MongoDB Advanced Administrator Training

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MongoDB, Inc.

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Contents

1 Advanced Administrator

1.1 Advanced Administrator Course

Learning Objectives

Upon completing this training, students should understand:

- How to install and configure a highly available Ops Manager deployment
- Understand all the necessary components and architecture choices for an Ops Manager deployment
- How to effectively manage clusters using Ops Manager
- How to deploy and operate secured MongoDB deployments

Hands-on Approach

This training is a full hands-on experience.

- You will be given access to a set of AWS instances.
- You are expected to work in teams. So you will be sharing a set of machines with your colleagues.
- All the necessary software will be available within those same instances
- However, all architecture decisions and configuration steps will be made by the students
- Use the instructor for guidance and advice but he should mostly be there for observation and time boxing the labs.

Expected Takeaways

There are a few important objectives that we want to accomplish by the end of this course:

- Understand the necessary infrastructure needed to run Ops Manager
- Understand the different architecture choices and their tradeoffs in different deployments
- Understand the different options that Ops Manager offers for backup
- Clear understanding of the benefits of using Ops Manager to manage different clusters
- Deploy secured, monitored, and fully managed infrastructure for your application

Take your time, ask questions

It's important to foster the discussion of different options and review those options so:

- Use the whiteboard (if available)
- Talk to your team members to defined clear tasks and responsibilities
- Use the instructor for guidance and ask for advice
- Take chances, break stuff!

Let's review what we have

Once we have our teams assembled it is time to do our first checklist.

Within your team configuration file you should have:

- Load balancer address.
- Public and private ip address for each AWS instance.
- An internal VPC set of ip addresses for each instance.
- 3 <*opsmgr*> instances.
- Up to 12 <*node*> instances.
- *AdvancedAdministrator.pem* key file to allow access to the instances.

Exercise: Accessing your instances from Windows

- Download and install Putty from **http://www.putty.org/**
- Start Putty with: **All Programs > PuTTY > PuTTY**
- In **Session**:
  - In the **Host Name** box, enter **centos@<publicIP>**
  - Under **Connection type**, select **SSH**
- In **Connection/SSH/Auth**,
  - Browse to the **AdvancedAdministrator.ppk** file
- Click **Open**
- Detailed info at: Connect to AWS with Putty[1]

[1] http://docs.aws.amazon.com/AWSEC2/latest/UserGuide/putty.html

Exercise: Accessing your instances from Linux or Mac

- get your .pem file and close the permissions on it

```
chmod 600 AdvancedAdministrator.pem
```

- enable the keychain and `ssh` into `node1`, propagating your credentials

```
ssh-add -K AdvancedAdministrator.pem
ssh -i AdvancedAdministrator.pem -A centos@54.235.1.1
```

- ssh into `node2` from `node1`

```
ssh -A node2
```

Solution: Accessing your instances

In our machines we will have access to all nodes in the deployment:

```
cat /etc/hosts
```

A `/share/downloads` folder with all necessary software downloaded

```
ls /share/downloads
ls /etc/ssl/mongodb
```

1.2 Lab: Ops Manager Installation

Premise

Ops Manager is an On-Prem operational solution for the management of MongoDB clusters.

Enables features like:

- Automation
- Backup and Recovery
- Monitoring

Over the course of this lab we will be installing Ops Manager with high availability and scalability in mind.

Ops Manager HA

Ops Manager requires a number of servers for high availability (HA).

- Monitoring and backup/recovery are essential for production operations.
- Therefore, it's important to assure high availability for Ops Manager.
- For this we need to follow a specific deployment topology.

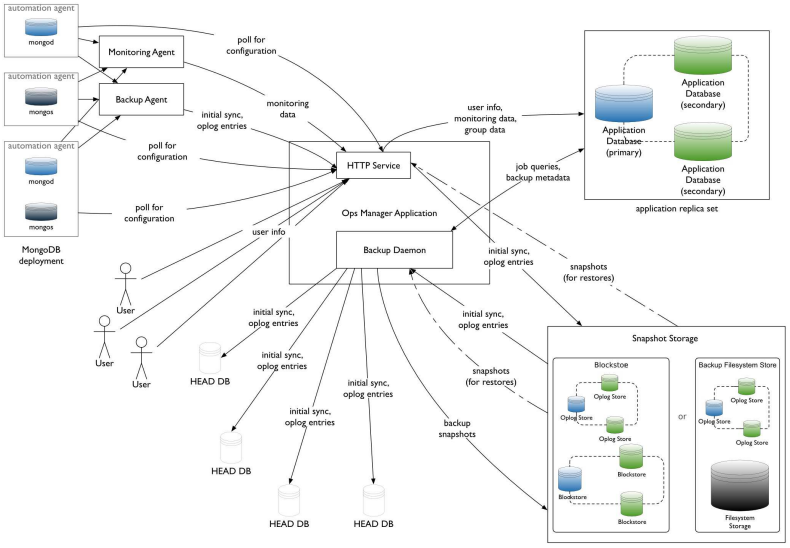
Ops Manager Scalability

Why do we need our operations tool to be scalable?

- The main reason is backup and recovery requirements
- The amount of data individual applications generate will grow
- The number of applications your Ops Manager deployment supports will grow
- Plan to accommodate both forms of growth

Ops Manager Architecture Review

Let's review the Ops Manager architecture[2] :



[2] https://docs.opsmanager.mongodb.com/current/core/system-overview/

Exercise: Architect the Ops Manager Deployment

It's time to set up the our Ops Manager Deployment. As a team, make a plan for the following:

- Two replica sets of 3 nodes
  - Application Database replica set as **APPDB**
  - Backup Database replica set as **BACKUPDB**
- A redundant service of the Ops Manager Application
  - The hosts that will be supporting the OM App: `opsmgr1`, `opsmgr2` and `opsmgr3`
  - Load Balancer in front of those 3 instances
  - The load balancer is already set up. The name is in the info file

Exercise: Configure Ops Manager Application Database

Ops Manager needs to store data:

- Configuration of nodes, groups, users
- Metrics for monitoring
- Backup metadata and job queries

Also consider relevant security settings[3] for this database.

From the available machines go ahead and set up a replica set to support the *Application Database*.

Name this replica set **APPDB**

Exercise: Configure Ops Manager Backup Database

Ops Manager needs to store backup blocks/snaphots, either

- in database
- file system

From the available machines go ahead and set up a replica set to support the *Backup Database*.

Name this replica set **BACKUPDB**

[3] https://docs.mongodb.com/manual/administration/security-checklist/

Exercise: Install, Configure and Launch the Ops Manager Service

Habemus Replica Sets! Now it's time to launch the **Ops Manager** service. For this you will need to:

- Install Ops Manager
  - The files can be found in /share/downloads/opsmgr_packages
  - Follow the instructions to install from rpm[4]
- Edit Ops Manager configuration `conf-mms.properties`:
  - Point the config to the replica set: **APPDB**
- Launch the Ops Manager service
- Hint: there is a common keyfile shared by all 3 instances

Solution: Install, Configure and Launch the Ops Manager Service

Details on how to configure HA configure HA app[5]

Generate a keyfile `gen.key` for the 3 hosts:

```
ssh -A centos@opsmgr1
#Install ops manager server
yum install -y /share/downloads/mongodb_packages/mongodb-mms-2.0.6.363-1.x86_64.rpm
#Edit the configuration options
vi /opt/mongodb/mms/conf/conf-mms.properties
#Generate a gen.key file
openssl rand 24 > /share/gen.key
cp /share/gen.key /etc/mongodb-mms/

#Copy this generated file to all opsmgr hosts
scp /share/gen.key centos@opsmgr2:/etc/mongodb-mms/opsmgr.key
scp /share/gen.key centos@opsmgr3:/etc/mongodb-mms/opsmgr.key
#Make sure you use replace opsmgr for the host ip
```

Install Ops Manager Automation Agents

At this point **Ops Manager** should be up and running. Now it's time to install our Automation Agents[6]:

- In the remaining VMs, install the automation agent
- Make sure that all nodes are discoverable on the servers dashboard
- Validate that all agents are reporting pings correctly

[4] https://docs.opsmanager.mongodb.com/current/tutorial/install-on-prem-with-rpm-packages/#install-the-onprem-package-on-each-server-being-used-for-onprem
[5] https://docs.opsmanager.mongodb.com/current/tutorial/configure-application-high-availability/
[6] https://docs.opsmanager.mongodb.com/current/tutorial/nav/install-automation-agent/

1.3 Lab: Enable the Ops Manager Public API

Learning Objectives

Upon completing this lab, students will be able to:

- Understand the requirements for enabling Ops Manager Public API
- Configure Ops Manager groups to allow Public API requests

Exercise: Selective Node Rest Client

Ops Manager enables administrators to determine from where Public API calls are allowed. From which client nodes it accepts such interface requests.

Enable your deployment of Ops Manager to allow only one specific client to perform API calls.

- Generate an API Key called “generic”
- Add CIDR block for ip whitelisting enabling

Exercise: Enable Group Public API

Groups are more than just sets of machines and MongoDB instances. Groups also enclose security considerations.

Administrators have the ability to enable the Public API interface on a per group basis.

For this exercise go ahead and:

- Create a group called “LOVE_API_CALLS”
- Enable Public API for this group

1.4 Lab: Ops Manager User Administration

Learning Objectives

Upon completing this lab, students will be able to:

- Administer Ops Manager groups
- Identify the differences between Ops Manager user roles
- Create and define Ops Manager users

Exercise: Create Group

Connect to your Ops Manager instance and create the following `group`:

- **CIRCUS_MAXIMUS**

Exercise: Create Users

Using the Ops Manager API[7] , create the following users:

- **aediles@localhost.com** :
  - password: "123ABCabc!"
  - role: Owner[8]
- **patrician@localhost.com** :
  - password: "123ABCabc!"
  - role: Monitoring Admin[9]
- **consus@localhost.com** :
  - password: "&o7chac0v3r3d"
  - role: Backup Admin[10]

Exercise: Create Global Users

In various different situations, we will need users with global roles. Please create, either through the API or web console, the following users:

- First user with Global Automation Admin[11] role : *automater@localhost.com*
- Second user granted Global User Admin[12] user : *masterchef@localhost.com*

After creating these users, connect with the most appropriate user to change the password of the **CIRCUS_MAXIMUS** *Owner* user. The new password should be *"$uperC00l"*

This last operation should be accomplished using the HTTP Rest API interface.

[7] https://docs.opsmanager.mongodb.com/current/api/
[8] https://docs.opsmanager.mongodb.com/current/reference/user-roles/#owner
[9] https://docs.opsmanager.mongodb.com/current/reference/user-roles/#monitoring-admin
[10] https://docs.opsmanager.mongodb.com/current/reference/user-roles/#backup-admin
[11] https://docs.opsmanager.mongodb.com/current/reference/user-roles/#global-automation-admin
[12] https://docs.opsmanager.mongodb.com/current/reference/user-roles/#global-user-admin

1.5 Lab: Secure Replica Set

Premise

- Setting up a MongoDB Replica set is quite easy and fast.
- Setting up a Secured MongoDB replica set requires a few extra steps.
- In this lab we will be exploring how to setup a secured Replica Set through Ops Manager.

X.509 Authentication Mechanism

We will be using X.509 certificates[13] for authentication and TLS/SSL network encryption.

Ops Manager Group SSL and Auth

To build secured MongoDB deployments you first need to enable Auth and SSL[14] on your group.

All VMs have a set of certificates that you will be using to configure your secured deployment.

In folder `/share/downloads/certs` (linked to `/etc/ssl/mongodb`) you will find:

- `ca.pem`: SSL CA certificate
- `automation.pem`: Automation agent certificate
- `backup.pem`: Backup agent certificate
- `monitor.pem`: Monitoring agent certificate
- `nodeX.pem`: Replica set member certificates (X)
- `dbadmin.pem`: MongoDB DB Admin certificate

`VERYSAFE` Group

Let's start by creating a group called `VERYSAFE` that has SSL enabled.

- Using the existing certificates, configure the agents accordingly.
- You need to specify certificates for
  - Certificate Authority
  - Monitoring Agent
  - Backup Agent
  - Automation Agent
- **The existing certificates do not have any decryption password!**

[13] https://docs.mongodb.com/manual/core/security-x.509/
[14] https://docs.opsmanager.mongodb.com/current/tutorial/enable-ssl-for-a-deployment/

Secure Replica Set Deploy

Once the automation agent has been reconfigured and servers are detected on your deployment, it's then time to deploy our secure replica set.

Create a replica set named **SECURE** with the following configuration:

- 3 Nodes:
  - **node1**, **node2** and **node3**
  - Port *27000*
- **clusterAuthMechanism**: x509
- **sslMode**: requiredSSL
- **sslPEMKeyFile**: */etc/ssl/mongodb/nodeX.pem*

X509 Users

Time to create users that will authenticate using an X.509 certificate.

- Go ahead and create a dbAdminAnyDatabase[15] user that authenticates using `dbadmin.pem` certificate.
- To create users that authenticate using X509 certificates you should check Certificate Subject as user[16] docs
- After the user has been created, connect to the *Primary* node of the replica set and create database "`allgood`".

1.6 Lab: Reconfig Replica Set

Learning Objectives

Upon completing this lab, students should be able to:

- Reconfigure a replica set
- Outline the different stages of deployments

Dependencies

- In order to complete all purposed exercises we need to first enable the Public API.
- Go to your group settings and enable the Public API.
- Do not forget to set an appropriate CIDR block for the IP whitelist and Generate the API Key.

[15] https://docs.mongodb.com/manual/reference/built-in-roles/#dbAdminAnyDatabase
[16] https://docs.mongodb.com/manual/tutorial/configure-x509-client-authentication/#add-x-509-certificate-subject-as-a-user

Exercise: Initial Replica Set

- Using the Ops Manager UI go ahead and create a 3 node replica set:
  - Replica set name `META`
  - Two data bearing nodes
    - use hosts: `node3` and `node4`
  - One arbiter
    - use host: `node5`
  - All nodes should be set to use port **27000**

Note: All instances should be installed using MongoDB 3.2.1 enterprise

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Exercise: Add Replica Set Members

- Let's assume that we require highler level of High Availability (HA).
- Add 2 new data bearing nodes
  - First node should have priority 0
    - use `node6`
  - Second node should be an hidden replica.
    - use `node8`

Exercise: Decomission Replica Member

- One of your nodes is not making the cut. - Not pointing fingers but ... `node3` is *acting up*
- Change your replica set by *"decommissioning"* one of the instances
- Make sure that your replica set keeps up majority and previous level of node failure resilience

Exercise: Upgrade MongoDB Version

- Our CTO, for compliance reasons, demands that all of our nodes should be on the lattest version of MongoDB.
- Upgrade all nodes in your replica set without downtime.

Exercise: Update Node Priority

Our initial setup is not in line with the expectations of the CTO in terms of hierarchy *(talking about micromanagement!)*.

- Update the priorities of nodes to the following configuration:
  - **node4**: 10
  - **node6**: 7
  - **node5**: Arbiter
  - **node8**: 0 and slave delayed by 10hours
- All of these changes should be done using the Ops Manager API!

Lab: Shard Cluster **(page 13)** Deploy sharded cluster

Lab: Analyzing Profiler Data **(page 16)** Cluster performance analysis using profiler and monitoring dashboards

Lab: Ops Manager Point-in-Time Backup **(page 17)** Perform point-in-time backup restores using Ops Manager backup

1.7 Lab: Shard Cluster

Learning Objectives

Upon completing this lab, students will be able to:

- Create a sharded cluster using Ops Manager
- Identify the necessary steps to configure the cluster
- Create the correct shard key for a given dataset
- Understand Zone sharding
- Detect balancing issues

Exercise: Create Shard Cluster

Using the Ops Manager UI, let's create a MongoDB sharded cluster with the following configuration:

- Two shards cluster, with three nodes per shard, distributing the process like that:
  - **shard001**: `node1`, `node2` and `node3`
  - **shard002**: `node4`, `node5` and `node6`
  - **config servers**: 3 processes on `node9`
  - **mongos**: `opsmgr1`, `node10` and `node11`
  - Each `mongod` should be running on different hosts
  - All config servers[17] should be running on a single host
    - These should be placed on host `node10`

[17] https://docs.mongodb.com/manual/core/sharded-cluster-config-servers/

Exercise: Correct Config Servers Distribution

Like Britney Spears used to say *"Oops, I did it again"*, we made a mistake on our previous setup and installed all our config servers[18] on a single host.

So now we need to fix our deployment by doing a configuration change:

- Edit the cluster configuration by setting the config servers[19] into separate instances
  - They should be placed on `node9`, `node8` and `node7`

Exercise: Detect Node Down

Our shard cluster is composed by several different nodes (mongods) running on several different hosts.

It's critical that we keep an eye on our cluster. Using the tools available to you, create the necessary mechanisms to be notified in the event of a node failure.

Exercise: Configure Shard

Time to use our distributed database in it's full power.

We will be using a dataset of US consumer complaints. These are records of complaints, on several sectors/states/companies, filed by US consumers.

The dataset should be imported as collection *"complaints"* in the database *"consumer"*, which can also be referred as the **"complaints.consumer"** namespace.

We also want you to configure a few settings:

- set the chunksize[20] to 1MB (the smallest allowed)
- set the primary shard to max shard size[21] of 500MB (512)

Exercise: Configure Shard (continued)

Let's go ahead and import the **consumer** dataset that is available in the `opsmgr` instances in the folder `/dataset/consumer`:

- import/restore this dataset into the *consumer.complaints* namespace
- Once data is imported let's shard the `complaints` collection using the following shard key:

```
sh.enableSharding('consumer')
sh.shardCollection('consumer.complaints', {company:1, state: 1})
```

Note: The above set of instructions are incomplete. We need a prior step, before running `db.shardCollection` command!

Which command is it ?

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[18] https://docs.mongodb.com/manual/core/sharded-cluster-config-servers/
[19] https://docs.mongodb.com/manual/core/sharded-cluster-config-servers/
[20] https://docs.mongodb.com/manual/tutorial/modify-chunk-size-in-sharded-cluster/
[21] https://docs.mongodb.com/manual/tutorial/manage-sharded-cluster-balancer/#sharded-cluster-config-max-shard-size

Exercise: Zone Sharding

We want to isolate subsets of data into a particular shard.

Let's create a zone shard[22] that assigns all data from the company **Bank of America** to one particular shard, **shard002**, and all other data on the remaining shard.

Exercise: Detect Balancing Issues

To avoid having unbalanced shards we should look for some metrics on the sharded collection:

- Which command should we use to detect possible inbalances?
- What's the procedure to solve unbalanced distribution of data accross shards?

Exercise: Move Primary Shard

All sharding enabled[23] databases will have a primary shard. The primary shard will host/hold all non-sharded collections.

We can check each database primary shard using the `sh.status()` command.

For this exercise we are going to do the following:

- add two more shard nodes
  - three data bearing *mongod* each
  - each mongod a separate host
  - these should be named **shard003** and **shard004**
- move primary[24] shard of **consumer** database to **shard003**

Exercise: Drain Shard

So aparently our application can survive with only two shards.

Given the elastic nature of MongoDB we can change the sharding configuration and consequent server footprint.

Go ahead and remove one of the shards from your sharded cluster.

The procedure should be: - make sure we have ready backup - remove it from the cluster

[22] https://docs.mongodb.com/manual/release-notes/3.3-dev-series/#sharded-cluster
[23] https://docs.mongodb.com/manual/reference/method/sh.enableSharding/#sh.enableSharding
[24] https://docs.mongodb.com/manual/reference/command/movePrimary/

1.8 Lab: Analyzing Profiler Data

Premise

"*Your cluster is experiencing some performance issues and you would like to determine where the bottlenecks are. You will need to create statistics on slow queries, locking, and operations: use the database profiler and write some aggregation queries to analyze the profiling data.*"

Setup

1. First enable the profiler for a new agg database (to record all queries):

```
use agg;
db.setProfilingLevel(2);
```

2. Add some sample data.

```
for (i=0; i<100000; i++) { db.aggcol.insert( { count : i } ); }
```

3. Add some queries.

```
for (i=0; i<100; i++) { db.aggcol.find( { count : i } ).toArray(); }
for (i=0; i<100; i++) { db.aggcol.update( { count : i },
                                { $set : { "another_field" : i } } ); }
```

Exercise

Find the maximum response time and average response time for each type of operation in the `system.profile` collection.

Hint: group on the `op` field.

Results

Your aggregation query should return documents of the following form:

```
{
  "_id" : "update",
  "count" : <NUMBER>,
  "max response time" : <NUMBER>,
  "avg response time" : <NUMBER>
}
{
  "_id" : "insert",
  "count" : <NUMBER>,
  "max response time" : <NUMBER>,
  "avg response time" : <NUMBER>
}

// ... for every operation in the system.profile.op field
```

1.9 Lab: Ops Manager Point-in-Time Backup

Exercise: Point-in-Time Backup

Premise: "*Suppose someone introduced an incorrect code path that randomly drops the database from our production environment.*"

Your data is backed up in Ops Manager, so you can recover all the data that existed immediately before the drop. You'll need to request a point-in-time backup and then restore it.

The collection is `injector.data` and the total number of documents, regardless of the drop, should be 20,000.

Find out more
mongodb.com | mongodb.org
university.mongodb.com

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