#geometrycollection>

<sup>145</sup> The drivers will call `getLastError` (page 720) without arguments, which is logically equivalent to the `w: 1` option; however, this operation allows *replica set* users to override the default write concern with the `getLastErrorDefaults` (page 483) setting in the *Replica Set Configuration* (page 479).

## Releases

The following driver releases will include the changes outlined in [Changes](#) (page 1089). See each driver's release notes for a full account of each release as well as other related driver-specific changes.

- C#, version 1.7
- Java, version 2.10.0
- Node.js, version 1.2
- Perl, version 0.501.1
- PHP, version 1.4
- Python, version 2.4
- Ruby, version 1.8

## 12.5 MongoDB Version Numbers

For MongoDB 2.4.1, 2.4 refers to the release series and .1 refers to the revision. The second component of the release series (e.g. 4 in 2.4.1) describes the type of release series. Release series ending with even numbers (e.g. 4 above) are *stable* and ready for production, while odd numbers are for *development* and testing only.

Generally, changes in the release series (e.g. 2.2 to 2.4) mark the introduction of new features that may break backwards compatibility. Changes to the revision number mark the release bug fixes and backwards-compatible changes.

---

**Important:** Always upgrade to the latest stable revision of your release series.

The version numbering system for MongoDB differs from the system used for the MongoDB drivers. Drivers use only the first number to indicate a major version. For details, see [Driver Version Numbers](#) (page 96).

---

### Example

Version numbers

- 2.0.0 : Stable release.
  - 2.0.1 : Revision.
  - 2.1.0 : Development release *for testing only*. Includes new features and changes for testing. Interfaces and stability may not be compatible in development releases.
  - 2.2.0 : Stable release. This is a culmination of the 2.1.x development series.
-

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## About MongoDB Documentation

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The MongoDB Manual<sup>1</sup> contains comprehensive documentation on the MongoDB *document*-oriented database management system. This page describes the manual's licensing, editions, and versions, and describes how to make a change request and how to contribute to the manual.

For more information on MongoDB, see [MongoDB: A Document Oriented Database](#)<sup>2</sup>. To download MongoDB, see the [downloads page](#)<sup>3</sup>.

### 13.1 License

This manual is licensed under a Creative Commons “Attribution-NonCommercial-ShareAlike 3.0 Unported<sup>4</sup>” (i.e. “CC-BY-NC-SA”) license.

The MongoDB Manual is copyright © 2011-2013 MongoDB, Inc.

### 13.2 Editions

In addition to the [MongoDB Manual](#)<sup>5</sup>, you can also access this content in the following editions:

- [ePub Format](#)<sup>6</sup>
- [Single HTML Page](#)<sup>7</sup>
- [PDF Format](#)<sup>8</sup>
- [HTML tar.gz](#)<sup>9</sup>

You also can access PDF files that contain subsets of the MongoDB Manual:

- [MongoDB Reference Manual](#)<sup>10</sup>
- [MongoDB CRUD Operations](#)<sup>11</sup>

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<sup>1</sup><http://docs.mongodb.org/manual/#>

<sup>2</sup><http://www.mongodb.org/about/>

<sup>3</sup><http://www.mongodb.org/downloads>

<sup>4</sup><http://creativecommons.org/licenses/by-nc-sa/3.0/>

<sup>5</sup><http://docs.mongodb.org/manual/#>

<sup>6</sup><http://docs.mongodb.org/master/MongoDB-manual.epub>

<sup>7</sup><http://docs.mongodb.org/master/single/>

<sup>8</sup><http://docs.mongodb.org/master/MongoDB-manual.pdf>

<sup>9</sup><http://docs.mongodb.org/master/MongoDB-manual.tar.gz>

<sup>10</sup><http://docs.mongodb.org/master/MongoDB-reference-manual.pdf>

<sup>11</sup><http://docs.mongodb.org/master/MongoDB-crud-guide.pdf>

- MongoDB Data Aggregation<sup>12</sup>
- Replication and MongoDB<sup>13</sup>
- Sharding and MongoDB<sup>14</sup>
- MongoDB Administration<sup>15</sup>
- MongoDB Security<sup>16</sup>

MongoDB Reference documentation is also available as part of dash<sup>17</sup>. You can also access the MongoDB Man Pages<sup>18</sup> which are also distributed with the official MongoDB Packages.

## 13.3 Version and Revisions

This version of the manual reflects version 2.4 of MongoDB.

See the [MongoDB Documentation Project Page](#)<sup>19</sup> for an overview of all editions and output formats of the MongoDB Manual. You can see the full revision history and track ongoing improvements and additions for all versions of the manual from its [GitHub repository](#)<sup>20</sup>.

This edition reflects “master” branch of the documentation as of the “79c16860e77d678e9d112401aa0a6b47f4a21526” revision. This branch is explicitly accessible via “<http://docs.mongodb.org/master>” and you can always reference the commit of the current manual in the [release.txt](#)<sup>21</sup> file.

The most up-to-date, current, and stable version of the manual is always available at “<http://docs.mongodb.org/manual/>”.

## 13.4 Report an Issue or Make a Change Request

To report an issue with this manual or to make a change request, file a ticket at the [MongoDB DOCS Project on Jira](#)<sup>22</sup>.

## 13.5 Contribute to the Documentation

### 13.5.1 MongoDB Manual Translation

The original authorship language for all MongoDB documentation is American English. However, ensuring that speakers of other languages can read and understand the documentation is of critical importance to the documentation project.

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<sup>12</sup><http://docs.mongodb.org/master/MongoDB-aggregation-guide.pdf>

<sup>13</sup><http://docs.mongodb.org/master/MongoDB-replication-guide.pdf>

<sup>14</sup><http://docs.mongodb.org/master/MongoDB-sharding-guide.pdf>

<sup>15</sup><http://docs.mongodb.org/master/MongoDB-administration-guide.pdf>

<sup>16</sup><http://docs.mongodb.org/master/MongoDB-security-guide.pdf>

<sup>17</sup><http://kapeli.com/dash>

<sup>18</sup><http://docs.mongodb.org/master/manpages.tar.gz>

<sup>19</sup><http://docs.mongodb.org>

<sup>20</sup><https://github.com/mongodb/docs>

<sup>21</sup><http://docs.mongodb.org/master/release.txt>

<sup>22</sup><https://jira.mongodb.org/browse/DOCS>

In this direction, the MongoDB Documentation project uses the service provided by [Smartling](#)<sup>23</sup> to translate the MongoDB documentation into additional non-English languages. This translation project is largely supported by the work of volunteer translators from the MongoDB community who contribute to the translation effort.

If you would like to volunteer to help translate the MongoDB documentation, please:

- complete the [MongoDB Contributor Agreement](#)<sup>24</sup>, and
- create an account on Smartling at [translate.docs.mongodb.org](http://translate.docs.mongodb.org)<sup>25</sup>.

Please use the same email address you use to sign the contributor as you use to create your Smartling account.

The [mongodb-translators](#)<sup>26</sup> user group exists to facilitate collaboration between translators and the documentation team at large. You can join the Google Group without signing the contributor's agreement.

We currently have the following languages configured:

- Arabic<sup>27</sup>
- Chinese<sup>28</sup>
- Czech<sup>29</sup>
- French<sup>30</sup>
- German<sup>31</sup>
- Hungarian<sup>32</sup>
- Indonesian<sup>33</sup>
- Italian<sup>34</sup>
- Japanese<sup>35</sup>
- Korean<sup>36</sup>
- Lithuanian<sup>37</sup>
- Polish<sup>38</sup>
- Portuguese<sup>39</sup>
- Romanian<sup>40</sup>
- Russian<sup>41</sup>
- Spanish<sup>42</sup>

<sup>23</sup><http://smartling.com/>

<sup>24</sup><http://www.mongodb.com/legal/contributor-agreement>

<sup>25</sup><http://translate.docs.mongodb.org/>

<sup>26</sup><http://groups.google.com/group/mongodb-translators>

<sup>27</sup><http://ar.docs.mongodb.org>

<sup>28</sup><http://cn.docs.mongodb.org>

<sup>29</sup><http://cs.docs.mongodb.org>

<sup>30</sup><http://fr.docs.mongodb.org>

<sup>31</sup><http://de.docs.mongodb.org>

<sup>32</sup><http://hu.docs.mongodb.org>

<sup>33</sup><http://id.docs.mongodb.org>

<sup>34</sup><http://it.docs.mongodb.org>

<sup>35</sup><http://jp.docs.mongodb.org>

<sup>36</sup><http://ko.docs.mongodb.org>

<sup>37</sup><http://lt.docs.mongodb.org>

<sup>38</sup><http://pl.docs.mongodb.org>

<sup>39</sup><http://pt.docs.mongodb.org>

<sup>40</sup><http://ro.docs.mongodb.org>

<sup>41</sup><http://ru.docs.mongodb.org>

<sup>42</sup><http://es.docs.mongodb.org>

- [Turkish<sup>43</sup>](#)
- [Ukrainian<sup>44</sup>](#)

If you would like to initiate a translation project to an additional language, please report this issue using the “*Report a Problem*” link above or by posting to the [mongodb-translators<sup>45</sup>](#) list.

Currently the translation project only publishes rendered translation. While the translation effort is currently focused on the web site we are evaluating how to retrieve the translated phrases for use in other media.

### See also:

- [Contribute to the Documentation](#) (page 1092)
- [Style Guide and Documentation Conventions](#) (page 1094)
- [MongoDB Manual Organization](#) (page 1102)
- [MongoDB Documentation Practices and Processes](#) (page 1098)
- [MongoDB Documentation Build System](#) (page 1103)

The entire documentation source for this manual is available in the [mongodb/docs](#) repository<sup>46</sup>, which is one of the MongoDB project repositories on [GitHub<sup>47</sup>](#).

To contribute to the documentation, you can open a [GitHub account<sup>48</sup>](#), fork the [mongodb/docs](#) repository<sup>49</sup>, make a change, and issue a pull request.

In order for the documentation team to accept your change, you must complete the [MongoDB Contributor Agreement<sup>50</sup>](#).

You can clone the repository by issuing the following command at your system shell:

```
git clone git://github.com/mongodb/docs.git
```

### 13.5.2 About the Documentation Process

The MongoDB Manual uses [Sphinx<sup>51</sup>](#), a sophisticated documentation engine built upon [Python Docutils<sup>52</sup>](#). The original [reStructured Text<sup>53</sup>](#) files, as well as all necessary Sphinx extensions and build tools, are available in the same repository as the documentation.

For more information on the MongoDB documentation process, see:

#### Style Guide and Documentation Conventions

This document provides an overview of the style for the MongoDB documentation stored in this repository. The overarching goal of this style guide is to provide an accessible base style to ensure that our documentation is easy to read, simple to use, and straightforward to maintain.

For information regarding the MongoDB Manual organization, see [MongoDB Manual Organization](#) (page 1102).

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<sup>43</sup><http://tr.docs.mongodb.org>

<sup>44</sup><http://uk.docs.mongodb.org>

<sup>45</sup><http://groups.google.com/group/mongodb-translators>

<sup>46</sup><https://github.com/mongodb/docs>

<sup>47</sup><http://github.com/mongodb>

<sup>48</sup><https://github.com/>

<sup>49</sup><https://github.com/mongodb/docs>

<sup>50</sup><http://www.mongodb.com/contributor>

<sup>51</sup><http://sphinx-doc.org/>

<sup>52</sup><http://docutils.sourceforge.net/>

<sup>53</sup><http://docutils.sourceforge.net/rst.html>

## Document History

**2011-09-27:** Document created with a (very) rough list of style guidelines, conventions, and questions.

**2012-01-12:** Document revised based on slight shifts in practice, and as part of an effort of making it easier for people outside of the documentation team to contribute to documentation.

**2012-03-21:** Merged in content from the Jargon, and cleaned up style in light of recent experiences.

**2012-08-10:** Addition to the “Referencing” section.

**2013-02-07:** Migrated this document to the manual. Added “map-reduce” terminology convention. Other edits.

## Naming Conventions

This section contains guidelines on naming files, sections, documents and other document elements.

- File naming Convention:
  - For Sphinx, all files should have a `.txt` extension.
  - Separate words in file names with hyphens (i.e. `-`.)
  - For most documents, file names should have a terse one or two word name that describes the material covered in the document. Allow the path of the file within the document tree to add some of the required context/categorization. For example it’s acceptable to have `http://docs.mongodb.org/manualcore/sharding.rst` and `http://docs.mongodb.org/manualadministration/sharding.rst`.
  - For tutorials, the full title of the document should be in the file name. For example, `http://docs.mongodb.org/manualtutorial/replace-one-configuration-server-in-a-shard-`
- Phrase headlines and titles so that they the content contained within the section so that users can determine what questions the text will answer, and material that it will address without needing them to read the content. This shortens the amount of time that people spend looking for answers, and improvise search/scanning, and possibly “SEO.”
- Prefer titles and headers in the form of “Using foo” over “How to Foo.”
- When using target references (i.e. `:ref:` references in documents,) use names that include enough context to be intelligible thought all documentations. For example, use “replica-set-secondary-only-node” as opposed to “secondary-only-node”. This is to make the source more usable and easier to maintain.

## Style Guide

This includes the local typesetting, English, grammatical, conventions and preferences that all documents in the manual should use. The goal here is to choose good standards, that are clear, and have a stylistic minimalism that does not interfere with or distract from the content. A uniform style will improve user experience, and minimize the effect of a multi-authored document.

## Punctuation

- Use the oxford comma.
- Oxford commas are the commas in a list of things (e.g. “something, something else, and another thing”) before the conjunction (e.g. “and” or “or.”).
- Do not add two spaces after terminal punctuation, such as periods.

- Place commas and periods inside quotation marks.
- Use title case for headings and document titles. Title case capitalizes the first letter of the first, last, and all significant words.

### Verbs Verb tense and mood preferences, with examples:

- **Avoid** the first person. For example do not say, “We will begin the backup process by locking the database,” or “I begin the backup process by locking my database instance.”
- **Use** the second person. “If you need to back up your database, start by locking the database first.” In practice, however, it’s more concise to imply second person using the imperative, as in “Before initiating a backup, lock the database.”
- When indicated, use the imperative mood. For example: “Backup your databases often” and “To prevent data loss, back up your databases.”
- The future perfect is also useful in some cases. For example, “Creating disk snapshots without locking the database will lead to an inconsistent state.”
- Avoid helper verbs, as possible, to increase clarity and concision. For example, attempt to avoid “this does foo” and “this will do foo” when possible. Use “does foo” over “will do foo” in situations where “this foos” is unacceptable.

### Referencing

- To refer to future or planned functionality in MongoDB or a driver, *always* link to the Jira case. The Manual’s `conf.py` provides an `:issue:` role that links directly to a Jira case (e.g. `:issue:\`SERVER-9001\``).
- For non-object references (i.e. functions, operators, methods, database commands, settings) always reference only the first occurrence of the reference in a section. You should *always* reference objects, except in section headings.
- Structure references with the *why* first; the link second.

For example, instead of this:

Use the *Convert a Replica Set to a Replicated Sharded Cluster* (page 530) procedure if you have an existing replica set.

Type this:

To deploy a sharded cluster for an existing replica set, see *Convert a Replica Set to a Replicated Sharded Cluster* (page 530).

### General Formulations

- Contractions are acceptable insofar as they are necessary to increase readability and flow. Avoid otherwise.
- Make lists grammatically correct.
  - Do not use a period after every item unless the list item completes the unfinished sentence before the list.
  - Use appropriate commas and conjunctions in the list items.
  - Typically begin a bulleted list with an introductory sentence or clause, with a colon or comma.
- The following terms are one word:
  - standalone
  - workflow

- Use “unavailable,” “offline,” or “unreachable” to refer to a mongod instance that cannot be accessed. Do not use the colloquialism “down.”
- Always write out units (e.g. “megabytes”) rather than using abbreviations (e.g. “MB”).

## Structural Formulations

- There should be at least two headings at every nesting level. Within an “h2” block, there should be either: no “h3” blocks, 2 “h3” blocks, or more than 2 “h3” blocks.
- Section headers are in title case (capitalize first, last, and all important words) and should effectively describe the contents of the section. In a single document you should strive to have section titles that are not redundant and grammatically consistent with each other.
- Use paragraphs and paragraph breaks to increase clarity and flow. Avoid burying critical information in the middle of long paragraphs. Err on the side of shorter paragraphs.
- Prefer shorter sentences to longer sentences. Use complex formations only as a last resort, if at all (e.g. compound complex structures that require semi-colons).
- Avoid paragraphs that consist of single sentences as they often represent a sentence that has unintentionally become too complex or incomplete. However, sometimes such paragraphs are useful for emphasis, summary, or introductions.

As a corollary, most sections should have multiple paragraphs.

- For longer lists and more complex lists, use bulleted items rather than integrating them inline into a sentence.
- Do not expect that the content of any example (inline or blocked,) will be self explanatory. Even when it feels redundant, make sure that the function and use of every example is clearly described.

## ReStructured Text and Typesetting

- Place spaces between nested parentheticals and elements in JavaScript examples. For example, prefer { [ a, a, ] } over { [a,a,a] }.
- For underlines associated with headers in RST, use:
  - = for heading level 1 or h1s. Use underlines and overlines for document titles.
  - – for heading level 2 or h2s.
  - ~ for heading level 3 or h3s.
  - ` for heading level 4 or h4s.
- Use hyphens (–) to indicate items of an ordered list.
- Place footnotes and other references, if you use them, at the end of a section rather than the end of a file.

Use the footnote format that includes automatic numbering and a target name for ease of use. For instance a footnote tag may look like: [#note]\_ with the corresponding directive holding the body of the footnote that resembles the following: . . . [#note].

**Do not** include . . . code-block:: [language] in footnotes.

- As it makes sense, use the . . . code-block:: [language] form to insert literal blocks into the text. While the double colon, ::, is functional, the . . . code-block:: [language] form makes the source easier to read and understand.
- For all mentions of referenced types (i.e. commands, operators, expressions, functions, statuses, etc.) use the reference types to ensure uniform formatting and cross-referencing.

## Jargon and Common Terms

### Database Systems and Processes

- To indicate the entire database system, use “MongoDB,” not mongo or Mongo.
- To indicate the database process or a server instance, use mongod or mongos. Refer to these as “processes” or “instances.” Reserve “database” for referring to a database structure, i.e., the structure that holds collections and refers to a group of files on disk.

### Distributed System Terms

- Refer to partitioned systems as “sharded clusters.” Do not use shard clusters or sharded systems.
- Refer to configurations that run with replication as “replica sets” (or “master/slave deployments”) rather than “clusters” or other variants.

### Data Structure Terms

- “document” refers to “rows” or “records” in a MongoDB database. Potential confusion with “JSON Documents.”

Do not refer to documents as “objects,” because drivers (and MongoDB) do not preserve the order of fields when fetching data. If the order of objects matter, use an array.

- “field” refers to a “key” or “identifier” of data within a MongoDB document.
- “value” refers to the contents of a “field”.
- “sub-document” describes a nested document.

### Other Terms

- Use example.net (and .org or .com if needed) for all examples and samples.
- Hyphenate “map-reduce” in order to avoid ambiguous reference to the command name. Do not camel-case.

## Notes on Specific Features

- Geo-Location
  1. While MongoDB *is capable* of storing coordinates in sub-documents, in practice, users should only store coordinates in arrays. (See: DOCS-41<sup>54</sup>.)

## MongoDB Documentation Practices and Processes

This document provides an overview of the practices and processes.

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<sup>54</sup><https://jira.mongodb.org/browse/DOCS-41>

## Practices

- [Commits](#) (page 1099)
- [Standards and Practices](#) (page 1099)
- [Collaboration](#) (page 1099)
- [Builds](#) (page 1100)
- [Publication](#) (page 1100)
- [Branches](#) (page 1100)
- [Migration from Legacy Documentation](#) (page 1100)
- [Review Process](#) (page 1101)
  - [Types of Review](#) (page 1101)
    - \* [Initial Technical Review](#) (page 1101)
    - \* [Content Review](#) (page 1101)
    - \* [Consistency Review](#) (page 1101)
    - \* [Subsequent Technical Review](#) (page 1101)
  - [Review Methods](#) (page 1101)

## Commits

When relevant, include a Jira case identifier in a commit message. Reference documentation cases when applicable, but feel free to reference other cases from [jira.mongodb.org](http://jira.mongodb.org)<sup>55</sup>.

Err on the side of creating a larger number of discrete commits rather than bundling large set of changes into one commit.

For the sake of consistency, remove trailing whitespaces in the source file.

“Hard wrap” files to between 72 and 80 characters per-line.

## Standards and Practices

- At least two people should vet all non-trivial changes to the documentation before publication. One of the reviewers should have significant technical experience with the material covered in the documentation.
- All development and editorial work should transpire on GitHub branches or forks that editors can then merge into the publication branches.

## Collaboration

To propose a change to the documentation, do either of the following:

- Open a ticket in the [documentation project](#)<sup>56</sup> proposing the change. Someone on the documentation team will make the change and be in contact with you so that you can review the change.
- Using [GitHub](#)<sup>57</sup>, fork the [mongodb/docs repository](#)<sup>58</sup>, commit your changes, and issue a pull request. Someone on the documentation team will review and incorporate your change into the documentation.

<sup>55</sup><http://jira.mongodb.org/>

<sup>56</sup><https://jira.mongodb.org/browse/DOCS>

<sup>57</sup><https://github.com/>

<sup>58</sup><https://github.com/mongodb/docs>

### Builds

Building the documentation is useful because Sphinx<sup>59</sup> and docutils can catch numerous errors in the format and syntax of the documentation. Additionally, having access to an example documentation as it *will* appear to the users is useful for providing more effective basis for the review process. Besides Sphinx, Pygments, and Python-Docutils, the documentation repository contains all requirements for building the documentation resource.

Talk to someone on the documentation team if you are having problems running builds yourself.

### Publication

The makefile for this repository contains targets that automate the publication process. Use `make html` to publish a test build of the documentation in the `build/` directory of your repository. Use `make publish` to build the full contents of the manual from the current branch in the `../public-docs/` directory relative the docs repository.

Other targets include:

- `man` - builds UNIX Manual pages for all Mongodbd utilities.
- `push` - builds and deploys the contents of the `../public-docs/`.
- `pdfs` - builds a PDF version of the manual (requires LaTeX dependencies.)

### Branches

This section provides an overview of the git branches in the MongoDB documentation repository and their use.

At the present time, future work transpires in the `master`, with the main publication being `current`. As the documentation stabilizes, the documentation team will begin to maintain branches of the documentation for specific MongoDB releases.

### Migration from Legacy Documentation

The MongoDB.org Wiki contains a wealth of information. As the transition to the Manual (i.e. this project and resource) continues, it's *critical* that no information disappears or goes missing. The following process outlines *how* to migrate a wiki page to the manual:

1. Read the relevant sections of the Manual, and see what the new documentation has to offer on a specific topic.  
In this process you should follow cross references and gain an understanding of both the underlying information and how the parts of the new content relates its constituent parts.
2. Read the wiki page you wish to redirect, and take note of all of the factual assertions, examples presented by the wiki page.
3. Test the factual assertions of the wiki page to the greatest extent possible. Ensure that example output is accurate. In the case of commands and reference material, make sure that documented options are accurate.
4. Make corrections to the manual page or pages to reflect any missing pieces of information.

The target of the redirect need *not* contain every piece of information on the wiki page, **if** the manual as a whole does, and relevant section(s) with the information from the wiki page are accessible from the target of the redirection.

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<sup>59</sup><http://sphinx.pocoo.org/>

5. As necessary, get these changes reviewed by another writer and/or someone familiar with the area of the information in question.

At this point, update the relevant Jira case with the target that you've chosen for the redirect, and make the ticket unassigned.

6. When someone has reviewed the changes and published those changes to Manual, you, or preferably someone else on the team, should make a final pass at both pages with fresh eyes and then make the redirect.

Steps 1-5 should ensure that no information is lost in the migration, and that the final review in step 6 should be trivial to complete.

## Review Process

**Types of Review** The content in the Manual undergoes many types of review, including the following:

**Initial Technical Review** Review by an engineer familiar with MongoDB and the topic area of the documentation. This review focuses on technical content, and correctness of the procedures and facts presented, but can improve any aspect of the documentation that may still be lacking. When both the initial technical review and the content review are complete, the piece may be “published.”

**Content Review** Textual review by another writer to ensure stylistic consistency with the rest of the manual. Depending on the content, this may precede or follow the initial technical review. When both the initial technical review and the content review are complete, the piece may be “published.”

**Consistency Review** This occurs post-publication and is content focused. The goals of consistency reviews are to increase the internal consistency of the documentation as a whole. Insert relevant cross-references, update the style as needed, and provide background fact-checking.

When possible, consistency reviews should be as systematic as possible and we should avoid encouraging stylistic and information drift by editing only small sections at a time.

**Subsequent Technical Review** If the documentation needs to be updated following a change in functionality of the server or following the resolution of a user issue, changes may be significant enough to warrant additional technical review. These reviews follow the same form as the “initial technical review,” but is often less involved and covers a smaller area.

**Review Methods** If you’re not a usual contributor to the documentation and would like to review something, you can submit reviews in any of the following methods:

- If you’re reviewing an open pull request in GitHub, the best way to comment is on the “overview diff,” which you can find by clicking on the “diff” button in the upper left portion of the screen. You can also use the following URL to reach this interface:

[https://github.com/mongodb/docs/pull/\[pull-request-id\]/files](https://github.com/mongodb/docs/pull/[pull-request-id]/files)

Replace [pull-request-id] with the identifier of the pull request. Make all comments inline, using GitHub’s comment system.

You may also provide comments directly on commits, or on the pull request itself but these commit-comments are archived in less coherent ways and generate less useful emails, while comments on the pull request lead to less specific changes to the document.

- Leave feedback on Jira cases in the [DOCS<sup>60</sup>](#) project. These are better for more general changes that aren't necessarily tied to a specific line, or affect multiple files.
- Create a fork of the repository in your GitHub account, make any required changes and then create a pull request with your changes.

If you insert lines that begin with any of the following annotations:

```
... TODO:
TODO:
... TODO
TODO
```

followed by your comments, it will be easier for the original writer to locate your comments. The two dots ... format is a comment in reStructured Text, which will hide your comments from Sphinx and publication if you're worried about that.

This format is often easier for reviewers with larger portions of content to review.

## MongoDB Manual Organization

This document provides an overview of the global organization of the documentation resource. Refer to the notes below if you are having trouble understanding the reasoning behind a file's current location, or if you want to add new documentation but aren't sure how to integrate it into the existing resource.

If you have questions, don't hesitate to open a ticket in the [Documentation Jira Project<sup>61</sup>](#) or contact the [documentation team<sup>62</sup>](#).

### Global Organization

**Indexes and Experience** The documentation project has two "index files": <http://docs.mongodb.org/manualcontents.txt> and <http://docs.mongodb.org/manualindex.txt>. The "contents" file provides the documentation's tree structure, which Sphinx uses to create the left-pane navigational structure, to power the "Next" and "Previous" page functionality, and to provide all overarching outlines of the resource. The "index" file is not included in the "contents" file (and thus builds will produce a warning here) and is the page that users first land on when visiting the resource.

Having separate "contents" and "index" files provides a bit more flexibility with the organization of the resource while also making it possible to customize the primary user experience.

Additionally, in the top level of the source/ directory, there are a number of "topical" index or outline files. These (like the "index" and "contents" files) use the ... `toctree::` directive to provide organization within the documentation. The subject-specific landing pages indexes combine to create the index in the contents file.

**Topical Indexes and Meta Organization** Because the documentation on any given subject exists in a number of different locations across the resource the "topical" indexes provide the real structure and organization to the resource. This organization makes it possible to provide great flexibility while still maintaining a reasonable organization of files and URLs for the documentation. Consider the following example:

Given that topic such as "replication," has material regarding the administration of replica sets, as well as reference material, an overview of the functionality, and operational tutorials, it makes more sense to include a few locations for documents, and use the meta documents to provide the topic-level organization.

Current landing pages include:

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<sup>60</sup><http://jira.mongodb.org/browse/DOCS>

<sup>61</sup><https://jira.mongodb.org/browse/DOCS>

<sup>62</sup>[docs@mongodb.com](mailto:docs@mongodb.com)

- administration
- applications
- crud
- faq
- mongo
- reference
- replication
- security
- sharding

Additional topical indexes are forthcoming.

### The Top Level Folders

The documentation has a number of top-level folders, that hold all of the content of the resource. Consider the following list and explanations below:

- “administration” - contains all of the operational and architectural information that systems and database administrators need to know in order to run MongoDB. Topics include: monitoring, replica sets, shard clusters, deployment architectures, and configuration.
- “applications” - contains information about application development and use. While most documentation regarding application development is within the purview of the driver documentation, there are some larger topics regarding the use of these features that deserve some coverage in this context. Topics include: drivers, schema design, optimization, replication, and sharding.
- “core” - contains overviews and introduction to the core features, functionality, and concepts of MongoDB. Topics include: replication, sharding, capped collections, journaling/durability, aggregation.
- “reference” - contains references and indexes of shell functions, database commands, status outputs, as well as manual pages for all of the programs come with MongoDB (e.g. mongostat and mongodump.)
- “tutorial” - contains operational guides and tutorials that lead users through common tasks (administrative and conceptual) with MongoDB. This includes programming patterns and operational guides.
- “faq” - contains all the frequently asked questions related to MongoDB, in a collection of topical files.

### MongoDB Documentation Build System

This document contains more direct instructions for building the MongoDB documentation.

### Getting Started

**Install Dependencies** The MongoDB Documentation project depends on the following tools:

- GNU Make
- GNU Tar
- Python
- Git

- Sphinx (documentation management toolchain)
- Pygments (syntax highlighting)
- PyYAML (for the generated tables)
- Droopy (Python package for static text analysis)
- Fabric (Python package for scripting and orchestration)
- Inkscape (Image generation.)
- python-argparse (For Python 2.6.)
- LaTeX/PDF LaTeX (typically texlive; for building PDFs)
- Common Utilities (rsync, tar, gzip, sed)

**OS X** Install Sphinx, Docutils, and their dependencies with `easy_install` the following command:

```
easy_install Sphinx Jinja2 Pygments docutils PyYAML droopy fabric
```

Feel free to use `pip` rather than `easy_install` to install python packages.

To generate the images used in the documentation, [download and install Inkscape](#)<sup>63</sup>.

---

#### Optional

To generate PDFs for the full production build, install a TeX distribution (for building the PDF.) If you do not have a LaTeX installation, use [MacTeX](#)<sup>64</sup>. This is **only** required to build PDFs.

---

**Arch Linux** Install packages from the system repositories with the following command:

```
pacman -S python2-sphinx python2-yaml inkscape python2-pip
```

Then install the following Python packages:

```
pip install droopy fabric
```

---

#### Optional

To generate PDFs for the full production build, install the following packages from the system repository:

```
pacman -S texlive-bin texlive-core texlive-latexextra
```

**Debian/Ubuntu** Install the required system packages with the following command:

```
apt-get install python-sphinx python-yaml python-argparse inkscape python-pip
```

Then install the following Python packages:

```
pip install droopy fabric
```

---

#### Optional

To generate PDFs for the full production build, install the following packages from the system repository:

---

<sup>63</sup><http://inkscape.org/download/>

<sup>64</sup><http://www.tug.org/mactex/2011/>

---

```
apt-get install texlive-latex-recommended texlive-latex-recommended
```

---

### Setup and Configuration

Clone the repository:

```
git clone git://github.com/mongodb/docs.git
```

Then run the `bootstrap.py` script in the `docs/` repository, to configure the build dependencies:

```
python bootstrap.py
```

This downloads and configures the `mongodb/docs-tools`<sup>65</sup> repository, which contains the authoritative build system shared between branches of the MongoDB Manual and other MongoDB documentation projects.

You can run `bootstrap.py` regularly to update build system.

### Building the Documentation

The MongoDB documentation build system is entirely accessible via `make` targets. For example, to build an HTML version of the documentation issue the following command:

```
make html
```

You can find the build output in `build/<branch>/html`, where `<branch>` is the name of the current branch.

In addition to the `html` target, the build system provides the following targets:

**publish** Builds and integrates all output for the production build. Build output is in `build/public/<branch>/`. When you run `publish` in the `master`, the build will generate some output in `build/public/`.

**push; stage** Uploads the production build to the production or staging web servers. Depends on `publish`. Requires access production or staging environment.

**push-all; stage-all** Uploads the entire content of `build/public/` to the web servers. Depends on `publish`. Not used in common practice.

**push-with-delete; stage-with-delete** Modifies the action of `push` and `stage` to remove remote file that don't exist in the local build. Use with caution.

**html; latex; dirhtml; epub; texinfo; man; json** These are standard targets derived from the default Sphinx Makefile, with adjusted dependencies. Additionally, for all of these targets you can append `-nitpick` to increase Sphinx's verbosity, or `-clean` to remove all Sphinx build artifacts.

`latex` performs several additional post-processing steps on `.tex` output generated by Sphinx. This target will also compile PDFs using `pdflatex`.

`html` and `man` also generates a `.tar.gz` file of the build outputs for inclusion in the final releases.

### Build Mechanics and Tools

Internally the build system has a number of components and processes. See the `docs-tools` README<sup>66</sup> for more information on the internals. This section documents a few of these components from a very high level and lists useful operations for contributors to the documentation.

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<sup>65</sup><http://github.com/mongodb/docs-tools/>

<sup>66</sup><https://github.com/mongodb/docs-tools/blob/master/README.rst>

**Fabric** Fabric is an orchestration and scripting package for Python. The documentation uses Fabric to handle the deployment of the build products to the web servers and also unifies a number of independent build operations. Fabric commands have the following form:

```
fab <module>.<task>[:<argument>]
```

The <argument> is optional in most cases. Additionally some tasks are available at the root level, without a module. To see a full list of fabric tasks, use the following command:

```
fab -l
```

You can chain fabric tasks on a single command line, although this doesn't always make sense.

Important fabric tasks include:

**tools.bootstrap** Runs the `bootstrap.py` script. Useful for re-initializing the repository without needing to be in root of the repository.

**tools.dev; tools.reset** `tools.dev` switches the `origin` remote of the `docs-tools` checkout in `build` directory, to `../docs-tools` to facilitate build system testing and development. `tools.reset` resets the `origin` remote for normal operation.

**tools.conf** `tools.conf` returns the content of the configuration object for the current project. These data are useful during development.

**stats.report:<filename>** Returns, a collection of readability statistics. Specify file names relative to source/ tree.

**make** Provides a thin wrapper around Make calls. Allows you to start make builds from different locations in the project repository.

**process.refresh\_dependencies** Updates the time stamp of `.txt` source files with changed include files, to facilitate Sphinx's incremental rebuild process. This task runs internally as part of the build process.

**Buildcloth** `Buildcloth`<sup>67</sup> is a meta-build tool, used to generate Makefiles programatically. This makes the build system easier to maintain, and makes it easier to use the same fundamental code to generate various branches of the Manual as well as related documentation projects. See [makecloth/ in the docs-tools repository](#)<sup>68</sup> for the relevant code.

Running `make` with no arguments will regenerate these parts of the build system automatically.

**Rstcloth** `Rstcloth`<sup>69</sup> is a library for generating reStructuredText programatically. This makes it possible to generate content for the documentation, such as tables, tables of contents, and API reference material programatically and transparently. See [rstcloth/ in the docs-tools repository](#)<sup>70</sup> for the relevant code.

If you have any questions, please feel free to open a [Jira Case](#)<sup>71</sup>.

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<sup>67</sup><https://pypi.python.org/pypi/buildcloth/>

<sup>68</sup><https://github.com/mongodb/docs-tools/tree/master/makecloth>

<sup>69</sup><https://pypi.python.org/pypi/rstcloth>

<sup>70</sup><https://github.com/mongodb/docs-tools/tree/master/rstcloth>

<sup>71</sup><https://jira.mongodb.org/browse/DOCS>

## Symbols

- {-}all
    - command line option 976
  - {-}auth
    - command line option 927
  - {-}authenticationDatabase <dbname>
    - command line option 942, 944, 953, 957, 963, 967, 971, 975, 980, 988
  - {-}authenticationMechanism <name>
    - command line option 942, 944, 953, 958, 963, 967, 971, 976, 980, 988
  - {-}autoresync
    - command line option 934
  - {-}bind\_ip <ip address>
    - command line option 926, 938
  - {-}chunkSize <value>
    - command line option 941
  - {-}collection <collection>, -c <collection>
    - command line option 953, 958, 967, 971, 989
  - {-}config <filename>, -f <filename>
    - command line option 925, 938
  - {-}configdb <config1>, <config2><:port>, <config3>
    - command line option 940
  - {-}configsrv
    - command line option 935
  - {-}cpu
    - command line option 927
  - {-}csv
    - command line option 972
  - {-}db <db>, -d <db>
    - command line option 953, 958, 967, 971, 989
  - {-}dbpath <path>
    - command line option 928, 953, 958, 964, 967, 971, 988
  - {-}diaglog <value>
    - command line option 928
  - {-}directoryperdb
    - command line option 928, 953, 958, 964, 967, 971, 988
  - {-}discover
    - command line option 976
  - {-}drop
    - command line option 959, 968
  - {-}eval <javascript>
    - command line option 943
  - {-}fastsync
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