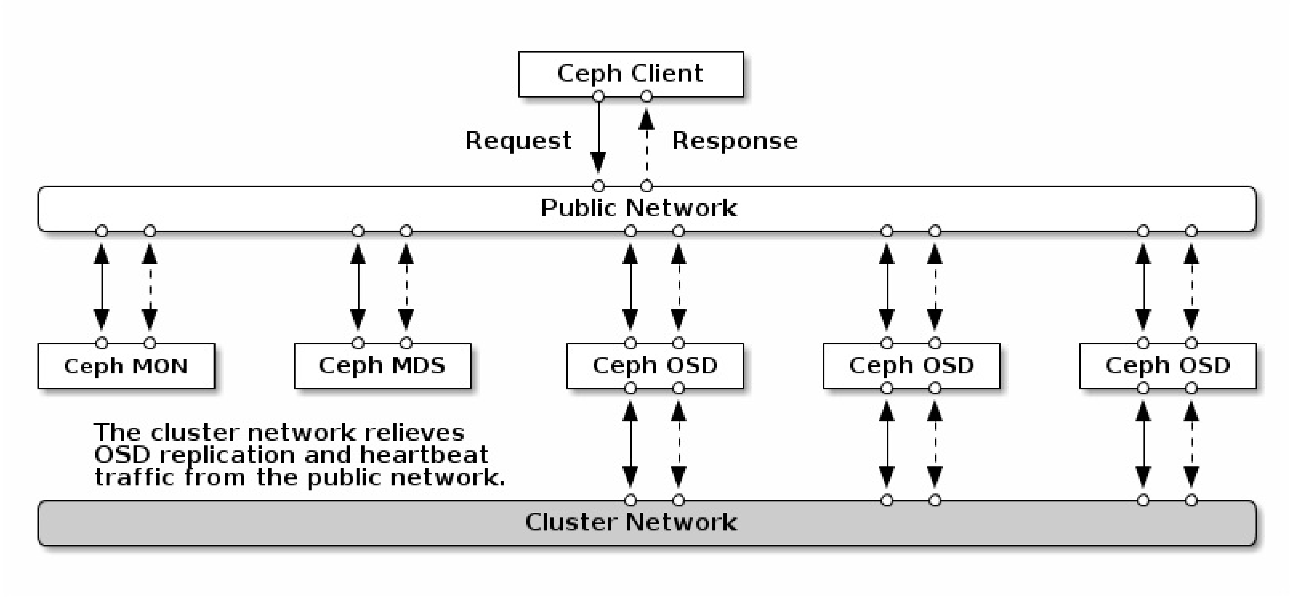
NETWORK CONFIGURATION REFERENCE

Network configuration is critical for building a high performance Ceph cluster. The Ceph cluster does not perform request routing or dispatching on behalf of the client. Instead, Ceph clients (i.e., block device, CephFS, REST gateway) make requests directly to OSDs. Ceph OSDs perform data replication on behalf of clients, which means replication and other factors impose additional loads on Ceph cluster networks.

Our 5-minute Quick Start provides a trivial Ceph configuration file that sets monitor IP addresses and daemon host names only. The quick start configuration 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 cluster with two networks: a public (front-side) network and a cluster (back-side) network. To support two networks, your hosts need to have more than one NIC. See Hardware Recommendations - Networks for additional details.



There are several reasons to consider operating two separate networks:

1. **Peformance:** OSDs handle data replication for the clients. When OSDs replicate data more than once, the network load between OSDs easily dwarfs the network load between clients and the Ceph cluster. This can introduce latency and create a performance problem. Recovery and rebalancing can also introduce significant latency on the public network. See How Ceph Scales for additional details on how Ceph replicates data. See Monitor / OSD Interaction for details on heartbeat traffic.
2. **Security**: While most people are generally civil, a very tiny segment of the population likes to engage in what’s known as a Denial of Service (DoS) attack. When traffic between OSDs gets disrupted, 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. Also, consider using Message Signatures to defeat spoofing attacks.

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.

```
sudo iptables -L
```

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 will need to 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 cluster hosts.

MONITOR IP TABLES

Monitors listen on port 6789 by default. Additionally, 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
```

MDS IP TABLES

Metadata servers listen on the first available port on the public network beginning at port 6800. Ensure that you open one port beginning at port 6800 for each metadata server that runs on the host. 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 of the public network.

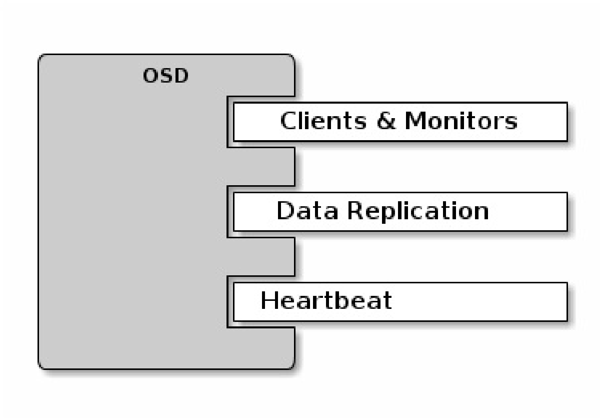
For example:

```
sudo iptables -A INPUT -i {iface} -m multiport -p tcp -s {ip-address}/{netmask} --dports 6800
```

OSD IP TABLES

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

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



Ports are host-specific, so you don’t need to open any more ports than the number of ports needed by Ceph daemons running on that host. 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 OSDs 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 680
```

Tip: If you run metadata servers on the same host as the OSDs, you can consolidate the public network configuration step. Ensure that you open the number of ports required for each daemon per host.

CEPH NETWORKS

To configure Ceph networks, you must add a network configuration to the `[global]` section of the configuration file. Our 5-

minute Quick Start provides a trivial Ceph configuration file that assumes one public network with client and server on the same network and subnet. 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.

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}
```

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.

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.

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.

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

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

BIND

Bind settings set the default port ranges Ceph OSD and MDS daemons use. The default range is `6800:7100`. Ensure that your IP

Tables 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 or MDS daemon will bind.
Type:	32-bit Integer
Default:	`6800`
Required:	No

`ms bind port max`

Description:	The maximum port number to which an OSD or MDS 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

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.

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.