Red Hat Ceph Storage 1.2.3 Ceph Configuration Guide

Configuration settings for Ceph Storage.

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Abstract

This document provides instructions for configuring Ceph at boot time and run time. It also provides Ceph configuration reference information.

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CHAPTER 1. CEPH CONFIGURATION REFERENCE

All Ceph clusters have a configuration, which defines:

- Cluster Identity
- Authentication settings
- Ceph daemon membership in the cluster
- Network configuration
- Host names and addresses
- Paths to keyrings
- Paths to data (including journals)
- Other runtime options

A deployment tool such as **`ceph-deploy`** will typically create an initial Ceph configuration file for you. However, you can create one yourself if you prefer to bootstrap a cluster without using a deployment tool.

For your convenience, each daemon has a series of default values (i.e., many are set by **`ceph/src/common/config_opts.h`**). You may override these settings with a Ceph configuration file or at runtime via the monitor **`tell`** command or connecting directly to a daemon socket on a Ceph host.

1. GENERAL RECOMMENDATIONS

You may maintain a Ceph configuration file anywhere you like, but we recommend having an admin node where you maintain a master copy of the Ceph configuration file. When you make changes to your Ceph configuration file, it is a good practice to push the updated configuration file to your Ceph nodes to maintain consistency.

```
ceph-deploy --overwrite-conf config push {node1}[, {node2}, ...]
```

If your Ceph nodes have a more recent copy, you can simply pull the Ceph configuration file to your admin node.

```
ceph-deploy --overwrite-conf config pull {node}
```

The commands in this reference assume you have an admin keyring. You will need to change the permissions to enable the current user or use **sudo** with the **`ceph`** command to access that **`ceph.client.admin.keyring`**.

2. CONFIGURATION FILE STRUCTURE

The Ceph configuration file configures Ceph daemons at start time—overriding default values. Ceph configuration files use an *ini* style syntax. You can add comments by preceding comments with a pound sign (#) or a semi-colon (;). For example:

```
# <--A number (#) sign precedes a comment.
; A comment may be anything.
```

```
# Comments always follow a semi-colon (;) or a pound (#) on each line.
# The end of the line terminates a comment.
# We recommend that you provide comments in your configuration file(s).
```

The configuration file can configure all Ceph daemons in a Ceph Storage Cluster or all Ceph daemons of a particular type at start time. To configure a series of daemons, the settings must be included under the processes that will receive the configuration as follows:

[global]

Description

Settings under **[global]** affect all daemons in a Ceph Storage Cluster.

Example

```
auth supported = cephx
```

[osd]

Description

Settings under **[osd]** affect all **ceph-osd** daemons in the Ceph Storage Cluster, and override the same setting in **[global]**.

Example

```
osd journal size = 1000
```

[mon]

Description

Settings under **[mon]** affect all **ceph-mon** daemons in the Ceph Storage Cluster, and override the same setting in **[global]**.

Example

```
mon addr = 10.0.0.101:6789
```

[client]

Description

Settings under **[client]** affect all Ceph Clients (e.g., mounted Ceph Block Devices, Ceph Object Gateways, etc.).

Example

```
log file = /var/log/ceph/radosgw.log
```

Global settings affect all instances of all daemon in the Ceph Storage Cluster. Use the **[global]** setting for values that are common for all daemons in the Ceph Storage Cluster. You can override each **[global]** setting by:

1. Changing the setting in a particular process type (*e.g.,* **[osd]**, **[mon]**).

2. Changing the setting in a particular process (*e.g.,* **[osd.1]**).

Overriding a global setting affects all child processes, except those that you specifically override in a particular daemon.

A typical global setting involves activating authentication. For example:

```
[global]
#Enable authentication between hosts within the cluster.
auth cluster required = cephx
auth service required = cephx
auth client required = cephx
```

You can specify settings that apply to a particular type of daemon. When you specify settings under **[osd]** or **[mon]** without specifying a particular instance, the setting will apply to all OSD or monitor daemons respectively.

A typical daemon-wide setting involves setting journal sizes, filestore settings, etc. For example:

```
[osd]
osd journal size = 1000
```

You may specify settings for particular instances of a daemon. You may specify an instance by entering its type, delimited by a period (.) and by the instance ID. The instance ID for a Ceph OSD Daemon is always numeric, but it may be alphanumeric for Ceph Monitors.

```
[osd.1]
# settings affect osd.1 only.

[mon.a]
# settings affect mon.a only.
```

The default Ceph configuration file locations in sequential order include:

1. **$CEPH_CONF** (*i.e.,* the path following the **$CEPH_CONF** environment variable)
2. **-c path/path** (*i.e.,* the **-c** command line argument)
3. **/etc/ceph/ceph.conf**
4. **~/.ceph/config**
5. **./ceph.conf** (*i.e.,* in the current working directory)

A typical Ceph configuration file has at least the following settings:

```
[global]
fsid = {cluster-id}
mon initial members = {hostname}[, {hostname}]
mon host = {ip-address}[, {ip-address}]

#All clusters have a front-side public network.
#If you have two NICs, you can configure a back side cluster
#network for OSD object replication, heart beats, backfilling,
#recovery, etc.
public network = {network}[, {network}]
```

```
#cluster network = {network}[, {network}]

#Clusters require authentication by default.
auth cluster required = cephx
auth service required = cephx
auth client required = cephx

#Choose reasonable numbers for your journals, number of replicas
#and placement groups.
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}

#Choose a reasonable crush leaf type.
#0 for a 1-node cluster.
#1 for a multi node cluster in a single rack
#2 for a multi node, multi chassis cluster with multiple hosts in a
chassis
#3 for a multi node cluster with hosts across racks, etc.
osd crush chooseleaf type = {n}
```

3. METAVARIABLES

Metavariables simplify Ceph Storage Cluster configuration dramatically. When a metavariable is set in a configuration value, Ceph expands the metavariable into a concrete value. Metavariables are very powerful when used within the **[global]**, **[osd]**, **[mon]** or **[client]** sections of your configuration file; however, you may also use them with the admin socket. Ceph metavariables are similar to Bash shell expansion.

Ceph supports the following metavariables:

$cluster

Description

Expands to the Ceph Storage Cluster name. Useful when running multiple Ceph Storage Clusters on the same hardware.

Example

/etc/ceph/$cluster.keyring

Default

ceph

$type

Description

Expands to one of **osd** or **mon**, depending on the type of the instant daemon.

Example

`/var/lib/ceph/$type`

$id

Description

Expands to the daemon identifier. For **`osd.0`**, this would be **`0`**.

Example

`/var/lib/ceph/$type/$cluster-$id`

$host

Description

Expands to the host name of the instant daemon.

$name

Description

Expands to **`$type.$id`**.

Example

`/var/run/ceph/$cluster-$name.asok`

4. VIEWING THE CEPH RUNTIME CONFIGURATION

To view a runtime configuration, log in to a Ceph node and execute:

```
ceph daemon {daemon-type}.{id} config show
```

For example, if you want to see the configuration for **`osd.0`**, log into the node containing **`osd.0`** and execute:

```
ceph daemon osd.0 config show
```

For additional options, specify a daemon and **`help`**. For example:

```
ceph daemon osd.0 help
```

5. GET A SPECIFIC CONFIG SETTING AT RUNTIME

To get a specific configuration setting at runtime, log in to a Ceph node and execute:

```
ceph daemon {daemon-type}.{id} config get {parameter}
```

For example to retrieve the public address of OSD 0, execute:

```
ceph daemon osd.0 config get public_addr
```

6. SET A SPECIFIC CONFIG SETTING AT RUNTIME

There are two general ways to set a runtime configuration:

- Via the Ceph monitor
- Via the admin socket

You can set a Ceph runtime configuration setting by contacting the monitor using the **`tell`** and **`injectargs`** command. To use this approach, your monitors and the daemon you are trying to modify must be running.

```
ceph tell {daemon-type}.{daemon id or *} injectargs --{name} {value} [--{name} {value}]
```

Replace **`{daemon-type}`** with one of **`osd`** or **`mon`**. You may apply the runtime setting to all daemons of a particular type with **`*`**, or specify a specific daemon's ID (i.e., its number or name). For example, to change the debug logging for a **`ceph-osd`** daemon named **`osd.0`** to **`0/5`**, execute the following:

```
ceph tell osd.0 injectargs '--debug-osd 0/5'
```

The **`tell`** command takes multiple arguments, so each argument for **`tell`** should be within single quotes, and the configuration prepended with two dashes (**`'--{config_opt} {opt-val}' ['--{config_opt} {opt-val}']`**). Quotes are not necessary for the **`daemon`** command, because it only takes one argument.

The **`ceph tell`** command goes through the monitors. If you cannot bind to the monitor, you can still make the change by logging into the host of the daemon whose configuration you'd like to change using **`ceph daemon`**. For example:

```
sudo ceph osd.0 config set debug_osd 0/5
```

CHAPTER 2. GENERAL CONFIG REFERENCE

fsid

Description

The filesystem ID. One per cluster.

Type

UUID

Required

No.

Default

N/A. Usually generated by deployment tools.

admin_socket

Description

The socket for executing administrative commands on a daemon, irrespective of whether Ceph monitors have established a quorum.

Type

String

Required

No

Default

`/var/run/ceph/$cluster-$name.asok`

pid_file

Description

The file in which the monitor or OSD will write its PID. For instance, `/var/run/$cluster/$type.$id.pid` will create /var/run/ceph/mon.a.pid for the `mon` with id `a` running in the `ceph` cluster. The `pid file` is removed when the daemon stops gracefully. If the process is not daemonized (i.e. runs with the `-f` or `-d` option), the `pid file` is not created.

Type

String

Required

No

Default

No

chdir

Description

The directory Ceph daemons change to once they are up and running. Default `/` directory recommended.

Type

String

Required

No

Default

`/`

max_open_files

Description

If set, when the Red Hat Ceph Storage cluster starts, Ceph sets the **`max_open_fds`** at the OS level (i.e., the max # of file descriptors). It helps prevents Ceph OSDs from running out of file descriptors.

Type

64-bit Integer

Required

No

Default

`0`

fatal_signal_handlers

Description

If set, we will install signal handlers for SEGV, ABRT, BUS, ILL, FPE, XCPU, XFSZ, SYS signals to generate a useful log message.

Type

Boolean

Default

`true`

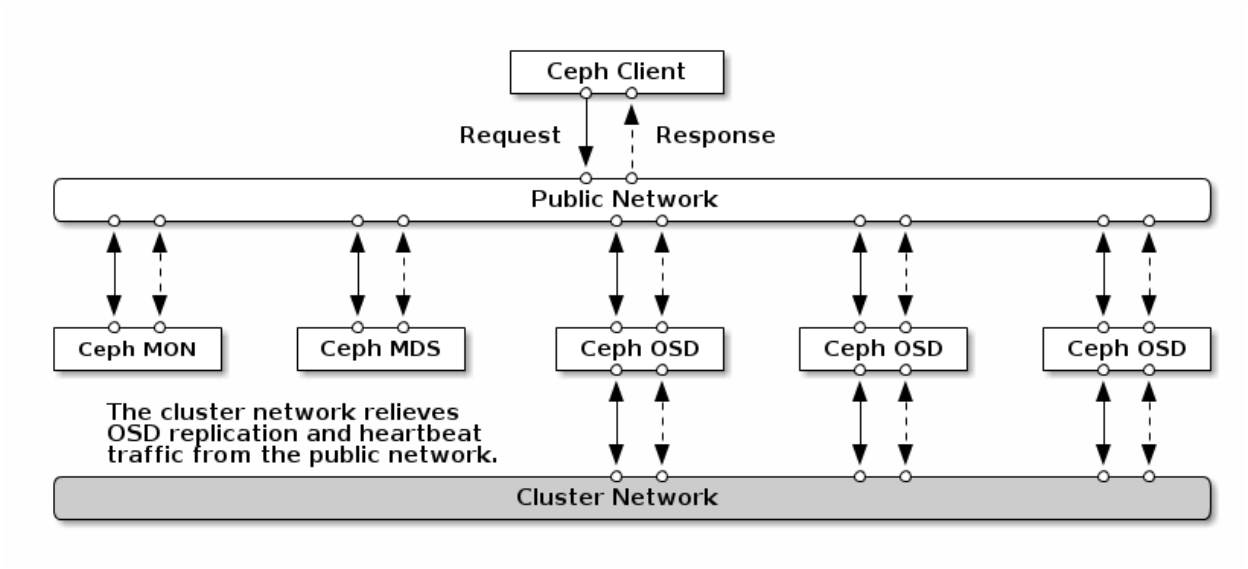
1. NETWORK CONFIGURATION REFERENCE

Network configuration is critical for building a high performance Red Hat Ceph Storage cluster. The Ceph storage cluster does not perform request routing or dispatching on behalf of the Ceph client. Instead, Ceph clients make requests directly to Ceph OSD daemons. Ceph OSDs perform data

replication on behalf of Ceph clients, which means replication and other factors impose additional loads on the networks of Ceph storage clusters.

All Ceph clusters must use a "public" (front-side) network. However, unless you specify a "cluster" (back-side) network, Ceph assumes a single "public" network. Ceph functions just fine with a public network only, but you may see significant performance improvement with a second "cluster" network in a large cluster.

We recommend running a Ceph storage cluster with two networks: a public (front-side) network and a cluster (back-side) network. To support two networks, each Ceph Node will need to have more than one NIC.



There are several reasons to consider operating two separate networks:

1. **Performance:** Ceph OSDs handle data replication for the Ceph clients. When Ceph OSDs replicate data more than once, the network load between Ceph OSDs easily dwarfs the network load between Ceph clients and the Ceph storage cluster. This can introduce latency and create a performance problem. Recovery and re-balancing can also introduce significant latency on the public network.
2. **Security**: While most people are generally civil, some actors will engage in what's known as a Denial of Service (DoS) attack. When traffic between Ceph OSDs gets disrupted, peering may fail and placement groups may no longer reflect an **`active + clean`** state, which may prevent users from reading and writing data. A great way to defeat this type of attack is to maintain a completely separate cluster network that doesn't connect directly to the internet.

1.1. IP Tables

By default, daemons bind to ports within the **`6800:7100`** range. You may configure this range at your discretion. Before configuring your IP tables, check the default **`iptables`** configuration. You may configure this range at your discretion.

```
sudo iptables -L
```

For **`firewall.d`**, execute:

```
sudo firewall-cmd --list-all-zones
```

Some Linux distributions include rules that reject all inbound requests except SSH from all network interfaces. For example:

```
REJECT all -- anywhere anywhere reject-with icmp-host-prohibited
```

You may need to modify or delete these rules on both your public and cluster networks initially, and replace them with appropriate rules when you are ready to harden the ports on your Ceph Nodes.

1.1.1. Monitor IP Tables

Ceph Monitors listen on port **6789** by default. Additionally, Ceph Monitors always operate on the public network. When you add the rule using the example below, make sure you replace **<iface>** with the public network interface (e.g., **eth0**, **eth1**, etc.), **<ip-address>** with the IP address of the public network and **<netmask>** with the netmask for the public network.

```
sudo iptables -A INPUT -i <iface> -p tcp -s <ip-address>/<netmask> --
dport 6789 -j ACCEPT
```

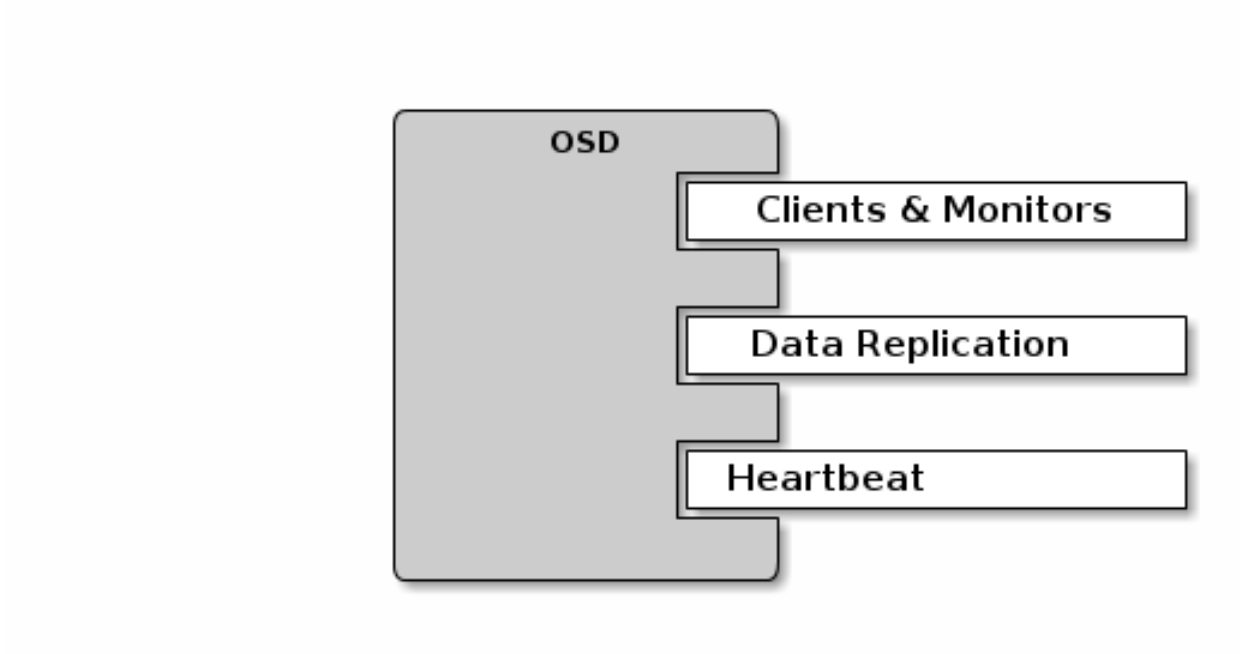
For **firewall.d**, execute:

```
sudo firewall-cmd --zone=public --add-port=6789/tcp --permanent
```

1.1.2. OSD IP Tables

By default, Ceph OSDs bind to the first available ports on a Ceph node beginning at port 6800. Ensure that you open at least three ports beginning at port 6800 for each OSD that runs on the host:

1. One for talking to clients and monitors.
2. One for sending data to other OSDs.
3. One for heartbeating.



Ports are node-specific, so you don't need to open any more ports than the number of ports needed by Ceph daemons running on that Ceph Node. You may consider opening a few additional ports in case a daemon fails and restarts without letting go of the port such that the restarted daemon binds to a new port.

If you set up separate public and cluster networks, you must add rules for both the public network and the cluster network, because clients will connect using the public network and other Ceph OSD Daemons will connect using the cluster network. When you add the rule using the example below, make sure you replace **<iface>** with the network interface (e.g., **eth0**, **eth1**, etc.), **<ip-address>** with the IP address and **<netmask>** with the netmask of the public or cluster network. For example:

```
sudo iptables -A INPUT -i <iface>  -m multiport -p tcp -s <ip-
address>/<netmask> --dports 6800:6810 -j ACCEPT
```

For **firewall.d**, execute:

```
sudo firewall-cmd --zone=public --add-port=6800-6810/tcp --permanent
```

If you put your cluster network into another zone, open the ports within that zone as appropriate.

1.2. Ceph Networks

To configure Ceph networks, you must add a network configuration to the **[global]** section of the configuration file. Ceph functions just fine with a public network only. However, Ceph allows you to establish much more specific criteria, including multiple IP network and subnet masks for your public network. You can also establish a separate cluster network to handle OSD heartbeat, object replication and recovery traffic. Don't confuse the IP addresses you set in your configuration with the public-facing IP addresses network clients may use to access your service. Typical internal IP networks are often **192.168.0.0** or **10.0.0.0**.

Tip

If you specify more than one IP address and subnet mask for either the public or the cluster network, the subnets within the network must be capable of routing to each other. Additionally, make sure you include each IP address/subnet in your IP tables and open ports for them as necessary.

Note

Ceph uses CIDR notation for subnets (e.g., **10.0.0.0/24**).

When you've configured your networks, you may restart your cluster or restart each daemon. Ceph daemons bind dynamically, so you do not have to restart the entire cluster at once if you change your network configuration.

1.2.1. Public Network

To configure a public network, add the following option to the **[global]** section of your Ceph configuration file.

```
[global]
    ...
    public network = <public-network/netmask>
```

1.2.2. Cluster Network

If you declare a cluster network, OSDs will route heartbeat, object replication and recovery traffic over the cluster network. This may improve performance compared to using a single network. To configure a cluster network, add the following option to the **`[global]`** section of your Ceph configuration file.

```
[global]
    ...
    cluster network = <cluster-network/netmask>
```

We prefer that the cluster network is **NOT** reachable from the public network or the Internet for added security.

1.3. Ceph Daemons

Ceph has one network configuration requirement that applies to all daemons: the Ceph configuration file **MUST** specify the **`host`** for each daemon. Ceph also requires that a Ceph configuration file specify the monitor IP address and its port.

Important

Some deployment tools (e.g., **`ceph-deploy`**, Chef) may create a configuration file for you. **DO NOT** set these values if the deployment tool does it for you.

Tip

The **`host`** setting is the short name of the host (i.e., not an fqdn). It is**NOT** an IP address either. Enter **`hostname -s`** on the command line to retrieve the name of the host.

```
[mon.a]

    host = <hostname>
    mon addr = <ip-address>:6789

[osd.0]
    host = <hostname>
```

You do not have to set the host IP address for a daemon. If you have a static IP configuration and both public and cluster networks running, the Ceph configuration file may specify the IP address of the host for each daemon. To set a static IP address for a daemon, the following option(s) should appear in the daemon instance sections of your **`ceph.conf`** file.

```
[osd.0]
    public addr = <host-public-ip-address>
    cluster addr = <host-cluster-ip-address>
```

One NIC OSD in a Two Network Cluster

Generally, we do not recommend deploying an OSD host with a single NIC in a cluster with two networks. However, you may accomplish this by forcing the OSD host to operate on the public network by adding a **`public addr`** entry to the **`[osd.n]`** section of the Ceph configuration file, where **n** refers to the number of the OSD with one NIC. Additionally, the public network and cluster network must be able to route traffic to each other, which we don't recommend for security reasons.

1.4. Network Config Settings

Network configuration settings are not required. Ceph assumes a public network with all hosts operating on it unless you specifically configure a cluster network.

1.4.1. Public Network

The public network configuration allows you specifically define IP addresses and subnets for the public network. You may specifically assign static IP addresses or override **`public network`** settings using the **`public addr`** setting for a specific daemon.

public network

Description

The IP address and netmask of the public (front-side) network (e.g., **`192.168.0.0/24`**). Set in **`[global]`**. You may specify comma-delimited subnets.

Type

`<ip-address>/<netmask> [, <ip-address>/<netmask>]`

Required

No

Default

N/A

public addr

Description

The IP address for the public (front-side) network. Set for each daemon.

Type

IP Address

Required

No

Default

N/A

1.4.2. Cluster Network

The cluster network configuration allows you to declare a cluster network, and specifically define IP addresses and subnets for the cluster network. You may specifically assign static IP addresses or override **`cluster network`** settings using the **`cluster addr`** setting for specific OSD daemons.

cluster network

Description

The IP address and netmask of the cluster (back-side) network (e.g., **`10.0.0.0/24`**). Set in **`[global]`**. You may specify comma-delimited subnets.

Type

`<ip-address>/<netmask> [, <ip-address>/<netmask>]`

Required

No

Default

N/A

cluster addr

Description

The IP address for the cluster (back-side) network. Set for each daemon.

Type

Address

Required

No

Default

N/A

1.4.3. Bind

Bind settings set the default port ranges Ceph OSD daemons use. The default range is **`6800:7100`**. Ensure that your firewall configuration allows you to use the configured port range.

You may also enable Ceph daemons to bind to IPv6 addresses.

ms bind port min

Description

The minimum port number to which an OSD daemon will bind.

Type

32-bit Integer

Default

`6800`

Required

No

ms bind port max

Description

The maximum port number to which an OSD daemon will bind.

Type

32-bit Integer

Default

`7100`

Required

No.

ms bind ipv6

Description

Enables Ceph daemons to bind to IPv6 addresses.

Type

Boolean

Default

`false`

Required

No

1.4.4. Hosts

Ceph expects at least one monitor declared in the Ceph configuration file, with a **`mon addr`** setting under each declared monitor. Ceph expects a **`host`** setting under each declared monitor, metadata server and OSD in the Ceph configuration file.

mon addr

Description

A list of **`<hostname>:<port>`** entries that clients can use to connect to a Ceph monitor. If not set, Ceph searches **`[mon.*]`** sections.

Type

String

Required

No

Default

N/A

host

Description

The hostname. Use this setting for specific daemon instances (e.g., **`[osd.0]`**).

Type

String

Required

Yes, for daemon instances.

Default

`localhost`

Tip

Do not use **`localhost`**. To get your host name, execute **`hostname -s`** on your command line and use the name of your host (to the first period, not the fully-qualified domain name).

Important

You should not specify any value for **`host`** when using a third party deployment system that retrieves the host name for you.

1.4.5. TCP

Ceph disables TCP buffering by default.

tcp nodelay

Description

Ceph enables **`tcp nodelay`** so that each request is sent immediately (no buffering). Disabling Nagle's algorithm increases network traffic, which can introduce latency. If you experience large numbers of small packets, you may try disabling **`tcp nodelay`**.

Type

Boolean

Required

No

Default

`true`

tcp rcvbuf

Description

The size of the socket buffer on the receiving end of a network connection. Disable by default.

Type

32-bit Integer

Required

No

Default

`0`

ms tcp read timeout

Description

If a client or daemon makes a request to another Ceph daemon and does not drop an unused connection, the **`tcp read timeout`** defines the connection as idle after the specified number of seconds.

Type

Unsigned 64-bit Integer

Required

No

Default

`900` 15 minutes.

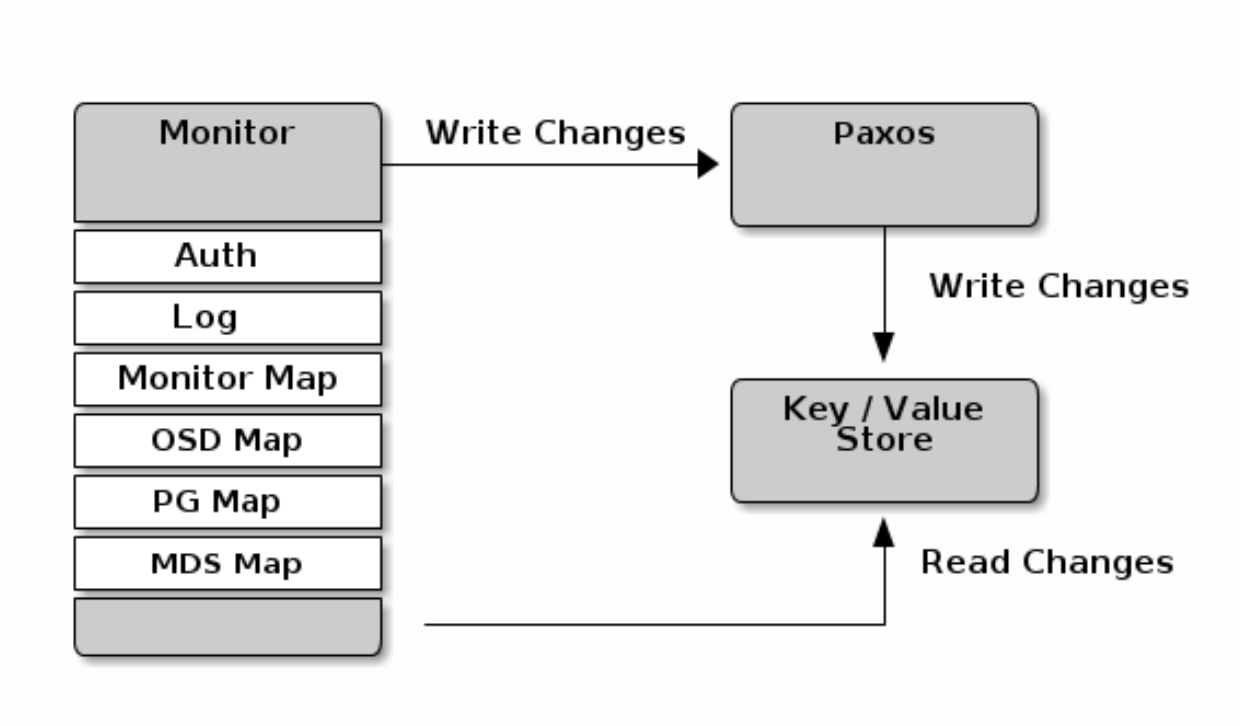
CHAPTER 3. MONITOR CONFIG REFERENCE

Understanding how to configure a Ceph monitor is an important part of building a reliable Red Hat Ceph Storage cluster. **All clusters have at least one monitor**. A monitor configuration usually remains fairly consistent, but you can add, remove or replace a monitor in a cluster.

1. BACKGROUND

Ceph monitors maintain a "master copy" of the cluster map, which means a Ceph client can determine the location of all Ceph monitors and Ceph OSDs just by connecting to one Ceph monitor and retrieving a current cluster map. Before Ceph clients can read from or write to Ceph OSDs, they must connect to a Ceph monitor first. With a current copy of the cluster map and the CRUSH algorithm, a Ceph client can compute the location for any object. The ability to compute object locations allows a Ceph client to talk directly to Ceph OSDs, which is a very important aspect of Ceph's high scalability and performance.

The primary role of the Ceph monitor is to maintain a master copy of the cluster map. Ceph monitors also provide authentication and logging services. Ceph monitors write all changes in the monitor services to a single Paxos instance, and Paxos writes the changes to a key/value store for strong consistency. Ceph monitors can query the most recent version of the cluster map during sync operations. Ceph monitors leverage the key/value store's snapshots and iterators (using leveldb) to perform store-wide synchronization.



1.1. Cluster Maps

The cluster map is a composite of maps, including the monitor map, the OSD map, and the placement group map. The cluster map tracks a number of important things: which processes are **`in`** the Red Hat Ceph Storage cluster; which processes that are **`in`** the Red Hat Ceph Storage cluster are **`up`** and running or **`down`**; whether, the placement groups are **`active`** or **`inactive`**, and **`clean`** or in some other state; and, other details that reflect the current state of the cluster such as the total amount of storage space, and the amount of storage used.

When there is a significant change in the state of the cluster—e.g., a Ceph OSD goes down, a placement group falls into a degraded state, etc.--the cluster map gets updated to reflect the current state of the cluster. Additionally, the Ceph monitor also maintains a history of the prior states of the cluster. The monitor map, OSD map and placement group map each maintain a history of their map versions. We call each version an "epoch."

When operating your Red Hat Ceph Storage cluster, keeping track of these states is an important part of your system administration duties.

1.2. Monitor Quorum

A cluster will run fine with a single monitor; however, **a single monitor is a single-point-of-failure**. To ensure high availability in a production Ceph Storage cluster, you should run Ceph with multiple monitors so that the failure of a single monitor **WILL NOT** bring down your entire cluster.

When a Ceph Storage cluster runs multiple Ceph monitors for high availability, Ceph monitors use Paxos to establish consensus about the master cluster map. A consensus requires a majority of monitors running to establish a quorum for consensus about the cluster map (e.g., 1; 2 out of 3; 3 out of 5; 4 out of 6; etc.).

1.3. Consistency

When you add monitor settings to your Ceph configuration file, you need to be aware of some of the architectural aspects of Ceph monitors. **Ceph imposes strict consistency requirements** for a Ceph monitor when discovering another Ceph monitor within the cluster. Whereas, Ceph Clients and other Ceph daemons use the Ceph configuration file to discover monitors, monitors discover each other using the monitor map (monmap), not the Ceph configuration file.

A Ceph monitor always refers to the local copy of the monmap when discovering other Ceph monitors in the Red Hat Ceph Storage cluster. Using the monmap instead of the Ceph configuration file avoids errors that could break the cluster (e.g., typos in **`ceph.conf`** when specifying a monitor address or port). Since monitors use monmaps for discovery and they share monmaps with clients and other Ceph daemons, **the monmap provides monitors with a strict guarantee that their consensus is valid.**

Strict consistency also applies to updates to the monmap. As with any other updates on the Ceph monitor, changes to the monmap always run through a distributed consensus algorithm called Paxos. The Ceph Monitors must agree on each update to the monmap, such as adding or removing a Ceph monitor, to ensure that each monitor in the quorum has the same version of the monmap. Updates to the monmap are incremental so that Ceph monitors have the latest agreed upon version, and a set of previous versions. Maintaining a history enables a Ceph monitor that has an older version of the monmap to catch up with the current state of the Red Hat Ceph Storage cluster.

If Ceph monitors discovered each other through the Ceph configuration file instead of through the monmap, it would introduce additional risks because the Ceph configuration files aren’t updated and distributed automatically. Ceph monitors might inadvertently use an older Ceph configuration file, fail to recognize a Ceph monitor, fall out of a quorum, or develop a situation where Paxos isn’t able to determine the current state of the system accurately.

1.4. Bootstrapping Monitors

In most configuration and deployment cases, tools that deploy Ceph may help bootstrap the Ceph monitors by generating a monitor map for you (e.g., **`ceph-deploy`**, etc). A Ceph monitor requires a few explicit settings:

- **Filesystem ID**: The **fsid** is the unique identifier for your object store. Since you can run multiple clusters on the same hardware, you must specify the unique ID of the object store when bootstrapping a monitor. Deployment tools usually do this for you (e.g., **ceph-deploy** can call a tool like **uuidgen**), but you may specify the **fsid** manually too.
- **Monitor ID**: A monitor ID is a unique ID assigned to each monitor within the cluster. It is an alphanumeric value, and by convention the identifier usually follows an alphabetical increment (e.g., **a**, **b**, etc.). This can be set in a Ceph configuration file (e.g., **[mon.a]**, **[mon.b]**, etc.), by a deployment tool, or using the **ceph** commandline.
- **Keys**: The monitor must have secret keys. A deployment tool such as **ceph-deploy** usually does this for you, but you may perform this step manually too.

2. CONFIGURING MONITORS

To apply configuration settings to the entire cluster, enter the configuration settings under **[global]**. To apply configuration settings to all monitors in your cluster, enter the configuration settings under **[mon]**. To apply configuration settings to specific monitors, specify the monitor instance (e.g., **[mon.a]**). By convention, monitor instance names use alpha notation.

```
[global]

[mon]

[mon.a]

[mon.b]

[mon.c]
```

2.1. Minimum Configuration

The bare minimum monitor settings for a Ceph monitor via the Ceph configuration file include a hostname and a monitor address for each monitor. You can configure these under **[mon]** or under the entry for a specific monitor.

```
[mon]
mon_host = hostname1,hostname2,hostname3
mon_addr = 10.0.0.10:6789,10.0.0.11:6789,10.0.0.12:6789
```

```
[mon.a]
host = hostname1
mon_addr = 10.0.0.10:6789
```

Note

This minimum configuration for monitors assumes that a deployment tool generates the **fsid** and the **mon.** key for you.

Once you deploy a Ceph cluster, you **SHOULD NOT** change the IP address of the monitors.

2.2. Cluster ID

Each Red Hat Ceph Storage cluster has a unique identifier (**`fsid`**). If specified, it usually appears under the **`[global]`** section of the configuration file. Deployment tools usually generate the **`fsid`** and store it in the monitor map, so the value may not appear in a configuration file. The **`fsid`** makes it possible to run daemons for multiple clusters on the same hardware.

fsid

Description

The cluster ID. One per cluster.

Type

UUID

Required

Yes.

Default

N/A. May be generated by a deployment tool if not specified.

Note

Do not set this value if you use a deployment tool that does it for you.

2.3. Initial Members

We recommend running a production Red Hat Ceph Storage cluster with at least three Ceph monitors to ensure high availability. When you run multiple monitors, you may specify the initial monitors that must be members of the cluster in order to establish a quorum. This may reduce the time it takes for your cluster to come online.

```
[mon]
mon_initial_members = a,b,c
```

mon_initial_members

Description

The IDs of initial monitors in a cluster during startup. If specified, Ceph requires an odd number of monitors to form an initial quorum (e.g., 3).

Type

String

Default

None

Note

A *majority* of monitors in your cluster must be able to reach each other in order to establish a quorum. You can decrease the initial number of monitors to establish a quorum with this setting.

2.4. Data

Ceph provides a default path where Ceph monitors store data. For optimal performance in a production Red Hat Ceph Storage cluster, we recommend running Ceph monitors on separate hosts and drives from Ceph OSDs. Ceph Monitors do lots of **`fsync()`**, which can interfere with Ceph OSD workloads.

Ceph monitors store their data as key/value pairs. Using a data store prevents recovering Ceph monitors from running corrupted versions through Paxos, and it enables multiple modification operations in one single atomic batch, among other advantages.

Generally, we do not recommend changing the default data location. If you modify the default location, we recommend that you make it uniform across Ceph monitors by setting it in the **`[mon]`** section of the configuration file.

mon_data

Description

The monitor's data location.

Type

String

Default

`/var/lib/ceph/mon/$cluster-$id`

2.5. Storage Capacity

When a Red Hat Ceph Storage cluster gets close to its maximum capacity (i.e., **`mon_osd_full_ratio`**), Ceph prevents you from writing to or reading from Ceph OSDs as a safety measure to prevent data loss. Therefore, letting a production Red Hat Ceph Storage cluster approach its full ratio is not a good practice, because it sacrifices high availability. The default full ratio is **`.95`**, or 95% of capacity. This a very aggressive setting for a test cluster with a small number of OSDs.

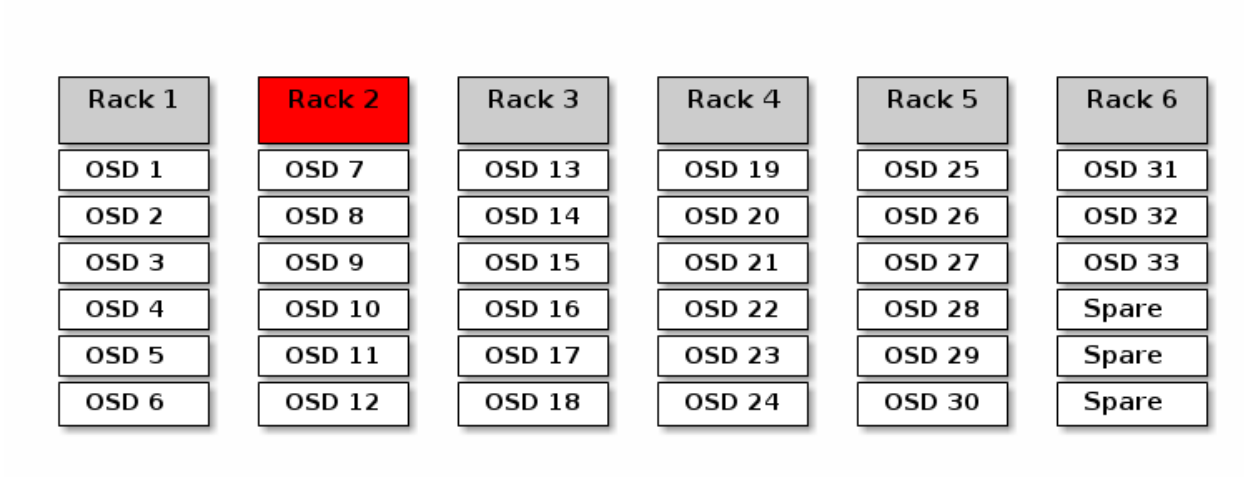
Tip

When monitoring your cluster, be alert to warnings related to the **`nearfull`** ratio. This means that a failure of some OSDs could result in a temporary service disruption if one or more OSDs fails. Consider adding more OSDs to increase storage capacity.

A common scenario for test clusters involves a system administrator removing a Ceph OSD from the Red Hat Ceph Storage cluster to watch the cluster re-balance; then, removing another Ceph OSD, and so on until the Red Hat Ceph Storage cluster eventually reaches the full ratio and locks

up. We recommend a bit of capacity planning even with a test cluster. Planning enables you to gauge how much spare capacity you will need in order to maintain high availability. Ideally, you want to plan for a series of Ceph OSD failures where the cluster can recover to an **`active + clean`** state without replacing those Ceph OSDs immediately. You can run a cluster in an **`active + degraded`** state, but this is not ideal for normal operating conditions.

The following diagram depicts a simplistic Red Hat Ceph Storage cluster containing 33 Ceph Nodes with one Ceph OSD per host, each Ceph OSD Daemon reading from and writing to a 3TB drive. So this exemplary Red Hat Ceph Storage cluster has a maximum actual capacity of 99TB. With a **`mon osd full ratio`** of **`0.95`**, if the Red Hat Ceph Storage cluster falls to 5TB of remaining capacity, the cluster will not allow Ceph clients to read and write data. So the Red Hat Ceph Storage cluster's operating capacity is 95TB, not 99TB.



It is normal in such a cluster for one or two OSDs to fail. A less frequent but reasonable scenario involves a rack's router or power supply failing, which brings down multiple OSDs simultaneously (e.g., OSDs 7-12). In such a scenario, you should still strive for a cluster that can remain operational and achieve an **`active + clean`** state—even if that means adding a few hosts with additional OSDs in short order. If your capacity utilization is too high, you may not lose data, but you could still sacrifice data availability while resolving an outage within a failure domain if capacity utilization of the cluster exceeds the full ratio. For this reason, we recommend at least some rough capacity planning.

Identify two numbers for your cluster:

1. The number of OSDs.
2. The total capacity of the cluster

If you divide the total capacity of your cluster by the number of OSDs in your cluster, you will find the mean average capacity of an OSD within your cluster. Consider multiplying that number by the number of OSDs you expect will fail simultaneously during normal operations (a relatively small number). Finally multiply the capacity of the cluster by the full ratio to arrive at a maximum operating capacity; then, subtract the number of amount of data from the OSDs you expect to fail to arrive at a reasonable full ratio. Repeat the foregoing process with a higher number of OSD failures (e.g., a rack of OSDs) to arrive at a reasonable number for a near full ratio.

```
[global]
...
mon_osd_full_ratio = .80
mon_osd_nearfull_ratio = .70
```

mon_osd_full_ratio

Description

The percentage of disk space used before an OSD is considered **`full`**.

Type

Float

Default

`.95`

mon_osd_nearfull_ratio

Description

The percentage of disk space used before an OSD is considered **`nearfull`**.

Type

Float

Default

`.85`

Tip

If some OSDs are nearfull, but others have plenty of capacity, you may have a problem with the CRUSH weight for the nearfull OSDs.

2.6. Heartbeat

Ceph monitors know about the cluster by requiring reports from each OSD, and by receiving reports from OSDs about the status of their neighboring OSDs. Ceph provides reasonable default settings for monitor/OSD interaction; however, you may modify them as needed.

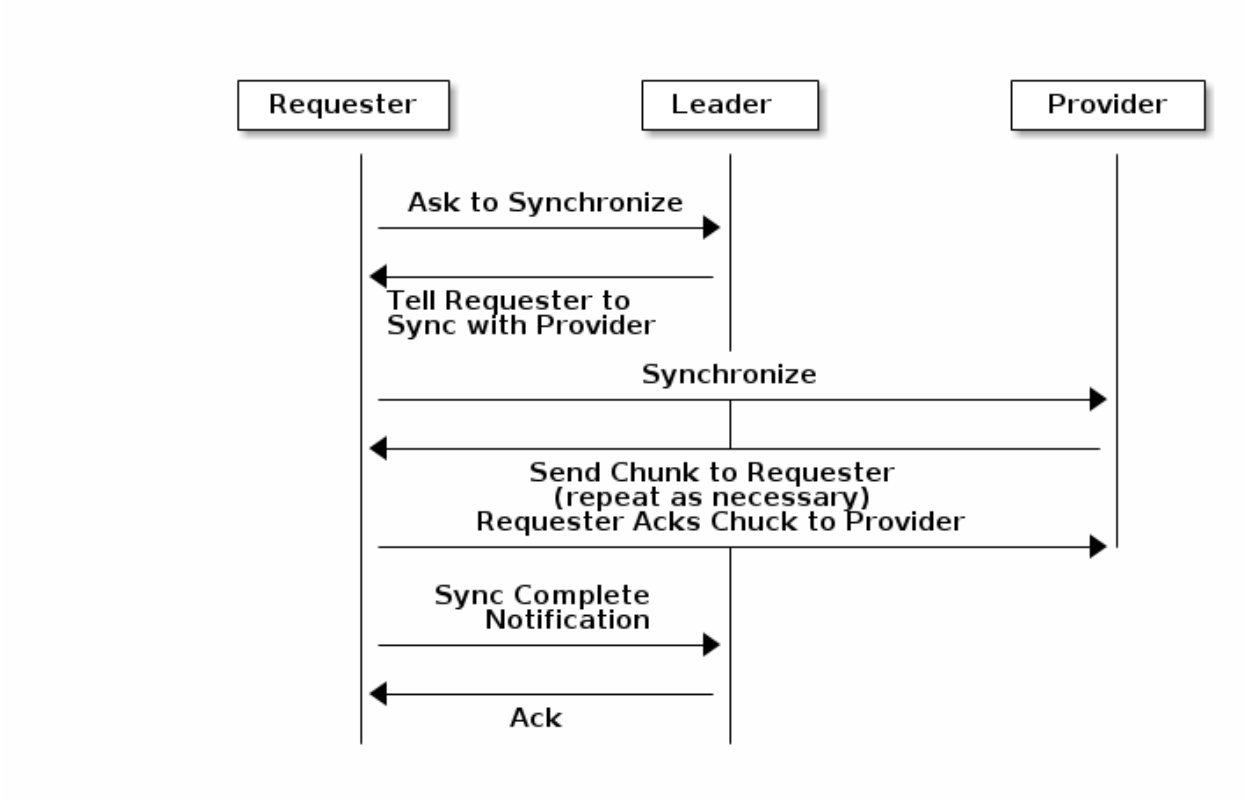
2.7. Monitor Store Synchronization

When you run a production cluster with multiple monitors (recommended), each monitor checks to see if a neighboring monitor has a more recent version of the cluster map (e.g., a map in a neighboring monitor with one or more epoch numbers higher than the most current epoch in the map of the instant monitor). Periodically, one monitor in the cluster may fall behind the other monitors to the point where it must leave the quorum, synchronize to retrieve the most current information about the cluster, and then rejoin the quorum. For the purposes of synchronization, monitors may assume one of three roles:

1. **Leader**: The Leader is the first monitor to achieve the most recent Paxos version of the cluster map.
2. **Provider**: The Provider is a monitor that has the most recent version of the cluster map, but wasn't the first to achieve the most recent version.
3. **Requester:** A Requester is a monitor that has fallen behind the leader and must

synchronize in order to retrieve the most recent information about the cluster before it can rejoin the quorum.

These roles enable a leader to delegate synchronization duties to a provider, which prevents synchronization requests from overloading the leader—improving performance. In the following diagram, the requester has learned that it has fallen behind the other monitors. The requester asks the leader to synchronize, and the leader tells the requester to synchronize with a provider.



Synchronization always occurs when a new monitor joins the cluster. During runtime operations, monitors may receive updates to the cluster map at different times. This means the leader and provider roles may migrate from one monitor to another. If this happens while synchronizing (e.g., a provider falls behind the leader), the provider can terminate synchronization with a requester.

Once synchronization is complete, Ceph requires trimming across the cluster. Trimming requires that the placement groups are **`active + clean`**.

mon_sync_trim_timeout

Description, Type

Double

Default

`30.0`

mon_sync_heartbeat_timeout

Description, Type

Double

Default

30.0

mon_sync_heartbeat_interval

Description, Type

Double

Default

5.0

mon_sync_backoff_timeout

Description, Type

Double

Default

30.0

mon_sync_timeout

Description, Type

Double

Default

30.0

mon_sync_max_retries

Description, Type

Integer

Default

5

mon_sync_max_payload_size

Description

The maximum size for a sync payload.

Type

32-bit Integer

Default

1045676

mon_accept_timeout

Description

Number of seconds the Leader will wait for the Requester(s) to accept a Paxos update. It is also used during the Paxos recovery phase for similar purposes.

Type

Float

Default

`10.0`

paxos_propose_interval

Description

Gather updates for this time interval before proposing a map update.

Type

Double

Default

`1.0`

paxos_min_wait

Description

The minimum amount of time to gather updates after a period of inactivity.

Type

Double

Default

`0.05`

paxos_trim_tolerance

Description

The number of extra proposals tolerated before trimming.

Type

Integer

Default

`30`

paxos_trim_disabled_max_versions

Description

The maximimum number of version allowed to pass without trimming.

Type

Integer

Default

100

mon_lease

Description

The length (in seconds) of the lease on the monitor's versions.

Type

Float

Default

5

mon_lease_renew_interval

Description

The interval (in seconds) for the Leader to renew the other monitor's leases.

Type

Float

Default

3

mon_lease_ack_timeout

Description

The number of seconds the Leader will wait for the Providers to acknowledge the lease extension.

Type

Float

Default

10.0

mon_min_osdmap_epochs

Description

Minimum number of OSD map epochs to keep at all times.

Type

32-bit Integer

Default

500

mon_max_pgmap_epochs

Description

Maximum number of PG map epochs the monitor should keep.

Type

32-bit Integer

Default

500

mon_max_log_epochs

Description

Maximum number of Log epochs the monitor should keep.

Type

32-bit Integer

Default

500

2.8. Clock

Ceph daemons pass critical messages to each other, which must be processed before daemons reach a timeout threshold. If the clocks in Ceph monitors are not synchronized, it can lead to a number of anomalies. For example:

- Daemons ignoring received messages (e.g., timestamps outdated)
- Timeouts triggered too soon/late when a message wasn't received in time.

See Monitor Store Synchronization_ for details.

Tip

You SHOULD install NTP on your Ceph monitor hosts to ensure that the monitor cluster operates with synchronized clocks.

Clock drift may still be noticeable with NTP even though the discrepancy isn't yet harmful. Ceph's clock drift / clock skew warnings may get triggered even though NTP maintains a reasonable level of synchronization. Increasing your clock drift may be tolerable under such circumstances; however, a number of factors such as workload, network latency, configuring overrides to default timeouts and the Monitor Store Synchronization settings may influence the level of acceptable clock drift without compromising Paxos guarantees.

Ceph provides the following tunable options to allow you to find acceptable values.

clock_offset

Description

How much to offset the system clock. See **`Clock.cc`** for details.

Type

Double

Default

`0`

mon_tick_interval

Description

A monitor's tick interval in seconds.

Type

32-bit Integer

Default

`5`

mon_clock_drift_allowed

Description

The clock drift in seconds allowed between monitors.

Type

Float

Default

`.050`

mon_clock_drift_warn_backoff

Description

Exponential backoff for clock drift warnings

Type

Float

Default

`5`

mon_timecheck_interval

Description

The time check interval (clock drift check) in seconds for the leader.

Type

Float

Default

`300.0`

2.9. Client

mon_client_hung_interval

Description

The client will try a new monitor every `N` seconds until it establishes a connection.

Type

Double

Default

`3.0`

mon_client_ping_interval

Description

The client will ping the monitor every `N` seconds.

Type

Double

Default

`10.0`

mon_client_max_log_entries_per_message

Description

The maximum number of log entries a monitor will generate per client message.

Type

Integer

Default

`1000`

mon_client_bytes

Description

The amount of client message data allowed in memory (in bytes).

Type

64-bit Integer Unsigned

Default

`100ul << 20`

3. MISCELLANEOUS

mon_max_osd

Description

The maximum number of OSDs allowed in the cluster.

Type

32-bit Integer

Default

`10000`

mon_globalid_prealloc

Description

The number of global IDs to pre-allocate for clients and daemons in the cluster.

Type

32-bit Integer

Default

`100`

mon_sync_fs_threshold

Description

Synchronize with the filesystem when writing the specified number of objects. Set it to `0` to disable it.

Type

32-bit Integer

Default

`5`

mon_subscribe_interval

Description

The refresh interval (in seconds) for subscriptions. The subscription mechanism enables obtaining the cluster maps and log information.

Type

Double

Default

300

mon_stat_smooth_intervals

Description

Ceph will smooth statistics over the last **N** PG maps.

Type

Integer

Default

2

mon_probe_timeout

Description

Number of seconds the monitor will wait to find peers before bootstrapping.

Type

Double

Default

2.0

mon_daemon_bytes

Description

The message memory cap for metadata server and OSD messages (in bytes).

Type

64-bit Integer Unsigned

Default

400ul << 20

mon_max_log_entries_per_event

Description

The maximum number of log entries per event.

Type

Integer

Default

`4096`

CHAPTER 4. CEPHX CONFIG REFERENCE

The **cephx** protocol is enabled by default. Cryptographic authentication has some computational costs, though they should generally be quite low. If the network environment connecting your client and server hosts is very safe and you cannot afford authentication, you can turn it off. **We recommend using authentication**.

Note

If you disable authentication, you are at risk of a man-in-the-middle attack altering your client/server messages, which could lead to significant security issues.

1. DEPLOYMENT SCENARIOS

There are two main scenarios for deploying a Ceph cluster, which impact how you initially configure Cephx. Most first time Ceph users use **ceph-deploy** to create a cluster (easiest). For clusters using other deployment tools (e.g., Chef, Juju, Puppet, etc.), you will need to use the manual procedures or configure your deployment tool to bootstrap your monitor(s).

1.1. ceph-deploy

When you deploy a cluster with **ceph-deploy**, you do not have to bootstrap the monitor manually or create the **client.admin** user or keyring. The steps you execute in the Storage Cluster Quick Start will invoke **ceph-deploy** to do that for you.

When you execute **ceph-deploy new <initial-monitor(s)>**, Ceph will create a monitor keyring for you (only used to bootstrap monitors), and it will generate an initial Ceph configuration file for you, which contains the following authentication settings, indicating that Ceph enables authentication by default:

```
auth_cluster_required = cephx
auth_service_required = cephx
auth_client_required = cephx
```

When you execute **ceph-deploy mon create-initial**, Ceph will bootstrap the initial monitor(s), retrieve a **ceph.client.admin.keyring** file containing the key for the **client.admin** user. Additionally, it will also retrieve keyrings that give **ceph-deploy** and **ceph-disk** utilities the ability to prepare and activate OSDs.

When you execute **ceph-deploy admin <node-name>** (**note:** Ceph must be installed first), you are pushing a Ceph configuration file and the **ceph.client.admin.keyring** to the **/etc/ceph** directory of the node. You will be able to execute Ceph administrative functions as **root** on the command line of that node.

1.2. Manual Deployment

When you deploy a cluster manually, you have to bootstrap the monitor manually and create the **client.admin** user and keyring. The steps for monitor bootstrapping are the logical steps you must perform when using third party deployment tools like Chef, Puppet, Juju, etc.

2. ENABLING/DISABLING CEPHX

2. ENABLING/DISABLING CEPHX

Enabling Cephx requires that you have deployed keys for your monitors and OSDs. If you are simply toggling Cephx on / off, you do not have to repeat the bootstrapping procedures.

2.1. Enabling Cephx

When **cephx** is enabled, Ceph will look for the keyring in the default search path, which includes **/etc/ceph/$cluster.$name.keyring**. You can override this location by adding a **keyring** option in the **[global]** section of your Ceph configuration file, but this is not recommended.

Execute the following procedures to enable **cephx** on a cluster with authentication disabled. If you (or your deployment utility) have already generated the keys, you may skip the steps related to generating keys.

1. Create a **client.admin** key, and save a copy of the key for your client host:

   ```
   ceph auth get-or-create client.admin mon 'allow *' osd 'allow *'
   -o /etc/ceph/ceph.client.admin.keyring
   ```

   Warning: This will erase the contents of any existing **/etc/ceph/client.admin.keyring** file. Do not perform this step if a deployment tool has already done it for you. Be careful!

2. Create a keyring for your monitor cluster and generate a monitor secret key. :

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

3. Copy the monitor keyring into a **ceph.mon.keyring** file in every monitor's **mon data** directory. For example, to copy it to **mon.a** in cluster **ceph**, use the following:

   ```
   cp /tmp/ceph.mon.keyring /var/lib/ceph/mon/ceph-a/keyring
   ```

4. Generate a secret key for every OSD, where **{$id}** is the OSD number:

   ```
   ceph auth get-or-create osd.{$id} mon 'allow rwx' osd 'allow *' -
   o /var/lib/ceph/osd/ceph-{$id}/keyring
   ```

5. Enable **cephx** authentication by setting the following options in the **[global]** section of your Ceph configuration file:

   ```
   auth cluster required = cephx
   auth service required = cephx
   auth client required = cephx
   ```

6. Start or restart the Ceph cluster.

2.2. Disabling Cephx

The following procedure describes how to disable Cephx. If your cluster environment is relatively safe, you can offset the computation expense of running authentication. **We recommend enabling authentication.** However, it may be easier during setup and/or troubleshooting to temporarily disable authentication.

1. Disable **cephx** authentication by setting the following options in the **[global]** section of your Ceph configuration file:

```
auth cluster required = none
auth service required = none
auth client required = none
```

2. Start or restart the Ceph cluster.

3. CONFIGURATION SETTINGS

3.1. Enablement

auth_cluster_required

Description

If enabled, the Red Hat Ceph Storage cluster daemons (i.e., **ceph-mon** and **ceph-osd**) must authenticate with each other. Valid settings are **cephx** or **none**.

Type

String

Required

No

Default

cephx.

auth_service_required

Description

If enabled, the Red Hat Ceph Storage cluster daemons require Ceph clients to authenticate with the Red Hat Ceph Storage cluster in order to access Ceph services. Valid settings are **cephx** or **none**.

Type

String

Required

No

Default

cephx.

auth_client_required

Description

If enabled, the Ceph client requires the Red Hat Ceph Storage cluster to authenticate with the Ceph client. Valid settings are **cephx** or **none**.

Type

String

Required

No

Default

cephx.

3.2. Keys

When you run Ceph with authentication enabled, **ceph** administrative commands and Ceph clients require authentication keys to access the Ceph Storage Cluster.

The most common way to provide these keys to the **ceph** administrative commands and clients is to include a Ceph keyring under the **/etc/ceph** directory. The filename is usually **ceph.client.admin.keyring** (or **$cluster.client.admin.keyring**). If you include the keyring under the **/etc/ceph** directory, you don't need to specify a **keyring** entry in your Ceph configuration file.

We recommend copying the Red Hat Ceph Storage cluster's keyring file to nodes where you will run administrative commands, because it contains the **client.admin** key.

You may use **ceph-deploy admin** to perform this task. To perform this step manually, execute the following:

```
sudo scp {user}@{ceph-cluster-host}:/etc/ceph/ceph.client.admin.keyring
/etc/ceph/ceph.client.admin.keyring
```

Tip

Ensure the **ceph.keyring** file has appropriate permissions set on your client machine.

You may specify the key itself in the Ceph configuration file using the **key** setting (not recommended), or a path to a keyfile using the **keyfile** setting.

keyring

Description

The path to the keyring file.

Type

String

Required

No

Default

`/etc/ceph/$cluster.$name.keyring,/etc/ceph/$cluster.keyring,/etc/ceph/keyring,/etc/ceph/keyring.bin`

keyfile

Description

The path to a key file (i.e,. a file containing only the key).

Type

String

Required

No

Default

None

key

Description

The key (i.e., the text string of the key itself). Not recommended.

Type

String

Required

No

Default

None

3.3. Daemon Keyrings

Administrative users or deployment tools (e.g., **`ceph-deploy`**) may generate daemon keyrings in the same way as generating user keyrings. By default, Ceph stores daemons keyrings inside their data directory. The default keyring locations, and the capabilities necessary for the daemon to function, are shown below.

ceph-mon

Location

`$mon_data/keyring`

Capabilities

mon 'allow *'

ceph-osd

Location

$osd_data/keyring

Capabilities

mon 'allow profile osd' osd 'allow *'

radosgw

Location

$rgw_data/keyring

Capabilities

mon 'allow rwx' osd 'allow rwx'

Note

The monitor keyring (i.e., **mon.**) contains a key but no capabilities, and is not part of the cluster **auth** database.

The daemon data directory locations default to directories of the form:

```
/var/lib/ceph/$type/$cluster-$id
```

For example, **osd.12** would be:

```
/var/lib/ceph/osd/ceph-12
```

You can override these locations, but it is not recommended.

3.4. Signatures

We prefer that Ceph authenticate all ongoing messages between the entities using the session key set up for that initial authentication.

Like other parts of Ceph authentication, Ceph provides fine-grained control so you can enable/disable signatures for service messages between the client and Ceph, and you can enable/disable signatures for messages between Ceph daemons.

cephx_require_signatures

Description

If set to **true**, Ceph requires signatures on all message traffic between the Ceph client and the Red Hat Ceph Storage cluster, and between daemons comprising the Red Hat Ceph Storage cluster.

Type

Boolean

Required

No

Default

`false`

cephx_cluster_require_signatures

Description

If set to `true`, Ceph requires signatures on all message traffic between Ceph daemons comprising the Red Hat Ceph Storage cluster.

Type

Boolean

Required

No

Default

`false`

cephx_service_require_signatures

Description

If set to `true`, Ceph requires signatures on all message traffic between Ceph clients and the Red Hat Ceph Storage cluster.

Type

Boolean

Required

No

Default

`false`

cephx_sign_messages

Description

If the Ceph version supports message signing, Ceph will sign all messages so they cannot be spoofed.

Type

Boolean

Default

`true`

Note

Ceph kernel modules do not support signatures yet.

3.5. Time to Live

auth_service_ticket_ttl

Description

When the Red Hat Ceph Storage cluster sends a Ceph client a ticket for authentication, the Red Hat Ceph Storage cluster assigns the ticket a time to live.

Type

Double

Default

`60*60`

CHAPTER 5. POOL, PG AND CRUSH CONFIG REFERENCE

When you create pools and set the number of placement groups for the pool, Ceph uses default values when you don't specifically override the defaults. **We recommend** overridding some of the defaults. Specifically, we recommend setting a pool's replica size and overriding the default number of placement groups. You can specifically set these values when running pool commands. You can also override the defaults by adding new ones in the **`[global]`** section of your Ceph configuration file.

```
[global]

# By default, Ceph makes 3 replicas of objects. If you want to make
four
# copies of an object the default value--a primary copy and three
replica
# copies--reset the default values as shown in 'osd pool default size'.
# If you want to allow Ceph to write a lesser number of copies in a
degraded
# state, set 'osd pool default min size' to a number less than the
# 'osd pool default size' value.

osd pool default size = 4  # Write an object 4 times.
osd pool default min size = 1 # Allow writing one copy in a degraded
state.

# Ensure you have a realistic number of placement groups. We recommend
# approximately 100 per OSD. E.g., total number of OSDs multiplied by
100
# divided by the number of replicas (i.e., osd pool default size). So
for
# 10 OSDs and osd pool default size = 4, we'd recommend approximately
# (100 * 10) / 4 = 250.

osd pool default pg num = 250
osd pool default pgp num = 250
```

mon_max_pool_pg_num

Description

The maximum number of placement groups per pool.

Type

Integer

Default

65536

mon_pg_create_interval

Description

Number of seconds between PG creation in the same Ceph OSD Daemon.

Type

Float

Default

30.0

mon_pg_stuck_threshold

Description

Number of seconds after which PGs can be considered as being stuck.

Type

32-bit Integer

Default

300

osd_pg_bits

Description

Placement group bits per Ceph OSD Daemon.

Type

32-bit Integer

Default

6

osd_pgp_bits

Description

The number of bits per Ceph OSD Daemon for PGPs.

Type

32-bit Integer

Default

6

osd_crush_chooseleaf_type

Description

The bucket type to use for **chooseleaf** in a CRUSH rule. Uses ordinal rank rather than name.

Type

32-bit Integer

Default

1. Typically a host containing one or more Ceph OSD Daemons.

osd_pool_default_crush_replicated_ruleset

Description

The default CRUSH ruleset to use when creating a replicated pool.

Type

8-bit Integer

Default

0

osd_pool_erasure_code_stripe_width

Description

Sets the desired size, in bytes, of an object stripe on every erasure coded pools. Every object if size S will be stored as N stripes and each stripe will be encoded/decoded individually.

Type

Unsigned 32-bit Integer

Default

4096

osd_pool_default_size

Description

Sets the number of replicas for objects in the pool. The default value is the same as **ceph osd pool set {pool-name} size {size}**.

Type

32-bit Integer

Default

3

osd_pool_default_min_size

Description

Sets the minimum number of written replicas for objects in the pool in order to acknowledge a write operation to the client. If minimum is not met, Ceph will not acknowledge the write to the client. This setting ensures a minimum number of replicas when operating in **degraded** mode.

Type

32-bit Integer

Default

0, which means no particular minimum. If **0**, minimum is **size - (size / 2)**.

osd_pool_default_pg_num

Description

The default number of placement groups for a pool. The default value is the same as **pg_num** with **mkpool**.

Type

32-bit Integer

Default

8

osd_pool_default_pgp_num

Description

The default number of placement groups for placement for a pool. The default value is the same as **pgp_num** with **mkpool**. PG and PGP should be equal (for now).

Type

32-bit Integer

Default

8

osd_pool_default_flags

Description

The default flags for new pools.

Type

32-bit Integer

Default

0

osd_max_pgls

Description

The maximum number of placement groups to list. A client requesting a large number can tie up the Ceph OSD Daemon.

Type

Unsigned 64-bit Integer

Default

1024

Note

Default should be fine.

osd_min_pg_log_entries

Description

The minimum number of placement group logs to maintain when trimming log files.

Type

32-bit Int Unsigned

Default

1000

osd_default_data_pool_replay_window

Description

The time (in seconds) for an OSD to wait for a client to replay a request.

Type

32-bit Integer

Default

45

CHAPTER 6. OSD CONFIG REFERENCE

You can configure Ceph OSDs in the Ceph configuration file, but Ceph OSDs can use the default values and a very minimal configuration. A minimal Ceph OSD configuration sets **`osd journal size`** and **`osd host`**, and uses default values for nearly everything else.

Ceph OSDs are numerically identified in incremental fashion, beginning with **`0`** using the following convention:

```
osd.0
osd.1
osd.2
```

In a configuration file, you may specify settings for all Ceph OSDs in the cluster by adding configuration settings to the **`[osd]`** section of your configuration file. To add settings directly to a specific Ceph OSD (e.g., **`osd host`**), enter it in an OSD-specific section of your configuration file. For example:

```
[osd]
osd journal size = 1024

[osd.0]
osd host = osd-host-a

[osd.1]
osd host = osd-host-b
```

1. GENERAL SETTINGS

The following settings provide a Ceph OSD's ID, and determine paths to data and journals. Ceph deployment scripts typically generate the UUID automatically. We **DO NOT** recommend changing the default paths for data or journals, as it makes it more problematic to troubleshoot Ceph later.

The journal size should be at least twice the product of the expected drive speed multiplied by **`filestore max sync interval`**. However, the most common practice is to partition the journal drive (often an SSD), and mount it such that Ceph uses the entire partition for the journal.

osd_uuid

Description

The universally unique identifier (UUID) for the Ceph OSD.

Type

UUID

Default

The UUID.

Note

The **`osd uuid`** applies to a single Ceph OSD. The **`fsid`** applies to the entire cluster.

osd_data

Description

The path to the OSD's data. You must create the directory when deploying Ceph. You should mount a drive for OSD data at this mount point. We do not recommend changing the default.

Type

String

Default

`/var/lib/ceph/osd/$cluster-$id`

osd_max_write_size

Description

The maximum size of a write in megabytes.

Type

32-bit Integer

Default

`90`

osd_client_message_size_cap

Description

The largest client data message allowed in memory.

Type

64-bit Integer Unsigned

Default

500MB default. `500*1024L*1024L`

osd_class_dir

Description

The class path for RADOS class plug-ins.

Type

String

Default

`$libdir/rados-classes`

2. JOURNAL SETTINGS

By default, Ceph expects that you will store a Ceph OSD's journal with the following path:

```
/var/lib/ceph/osd/$cluster-$id/journal
```

Without performance optimization, Ceph stores the journal on the same disk as the Ceph OSD's data. A Ceph OSD optimized for performance may use a separate disk to store journal data (e.g., a solid state drive delivers high performance journaling).

Ceph's default **`osd journal size`** is 0, so you will need to set this in your **`ceph.conf`** file. A journal size should find the product of the **`filestore max sync interval`** and the expected throughput, and multiply the product by two (2):

```
osd journal size = <2 * (expected throughput * filestore max sync
interval)>
```

The expected throughput number should include the expected disk throughput (i.e., sustained data transfer rate), and network throughput. For example, a 7200 RPM disk will likely have approximately 100 MB/s. Taking the **`min()`** of the disk and network throughput should provide a reasonable expected throughput. Some users just start off with a 10GB journal size. For example:

```
osd journal size = 10000
```

osd_journal

Description

The path to the OSD's journal. This may be a path to a file or a block device (such as a partition of an SSD). If it is a file, you must create the directory to contain it. We recommend using a drive separate from the **`osd data`** drive.

Type

String

Default

`/var/lib/ceph/osd/$cluster-$id/journal`

osd_journal_size

Description

The size of the journal in megabytes. If this is 0, and the journal is a block device, the entire block device is used. Since v0.54, this is ignored if the journal is a block device, and the entire block device is used.

Type

32-bit Integer

Default

`5120`

Recommended

Begin with 1GB. Should be at least twice the product of the expected speed multiplied by `filestore max sync interval`.

3. SCRUBBING

In addition to making multiple copies of objects, Ceph insures data integrity by scrubbing placement groups. Ceph scrubbing is analogous to `fsck` on the object storage layer. For each placement group, Ceph generates a catalog of all objects and compares each primary object and its replicas to ensure that no objects are missing or mismatched. Light scrubbing (daily) checks the object size and attributes. Deep scrubbing (weekly) reads the data and uses checksums to ensure data integrity.

Scrubbing is important for maintaining data integrity, but it can reduce performance. You can adjust the following settings to increase or decrease scrubbing operations.

osd_max_scrubs

Description

The maximum number of simultaneous scrub operations for a Ceph OSD.

Type

32-bit Int

Default

`1`

osd_scrub_thread_timeout

Description

The maximum time in seconds before timing out a scrub thread.

Type

32-bit Integer

Default

`60`

osd_scrub_finalize_thread_timeout

Description

The maximum time in seconds before timing out a scrub finalize thread.

Type

32-bit Integer

Default

`60*10`

osd_scrub_load_threshold

Description

The maximum load. Ceph will not scrub when the system load (as defined by **`getloadavg()`**) is higher than this number. Default is **`0.5`**.

Type

Float

Default

`0.5`

osd_scrub_min_interval

Description

The maximum interval in seconds for scrubbing the Ceph OSD when the Red Hat Ceph Storage cluster load is low.

Type

Float

Default

Once per day. **`60*60*24`**

osd_scrub_max_interval

Description

The maximum interval in seconds for scrubbing the Ceph OSD irrespective of cluster load.

Type

Float

Default

Once per week. **`7*60*60*24`**

osd_deep_scrub_interval

Description

The interval for "deep" scrubbing (fully reading all data). The **`osd scrub load threshold`** does not affect this setting.

Type

Float

Default

Once per week. **`60*60*24*7`**

osd_deep_scrub_stride

Description

Description

Read size when doing a deep scrub.

Type

32-bit Integer

Default

512 KB. **524288**

4. OPERATIONS

Operations settings allow you to configure the number of threads for servicing requests. If you set **`osd op threads`** to **`0`**, it disables multi-threading. By default, Ceph uses two threads with a 30 second timeout and a 30 second complaint time if an operation doesn't complete within those time parameters. You can set operations priority weights between client operations and recovery operations to ensure optimal performance during recovery.

osd_op_threads

Description

The number of threads to service Ceph OSD operations. Set to **`0`** to disable it. Increasing the number may increase the request processing rate.

Type

32-bit Integer

Default

2

osd_client_op_priority

Description

The priority set for client operations. It is relative to **`osd recovery op priority`**.

Type

32-bit Integer

Default

63

Valid Range

1-63

osd_recovery_op_priority

Description

The priority set for recovery operations. It is relative to **`osd client op priority`**.

Type

32-bit Integer

Default

10

Valid Range

1-63

osd_op_thread_timeout

Description

The Ceph OSD operation thread timeout in seconds.

Type

32-bit Integer

Default

30

osd_op_complaint_time

Description

An operation becomes complaint worthy after the specified number of seconds have elapsed.

Type

Float

Default

30

osd_disk_threads

Description

The number of disk threads, which are used to perform background disk intensive OSD operations such as scrubbing and snap trimming.

Type

32-bit Integer

Default

1

osd_disk_thread_ioprio_class

Description

Warning: it will only be used if both **`osd disk thread ioprio class`** and **`osd disk thread ioprio priority`** are set to a non default value. Sets the **`ioprio_set(2)`** I/O scheduling **`class`** for the disk thread. Acceptable values are **`idle`**, **`be`** or **`rt`**. The **`idle`** class means the disk thread will have lower priority than any other thread in the OSD. This is useful to slow down scrubbing on an OSD that is busy handling client operations. **`be`** is the default and is the same priority as all other threads in the OSD. **`rt`** means the disk thread will have precedence over all other threads in the OSD. This is useful if scrubbing is much needed and must make progress at the expense of client operations. Note: Only works with the Linux Kernel CFQ scheduler.

Type

String

Default

the empty string

osd_disk_thread_ioprio_priority

Description

Warning: it will only be used if both **`osd disk thread ioprio class`** and **`osd disk thread ioprio priority`** are set to a non default value. It sets the **`ioprio_set(2)`** I/O scheduling **`priority`** of the disk thread ranging from 0 (highest) to 7 (lowest). If all OSDs on a given host were in class **`idle`** and compete for I/O (i.e. due to controller congestion), it can be used to lower the disk thread priority of one OSD to 7 so that another OSD with priority 0 can potentially scrub faster. Note: Only works with the Linux Kernel CFQ scheduler.

Type

Integer in the range of 0 to 7 or -1 if not to be used.

Default

`-1`

osd_op_history_size

Description

The maximum number of completed operations to track.

Type

32-bit Unsigned Integer

Default

`20`

osd_op_history_duration

Description

The oldest completed operation to track.

Type

32-bit Unsigned Integer

Default

600

osd_op_log_threshold

Description

How many operations logs to display at once.

Type

32-bit Integer

Default

5

5. BACKFILLING

When you add or remove Ceph OSDs to a cluster, the CRUSH algorithm will want to rebalance the cluster by moving placement groups to or from Ceph OSDs to restore the balance. The process of migrating placement groups and the objects they contain can reduce the cluster's operational performance considerably. To maintain operational performance, Ceph performs this migration with *backfilling*, which allows Ceph to set backfill operations to a lower priority than requests to read or write data.

osd_max_backfills

Description

The maximum number of backfills allowed to or from a single OSD.

Type

64-bit Unsigned Integer

Default

10

osd_backfill_scan_min

Description

The minimum number of objects per backfill scan.

Type

32-bit Integer

Default

64

osd_backfill_scan_max

Description

The maximum number of objects per backfill scan.

Type

32-bit Integer

Default

`512`

osd_backfill_full_ratio

Description

Refuse to accept backfill requests when the Ceph OSD's full ratio is above this value.

Type

Float

Default

`0.85`

osd_backfill_retry_interval

Description

The number of seconds to wait before retrying backfill requests.

Type

Double

Default

`10.0`

6. OSD MAP

OSD maps reflect the OSD daemons operating in the cluster. Over time, the number of map epochs increases. Ceph provides some settings to ensure that Ceph performs well as the OSD map grows larger.

osd_map_dedup

Description

Enable removing duplicates in the OSD map.

Type

Boolean

Default

`true`

osd_map_cache_size

Description

The size of the OSD map cache in megabytes.

Type

32-bit Integer

Default

`500`

osd_map_cache_bl_size

Description

The size of the in-memory OSD map cache in OSD daemons.

Type

32-bit Integer

Default

`50`

osd_map_cache_bl_inc_size

Description

The size of the in-memory OSD map cache incrementals in OSD daemons.

Type

32-bit Integer

Default

`100`

osd_map_message_max

Description

The maximum map entries allowed per MOSDMap message.

Type

32-bit Integer

Default

`100`

7. RECOVERY

When the cluster starts or when a Ceph OSD crashes and restarts, the OSD begins peering with other Ceph OSDs before writes can occur.

If a Ceph OSD crashes and comes back online, usually it will be out of sync with other Ceph OSDs containing more recent versions of objects in the placement groups. When this happens, the Ceph OSD goes into recovery mode and seeks to get the latest copy of the data and bring its map back up to date. Depending upon how long the Ceph OSD was down, the OSD's objects and placement groups may be significantly out of date. Also, if a failure domain went down (e.g., a rack), more than one Ceph OSD may come back online at the same time. This can make the recovery process time consuming and resource intensive.

To maintain operational performance, Ceph performs recovery with limitations on the number recovery requests, threads and object chunk sizes which allows Ceph perform well in a degraded state.

osd_recovery_delay_start

Description

After peering completes, Ceph will delay for the specified number of seconds before starting to recover objects.

Type

Float

Default

```
0
```

osd_recovery_max_active

Description

The number of active recovery requests per OSD at one time. More requests will accelerate recovery, but the requests places an increased load on the cluster.

Type

32-bit Integer

Default

```
15
```

osd_recovery_max_chunk

Description

The maximum size of a recovered chunk of data to push.

Type

64-bit Integer Unsigned

Default

```
8 << 20
```

osd_recovery_threads

Description

The number of threads for recovering data.

Type

32-bit Integer

Default

1

osd_recovery_thread_timeout

Description

The maximum time in seconds before timing out a recovery thread.

Type

32-bit Integer

Default

30

osd_recover_clone_overlap

Description

Preserves clone overlap during recovery. Should always be set to **true**.

Type

Boolean

Default

true

8. MISCELLANEOUS

osd_snap_trim_thread_timeout

Description

The maximum time in seconds before timing out a snap trim thread.

Type

32-bit Integer

Default

60*60*1

osd_backlog_thread_timeout

Description

The maximum time in seconds before timing out a backlog thread.

Type

32-bit Integer

Default

`60*60*1`

osd_default_notify_timeout

Description

The OSD default notification timeout (in seconds).

Type

32-bit Integer Unsigned

Default

`30`

osd_check_for_log_corruption

Description

Check log files for corruption. Can be computationally expensive.

Type

Boolean

Default

`false`

osd_remove_thread_timeout

Description

The maximum time in seconds before timing out a remove OSD thread.

Type

32-bit Integer

Default

`60*60`

osd_command_thread_timeout

Description

The maximum time in seconds before timing out a command thread.

Type

32-bit Integer

Default

`10*60`

osd_command_max_records

Description

Limits the number of lost objects to return.

Type

32-bit Integer

Default

`256`

osd_auto_upgrade_tmap

Description

Uses **`tmap`** for **`omap`** on old objects.

Type

Boolean

Default

`true`

osd_tmapput_sets_users_tmap

Description

Uses **`tmap`** for debugging only.

Type

Boolean

Default

`false`

osd_preserve_trimmed_log

Description

Preserves trimmed log files, but uses more disk space.

Type

Boolean

Default

`false`

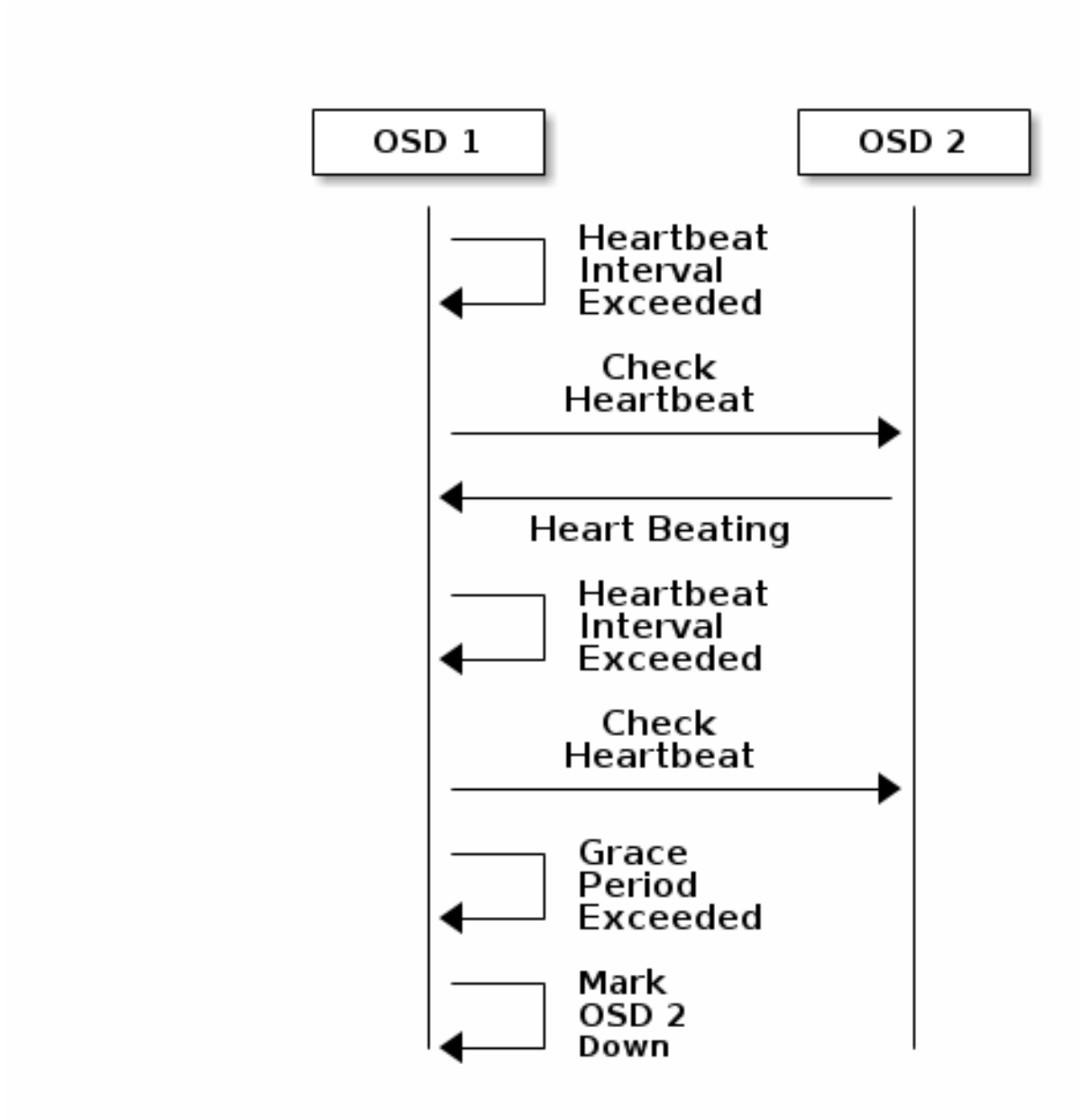
CHAPTER 7. CONFIGURING MONITOR/OSD INTERACTION

After you have completed your initial Ceph configuration, you may deploy and run Ceph. When you execute a command such as **`ceph health`** or **`ceph -s`**, the Ceph Monitor reports on the current state of the Ceph Storage Cluster. The Ceph Monitor knows about the Ceph Storage Cluster by requiring reports from each Ceph OSD Daemon, and by receiving reports from Ceph OSD Daemons about the status of their neighboring Ceph OSD Daemons. If the Ceph Monitor doesn't receive reports, or if it receives reports of changes in the Ceph Storage Cluster, the Ceph Monitor updates the status of the Ceph Cluster Map.

Ceph provides reasonable default settings for Ceph Monitor/Ceph OSD Daemon interaction. However, you may override the defaults. The following sections describe how Ceph Monitors and Ceph OSD Daemons interact for the purposes of monitoring the Ceph Storage Cluster.

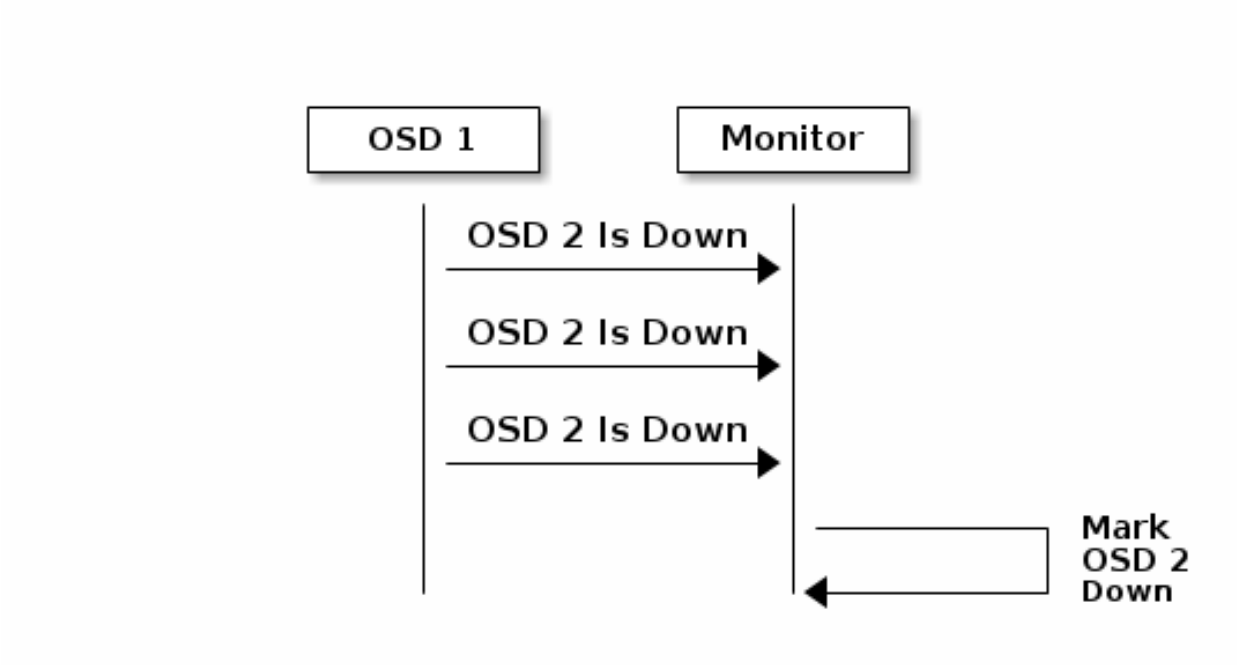
1. OSDS CHECK HEARTBEATS

Each Ceph OSD Daemon checks the heartbeat of other Ceph OSD Daemons every 6 seconds. You can change the heartbeat interval by adding an **`osd heartbeat interval`** setting under the **`[osd]`** section of your Ceph configuration file, or by setting the value at runtime. If a neighboring Ceph OSD Daemon doesn't show a heartbeat within a 20 second grace period, the Ceph OSD Daemon may consider the neighboring Ceph OSD Daemon **down** and report it back to a Ceph Monitor, which will update the Ceph Cluster Map. You may change this grace period by adding an **`osd heartbeat grace`** setting under the **`[osd]`** section of your Ceph configuration file, or by setting the value at runtime.



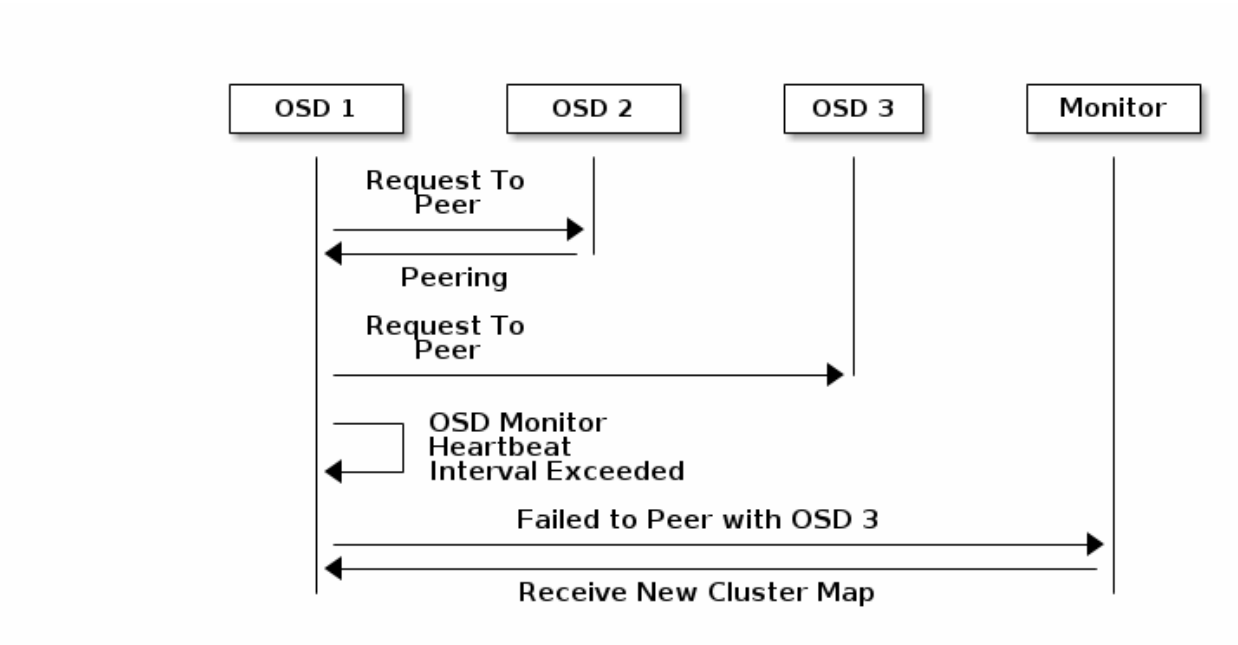
2. OSDS REPORT DOWN OSDS

By default, a Ceph OSD Daemon must report to the Ceph Monitors that another Ceph OSD Daemon is **down** three times before the Ceph Monitors acknowledge that the reported Ceph OSD Daemon is **down**. You can change the minimum number of **`osd down`** reports by adding an **`mon osd min down reports`** setting (**`osd min down reports`** prior to v0.62) under the **`[mon]`** section of your Ceph configuration file, or by setting the value at runtime. By default, only one Ceph OSD Daemon is required to report another Ceph OSD Daemon **down**. You can change the number of Ceph OSD Daemones required to report a Ceph OSD Daemon **down** to a Ceph Monitor by adding an **`mon osd min down reporters`** setting (**`osd min down reporters`** prior to v0.62) under the **`[mon]`** section of your Ceph configuration file, or by setting the value at runtime.



3. OSDS REPORT PEERING FAILURE

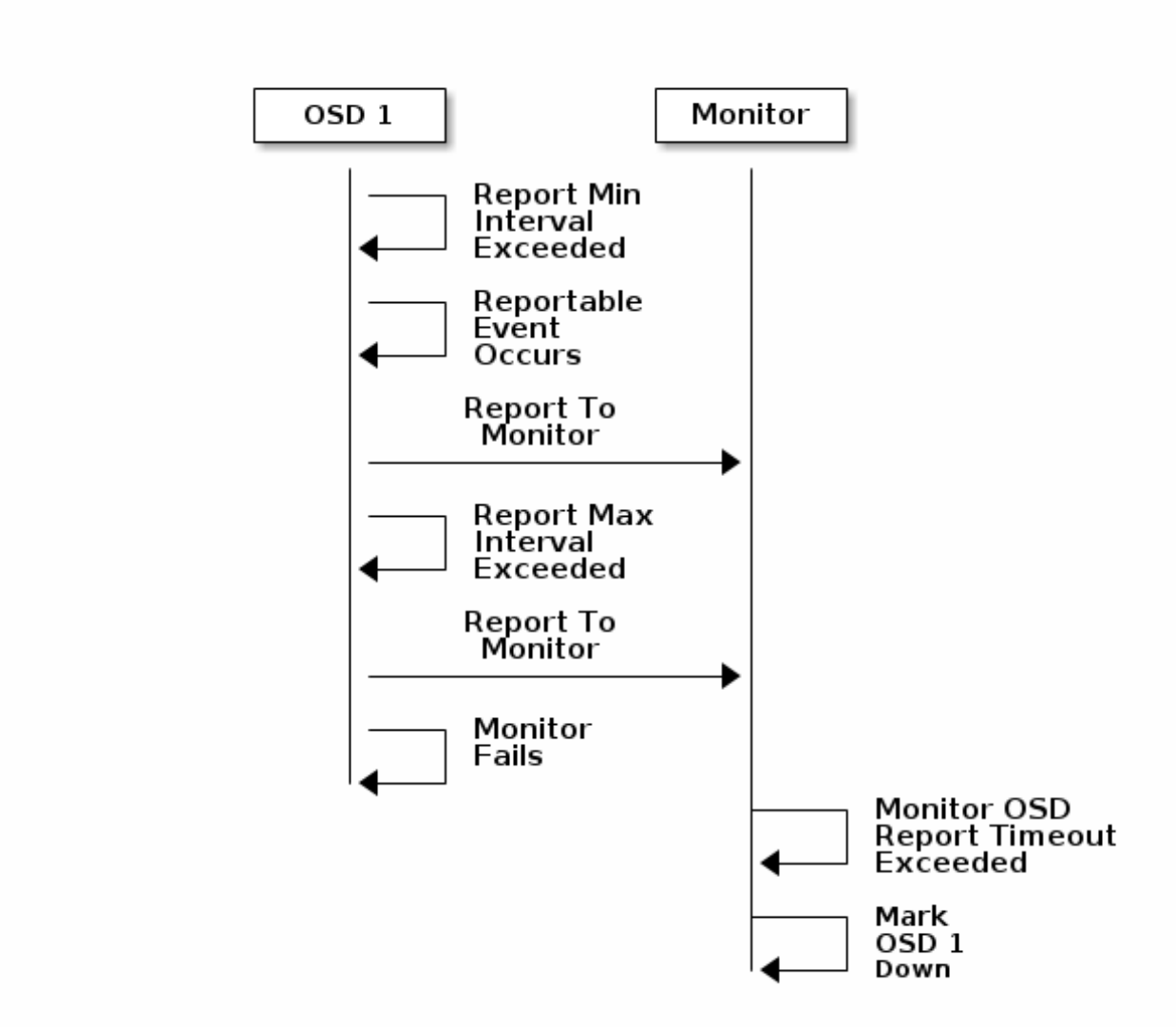
If a Ceph OSD Daemon cannot peer with any of the Ceph OSD Daemons defined in its Ceph configuration file (or the cluster map), it will ping a Ceph Monitor for the most recent copy of the cluster map every 30 seconds. You can change the Ceph Monitor heartbeat interval by adding an **`osd mon heartbeat interval`** setting under the **`[osd]`** section of your Ceph configuration file, or by setting the value at runtime.



4. OSDS REPORT THEIR STATUS

If an Ceph OSD Daemon doesn't report to a Ceph Monitor, the Ceph Monitor will consider the Ceph OSD Daemon **`down`** after the **`mon osd report timeout`** elapses. A Ceph OSD Daemon sends a report to a Ceph Monitor when a reportable event such as a failure, a change in placement group stats, a change in **`up_thru`** or when it boots within 5 seconds. You can change the Ceph OSD

Daemon minimum report interval by adding an **`osd mon report interval min`** setting under the **`[osd]`** section of your Ceph configuration file, or by setting the value at runtime. A Ceph OSD Daemon sends a report to a Ceph Monitor every 120 seconds irrespective of whether any notable changes occur. You can change the Ceph Monitor report interval by adding an **`osd mon report interval max`** setting under the **`[osd]`** section of your Ceph configuration file, or by setting the value at runtime.



5. CONFIGURATION SETTINGS

When modifying heartbeat settings, you should include them in the **`[global]`** section of your configuration file.

5.1. Monitor Settings

mon_osd_min_up_ratio

Description

The minimum ratio of **`up`** Ceph OSD Daemons before Ceph will mark Ceph OSD Daemons **`down`**.

Type

Double

Default

`.3`

mon_osd_min_in_ratio

Description

The minimum ratio of **`in`** Ceph OSD Daemons before Ceph will mark Ceph OSD Daemons **`out`**.

Type

Double

Default

`.3`

mon_osd_laggy_halflife

Description

The number of seconds laggy estimates will decay.

Type

Integer

Default

`60*60`

mon_osd_laggy_weight

Description

The weight for new samples in laggy estimation decay.

Type

Double

Default

`0.3`

mon_osd_adjust_heartbeat_grace

Description

If set to **`true`**, Ceph will scale based on laggy estimations.

Type

Boolean

Default

`true`

mon_osd_adjust_down_out_interval

Description

If set to **`true`**, Ceph will scaled based on laggy estimations.

Type

Boolean

Default

`true`

mon_osd_auto_mark_in

Description

Ceph will mark any booting Ceph OSD Daemons as **`in`** the Ceph Storage Cluster.

Type

Boolean

Default

`false`

mon_osd_auto_mark_auto_out_in

Description

Ceph will mark booting Ceph OSD Daemons auto marked **`out`** of the Ceph Storage Cluster as **`in`** the cluster.

Type

Boolean

Default

`true`

mon_osd_auto_mark_new_in

Description

Ceph will mark booting new Ceph OSD Daemons as **`in`** the Ceph Storage Cluster.

Type

Boolean

Default

`true`

mon_osd_down_out_interval

Description

The number of seconds Ceph waits before marking a Ceph OSD Daemon **down** and **out** if it doesn't respond.

Type

32-bit Integer

Default

300

mon_osd_downout_subtree_limit

Description

The largest CRUSH unit type that Ceph will automatically mark **out**.

Type

String

Default

rack

mon_osd_report_timeout

Description

The grace period in seconds before declaring unresponsive Ceph OSD Daemons **down**.

Type

32-bit Integer

Default

900

mon_osd_min_down_reporters

Description

The minimum number of Ceph OSD Daemons required to report a **down** Ceph OSD Daemon.

Type

32-bit Integer

Default

1

mon_osd_min_down_reports

Description

The minimum number of times a Ceph OSD Daemon must report that another Ceph OSD Daemon is **down**.

Type

32-bit Integer

Default

3

5.2. OSD Settings

osd_heartbeat_address

Description

An Ceph OSD Daemon's network address for heartbeats.

Type

Address

Default

The host address.

osd_heartbeat_interval

Description

How often an Ceph OSD Daemon pings its peers (in seconds).

Type

32-bit Integer

Default

6

osd_heartbeat_grace

Description

The elapsed time when a Ceph OSD Daemon hasn't shown a heartbeat that the Ceph Storage Cluster considers it **down**.

Type

32-bit Integer

Default

20

osd_mon_heartbeat_interval

Description

How often the Ceph OSD Daemon pings a Ceph Monitor if it has no Ceph OSD Daemon peers.

Type

32-bit Integer

Default

30

osd_mon_report_interval_max

Description

The maximum time in seconds that a Ceph OSD Daemon can wait before it must report to a Ceph Monitor.

Type

32-bit Integer

Default

120

osd_mon_report_interval_min

Description

The minimum number of seconds a Ceph OSD Daemon may wait from startup or another reportable event before reporting to a Ceph Monitor.

Type

32-bit Integer

Default

5

Valid Range

Should be less than **osd mon report interval max**

osd_mon_ack_timeout

Description

The number of seconds to wait for a Ceph Monitor to acknowledge a request for statistics.

Type

32-bit Integer

Default

30

CHAPTER 8. FILESTORE CONFIG REFERENCE

1. EXTENDED ATTRIBUTES

Extended Attributes (XATTRs) are an important aspect in your configuration. Some file systems have limits on the number of bytes stored in XATTRS. Additionally, in some cases, the filesystem may not be as fast as an alternative method of storing XATTRs. The following settings may help improve performance by using a method of storing XATTRs that is extrinsic to the underlying filesystem.

Ceph XATTRs are stored as **`inline xattr`**, using the XATTRs provided by the underlying file system, if it does not impose a size limit. If there is a size limit (4KB total on ext4, for instance), some Ceph XATTRs will be stored in an key/value database (aka **`omap`**) when the **`filestore max inline xattr size`** or **`filestore max inline xattrs`** threshold are reached.

filestore_xattr_use_omap

Description

Use object map for XATTRS. Set to **`true`** for **`ext4`** file systems.

Type

Boolean

Required

No

Default

`false`

filestore_omap_header_cache_size

Description

Determines the size of the LRU used to cache object omap headers. Larger values use more memory but may reduce lookups on omap. (Experts only).

Type

Integer

Default

`1024`

filestore_omap_backend

Description

Used to determine which backend is used for the omap. Can be set to "leveldb" or "rocksdb". (Experts only. **`rocksdb`** is experimental.)

Type

String

Default

"leveldb"

filestore_debug_omap_check

Description

Debugging check on synchronization. Expensive. For debugging only.

Type

Boolean

Required

No

Default

0

filestore_max_inline_xattr_size

Description

The maximimum size of an XATTR stored in the filesystem (i.e., XFS, btrfs, ext4, etc.) per object. Should not be larger than the filesytem can handle.

Type

Unsigned 32-bit Integer

Required

No

Default

512

filestore_max_inline_xattrs

Description

The maximum number of XATTRs stored in the fileystem per object.

Type

32-bit Integer

Required

No

Default

2

filestore_max_inline_xattr_size_xfs

Description

The maximimum size of an XATTR stored in the filesystem for XFS filesystems per object. Should not be larger than the filesytem can handle.

Type

Unsigned 32-bit Integer

Default

65536

filestore_max_inline_xattr_size_btrfs

Description

The maximimum size of an XATTR stored in the filesystem for **btrfs** per object. Should not be larger than the filesytem can handle.

Type

Unsigned 32-bit Integer

Default

2048

filestore_max_inline_xattr_size_other

Description

The maximimum size of an XATTR stored in the filesystem for filesystems other than **btrfs** or XFS (i.e., ext3, ext4, etc.) per object. Should not be larger than the filesystem can handle.

Type

Unsigned 32-bit Integer

Default

512

filestore_max_inline_xattrs

Description

The maximum number of XATTRs stored in the fileystem per object. Overrides fine-grained settings.

Type

Unsigned 32-bit Integer

Default

0

filestore_max_inline_xattrs_xfs

Description

The maximum number of XATTRs stored in an XFS fileystem per object.

Type

Unsigned 32-bit Integer

Default

10

filestore_max_inline_xattrs_btrfs

Description

The maximum number of XATTRs stored in a **btrfs** fileystem per object.

Type

Unsigned 32-bit Integer

Default

10

filestore_max_inline_xattrs_other

Description

The maximum number of XATTRs stored in filesystems other than **btrfs** or XFS (i.e., ext3, ext4, etc.) per object.

Type

Unsigned 32-bit Integer

Default

2

2. SYNCHRONIZATION INTERVALS

Periodically, the filestore needs to quiesce writes and synchronize the filesystem, which creates a consistent commit point. It can then free journal entries up to the commit point. Synchronizing more frequently tends to reduce the time required to perform synchronization, and reduces the amount of data that needs to remain in the journal. Less frequent synchronization allows the backing filesystem to coalesce small writes and metadata updates more optimally—potentially resulting in more efficient synchronization.

filestore_max_sync_interval

Description

The maximum interval in seconds for synchronizing the filestore.

Type

Double

Required

No

Default

5

filestore_min_sync_interval

Description

The minimum interval in seconds for synchronizing the filestore.

Type

Double

Required

No

Default

.01

3. FLUSHER

The filestore flusher forces data from large writes to be written out using **sync file range** before the sync in order to (hopefully) reduce the cost of the eventual sync. In practice, disabling *filestore flusher* seems to improve performance in some cases.

filestore_flusher

Description

Enables the filestore flusher.

Type

Boolean

Required

No

Default

false

filestore_flusher_max_fds

Description

Sets the maximum number of file descriptors for the flusher.

Type

Integer

Required

No

Default

512

filestore_sync_flush

Description

Enables the synchronization flusher.

Type

Boolean

Required

No

Default

false

filestore_fsync_flushes_journal_data

Description

Flush journal data during filesystem synchronization.

Type

Boolean

Required

No

Default

false

4. QUEUE

The following settings provide limits on the size of filestore queue.

filestore_queue_max_ops

Description

Defines the maximum number of in progress operations the file store accepts before blocking on queuing new operations.

Type

Integer

Required

No. Minimal impact on performance.

Default

`500`

filestore_queue_max_bytes

Description

The maximum number of bytes for an operation.

Type

Integer

Required

No

Default

`100 << 20`

filestore_queue_committing_max_ops

Description

The maximum number of operations the filestore can commit.

Type

Integer

Required

No

Default

`500`

filestore_queue_committing_max_bytes

Description

The maximum number of bytes the filestore can commit.

Type

Integer

Required

No

Default

`100 << 20`

5. WRITEBACK THROTTLE

Ceph replicates some of the writeback behavior in the kernel, because the page cache tends to keep dirty data round too long.

filestore_wbthrottle_enable

Description

Enables the filestore writeback throttle. The filestore writeback throttle is used to prevent large amounts of uncommitted data from building up before each filestore sync. (Experts only).

Type

Boolean

Default

`true`

filestore_wbthrottle_btrfs_bytes_start_flusher

Description

Dirty bytes threshold at which Ceph begins background flushing for `btrfs`.

Type

64-bit Unsigned Integer

Default

`41943040`

filestore_wbthrottle_btrfs_bytes_hard_limit

Description

Dirty bytes threshold at which Ceph begins to throttle I/O until the flusher catches up for `btrfs`.

Type

64-bit Unsigned Integer

Default

`419430400`

filestore_wbthrottle_btrfs_ios_start_flusher

Description

Dirty ios threshhold at which Ceph begins background flushing for **`btrfs`**.

Type

64-bit Unsigned Integer

Default

`500`

filestore_wbthrottle_btrfs_ios_hard_limit

Description

Dirty ios threshhold at which Ceph begins to throttle IO until the flusher catches up for **`btrfs`**.

Type

64-bit Unsigned Integer

Default

`5000`

filestore_wbthrottle_btrfs_inodes_start_flusher

Description

Dirty inodes threshhold at which Ceph begins background flushing for **`btrfs`**.

Type

64-bit Unsigned Integer

Default

`500`

filestore_wbthrottle_btrfs_inodes_hard_limit

Description

Dirty inodes threshhold at which Ceph begins to throttle IO until the flusher catches up for **`btrfs`**. Must be less than the **`fd`** limit.

Type

64-bit Unsigned Integer

Default

`5000`

filestore_wbthrottle_xfs_bytes_start_flusher

Description

Dirty bytes threshold at which Ceph begins background flushing for XFS.

Type

64-bit Unsigned Integer

Default

41943040

filestore_wbthrottle_xfs_bytes_hard_limit

Description

Dirty bytes threshold at which Ceph begins to throttle IO until the flusher catches up for XFS.

Type

64-bit Unsigned Integer

Default

419430400

filestore_wbthrottle_xfs_ios_start_flusher

Description

Dirty ios threshhold at which Ceph begins background flushing for XFS.

Type

64-bit Unsigned Integer

Default

500

filestore_wbthrottle_xfs_ios_hard_limit

Description

Dirty ios threshhold at which Ceph begins to throttle IO until the flusher catches up for XFS.

Type

64-bit Unsigned Integer

Default

5000

filestore_wbthrottle_xfs_inodes_start_flusher

Description

Dirty inodes threshhold at which Ceph begins background flushing for XFS.

Type

64-bit Unsigned Integer

Default

500

filestore_wbthrottle_xfs_inodes_hard_limit

Description

Dirty inodes threshhold at which Ceph begins to throttle IO until the flusher catches up for XFS. Must be less than the **fd** limit.

Type

64-bit Unsigned Integer

Default

5000

6. TIMEOUTS

filestore_op_threads

Description

The number of filesystem operation threads that execute in parallel.

Type

Integer

Required

No

Default

2

filestore_op_thread_timeout

Description

The timeout for a filesystem operation thread (in seconds).

Type

Integer

Required

No

Default

60

filestore_op_thread_suicide_timeout

Description

The timeout for a commit operation before canceling the commit (in seconds).

Type

Integer

Required

No

Default

`180`

7. B-TREE FILESYSTEM

filestore_btrfs_snap

Description

Enable snapshots for a `btrfs` filestore.

Type

Boolean

Required

No. Only used for `btrfs`.

Default

`true`

filestore_btrfs_clone_range`

Description

Enable cloning ranges for a `btrfs` filestore.

Type

Boolean

Required

No. Only used for `btrfs`.

Default

`true`

8. JOURNAL

filestore_journal_parallel

Description

Enables parallel journaling, default for btrfs.

Type

Boolean

Required

No

Default

`false`

filestore_journal_writeahead

Description

Enables writeahead journaling, default for xfs.

Type

Boolean

Required

No

Default

`false`

filestore_journal_trailing

Description

Deprecated, never use.

Type

Boolean

Required

No

Default

`false`

9. MISC

filestore_merge_threshold

Description

Min number of files in a subdir before merging into parent NOTE: A negative value means to disable subdir merging

Type

Integer

Required

No

Default

10

filestore_split_multiple

Description

filestore_split_multiple * abs(filestore_merge_threshold) * 16 is the maximum number of files in a subdirectory before splitting into child directories.

Type

Integer

Required

No

Default

2

filestore_update_to

Description

Limits filestore auto upgrade to specified version.

Type

Integer

Required

No

Default

1000

filestore_blackhole

Description

Drop any new transactions on the floor.

Type

Boolean

Required

No

Default

`false`

filestore_dump_file

Description

File onto which store transaction dumps.

Type

Boolean

Required

No

Default

`false`

filestore_kill_at

Description

inject a failure at the n’th opportunity

Type

String

Required

No

Default

`false`

filestore_fail_eio

Description

Fail/Crash on eio.

Type

Boolean

Required

No

Default

`true`

CHAPTER 9. JOURNAL CONFIG REFERENCE

Ceph OSDs use a journal for two reasons: speed and consistency.

- **Speed:** The journal enables the Ceph OSD Daemon to commit small writes quickly. Ceph writes small, random i/o to the journal sequentially, which tends to speed up bursty workloads by allowing the backing filesystem more time to coalesce writes. The Ceph OSD Daemon's journal, however, can lead to spiky performance with short spurts of high-speed writes followed by periods without any write progress as the filesystem catches up to the journal.
- **Consistency:** Ceph OSD Daemons require a filesystem interface that guarantees atomic compound operations. Ceph OSD Daemons write a description of the operation to the journal and apply the operation to the filesystem. This enables atomic updates to an object (for example, placement group metadata). Every few seconds—between **`filestore max sync interval`** and **`filestore min sync interval`** settings—the Ceph OSD stops writes and synchronizes the journal with the filesystem, allowing Ceph OSDs to trim operations from the journal and reuse the space. On failure, Ceph OSDs replay the journal starting after the last synchronization operation.

Ceph OSD Daemons support the following journal settings:

journal_dio

Description

Enables direct i/o to the journal. Requires **`journal block align`** set to **`true`**.

Type

Boolean

Required

Yes when using **`aio`**.

Default

`true`

journal_aio

Description

Enables using **`libaio`** for asynchronous writes to the journal. Requires **`journal dio`** set to **`true`**.

Type

Boolean

Required

No.

Default

`true`.

journal_block_align

Description

Block aligns write operations. Required for **`dio`** and **`aio`**.

Type

Boolean

Required

Yes when using **`dio`** and **`aio`**.

Default

`true`

journal_max_write_bytes

Description

The maximum number of bytes the journal will write at any one time.

Type

Integer

Required

No

Default

`10 << 20`

journal_max_write_entries

Description

The maximum number of entries the journal will write at any one time.

Type

Integer

Required

No

Default

`100`

journal_queue_max_ops

Description

The maximum number of operations allowed in the queue at any one time.

Type

Integer

Required

No

Default

`500`

journal_queue_max_bytes

Description

The maximum number of bytes allowed in the queue at any one time.

Type

Integer

Required

No

Default

`10 << 20`

journal_align_min_size

Description

Align data payloads greater than the specified minimum.

Type

Integer

Required

No

Default

`64 << 10`

journal_zero_on_create

Description

Causes the file store to overwrite the entire journal with `0`'s during `mkfs`.

Type

Boolean

Required

No

Default

`false`

1. LOGGING AND DEBUGGING

Typically, when you add debugging to your Ceph configuration, you do so at runtime. You can also add Ceph debug logging to your Ceph configuration file if you are encountering issues when starting your cluster. You may view Ceph log files under **`/var/log/ceph`** (the default location).

Tip

When debug output slows down your system, the latency can hide race conditions.

Logging is resource intensive. If you are encountering a problem in a specific area of your cluster, enable logging for that area of the cluster. For example, if your OSDs are running fine, but your gateways are not, you should start by enabling debug logging for the specific gateway instance(s) giving you trouble. Enable logging for each subsystem as needed.

Important

Verbose logging can generate over 1GB of data per hour. If your OS disk reaches its capacity, the node will stop working.

If you enable or increase the rate of Ceph logging, ensure that you have sufficient disk space on your OS disk. See Accelerating Log Rotation for details on rotating log files. When your system is running well, remove unnecessary debugging settings to ensure your cluster runs optimally. Logging debug output messages is relatively slow, and a waste of resources when operating your cluster.

See Subsystem, Log and Debug Settings for details on available settings.

1.1. Runtime

If you would like to see the configuration settings at runtime, you must log in to a host with a running daemon and execute the following:

```
ceph --admin-daemon </path/to/admin/socket> config show | less
ceph --admin-daemon /var/run/ceph/ceph-osd.0.asok config show | less
```

To activate Ceph's debugging output (*i.e.*, **`dout()`**) at runtime, use the **`ceph tell`** command to inject arguments into the runtime configuration:

```
ceph tell <daemon-type>.<daemon id or *> injectargs --<name> <value> [--<name> <value>]
```

Replace **`<daemon-type>`** with one of **`osd`** or **`mon`**. You may apply the runtime setting to all daemons of a particular type with **`*`**, or specify a specific daemon's ID (i.e., its number or letter). For example, to increase debug logging for a **`ceph-osd`** daemon named **`osd.0`**, execute the following:

```
ceph tell osd.0 injectargs --debug-osd 0/5
```

The **`ceph tell`** command goes through the monitors. If you cannot bind to the monitor, you can still make the change by logging into the host of the daemon whose configuration you'd like to

change using **`ceph --admin-daemon`**. For example:

```
sudo ceph --admin-daemon /var/run/ceph/ceph-osd.0.asok config set
debug_osd 0/5
```

See Subsystem, Log and Debug Settings for details on available settings.

1.2. Boot Time

To activate Ceph's debugging output (*i.e.*, **`dout()`**) at boot time, you must add settings to your Ceph configuration file. Subsystems common to each daemon may be set under **`[global]`** in your configuration file. Subsystems for particular daemons are set under the daemon section in your configuration file (*e.g.*, **`[mon]`**, **`[osd]`**). For example:

```
[global]
    debug ms = 1/5

[mon]
    debug mon = 20
    debug paxos = 1/5
    debug auth = 2

[osd]
    debug osd = 1/5
    debug filestore = 1/5
    debug journal = 1
    debug monc = 5/20
```

See Subsystem, Log and Debug Settings for details on available settings.

1.3. Accelerating Log Rotation

If your OS disk is relatively full, you can accelerate log rotation by modifying the Ceph log rotation file at **`/etc/logrotate.d/ceph`**. Add a size setting after the rotation frequency to accelerate log rotation (via cronjob) if your logs exceed the size setting. For example, the default setting looks like this:

```
rotate 7
weekly
compress
sharedscripts
```

Modify it by adding a **`size`** setting.

```
rotate 7
weekly
size 500M
compress
sharedscripts
```

Then, start the crontab editor for your user space.

```
crontab -e
```

Finally, add an entry to check the **etc/logrotate.d/ceph** file.

```
30 * * * * /usr/sbin/logrotate /etc/logrotate.d/ceph >/dev/null 2>&1
```

The preceding example checks the **etc/logrotate.d/ceph** file every 30 minutes.

1.4. Valgrind

Debugging may also require you to track down memory and threading issues. You can run a single daemon, a type of daemon, or the whole cluster with Valgrind. You should only use Valgrind when developing or debugging Ceph. Valgrind is computationally expensive, and will slow down your system otherwise. Valgrind messages are logged to **stderr**.

1.5. Subsystem, Log and Debug Settings

In most cases, you will enable debug logging output via subsystems.

1.5.1. Ceph Subsystems

Each subsystem has a logging level for its output logs, and for its logs in-memory. You may set different values for each of these subsystems by setting a log file level and a memory level for debug logging. Ceph's logging levels operate on a scale of **1** to **20**, where **1** is terse and **20** is verbose.

A debug logging setting can take a single value for the log level and the memory level, which sets them both as the same value. For example, if you specify **debug ms = 5**, Ceph will treat it as a log level and a memory level of **5**. You may also specify them separately. The first setting is the log level, and the second setting is the memory level. You must separate them with a forward slash (/). For example, if you want to set the **ms** subsystem's debug logging level to **1** and its memory level to **5**, you would specify it as **debug ms = 1/5**. For example:

```
debug <subsystem> = <log-level>/<memory-level>
#for example
debug osd log = 1/20
```

The following table provides a list of Ceph subsystems and their default log and memory levels. Once you complete your logging efforts, restore the subsystems to their default level or to a level suitable for normal operations.

Subsystem	Log Level	Memory Level
default	0	5
lockdep	0	5
context	0	5

Subsystem	Log Level	Memory Level
crush	1	5
buffer	0	0
timer	0	5
filer	0	5
objecter	0	0
rados	0	5
rbd	0	5
journaler	0	5
objectcacher	0	5
client	0	5
osd	0	5
optracker	0	5
objclass	0	5
filestore	1	5
journal	1	5

Subsystem	Log Level	Memory Level
ms	0	5
mon	1	5
monc	0	5
paxos	0	5
tp	0	5
auth	1	5
finisher	1	5
heartbeatmap	1	5
perfcounter	1	5
rgw	1	5
javaclient	1	5
asok	1	5
throttle	1	5

1.5.2. Logging Settings

Logging and debugging settings are not required in a Ceph configuration file, but you may override default settings as needed. Ceph supports the following settings:

log file

Description

The location of the logging file for your cluster.

Type

String

Required

No

Default

`/var/log/ceph/$cluster-$name.log`

log max new

Description

The maximum number of new log files.

Type

Integer

Required

No

Default

`1000`

log max recent

Description

The maximum number of recent events to include in a log file.

Type

Integer

Required

No

Default

`1000000`

log to stderr

Description

Determines if logging messages should appear in `stderr`.

Type

Boolean

Required

No

Default

`true`

err to stderr

Description

Determines if error messages should appear in **`stderr`**.

Type

Boolean

Required

No

Default

`true`

log to syslog

Description

Determines if logging messages should appear in **`syslog`**.

Type

Boolean

Required

No

Default

`false`

err to syslog

Description

Determines if error messages should appear in **`syslog`**.

Type

Boolean

Required

No

Default

`false`

log flush on exit

Description

Determines if Ceph should flush the log files after exit.

Type

Boolean

Required

No

Default

`true`

clog to monitors

Description

Determines if **`clog`** messages should be sent to monitors.

Type

Boolean

Required

No

Default

`true`

clog to syslog

Description

Determines if **`clog`** messages should be sent to syslog.

Type

Boolean

Required

No

Default

`false`

mon cluster log to syslog

Description

Determines if the cluster log should be output to the syslog.

Type

Boolean

Required

No

Default

`false`

mon cluster log file

Description

The location of the cluster's log file.

Type

String

Required

No

Default

`/var/log/ceph/$cluster.log`

1.5.3. OSD

osd preserve trimmed log

Description

Preserves trimmed logs after trimming.

Type

Boolean

Required

No

Default

`false`

osd tmapput sets uses tmap

Description

Uses `tmap`. For debug only.

Type

Boolean

Required

No

Default

`false`

osd min pg log entries

Description

The minimum number of log entries for placement groups.

Type

32-bit Unsigned Integer

Required

No

Default

1000

osd op log threshold

Description

How many op log messages to show up in one pass.

Type

Integer

Required

No

Default

5

1.5.4. Filestore

filestore debug omap check

Description

Debugging check on synchronization. This is an expensive operation.

Type

Boolean

Required

No

Default

0

1.5.5. RADOS Gateway

rgw log nonexistent bucket

Description

Log non-existent buckets.

Type

Boolean

Required

No

Default

`false`

rgw log object name

Description

Log an object's name.

Type

String

Required

No

Default

`%Y-%m-%d-%H-%i-%n`

rgw log object name utc

Description

Object log name contains UTC.

Type

Boolean

Required

No

Default

`false`

rgw enable ops log

Description

Enables logging of every RGW operation.

Type

Boolean

Required

No

Default

`true`

rgw enable usage log

Description

Enable logging of RGW's bandwidth usage.

Type

Boolean

Required

No

Default

`true`

rgw usage log flush threshold

Description

Threshold to flush pending log data.

Type

Integer

Required

No

Default

`1024`

rgw usage log tick interval

Description

Flush pending log data every `s` seconds.

Type

Integer

Required

No

Default

30

rgw intent log object name

Description, Type

String

Required

No

Default

`%Y-%m-%d-%i-%n`

rgw intent log object name utc

Description

Include a UTC timestamp in the intent log object name.

Type

Boolean

Required

No

Default

`false`