# Red Hat Ceph Storage 3

## Installation Guide for Red Hat Enterprise Linux

Installing Red Hat Ceph Storage on Red Hat Enterprise Linux

Last Updated: 2018-09-07

# Red Hat Ceph Storage 3 Installation Guide for Red Hat Enterprise Linux

Installing Red Hat Ceph Storage on Red Hat Enterprise Linux

## Legal Notice

Copyright © 2018 Red Hat, Inc.

The text of and illustrations in this document are licensed by Red Hat under a Creative Commons Attribution–Share Alike 3.0 Unported license ("CC-BY-SA"). An explanation of CC-BY-SA is available at
http://creativecommons.org/licenses/by-sa/3.0/
. In accordance with CC-BY-SA, if you distribute this document or an adaptation of it, you must provide the URL for the original version.

Red Hat, as the licensor of this document, waives the right to enforce, and agrees not to assert, Section 4d of CC-BY-SA to the fullest extent permitted by applicable law.

Red Hat, Red Hat Enterprise Linux, the Shadowman logo, JBoss, OpenShift, Fedora, the Infinity logo, and RHCE are trademarks of Red Hat, Inc., registered in the United States and other countries.

Linux ® is the registered trademark of Linus Torvalds in the United States and other countries.

Java ® is a registered trademark of Oracle and/or its affiliates.

XFS ® is a trademark of Silicon Graphics International Corp. or its subsidiaries in the United States and/or other countries.

MySQL ® is a registered trademark of MySQL AB in the United States, the European Union and other countries.

Node.js ® is an official trademark of Joyent. Red Hat Software Collections is not formally related to or endorsed by the official Joyent Node.js open source or commercial project.

The OpenStack ® Word Mark and OpenStack logo are either registered trademarks/service marks or trademarks/service marks of the OpenStack Foundation, in the United States and other countries and are used with the OpenStack Foundation's permission. We are not affiliated with, endorsed or sponsored by the OpenStack Foundation, or the OpenStack community.

All other trademarks are the property of their respective owners.

## Abstract

This document provides instructions on installing Red Hat Ceph Storage on Red Hat Enterprise Linux 7 running on AMD64 and Intel 64 architectures.

# Table of Contents

**CHAPTER 1. WHAT IS RED HAT CEPH STORAGE? . . . . . 4**

**CHAPTER 2. REQUIREMENTS FOR INSTALLING RED HAT CEPH STORAGE . . . . . 6**
2.1. PREREQUISITES 6
2.2. REQUIREMENTS CHECKLIST FOR INSTALLING RED HAT CEPH STORAGE 6
2.3. OPERATING SYSTEM REQUIREMENTS FOR RED HAT CEPH STORAGE 7
2.4. REGISTERING RED HAT CEPH STORAGE NODES TO THE CDN AND ATTACHING SUBSCRIPTIONS 7
Prerequisites 8
Procedure 8
Additional Resources 9
2.5. ENABLING THE RED HAT CEPH STORAGE REPOSITORIES 9
Prerequisites 9
Procedure 9
Additional Resources 10
2.6. CONSIDERATIONS FOR USING A RAID CONTROLLER WITH OSD NODES (OPTIONAL) 10
2.7. CONSIDERATIONS FOR USING NVME WITH OBJECT GATEWAY (OPTIONAL) 10
2.8. VERIFYING THE NETWORK CONFIGURATION FOR RED HAT CEPH STORAGE 11
Prerequisites 11
Procedure 11
Additional Resources 11
2.9. CONFIGURING A FIREWALL FOR RED HAT CEPH STORAGE 11
2.10. CREATING AN ANSIBLE USER WITH SUDO ACCESS 15
2.11. ENABLING PASSWORD-LESS SSH FOR ANSIBLE 17
Prerequisites 17
Procedure 17
Additional Resources 19

**CHAPTER 3. DEPLOYING RED HAT CEPH STORAGE . . . . . 20**
3.1. PREREQUISITES 20
3.2. INSTALLING A RED HAT CEPH STORAGE CLUSTER 20
Prerequisites 20
Procedure 21
3.3. INSTALLING METADATA SERVERS 27
Procedure 27
Additional Resources 28
3.4. INSTALLING THE CEPH CLIENT ROLE 28
Prerequisites 28
Procedure 28
Additional Resources 29
3.5. INSTALLING THE CEPH OBJECT GATEWAY 29
Prerequisites 29
Procedure 29
Additional Resources 31
3.6. INSTALLING THE NFS-GANESHA GATEWAY 31
Prerequisites 31
Procedure 31
Additional Resources 32
3.7. UNDERSTANDING THE LIMIT OPTION 32
3.8. ADDITIONAL RESOURCES 33

**CHAPTER 4. UPGRADING A RED HAT CEPH STORAGE CLUSTER . . . . . 34**
Prerequisites 35

Procedure 36

**CHAPTER 5. WHAT TO DO NEXT? 39**

**APPENDIX A. TROUBLESHOOTING 40**
A.1. ANSIBLE STOPS INSTALLATION BECAUSE IT DETECTS LESS DEVICES THAN IT EXPECTED 40

**APPENDIX B. MANUALLY INSTALLING RED HAT CEPH STORAGE 41**
Configuring the Network Time Protocol for Red Hat Ceph Storage 41
Prerequisites 41
Procedure: Configuring the Network Time Protocol for RHCS 41
Additional Resources 42
MONITOR BOOTSTRAPPING 42
OSD BOOTSTRAPPING 48

**APPENDIX C. INSTALLING THE CEPH COMMAND LINE INTERFACE 54**
Prerequisites 54
Procedure 54

**APPENDIX D. MANUALLY INSTALLING CEPH BLOCK DEVICE 55**
Prerequisites 55
Procedure 55

**APPENDIX E. MANUALLY INSTALLING CEPH OBJECT GATEWAY 58**
Prerequisites 58
Procedure 58
Additional Details 60

**APPENDIX F. OVERRIDING CEPH DEFAULT SETTINGS 61**

**APPENDIX G. MANUALLY UPGRADING FROM RED HAT CEPH STORAGE 2 TO 3 62**
Prerequisites 62
Upgrading Monitor Nodes 63
Procedure 63
Upgrading OSD Nodes 64
Prerequisites 64
Procedure 65
Additional Resources 67
Upgrading the Ceph Object Gateway Nodes 67
Prerequisites 67
Procedure 67
See Also 69
Upgrading a Ceph Client Node 69
Prerequisites 69
Procedure 69

**APPENDIX H. CHANGES IN ANSIBLE VARIABLES BETWEEN VERSION 2 AND 3 70**

**APPENDIX I. IMPORTING AN EXISTING CEPH CLUSTER TO ANSIBLE 71**

**APPENDIX J. PURGING A CEPH CLUSTER BY USING ANSIBLE 72**

# CHAPTER 1. WHAT IS RED HAT CEPH STORAGE?

Red Hat Ceph Storage is a scalable, open, software-defined storage platform that combines the most stable version of the Ceph storage system with a Ceph management platform, deployment utilities, and support services.

Red Hat Ceph Storage is designed for cloud infrastructure and web-scale object storage. Red Hat Ceph Storage clusters consist of the following types of nodes:

**Red Hat Ceph Storage Ansible administration node**

This type of node acts as the traditional Ceph Administration node did for previous versions of Red Hat Ceph Storage. This type of node provides the following functions:

- Centralized storage cluster management
- The Ceph configuration files and keys
- Optionally, local repositories for installing Ceph on nodes that cannot access the Internet for security reasons

**Monitor nodes**

Each monitor node runs the monitor daemon (**`ceph-mon`**), which maintains a master copy of the cluster map. The cluster map includes the cluster topology. A client connecting to the Ceph cluster retrieves the current copy of the cluster map from the monitor which enables the client to read from and write data to the cluster.

**IMPORTANT**

Ceph can run with one monitor; however, to ensure high availability in a production cluster, Red Hat will only support deployments with at least three monitor nodes.

**OSD nodes**

Each Object Storage Device (OSD) node runs the Ceph OSD daemon (**`ceph-osd`**), which interacts with logical disks attached to the node. Ceph stores data on these OSD nodes.
Ceph can run with very few OSD nodes, which the default is three, but production clusters realize better performance beginning at modest scales, for example 50 OSDs in a storage cluster. Ideally, a Ceph cluster has multiple OSD nodes, allowing isolated failure domains by creating the CRUSH map.

**MDS nodes**

Each Metadata Server (MDS) node runs the MDS daemon (**`ceph-mds`**), which manages metadata related to files stored on the Ceph File System (CephFS). The MDS daemon also coordinates access to the shared cluster.

**Object Gateway node**

Ceph Object Gateway node runs the Ceph RADOS Gateway daemon (**`ceph-radosgw`**), and is an object storage interface built on top of **`librados`** to provide applications with a RESTful gateway to Ceph Storage Clusters. The Ceph Object Gateway supports two interfaces:

**S3**

Provides object storage functionality with an interface that is compatible with a large subset of the Amazon S3 RESTful API.

**Swift**

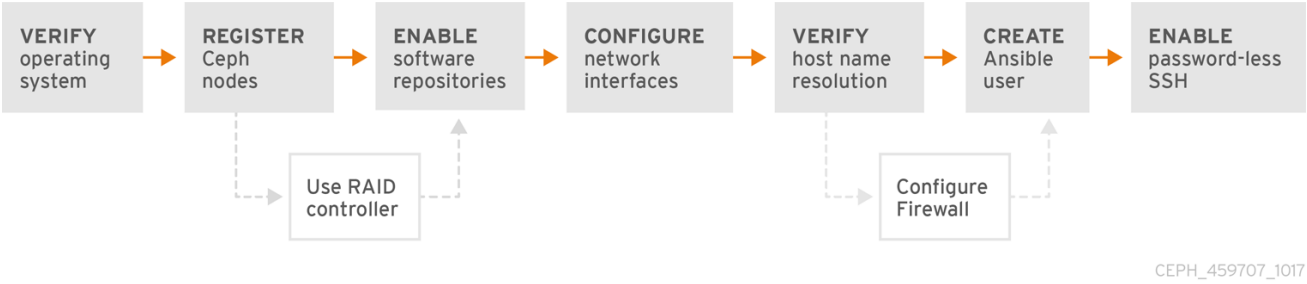
Provides object storage functionality with an interface that is compatible with a large subset of the OpenStack Swift API.

For details on the Ceph architecture, see the *Architecture Guide* for Red Hat Ceph Storage 3.

For minimum recommended hardware, see the Red Hat Ceph Storage Hardware Selection Guide 3.

# CHAPTER 2. REQUIREMENTS FOR INSTALLING RED HAT CEPH STORAGE

**Figure 2.1. Prerequisite Workflow**




Before installing Red Hat Ceph Storage (RHCS), review the following requirements and prepare each Monitor, OSD, Metadata Server, and client nodes accordingly.

## 2.1. PREREQUISITES

- Verify the hardware meets the minimum requirements. For details, see the Hardware Guide for Red Hat Ceph Storage 3.

## 2.2. REQUIREMENTS CHECKLIST FOR INSTALLING RED HAT CEPH STORAGE

| Task | Required | Section | Recommendation |
|---|---|---|---|
| Verifying the operating system version | Yes | Section 2.3, “Operating system requirements for Red Hat Ceph Storage” | |
| Registering Ceph nodes | Yes | Section 2.4, “Registering Red Hat Ceph Storage Nodes to the CDN and Attaching Subscriptions” | |
| Enabling Ceph software repositories | Yes | Section 2.5, “Enabling the Red Hat Ceph Storage Repositories” | |
| Using a RAID controller with OSD nodes | No | Section 2.6, “Considerations for Using a RAID Controller with OSD Nodes (optional)” | Enabling write-back caches on a RAID controller might result in increased small I/O write throughput for OSD nodes. |

| Task | Required | Section | Recommendation |
|---|---|---|---|
| Configuring the network | Yes | Section 2.8, “Verifying the Network Configuration for Red Hat Ceph Storage” | At minimum, a public network is required. However, a private network for cluster communication is recommended. |
| Configuring a firewall | No | Section 2.9, “Configuring a firewall for Red Hat Ceph Storage” | A firewall can increase the level of trust for a network. |
| Creating an Ansible user | Yes | Section 2.10, “Creating an Ansible user with **sudo** access” | Creating the Ansible user is required on all Ceph nodes. |
| Enabling password-less SSH | Yes | Section 2.11, “Enabling Password-less SSH for Ansible” | Required for Ansible. |

## 2.3. OPERATING SYSTEM REQUIREMENTS FOR RED HAT CEPH STORAGE

Red Hat Ceph Storage 3 requires Red Hat Enterprise Linux 7.5 Server with a homogeneous version, such as the AMD64 or Intel 64 architectures, across all Ceph nodes in the storage cluster.

**IMPORTANT**

Red Hat does not support clusters with heterogeneous operating systems and versions.

**Additional Resources**

- The Installation Guide for Red Hat Enterprise Linux 7.
- The System Administrator’s Guide for Red Hat Enterprise Linux 7.

*Return to requirements checklist*

## 2.4. REGISTERING RED HAT CEPH STORAGE NODES TO THE CDN AND ATTACHING SUBSCRIPTIONS

Register each Red Hat Ceph Storage (RHCS) node to the Content Delivery Network (CDN) and attach the appropriate subscription so that the node has access to software repositories. Each RHCS node must be able to access the full Red Hat Enterprise Linux 7 base content and the extras repository content.

**NOTE**

For RHCS nodes that cannot access the Internet during the installation, provide the software content by using the Red Hat Satellite server. Alternatively, mount a local Red Hat Enterprise Linux 7 Server ISO image and point the RHCS nodes to the ISO image. For additional details, contact Red Hat Support.

For more information on registering Ceph nodes with the Red Hat Satellite server, see the How to Register Ceph with Satellite 6 and How to Register Ceph with Satellite 5 articles on the Red Hat Customer Portal.

### Prerequisites

- A valid Red Hat subscription
- RHCS nodes must be able to connect to the Internet.

### Procedure

Perform the following steps on all nodes in the storage cluster as the **root** user.

1. Register the node. When prompted, enter your Red Hat Customer Portal credentials:

```
# subscription-manager register
```

2. Pull the latest subscription data from the CDN:

```
# subscription-manager refresh
```

3. List all available subscriptions for Red Hat Ceph Storage:

```
# subscription-manager list --available --all --matches="*Ceph*"
```

Identify the appropriate subscription and retrieve its Pool ID.

4. Attach the subscription:

```
# subscription-manager attach --pool=$POOL_ID
```

**Replace**

- **$POOL_ID** with the Pool ID identified in the previous step.

5. Disable the default software repositories. Then, enable the Red Hat Enterprise Linux 7 Server and Red Hat Enterprise Linux 7 Server Extras repositories:

```
# subscription-manager repos --disable=*
# subscription-manager repos --enable=rhel-7-server-rpms
# subscription-manager repos --enable=rhel-7-server-extras-rpms
```

6. Update the system to receive the latest packages:

```
# yum update
```

### Additional Resources

- See the Registering a System and Managing Subscriptions chapter in the System Administrator's Guide for Red Hat Enterprise Linux 7.
- Section 2.5, "Enabling the Red Hat Ceph Storage Repositories"

*Return to requirements checklist*

## 2.5. ENABLING THE RED HAT CEPH STORAGE REPOSITORIES

Before installing Red Hat Ceph Storage (RHCS), enable the appropriate software repositories on each node in the storage cluster. The Red Hat Content Delivery Network (CDN) contains all the RHCS software.

### Prerequisites

- Valid customer subscription.
- RHCS nodes can connect to the Internet.
- Register the cluster nodes with CDN.
- Disable the EPEL software repository:

```
[root@monitor ~]# yum install yum-utils vim -y
[root@monitor ~]# yum-config-manager --disable epel
```

### Procedure

Enable the software repository for the appropriate RHCS node type as the **root** user.

1. On **Monitor nodes** enable the Red Hat Ceph Storage 3 Monitor repository:

```
[root@monitor ~]# subscription-manager repos --enable=rhel-7-server-
rhceph-3-mon-rpms
```

2. On **OSD nodes** enable the Red Hat Ceph Storage 3 OSD repository:

```
[root@osd ~]# subscription-manager repos --enable=rhel-7-server-
rhceph-3-osd-rpms
```

3. On the **Ansible administration node**, enable the Red Hat Ceph Storage 3 Tools repository and Ansible repository:

```
[root@admin ~]# subscription-manager repos --enable=rhel-7-server-
rhceph-3-tools-rpms --enable=rhel-7-server-ansible-2.4-rpms
```

4. Optional. If you want to deploy the Ceph File System, enable the Red Hat Ceph Storage 3 Tools repository on the **Metadata Server (MDS) nodes**:

```
[root@mds ~]# subscription-manager repos --enable=rhel-7-server-
rhceph-3-tools-rpms
```

5. Optional. If you want to deploy the Ceph Object Gateway, enable the Red Hat Ceph Storage 3 Tools repository on the **Ceph Object Gateway nodes**:

```
[root@gateway ~]# subscription-manager repos --enable=rhel-7-server-
rhceph-3-tools-rpms
```

6. Optional. If you want to deploy a Ceph client, on the **client node**, enable the Red Hat Ceph Storage 3 Tools repository:

```
[root@client ~]# subscription-manager repos --enable=rhel-7-server-
rhceph-3-tools-rpms
```

### Additional Resources

- The Registering and Managing Subscriptions chapter in the System Administrator's Guide for Red Hat Enterprise Linux.

*Return to the requirements checklist*

## 2.6. CONSIDERATIONS FOR USING A RAID CONTROLLER WITH OSD NODES (OPTIONAL)

If an OSD node has a RAID controller with 1-2GB of cache installed, enabling the write-back cache might result in increased small I/O write throughput. However, the cache must be non-volatile.

Modern RAID controllers usually have super capacitors that provide enough power to drain volatile memory to non-volatile NAND memory during a power loss event. It is important to understand how a particular controller and its firmware behave after power is restored.

Some RAID controllers require manual intervention. Hard drives typically advertise to the operating system whether their disk caches should be enabled or disabled by default. However, certain RAID controllers and some firmware do not provide such information. Verify that disk level caches are disabled to avoid file system corruption.

Create a single RAID 0 volume with write-back for each Ceph OSD data drive with write-back cache enabled.

If Serial Attached SCSI (SAS) or SATA connected Solid-state Drive (SSD) disks are also present on the RAID controller, then investigate whether the controller and firmware support *pass-through* mode. Enabling *pass-through* mode helps avoid caching logic, and generally results in much lower latency for fast media.

*Return to requirements checklist*

## 2.7. CONSIDERATIONS FOR USING NVME WITH OBJECT GATEWAY (OPTIONAL)

If you plan to use the Object Gateway feature of Red Hat Ceph Storage and your OSD nodes have NVMe based SSDs or SATA SSDs, consider following the procedures in Ceph Object Gateway for Production to use NVMe with LVM optimally. These procedures explain how to use specially designed Ansible playbooks which will place journals and bucket indexes together on SSDs, which can increase performance compared to having all journals on one device. The information on using NVMe with LVM optimally should be referenced in combination with this Installation Guide.

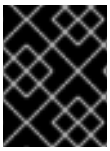
*Return to requirements checklist*

## 2.8. VERIFYING THE NETWORK CONFIGURATION FOR RED HAT CEPH STORAGE

All Red Hat Ceph Storage (RHCS) nodes require a public network. You must have a network interface card configured to a public network where Ceph clients can reach Ceph monitors and Ceph OSD nodes.

You might have a network interface card for a cluster network so that Ceph can conduct heart-beating, peering, replication, and recovery on a network separate from the public network.

Configure the network interface settings and ensure to make the changes persistent.



**IMPORTANT**

Red Hat does not recommend using a single network interface card for both a public and private network.

### Prerequisites

- Network interface card connected to the network.

### Procedure

Do the following steps on all RHCS nodes in the storage cluster, as the **`root`** user.

1. Verify the following settings are in the **`/etc/sysconfig/network-scripts/ifcfg-*`** file corresponding the public-facing network interface card:

   a. The **`BOOTPROTO`** parameter is set to **`none`** for static IP addresses.

   b. The **`ONBOOT`** parameter must be set to **`yes`**.
   If it is set to **`no`**, the Ceph storage cluster might fail to peer on reboot.

   c. If you intend to use IPv6 addressing, you must set the IPv6 parameters such as **`IPV6INIT`** to **`yes`**, except the **`IPV6_FAILURE_FATAL`** parameter.
   Also, edit the Ceph configuration file, **`/etc/ceph/ceph.conf`**, to instruct Ceph to use IPv6, otherwise, Ceph will use IPv4.

### Additional Resources

- For details on configuring network interface scripts for Red Hat Enterprise Linux 7, see the *Configuring a Network Interface Using ifcfg Files* chapter in the *Networking Guide* for Red Hat Enterprise Linux 7.

- For more information on network configuration see the *Network Configuration Reference* chapter in the *Configuration Guide* for Red Hat Ceph Storage 3.

*Return to requirements checklist*

## 2.9. CONFIGURING A FIREWALL FOR RED HAT CEPH STORAGE

Red Hat Ceph Storage (RHCS) uses the **`firewalld`** service.

The Monitor daemons use port **`6789`** for communication within the Ceph storage cluster.

On each Ceph OSD node, the OSD daemons use several ports in the range **6800-7300**:

- One for communicating with clients and monitors over the public network
- One for sending data to other OSDs over a cluster network, if available; otherwise, over the public network
- One for exchanging heartbeat packets over a cluster network, if available; otherwise, over the public network

The Ceph Manager (**ceph-mgr**) daemons use ports in range **6800-7300**. Consider colocating the **ceph-mgr** daemons with Ceph Monitors on same nodes.

The Ceph Metadata Server nodes (**ceph-mds**) use port **6800**.

The Ceph Object Gateway nodes use port **7480** by default. However, you can change the default port, for example to port **80**.

To use the SSL/TLS service, open port **443**.

**Prerequisite**

- Network hardware is connected.

**Procedure**

1. On all RHCS nodes, start the **firewalld** service. Enable it to run on boot, and ensure that it is running:

```
# systemctl enable firewalld
# systemctl start firewalld
# systemctl status firewalld
```

2. On all Monitor nodes, open port **6789** on the public network:

```
[root@monitor ~]# firewall-cmd --zone=public --add-port=6789/tcp
[root@monitor ~]# firewall-cmd --zone=public --add-port=6789/tcp --
permanent
```

To limit access based on the source address:

```
firewall-cmd --zone=public --add-rich-rule="rule family="ipv4" \
source address="$IP_ADDR/$NETMASK_PREFIX" port protocol="tcp" \
port="6789" accept"
```

```
firewall-cmd --zone=public --add-rich-rule="rule family="ipv4" \
source address="$IP_ADDR/$NETMASK_PREFIX" port protocol="tcp" \
port="6789" accept" --permanent
```

**Replace**

- **$IP_ADDR** with the network address of the Monitor node.
- **$NETMASK_PREFIX** with the netmask in CIDR notation.

**Example**

```
[root@monitor ~]# firewall-cmd --zone=public --add-rich-rule="rule
family="ipv4" \
source address="192.168.0.11/24" port protocol="tcp" \
port="6789" accept"
```

```
[root@monitor ~]# firewall-cmd --zone=public --add-rich-rule="rule
family="ipv4" \
source address="192.168.0.11/24" port protocol="tcp" \
port="6789" accept" --permanent
```

3. On all OSD nodes, open ports **6800-7300** on the public network:

```
[root@osd ~]# firewall-cmd --zone=public --add-port=6800-7300/tcp
[root@osd ~]# firewall-cmd --zone=public --add-port=6800-7300/tcp --
permanent
```

If you have a separate cluster network, repeat the commands with the appropriate zone.

4. On all Ceph Manager (**ceph-mgr**) nodes (usually the same nodes as Monitor ones), open ports **6800-7300** on the public network:

```
[root@monitor ~]# firewall-cmd --zone=public --add-port=6800-
7300/tcp
[root@monitor ~]# firewall-cmd --zone=public --add-port=6800-
7300/tcp --permanent
```

If you have a separate cluster network, repeat the commands with the appropriate zone.

5. On all Ceph Metadata Server (**ceph-mds**) nodes, open port **6800** on the public network:

```
[root@monitor ~]# firewall-cmd --zone=public --add-port=6800/tcp
[root@monitor ~]# firewall-cmd --zone=public --add-port=6800/tcp --
permanent
```

If you have a separate cluster network, repeat the commands with the appropriate zone.

6. On all Ceph Object Gateway nodes, open the relevant port or ports on the public network.

   a. To open the default port **7480**:

```
[root@gateway ~]# firewall-cmd --zone=public --add-port=7480/tcp
[root@gateway ~]# firewall-cmd --zone=public --add-port=7480/tcp
--permanent
```

   To limit access based on the source address:

```
firewall-cmd --zone=public --add-rich-rule="rule family="ipv4" \
source address="$IP_ADDR/$NETMASK_PREFIX" port protocol="tcp" \
port="7480" accept"
```

```
firewall-cmd --zone=public --add-rich-rule="rule family="ipv4" \
source address="$IP_ADDR/$NETMASK_PREFIX" port protocol="tcp" \
port="7480" accept" --permanent
```

**Replace**

- **$IP_ADDR** with the network address of the object gateway node.
- **$NETMASK_PREFIX** with the netmask in CIDR notation.

**Example**

```
[root@gateway ~]# firewall-cmd --zone=public --add-rich-
rule="rule family="ipv4" \
source address="192.168.0.31/24" port protocol="tcp" \
port="7480" accept"
```

```
[root@gateway ~]# firewall-cmd --zone=public --add-rich-
rule="rule family="ipv4" \
source address="192.168.0.31/24" port protocol="tcp" \
port="7480" accept" --permanent
```

b. Optional. If you changed the default Ceph Object Gateway port, for example, to port **80**, open this port:

```
[root@gateway ~]# firewall-cmd --zone=public --add-port=80/tcp
[root@gateway ~]# firewall-cmd --zone=public --add-port=80/tcp --
permanent
```

To limit access based on the source address, run the following commands:

```
firewall-cmd --zone=public --add-rich-rule="rule family="ipv4" \
source address="$IP_ADDR/$NETMASK_PREFIX" port protocol="tcp" \
port="80" accept"
```

```
firewall-cmd --zone=public --add-rich-rule="rule family="ipv4" \
source address="$IP_ADDR/$NETMASK_PREFIX" port protocol="tcp" \
port="80" accept" --permanent
```

**Replace**

- **$IP_ADDR** with the network address of the object gateway node.
- **$NETMASK_PREFIX** with the netmask in CIDR notation.

**Example**

```
[root@gateway ~]# firewall-cmd --zone=public --add-rich-
rule="rule family="ipv4" \
source address="192.168.0.31/24" port protocol="tcp" \
port="80" accept"
```

```
[root@gateway ~]# firewall-cmd --zone=public --add-rich-
rule="rule family="ipv4" \
source address="192.168.0.31/24" port protocol="tcp" \
port="80" accept" --permanent
```

c. Optional. To use SSL/TLS, open port **443**:

```
[root@gateway ~]# firewall-cmd --zone=public --add-port=443/tcp
[root@gateway ~]# firewall-cmd --zone=public --add-port=443/tcp -
-permanent
```

To limit access based on the source address, run the following commands:

```
firewall-cmd --zone=public --add-rich-rule="rule family="ipv4" \
source address="$IP_ADDR/$NETMASK_PREFIX" port protocol="tcp" \
port="443" accept"
```

```
firewall-cmd --zone=public --add-rich-rule="rule family="ipv4" \
source address="$IP_ADDR/$NETMASK_PREFIX" port protocol="tcp" \
port="443" accept" --permanent
```

**Replace**

- **`$IP_ADDR`** with the network address of the object gateway node.
- **`$NETMASK_PREFIX`** with the netmask in CIDR notation.

**Example**

```
[root@gateway ~]# firewall-cmd --zone=public --add-rich-
rule="rule family="ipv4" \
source address="192.168.0.31/24" port protocol="tcp" \
port="443" accept"
[root@gateway ~]# firewall-cmd --zone=public --add-rich-
rule="rule family="ipv4" \
source address="192.168.0.31/24" port protocol="tcp" \
port="443" accept" --permanent
```

**Additional Resources**

- For more information about public and cluster network, see Verifying the Network Configuration for Red Hat Ceph Storage.
- For additional details on **`firewalld`**, see the Using Firewalls chapter in the Security Guide for Red Hat Enterprise Linux 7.

*Return to requirements checklist*

## 2.10. CREATING AN ANSIBLE USER WITH SUDO ACCESS

Ansible must be able to log into all the Red Hat Ceph Storage (RHCS) nodes as a user that has **`root`** privileges to install software and create configuration files without prompting for a password. You must

create an Ansible user with password-less **root** access on all nodes in the storage cluster when deploying and configuring a Red Hat Ceph Storage cluster with Ansible.

**Prerequisite**

- Having **root** or **sudo** access to all nodes in the storage cluster.

**Procedure**

1. Log in to a Ceph node as the **root** user:

   ```
   ssh root@$HOST_NAME
   ```

   **Replace**

   - **$HOST_NAME** with the host name of the Ceph node.

   **Example**

   ```
   # ssh root@mon01
   ```

   Enter the **root** password when prompted.

2. Create a new Ansible user:

   ```
   adduser $USER_NAME
   ```

   **Replace**

   - **$USER_NAME** with the new user name for the Ansible user.

   **Example**

   ```
   # adduser admin
   ```

   **IMPORTANT**

   Do not use **ceph** as the user name. The **ceph** user name is reserved for the Ceph daemons. A uniform user name across the cluster can improve ease of use, but avoid using obvious user names, because intruders typically use them for brute-force attacks.

3. Set a new password for this user:

   ```
   # passwd $USER_NAME
   ```

   **Replace**

   - **$USER_NAME** with the new user name for the Ansible user.

```
# passwd admin
```

Enter the new password twice when prompted.

4. Configure **sudo** access for the newly created user:

```
cat << EOF >/etc/sudoers.d/$USER_NAME
$USER_NAME ALL = (root) NOPASSWD:ALL
EOF
```

**Replace**

- **$USER_NAME** with the new user name for the Ansible user.

**Example**

```
# cat << EOF >/etc/sudoers.d/admin
admin ALL = (root) NOPASSWD:ALL
EOF
```

5. Assign the correct file permissions to the new file:

```
chmod 0440 /etc/sudoers.d/$USER_NAME
```

**Replace**

- **$USER_NAME** with the new user name for the Ansible user.

**Example**

```
# chmod 0440 /etc/sudoers.d/admin
```

**Additional Resources**

- The Adding a New User section in the *System Administrator's Guide* for Red Hat Enterprise Linux 7.

*Return to the requirements checklist*

## 2.11. ENABLING PASSWORD-LESS SSH FOR ANSIBLE

Generate an SSH key pair on the Ansible administration node and distribute the public key to each node in the storage cluster so that Ansible can access the nodes without being prompted for a password.

**Prerequisites**

- Create an Ansible user with **sudo** access.

**Procedure**

Do the following steps from the Ansible administration node, and as the Ansible user.

1. Generate the SSH key pair, accept the default file name and leave the passphrase empty:

```
[user@admin ~]$ ssh-keygen
```

2. Copy the public key to all nodes in the storage cluster:

```
ssh-copy-id $USER_NAME@$HOST_NAME
```

**Replace**

- **$USER_NAME** with the new user name for the Ansible user.
- **$HOST_NAME** with the host name of the Ceph node.

**Example**

```
[user@admin ~]$ ssh-copy-id ceph-admin@ceph-mon01
```

3. Create and edit the **~/.ssh/config** file.

**IMPORTANT**

By creating and editing the **~/.ssh/config** file you do not have to specify the **-u $USER_NAME** option each time you execute the **ansible-playbook** command.

a. Create the SSH **config** file:

```
[user@admin ~]$ touch ~/.ssh/config
```

b. Open the **config** file for editing. Set the **Hostname** and **User** options for each node in the storage cluster:

```
Host node1
   Hostname $HOST_NAME
   User $USER_NAME
Host node2
   Hostname $HOST_NAME
   User $USER_NAME
...
```

**Replace**

- **$HOST_NAME** with the host name of the Ceph node.
- **$USER_NAME** with the new user name for the Ansible user.

**Example**

```
Host node1
   Hostname monitor
   User admin
Host node2
```

```
    Hostname osd
    User admin
Host node3
    Hostname gateway
    User admin
```

4. Set the correct file permissions for the **~/.ssh/config** file:

```
[admin@admin ~]$ chmod 600 ~/.ssh/config
```

### Additional Resources

- The **ssh_config(5)** manual page
- The OpenSSH chapter in the *System Administrator's Guide* for Red Hat Enterprise Linux 7

*Return to requirements checklist*

# CHAPTER 3. DEPLOYING RED HAT CEPH STORAGE

This chapter describes how to use the Ansible application to deploy a Red Hat Ceph Storage cluster and other components, such as Metadata Servers or the Ceph Object Gateway.

- To install a Red Hat Ceph Storage cluster, see Section 3.2, “Installing a Red Hat Ceph Storage Cluster”.
- To install Metadata Servers, see Section 3.3, “Installing Metadata Servers”.
- To install the **ceph-client** role, see Section 3.4, “Installing the Ceph Client Role”.
- To install the Ceph Object Gateway, see Section 3.5, “Installing the Ceph Object Gateway”.
- To learn about the Ansible **--limit** option, see Section 3.7, “Understanding the **limit** option”.

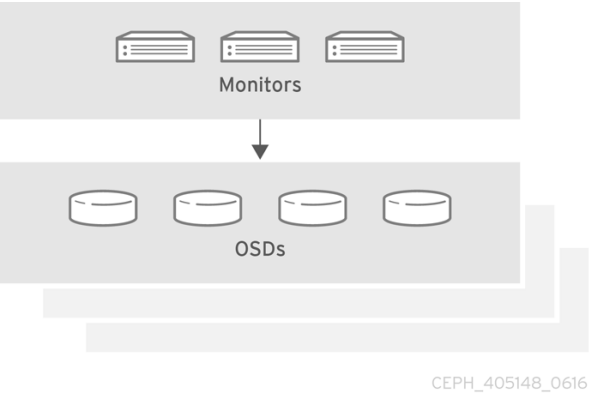
## 3.1. PREREQUISITES

- Obtain a valid customer subscription.
- Prepare the cluster nodes. On each node:
  - Register the node to the Content Delivery Network (CDN) and attach subscriptions.
  - Enable the appropriate software repositories.
  - Create an Ansible user.
  - Enable passwordless SSH access.
  - Optional. Configure firewall.

## 3.2. INSTALLING A RED HAT CEPH STORAGE CLUSTER

Use the Ansible application with the **ceph-ansible** playbook to install Red Hat Ceph Storage 3.

Production Ceph storage clusters start with a minimum of three monitor hosts and three OSD nodes containing multiple OSD daemons.




### Prerequisites

- On the Ansible administration node, install the **ceph-ansible** package:

```
[root@admin ~]# yum install ceph-ansible
```

### Procedure

Use the following commands from the Ansible administration node if not instructed otherwise.

1. In the user's home directory, create the **ceph-ansible-keys** directory where Ansible stores temporary values generated by the **ceph-ansible** playbook.

```
[user@admin ~]$ mkdir ~/ceph-ansible-keys
```

2. Create a symbolic link to the **/usr/share/ceph-ansible/group_vars** directory in the **/etc/ansible/** directory:

```
[root@admin ~]# ln -s /usr/share/ceph-ansible/group_vars
/etc/ansible/group_vars
```

3. Navigate to the **/usr/share/ceph-ansible/** directory:

```
[user@admin ~]$ cd /usr/share/ceph-ansible
```

4. Create new copies of the **yml.sample** files:

```
[root@admin ceph-ansible]# cp group_vars/all.yml.sample
group_vars/all.yml
[root@admin ceph-ansible]# cp group_vars/osds.yml.sample
group_vars/osds.yml
[root@admin ceph-ansible]# cp site.yml.sample site.yml
```

5. Edit the copied files.

   a. Edit the **group_vars/all.yml** file. See the table below for the most common required and optional parameters to uncomment. Note that the table does not include all parameters.

**Table 3.1. General Ansible Settings**

| Option | Value | Required | Notes |
|---|---|---|---|
| **ceph_repository_type** | **cdn** or **iso** | Yes | |
| **ceph_rhcs_version** | **3** | Yes | |
| **ceph_rhcs_iso_path** | The path to the ISO image | Yes if using an ISO image | |
| **monitor_interface** | The interface that the Monitor nodes listen to | **monitor_interface**, **monitor_address**, or **monitor_address_block** is required | |

| Option | Value | Required | Notes |
|---|---|---|---|
| | | | |
| **monitor_address** | The address that the Monitor nodes listen to | | |
| **monitor_address_block** | The subnet of the Ceph public network | | Use when the IP addresses of the nodes are unknown, but the subnet is known |
| **ip_version** | **ipv6** | Yes if using IPv6 addressing | |
| **public_network** | The IP address and netmask of the Ceph public network | Yes | Section 2.8, “Verifying the Network Configuration for Red Hat Ceph Storage” |
| **cluster_network** | The IP address and netmask of the Ceph cluster network | No, defaults to **public_network** | |

An example of the **all.yml** file can look like:

```
ceph_origin: repository
ceph_repository: rhcs
ceph_repository_type: cdn
ceph_rhcs_version: 3
monitor_interface: eth0
public_network: 192.168.0.0/24
```

**NOTE**

Having the **ceph_rhcs_version** option set to **3** will pull in the latest version of Red Hat Ceph Storage 3.

For additional details, see the **all.yml** file.

a. Edit the **group_vars/osds.yml** file. See the table below for the most common required and optional parameters to uncomment. Note that the table does not include all parameters.

**Table 3.2. OSD Ansible Settings**

| Option | Value | Required | Notes |
|---|---|---|---|
| **osd_scenario** | **collocated** to use the same device for journal and OSD data<br><br>**non-collocated** to use a dedicated device to store journal data<br><br>**lvm** to use the Logical Volume Manager to store OSD data | Yes | When using **osd_scenario: non-collocated**, **ceph-ansible** expects the variables **devices** and **dedicated_devices** to match. For example, if you specify 10 disks in **devices**, you must specify 10 entries in **dedicated_devices**. Currently, Red Hat only supports dedicated journals when using **osd_scenario: lvm**, not collocated journals. |
| **osd_auto_discovery** | **true** to automatically discover OSDs | Yes if using **osd_scenario: collocated** | Cannot be used when **devices** setting is used |
| **devices** | List of devices where **ceph data** is stored | Yes to specify the list of devices | Cannot be used when **osd_auto_discovery** setting is used |
| **dedicated_devices** | List of dedicated devices for non-collocated OSDs where **ceph journal** is stored | Yes if **osd_scenario: non-collocated** | Should be nonpartitioned devices |
| **dmcrypt** | **true** to encrypt OSDs | No | Defaults to **false** |

| Option | Value | Required | Notes |
|---|---|---|---|
| **lvm_volumes** | a list of dictionaries | Yes if using **osd_scenario: lvm** | Each dictionary must contain a **data**, **journal** and **data_vg** keys. The **data** key must be a logical volume. The **journal** key can be a logical volume (LV), device or partition, but do not use one journal for multiple **data** LVs. The **data_vg** key must be the volume group containing the **data** LV. Optionally, the **journal_vg** key can be used to specify the volume group containing the journal LV, if applicable. |

The following are examples of the **osds.yml** file using these three **osd_scenario:**: **collocated**, **non-collocated**, and **lvm**.

```
osd_scenario: non-collocated
devices:
  - /dev/sda
  - /dev/sdb
  - /dev/sdc
  - /dev/sdd
dedicated_devices:
   - /dev/nvme0n1
   - /dev/nvme0n1
   - /dev/nvme0n1
   - /dev/nvme0n1
```

```
osd_scenario: non-collocated
devices:
  - /dev/sda
  - /dev/sdb
  - /dev/sdc
  - /dev/sdd
dedicated_devices:
   - /dev/nvme0n1
   - /dev/nvme0n1
   - /dev/nvme0n1
   - /dev/nvme0n1
```

```
osd_scenario: lvm
```

```
lvm_volumes:
   - data: data-lv1
     data_vg: vg1
     journal: journal-lv1
     journal_vg: vg2
   - data: data-lv2
     journal: /dev/sda
     data_vg: vg1
```

For additional details, see the comments in the **osds.yml** file.

**NOTE**

Currently, **ceph-ansible** does not create the volume groups or the logical volumes. This must be done before running the Anisble playbook.

6. Edit the Ansible inventory file located by default at **/etc/ansible/hosts**. Remember to comment out example hosts.

   a. Add the Monitor nodes under the **[mons]** section:

```
[mons]
<monitor-host-name>
<monitor-host-name>
<monitor-host-name>
```

   b. Add OSD nodes under the **[osds]** section. If the nodes have sequential naming, consider using a range:

```
[osds]
<osd-host-name[1:10]>
```

   Optionally, use the **devices** parameter to specify devices that the OSD nodes will use. Use a comma-separated list to list multiple devices.

```
[osds]
<ceph-host-name> devices="[ '<device_1>', '<device_2>' ]"
```

   For example:

```
[osds]
ceph-osd-01 devices="[ '/dev/sdb', '/dev/sdc' ]"
ceph-osd-02 devices="[ '/dev/sdb', '/dev/sdc', '/dev/sdd' ]"
```

   When specifying no devices, set the **osd_auto_discovery** option to **true** in the **osds.yml** file.

**NOTE**

Using the **devices** parameter is useful when OSDs use devices with different names or when one of the devices failed on one of the OSDs.

   c. Add the Ceph Manager (**ceph-mgr**) nodes under the **[mgrs]** section. Colocate the Ceph

Manager daemon with Monitor nodes.

```
[mgrs]
<monitor-host-name>
<monitor-host-name>
<monitor-host-name>
```

7. As the Ansible user, ensure that Ansible can reach the Ceph hosts:

```
[user@admin ~]$ ansible all -m ping
```

8. Add the following line to the **/etc/ansible/ansible.cfg** file:

```
retry_files_save_path = ~/
```

9. As **root**, create the **/var/log/ansible/** directory and assign the appropriate permissions for the **ansible** user:

```
[root@admin ceph-ansible]# mkdir /var/log/ansible
[root@admin ceph-ansible]# chown ansible:ansible  /var/log/ansible
[root@admin ceph-ansible]# chmod 755 /var/log/ansible
```

   a. Edit the **/usr/share/ceph-ansible/ansible.cfg** file, updating the **log_path** value as follows:

```
log_path = /var/log/ansible/ansible.log
```

10. As the Ansible user, run the **ceph-ansible** playbook.

```
[user@admin ceph-ansible]$ ansible-playbook site.yml
```

11. From a Monitor node, verify the status of the Ceph cluster.

```
[root@monitor ~]# ceph health
HEALTH_OK
```

12. Verify the cluster is functioning using **rados**.

   a. From a monitor node, create a test pool with eight placement groups:
   **Syntax**

```
[root@monitor ~]# ceph osd pool create <pool-name> <pg-number>
```

   **Example**

```
[root@monitor ~]# ceph osd pool create test 8
```

   b. Create a file called **hello-world.txt**:
   **Syntax**

```
[root@monitor ~]# vim <file-name>
```

**Example**

```
[root@monitor ~]# vim hello-world.txt
```

c. Upload **hello-world.txt** to the test pool using the object name **hello-world**:
**Syntax**

```
[root@monitor ~]# rados --pool <pool-name> put <object-name>
<object-file>
```

**Example**

```
[root@monitor ~]# rados --pool test put hello-world hello-
world.txt
```

d. Download **hello-world** from the test pool as file name **fetch.txt**:
**Syntax**

```
[root@monitor ~]# rados --pool <pool-name> get <object-name>
<object-file>
```

**Example**

```
[root@monitor ~]# rados --pool test get hello-world fetch.txt
```

e. Check the contents of **fetch.txt**:

```
[root@monitor ~]# cat fetch.txt
```

The output should be:

```
"Hello World!"
```

**NOTE**

In addition to verifying the cluster status, you can use the **ceph-medic** utility to overall diagnose the Ceph Storage Cluster. See the *Installing and Using **ceph-medic** to Diagnose a Ceph Storage Cluster* chapter in the Red Hat Ceph Storage 3 *Troubleshooting Guide*.

## 3.3. INSTALLING METADATA SERVERS

Use the Ansible automation application to install a Ceph Metadata Server (MDS). Metadata Server daemons are necessary for deploying a Ceph File System.

### Procedure

Perform the following steps on the Ansible administration node.

1. Add a new section **[mdss]** to the **/etc/ansible/hosts** file:

```
[mdss]
```

```
<hostname>
<hostname>
<hostname>
```

Replace **<hostname>** with the host names of the nodes where you want to install the Ceph Metadata Servers.

2. Navigate to the **/usr/share/ceph-ansible** directory:

```
[root@admin ~]# cd /usr/share/ceph-ansible
```

3. Create a copy of the **group_vars/mdss.yml.sample** file named **mdss.yml**:

```
[root@admin ceph-ansible]# cp group_vars/mdss.yml.sample
group_vars/mdss.yml
```

4. Optionally, edit parameters in **mdss.yml**. See **mdss.yml** for details.

5. Run the Ansible playbook:

```
[user@admin ceph-ansible]$ ansible-playbook site-docker.yml --limit
mdss
```

6. After installing Metadata Servers, configure them. For details, see the *Configuring Metadata Server Daemons* chapter in the Ceph File System Guide for Red Hat Ceph Storage 3.

### Additional Resources

- The *Ceph File System Guide* for Red Hat Ceph Storage 3
- Section 3.7, "Understanding the **limit** option"

## 3.4. INSTALLING THE CEPH CLIENT ROLE

The **ceph-ansible** utility provides the **ceph-client** role that copies the Ceph configuration file and the administration keyring to nodes. In addition, you can use this role to create custom pools and clients.

### Prerequisites

- A running Ceph storage cluster, preferably in the **active + clean** state.
- Perform the tasks listed in Chapter 2, *Requirements for Installing Red Hat Ceph Storage*.

### Procedure

Perform the following tasks on the Ansible administration node.

1. Add a new section **[clients]** to the **/etc/ansible/hosts** file:

```
[clients]
<client-hostname>
```

Replace **<client-hostname>** with the host name of the node where you want to install the **ceph-client** role.

2. Navigate to the **/usr/share/ceph-ansible** directory:

```
[root@admin ~]# cd /usr/share/ceph-ansible
```

3. Create a new copy of the **clients.yml.sample** file named **clients.yml**:

```
[root@admin ceph-ansible ~]# cp group_vars/clients.yml.sample
group_vars/clients.yml
```

4. Optionally, instruct **ceph-client** to create pools and clients.

   a. Update **clients.yml**.

      - Uncomment the **user_config** setting and set it to **true**.
      - Uncomment the **pools** and **keys** sections and update them as required. You can define custom pools and client names altogether with the **cephx** capabilities.

   b. Add the **osd_pool_default_pg_num** setting to the **ceph_conf_overrides** section in the **all.yml** file:

```
ceph_conf_overrides:
   global:
      osd_pool_default_pg_num: <number>
```

   Replace **<number>** with the default number of placement groups.

5. Run the Ansible playbook:

```
[user@admin ceph-ansible]$ ansible-playbook site.yml --limit clients
```

### Additional Resources

- Section 3.7, “Understanding the **limit** option”

## 3.5. INSTALLING THE CEPH OBJECT GATEWAY

The Ceph Object Gateway, also know as the RADOS gateway, is an object storage interface built on top of the **librados** API to provide applications with a RESTful gateway to Ceph storage clusters.

### Prerequisites

- A running Ceph storage cluster, preferably in the **active + clean** state.
- On the Ceph Object Gateway node, perform the tasks listed in Chapter 2, *Requirements for Installing Red Hat Ceph Storage*.

### Procedure

Perform the following tasks on the Ansible administration node.

1. Create the **rgws** file from the sample file:

```
[root@ansible ~]# cd /etc/ansible/group_vars
[root@ansible ~]# cp rgws.yml.sample rgws.yml
```

2. Add gateway hosts to the **/etc/ansible/hosts** file under the **[rgws]** section to identify their roles to Ansible. If the hosts have sequential naming, use a range. For example:

```
[rgws]
<rgw_host_name_1>
<rgw_host_name_2>
<rgw_host_name[3..10]>
```

3. Navigate to the Ansible configuration directory, **/etc/ansible/**:

```
[root@ansible ~]# cd /usr/share/ceph-ansible
```

4. To copy the administrator key to the Ceph Object Gateway node, uncomment the **copy_admin_key** setting in the **/usr/share/ceph-ansible/group_vars/rgws.yml** file:

```
copy_admin_key: true
```

5. The **rgws.yml** file may specify a different default port than the default port **7480**. For example:

```
ceph_rgw_civetweb_port: 80
```

6. The **all.yml** file **MUST** specify a **radosgw_interface**. For example:

```
radosgw_interface: eth0
```

   Specifying the interface prevents Civetweb from binding to the same IP address as another Civetweb instance when running multiple instances on the same host.

7. Generally, to change default settings, uncomment the settings in the **rgw.yml** file, and make changes accordingly. To make additional changes to settings that aren't in the **rgw.yml** file, use **ceph_conf_overrides:** in the **all.yml** file. For example, set the **rgw_dns_name:** with the host of the DNS server and ensure the cluster's DNS server to configure it for wild cards to enable S3 subdomains.

```
ceph_conf_overrides:
   client.rgw.rgw1:
      rgw_dns_name: <host_name>
      rgw_override_bucket_index_max_shards: 16
      rgw_bucket_default_quota_max_objects: 1638400
```

   For advanced configuration details, see the Red Hat Ceph Storage 3 *Ceph Object Gateway for Production* guide. Advanced topics include:

   - *Configuring Ansible Groups*
   - *Developing Storage Strategies*. See the *Creating the Root Pool*, *Creating System Pools*, and *Creating Data Placement Strategies* sections for additional details on how create and configure the pools.
     See Bucket Sharding for configuration details on bucket sharding.

8. Uncomment the **radosgw_interface** parameter in the **group_vars/all.yml** file.

```
radosgw_interface: <interface>
```

*Replace:*

- **`<interface>`** with the interface that the Ceph Object Gateway nodes listen to

For additional details, see the **`all.yml`** file.

9. Run the Ansible playbook:

```
[user@admin ceph-ansible]$ ansible-playbook site.yml --limit rgws
```

**NOTE**

Ansible ensures that each Ceph Object Gateway is running.

For a single site configuration, add Ceph Object Gateways to the Ansible configuration.

For multi-site deployments, you should have an Ansible configuration for each zone. That is, Ansible will create a Ceph storage cluster and gateway instances for that zone.

After installation for a multi-site cluster is complete, proceed to the Multi-site chapter in the *Object Gateway Guide for Red Hat Enterprise Linux* for details on configuring a cluster for multi-site.

### Additional Resources

- Section 3.7, “Understanding the **`limit`** option”
- The *Object Gateway Guide for Red Hat Enterprise Linux*

## 3.6. INSTALLING THE NFS-GANESHA GATEWAY

The Ceph NFS Ganesha Gateway is an NFS interface built on top of the Ceph Object Gateway to provide applications with a POSIX filesystem interface to the Ceph Object Gateway for migrating files within filesystems to Ceph Object Storage.

### Prerequisites

- A running Ceph storage cluster, preferably in the **`active + clean`** state.
- At least one node running a Ceph Object Gateway.
- At least one S3 user with an access key and secret.
- Perform the Before You Start procedure.

### Procedure

Perform the following tasks on the Ansible administration node.

1. Create the **`nfss`** file from the sample file:

```
[root@ansible ~]# cd /etc/ansible/group_vars
[root@ansible ~]# cp nfss.yml.sample nfss.yml
```

2. Add gateway hosts to the **`/etc/ansible/hosts`** file under an **`[nfss]`** group to identify their group membership to Ansible. If the hosts have sequential naming, use a range. For example:

```
[nfss]
<nfs_host_name_1>
<nfs_host_name_2>
<nfs_host_name[3..10]>
```

3. Navigate to the Ansible configuration directory, **/etc/ansible/**:

```
[root@ansible ~]# cd /usr/share/ceph-ansible
```

4. To copy the administrator key to the Ceph Object Gateway node, uncomment the **copy_admin_key** setting in the **/usr/share/ceph-ansible/group_vars/nfss.yml** file:

```
copy_admin_key: true
```

5. Configure the FSAL (File System Abstraction Layer) sections of the **/usr/share/ceph-ansible/group_vars/nfss.yml** file. Provide an ID, S3 user ID, S3 access key and secret. For NFSv4, it should look something like this:

```
###################
# FSAL RGW Config #
###################
#ceph_nfs_rgw_export_id: <replace-w-numeric-export-id>
#ceph_nfs_rgw_pseudo_path: "/"
#ceph_nfs_rgw_protocols: "3,4"
#ceph_nfs_rgw_access_type: "RW"
#ceph_nfs_rgw_user: "cephnfs"
# Note: keys are optional and can be generated, but not on
containerized, where
# they must be configered.
#ceph_nfs_rgw_access_key: "<replace-w-access-key>"
#ceph_nfs_rgw_secret_key: "<replace-w-secret-key>"
```

6. Run the Ansible playbook:

```
[user@admin ceph-ansible]$ ansible-playbook site.yml --limit nfss
```

### Additional Resources

- Section 3.7, “Understanding the **limit** option”
- The *Object Gateway Guide for Red Hat Enterprise Linux*

## 3.7. UNDERSTANDING THE LIMIT OPTION

This section contains information about the Ansible **--limit** option.

Ansible supports the **--limit** option that enables you to use the **site**, **site-docker**, and **rolling_upgrade** Ansible playbooks for a particular section of the inventory file.

```
$ ansible-playbook site.yml|rolling_upgrade.yml|site-docker.yml --limit
osds|rgws|clients|mdss|nfss
```

For example, to redeploy only OSDs:

```
$ ansible-playbook /usr/share/ceph-ansible/site.yml --limit osds
```

**IMPORTANT**

If you colocate Ceph components on one node, Ansible applies a playbook to all components on the node despite that only one component type was specified with the **`limit`** option. For example, if you run the **`rolling_update`** playbook with the **`--limit osds`** option on a node that contains OSDs and Metadata Servers (MDS), Ansible will upgrade both components, OSDs and MDSs.

## 3.8. ADDITIONAL RESOURCES

- The Ansible Documentation

# CHAPTER 4. UPGRADING A RED HAT CEPH STORAGE CLUSTER

This section describes how to upgrade to a new major or minor version of Red Hat Ceph Storage.

**IMPORTANT**

Please contact Red Hat support prior to upgrading, if you have a large Ceph Object Gateway storage cluster with millions of objects present in buckets.

For more details refer to the Red Hat Ceph Storage 3.0 Release Notes, under the *Slow OSD startup after upgrading to Red Hat Ceph Storage 3.0* heading.

Use the Ansible **`rolling_update.yml`** playbook located in the **`/usr/share/ceph-ansible/infrastructure-playbooks/`** directory from the administration node to upgrade between two major or minor versions of Red Hat Ceph Storage, or to apply asynchronous updates.

Ansible upgrades the Ceph nodes in the following order:

- Monitor nodes
- MGR nodes
- OSD nodes
- MDS nodes
- Ceph Object Gateway nodes
- All other Ceph client nodes

**NOTE**

Red Hat Ceph Storage 3 introduces several changes in Ansible configuration files located in the **`/usr/share/ceph-ansible/group_vars/`** directory; certain parameters were renamed or removed. Therefore, make backup copies of the **`all.yml`** and **`osds.yml`** files before creating new copies from the **`all.yml.sample`** and **`osds.yml.sample`** files after upgrading to version 3. For more details about the changes, see *Appendix H, Changes in Ansible Variables Between Version 2 and 3*.

**NOTE**

Red Hat Ceph Storage 3.1 introduces new Ansible playbooks to optimize storage for performance when using Object Gateway and high speed NVMe based SSDs (and SATA SSDs). The playbooks do this by placing journals and bucket indexes together on SSDs, which can increase performance compared to having all journals on one device. These playbooks are designed to be used when installing Ceph. Existing OSDs continue to work and need no extra steps during an upgrade. There is no way to upgrade a Ceph cluster while simultaneously reconfiguring OSDs to optimize storage in this way. To use different devices for journals or bucket indexes requires reprovisioning OSDs. For more information see Using NVMe with LVM optimally in Ceph Object Gateway for Production.

**IMPORTANT**

The **rolling_update.yml** playbook includes the **serial** variable that adjusts the number of nodes to be updated simultaneously. Red Hat strongly recommends to use the default value (**1**), which ensures that Ansible will upgrade cluster nodes one by one.

**IMPORTANT**

When using the **rolling_update.yml** playbook to upgrade to Red Hat Ceph Storage 3.0 and from version 3.0 to other zStream releases of 3.0, users who use the Ceph File System (CephFS) must manually update the Metadata Server (MDS) cluster. This is due to a known issue.

Comment the MDS hosts in **/etc/ansible/hosts** before upgrading the entire cluster using **ceph-ansible rolling-upgrade.yml**, and then upgrade MDS manually. In the **/etc/ansible/hosts** file:

```
#[mdss]
#host-abc
```

For more details about this known issue, including how to update the MDS cluster, refer to the Red Hat Ceph Storage 3.0 Release Notes.

## Prerequisites

- On all nodes in the cluster, enable the **rhel-7-server-extras-rpms** repository.

```
# subscription-manager repos --enable=rhel-7-server-extras-rpms
```

- If the Ceph nodes are not connected to the Red Hat Content Delivery Network (CDN) and you used an ISO image to install Red Hat Ceph Storage, update the local repository with the latest version of Red Hat Ceph Storage. See Section 2.5, “Enabling the Red Hat Ceph Storage Repositories” for details.

- If upgrading from Red Hat Ceph Storage 2.x to 3.x, on the Ansible administration node and the RBD mirroring node, enable the Red Hat Ceph Storage 3 Tools repository and Ansible repository:

```
[root@admin ~]# subscription-manager repos --enable=rhel-7-server-
rhceph-3-tools-rpms --enable=rhel-7-server-ansible-2.4-rpms
```

- If upgrading from Red Hat Ceph Storage 3.0 to 3.1 and using Red Hat Ceph Storage Dashboard, before upgrading the cluster, purge the old cephmetrics installation from the cluster. This avoids an issue where the dashboard won’t display data after upgrade.

  1. If the **cephmetrics-ansible** package isn’t already updated, update it:

```
[root@admin ~]# yum update cephmetrics-ansible
```

  2. Change to the /usr/share/cephmetrics-ansible/ directory.

```
[root@admin ~]# cd /usr/share/cephmetrics-ansible
```

3. Purge the existing cephmetrics installation.

```
[root@admin cephmetrics-ansible]# ansible-playbook -v purge.yml
```

4. Install the updated Red Hat Ceph Storage Dashboard

```
[root@admin cephmetrics-ansible]# ansible-playbook -v
playbook.yml
```

- If the Ceph nodes are not connected to the Red Hat Content Delivery Network (CDN) and you used an ISO image to install Red Hat Ceph Storage, update the local repository with the latest version of Red Hat Ceph Storage. See Section 2.5, “Enabling the Red Hat Ceph Storage Repositories” for details.

- On the Ansible administration node, ensure the latest version of the **ansible** and **ceph-ansible** packages are installed.

```
[root@admin ~]# yum update ansible ceph-ansible
```

- In the **rolling_update.yml** playbook, change the **health_osd_check_retries** and **health_osd_check_delay** values to **40** and **30** respectively.

```
health_osd_check_retries: 40
health_osd_check_delay: 30
```

  For each OSD node, Ansible will wait up to 20 minutes. Also, Ansible will check the cluster health every 30 seconds, waiting before continuing the upgrade process.

- If the cluster you want to upgrade contains Ceph Block Device images that use the **exclusive-lock** feature, ensure that all Ceph Block Device users have permissions to blacklist clients:

```
ceph auth caps client.<ID> mon 'allow r, allow command "osd
blacklist"' osd '<existing-OSD-user-capabilities>'
```

## Procedure

Use the following commands from the Ansible administration node.

1. Navigate to the **/usr/share/ceph-ansible/** directory:

```
[user@admin ~]$ cd /usr/share/ceph-ansible/
```

2. Back up the **group_vars/all.yml** and **group_vars/osds.yml** files. Skip this step when upgrading from version 3.x to the latest version.

```
[root@admin ceph-ansible]# cp group_vars/all.yml
group_vars/all_old.yml
[root@admin ceph-ansible]# cp group_vars/osds.yml
group_vars/osds_old.yml
```

3. Create new copies of the **group_vars/all.yml.sample** and **group_vars/osds.yml.sample** named **group_vars/all.yml** and **group_vars/osds.yml** respectively and edit them according to you deployment. Skip this

step when upgrading from version 3.x to the latest version. For details, see Appendix H, *Changes in Ansible Variables Between Version 2 and 3* and Section 3.2, "Installing a Red Hat Ceph Storage Cluster" .

```
[root@admin ceph-ansible]# cp group_vars/all.yml.sample
group_vars/all.yml
[root@admin ceph-ansible]# cp group_vars/osds.yml.sample
group_vars/osds.yml
```

4. In the **group_vars/all.yml** file, uncomment the **upgrade_ceph_packages** option and set it to **True**.

```
upgrade_ceph_packages: True
```

5. In the **group_vars/all.yml** file, set **ceph_rhcs_version** to **3**.

```
ceph_rhcs_version: 3
```

**NOTE**

Having the **ceph_rhcs_version** option set to **3** will pull in the latest version of Red Hat Ceph Storage 3.

6. Add the **fetch_directory** parameter to the **group_vars/all.yml** file.

```
fetch_directory: <full_directory_path>
```

*Replace:*

- **<full_directory_path>** with a writable location, such as the Ansible user's home directory.

7. If the cluster you want to upgrade contains any Ceph Object Gateway nodes, add the **radosgw_interface** parameter to the **group_vars/all.yml** file.

```
radosgw_interface: <interface>
```

*Replace:*

- **<interface>** with the interface that the Ceph Object Gateway nodes listen to.

8. In the Ansible inventory file located at **/etc/ansible/hosts**, add the Ceph Manager (**ceph-mgr**) nodes under the **[mgrs]** section. Colocate the Ceph Manager daemon with Monitor nodes. Skip this step when upgrading from version 3.x to the latest version.

```
[mgrs]
<monitor-host-name>
<monitor-host-name>
<monitor-host-name>
```

9. Copy **rolling_update.yml** from the **infrastructure-playbooks** directory to the current directory.

```
[root@admin ceph-ansible]# cp infrastructure-
playbooks/rolling_update.yml .
```

10. Create the **/var/log/ansible/** directory and assign the appropriate permissions for the **ansible** user:

```
[root@admin ceph-ansible]# mkdir /var/log/ansible
[root@admin ceph-ansible]# chown ansible:ansible  /var/log/ansible
[root@admin ceph-ansible]# chmod 755 /var/log/ansible
```

    a. Edit the **/usr/share/ceph-ansible/ansible.cfg** file, updating the **log_path** value as follows:

```
log_path = /var/log/ansible/ansible.log
```

11. Run the playbook:

```
[user@admin ceph-ansible]$ ansible-playbook rolling_update.yml
```

    To use the playbook only for a particular group of nodes on the Ansible inventory file, use the **--limit** option. For details, see Section 3.7, “Understanding the **limit** option”.

12. From the RBD mirroring daemon node, upgrade **rbd-mirror** manually:

```
# yum upgrade rbd-mirror
```

    Restart the daemon:

```
# systemctl restart  ceph-rbd-mirror@<client-id>
```

13. Verify that the cluster health is OK.

```
[root@monitor ~]# ceph -s
```

# CHAPTER 5. WHAT TO DO NEXT?

This is only the beginning of what Red Hat Ceph Storage can do to help you meet the challenging storage demands of the modern data center. Here are links to more information on a variety of topics:

- Benchmarking performance and accessing performance counters, see the Benchmarking Performance chapter in the Administration Guide for Red Hat Ceph Storage 3.
- Creating and managing snapshots, see the Snapshots chapter in the Block Device Guide for Red Hat Ceph Storage 3.
- Expanding the Red Hat Ceph Storage cluster, see the Managing Cluster Size chapter in the Administration Guide for Red Hat Ceph Storage 3.
- Mirroring Ceph Block Devices, see the Block Device Mirroring chapter in the Block Device Guide for Red Hat Ceph Storage 3.
- Process management, see the Process Management chapter in the Administration Guide for Red Hat Ceph Storage 3.
- Tunable parameters, see the Configuration Guide for Red Hat Ceph Storage 3.
- Using Ceph as the back end storage for OpenStack, see the Back-ends section in the Storage Guide for Red Hat OpenStack Platform.

# APPENDIX A. TROUBLESHOOTING

## A.1. ANSIBLE STOPS INSTALLATION BECAUSE IT DETECTS LESS DEVICES THAN IT EXPECTED

The Ansible automation application stops the installation process and returns the following error:

```
- name: fix partitions gpt header or labels of the osd disks (autodiscover
disks)
  shell: "sgdisk --zap-all --clear --mbrtogpt -- '/dev/{{ item.0.item.key
}}' || sgdisk --zap-all --clear --mbrtogpt -- '/dev/{{ item.0.item.key
}}'"
  with_together:
    - "{{ osd_partition_status_results.results }}"
    - "{{ ansible_devices }}"
  changed_when: false
  when:
    - ansible_devices is defined
    - item.0.item.value.removable == "0"
    - item.0.item.value.partitions|count == 0
    - item.0.rc != 0
```

### What this means:

When the **osd_auto_discovery** parameter is set to **true** in the **/etc/ansible/group_vars/osds.yml** file, Ansible automatically detects and configures all the available devices. During this process, Ansible expects that all OSDs use the same devices. The devices get their names in the same order in which Ansible detects them. If one of the devices fails on one of the OSDs, Ansible fails to detect the failed device and stops the whole installation process.

*Example situation:*

1. Three OSD nodes (**host1**, **host2**, **host3**) use the **/dev/sdb**, **/dev/sdc**, and **dev/sdd** disks.
2. On **host2**, the **/dev/sdc** disk fails and is removed.
3. Upon the next reboot, Ansible fails to detect the removed **/dev/sdc** disk and expects that only two disks will be used for **host2**, **/dev/sdb** and **/dev/sdc** (formerly **/dev/sdd**).
4. Ansible stops the installation process and returns the above error message.

### To fix the problem:

In the **/etc/ansible/hosts** file, specify the devices used by the OSD node with the failed disk (**host2** in the Example situation above):

```
[osds]
host1
host2 devices="[ '/dev/sdb', '/dev/sdc' ]"
host3
```

See Chapter 3, *Deploying Red Hat Ceph Storage* for details.

# APPENDIX B. MANUALLY INSTALLING RED HAT CEPH STORAGE

**IMPORTANT**

Red Hat does not support or test upgrading manually deployed clusters. Therefore, Red Hat recommends to use Ansible to deploy a new cluster with Red Hat Ceph Storage 3. See Chapter 3, *Deploying Red Hat Ceph Storage* for details.

You can use command-line utilities, such as Yum, to upgrade manually deployed clusters, but Red Hat does not support or test this.

All Ceph clusters require at least one monitor, and at least as many OSDs as copies of an object stored on the cluster. Red Hat recommends using three monitors for production environments and a minimum of three Object Storage Devices (OSD).

Bootstrapping the initial monitor is the first step in deploying a Ceph storage cluster. Ceph monitor deployment also sets important criteria for the entire cluster, such as:

- The number of replicas for pools
- The number of placement groups per OSD
- The heartbeat intervals
- Any authentication requirement

Most of these values are set by default, so it is useful to know about them when setting up the cluster for production.

Installing a Ceph storage cluster by using the command line interface involves these steps:

- Bootstrapping the initial Monitor node
- Adding an Object Storage Device (OSD) node

## Configuring the Network Time Protocol for Red Hat Ceph Storage

All Ceph Monitor and OSD nodes requires configuring the Network Time Protocol (NTP). Ensure that Ceph nodes are NTP peers. NTP helps preempt issues that arise from clock drift.

**NOTE**

When using Ansible to deploy a Red Hat Ceph Storage cluster, Ansible automatically installs, configures, and enables NTP.

### Prerequisites

- Network access to a valid time source.

### Procedure: Configuring the Network Time Protocol for RHCS

Do the following steps on the all RHCS nodes in the storage cluster, as the **`root`** user.

1. Install the **`ntp`** package:

```
# yum install ntp
```

2. Start and enable the NTP service to be persistent across a reboot:

```
# systemctl start ntpd
# systemctl enable ntpd
```

3. Ensure that NTP is synchronizing clocks properly:

```
$ ntpq -p
```

### Additional Resources

- The Configuring NTP Using ntpd chapter in the System Administrator's Guide for Red Hat Enterprise Linux 7.

## MONITOR BOOTSTRAPPING

Bootstrapping a Monitor and by extension a Ceph storage cluster, requires the following data:

**Unique Identifier**

The File System Identifier (**fsid**) is a unique identifier for the cluster. The **fsid** was originally used when the Ceph storage cluster was principally used for the Ceph file system. Ceph now supports native interfaces, block devices, and object storage gateway interfaces too, so **fsid** is a bit of a misnomer.

**Cluster Name**

Ceph clusters have a cluster name, which is a simple string without spaces. The default cluster name is **ceph**, but you can specify a different cluster name. Overriding the default cluster name is especially useful when you work with multiple clusters.
When you run multiple clusters in a multi-site architecture, the cluster name for example, **us-west**, **us-east** identifies the cluster for the current command-line session.

**NOTE**

To identify the cluster name on the command-line interface, specify the Ceph configuration file with the cluster name, for example, **ceph.conf**, **us-west.conf**, **us-east.conf**, and so on.

**Example:**

```
# ceph --cluster us-west.conf ...
```

**Monitor Name**

Each Monitor instance within a cluster has a unique name. In common practice, the Ceph Monitor name is the node name. Red Hat recommend one Ceph Monitor per node, and no co-locating the Ceph OSD daemons with the Ceph Monitor daemon. To retrieve the short node name, use the **hostname -s** command.

**Monitor Map**

Bootstrapping the initial Monitor requires you to generate a Monitor map. The Monitor map requires:

- The File System Identifier (**fsid**)

- The cluster name, or the default cluster name of **ceph** is used
- At least one host name and its IP address.

**Monitor Keyring**

Monitors communicate with each other by using a secret key. You must generate a keyring with a Monitor secret key and provide it when bootstrapping the initial Monitor.

**Administrator Keyring**

To use the **ceph** command-line interface utilities, create the **client.admin** user and generate its keyring. Also, you must add the **client.admin** user to the Monitor keyring.

The foregoing requirements do not imply the creation of a Ceph configuration file. However, as a best practice, Red Hat recommends creating a Ceph configuration file and populating it with the **fsid**, the **mon initial members** and the **mon host** settings at a minimum.

You can get and set all of the Monitor settings at runtime as well. However, the Ceph configuration file might contain only those settings which overrides the default values. When you add settings to a Ceph configuration file, these settings override the default settings. Maintaining those settings in a Ceph configuration file makes it easier to maintain the cluster.

To bootstrap the initial Monitor, perform the following steps:

1. Enable the Red Hat Ceph Storage 3 Monitor repository:

```
[root@monitor ~]# subscription-manager repos --enable=rhel-7-server-
rhceph-3-mon-rpms
```

2. On your initial Monitor node, install the **ceph-mon** package as **root**:

```
# yum install ceph-mon
```

3. As **root**, create a Ceph configuration file in the **/etc/ceph/** directory. By default, Ceph uses **ceph.conf**, where **ceph** reflects the cluster name:

   **Syntax**

```
# touch /etc/ceph/<cluster_name>.conf
```

   **Example**

```
# touch /etc/ceph/ceph.conf
```

4. As **root**, generate the unique identifier for your cluster and add the unique identifier to the **[global]** section of the Ceph configuration file:

   **Syntax**

```
# echo "[global]" > /etc/ceph/<cluster_name>.conf
# echo "fsid = `uuidgen`" >> /etc/ceph/<cluster_name>.conf
```

   **Example**

```
# echo "[global]" > /etc/ceph/ceph.conf
# echo "fsid = `uuidgen`" >> /etc/ceph/ceph.conf
```

5. View the current Ceph configuration file:

```
$ cat /etc/ceph/ceph.conf
[global]
fsid = a7f64266-0894-4f1e-a635-d0aeaca0e993
```

6. As **root**, add the initial Monitor to the Ceph configuration file:

**Syntax**

```
# echo "mon initial members = <monitor_host_name>[,
<monitor_host_name>]" >> /etc/ceph/<cluster_name>.conf
```

**Example**

```
# echo "mon initial members = node1" >> /etc/ceph/ceph.conf
```

7. As **root**, add the IP address of the initial Monitor to the Ceph configuration file:

**Syntax**

```
# echo "mon host = <ip-address>[,<ip-address>]" >>
/etc/ceph/<cluster_name>.conf
```

**Example**

```
# echo "mon host = 192.168.0.120" >> /etc/ceph/ceph.conf
```

**NOTE**

To use IPv6 addresses, you set the **ms bind ipv6** option to **true**. For details, see the Bind section in the Configuration Guide for Red Hat Ceph Storage 3.

8. As **root**, create the keyring for the cluster and generate the Monitor secret key:

**Syntax**

```
# ceph-authtool --create-keyring /tmp/<cluster_name>.mon.keyring --
gen-key -n mon. --cap mon '<capabilites>'
```

**Example**

```
# ceph-authtool --create-keyring /tmp/ceph.mon.keyring --gen-key -n
mon. --cap mon 'allow *'
creating /tmp/ceph.mon.keyring
```

9. As **root**, generate an administrator keyring, generate a **<cluster_name>.client.admin.keyring** user and add the user to the keyring:

**Syntax**

```
# ceph-authtool --create-keyring
/etc/ceph/<cluster_name>.client.admin.keyring --gen-key -n
client.admin --set-uid=0 --cap mon '<capabilites>' --cap osd
'<capabilites>' --cap mds '<capabilites>'
```

**Example**

```
# ceph-authtool --create-keyring /etc/ceph/ceph.client.admin.keyring
--gen-key -n client.admin --set-uid=0 --cap mon 'allow *' --cap osd
'allow *' --cap mds 'allow'
creating /etc/ceph/ceph.client.admin.keyring
```

10. As **root**, add the **<cluster_name>.client.admin.keyring** key to the **<cluster_name>.mon.keyring**:

**Syntax**

```
# ceph-authtool /tmp/<cluster_name>.mon.keyring --import-keyring
/etc/ceph/<cluster_name>.client.admin.keyring
```

**Example**

```
# ceph-authtool /tmp/ceph.mon.keyring --import-keyring
/etc/ceph/ceph.client.admin.keyring
importing contents of /etc/ceph/ceph.client.admin.keyring into
/tmp/ceph.mon.keyring
```

11. Generate the Monitor map. Specify using the node name, IP address and the **fsid**, of the initial Monitor and save it as **/tmp/monmap**:

**Syntax**

```
$ monmaptool --create --add <monitor_host_name> <ip-address> --fsid
<uuid> /tmp/monmap
```

**Example**

```
$ monmaptool --create --add node1 192.168.0.120 --fsid a7f64266-
0894-4f1e-a635-d0aeaca0e993 /tmp/monmap
monmaptool: monmap file /tmp/monmap
monmaptool: set fsid to a7f64266-0894-4f1e-a635-d0aeaca0e993
monmaptool: writing epoch 0 to /tmp/monmap (1 monitors)
```

12. As **root** on the initial Monitor node, create a default data directory:

**Syntax**

```
# mkdir /var/lib/ceph/mon/<cluster_name>-<monitor_host_name>
```

**Example**

```
# mkdir /var/lib/ceph/mon/ceph-node1
```

13. As **root**, populate the initial Monitor daemon with the Monitor map and keyring:

**Syntax**

```
# ceph-mon [--cluster <cluster_name>] --mkfs -i <monitor_host_name>
--monmap /tmp/monmap --keyring /tmp/<cluster_name>.mon.keyring
```

**Example**

```
# ceph-mon --mkfs -i node1 --monmap /tmp/monmap --keyring
/tmp/ceph.mon.keyring
ceph-mon: set fsid to a7f64266-0894-4f1e-a635-d0aeaca0e993
ceph-mon: created monfs at /var/lib/ceph/mon/ceph-node1 for
mon.node1
```

14. View the current Ceph configuration file:

```
# cat /etc/ceph/ceph.conf
[global]
fsid = a7f64266-0894-4f1e-a635-d0aeaca0e993
mon_initial_members = node1
mon_host = 192.168.0.120
```

For more details on the various Ceph configuration settings, see the Configuration Guide for Red Hat Ceph Storage 3. The following example of a Ceph configuration file lists some of the most common configuration settings:

**Example**

```
[global]
fsid = <cluster-id>
mon initial members = <monitor_host_name>[, <monitor_host_name>]
mon host = <ip-address>[, <ip-address>]
public network = <network>[, <network>]
cluster network = <network>[, <network>]
auth cluster required = cephx
auth service required = cephx
auth client required = cephx
osd journal size = <n>
osd pool default size = <n>  # Write an object n times.
osd pool default min size = <n> # Allow writing n copy in a degraded
state.
osd pool default pg num = <n>
osd pool default pgp num = <n>
osd crush chooseleaf type = <n>
```

15. As **root**, create the **done** file:

**Syntax**

```
# touch /var/lib/ceph/mon/<cluster_name>-<monitor_host_name>/done
```

**Example**

```
# touch /var/lib/ceph/mon/ceph-node1/done
```

16. As **root**, update the owner and group permissions on the newly created directory and files:

**Syntax**

```
# chown -R <owner>:<group> <path_to_directory>
```

**Example**

```
# chown -R ceph:ceph /var/lib/ceph/mon
# chown -R ceph:ceph /var/log/ceph
# chown -R ceph:ceph /var/run/ceph
# chown ceph:ceph /etc/ceph/ceph.client.admin.keyring
# chown ceph:ceph /etc/ceph/ceph.conf
# chown ceph:ceph /etc/ceph/rbdmap
```

**NOTE**

If the Ceph Monitor node is co-located with an OpenStack Controller node, then the Glance and Cinder keyring files must be owned by **glance** and **cinder** respectively. For example:

```
# ls -l /etc/ceph/
...
-rw-------.  1 glance glance      64 <date>
ceph.client.glance.keyring
-rw-------.  1 cinder cinder      64 <date>
ceph.client.cinder.keyring
...
```

17. For storage clusters with custom names, as **root**, add the the following line:

**Syntax**

```
# echo "CLUSTER=<custom_cluster_name>" >> /etc/sysconfig/ceph
```

**Example**

```
# echo "CLUSTER=test123" >> /etc/sysconfig/ceph
```

18. As **root**, start and enable the **ceph-mon** process on the initial Monitor node:

**Syntax**

```
# systemctl enable ceph-mon.target
# systemctl enable ceph-mon@<monitor_host_name>
```

```
# systemctl start ceph-mon@<monitor_host_name>
```

**Example**

```
# systemctl enable ceph-mon.target
# systemctl enable ceph-mon@node1
# systemctl start ceph-mon@node1
```

19. As **root**, verify the monitor daemon is running:

**Syntax**

```
# systemctl status ceph-mon@<monitor_host_name>
```

**Example**

```
# systemctl status ceph-mon@node1
● ceph-mon@node1.service - Ceph cluster monitor daemon
   Loaded: loaded (/usr/lib/systemd/system/ceph-mon@.service;
enabled; vendor preset: disabled)
   Active: active (running) since Wed 2018-06-27 11:31:30 PDT; 5min
ago
 Main PID: 1017 (ceph-mon)
   CGroup: /system.slice/system-ceph\x2dmon.slice/ceph-
mon@node1.service
           └─1017 /usr/bin/ceph-mon -f --cluster ceph --id node1 --
setuser ceph --setgroup ceph

Jun 27 11:31:30 node1 systemd[1]: Started Ceph cluster monitor
daemon.
Jun 27 11:31:30 node1 systemd[1]: Starting Ceph cluster monitor
daemon...
```

To add more Red Hat Ceph Storage Monitors to the storage cluster, see the Adding a Monitor section in the Administration Guide for Red Hat Ceph Storage 3.

## OSD BOOTSTRAPPING

Once you have your initial monitor running, you can start adding the Object Storage Devices (OSDs). Your cluster cannot reach an **active + clean** state until you have enough OSDs to handle the number of copies of an object.

The default number of copies for an object is three. You will need three OSD nodes at minimum. However, if you only want two copies of an object, therefore only adding two OSD nodes, then update the **osd pool default size** and **osd pool default min size** settings in the Ceph configuration file.

For more details, see the *OSD Configuration Reference* section in the *Configuration Guide* for Red Hat Ceph Storage 3.

After bootstrapping the initial monitor, the cluster has a default CRUSH map. However, the CRUSH map does not have any Ceph OSD daemons mapped to a Ceph node.

To add an OSD to the cluster and updating the default CRUSH map, execute the following on each OSD node:

1. Enable the Red Hat Ceph Storage 3 OSD repository:

```
[root@osd ~]# subscription-manager repos --enable=rhel-7-server-
rhceph-3-osd-rpms
```

2. As **root**, install the **ceph-osd** package on the Ceph OSD node:

```
# yum install ceph-osd
```

3. Copy the Ceph configuration file and administration keyring file from the initial Monitor node to the OSD node:

**Syntax**

```
# scp <user_name>@<monitor_host_name>:<path_on_remote_system>
<path_to_local_file>
```

**Example**

```
# scp root@node1:/etc/ceph/ceph.conf /etc/ceph
# scp root@node1:/etc/ceph/ceph.client.admin.keyring /etc/ceph
```

4. Generate the Universally Unique Identifier (UUID) for the OSD:

```
$ uuidgen
b367c360-b364-4b1d-8fc6-09408a9cda7a
```

5. As **root**, create the OSD instance:

**Syntax**

```
# ceph osd create <uuid> [<osd_id>]
```

**Example**

```
# ceph osd create b367c360-b364-4b1d-8fc6-09408a9cda7a
0
```

**NOTE**

This command outputs the OSD number identifier needed for subsequent steps.

6. As **root**, create the default directory for the new OSD:

**Syntax**

```
# mkdir /var/lib/ceph/osd/<cluster_name>-<osd_id>
```

**Example**

```
# mkdir /var/lib/ceph/osd/ceph-0
```

7. As **root**, prepare the drive for use as an OSD, and mount it to the directory you just created. Create a partition for the Ceph data and journal. The journal and the data partitions can be located on the same disk. This example is using a 15 GB disk:

**Syntax**

```
# parted <path_to_disk> mklabel gpt
# parted <path_to_disk> mkpart primary 1 10000
# mkfs -t <fstype> <path_to_partition>
# mount -o noatime <path_to_partition>
/var/lib/ceph/osd/<cluster_name>-<osd_id>
# echo "<path_to_partition>  /var/lib/ceph/osd/<cluster_name>-
<osd_id>   xfs defaults,noatime 1 2" >> /etc/fstab
```

**Example**

```
# parted /dev/sdb mklabel gpt
# parted /dev/sdb mkpart primary 1 10000
# parted /dev/sdb mkpart primary 10001 15000
# mkfs -t xfs /dev/sdb1
# mount -o noatime /dev/sdb1 /var/lib/ceph/osd/ceph-0
# echo "/dev/sdb1 /var/lib/ceph/osd/ceph-0  xfs defaults,noatime 1
2" >> /etc/fstab
```

8. As **root**, initialize the OSD data directory:

**Syntax**

```
# ceph-osd -i <osd_id> --mkfs --mkkey --osd-uuid <uuid>
```

**Example**

```
# ceph-osd -i 0 --mkfs --mkkey --osd-uuid b367c360-b364-4b1d-8fc6-
09408a9cda7a
... auth: error reading file: /var/lib/ceph/osd/ceph-0/keyring:
can't open /var/lib/ceph/osd/ceph-0/keyring: (2) No such file or
directory
... created new key in keyring /var/lib/ceph/osd/ceph-0/keyring
```

**NOTE**

The directory must be empty before you run **ceph-osd** with the **--mkkey** option. If you have a custom cluster name, the **ceph-osd** utility requires the **--cluster** option.

9. As **root**, register the OSD authentication key. If your cluster name differs from **ceph**, insert your cluster name instead:

**Syntax**

```
# ceph auth add osd.<osd_id> osd 'allow *' mon 'allow profile osd' -
i /var/lib/ceph/osd/<cluster_name>-<osd_id>/keyring
```

**Example**

```
# ceph auth add osd.0 osd 'allow *' mon 'allow profile osd' -i
/var/lib/ceph/osd/ceph-0/keyring
added key for osd.0
```

10. As **root**, add the OSD node to the CRUSH map:

**Syntax**

```
# ceph [--cluster <cluster_name>] osd crush add-bucket <host_name>
host
```

**Example**

```
# ceph osd crush add-bucket node2 host
```

11. As **root**, place the OSD node under the **default** CRUSH tree:

**Syntax**

```
# ceph [--cluster <cluster_name>] osd crush move <host_name>
root=default
```

**Example**

```
# ceph osd crush move node2 root=default
```

12. As **root**, add the OSD disk to the CRUSH map

**Syntax**

```
# ceph [--cluster <cluster_name>] osd crush add osd.<osd_id>
<weight> [<bucket_type>=<bucket-name> ...]
```

**Example**

```
# ceph osd crush add osd.0 1.0 host=node2
add item id 0 name 'osd.0' weight 1 at location {host=node2} to
crush map
```

**NOTE**

You can also decompile the CRUSH map, and add the OSD to the device list. Add the OSD node as a bucket, then add the device as an item in the OSD node, assign the OSD a weight, recompile the CRUSH map and set the CRUSH map. For more details, see the Editing a CRUSH map section in the *Storage Strategies Guide* for Red Hat Ceph Storage 3. for more details.

13. As **root**, update the owner and group permissions on the newly created directory and files:

    **Syntax**

    ```
    # chown -R <owner>:<group> <path_to_directory>
    ```

    **Example**

    ```
    # chown -R ceph:ceph /var/lib/ceph/osd
    # chown -R ceph:ceph /var/log/ceph
    # chown -R ceph:ceph /var/run/ceph
    # chown -R ceph:ceph /etc/ceph
    ```

14. For storage clusters with custom names, as **root**, add the following line to the **/etc/sysconfig/ceph** file:

    **Syntax**

    ```
    # echo "CLUSTER=<custom_cluster_name>" >> /etc/sysconfig/ceph
    ```

    **Example**

    ```
    # echo "CLUSTER=test123" >> /etc/sysconfig/ceph
    ```

15. The OSD node is in your Ceph storage cluster configuration. However, the OSD daemon is **down** and **in**. The new OSD must be **up** before it can begin receiving data. As **root**, enable and start the OSD process:

    **Syntax**

    ```
    # systemctl enable ceph-osd.target
    # systemctl enable ceph-osd@<osd_id>
    # systemctl start ceph-osd@<osd_id>
    ```

    **Example**

    ```
    # systemctl enable ceph-osd.target
    # systemctl enable ceph-osd@0
    # systemctl start ceph-osd@0
    ```

    Once you start the OSD daemon, it is **up** and **in**.

Now you have the monitors and some OSDs up and running. You can watch the placement groups peer by executing the following command:

```
$ ceph -w
```

To view the OSD tree, execute the following command:

```
$ ceph osd tree
```

### Example

```
ID  WEIGHT    TYPE NAME        UP/DOWN  REWEIGHT  PRIMARY-AFFINITY
-1       2    root default
-2       2        host node2
 0       1            osd.0         up         1                 1
-3       1        host node3
 1       1            osd.1         up         1                 1
```

To expand the storage capacity by adding new OSDs to the storage cluster, see the Adding an OSD section in the *Administration Guide* for Red Hat Ceph Storage 3.

# APPENDIX C. INSTALLING THE CEPH COMMAND LINE INTERFACE

The Ceph command-line interface (CLI) enables administrators to execute Ceph administrative commands. The CLI is provided by the **ceph-common** package and includes the following utilities:

- **ceph**
- **ceph-authtool**
- **ceph-dencoder**
- **rados**

## Prerequisites

- A running Ceph storage cluster, preferably in the **active + clean** state.

## Procedure

1. On the client node, enable the Red Hat Ceph Storage 3 Tools repository:

```
[root@gateway ~]# subscription-manager repos --enable=rhel-7-server-
rhceph-3-tools-rpms
```

2. On the client node, install the **ceph-common** package:

```
# yum install ceph-common
```

3. From the initial monitor node, copy the Ceph configuration file, in this case **ceph.conf**, and the administration keyring to the client node:

**Syntax**

```
# scp /etc/ceph/<cluster_name>.conf
<user_name>@<client_host_name>:/etc/ceph/
# scp /etc/ceph/<cluster_name>.client.admin.keyring
<user_name>@<client_host_name:/etc/ceph/
```

**Example**

```
# scp /etc/ceph/ceph.conf root@node1:/etc/ceph/
# scp /etc/ceph/ceph.client.admin.keyring root@node1:/etc/ceph/
```

Replace **<client_host_name>** with the host name of the client node.

# APPENDIX D. MANUALLY INSTALLING CEPH BLOCK DEVICE

The following procedure shows how to install and mount a thin-provisioned, resizable Ceph Block Device.

**IMPORTANT**

Ceph Block Devices must be deployed on separate nodes from the Ceph Monitor and OSD nodes. Running kernel clients and kernel server daemons on the same node can lead to kernel deadlocks.

## Prerequisites

- Ensure to perform the tasks listed in the Appendix C, *Installing the Ceph Command Line Interface* section.
- If you use Ceph Block Devices as a back end for virtual machines (VMs) that use QEMU, increase the default file descriptor. See the Ceph - VM hangs when transferring large amounts of data to RBD disk Knowledgebase article for details.

## Procedure

1. Create a Ceph Block Device user named **client.rbd** with full permissions to files on OSD nodes (**osd 'allow rwx'**) and output the result to a keyring file:

   ```
   ceph auth get-or-create client.rbd mon 'profile rbd' osd 'profile
   rbd pool=<pool_name>' \
   -o /etc/ceph/rbd.keyring
   ```

   Replace **<pool_name>** with the name of the pool that you want to allow **client.rbd** to have access to, for example **rbd**:

   ```
   # ceph auth get-or-create \
   client.rbd mon 'allow r' osd 'allow rwx pool=rbd' \
   -o /etc/ceph/rbd.keyring
   ```

   See the *User Management* section in the Red Hat Ceph Storage 3 *Administration Guide* for more information about creating users.

2. Create a block device image:

   ```
   rbd create <image_name> --size <image_size> --pool <pool_name> \
   --name client.rbd --keyring /etc/ceph/rbd.keyring
   ```

   Specify **<image_name>**, **<image_size>**, and **<pool_name>**, for example:

   ```
   $ rbd create image1 --size 4096 --pool rbd \
   --name client.rbd --keyring /etc/ceph/rbd.keyring
   ```

**WARNING**

The default Ceph configuration includes the following Ceph Block Device features:

- **layering**
- **exclusive-lock**
- **object-map**
- **deep-flatten**
- **fast-diff**

If you use the kernel RBD (**krbd**) client, you will not be able to map the block device image because the current kernel version included in Red Hat Enterprise Linux 7.3 does not support **object-map**, **deep-flatten**, and **fast-diff**.

To work around this problem, disable the unsupported features. Use one of the following options to do so:

- Disable the unsupported features dynamically:

  ```
  rbd feature disable <image_name> <feature_name>
  ```

  For example:

  ```
  # rbd feature disable image1 object-map deep-
  flatten fast-diff
  ```

- Use the **--image-feature layering** option with the **rbd create** command to enable only **layering** on newly created block device images.

- Disable the features be default in the Ceph configuration file:

  ```
  rbd_default_features = 1
  ```

This is a known issue, for details see the *Known Issues* chapter in the *Release Notes* for Red Hat Ceph Storage 3.

All these features work for users that use the user-space RBD client to access the block device images.

3. Map the newly created image to the block device:

```
rbd map <image_name> --pool <pool_name>\
--name client.rbd --keyring /etc/ceph/rbd.keyring
```

For example:

```
# rbd map image1 --pool rbd --name client.rbd \
--keyring /etc/ceph/rbd.keyring
```

**IMPORTANT**

Kernel block devices currently only support the legacy straw bucket algorithm in the CRUSH map. If you have set the CRUSH tunables to optimal, you must set them to legacy or an earlier major release, otherwise, you will not be able to map the image.

Alternatively, replace **straw2** with **straw** in the CRUSH map. For details, see the *Editing a CRUSH Map* chapter in the *Storage Strategies* guide for Red Hat Ceph Storage 3.

4. Use the block device by creating a file system:

```
mkfs.ext4 -m5 /dev/rbd/<pool_name>/<image_name>
```

Specify the pool name and the image name, for example:

```
# mkfs.ext4 -m5 /dev/rbd/rbd/image1
```

This can take a few moments.

5. Mount the newly created file system:

```
mkdir <mount_directory>
mount /dev/rbd/<pool_name>/<image_name> <mount_directory>
```

For example:

```
# mkdir /mnt/ceph-block-device
# mount /dev/rbd/rbd/image1 /mnt/ceph-block-device
```

For additional details, see the Block Device Guide for Red Hat Ceph Storage 3.

# APPENDIX E. MANUALLY INSTALLING CEPH OBJECT GATEWAY

The Ceph object gateway, also know as the RADOS gateway, is an object storage interface built on top of the **librados** API to provide applications with a RESTful gateway to Ceph storage clusters.

## Prerequisites

- A running Ceph storage cluster, preferably in the **active + clean** state.
- Perform the tasks listed in Chapter 2, *Requirements for Installing Red Hat Ceph Storage*.

## Procedure

1. Enable the Red Hat Ceph Storage 3 Tools repository:

```
[root@gateway ~]# subscription-manager repos --enable=rhel-7-server-
rhceph-3-tools-rpms
```

2. On the Object Gateway node, install the **ceph-radosgw** package:

```
# yum install ceph-radosgw
```

3. On the initial Monitor node, do the following steps.

   a. Update the Ceph configuration file as follows:

```
[client.rgw.<obj_gw_hostname>]
host = <obj_gw_hostname>
rgw frontends = "civetweb port=80"
rgw dns name = <obj_gw_hostname>.example.com
```

   Where **<obj_gw_hostname>** is a short host name of the gateway node. To view the short host name, use the **hostname -s** command.

   b. Copy the updated configuration file to the new Object Gateway node and all other nodes in the Ceph storage cluster:

   **Syntax**

```
# scp /etc/ceph/<cluster_name>.conf
<user_name>@<target_host_name>:/etc/ceph
```

   **Example**

```
# scp /etc/ceph/ceph.conf root@node1:/etc/ceph/
```

   c. Copy the **<cluster_name>.client.admin.keyring** file to the new Object Gateway node:

   **Syntax**

```
# scp /etc/ceph/<cluster_name>.client.admin.keyring
<user_name>@<target_host_name>:/etc/ceph/
```

**Example**

```
# scp /etc/ceph/ceph.client.admin.keyring root@node1:/etc/ceph/
```

4. On the Object Gateway node, create the data directory:

**Syntax**

```
# mkdir -p /var/lib/ceph/radosgw/<cluster_name>-rgw.`hostname -s`
```

**Example**

```
# mkdir -p /var/lib/ceph/radosgw/ceph-rgw.`hostname -s`
```

5. On the Object Gateway node, add a user and keyring to bootstrap the object gateway:

**Syntax**

```
# ceph auth get-or-create client.rgw.`hostname -s` osd 'allow rwx'
mon 'allow rw' -o /var/lib/ceph/radosgw/<cluster_name>-rgw.`hostname
-s`/keyring
```

**Example**

```
# ceph auth get-or-create client.rgw.`hostname -s` osd 'allow rwx'
mon 'allow rw' -o /var/lib/ceph/radosgw/ceph-rgw.`hostname -
s`/keyring
```

**IMPORTANT**

When you provide capabilities to the gateway key you must provide the read capability. However, providing the Monitor write capability is optional; if you provide it, the Ceph Object Gateway will be able to create pools automatically.

In such a case, ensure to specify a reasonable number of placement groups in a pool. Otherwise, the gateway uses the default number, which might not be suitable for your needs. See Ceph Placement Groups (PGs) per Pool Calculator for details.

6. On the Object Gateway node, create the **done** file:

**Syntax**

```
# touch /var/lib/ceph/radosgw/<cluster_name>-rgw.`hostname -s`/done
```

**Example**

```
# touch /var/lib/ceph/radosgw/ceph-rgw.`hostname -s`/done
```

7. On the Object Gateway node, change the owner and group permissions:

```
# chown -R ceph:ceph /var/lib/ceph/radosgw
# chown -R ceph:ceph /var/log/ceph
# chown -R ceph:ceph /var/run/ceph
# chown -R ceph:ceph /etc/ceph
```

8. For storage clusters with custom names, as **root**, add the following line:

**Syntax**

```
# echo "CLUSTER=<custom_cluster_name>" >> /etc/sysconfig/ceph
```

**Example**

```
# echo "CLUSTER=test123" >> /etc/sysconfig/ceph
```

9. On the Object Gateway node, open TCP port 80:

```
# firewall-cmd --zone=public --add-port=80/tcp
# firewall-cmd --zone=public --add-port=80/tcp --permanent
```

10. On the Object Gateway node, start and enable the **ceph-radosgw** process:

**Syntax**

```
# systemctl enable ceph-radosgw.target
# systemctl enable ceph-radosgw@rgw.<rgw_hostname>
# systemctl start ceph-radosgw@rgw.<rgw_hostname>
```

**Example**

```
# systemctl enable ceph-radosgw.target
# systemctl enable ceph-radosgw@rgw.node1
# systemctl start ceph-radosgw@rgw.node1
```

Once installed, the Ceph Object Gateway automatically creates pools if the write capability is set on the Monitor. See the Pools chapter in the Storage Strategies Guide for information on creating pools manually.

## Additional Details

- The Red Hat Ceph Storage 3 the Object Gateway Guide for Red Hat Enterprise Linux

# APPENDIX F. OVERRIDING CEPH DEFAULT SETTINGS

Unless otherwise specified in the Ansible configuration files, Ceph uses its default settings.

Because Ansible manages the Ceph configuration file, edit the **/etc/ansible/group_vars/all.yml** file to change the Ceph configuration. Use the **ceph_conf_overrides** setting to override the default Ceph configuration.

Ansible supports the same sections as the Ceph configuration file; **[global]**, **[mon]**, **[osd]**, **[mds]**, **[rgw]**, and so on. You can also override particular instances, such as a particular Ceph Object Gateway instance. For example:

```
###################
# CONFIG OVERRIDE #
###################

ceph_conf_overrides:
   client.rgw.rgw1:
      log_file: /var/log/ceph/ceph-rgw-rgw1.log
```

**NOTE**

Ansible does not include braces when referring to a particular section of the Ceph configuration file. Sections and settings names are terminated with a colon.

**IMPORTANT**

Do not set the cluster network with the **cluster_network** parameter in the **CONFIG OVERRIDE** section because this can cause two conflicting cluster networks being set in the Ceph configuration file.

To set the cluster network, use the **cluster_network** parameter in the **CEPH CONFIGURATION** section. For details, see Section 3.2, “Installing a Red Hat Ceph Storage Cluster”.

# APPENDIX G. MANUALLY UPGRADING FROM RED HAT CEPH STORAGE 2 TO 3

This chapter provides information on how to manually upgrade from Red Hat Ceph storage version 2.4 to 3.0.

You can upgrade the Ceph Storage Cluster in a rolling fashion and while the cluster is running. Upgrade each node in the cluster sequentially, only proceeding to the next node after the previous node is done.

Red Hat recommends upgrading the Ceph components in the following order:

- Monitor nodes
- OSD nodes
- Ceph Object Gateway nodes
- All other Ceph client nodes

Two methods are available to upgrade a Red Hat Ceph Storage 2.3 to 3:

- Using Red Hat's Content Delivery Network (CDN)
- Using a Red Hat provided ISO image file

After upgrading the storage cluster you might have a health warning regarding the CRUSH map using legacy tunables. For details, see the CRUSH Tunables section in the Storage Strategies guide for Red Hat Ceph Storage 3.

### Example

```
$ ceph -s
    cluster 848135d7-cdb9-4084-8df2-fb5e41ae60bd
     health HEALTH_WARN
            crush map has legacy tunables (require bobtail, min is
firefly)
     monmap e1: 1 mons at {ceph1=192.168.0.121:6789/0}
            election epoch 2, quorum 0 ceph1
     osdmap e83: 2 osds: 2 up, 2 in
      pgmap v1864: 64 pgs, 1 pools, 38192 kB data, 17 objects
            10376 MB used, 10083 MB / 20460 MB avail
                  64 active+clean
```

**IMPORTANT**

Red Hat recommends all Ceph clients to be running the same version as the Ceph storage cluster.

### Prerequisites

- If the cluster you want to upgrade contains Ceph Block Device images that use the **`exclusive-lock`** feature, ensure that all Ceph Block Device users have permissions to blacklist clients:

```
ceph auth caps client.<ID> mon 'allow r, allow command "osd
blacklist"' osd '<existing-OSD-user-capabilities>'
```

## Upgrading Monitor Nodes

This section describes steps to upgrade a Ceph Monitor node to a later version. There must be an odd number of Monitors. While you are upgrading one Monitor, the storage cluster will still have quorum.

### Procedure

Do the following steps on each Monitor node in the storage cluster. Upgrade only one Monitor node at a time.

1. If you installed Red Hat Ceph Storage 2 by using software repositories, disable the repositories:

```
# subscription-manager repos --disable=rhel-7-server-rhceph-2-mon-
rpms --disable=rhel-7-server-rhceph-2-installer-rpms
```

2. Enable the Red Hat Ceph Storage 3 Monitor repository:

```
[root@monitor ~]# subscription-manager repos --enable=rhel-7-server-
rhceph-3-mon-rpms
```

3. As **root**, stop the Monitor process:

   **Syntax**

```
# service ceph stop <daemon_type>.<monitor_host_name>
```

   **Example**

```
# service ceph stop mon.node1
```

4. As **root**, update the **ceph-mon** package:

```
# yum update ceph-mon
```

5. As **root**, update the owner and group permissions:

   **Syntax**

```
# chown -R <owner>:<group> <path_to_directory>
```

   **Example**

```
# chown -R ceph:ceph /var/lib/ceph/mon
# chown -R ceph:ceph /var/log/ceph
# chown -R ceph:ceph /var/run/ceph
# chown ceph:ceph /etc/ceph/ceph.client.admin.keyring
# chown ceph:ceph /etc/ceph/ceph.conf
# chown ceph:ceph /etc/ceph/rbdmap
```

**NOTE**

If the Ceph Monitor node is colocated with an OpenStack Controller node, then the Glance and Cinder keyring files must be owned by **glance** and **cinder** respectively. For example:

```
# ls -l /etc/ceph/
...
-rw-------.  1 glance glance      64 <date>
ceph.client.glance.keyring
-rw-------.  1 cinder cinder      64 <date>
ceph.client.cinder.keyring
...
```

6. If SELinux is in enforcing or permissive mode, relabel the SELinux context on the next reboot.

```
# touch /.autorelabel
```

**WARNING**

Relabeling can take a long time to complete because SELinux must traverse every file system and fix any mislabeled files. To exclude directories from being relabeled, add the directories to the **/etc/selinux/fixfiles_exclude_dirs** file before rebooting.

7. As **root**, enable the **ceph-mon** process:

```
# systemctl enable ceph-mon.target
# systemctl enable ceph-mon@<monitor_host_name>
```

8. As **root**, reboot the Monitor node:

```
# shutdown -r now
```

9. Once the Monitor node is up, check the health of the Ceph storage cluster before moving to the next Monitor node:

```
# ceph -s
```

## Upgrading OSD Nodes

This section describes steps to upgrade a Ceph OSD node to a later version.

### Prerequisites

When upgrading an OSD node, some placement groups will become degraded because the OSD might be down or restarting. To prevent Ceph from starting the recovery process, on a Monitor node, set the **noout** and **norebalance** OSD flags:

```
[root@monitor ~]# ceph osd set noout
[root@monitor ~]# ceph osd set norebalance
```

### Procedure

Do the following steps on each OSD node in the storage cluster. Upgrade only one OSD node at a time. If an ISO-based installation was performed for Red Hat Ceph Storage 2.3, then skip this first step.

1. As **root**, disable the Red Hat Ceph Storage 2 repositories:

   ```
   # subscription-manager repos --disable=rhel-7-server-rhceph-2-osd-
   rpms --disable=rhel-7-server-rhceph-2-installer-rpms
   ```

2. Enable the Red Hat Ceph Storage 3 OSD repository:

   ```
   [root@osd ~]# subscription-manager repos --enable=rhel-7-server-
   rhceph-3-osd-rpms
   ```

3. As **root**, stop any running OSD process:

   **Syntax**

   ```
   # service ceph stop <daemon_type>.<osd_id>
   ```

   **Example**

   ```
   # service ceph stop osd.0
   ```

4. As **root**, update the **ceph-osd** package:

   ```
   # yum update ceph-osd
   ```

5. As **root**, update the owner and group permissions on the newly created directory and files:

   **Syntax**

   ```
   # chown -R <owner>:<group> <path_to_directory>
   ```

   **Example**

   ```
   # chown -R ceph:ceph /var/lib/ceph/osd
   # chown -R ceph:ceph /var/log/ceph
   # chown -R ceph:ceph /var/run/ceph
   # chown -R ceph:ceph /etc/ceph
   ```

**NOTE**

Using the following **find** command might quicken the process of changing ownership by using the **chown** command in parallel on a Ceph storage cluster with a large number of disks:

```
# find /var/lib/ceph/osd -maxdepth 1 -mindepth 1 -print |
xargs -P12 -n1 chown -R ceph:ceph
```

6. If SELinux is set to enforcing or permissive mode, then set a relabelling of the SELinux context on files for the next reboot:

```
# touch /.autorelabel
```

**WARNING**

Relabeling will take a long time to complete, because SELinux must traverse every file system and fix any mislabeled files. To exclude directories from being relabelled, add the directory to the **/etc/selinux/fixfiles_exclude_dirs** file before rebooting.

**NOTE**

In environments with large number of objects per placement group (PG), the directory enumeration speed will decrease, causing a negative impact to performance. This is caused by the addition of xattr queries which verifies the SELinux context. Setting the context at mount time removes the xattr queries for context and helps overall disk performance, especially on slower disks.

Add the following line to the **[osd]** section in the **/etc/ceph/ceph.conf** file:

+

```
osd_mount_options_xfs=rw,noatime,inode64,context="system_
u:object_r:ceph_var_lib_t:s0"
```

7. As **root**, replay device events from the kernel:

```
# udevadm trigger
```

8. As **root**, enable the **ceph-osd** process:

```
# systemctl enable ceph-osd.target
# systemctl enable ceph-osd@<osd_id>
```

9. As **root**, reboot the OSD node:

```
# shutdown -r now
```

10. Move to the next OSD node.

**NOTE**

If the **noout** and **norebalance** flags are set, the storage cluster is in **HEALTH_WARN** state

```
$ ceph health
HEALTH_WARN noout,norebalance flag(s) set
```

Once you are done upgrading the Ceph Storage Cluster, unset the previously set OSD flags and verify the storage cluster status.

On a Monitor node, and after all OSD nodes have been upgraded, unset the **noout** and **norebalance** flags:

```
# ceph osd unset noout
# ceph osd unset norebalance
```

In addition, execute the **ceph osd require-osd-release <release>** command. This command ensures that no more OSDs with Red Hat Ceph Storage 2.3 can be added to the storage cluster. If you do not run this command, the storage status will be **HEALTH_WARN**.

```
# ceph osd require-osd-release luminous
```

### Additional Resources

- To expand the storage capacity by adding new OSDs to the storage cluster, see the *Add an OSD* section in the *Administration Guide* for Red Hat Ceph Storage 3

## Upgrading the Ceph Object Gateway Nodes

This section describes steps to upgrade a Ceph Object Gateway node to a later version.

### Prerequisites

- Red Hat recommends putting a Ceph Object Gateway behind a load balancer, such as HAProxy. If you use a load balancer, remove the Ceph Object Gateway from the load balancer once no requests are being served.

- If you use a custom name for the region pool, specified in the **rgw_region_root_pool** parameter, add the **rgw_zonegroup_root_pool** parameter to the **[global]** section of the Ceph configuration file. Set the value of **rgw_zonegroup_root_pool** to be the same as **rgw_region_root_pool**, for example:

  ```
  [global]
  rgw_zonegroup_root_pool = .us.rgw.root
  ```

### Procedure

Do the following steps on each Ceph Object Gateway node in the storage cluster. Upgrade only one node at a time.

1. If you used online repositories to install Red Hat Ceph Storage, disable the 2 repositories.

```
# subscription-manager repos --disable=rhel-7-server-rhceph-2.3-
tools-rpms --disable=rhel-7-server-rhceph-2-installer-rpms
```

2. Enable the Red Hat Ceph Storage 3 Tools repository:

```
[root@gateway ~]# subscription-manager repos --enable=rhel-7-server-
rhceph-3-tools-rpms
```

3. Stop the Ceph Object Gateway process (**ceph-radosgw**):

```
# service ceph-radosgw stop
```

4. Update the **ceph-radosgw** package:

```
# yum update ceph-radosgw
```

5. Change the owner and group permissions on the newly created **/var/lib/ceph/radosgw/** and **/var/log/ceph/** directories and their content to **ceph**.

```
# chown -R ceph:ceph /var/lib/ceph/radosgw
# chown -R ceph:ceph /var/log/ceph
```

6. If SELinux is set to run in enforcing or permissive mode, instruct it to relabel SELinux context on the next boot.

```
# touch /.autorelabel
```

**IMPORTANT**

Relabeling takes a long time to complete, because SELinux must traverse every file system and fix any mislabeled files. To exclude directories from being relabeled, add them to the **/etc/selinux/fixfiles_exclude_dirs** file before rebooting.

7. Enable the **ceph-radosgw** process.

```
# systemctl enable ceph-radosgw.target
# systemctl enable ceph-radosgw@rgw.<hostname>
```

Replace **<hostname>** with the name of the Ceph Object Gateway host, for example **gateway-node**.

```
# systemctl enable ceph-radosgw.target
# systemctl enable ceph-radosgw@rgw.gateway-node
```

8. Reboot the Ceph Object Gateway node.

```
# shutdown -r now
```

9. If you use a load balancer, add the Ceph Object Gateway node back to the load balancer.

### See Also

- The *Ceph Object Gateway Guide for Red Hat Enterprise Linux*

## Upgrading a Ceph Client Node

Ceph clients are:

- Ceph Block Devices
- OpenStack Nova compute nodes
- QEMU/KVM hypervisors
- Any custom application that uses the Ceph client-side libraries

Red Hat recommends all Ceph clients to be running the same version as the Ceph storage cluster.

### Prerequisites

- Stop all I/O requests against a Ceph client node while upgrading the packages to prevent unexpected errors to occur

### Procedure

1. If you installed Red Hat Ceph Storage 2 clients by using software repositories, disable the repositories:

```
# subscription-manager repos --disable=rhel-7-server-rhceph-2-tools-rpms --disable=rhel-7-server-rhceph-2-installer-rpms
```

**NOTE**

If an ISO-based installation was performed for Red Hat Ceph Storage 2 clients, skip this first step.

2. On the client node, enable the Red Hat Ceph Storage Tools 3 repository:

```
[root@gateway ~]# subscription-manager repos --enable=rhel-7-server-rhceph-3-tools-rpms
```

3. On the client node, update the **ceph-common** package:

```
# yum update ceph-common
```

Restart any application that depends on the Ceph client-side libraries after upgrading the **ceph-common** package.

**NOTE**

If you are upgrading OpenStack Nova compute nodes that have running QEMU/KVM instances or use a dedicated QEMU/KVM client, stop and start the QEMU/KVM instance because restarting the instance does not work in this case.

# APPENDIX H. CHANGES IN ANSIBLE VARIABLES BETWEEN VERSION 2 AND 3

With Red Hat Ceph Storage 3, certain variables in the configuration files located in the **/usr/share/ceph-ansible/group_vars/** directory have changed or have been removed. The following table lists all the changes. After upgrading to version 3, copy the **all.yml.sample** and **osds.yml.sample** files again to reflect these changes. See Chapter 4, *Upgrading a Red Hat Ceph Storage Cluster* for details.

| Old Option | New Option | File |
|---|---|---|
| **ceph_rhcs_cdn_install** | **ceph_repository_type: cdn** | **all.yml** |
| **ceph_rhcs_iso_install** | **ceph_repository_type: iso** | **all.yml** |
| **ceph_rhcs** | **ceph_origin: repository** and **ceph_repository: rhcs** (enabled by default) | **all.yml** |
| **journal_collocation** | **osd_scenario: collocated** | **osds.yml** |
| **raw_multi_journal** | **osd_scenario: non-collocated** | **osds.yml** |
| **raw_journal_devices** | **dedicated_devices** | **osds.yml** |
| **dmcrytpt_journal_collocation** | **dmcrypt: true** + **osd_scenario: collocated** | **osds.yml** |
| **dmcrypt_dedicated_journal** | **dmcrypt: true** + **osd_scenario: non-collocated** | **osds.yml** |

# APPENDIX I. IMPORTING AN EXISTING CEPH CLUSTER TO ANSIBLE

You can configure Ansible to use a cluster deployed without Ansible. For example, if you upgraded Red Hat Ceph Storage 1.3 clusters to version 2 manually, configure them to use Ansible by following this procedure:

1. After manually upgrading from version 1.3 to version 2, install and configure Ansible on the administration node.

2. Ensure that the Ansible administration node has passwordless **ssh** access to all Ceph nodes in the cluster. See Section 2.11, “Enabling Password-less SSH for Ansible” for more details.

3. As **root**, create a symbolic link to the Ansible **group_vars** directory in the **/etc/ansible/** directory:

```
# ln -s /usr/share/ceph-ansible/group_vars /etc/ansible/group_vars
```

4. As **root**, create an **all.yml** file from the **all.yml.sample** file and open it for editing:

```
# cd /etc/ansible/group_vars
# cp all.yml.sample all.yml
# vim all.yml
```

5. Set the **generate_fsid** setting to **false** in **group_vars/all.yml**.

6. Get the current cluster **fsid** by executing **ceph fsid**.

7. Set the retrieved **fsid** in **group_vars/all.yml**.

8. Modify the Ansible inventory in **/etc/ansible/hosts** to include Ceph hosts. Add monitors under a **[mons]** section, OSDs under an **[osds]** section and gateways under an **[rgws]** section to identify their roles to Ansible.

9. Make sure **ceph_conf_overrides** is updated with the original **ceph.conf** options used for **[global]**, **[osd]**, **[mon]**, and **[client]** sections in the **all.yml** file.
   Options like **osd journal**, **public_network** and **cluster_network** should not be added in **ceph_conf_overrides** because they are already part of **all.yml**. Only the options that are not part of **all.yml** and are in the original **ceph.conf** should be added to **ceph_conf_overrides**.

10. From the **/usr/share/ceph-ansible/** directory run the playbook.

```
# cd /usr/share/ceph-ansible/
# cp infrastructure-playbooks/take-over-existing-cluster.yml .
$ ansible-playbook take-over-existing-cluster.yml -u <username>
```

# APPENDIX J. PURGING A CEPH CLUSTER BY USING ANSIBLE

If you deployed a Ceph cluster using Ansible and you want to purge the cluster, then use the **purge-cluster.yml** Ansible playbook located in the **infrastructure-playbooks** directory.

**IMPORTANT**

Purging a Ceph cluster will lose data stored on the cluster's OSDs.

### Before purging the Ceph cluster…

Check the **osd_auto_discovery** option in the **osds.yml** file. Having this option set to **true** will cause the purge to fail. To prevent the failure, do the following steps before running the purge:

1. Declare the OSD devices in the **osds.yml** file. See Section 3.2, "Installing a Red Hat Ceph Storage Cluster" for more details.
2. Comment out the **osd_auto_discovery** option in the **osds.yml** file.

**To purge the Ceph cluster…**

1. As **root**, navigate to the **/usr/share/ceph-ansible/** directory:

```
# cd /usr/share/ceph-ansible
```

2. As **root**, copy the **purge-cluster.yml** Ansible playbook to the current directory:

```
# cp infrastructure-playbooks/purge-cluster.yml .
```

3. Run the **purge-cluster.yml** Ansible playbook:

```
$ ansible-playbook purge-cluster.yml
```