Percona Server for MongoDB 6.0 Documentation

Release 6.0.1-1

Percona LLC and/or its affiliates 2015-2022

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CONTENTS

Percona Server for MongoDB is a free, enhanced, fully compatible, source available, drop-in replacement for MongoDB 6.0 Community Edition with enterprise-grade features. It requires no changes to MongoDB applications or code.

Hint: To see which version of *Percona Server for MongoDB* you are using, check the value of the `psmdbVersion` key in the output of the buildInfo database command. If this key does not exist, *Percona Server for MongoDB* is not installed on the server.

Percona Server for MongoDB provides the following features:

- MongoDB's default WiredTiger engine
- *Percona Memory Engine* storage engine
- *Data at Rest Encryption*
- *External authentication* using OpenLDAP or Active Directory
- *Audit logging* to track and query database interactions of users or applications
- *Hot Backup* for the default WiredTiger
- *Profiling Rate Limit* to decrease the impact of the profiler on performance

Learn more in *Percona Server for MongoDB Feature Comparison*.

Part I

About Percona Server for MongoDB

CHAPTER

ONE

PERCONA SERVER FOR MONGODB FEATURE COMPARISON

Percona Server for MongoDB 6.0 is based on MongoDB 6.0. *Percona Server for MongoDB* extends MongoDB Community Edition to include the functionality that is otherwise only available in MongoDB Enterprise Edition.

	PSMDB	MongoDB
Storage Engines	• WiredTiger (default) • *Percona Memory Engine*	• WiredTiger (default) • In-Memory (Enterprise only)
Encryption-at-Rest	• Key servers = *Hashicorp Vault*, *KMIP* • Fully open source	• Key server = KMIP • Enterprise only
Hot Backup	*YES* (replica set)	NO
LDAP Authentication	• (legacy) *LDAP authentication with SASL*	• Enterprise only
LDAP Authorization	*YES*	Enterprise only
Kerberos Authentication	*YES*	Enterprise only
Audit Logging	*YES*	Enterprise only
Log redaction	*YES*	Enterprise only
SNMP Monitoring	NO	Enterprise only

1.1 Profiling Rate Limiting

Profiling Rate Limiting was added to *Percona Server for MongoDB* in v3.4 with the `--rateLimit` argument. Since v3.6, MongoDB Community (and Enterprise) Edition includes a similar option slowOpSampleRate. Please see *Profiling Rate Limit* for more information.

Part II

Installation

CHAPTER

TWO

INSTALLING PERCONA SERVER FOR MONGODB

Percona provides installation packages of *Percona Server for MongoDB* for the most 64-bit Linux distributions. Find the full list of supported platforms on the Percona Software and Platform Lifecycle page.

The recommended installation method is from Percona repositories. Follow the links below for the installation instructions for your operating system.

- *Install on Debian or Ubuntu*
- *Install on Red Hat Enterprise Linux or derivatives*

2.1 Alternative Install Instructions

You can also download packages from the Percona website and install them manually using **`dpkg`** or **`rpm`**.

Note: In this case, you will have to make sure that all dependencies are satisfied.

If you want more control over the installation, you can *install Percona Server for MongoDB from binary tarballs*.

Note: This method is for advanced users with specific needs that are not addressed by DEB and RPM packages.

If you want to run *Percona Server for MongoDB* in a Docker container, see *Running Percona Server for MongoDB in a Docker Container*.

2.2 Upgrade Instructions

If you are currently using MongoDB, see *Upgrading from MongoDB*.

If you are running an earlier version of *Percona Server for MongoDB*, see *Upgrading from Version 5.0*.

2.3 Uninstall Instructions

To uninstall *Percona Server for MongoDB*, see *Uninstalling Percona Server for MongoDB*.

2.3.1 Installing Percona Server for MongoDB on Debian and Ubuntu

Use this document to install *Percona Server for MongoDB* from Percona repositories on DEB-based distributions such as Debian and Ubuntu.

Note: *Percona Server for MongoDB* should work on other DEB-based distributions, but it is tested only on platforms listed on the Percona Software and Platform Lifecycle page.

Package Contents

Package	Contains
percona-server-mongodb	The `mongosh` shell, import/export tools, other client utilities, server software, default configuration, and `init.d` scripts.
percona-server-mongodb-server	The **`mongod`** server, default configuration files, and `init.d` scripts
percona-server-mongodb-shell	The `mongosh` shell
percona-server-mongodb-mongos	The `mongos` sharded cluster query router
percona-server-mongodb-tools	Mongo tools for high-performance MongoDB fork from Percona
percona-server-mongodb-dbg	Debug symbols for the server

Installing from Percona repositories

It is recommended to install *Percona Server for MongoDB* from official Percona repositories using the **percona-release** utility.

Configure Percona repository

Run the following commands as root or by using the **sudo** command

1. Fetch **percona-release** packages from Percona web:

```
$ wget https://repo.percona.com/apt/percona-release_latest.$(lsb_release -sc)_all.
↪deb
```

2. Install the downloaded package with **dpkg**:

```
$ sudo dpkg -i percona-release_latest.$(lsb_release -sc)_all.deb
```

   Once you install `percona-release`, the *Percona* repositories should be available. You can check the repository setup in the `/etc/apt/sources.list.d/percona-release.list` file.

3. Enable the repository:

```
$ sudo percona-release enable psmdb-60 release
```

4. Remember to update the local cache:

```
$ sudo apt update
```

Install the latest version

Run the following command to install the latest version of *Percona Server for MongoDB*:

```
$ sudo apt install percona-server-mongodb
```

Install a specific version

To install a specific version of *Percona Server for MongoDB*, do the following:

1. List available versions:

```
$ sudo apt-cache madison percona-server-mongodb
```

Sample Output

```
percona-server-mongodb | 6.0.2-1.buster | http://repo.percona.com/psmdb-60/apt␣
↪buster/main amd64 Packages
```

2. Install a specific version packages. You must specify each package with the version number. For example, to install *Percona Server for MongoDB* 6.0.2-1, run the following command:

```
$ sudo apt install percona-server-mongodb=6.0.2-1.buster percona-server-mongodb-
↪mongos=6.0.2-1.buster percona-server-mongodb-shell=6.0.2-1.buster percona-server-
↪mongodb-server=6.0.2-1.buster percona-server-mongodb-tools=6.0.2-1.buster
```

Running Percona Server for MongoDB

By default, *Percona Server for MongoDB* stores data files in `/var/lib/mongodb/` and configuration parameters in `/etc/mongod.conf`.

Starting the service

Percona Server for MongoDB is started automatically after installation unless it encounters errors during the installation process.

You can also manually start it using the following command:

```
$ sudo systemctl start mongod
```

Confirming that the service is running

Check the service status using the following command:

```
$ sudo systemctl status mongod
```

Stopping the service

Stop the service using the following command:

```
$ sudo systemctl stop mongod
```

Restarting the service

Restart the service using the following command:

```
$ sudo systemctl restart mongod
```

2.3.2 Installing Percona Server for MongoDB on Red Hat Enterprise Linux and derivatives

Use this document to install Percona Server for MongoDB on RPM-based distributions such as Red Hat Enterprise Linux and derivatives from Percona repositories.

Note: *Percona Server for MongoDB* should work on other RPM-based distributions (for example, Amazon Linux AMI and Oracle Linux), but it is tested only on platforms listed on the Percona Software and Platform Lifecycle page.

Package Contents

Package	Contains
percona-server-mongodb	The `mongosh` shell, import/export tools, other client utilities, server software, default configuration, and `init.d` scripts.
percona-server-mongodb-server	The **`mongod`** server, default configuration files, and `init.d` scripts
percona-server-mongodb-shell	The `mongosh` shell
percona-server-mongodb-mongos	The `mongos` sharded cluster query router
percona-server-mongodb-tools	Mongo tools for high-performance MongoDB fork from Percona
percona-server-mongodb-debugsource	Debug sources for the server

Installing from Percona repositories

Percona repositories are managed using the **`percona-release`** tool. So in order to install *Percona Server for MongoDB*, install **`percona-release`** first.

Configure Percona repository

1. Install **`percona-release`**:

   ```
   $ sudo yum install https://repo.percona.com/yum/percona-release-latest.noarch.rpm
   ```

   Example of output

   ```
   Retrieving https://repo.percona.com/yum/percona-release-latest.noarch.rpm
   Preparing...                ########################################### [100%]
   1:percona-release         ########################################### [100%]
   ```

2. Enable the repository:

   ```
   $ sudo percona-release enable psmdb-60 release
   ```

See also:

More information about how to use the `percona-release` tool https://www.percona.com/doc/percona-repo-config/index.html

Install the latest version

To install the latest version of *Percona Server for MongoDB*, use the following command:

```
$ sudo yum install percona-server-mongodb
```

Install a specific version

To install a specific version of *Percona Server for MongoDB*, do the following:

1. List available versions:

   ```
   $ sudo yum list percona-server-mongodb --showduplicates
   ```

   Sample Output

   ```
       Available Packages
   percona-server-mongodb.x86_64    6.0.2-1.el8       psmdb-60-release-x86_64
   ```

2. Install a specific version packages. For example, to install *Percona Server for MongoDB* 6.0.1-1, run the following command:

   ```
   $ sudo yum install percona-server-mongodb-6.0.2-1.el8
   ```

Running Percona Server for MongoDB

Note: If you are using SELinux in enforcing mode, you must customize your SELinux user policies to allow access to certain `/sys` and `/proc` files for OS-level statistics. Also, you must customize directory and port access policies if you are using non-default locations.

Please refer to Configure SELinux section of MongoDB Documentation for policy configuration guidelines.

Percona Server for MongoDB stores data files in `/var/lib/mongodb/` by default. The configuration file is `/etc/mongod.conf`.

Starting the service

Percona Server for MongoDB is not started automatically after installation. Start it manually using the following command:

```
$ sudo systemctl start mongod
```

Confirming that service is running

Check the service status using the following command:

```
$ sudo systemctl status mongod
```

Stopping the service

Stop the service using the following command:

```
$ sudo systemctl stop mongod
```

Restarting the service

Restart the service using the following command:

```
$ sudo systemctl restart mongod
```

Running after reboot

The `mongod` service is not automatically started after you reboot the system. To make it start automatically after reboot, enable it using the `systemctl` utility:

```
$ sudo systemctl enable mongod
```

Then start the `mongod` service

```
$ sudo systemctl start mongod
```

2.3.3 Installing Percona Server for MongoDB from Binary Tarball

You can find links to the binary tarballs under the *Generic Linux* menu item on the Percona website

Preconditions

The following packages are required for the installation.

On Debian / Ubuntu

- `libcurl4`
- `libsasl2-modules`
- `libsasl2-modules-gssapi-mit`

On Red Hat Enterprise Linux and derivatives

- `libcurl`
- `cyrus-sasl-gssapi`
- `cyrus-sasl-plain`

Check that they are installed in your operating system. Otherwise install them.

Procedure

1. Fetch and extract the binary tarball. For example, if you are running Debian 10 ("buster"), use the following command:

```
$ wget https://www.percona.com/downloads/percona-server-mongodb-6.0/percona-server-
↪mongodb-6.0.2-1/binary/tarball/percona-server-mongodb-6.0.2-1-x86_64.glibc2.17.
↪tar.gz\
$ wget https://www.percona.com/downloads/percona-server-mongodb-6.0/percona-server-
↪mongodb-6.0.2-1/binary/tarball/percona-mongodb-mongosh-1.6.0-x86_64.tar.gz
```

2. Extract the tarballs:

```
$ tar -xf percona-server-mongodb-6.0.2-1-x86_64.glibc2.17.tar.gz
$ tar -xf percona-mongodb-mongosh-1.6.0-x86_64.tar.gz
```

3. Add the location of the binaries to the `PATH` variable:

```
$ export PATH=~/percona-server-mongodb-6.0.2-1/bin/:~/percona-mongodb-mongosh-1.6.0/
↪bin/:$PATH
```

4. Create the default data directory:

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

5. Make sure that you have read and write permissions for the data directory and run **mongod**.

2.3.4 Running *Percona Server for MongoDB* in a Docker Container

Docker images of *Percona Server for MongoDB* are hosted publicly on Docker Hub at https://hub.docker.com/r/percona/percona-server-mongodb/.

For more information about using Docker, see the Docker Docs.

Note: Make sure that you are using the latest version of Docker. The ones provided via `apt` and `yum` may be outdated and cause errors.

Note: By default, Docker will pull the image from Docker Hub if it is not available locally.

To run the latest *Percona Server for MongoDB* 6.0 in a Docker container, use the following command:

Run this command as root or by using the **sudo** command

```
$ docker run -d --name psmdb --restart always \
percona/percona-server-mongodb:6.0
```

The previous command does the following:

- The `docker run` command instructs the `docker` daemon to run a container from an image.
- The `-d` option starts the container in detached mode (that is, in the background).
- The `--name` option assigns a custom name for the container that you can use to reference the container within a Docker network. In this case: `psmdb`.

- The `--restart` option defines the container's restart policy. Setting it to `always` ensures that the Docker daemon will start the container on startup and restart it if the container exits.
- `percona/percona-server-mongodb:6.0` is the name and version tag of the image to derive the container from.

See also:

Docker Documentation: the full list of tags https://hub.docker.com/r/percona/percona-server-mongodb/tags/

Connecting from Another Docker Container

The *Percona Server for MongoDB* container exposes standard MongoDB port (27017), which can be used for connection from an application running in another container. To link the application container to the `psmdb` container, use the `--link psmdb` option when running the container with your app.

Connecting with the Mongo Shell

To start another container with the `mongo` shell that connects to your *Percona Server for MongoDB* container, run the following command:

```
$ docker run -it --link psmdb --rm percona/percona-server-mongodb:mongo mongo -h psmdb`
```

Part III

Features

CHAPTER

THREE

PERCONA MEMORY ENGINE

Percona Memory Engine is a special configuration of WiredTiger that does not store user data on disk. Data fully resides in the main memory, making processing much faster and smoother. Keep in mind that you need to have enough memory to hold the data set, and ensure that the server does not shut down.

The *Percona Memory Engine* is available in *Percona Server for MongoDB* along with the default MongoDB engine WiredTiger.

3.1 Using Percona Memory Engine

As of version 3.2, *Percona Server for MongoDB* runs with WiredTiger by default. You can select a storage engine using the `--storageEngine` command-line option when you start `mongod`. Alternatively, you can set the `storage.engine` variable in the configuration file (by default, `/etc/mongod.conf`):

```
storage:
  dbPath: <dataDir>
  engine: inMemory
```

See also:

MongoDB Documentation: Configuration File Options

- storage.engine Options
- storage.wiredTiger Options
- storage.inmemory Options

3.2 Switching storage engines

3.2.1 Considerations

If you have data files in your database and want to change to Percona Memory Engine, consider the following:

- Data files created by one storage engine are not compatible with other engines, because each one has its own data model.
- When changing the storage engine, the **mongod** node requires an empty dbPath data directory when it is restarted. Though Percona Memory Engine stores all data in memory, some metadata files, diagnostics logs and statistics metrics are still written to disk. This is controlled with the *--inMemoryStatisticsLogDelaySecs* option.

  Creating a new dbPath data directory for a different storage engine is the simplest solution. Yet when you switch between disk-using storage engines (e.g. from WiredTiger to *Percona Memory Engine*), you may have to delete the old data if there is not enough disk space for both. Double-check that your backups are solid and/or the replica set nodes are healthy before you switch to the new storage engine.

3.2.2 Procedure

To change a storage engine, you have the following options:

- If you simply want to temporarily test Percona Memory Engine, set a different data directory for the dbPath variable in the configuration file. Make sure that the user running **mongod** has read and write permissions for the new data directory.

```
$ service mongod stop
$ # In the configuration file, set the inmemory
$ # value for the storage.engine variable
$ # Set the <newDataDir> for the dbPath variable
$ service mongod start
```

- If you want to permanently switch to Percona Memory Engine and do not have any valuable data in your database, clean out the dbPath data directory (by default, /var/lib/mongodb) and edit the configuration file:

```
$ service mongod stop
$ rm -rf <dbpathDataDir>
$ # Update the configuration file by setting the new
$ # value for the storage.engine variable
$ # set the engine-specific settings such as
$ # storage.inMemory.engineConfig.inMemorySizeGB
$ service mongod start
```

- If there is data that you want to migrate and make compatible with Percona Memory Engine, use the following methods:
  - for replica sets, use the "rolling restart" process. Switch to the Percona Memory Engine on the secondary node. Clean out the dbPath data directory and edit the configuration file:

```
$ service mongod stop
$ rm -rf <dbpathDataDir>
$ # Update the configuration file by setting the new
$ # value for the storage.engine variable
$ # set the engine-specific settings such as
```

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```
$ # storage.inMemory.engineConfig.inMemorySizeGB
$ service mongod start
```

Wait for the node to rejoin with the other nodes and report the SECONDARY status.

Repeat the procedure to switch the remaining nodes to Percona Memory Engine.

– for a standalone instance or a single-node replica set, use the `mongodump` and `mongorestore` utilities:

```
$ mongodump --out <dumpDir>
$ service mongod stop
$ rm -rf <dbpathDataDir>
$ # Update the configuration file by setting the new
$ # value for the storage.engine variable
$ # set the engine-specific settings such as
$ # storage.inMemory.engineConfig.inMemorySizeGB
$ service mongod start
$ mongorestore <dumpDir>
```

3.2.3 Switching engines with encrypted data

Using *Data at Rest Encryption* means using the same `storage.*` configuration options as for WiredTiger. To change from normal to *Data at Rest Encryption* mode or backward, you must clean up the `dbPath` data directory, just as if you change the storage engine. This is because **`mongod`** cannot convert the data files to an encrypted format 'in place'. It must get the document data again either via the initial sync from another replica set member, or from imported backup dump.

3.3 Configuring Percona Memory Engine

You can configure the Percona Memory Engine using either command-line options or corresponding parameters in the `/etc/mongod.conf` file. The configuration file is formatted in YAML. For example:

```
storage:
  engine: inMemory
  inMemory:
    engineConfig:
      inMemorySizeGB: 140
      statisticsLogDelaySecs: 0
```

Setting parameters in the previous example configuration file is the same as starting the `mongod` daemon with the following options:

```
$ mongod --storageEngine=inMemory \
--inMemorySizeGB=140 \
--inMemoryStatisticsLogDelaySecs=0
```

The following options are available (with corresponding YAML configuration file parameters):

`--inMemorySizeGB`

Config `storage.inMemory.engineConfig.inMemorySizeGB`

Default 50% of total memory minus 1024 MB, but not less than 256 MB

Specifies the maximum memory in gigabytes to use for data.

`--inMemoryStatisticsLogDelaySecs`

Config `storage.inMemory.engineConfig.statisticsLogDelaySecs`

Default 0

Specifies the number of seconds between writes to statistics log. If 0 is specified then statistics are not logged.

CHAPTER FOUR

HOT BACKUP

Percona Server for MongoDB includes an integrated open-source hot backup system for the default WiredTiger storage engine. It creates a physical data backup on a running server without notable performance and operating degradation.

Note: Hot backups are done on `mongod` servers independently, without synchronizing them across replica set members and shards in a cluster. To ensure data consistency during backups and restores, we recommend using Percona Backup for MongoDB.

4.1 Making a backup

To take a hot backup of the database in your current `dbpath`, do the following:

- Make sure to provide access to the backup directory for the `mongod` user

```
chown mongod:mongod <backupDir>
```

- Run the `createBackup` command as administrator on the `admin` database and specify the backup directory.

```
> use admin
switched to db admin
> db.runCommand({createBackup: 1, backupDir: <backup_data_path>})
{ "ok" : 1 }
```

The backup taken is the snapshot of the `mongod` server's `dataDir` at the moment of the `createBackup` command start.

If the backup was successful, you should receive an `{ "ok" :  1 }` object. If there was an error, you will receive a failing `ok` status with the error message, for example:

```
> db.runCommand({createBackup: 1, backupDir: ""})
{ "ok" : 0, "errmsg" : "Destination path must be absolute" }
```

4.2 Saving a backup to a TAR archive

Implementation details

This feature was implemented in *Percona Server for MongoDB* 4.2.1-1.

To save a backup in the format of *tar* archive, use the *archive* field to specify the destination path:

```
> use admin
...
> db.runCommand({createBackup: 1, archive: <path_to_archive>.tar })
```

4.3 Streaming hot backups to a remote destination

Percona Server for MongoDB enables uploading hot backups to an Amazon S3 or a compatible storage service, such as MinIO.

This method requires that you provide the *bucket* field in the *s3* object:

```
> use admin
...
> db.runCommand({createBackup: 1, s3: {bucket: "backup20190510", path: <some_optional_
↪path>} })
```

In addition to the mandatory *bucket* field, the *s3* object may contain the following fields:

Field	Type	Description
bucket	string	The only mandatory field. Names are subject to restrictions described in the Bucket Restrictions and Limitations section of Amazon S3 documentation
path	string	The virtual path inside the specified bucket where the backup will be created. If the *path* is not specified then the backup is created in the root of the bucket. If there are any objects under the specified path, the backup will not be created and an error will be reported.
endpoint	string	The endpoint address and port - mainly for AWS S3 compatible servers such as the *MinIO* server. For a local MinIO server, this can be "127.0.0.1:9000". For AWS S3 this field can be omitted.
scheme	string	"HTTP" or "HTTPS" (default). For a local MinIO server started with the *minio server* command this should field should contain *HTTP*.
useVirtualAddressing	bool	The style of addressing buckets in the URL. By default 'true'. For MinIO servers, set this field to **false**. For more information, see Virtual Hosting of Buckets in the Amazon S3 documentation.
region	string	The name of an AWS region. The default region is **US_EAST_1**. For more information see AWS Service Endpoints in the Amazon S3 documentation.
profile	string	The name of a credentials profile in the *credentials* configuration file. If not specified, the profile named **default** is used.
accessKeyId	string	The access key id
secretAccessKey	string	The secret access key

4.3.1 Credentials

If the user provides the *access key id* and the *secret access key* parameters, these are used as credentials.

If the *access key id* parameter is not specified then the credentials are loaded from the credentials configuration file. By default, it is `~/.aws/credentials`.

An example of the credentials file

```
[default]
aws_access_key_id = ABC123XYZ456QQQAAAFFF
aws_secret_access_key = zuf+secretkey0secretkey1secretkey2
[localminio]
aws_access_key_id = ABCABCABCABC55566678
aws_secret_access_key = secretaccesskey1secretaccesskey2secretaccesskey3
```

4.3.2 Examples

Backup in root of bucket on local instance of MinIO server

```
> db.runCommand({createBackup: 1,  s3: {bucket: "backup20190901500",
scheme: "HTTP",
endpoint: "127.0.0.1:9000",
useVirtualAddressing: false,
profile: "localminio"}})
```

Backup on MinIO testing server with the default credentials profile

The following command creates a backup under the virtual path "year2019/day42" in the *backup* bucket:

```
> db.runCommand({createBackup: 1,  s3: {bucket: "backup",
path: "year2019/day42",
endpoint: "sandbox.min.io:9000",
useVirtualAddressing: false}})
```

Backup on AWS S3 service using default settings

```
> db.runCommand({createBackup: 1,  s3: {bucket: "backup", path: "year2019/day42"}})
```

See also:

AWS Documentation: Providing AWS Credentials https://docs.aws.amazon.com/sdk-for-cpp/v1/developer-guide/credentials.html

4.4 Restoring data from a backup

Restoring from backup on a standalone server

To restore your database on a standalone server, stop the mongod service, clean out the data directory and copy files from the backup directory to the data directory. The mongod user requires access to those files to start the service. Therefore, make the mongod user the owner of the data directory and all files and subdirectories under it, and restart the mongod service.

Run the following commands as root or by using the **sudo** command

```
# Stop the mongod service
$ systemctl stop mongod
# Clean out the data directory
$ rm -rf /var/lib/mongodb/*
# Copy backup files
$ cp -RT <backup_data_path> /var/lib/mongodb/
# Grant permissions to data files for the mongod user
$ chown -R mongod:mongod /var/lib/mongodb/
# Start the mongod service
$ systemctl start mongod
```

Restoring from backup in a replica set

The recommended way to restore the replica set from a backup is to restore it into a standalone node and then initiate it as the first member of a new replica set.

Note: If you try to restore the node into the existing replica set and there is more recent data, the restored node detects that it is out of date with the other replica set members, deletes the data and makes an initial sync.

Run the following commands as root or by using the **sudo** command

The restore steps are the following:

1. Stop the `mongod` service:

   ```
   $ sudo systemctl stop mongod
   ```

2. Clean the data directory and then copy the files from the backup directory to your data directory. Assuming that the data directory is `/var/lib/mongodb/`, use the following commands:

   ```
   $ rm -rf /var/lib/mongodb/*
   $ cp -RT <backup_data_path> /var/lib/mongodb/
   ```

3. Grant permissions to the data files for the `mongod` user

   ```
   $ chown -R mongod:mongod /var/lib/mongodb/
   ```

4. Make sure the replication is disabled in the config file and start the `mongod` service.

   ```
   $ sudo systemctl start mongod
   ```

5. Connect to your standalone node via the `mongo` shell and drop the local database

   ```
   > mongosh
   > use local
   > db.dropDatabase()
   ```

6. Restart the node with the replication enabled

   - Shut down the node.

     ```
     $ sudo systemctl stop mongod
     ```

   - Edit the configuration file and specify the `replication.replSetname` option
   - Start the `mongod` node:

     ```
     $ sudo systemctl start mongod
     ```

7. Initiate a new replica set

   ```
   # Start the mongo shell
   > mongosh
   # Initiate a new replica set
   > rs.initiate()
   ```

CHAPTER

FIVE

PROFILING RATE LIMIT

Percona Server for MongoDB can limit the number of queries collected by the database profiler to decrease its impact on performance. Rate limit is an integer between 1 and 1000 and represents the fraction of queries to be profiled. For example, if you set it to 20, then every 20th query will be logged. For compatibility reasons, rate limit of 0 is the same as setting it to 1, and will effectively disable the feature meaning that every query will be profiled.

The MongoDB database profiler can operate in one of three modes:

- `0`: Profiling is disabled. This is the default setting.
- `1`: The profiler collects data only for *slow* queries. By default, queries that take more than 100 milliseconds to execute are considered *slow*.
- `2`: Collects profiling data for all database operations.

Mode `1` ignores all *fast* queries, which may be the cause of problems that you are trying to find. Mode `2` provides a comprehensive picture of database performance, but may introduce unnecessary overhead.

With rate limiting you can collect profiling data for all database operations and reduce overhead by sampling queries. Slow queries ignore rate limiting and are always collected by the profiler.

5.1 Comparing to the `sampleRate` option

The `sampleRate` option (= slowOpSampleRate config file option) is a similar concept to `rateLimit`. But it works at different profile level, completely ignores operations faster than `slowOpsThresholdMs` (a.k.a. `slowMs`), and affects the log file printing, too.

	sampleRate	rateLimit
Affects profiling level 1	yes	no
Affects profiling level 2	no	yes
Discards/filters slow ops	yes	no
Discards/filters fast ops	no	yes
Affects log file	yes	no
Example value of option	0.02	50

`rateLimit` is a better way to have continuous profiling for monitoring or live analysis purposes. `sampleRate` requires setting slowOpsThresholdMs to zero if you want to sample all types of operations. `sampleRate` has an effect on the log file which may either decrease or increase the log volume.

5.2 Enabling the Rate Limit

To enable rate limiting, set the profiler mode to 2 and specify the value of the rate limit. Optionally, you can also change the default threshold for slow queries, which will not be sampled by rate limiting.

For example, to set the rate limit to `100` (profile every 100th *fast* query) and the slow query threshold to `200` (profile all queries slower than 200 milliseconds), run the `mongod` instance as follows:

```
$ mongod --profile 2 --slowms 200 --rateLimit 100
```

To do the same at runtime, use the `profile` command. It returns the *previous* settings and `"ok" : 1` indicates that the operation was successful:

```
> db.runCommand( { profile: 2, slowms: 200, ratelimit: 100 } );
{ "was" : 0, "slowms" : 100, "ratelimit" : 1, "ok" : 1 }
```

To check the current settings, run `profile: -1`:

```
> db.runCommand( { profile: -1 } );
{ "was" : 2, "slowms" : 200, "ratelimit" : 100, "ok" : 1 }
```

If you want to set or get just the rate limit value, use the `profilingRateLimit` parameter on the `admin` database:

```
> db.getSiblingDB('admin').runCommand( { setParameter: 1, "profilingRateLimit": 100 } );
{ "was" : 1, "ok" : 1 }
> db.getSiblingDB('admin').runCommand( { getParameter: 1, "profilingRateLimit": 1 } );
{ "profilingRateLimit" : 100, "ok" : 1 }
```

If you want rate limiting to persist when you restart `mongod`, set the corresponding variables in the MongoDB configuration file (by default, `/etc/mongod.conf`):

```
operationProfiling:
  mode: all
  slowOpThresholdMs: 200
  rateLimit: 100
```

Note: The value of the `operationProfiling.mode` variable is a string, which you can set to either `off`, `slowOp`, or `all`, corresponding to profiling modes `0`, `1`, and `2`.

5.3 Profiler Collection Extension

Each document in the `system.profile` collection includes an additional `rateLimit` field. This field always has the value of `1` for *slow* queries and the current rate limit value for *fast* queries.

CHAPTER

SIX

AUTHENTICATION

Authentication is the process of verifying a client's identity. Normally, a client needs to authenticate themselves against the MongoDB server user database before doing any work or reading any data from a `mongod` or `mongos` instance.

By default, *Percona Server for MongoDB* provides a SCRAM (Salted Challenge Response Authentication Mechanism) authentication mechanism where clients authenticate themselves by providing their user credentials. In addition, you can integrate *Percona Server for MongoDB* with a separate service, such as OpenLDAP or Active Directory. This enables users to access the database with the same credentials they use for their emails or workstations.

You can use any of these authentication mechanisms supported in *Percona Server for MongoDB*:

- *SCRAM* (default)
- *x.509 certificate authentication*
- *LDAP authentication with SASL*
- *Kerberos Authentication*
- *Authentication and authorization with direct binding to LDAP*

6.1 SCRAM

SCRAM is the default authentication mechanism. *Percona Server for MongoDB* verifies the credentials against the user's name, password and the database where the user record is created for a client (authentication database). For how to enable this mechanism, see *Enabling Authentication*.

6.2 x.509 certificate authentication

This authentication mechanism enables a client to authenticate in *Percona Server for MongoDB* by providing an x.509 certificate instead of user credentials. Each certificate contains the `subject` field defined in the DN (Distinguished Name) format. In *Percona Server for MongoDB*, each certificate has a corresponding user record in the `$external` database. When a user connects to the database, *Percona Server for MongoDB* matches the `subject` value against the usernames defined in the `$external` database.

For production use, we recommend using valid CA (Certified Authority) certificates. For testing purposes, you can generate and use self-signed certificates.

x.509 authentication is compatible with with *LDAP authorization* to enable you to control user access and operations in *Percona Server for MongoDB*. For configuration guidelines, refer to *Set up x.509 authentication and LDAP authorization*.

See also:

MongoDB Documentation: x.509

Percona Blog: Setting up MongoDB with Member x509 auth and SSL + easy-rsa

6.3 LDAP authentication with SASL

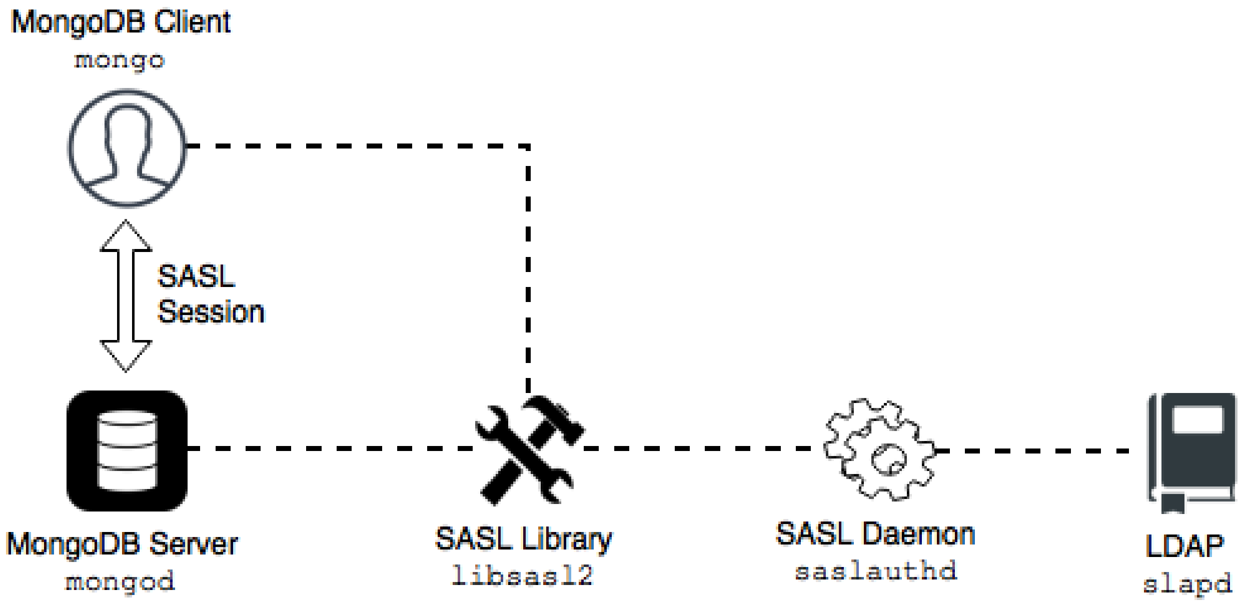
6.4 Overview

LDAP authentication with SASL (Simple Authentication and Security Layer) means that both the client and the server establish a SASL session using the SASL library. Then authentication (bind) requests are sent to the LDAP server through the SASL authentication daemon (`saslauthd`) that acts as a remote proxy for the `mongod` server.

The following components are necessary for external authentication to work:

- **LDAP Server**: Remotely stores all user credentials (i.e. user name and associated password).
- **SASL Daemon**: Used as a MongoDB server-local proxy for the remote LDAP service.
- **SASL Library**: Used by the MongoDB client and server to create data necessary for the authentication mechanism.

The following image illustrates this architecture:



An authentication session uses the following sequence:

1. A `mongo` client connects to a running `mongod` instance.
2. The client creates a `PLAIN` authentication request using the SASL library.
3. The client then sends this SASL request to the server as a special Mongo command.
4. The `mongod` server receives this SASL message, with its authentication request payload.
5. The server then creates a SASL session scoped to this client, using its own reference to the SASL library.
6. Then the server passes the authentication payload to the SASL library, which in turn passes it on to the `saslauthd` daemon.

7. The `saslauthd` daemon passes the payload on to the LDAP service to get a YES or NO authentication response (in other words, does this user exist and is the password correct).
8. The YES/NO response moves back from `saslauthd`, through the SASL library, to `mongod`.
9. The `mongod` server uses this YES/NO response to authenticate the client or reject the request.
10. If successful, the client has authenticated and can proceed.

For configuration instructions, refer to *Setting up LDAP authentication with SASL*.

6.5 Kerberos Authentication

Percona Server for MongoDB supports Kerberos authentication starting from release 4.2.6-6.

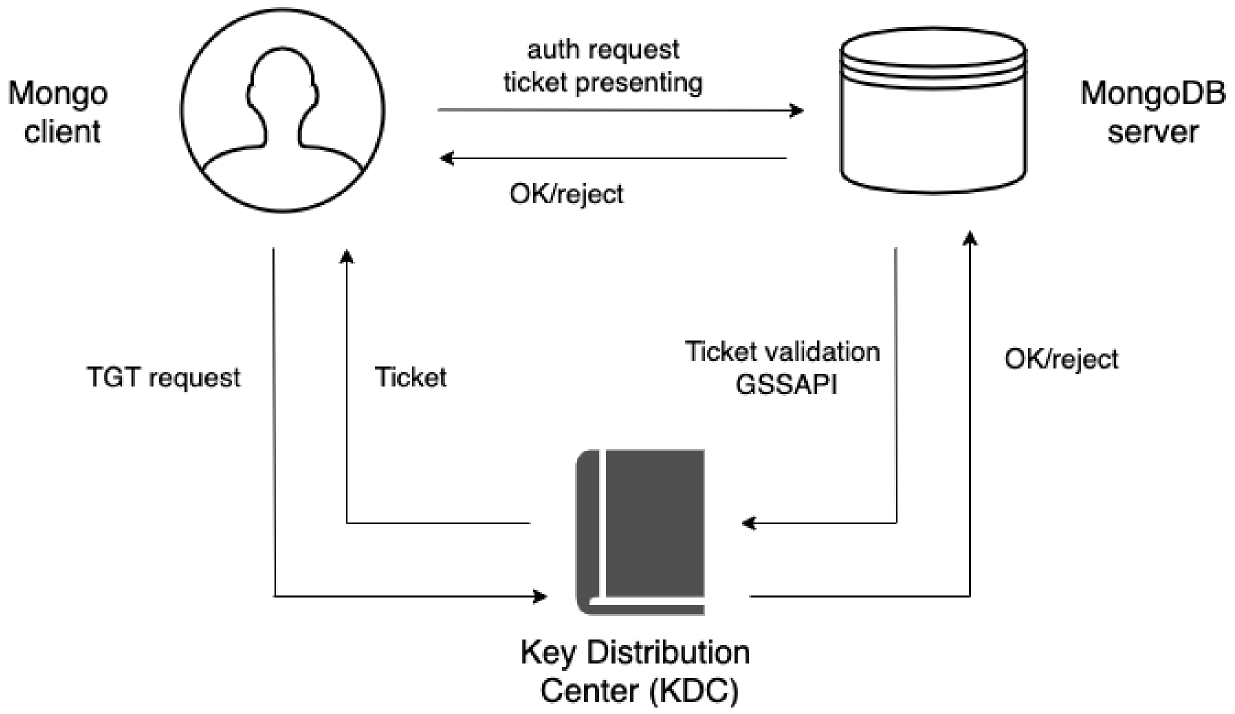
This authentication mechanism involves the use of a *Key Distribution Center (KDC)* - a symmetric encryption component which operates with tickets. A *ticket* is a small amount of encrypted data which is used for authentication. It is issued for a user session and has a limited lifetime.

When using Kerberos authentication, you also operate with principals and realms.

A *realm* is the logical network, similar to a domain, for all Kerberos nodes under the same master KDC.

A *principal* is a user or a service which is known to Kerberos. A principal name is used for authentication in Kerberos. A service principal represents the service, e.g. `mongodb`. A user principal represents the user. The user principal name corresponds to the username in the `$external` database in *Percona Server for MongoDB*.

The following diagram shows the authentication workflow:



The sequence is the following:

1. A `mongo` client sends the Ticket-Grantng Ticket (TGT) request to the Key Distribution Center (KDC)
2. The KDC issues the ticket and sends it to the `mongo` client.
3. The `mongo` client sends the authentication request to the `mongo` server presenting the ticket.

4. The `mongo` server validates the ticket in the KDC.
5. Upon successful ticket validation, the authentication request is approved and the user is authenticated.

Kerberos authentication in *Percona Server for MongoDB* is implemented the same way as in MongoDB Enterprise.

See also:

MongoDB Documentation: Kerberos Authentication

CHAPTER

SEVEN

LDAP AUTHORIZATION

LDAP authorization allows you to control user access and operations in your database environment using the centralized user management storage – an LDAP server. You create and manage user credentials and permission information in the LDAP server. In addition, you create roles in the `admin` database with the names that exactly match the LDAP group Distinguished Name. These roles define what privileges the users who belong to the corresponding LDAP group.

7.1 Supported authentication mechanisms

LDAP authorization is compatible with the following authentication mechanisms:

- *x.509 certificate authentication*
- *Kerberos Authentication*
- *Authentication and authorization with direct binding to LDAP*

7.2 Authentication and authorization with direct binding to LDAP

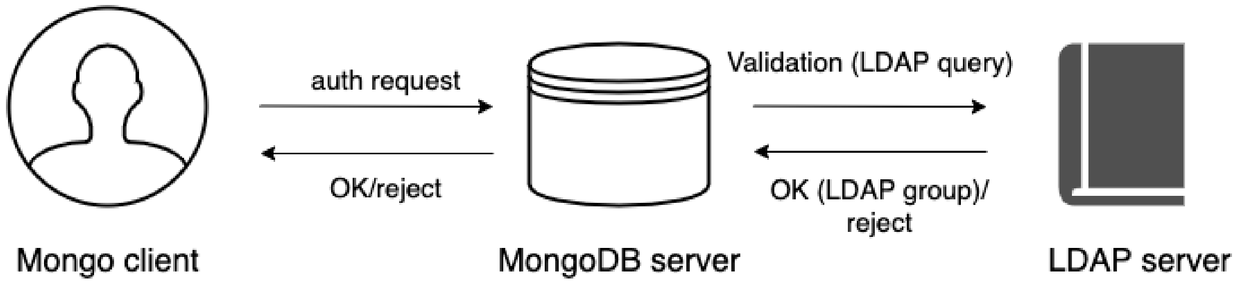
Starting with release 4.2.5-5, you can configure *Percona Server for MongoDB* to communicate with the LDAP server directly to authenticate and also authorize users.

The advantage of using this mechanism is that it is easy to setup and does not require pre-creating users in the dummy `$external` db. Nevertheless, the `--authenticationDatabase` connection argument will still need to be specified as `$external`.

The following example illustrates the connection to *Percona Server for MongoDB* from the `mongo` shell:

```
mongosh -u "CN=alice,CN=Users,DC=engineering,DC=example,DC=com" -p --
↪authenticationDatabase '$external' --authenticationMechanism PLAIN
```

The following diagram illustrates the authentication and authorization flow:



1. A user connects to the db providing their credentials
2. If required, *Percona Server for MongoDB* *transforms the username* to match the DN in the LDAP server according to the mapping rules specified for the `--ldapUserToDNMapping` parameter.
3. *Percona Server for MongoDB* queries the LDAP server for the user identity and /or the LDAP groups this user belongs to.
4. The LDAP server evaluates the query and if a user exists, returns their LDAP groups.
5. *Percona Server for MongoDB* authorizes the user by mapping the DN of the returned groups against the roles assigned to the user in the `admin` database. If a user belongs to several groups they receive permissions associated with every group.

7.2.1 Username transformation

If clients connect to *Percona Server for MongoDB* with usernames that are not LDAP DN, these usernames must be converted to the format acceptable by LDAP.

To achieve this, the `--ldapUserToDNMapping` parameter is available in *Percona Server for MongoDB* configuration.

The `--ldapUserToDNMapping` parameter is a JSON string representing an ordered array of rules expressed as JSON documents. Each document provides a regex pattern (`match` field) to match against a provided username. If that pattern matches, there are two ways to continue:

- If there is the `substitution` value, then the matched pattern becomes the username of the user for further processing.
- If there is the `ldapQuery` value, the matched pattern is sent to the LDAP server and the result of that LDAP query becomes the DN of the user for further processing.

Both `substitution` and `ldapQuery` should contain placeholders to insert parts of the original username – those placeholders are replaced with regular expression submatches found on the `match` stage.

So having an array of documents, *Percona Server for MongoDB* tries to match each document against the provided name and if it matches, the name is replaced either with the substitution string or with the result of the LDAP query.

LDAP referrals

As of version 4.2.10-11, *Percona Server for MongoDB* supports LDAP referrals as defined in RFC 4511 4.1.10. For security reasons, referrals are disabled by default. Double-check that using referrals is safe before enabling them.

To enable LDAP referrals, set the `ldapFollowReferrals` server parameter to `true` using the *setParameter* command or by editing the configuration file.

```
setParameter:
   ldapFollowReferrals: true
```

Connection pool

As of version 4.2.10-11, *Percona Server for MongoDB* always uses a connection pool to LDAP server to process bind requests. The connection pool is enabled by default. The default connection pool size is 2 connections.

You can change the connection pool size either at the server startup or dynamically by specifying the value for the `ldapConnectionPoolSizePerHost` server parameter.

For example, to set the number of connections in the pool to 5, use the `setParameter` command:

Command line

```
$ db.adminCommand( { setParameter: 1, ldapConnectionPoolSizePerHost: 5  } )
```

Configuration file:

```
setParameter:
  ldapConnectionPoolSizePerHost: 5
```

Support for multiple LDAP servers

As of version 4.2.12-13, you can specify multiple LDAP servers for failover. *Percona Server for MongoDB* sends bind requests to the first server defined in the list. When this server is down or unavailable, it sends requests to the next server and so on. Note that *Percona Server for MongoDB* keeps sending requests to this server even after the unavailable server recovers.

Specify the LDAP servers as a comma-separated list in the format `<host>:<port>` for the –ldapServers option.

You can define the option value at the server startup by editing the configuration file.

```
security:
  authorization: "enabled"
  ldap:
    servers: "ldap1.example.net,ldap2.example.net"
```

You can change `ldapServers` dynamically at runtime using the *setParameter*.

```
$ db.adminCommand( { setParameter: 1, ldapServers:"localhost,ldap1.example.net,ldap2.
↪example.net"} )
{ "was" : "ldap1.example.net,ldap2.example.net", "ok" : 1 }
```

See also:

***MongoDB* Documentation:**

- Authenticate and Authorize Users Using Active Directory via Native LDAP
- LDAP referrals

7.3 Configuration

For how to configure LDAP authorization with the native LDAP authentication, see *Setting up LDAP authentication and authorization using NativeLDAP*.

CHAPTER

EIGHT

AUDITING

Auditing allows administrators to track and log user activity on a MongoDB server. With auditing enabled, the server will generate an audit log file. This file contains information about different user events including authentication, authorization failures, and so on.

To enable audit logging, specify where to send audit events using the *--auditDestination* option on the command line or the `auditLog.destination` variable in the configuration file.

If you want to output events to a file, also specify the format of the file using the *--auditFormat* option or the `auditLog.format` variable, and the path to the file using the *--auditPath* option or the `auditLog.path` variable.

To filter recorded events, use the *--auditFilter* option or the `auditLog.filter` variable.

For example, to log only events from a user named *tim* and write them to a JSON file `/var/log/psmdb/audit.json`, start the server with the following parameters:

```
mongod \
 --dbpath data/db
 --auditDestination file \
 --auditFormat JSON \
 --auditPath /var/log/psmdb/audit.json \
 --auditFilter '{ "users.user" : "tim" }'
```

The options in the previous example can be used as variables in the MongoDB configuration file:

```
storage:
  dbPath: data/db
auditLog:
  destination: file
  format: JSON
  path: /var/log/psmdb/audit.json
  filter: '{ "users.user" : "tim" }'
```

This example shows how to send audit events to the `syslog`. Specify the following parameters:

```
mongod \
--dbpath data/db
--auditDestination syslog \
```

Alternatively, you can edit the MongoDB configuration file:

```
storage:
 dbPath: data/db
```

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```
auditLog:
 destination: syslog
```

Note: If you start the server with auditing enabled, it cannot be disabled dynamically during runtime.

8.1 Audit Options

The following options control audit logging:

`--auditDestination`

Variable `auditLog.destination`

Type String

Enables auditing and specifies where to send audit events:

- `console`: Output audit events to `stdout`.
- `file`: Output audit events to a file specified by the *`--auditPath`* option in a format specified by the *`--auditFormat`* option.
- `syslog`: Output audit events to `syslog`.

`--auditFilter`

Variable `auditLog.filter`

Type String

Specifies a filter to apply to incoming audit events, enabling the administrator to only capture a subset of them. The value must be interpreted as a query object with the following syntax:

```
{ <field1>: <expression1>, ... }
```

Audit log events that match this query will be logged. Events that do not match this query will be ignored.

For more information, see *Audit Filter Examples*.

`--auditFormat`

Variable `auditLog.format`

Type String

Specifies the format of the audit log file, if you set the *`--auditDestination`* option to `file`.

The default value is `JSON`. Alternatively, you can set it to `BSON`.

`--auditPath`

Variable `auditLog.path`

Type String

Specifies the fully qualified path to the file where audit log events are written, if you set the *`--auditDestination`* option to `file`.

If this option is not specified, then the `auditLog.json` file is created in the server's configured log path. If log path is not configured on the server, then the `auditLog.json` file is created in the current directory (from which `mongod` was started).

Note: This file will rotate in the same manner as the system log path, either on server reboot or using the logRotate command. The time of rotation will be added to the old file's name.

8.2 Audit Message Syntax

Audit logging writes messages in JSON format with the following syntax:

```
{
  atype: <String>,
  ts : { "$date": <timestamp> },
  local: { ip: <String>, port: <int> },
  remote: { ip: <String>, port: <int> },
  users : [ { user: <String>, db: <String> }, ... ],
  roles: [ { role: <String>, db: <String> }, ... ],
  param: <document>,
  result: <int>
}
```

atype Event type

ts Date and UTC time of the event

local Local IP address and port number of the instance

remote Remote IP address and port number of the incoming connection associated with the event

users Users associated with the event

roles Roles granted to the user

param Details of the event associated with the specific type

result Exit code (`0` for success)

8.3 Audit Filter Examples

The following examples demonstrate the flexibility of audit log filters.

- *Standard Query Selectors*
- *Regular Expressions*
- *Read and Write Operations*

```
auditLog:
   destination: file
      filter: '{atype: {$in: [
         "authenticate", "authCheck",
```

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```
        "renameCollection", "dropCollection", "dropDatabase",
        "createUser", "dropUser", "dropAllUsersFromDatabase", "updateuser",
        "grantRolesToUser", "revokeRolesFromUser", "createRole", "updateRole",
        "dropRole", "dropAllRolesFromDatabase", "grantRolesToRole", "revokeRolesFromRole
↪",
        "grantPrivilegesToRole", "revokePrivilegesFromRole",
        "replSetReconfig",
        "enableSharding", "shardCollection", "addShard", "removeShard",
        "shutdown",
        "applicationMessage"
     ]}}'
```

8.3.1 Standard Query Selectors

You can use query selectors, such as `$eq`, `$in`, `$gt`, `$lt`, `$ne`, and others to log multiple event types.

For example, to log only the `dropCollection` and `dropDatabase` events:

- Command line:

```
--auditDestination file --auditFilter '{ atype: { $in: [ "dropCollection",
↪"dropDatabase" ] } }'
```

- Config file:

```
auditLog:
  destination: file
  filter: '{ atype: { $in: [ "dropCollection", "dropDatabase" ] } }'
```

8.3.2 Regular Expressions

Another way to specify multiple event types is using regular expressions.

For example, to filter all `drop` operations:

- Command line:

```
--auditDestination file --auditFilter '{ "atype" : /^drop.*/ }'
```

- Config file:

```
auditLog:
  destination: file
  filter: '{ "atype" : /^drop.*/ }'
```

8.3.3 Read and Write Operations

By default, operations with successful authorization are not logged, so for this filter to work, enable `auditAuthorizationSuccess` parameter, as described in *Enabling Auditing of Authorization Success*.

For example, to filter read and write operations on all the collections in the `test` database:

Note: The dot (`.`) after the database name in the regular expression must be escaped with two backslashes (\\).

- Command line:

```
--setParameter auditAuthorizationSuccess=true --auditDestination file --auditFilter
↪'{ atype: "authCheck", "param.command": { $in: [ "find", "insert", "delete",
↪"update", "findandmodify" ] }, "param.ns": /^test\\./ } }'
```

- Config file:

```
auditLog:
  destination: file
  filter: '{ atype: "authCheck", "param.command": { $in: [ "find", "insert", "delete
↪", "update", "findandmodify" ] }, "param.ns": /^test\\./ } }'

setParameter: { auditAuthorizationSuccess: true }
```

8.4 Enabling Auditing of Authorization Success

By default, only authorization failures for the `authCheck` action are logged by the audit system. `authCheck` is for authorization by role-based access control, it does not concern authentication at logins.

To enable logging of authorization successes, set the `auditAuthorizationSuccess` parameter to `true`. Audit events will then be triggered by every command, including CRUD ones.

Warning: Enabling the `auditAuthorizationSuccess` parameter heavily impacts the performance compared to logging only authorization failures.

You can enable it on a running server using the following command:

```
db.adminCommand( { setParameter: 1, auditAuthorizationSuccess: true } )
```

To enable it on the command line, use the following option when running `mongod` or `mongos` process:

```
--setParameter auditAuthorizationSuccess=true
```

You can also add it to the configuration file as follows:

```
setParameter:
  auditAuthorizationSuccess: true
```

CHAPTER

NINE

LOG REDACTION

Percona Server for MongoDB can prevent writing sensitive data to the diagnostic log by redacting messages of events before they are logged. To enable log redaction, run `mongod` with the `--redactClientLogData` option.

Note: Metadata such as error or operation codes, line numbers, and source file names remain visible in the logs.

Log redaction is important for complying with security requirements, but it can make troubleshooting and diagnostics more difficult due to the lack of data related to the log event. For this reason, debug messages are not redacted even when log redaction is enabled. Keep this in mind when switching between log levels.

You can permanently enable log redaction by adding the following to the configuration file:

```
security:
  redactClientLogData: true
```

To enable log redaction at runtime, use the `setParameter` command as follows:

```
db.adminCommand(
  { setParameter: 1, redactClientLogData : true }
)
```

CHAPTER

TEN

DATA AT REST ENCRYPTION

Data at rest encryption for the WiredTiger storage engine in *MongoDB* was introduced in MongoDB Enterprise version 3.2 to ensure that encrypted data files can be decrypted and read by parties with the decryption key.

Differences from Upstream

The data encryption at rest in *Percona Server for MongoDB* is introduced in version 3.6 to be compatible with data encryption at rest interface in *MongoDB*. In the current release of *Percona Server for MongoDB*, the data encryption at rest does not include support for Amazon AWS key management service. Instead, *Percona Server for MongoDB* is *integrated with HashiCorp Vault*. Starting with release 5.0.7-6, *Percona Server for MongoDB* supports the secure transfer of keys using *Key Management Interoperability Protocol (KMIP)*. This allows users to store encryption keys in their favorite KMIP-compatible key manager when they set up encryption at rest.

Two types of keys are used for data at rest encryption:

- Database keys to encrypt data. They are stored internally, near the data that they encrypt.
- The master key to encrypt database keys. It is kept separately from the data and database keys and requires external management.

To manage the master key, use one of the supported key management options:

- Integration with an external key server (recommended). *Percona Server for MongoDB* is *integrated with HashiCorp Vault* and supports the secure transfer of keys using *Key Management Interoperability Protocol (KMIP)*.
- *Local key management using a keyfile*.

Note that you can use only one of the key management options at a time. However, you can switch from one management option to another (e.g. from a keyfile to HashiCorp Vault). Refer to *Migrating from Key File Encryption to HashiCorp Vault Encryption* section for details.

Important: You can only enable data at rest encryption and provide all encryption settings on an empty database, when you start the `mongod` instance for the first time. You cannot enable or disable encryption while the *Percona Server for MongoDB* server is already running and / or has some data. Nor can you change the effective encryption mode by simply restarting the server. Every time you restart the server, the encryption settings must be the same.

10.1 HashiCorp Vault Integration

Percona Server for MongoDB is integrated with HashiCorp Vault. HashiCorp Vault supports different secrets engines. *Percona Server for MongoDB* only supports the HashiCorp Vault back end with KV Secrets Engine - Version 2 (API) with versioning enabled.

See also:

Percona Blog: Using Vault to Store the Master Key for Data at Rest Encryption on *Percona Server for MongoDB*
https://www.percona.com/blog/2020/04/21/using-vault-to-store-the-master-key-for-data-at-rest-encryption-on-percona-server-fo

How to configure the KV Engine: https://www.vaultproject.io/api/secret/kv/kv-v2.html

---

HashiCorp Vault Parameters

Command line	Config file	Type	Description
vaultServerName	security.vault.serverName	string	The IP address of the Vault server
vaultPort	security.vault.port	int	The port on the Vault server
vaultTokenFile	security.vault.tokenFile	string	The path to the vault token file. The token file is used by *MongoDB* to access HashiCorp Vault. The vault token file consists of the raw vault token and does not include any additional strings or parameters. Example of a vault token file: `s.uTrHtzsZnEE7KyHeA797CkWA`

vaultSecret	security.vault.secret	string	The path to the vault secret. Note that vault secrets path format must be:
			`<vault_secret_mount>/data/<custom_path>`
			where:
			• `<vault_secret_mount>` is your Vault KV Secrets Engine;
			• `data` is the mandatory path prefix required by Version 2 API;
			• `<custom_path>` is your secrets path
			Example:
			`secret_v2/data/psmdb-test/rs1-27017`
			Note: It is recommended to use different secret paths for every database node.

vaultRotateMasterKey	security.vault.rotateMasterKey	switch	Enables master key rotation
vaultServerCAFile	security.vault.serverCAFile	string	The path to the TLS certificate file
vaultDisableTLSForTesting	security.vault.disableTLSForTesting	switch	Disables secure connection to HashiCorp Vault using SSL/TLS client certificates

Config file example

```
security:
  enableEncryption: true
  vault:
    serverName: 127.0.0.1
    port: 8200
    tokenFile: /home/user/path/token
    secret: secret/data/hello
```

During the first run of the *Percona Server for MongoDB*, the process generates a secure key and writes the key to the vault.

During the subsequent start, the server tries to read the master key from the vault. If the configured secret does not exist, vault responds with HTTP 404 error.

10.1.1 Namespaces

Namespaces are isolated environments in Vault that allow for separate secret key and policy management.

You can use Vault namespaces with *Percona Server for MongoDB*. Specify the namespace(s) for the `security.vault.secret` option value as follows:

```
<namespace>/secret/data/<secret_path>
```

For example, the path to secret keys for namespace `test` on the secrets engine `secret` will be `test/secret/<my_secret_path>`.

Note: You have the following options of how to target a particular namespace when configuring Vault:

1. Set the VAULT_NAMESPACE environment variable so that all subsequent commands are executed against that namespace. Use the following command to set the environment variable for the namespace `test`:

```
$ export VAULT_NAMESPACE=test
```

2. Provide the namespace with the `-namespace` flag in commands

See also:

HashiCorp Vault Documentation:

- **Namespaces** https://www.vaultproject.io/docs/enterprise/namespaces
- **Secure Multi-Tenancy with Namespaces** https://learn.hashicorp.com/tutorials/vault/namespaces

10.1.2 Key Rotation

Key rotation is replacing the old master key with a new one. This process helps to comply with regulatory requirements.

To rotate the keys for a single `mongod` instance, do the following:

1. Stop the `mongod` process
2. Add `--vaultRotateMasterKey` option via the command line or `security.vault.rotateMasterKey` to the config file.
3. Run the `mongod` process with the selected option, the process will perform the key rotation and exit.
4. Remove the selected option from the startup command or the config file.
5. Start `mongod` again.

Rotating the master key process also re-encrypts the keystore using the new master key. The new master key is stored in the vault. The entire dataset is not re-encrypted.

For a replica set, the steps are the following:

1. Rotate the master key for the secondary nodes one by one.

2. Step down the primary and wait for another primary to be elected.
3. Rotate the master key for the previous primary node.

10.2 Local key management using a keyfile

The key file must contain a 32 character string encoded in base64. You can generate a random key and save it to a file by using the **openssl** command:

```
$ openssl rand -base64 32 > mongodb-keyfile
```

Then, as the owner of the mongod process, update the file permissions: only the owner should be able to read and modify this file. The effective permissions specified with the chmod command can be:

- **600** - only the owner may read and modify the file
- **400** - only the owner may read the file.

```
$ chmod 600 mongodb-keyfile
```

Enable the data encryption at rest in *Percona Server for MongoDB* by setting these options:

- `--enableEncryption` to enable data at rest encryption
- `--encryptionKeyFile` to specify the path to a file that contains the encryption key

```
$ mongod ... --enableEncryption --encryptionKeyFile <fileName>
```

By default, *Percona Server for MongoDB* uses the `AES256-CBC` cipher mode. If you want to use the `AES256-GCM` cipher mode, then use the `encryptionCipherMode` parameter to change it.

If `mongod` is started with the `--relaxPermChecks` option and the key file is owned by `root`, then `mongod` can read the file based on the group bit set accordingly. The effective key file permissions in this case are:

- **440** - both the owner and the group can only read the file, or
- **640** - only the owner can read and the change the file, the group can only read the file.

See also:

MongoDB Documentation: Configure Encryption https://docs.mongodb.com/manual/tutorial/configure-encryption/#local-key-management

Percona **Blog: WiredTiger Encryption at Rest with Percona Server for MongoDB** https://www.percona.com/blog/2018/11/01/wiredtiger-encryption-at-rest-percona-server-for-mongodb/

All these options can be specified in the configuration file:

```
security:
   enableEncryption: <boolean>
   encryptionCipherMode: <string>
   encryptionKeyFile: <string>
   relaxPermChecks: <boolean>
```

See also:

MongoDB Documentation: How to set options in a configuration file https://docs.mongodb.com/manual/reference/configuration-options/index.html#configuration-file

10.3 Migrating from Key File Encryption to HashiCorp Vault Encryption

The steps below describe how to migrate from the key file encryption to using HashiCorp Vault.

Note: This is a simple guideline and it should be used for testing purposes only. We recommend to use Percona Consulting Services to assist you with migration in production environment.

Assumptions

We assume that you have installed and configured the vault server and enabled the KV Secrets Engine as the secrets storage for it.

1. Stop mongod.

```
$ sudo systemctl stop mongod
```

2. Insert the key from keyfile into the HashiCorp Vault server to the desired secret path.

```
# Retrieve the key value from the keyfile
$ sudo cat /data/key/mongodb.key
d0JTFcePmvROyLXwCbAH8fmiP/ZRm0nYbeJDMGaI7Zw=
# Insert the key into vault
$ vault kv put secret/dc/psmongodb1 value=d0JTFcePmvROyLXwCbAH8fmiP/
↪ZRm0nYbeJDMGaI7Zw=
```

Note: Vault KV Secrets Engine uses different read and write secrets paths. To insert data to vault, specify the secret path without the data/ prefix.

3. Edit the configuration file to provision the HashiCorp Vault configuration options instead of the key file encryption options.

```
security:
   enableEncryption: true
   vault:
      serverName: 10.0.2.15
      port: 8200
      secret: secret/data/dc/psmongodb1
      tokenFile: /etc/mongodb/token
      serverCAFile: /etc/mongodb/vault.crt
```

4. Start the mongod service

```
$ sudo systemctl start mongod
```

10.4 Using the Key Management Interoperability Protocol (KMIP)

Percona Server for MongoDB adds support for the secure transfer of keys using the OASIS Key Management Interoperability Protocol (KMIP). The KMIP implementation was tested with the PyKMIP server and the HashiCorp Vault Enterprise KMIP Secrets Engine.

KMIP enables the communication between a key management system and the database server. KMIP provides the following benefits:

- Streamlines encryption key management
- Eliminates redundant key management processes

You can specify multiple KMIP servers for failover. On startup, *Percona Server for MongoDB* connects to the servers in the order listed and selects the one with which the connection is successful.

KMIP parameters

Option	Type	Description
`--kmipServerName`	string	The hostname or IP address of the KMIP server. Multiple KMIP servers are supported as the comma-separated list, e.g. `kmip1.example.com,kmip2.example.com`
`--kmipPort`	number	The port used to communicate with the KMIP server. When undefined, the default port `5696` will be used.
`--kmipServerCAFile`	string	The path to the TLS certificate file. CA file is used to validate secure client connection to the KMIP server.
`--kmipClientCertificateFile`	string	The path to the PEM file with the KMIP client private key and the certificate chain. The database server uses this PEM file to authenticate the KMIP server.
`--kmipKeyIdentifier`	string	The identifier of the KMIP key. If the key does not exist, the database server creates a key on the KMIP server with the specified identifier. When you specify the identifier, the key with such an ID must exist on the key storage. You can only use this setting for the first time you enable encryption.
`--kmipRotateMasterKey`	boolean	Controls master keys rotation. When enabled, generates the new master key version and re-encrypts the keystore. Requires the unique `--kmipKeyIdentifier` for every `mongod` node.
`--kmipClientCertificatePassword`	string	The password for the KMIP client private key or certificate. Use this parameter only if the KMIP client private key or certificate is encrypted.

10.5 Key rotation

Percona Server for MongoDB supports the master key rotation to enable users to comply with data security regulations when using KMIP.

10.6 Configuration

Considerations

Make sure you have obtained the root certificate, and the keypair for the KMIP server and the `mongod` client. For testing purposes you can use the OpenSSL to issue self-signed certificates. For production use we recommend you use the valid certificates issued by the key management appliance.

To enable data-at-rest encryption in *Percona Server for MongoDB* using KMIP, edit the `/etc/mongod.conf` configuration file as follows:

```
security:
  enableEncryption: true
  kmip:
    serverName: <kmip_server_name>
    port: <kmip_port>
    clientCertificateFile: </path/client_certificate.pem>
    clientKeyFile: </path/client_key.pem>
    serverCAFile: </path/ca.pem>
    keyIdentifier: <key_name>
```

Alternatively, you can start *Percona Server for MongoDB* using the command line as follows:

```
$ mongod --enableEncryption \
  --kmipServerName <kmip_servername> \
  --kmipPort <kmip_port> \
  --kmipServerCAFile <path_to_ca_file> \
  --kmipClientCertificateFile <path_to_client_certificate> \
  --kmipClientKeyFile <path_to_client_private_key> \
  --kmipKeyIdentifier <kmip_identifier>
```

Important Configuration Options

Percona Server for MongoDB supports the `encryptionCipherMode` option where you choose one of the following cipher modes:

- AES256-CBC
- AES256-GCM

By default, the AES256-CBC cipher mode is applied. The following example demonstrates how to apply the AES256-GCM cipher mode when starting the **`mongod`** service:

```
$ mongod ... --encryptionCipherMode AES256-GCM
```

See also:

***MongoDB* Documentation: encryptionCipherMode Option** https://docs.mongodb.com/manual/reference/program/mongod/#cmdoption-mongod-encryptionciphermode

10.7 Encrypting Rollback Files

Starting from version 3.6, *Percona Server for MongoDB* also encrypts rollback files when data at rest encryption is enabled. To inspect the contents of these files, use **perconadecrypt**. This is a tool that you run from the command line as follows:

```
$ perconadecrypt --encryptionKeyFile FILE  --inputPath FILE --outputPath FILE [--
↪encryptionCipherMode MODE]
```

When decrypting, the cipher mode must match the cipher mode which was used for the encryption. By default, the `--encryptionCipherMode` option uses the AES256-CBC mode.

Parameters of `perconadecrypt`

Option	Purpose
–encryptionKeyFile	The path to the encryption key file
–encryptionCipher-Mode	The cipher mode for decryption. The supported values are AES256-CBC or AES256-GCM
–inputPath	The path to the encrypted rollback file
–outputPath	The path to save the decrypted rollback file

CHAPTER

ELEVEN

ADDITIONAL TEXT SEARCH ALGORITHM - *NGRAM*

The ngram text search algorithm is useful for searching text for a specific string of characters in a field of a collection. This feature can be used to find exact sub-string matches, which provides an alternative to parsing text from languages other than the list of European languages already supported by MongoDB Community's full text search engine. It may also turn out to be more convenient when working with the text where symbols like dash('-'), underscore('_'), or slash("/") are not token delimiters.

Unlike MongoDB full text search engine, *ngram* search algorithm uses only the following token delimiter characters that do not count as word characters in human languages:

- Horizontal tab
- Vertical tab
- Line feed
- Carriage return
- Space

The *ngram* text search is slower than MongoDB full text search.

11.1 Usage

To use *ngram*, create a text index on a collection setting the `default_language` parameter to **ngram**:

```
mongo > db.collection.createIndex({name:"text"}, {default_language: "ngram"})
```

ngram search algorithm treats special characters like individual terms. Therefore, you don't have to enclose the search string in escaped double quotes (`\"`) to query the text index. For example, to search for documents that contain the date `2021-02-12`, specify the following:

```
mongo > db.collection.find({ $text: { $search: "2021-02-12" } })
```

However, both *ngram* and MongoDB full text search engine treat words with the hyphen-minus `-` sign in front of them as negated (e.g. "-coffee") and exclude such words from the search results.

See also:

***MongoDB* documentation:**

- Text search
- Text indexes
- $text operator

More information about ngram implementation:

- https://github.com/percona/percona-server-mongodb/blob/v6.0/src/mongo/db/fts/ngram-tokenizer.md

CHAPTER

TWELVE

$BACKUPCURSOR AND $BACKUPCURSOREXTEND AGGREGATION STAGES

`$backupCursor` and `$backupCursorExtend` aggregation stages expose the WiredTiger API which allows making consistent backups. Running these stages allows listing and freezing the files so you can copy them without the files being deleted or necessary parts within them being overwritten.

- `$backupCursor` outputs the list of files and their size to copy.
- `$backupCursorExtend` outputs the list of WiredTiger transaction log files that have been updated or newly added since the `$backupCursor` was first run. Saving these files enables restoring the database to any arbitrary time between the `$backupCursor` and `$backupCursorExtend` execution times.

They are available in *Percona Server for MongoDB* starting with version 4.4.6-8.

Percona provides Percona Backup for MongoDB (PBM) – a light-weight open source solution for consistent backups and restores across sharded clusters. PBM relies on these aggregation stages for physical backups and restores. However, if you wish to develop your own backup application, this document describes the `$backupCursor` and `$backupCursorExtend` aggregation stages.

12.1 Usage

You can run these stages in any type of MongoDB deployment. If you need to back up a single node in a replica set, first run the `$backupCursor`, then the `$backupCursorExtend` and save the output files to the backup storage.

To make a consistent backup of a sharded cluster, run both aggregation stages on one node from each shard and the config server replica set. It can be either the primary or the secondary node. Note that since the secondary node may lag in syncing the data from the primary one, you will have to wait for the exact same time before running the `$backupCursorExtend`.

Note that for standalone MongoDB node with disabled oplogs, you can only run the `$backupCursor` aggregation stage.

12.1.1 Get a list of all files to copy with $backupCursor

```
var bkCsr = db.getSiblingDB("admin").aggregate([{$backupCursor: {}}])
bkCsrMetadata = bkCsr.next().metadata
```

Sample output:

```
[
  {
    metadata: {
      backupId: UUID("35c34101-0107-44cf-bdec-fad285e07534"),
      dbpath: '/var/lib/mongodb',
      oplogStart: { ts: Timestamp({ t: 1666631297, i: 1 }), t: Long("-1") },
      oplogEnd: { ts: Timestamp({ t: 1666631408, i: 1 }), t: Long("1") },
      checkpointTimestamp: Timestamp({ t: 1666631348, i: 1 })
    }
  },
```

Store the `metadata` document somewhere, because you need to pass the `backupId` parameter from this document as the input parameter for the `$backupCursorExtend` stage. Also you need the `oplogEnd` timestamp. Make sure that the `$backupCursor` is complete on all shards in your cluster.

Note: Note that when running `$backupCursor` in a standalone node deployment, `oplogStart`, `oplogEnd`, `checkpointTimesatmp` values may be absent. This is because standalone node deployments don't have oplogs.

12.1.2 Run `$backupCursorExtend` to retrieve the WiredTiger transaction logs

Pass the `backupId` from the metadata document as the first parameter. For the `timestamp` parameter, use the maximum (latest) value among the `oplogEnd` timestamps from all shards and config server replica set. This will be the target time to restore.

```
var bkExtCsr = db.aggregate([{$backupCursorExtend: {backupId: bkCsrMetadata.backupId,␣
↪timestamp: new Timestamp(1666631418, 1)}}])
```

Sample output:

```
{ "filename" : "/data/plain_rs/n1/data/journal/WiredTigerLog.0000000042" }
{ "filename" : "/data/plain_rs/n1/data/journal/WiredTigerLog.0000000043" }
{ "filename" : "/data/plain_rs/n1/data/journal/WiredTigerLog.0000000044" }
```

12.1.3 Loop the `$backupCursor`

Prevent the backup cursor from closing on timeout (default – 10 minutes). This is crucial since it prevents overwriting backup snapshot file blocks with new ones if the files take longer than 10 minutes to copy. Use the getMore command for this purpose.

12.1.4 Copy the files to the storage

Now you can copy the output of both aggregation stages to your backup storage.

After the backup is copied to the storage, terminate the getMore command and close the cursor.

Note: Save the timestamp that you passed for the $backupCursorExtend stage somewhere since you will need it for the restore.

Based on the material from Percona blog

Based on the blog post: Experimental Feature: $backupCursorExtend in Percona Server for MongoDB by Akira Kurogane

Part IV

How to

CHAPTER

THIRTEEN

ENABLING AUTHENTICATION

By default, *Percona Server for MongoDB* does not restrict access to data and configuration.

Enabling authentication enforces users to identify themselves when accessing the database. This documents describes how to enable built-in authentication mechanism. *Percona Server for MongoDB* also supports the number of external authentication mechanisms. To learn more, refer to *Authentication*.

You can enable authentication either automatically or manually.

13.1 Automatic setup

To enable authentication and automatically set it up, run the `/usr/bin/percona-server-mongodb-enable-auth.sh` script as root or using `sudo`.

This script creates the `dba` user with the `root` role. The password is randomly generated and printed out in the output. Then the script restarts *Percona Server for MongoDB* with access control enabled. The `dba` user has full superuser privileges on the server. You can add other users with various roles depending on your needs.

For usage information, run the script with the `-h` option.

13.2 Manual setup

To enable access control manually:

1. Add the following lines to the configuration file:

```
security:
  authorization: enabled
```

2. Run the following command on the `admin` database:

```
> db.createUser({user: 'USER', pwd: 'PASSWORD', roles: ['root'] });
```

3. Restart the `mongod` service:

```
$ sudo systemctl restart mongod
```

4. Connect to the database as the newly created user:

```
$ mongo --port 27017 -u 'USER' -p 'PASSWORD'  --authenticationDatabase "admin"
```

See also:

***MongoDB* Documentation: Enable Access Control** https://docs.mongodb.com/v5.0/tutorial/enable-authentication/

CHAPTER

FOURTEEN

SETTING UP LDAP AUTHENTICATION WITH SASL

This document describes an example configuration suitable only to test out the external authentication functionality in a non-production environment. Use common sense to adapt these guidelines to your production environment.

To learn more about how the authentication works, see *LDAP authentication with SASL*.

14.1 Environment setup and configuration

The following components are required:

- `slapd`: OpenLDAP server.
- `libsasl2` version 2.1.25 or later.
- `saslauthd`: SASL Authentication Daemon (distinct from `libsasl2`).

The following steps will help you configure your environment:

Assumptions

Before we move on to the configuration steps, we assume the following:

1. You have the LDAP server up and running and have configured users on it. The LDAP server is accessible to the server with *Percona Server for MongoDB* installed. This document focuses on OpenLDAP server. If you use Microsoft Windows Active Directory, refer to the *Microsoft Windows Active Directory* section for `saslauthd` configuration.
2. You must place these two servers behind a firewall as the communications between them will be in plain text. This is because the SASL mechanism of PLAIN can only be used when authenticating and credentials will be sent in plain text.
3. You have `sudo` privilege to the server with the *Percona Server for MongoDB* installed.

14.1.1 Configuring `saslauthd`

1. Install the SASL packages. Depending on your OS, use the following command:

   RedHat and CentOS

   ```
   $ sudo yum install -y cyrus-sasl
   ```

   Debian and Ubuntu

   ```
   $ sudo apt install -y sasl2-bin
   ```

2. Configure SASL to use `ldap` as the authentication mechanism.

   Note: Back up the original configuration file before making changes.

   RedHat and CentOS

   Specify the `ldap` value for the `--MECH` option using the following command:

   ```
   $ sudo sed -i -e s/^MECH=pam/MECH=ldap/g /etc/sysconfig/saslauthd
   ```

   Alternatively, you can edit the `/etc/sysconfig/saslauthd` configuration file:

   ```
   MECH=ldap
   ```

   Debian and Ubuntu

   Use the following commands to enable the `saslauthd` to auto-run on startup and to set the `ldap` value for the `--MECHANISMS` option:

   ```
   $ sudo sed -i -e s/^MECH=pam/MECH=ldap/g /etc/sysconfig/saslauthdsudo sed -i -e s/^
   ↪MECHANISMS="pam"/MECHANISMS="ldap"/g /etc/default/saslauthd
   $ sudo sed -i -e s/^START=no/START=yes/g /etc/default/saslauthd
   ```

Alternatively, you can edit the `/etc/default/sysconfig/saslauthd` configuration file:

```
START=yes
MECHANISMS="ldap"
```

3. Create the `/etc/saslauthd.conf` configuration file and specify the settings that `saslauthd` requires to connect to a local LDAP service:

OpenLDAP server

The following is the example configuration file. Note that the server address **MUST** match the OpenLDAP installation:

```
ldap_servers: ldap://localhost
ldap_mech: PLAIN
ldap_search_base: dc=example,dc=com
ldap_filter: (cn=%u)
ldap_bind_dn: cn=admin,dc=example,dc=com
ldap_password: secret
```

Note the LDAP password (`ldap_password`) and bind domain name (`ldap_bind_dn`). This allows the `saslauthd` service to connect to the LDAP service as admin. In production, this would not be the case; users should not store administrative passwords in unencrypted files.

Microsoft Windows Active Directory

In order for LDAP operations to be performed against a Windows Active Directory server, a user record must be created to perform the lookups.

The following example shows configuration parameters for `saslauthd` to communicate with an Active Directory server:

```
ldap_servers: ldap://localhost
ldap_mech: PLAIN
ldap_search_base: CN=Users,DC=example,DC=com
ldap_filter: (sAMAccountName=%u)
ldap_bind_dn: CN=ldapmgr,CN=Users,DC=<AD Domain>,DC=<AD TLD>
ldap_password: ld@pmgr_Pa55word
```

In order to determine and test the correct search base and filter for your Active Directory installation, the Microsoft LDP GUI Tool can be used to bind and search the LDAP-compatible directory.

4. Start the `saslauthd` process and set it to run at restart:

```
$ sudo systemctl start saslauthd
$ sudo systemctl enable saslauthd
```

5. Give write permissions to the `/run/saslauthd` folder for the `mongod`. Either change permissions to the `/run/saslauthd` folder:

```
$ sudo chmod 755 /run/saslauthd
```

Or add the `mongod` user to the `sasl` group:

```
$ sudo usermod -a -G sasl mongod
```

14.1.2 Sanity check

Verify that the `saslauthd` service can authenticate against the users created in the LDAP service:

```
$ testsaslauthd -u christian -p secret  -f /var/run/saslauthd/mux
```

This should return `0:OK "Success"`. If it doesn't, then either the user name and password are not in the LDAP service, or `sasaluthd` is not configured properly.

14.1.3 Configuring libsasl2

The `mongod` also uses the SASL library for communications. To configure the SASL library, create a configuration file.

The configuration file **must** be named `mongodb.conf` and placed in a directory where `libsasl2` can find and read it. `libsasl2` is hard-coded to look in certain directories at build time. This location may be different depending on the installation method.

In the configuration file, specify the following:

```
pwcheck_method: saslauthd
saslauthd_path: /var/run/saslauthd/mux
log_level: 5
mech_list: plain
```

The first two entries (`pwcheck_method` and `saslauthd_path`) are required for `mongod` to successfully use the `saslauthd` service. The `log_level` is optional but may help determine configuration errors.

See also:

SASL documentation:

14.1.4 Configuring `mongod` Server

The configuration consists of the following steps:

- Creating a user with the **root** privileges. This user is required to log in to *Percona Server for MongoDB* after the external authentication is enabled.
- Editing the configuration file to enable the external authentication

Create a root user

Create a user with the **root** privileges in the `admin` database. If you have already created this user, skip this step. Otherwise, run the following command to create the admin user:

```
> use admin
switched to db admin
> db.createUser({"user": "admin", "pwd": "$3cr3tP4ssw0rd", "roles": ["root"]})
Successfully added user: { "user" : "admin", "roles" : [ "root" ] }
```

Enable external authentication

Edit the `etc/mongod.conf` configuration file to enable the external authentication:

```
security:
  authorization: enabled

setParameter:
  authenticationMechanisms: PLAIN,SCRAM-SHA-1
```

Restart the `mongod` service:

```
$ sudo systemctl restart mongod
```

Add an external user to *Percona Server for MongoDB*

User authentication is done by mapping a user object on the LDAP server against a user created in the `$external` database. Thus, at this step, you create the user in the `$external` database and they inherit the roles and privileges. Note that the username must exactly match the name of the user object on the LDAP server.

Connect to *Percona Server for MongoDB* and authenticate as *the root user*.

```
$ mongosh --host localhost --port 27017 -u admin -p '$3cr3tP4ssw0rd' --
↪authenticationDatabase 'admin'
```

Use the following command to add an external user to *Percona Server for MongoDB*:

```
> db.getSiblingDB("$external").createUser( {user : "christian", roles: [ {role: "read",␣
↪db: "test"} ]} );
```

14.2 Authenticate as an external user in *Percona Server for MongoDB*

When running the `mongo` client, a user can authenticate against a given database using the following command:

```
> db.getSiblingDB("$external").auth({ mechanism:"PLAIN", user:"christian", pwd:"secret",␣
↪digestPassword:false})
```

Alternatively, a user can authenticate while connecting to *Percona Server for MongoDB*:

```
$ mongosh --host localhost --port 27017 --authenticationMechanism PLAIN --
↪authenticationDatabase \$external -u christian -p
```

Based on the material from Percona Database Performance Blog

This section is based on the blog post Percona Server for MongoDB Authentication Using Active Directory by *Doug Duncan*:

CHAPTER

FIFTEEN

SETTING UP LDAP AUTHENTICATION AND AUTHORIZATION USING NATIVELDAP

This document describes an example configuration of LDAP authentication and authorization using direct binding to an LDAP server (Native LDAP). We recommend testing this setup in a non-production environment first, before applying it in production.

15.1 Assumptions

1. The setup of an LDAP server is out of scope of this document. We assume that you are familiar with the LDAP server schema.
2. You have the LDAP server up and running and it is accessible to the servers with Percona Server for MongoDB installed.
3. This document primarily focuses on OpenLDAP used as the LDAP server and the examples are given based on the OpenLDAP format. If you are using Active Directory, refer to the *Active Directory configuration* section.
4. You have the `sudo` privilege to the server with the Percona Server for MongoDB installed.

15.2 Prerequisites

- In this setup we use anonymous binds to the LDAP server. If your LDAP server disallows anonymous binds, create the user that *Percona Server for MongoDB* will use to connect to and query the LDAP server. Define this user's credentials for the `security.ldap.bind.queryUser` and `security.ldap.bind.queryPassword` parameters in the `mongod.conf` configuration file.
- In this setup, we use the following OpenLDAP groups:

```
dn: cn=testusers,dc=percona,dc=com
objectClass: groupOfNames
cn: testusers
member: cn=alice,dc=percona,dc=com

dn: cn=otherusers,dc=percona,dc=com
objectClass: groupOfNames
cn: otherusers
member: cn=bob,dc=percona,dc=com
```

15.3 Setup procedure

15.3.1 Configure TLS/SSL connection for *Percona Server for MongoDB*

By default, *Percona Server for MongoDB* establishes the TLS connection when binding to the LDAP server and thus, it requires access to the LDAP CA certificates. To make *Percona Server for MongoDB* aware of the certificates, do the following:

1. Place the certificate in the `certs` directory. The path to the `certs` directory is:
   - On Debian / Ubuntu: `/etc/ssl/certs/`
   - On RHEL / CentOS: `/etc/openldap/certs/`
2. Specify the path to the certificates in the `ldap.conf` file:

   Debian / Ubuntu

   ```
   tee -a /etc/openldap/ldap.conf <<EOF
   TLS_CACERT /etc/ssl/certs/my_CA.crt
   EOF
   ```

   RHEL / CentOS

   ```
   tee -a /etc/openldap/ldap.conf <<EOF
   TLS_CACERT /etc/openldap/certs/my_CA.crt
   EOF
   ```

15.3.2 Create roles for LDAP groups in *Percona Server for MongoDB*

Percona Server for MongoDB authorizes users based on LDAP group membership. For every group, you must create the role in the `admin` database with the name that exactly matches the DN of the LDAP group.

Percona Server for MongoDB maps the user's LDAP group to the roles and determines what role is assigned to the user. *Percona Server for MongoDB* then grants privileges defined by this role.

To create the roles, use the following command:

```
var admin = db.getSiblingDB("admin")
db.createRole(
   {
     role: "cn=testusers,dc=percona,dc=com",
     privileges: [],
     roles: [ "readWrite"]
   }
)

db.createRole(
   {
     role: "cn=otherusers,dc=percona,dc=com",
     privileges: [],
```

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```
    roles: [ "read"]
  }
)
```

15.3.3 *Percona Server for MongoDB* configuration

Access without username transformation

This section assumes that users connect to *Percona Server for MongoDB* by providing their LDAP DN as the username.

1. Edit the *Percona Server for MongoDB* configuration file (by default, `/etc/mongod.conf`) and specify the following configuration:

   ```
   security:
     authorization: "enabled"
     ldap:
       servers: "ldap.example.com"
       transportSecurity: tls
       authz:
          queryTemplate: "dc=percona,dc=com??sub?(&(objectClass=groupOfNames)(member=
   ↪{PROVIDED_USER}))"

   setParameter:
     authenticationMechanisms: "PLAIN"
   ```

   The `{PROVIDED_USER}` variable substitutes the provided username before authentication or username transformation takes place.

   Replace `ldap.example.com` with the hostname of your LDAP server. In the LDAP query template, replace the domain controllers `percona` and `com` with those relevant to your organization.

2. Restart the `mongod` service:

   ```
   $ sudo systemctl restart mongod
   ```

3. Test the access to *Percona Server for MongoDB*:

   ```
   mongosh -u "cn=alice,dc=percona,dc=com" -p "secretpwd" --authenticationDatabase '
   ↪$external' --authenticationMechanism 'PLAIN'
   ```

Access with username transformation

If users connect to *Percona Server for MongoDB* with usernames that are not LDAP DN, you need to transform these usernames to be accepted by the LDAP server.

Using the `--ldapUserToDNMapping` configuration parameter allows you to do this. You specify the match pattern as a regexp to capture a username. Next, specify how to transform it - either to use a substitution value or to query the LDAP server for a username.

If you don't know what the substitution or LDAP query string should be, please consult with the LDAP administrators to figure this out.

Note that you can use only the `query` or the `substitution` stage, the combination of two is not allowed.

Substitution

1. Edit the *Percona Server for MongoDB* configuration file (by default, `/etc/mongod.conf`) and specify the `userToDNMapping` parameter:

```
security:
  authorization: "enabled"
  ldap:
    servers: "ldap.example.com"
    transportSecurity: tls
    authz:
       queryTemplate: "dc=percona,dc=com??sub?(&
↪(objectClass=groupOfNames)(member={USER}))"
    userToDNMapping: >-
          [
            {
              match: "([^@]+)@percona\\.com",
              substitution: "CN={0},DC=percona,DC=com"
            }
          ]

setParameter:
  authenticationMechanisms: "PLAIN"
```

   The `{USER}` variable substitutes the username transformed during the `userToDNMapping` stage.

   Modify the given example configuration to match your deployment.

2. Restart the `mongod` service:

```
$ sudo systemctl restart mongod
```

3. Test the access to *Percona Server for MongoDB*:

```
mongosh -u "alice@percona.com" -p "secretpwd" --authenticationDatabase '
↪$external' --authenticationMechanism 'PLAIN'
```

LDAP query

1. Edit the *Percona Server for MongoDB* configuration file (by default, `/etc/mongod.conf`) and specify `userToDNMapping` parameter:

```
security:
  authorization: "enabled"
  ldap:
    servers: "ldap.example.com"
    transportSecurity: tls
    authz:
       queryTemplate: "dc=percona,dc=com??sub?(&
↪(objectClass=groupOfNames)(member={USER}))"
    userToDNMapping: >-
          [
            {
```

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```
              match: "([^@]+)@percona\\.com",
              ldapQuery: "dc=percona,dc=com??sub?(&
↪(objectClass=organizationalPerson)(cn={0}))"
            }
          ]

setParameter:
  authenticationMechanisms: "PLAIN"
```

The {USER} variable substitutes the username transformed during the userToDNMapping stage.

Modify the given example configuration to match your deployment, For example, replace `ldap.example.com` with the hostname of your LDAP server. Replace the domain controllers (DC) `percona` and `com` with those relevant to your organization. Depending on your LDAP schema, further modifications of the LDAP query may be required.

2. Restart the `mongod` service:

```
$ sudo systemctl restart mongod
```

3. Test the access to *Percona Server for MongoDB*:

```
mongosh -u "alice" -p "secretpwd" --authenticationDatabase '$external' --
↪authenticationMechanism 'PLAIN'
```

15.3.4 Active Directory configuration

Microsoft Active Directory uses a different schema for user and group definition. To illustrate *Percona Server for MongoDB* configuration, we will use the following AD (Active Directory) users:

```
dn:CN=alice,CN=Users,DC=testusers,DC=percona,DC=com
userPrincipalName: alice@testusers.percona.com
memberOf: CN=testusers,CN=Users,DC=percona,DC=com

dn:CN=bob,CN=Users,DC=otherusers,DC=percona,DC=com
userPrincipalName: bob@otherusers.percona.com
memberOf: CN=otherusers,CN=Users,DC=percona,DC=com
```

The following are respective AD groups:

```
dn:CN=testusers,CN=Users,DC=percona,DC=com
member:CN=alice,CN=Users,DC=testusers,DC=example,DC=com

dn:CN=otherusers,CN=Users,DC=percona,DC=com
member:CN=bob,CN=Users,DC=otherusers,DC=example,DC=com
```

Use one of the given *Percona Server for MongoDB* configurations for user authentication and authorization in Active Directory:

No username transformation

1. Edit the `mongod` configuration file:

```
ldap:
  servers: "ldap.example.com"
  authz:
    queryTemplate: "DC=percona,DC=com??sub?(&(objectClass=group)(member:1.
↪2.840.113556.1.4.1941:={PROVIDED_USER}))"

  setParameter:
    authenticationMechanisms: "PLAIN"
```

2. Restart the mongod service:

```
$ sudo systemctl restart mongod
```

3. Test the access to *Percona Server for MongoDB*:

```
mongosh -u "CN=alice,CN=Users,DC=testusers,DC=percona,DC=com" -p "secretpwd
↪" --authenticationDatabase '$external' --authenticationMechanism 'PLAIN'
```

Username substitution

1. Edit the mongod configuration file:

```
ldap:
  servers: "ldap.example.com"
  authz:
    queryTemplate: "DC=percona,DC=com??sub?(&(objectClass=group)(member:1.
↪2.840.113556.1.4.1941:={USER}))"
  userToDNMapping: >-
          [
            {
              match: "([^@]+)@([^\\.]+)\\.percona\\.com",
              substitution: "CN={0},CN=Users,DC={1},DC=percona,DC=com"
            }
          ]

  setParameter:
    authenticationMechanisms: "PLAIN"
```

2. Restart the mongod service:

```
$ sudo systemctl restart mongod
```

3. Test the access to *Percona Server for MongoDB*:

```
mongosh -u "alice@percona.com" -p "secretpwd" --authenticationDatabase '
↪$external' --authenticationMechanism 'PLAIN'
```

LDAP query

1. Edit the mongod configuration file:

```
ldap:
  servers: "ldap.example.com"
  authz:
    queryTemplate: "DC=percona,DC=com??sub?(&(objectClass=group)(member:1.
↪2.840.113556.1.4.1941:={USER}))"
  userToDNMapping: >-
        [
          {
            match: "(.+)",
            ldapQuery: "dc=example,dc=com??sub?(&
↪(objectClass=organizationalPerson)(userPrincipalName={0}))"
          }
        ]

  setParameter:
    authenticationMechanisms: "PLAIN"
```

2. Restart the mongod service:

```
$ sudo systemctl restart mongod
```

3. Test the access to *Percona Server for MongoDB*:

```
mongosh -u "alice" -p "secretpwd" --authenticationDatabase '$external' --
↪authenticationMechanism 'PLAIN'
```

Modify one of this example configuration to match your deployment.

Based on the material from Percona Database Performance Blog

This document is based on the following blog posts:

- Percona Server for MongoDB LDAP Enhancements: User-to-DN Mapping by Igor Solodovnikov
- Authenticate Percona Server for MongoDB Users via Native LDAP by Ivan Groenewold

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CHAPTER

SIXTEEN

SET UP X.509 AUTHENTICATION AND LDAP AUTHORIZATION

x.509 certificate authentication is one of the supported authentication mechanisms in *Percona Server for MongoDB*. It is compatible with *LDAP authorization* to enable you to control user access and operations in your database environment.

This document provides the steps on how to configure and use x.509 certificates for authentication in *Percona Server for MongoDB* and authorize users in the LDAP server.

16.1 Considerations

1. For testing purposes, in this tutorial we use OpenSSL to issue self-signed certificates. For production use, we recommend using certificates issued and signed by the CA in *Percona Server for MongoDB*. Client certificates must meet the client certificate requirements.
2. The setup of the LDAP server and the configuration of the LDAP schema is out of scope of this document. We assume that you have the LDAP server up and running and accessible to *Percona Server for MongoDB*.

16.2 Setup procedure

16.2.1 Issue certificates

1. Create a directory to store the certificates. For example, `/var/lib/mongocerts`.

```
$ sudo mkdir -p /var/lib/mongocerts
```

2. Grant access to the `mongod` user to this directory:

```
$ sudo chown mongod:mongod /var/lib/mongocerts
```

Generate the root Certificate Authority certificate

The root Certificate Authority certificate will be used to sign the SSL certificates.

Run the following command and in the `-subj` flag, provide the details about your organization:

- C - Country Name (2 letter code);
- ST - State or Province Name (full name);
- L - Locality Name (city);
- O - Organization Name (company);

- CN - Common Name (your name or your server's hostname) .

```
$ cd /var/lib/mongocerts
$ sudo openssl req -nodes -x509 -newkey rsa:4096 -keyout ca.key -out ca.crt -subj "/C=US/
↪ST=California/L=SanFrancisco/O=Percona/OU=root/CN=localhost"
```

Generate server certificate

1. Create the server certificate request and key. In the `-subj` flag, provide the details about your organization:
   - C - Country Name (2 letter code);
   - ST - State or Province Name (full name);
   - L - Locality Name (city);
   - O - Organization Name (company);
   - CN - Common Name (your name or your server's hostname) .

   ```
   $ sudo openssl req -nodes -newkey rsa:4096 -keyout server.key -out server.csr -subj
   ↪"/C=US/ST=California/L=SanFrancisco/O=Percona/OU=server/CN=localhost"
   ```

2. Sign the server certificate request with the root CA certificate:

   ```
   $ sudo openssl x509 -req -in server.csr -CA ca.crt -CAkey ca.key -set_serial 01 -
   ↪out server.crt
   ```

3. Combine the server certificate and key to create a certificate key file. Run this command as the `root` user:

   ```
   $ cat server.key server.crt > server.pem
   ```

Generate client certificates

1. Generate client certificate request and key. In the `-subj` flag, specify the information about clients in the DN format.

   ```
   $ openssl req -nodes -newkey rsa:4096 -keyout client.key -out client.csr -subj "/
   ↪DC=com/DC=percona/CN=John Doe"
   ```

2. Sign the client certificate request with the root CA certificate.

   ```
   $ openssl x509 -req -in client.csr -CA ca.crt -CAkey ca.key -set_serial 02 -out␣
   ↪client.crt
   ```

3. Combine the client certificate and key to create a certificate key file.

   ```
   $ cat client.key client.crt > client.pem
   ```

16.2.2 Set up the LDAP server

The setup of the LDAP server is out of scope of this document. Please work with your LDAP administrators to set up the LDAP server and configure the LDAP schema.

16.2.3 Configure `mongod` server

The configuration consists of the following steps:

- Creating a role that matches the user group on the LDAP server
- Editing the configuration file to enable the x.509 authentication

Note: When you use x.509 authentication with LDAP authorization, you don't need to create users in the `$external` database. User management is done on the LDAP server so when a client connects to the database, they are authenticated and authorized through the LDAP server.

Create roles

At this step, create the roles in the `admin` database with the names that exactly match the names of the user groups on the LDAP server. These roles are used for user *LDAP authorization* in *Percona Server for MongoDB*.

In our example, we create the role *cn=otherusers,dc=percona,dc=com* that has the corresponding LDAP group.

```
var admin = db.getSiblingDB("admin")
db.createRole(
   {
     role: "cn=otherusers,dc=percona,dc=com",
     privileges: [],
     roles: [
           "userAdminAnyDatabase",
           "clusterMonitor",
           "clusterManager",
           "clusterAdmin"
            ]
   }
)
```

Output:

```
{
     "role" : "cn=otherusers,dc=percona,dc=com",
     "privileges" : [ ],
     "roles" : [
             "userAdminAnyDatabase",
             "clusterMonitor",
             "clusterManager",
             "clusterAdmin"
     ]
}
```

Enable x.509 authentication

1. Stop the `mongod` service

   ```
   $ sudo systemctl stop mongod
   ```

2. Edit the `/etc/mongod.conf` configuration file.

   ```
   net:
     port: 27017
     bindIp: 127.0.0.1
     tls:
       mode: requireTLS
       certificateKeyFile: /var/lib/mongocerts/server.pem
       CAFile: /var/lib/mongocerts/ca.crt

   security:
     authorization: enabled
     ldap:
       servers: "ldap.example.com"
       transportSecurity: none
       authz:
         queryTemplate: "dc=percona,dc=com??sub?(&(objectClass=groupOfNames)(member=
   ↪{USER}))"

   setParameter:
     authenticationMechanisms: PLAIN,MONGODB-X509
   ```

   Replace `ldap.example.com` with the hostname of your LDAP server. In the LDAP query template, replace the domain controllers `percona` and `com` with those relevant to your organization.

3. Start the `mongod` service

   ```
   $ sudo systemctl start mongod
   ```

16.2.4 Authenticate with the x.509 certificate

To test the authentication, connect to *Percona Server for MongoDB* using the following command:

```
$ mongosh --host localhost --tls --tlsCAFile /var/lib/mongocerts/ca.crt --
↪tlsCertificateKeyFile <path_to_client_certificate>/client.pem  --
↪authenticationMechanism MONGODB-X509 --authenticationDatabase='$external'
```

The result should look like the following:

```
> db.runCommand({connectionStatus : 1})
{
     "authInfo" : {
             "authenticatedUsers" : [
                     {
                             "user" : "CN=John Doe,DC=percona,DC=com",
                             "db" : "$external"
                     }
```

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```
                ],
                "authenticatedUserRoles" : [
                        {
                                "role" : "cn=otherreaders,dc=percona,dc=com",
                                "db" : "admin"
                        },
                        {
                                "role" : "clusterAdmin",
                                "db" : "admin"
                        },
                        {
                                "role" : "userAdminAnyDatabase",
                                "db" : "admin"
                        },
                        {
                                "role" : "clusterManager",
                                "db" : "admin"
                        },
                        {
                                "role" : "clusterMonitor",
                                "db" : "admin"
                        }
                ]
        },
        "ok" : 1
}
```

CHAPTER

SEVENTEEN

SETTING UP KERBEROS AUTHENTICATION

This document provides configuration steps for setting up *Kerberos Authentication* in *Percona Server for MongoDB*.

17.1 Assumptions

The setup of the Kerberos server itself is out of scope of this document. Please refer to the Kerberos documentation for the installation and configuration steps relevant to your operation system.

We assume that you have successfully completed the following steps:

- Installed and configured the Kerberos server
- Added necessary realms
- Added service, admin and user principals
- Configured the `A` and `PTR` DNS records for every host running *mongod* instance to resolve the hostnames onto Kerberos realm.

See also:

MongoDB Documentation: Kerberos Authentication

17.2 Add user principals to *Percona Server for MongoDB*

To get authenticated, users must exist both in the Kerberos and *Percona Server for MongoDB* servers with exactly matching names.

After you defined the user principals in the Kerberos server, add them to the `$external` database in *Percona Server for MongoDB* and assigned required roles:

```
use $external
db.createUser({user: "demo@PERCONATEST.COM",roles: [{role: "read", db: "admin"}]})
```

Replace `demo@PERCONATEST.COM` with your username and Kerberos realm.

17.3 Configure Kerberos keytab files

A keytab file stores the authentication keys for a service principal representing a `mongod` instance to access the Kerberos admin server.

After you have added the service principal to the Kerberos admin server, the entry for this principal is added to the `/etc/krb5.keytab` keytab file.

The `mongod` server must have access to the keytab file to authenticate. To keep the keytab file secure, restrict the access to it only for the user running the `mongod` process.

1. Stop the `mongod` service

```
$ sudo systemctl stop mongod
```

2. Generate the keytab file or get a copy of it if you generated the keytab file on another host. Save the keyfile under a separate path (e.g. /etc/mongodb.keytab)

```
$ cp /etc/krb5.keytab /etc/mongodb.keytab
```

3. Change the ownership to the keytab file

```
$ sudo chown mongod:mongod /etc/mongodb.keytab
```

4. Set the `KRB5_KTNAME` variable in the environment file for the `mongod` process.

On Debian and Ubuntu

Edit the environment file at the path `/etc/default/mongod` and specify the `KRB5_KTNAME` variable:

```
KRB5_KTNAME=/etc/mongodb.keytab
```

If you have a different path to the keytab file, specify it accordingly.

On RHEL and derivatives

Edit the environment file at the path `/etc/sysconfig/mongod` and specify the `KRB5_KTNAME` variable:

```
KRB5_KTNAME=/etc/mongodb.keytab
```

If you have a different path to the keytab file, specify it accordingly.

5. Restart the `mongod` service

```
$ sudo systemctl start mongod
```

17.4 *Percona Server for MongoDB* configuration

Enable external authentication in *Percona Server for MongoDB* configuration. Edit the `etc/mongod.conf` configuration file and specify the following configuration:

```
security:
  authorization: "enabled"

setParameter:
  authenticationMechanisms: GSSAPI
```

Restart the `mongod` service to apply the configuration:

```
$ sudo systemctl start mongod
```

17.5 Test the access to *Percona Server for MongoDB*

1. Obtain the Kerberos ticket for the user using the `kinit` command and specify the user password:

```
$ kinit demo
Password for demo@PERCONATEST.COM:
```

2. Check the user ticket:

```
$ klist -l
Principal name                 Cache name
--------------                 ----------
demo@PERCONATEST.COM           FILE:/tmp/<ticket>
```

3. Connect to *Percona Server for MongoDB*:

```
$ mongosh --host <hostname> --authenticationMechanism=GSSAPI --
↪authenticationDatabase='$external' --username demo@PERCONATEST.COM
```

The result should look like the following:

```
> db.runCommand({connectionStatus : 1})
{
     "authInfo" : {
             "authenticatedUsers" : [
                     {
                             "user" : "demo@PERCONATEST.COM",
                             "db" : "$external"
                     }
             ],
             "authenticatedUserRoles" : [
                     {
                             "role" : "read",
                             "db" : "admin"
                     }
             ]
     },
```

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```
    "ok" : 1
}
```

CHAPTER

EIGHTEEN

PERCONA SERVER FOR MONGODB PARAMETER TUNING GUIDE

Percona Server for MongoDB includes several parameters that can be changed in one of the following ways:

- The `setParameter` admonitions in the configuration file for persistent changes in production:

```
setParameter:
  cursorTimeoutMillis: <int>
  failIndexKeyTooLong: <boolean>
  internalQueryPlannerEnableIndexIntersection: <boolean>
  ttlMonitorEnabled: <boolean>
  ttlMonitorSleepSecs: <int>
```

- The `--setParameter` option arguments when running the `mongod` process for development or testing purposes:

```
$ mongod \
  --setParameter cursorTimeoutMillis=<int> \
  --setParameter failIndexKeyTooLong=<boolean> \
  --setParameter internalQueryPlannerEnableIndexIntersection=<boolean> \
  --setParameter ttlMonitorEnabled=<boolean> \
  --setParameter ttlMonitorSleepSecs=<int>
```

- The `setParameter` command on the `admin` database to make changes at runtime:

```
> db = db.getSiblingDB('admin')
> db.runCommand( { setParameter: 1, cursorTimeoutMillis: <int> } )
> db.runCommand( { setParameter: 1, failIndexKeyTooLong: <boolean> } )
> db.runCommand( { setParameter: 1, internalQueryPlannerEnableIndexIntersection:
↪<boolean> } )
> db.runCommand( { setParameter: 1, ttlMonitorEnabled: <int> } )
> db.runCommand( { setParameter: 1, ttlMonitorSleepSecs: <int> } )
```

18.1 Parameters

18.1.1 cursorTimeoutMillis

Value Type *integer*

Default `600000` (ten minutes)

Sets the duration of time after which idle query cursors are removed from memory.

18.1.2 failIndexKeyTooLong

Value Type *boolean*

Default `true`

Versions of MongoDB prior to 2.6 would insert and update documents even if an index key was too long. The documents would not be included in the index. Newer versions of MongoDB ignore documents with long index key. By setting this value to `false`, the old behavior is enabled.

18.1.3 internalQueryPlannerEnableIndexIntersection

Value Type *boolean*

Default `true`

Due to changes introduced in MongoDB 2.6.4, some queries that reference multiple indexed fields, where one field matches no documents, may choose a non-optimal single-index plan. Setting this value to `false` will enable the old behavior and select the index intersection plan.

18.1.4 ttlMonitorEnabled

Value Type *boolean*

Default `true`

If this option is set to `false`, the worker thread that monitors TTL Indexes and removes old documents will be disabled.

18.1.5 ttlMonitorSleepSecs

Value Type *integer*

Default `60` (one minute)

Defines the number of seconds to wait between checking TTL Indexes for old documents and removing them.

CHAPTER

NINETEEN

UPGRADING *PERCONA SERVER FOR MONGODB*

An in-place upgrade is done by keeping the existing data in the server. It involves changing out the MongoDB binaries. Generally speaking, the upgrade steps include:

1. Stopping the `mongod` service
2. Removing the old binaries
3. Installing the new server version binaries
4. Restarting the `mongod` service with the same `dbpath` data directory.

An in-place upgrade is suitable for most environments except the ones that use ephemeral storage and/or host addresses.

This document provides upgrade instructions for the following use cases:

- *Upgrading from MongoDB 6.0 Community Edition*;
- *Minor upgrade of Percona Server for MongoDB*

19.1 Upgrading from MongoDB 6.0 Community Edition

Note: MongoDB creates a user that belongs to two groups, which is a potential security risk. This is fixed in *Percona Server for MongoDB*: the user is included only in the `mongod` group. To avoid problems with current MongoDB setups, existing user group membership is not changed when you migrate to *Percona Server for MongoDB*. Instead, a new `mongod` user is created during installation, and it belongs to the `mongod` group.

This section describes an in-place upgrade of a `mongod` instance. If you are using data at rest encryption, refer to the *Upgrading to Percona Server for MongoDB with data at rest encryption enabled* section.

19.1.1 Prerequisites

Before you start the upgrade, update the MongoDB configuration file (`/etc/mongod.conf`) to contain the following settings.

```
processManagement:
   fork: true
   pidFilePath: /var/run/mongod.pid
```

Troubleshooting tip: The `pidFilePath` setting in `mongod.conf` must match the `PIDFile` option in the `systemd` `mongod` service unit. Otherwise, the service will kill the `mongod` process after a timeout.

Warning: Before starting the upgrade, we recommend to perform a full backup of your data.

Upgrading on Debian or Ubuntu

1. Stop the mongod service:

```
$ sudo systemctl stop mongod
```

2. Check for installed packages:

```
$ sudo dpkg -l | grep mongod
```

Output

```
ii  mongodb-org                      6.0.2                        amd64        ␣
↪MongoDB open source document-oriented database system (metapackage)
ii  mongodb-org-database             6.0.2                        amd64        ␣
↪MongoDB open source document-oriented database system (metapackage)
ii  mongodb-org-database-tools-extra 6.0.2                        amd64        ␣
↪Extra MongoDB database tools
ii  mongodb-org-mongos               6.0.2                        amd64        ␣
↪MongoDB sharded cluster query router
ii  mongodb-org-server               6.0.2                        amd64        ␣
↪MongoDB database server
ii  mongodb-org-shell                6.0.2                        amd64        ␣
↪MongoDB shell client
ii  mongodb-org-tools                6.0.2                        amd64        ␣
↪MongoDB tools
```

3. Remove the installed packages:

```
$ sudo apt remove \
  mongodb-org \
  mongodb-org-mongos \
  mongodb-org-server \
  mongodb-org-shell \
  mongodb-org-tools
```

4. Remove log files:

```
$ sudo rm -r /var/log/mongodb
```

5. Install *Percona Server for MongoDB* using apt.

6. Verify that the configuration file includes the correct options. For example, *Percona Server for MongoDB* stores data files in `/var/lib/mongodb` by default. If you used another `dbPath` data directory, edit the configuration file accordingly

7. Start the mongod service:

```
$ sudo systemctl mongod start
```

Upgrading on Red Hat Enterprise Linux or derivatives

1. Stop the mongod service:

```
$ sudo systemctl stop mongod
```

2. Check for installed packages:

```
$ sudo rpm -qa | grep mongo
```

Output

```
mongodb-org-shell-6.0.2-1.el8.x86_64
mongodb-org-database-6.0.0-1.el8.x86_64
mongodb-org-6.0.0-1.el8.x86_64
mongodb-database-tools-100.4.1-1.x86_64
mongodb-org-server-6.0.2-1.el8.x86_64
mongodb-org-mongos-6.0.2-1.el8.x86_64
mongodb-org-tools-6.0.0-1.el8.x86_64
```

3. Remove the installed packages:

```
$ sudo yum remove \
mongodb-org-tools-6.0.0-1.el8.x86_64 \
mongodb-org-shell-6.0.2-1.el8.x86_64 \
mongodb-org-database-6.0.0-1.el8.x86_64 \
mongodb-org-6.0.0-1.el8.x86_64 \
mongodb-database-tools-100.4.1-1.x86_64 \
mongodb-org-server-6.0.2-1.el8.x86_64 \
mongodb-org-mongos-6.0.2-1.el8.x86_64 \
```

4. Remove log files:

```
$ sudo rm -r /var/log/mongodb
```

5. Install Percona Server for MongoDB *using yum*.

Note: When you remove old packages, your existing configuration file is saved as `/etc/mongod.conf.rpmsave`. If you want to use this configuration with the new version, replace the default `/etc/mongod.conf` file. For example, existing data may not be compatible with the default WiredTiger storage engine.

# Start the `mongod` service:

```
$ sudo systemctl start mongod
```

To upgrade a replica set or a sharded cluster, use the *rolling restart* method. It allows you to perform the upgrade with minimum downtime. You upgrade the nodes one by one, while the whole cluster / replica set remains operational.

See also:

MongoDB Documentation:

- Upgrade a Replica Set
- Upgrade a Sharded Cluster

19.2 Minor upgrade of *Percona Server for MongoDB*

To upgrade *Percona Server for MongoDB* to the latest version, follow these steps:

1. Stop the *mongod* service:

```
$ sudo systemctl stop mongod
```

2. Install the latest version packages. Use the command relevant to your operating system.

On Debian and Ubuntu:

```
$ sudo apt install percona-server-mongodb
```

On Red Hat Enterprise Linux and derivatives:

```
$ sudo yum install percona-server-mongodb
```

3. Start the *mongod* service:

```
$ sudo systemctl start mongod
```

To upgrade a replica set or a sharded cluster, use the *rolling restart* method. It allows you to perform the upgrade with minimum downtime. You upgrade the nodes one by one, while the whole cluster / replica set remains operational.

19.3 Upgrading to *Percona Server for MongoDB* with data at rest encryption enabled

Steps to upgrade from MongoDB 6.0 Community Edition with data encryption enabled to *Percona Server for MongoDB* are different. `mongod` requires an empty `dbPath` data directory because it cannot encrypt data files in place. It must receive data from other replica set members during the initial sync. Please refer to the switch_storage_engines for more information on migration of encrypted data. Contact us for working at the detailed migration steps, if further assistance is needed.

CHAPTER

TWENTY

UPGRADING FROM *PERCONA SERVER FOR MONGODB* 5.0 TO 6.0

To upgrade *Percona Server for MongoDB* to version 6.0, you must be running version 5.0. Upgrades from earlier versions are not supported.

Before upgrading your production *Percona Server for MongoDB* deployments, test all your applications in a testing environment to make sure they are compatible with the new version. For more information, see Compatibility Changes in MongoDB 6.0

The general procedure for performing an in-place upgrade (where your existing data and configuration files are preserved) includes the following steps:

1. Stop the `mongod` instance
2. Enable Percona repository for *Percona Server for MongoDB* 6.0
3. Install new packages. Old packages are considered obsolete and automatically removed
4. Start the `mongod` instance

Similar to *installing Percona Server for MongoDB* , we recommend upgrading it from official Percona repositories using the `percona-release` tool. Install percona-release or update it to the latest version.

Warning: Perform a full backup of your data and configuration files before upgrading.

Upgrading on Debian or Ubuntu

1. Stop the `mongod` instance:

```
$ sudo systemctl stop mongod
```

2. Enable Percona repository for *Percona Server for MongoDB* 6.0:

```
$ sudo percona-release enable psmdb-60
```

3. Update the local cache:

```
$ sudo apt update
```

4. Install *Percona Server for MongoDB* 6.0 packages:

```
$ sudo apt install percona-server-mongodb
```

5. Start the `mongod` instance:

```
$ sudo systemctl start mongod
```

For more information, see *Installing Percona Server for MongoDB on Debian and Ubuntu*.

Upgrading on RHEL and CentOS

1. Stop the `mongod` instance:

```
$ sudo systemctl stop mongod
```

2. Enable Percona repository for *Percona Server for MongoDB* 6.0:

```
$ sudo percona-release enable psmdb-60
```

3. Install *Percona Server for MongoDB* 6.0 packages:
4. Start the `mongod` instance:

```
$ sudo systemctl start mongod
```

For more information, see *Installing Percona Server for MongoDB on Red Hat Enterprise Linux and derivatives*.

After the upgrade, *Percona Server for MongoDB* is started with the feature set of 5.0 version. Assuming that your applications are compatible with the new version, enable 6.0 version features. Run the following command against the `admin` database:

```
db.adminCommand( { setFeatureCompatibilityVersion: "6.0" } )
```

See also:

MongoDB Documentation:

- Upgrade a Standalone
- Upgrade a Replica Set
- Upgrade a Sharded Cluster

CHAPTER

TWENTYONE

UNINSTALLING *PERCONA SERVER FOR MONGODB*

To completely remove *Percona Server for MongoDB* you need to remove all the installed packages, data and configuration files. If you need the data, consider making a backup before uninstalling Percona Server for MongoDB.

Follow the instructions, relevant to your operating system:

Uninstall on Debian and Ubuntu

You can remove *Percona Server for MongoDB* packages with one of the following commands:

- `apt-get remove` will only remove the packages and leave the configuration and data files.
- `apt purge` will remove all the packages with configuration files and data.

Use either command depending on your needs.

1. Stop the `mongod` server:

```
$ sudo systemctl stop mongod
```

2. Remove the packages. There are two options.

   - To keep the configuration and data files, run:

   ```
   $ sudo apt remove percona-server-mongodb*
   ```

   - To delete both the configuration and data files and the packages, run:

   ```
   $ sudo apt purge percona-server-mongodb*
   ```

Uninstall on RHEL and derivatives

1. Stop the `mongod` service:

```
$ sudo systemctl stop mongod
```

2. Remove the packages:

```
$ sudo yum remove percona-server-mongodb*
```

3. Remove the data and configuration files:

```
$ sudo rm -rf /var/lib/mongodb
$ sudo rm -f /etc/mongod.conf
```

Warning: This will remove all the packages and delete all the data files (databases, tables, logs, etc.). You might want to back up your data before doing this in case you need the data later.

Part V

Release Notes

CHAPTER

TWENTYTWO

PERCONA SERVER FOR MONGODB 6.0 RELEASE NOTES

22.1 *Percona Server for MongoDB* 6.0.2-1 (2022-10-31)

Date October 31, 2022

Installation Installing Percona Server for MongoDB

We are pleased to announce the availability of Percona Server for MongoDB (PSMDB) 6.0.2-1 – the new major version of the source available, drop-in replacement of MongoDB 6.0 Community edition. It is available for download from Percona website and for installation from Percona Software Repositories.

Percona Server for MongoDB 6.0.2-1 fully supports MongoDB 6.0 protocols and drivers and does not require any code modifications.

22.1.1 Release Highlights

- *Data-at-rest encryption using the Key Management Interoperability Protocol (KMIP)* is generally available enabling you to use it in your production environment
- *$backupCursor and $backupCursorExtend aggregation stages* functionality is generally available, enabling your application developers to use it for building custom backup solutions.

Note: Percona provides Percona Backup for MongoDB - the open source tool for consistent backups and restores in MongoDB sharded clusters.

- *Percona Server for MongoDB* packages now include `mongosh` of the previous mongo shell. The previous legacy `mongo` shell was deprecated in MongoDB 5.0 and has been removed in version 6.0. Some older methods are unavailable or have been replaced with newer ones for the new `mongosh`. Please review any methods for compatibility.

  If you *install Percona Server for MongoDB from tarballs*, you must install `mongosh` from a separate tarball.

Percona Server for MongoDB 6.0.2-1 includes all the features of MongoDB 6.0.2 Community Edition, among which are the following:

- Enhanced time series collections enable you to:
  - Get deeper data analysis insights by building compound and secondary indexes on time, metadata and measurement fields.
  - Distribute the load among nodes in the cluster by sharding new and existing time series collections.
  - Benefit from faster reads and improved performance by applying the sorting on the most recent entry instead of the whole collection.

- The following change streams optimizations help you enhance your event-driven solutions:
  - Improve in-app notifications, reference deleted documents or feed the updated version of the entire doc to the downstream system using the before and after states of a document that was changed.
  - React not only to data changes but also to database change events like creating or dropping of collections with the Data Definition Language (DDL) support.
- New aggregation stages like `$densify`, `$documents`, `$fill` and operators like `$bottom`, `$firstN`, `$lastN`, `$maxN` / `$minN` and others enable you to off load work from your developers to the database. These operators allow automating key commands, getting required data insights by combining individual operators into aggregation pipelines. As a result, your developers spend less time on writing complex code or manipulating data manually and can focus on other activities.
- Cluster-wide configuration parameters and commands save your DBAs' time on cluster administration.
- The Stable API (formerly known as versioned API) features the extended set of new database commands and aggregation operators which enables you to improve communication of your apps and MongoDB.
- Speed up data processing and save on storage costs with clustered collections. Clustered collections don't require secondary indexes and thus, result in faster queries. A single read/write for the index and the document improves performance for inserts, updates, deletes and queries. With less storage space required by clustered connections, bulk updates and inserts are performed faster. And by turning clustered indexes to TTL indexes with a single field, you benefit from simplified delete operations and reduced storage costs.

Percona Server for MongoDB also includes the following bug fixes and enhancements provided upstream:

- SERVER-68511 - Fixed the issue that caused inconsistency in sharding metadata when running the `movePrimary` command on the database that has the Feature Compatibility Version (FCV) set to 4.4 or earlier. Affects MongoDB versions 5.0.0 through 5.0.10 and MongoDB 6.0.0. Upgrade to the the fixed version of MongoDB 6.0.2 / Percona Server for MongoDB 6.0.2-1 as soon as possible.
- SERVER-66072 - Fixed dependency analysis for `$match` aggregation stage with aggregation expressions with the `$rand` operator
- SERVER-68130 - Fixed the AutoSplitVector's behavior to predict the BSON object size when generating the response
- WT-9870 - Fixed the global time window state before performing the rollback to stable operation by updating the pinned timestamp as part of the transaction setup.
- SERVER-68628 - Fixed the issue when retrying a failed resharding operation after a primary failover could lead to server crash or lost writes.
- SERVER-68925 - Detect and resolve table logging inconsistencies for WiredTiger tables at startup

Find the full list of new features and improvements in MongoDB 6.0 Community Edition release notes.

Percona Server for MongoDB 6.0.2-1 extends this feature set by providing *enterprise-level enhancements for free*.

To upgrade to PSMDB, see our upgrade instructions.

Part VI

Reference

CHAPTER TWENTYTHREE

CONTACTING, CONTRIBUTING, REPORTING BUGS

If you want to contact developers, use the community forum.

Note: Please search the forum for similar questions and discussions before opening a new thread.

You will need to sign up for an account to post in the forum.

If you want to explore source code and contribute to the project use the GitHub repo and the Contributing guide.

Note: Search existing pull requests and recent commits for code that may fix what you are planning to suggest.

You will need a public GitHub account and request contributor access to the repo.

If you want to report a bug or feature request, use the PSMDB project in JIRA.

Note: Search JIRA for existing tickets before submitting a bug or feature request.

You will need a JIRA account to report bugs.

CHAPTER

TWENTYFOUR

GLOSSARY

ACID Set of properties that guarantee database transactions are processed reliably. Stands for *Atomicity*, *Consistency*, *Isolation*, *Durability*.

Atomicity Atomicity means that database operations are applied following a "all or nothing" rule. A transaction is either fully applied or not at all.

Consistency Consistency means that each transaction that modifies the database takes it from one consistent state to another.

Durability Once a transaction is committed, it will remain so.

Foreign Key A referential constraint between two tables. Example: A purchase order in the purchase_orders table must have been made by a customer that exists in the customers table.

Isolation The Isolation requirement means that no transaction can interfere with another.

Jenkins Jenkins is a continuous integration system that we use to help ensure the continued quality of the software we produce. It helps us achieve the aims of:

- no failed tests in trunk on any platform,
- aid developers in ensuring merge requests build and test on all platforms,
- no known performance regressions (without a damn good explanation).

Kerberos Kerberos is an authentication protocol for client/server authentication without sending the passwords over an insecure network. Kerberos uses symmetric encryption in the form of tickets - small pieces of encrypted data used for authentication. A ticket is issued for the client and validated by the server.

Rolling restart A rolling restart (rolling upgrade) is shutting down and upgrading nodes one by one. The whole cluster remains operational. There is no interruption to clients assuming the elections are short and all writes directed to the old primary use the retryWrite mechanism.

CHAPTER

TWENTYFIVE

COPYRIGHT AND LICENSING INFORMATION

25.1 Documentation Licensing

25.2 Software License

Percona Server for MongoDB is source-available software.

CHAPTER

TWENTYSIX

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