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Install Ceph 15 (Octopus) Cluster on CentOS 8 | ComputingForGeeks

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11-14 minutes

This tutorial will show you how to Install and configure Ceph Storage Cluster on CentOS 8 Linux servers. Ceph is an open source, massively scalable, simplified storage solution that implements distributed object storage cluster, and provides interfaces for an object, block, and file-level storage. Our installation of Ceph 15 (Octopus) Storage Cluster on CentOS 8 will use Ansible as automation method for deployment.

Ceph Cluster Components

The basic components of a Ceph storage cluster

- **Monitors**: A Ceph Monitor (`ceph-mon`) maintains maps of the cluster state, including the monitor map, manager map, the OSD map, and the CRUSH map
- **Ceph OSDs**: A Ceph OSD (object storage daemon, `ceph-osd`) stores data, handles data replication, recovery, rebalancing, and provides some monitoring information to Ceph Monitors and Managers by checking other Ceph OSD Daemons for a heartbeat. At least 3 Ceph OSDs are normally required for redundancy and high availability.
- **MDSs**: A Ceph Metadata Server (MDS, `ceph-mds`) stores metadata on behalf of the Ceph Filesystem (i.e., Ceph Block Devices and Ceph Object Storage do not use MDS). Ceph Metadata Servers allow POSIX file system users to execute basic commands (like,`ls`, `find` etc.) without placing an enormous burden on the Ceph Storage Cluster.\
- **Ceph Managers**: A Ceph Manager daemon (`ceph-mgr`) is responsible for keeping track of runtime metrics and the current state of the Ceph cluster, including storage utilization, current performance metrics, and system load.

Our Ceph Storage Cluster installation on CentOS 8 is based on below system design.

SERVER NAME	CEPH COMPONENT	Server Specs
cephadmin	ceph-ansible	2gb ram, 1vcpus
cephmon01	Ceph Monitor	8gb ram, 4vpcus
cephmon02	Ceph MON, MGR,MDS	8gb ram, 4vpcus
cephmon03	Ceph MON, MGR,MDS	8gb ram, 4vpcus
cephosd01	Ceph OSD	16gb ram, 8vpcus
cephosd02	Ceph OSD	16gb ram, 8vpcus
cephosd03	Ceph OSD	16gb ram, 8vpcus

The **cephadmin** node will be used for deployment of Ceph Storage Cluster on CentOS 8.

Step 1: Prepare all Nodes – ceph-ansible, OSD, MON, MGR, MDS

We need to prepare all the nodes by following below few steps.

- Set Correct hostname on each server
- Set correct time and configure chrony NTP service
- Add hostname with IP addresses to DNS server or update */etc/hosts* on all servers

Example of /**etc**/**hosts** contents on each host.

```
sudo tee -a /etc/hosts<<EOF
192.168.10.10  cephadmin
192.168.10.11  cephmon01
192.168.10.12  cephmon02
192.168.10.13  cephmon03
192.168.10.14  cephosd01
192.168.10.15  cephosd02
192.168.10.16  cephosd03
EOF
```

Once you've done above tasks, install basic packages:

```
sudo dnf update
sudo dnf install vim bash-completion tmux
```

Reboot each server after upgrade.

```
sudo dnf -y update && sudo reboot
```

Step 2: Prepare Ceph Admin Node

Login to the admin node:

```
$ ssh root@cephadmin
```

Add EPEL repository:

```
sudo dnf -y install https://dl.fedoraproject.org/pub/epel/epel-release-latest-8.noarch.rpm
sudo dnf config-manager --set-enabled PowerTools
```

Install Git:

```
sudo yum install git vim bash-completion
```

Clone Ceph Ansible repository:

```
git clone https://github.com/ceph/ceph-ansible.git
```

Choose ceph-ansible branch you wish to use. The command Syntax is:

```
git checkout $branch
```

I'll switch to *stable-5.0* which supports Ceph **octopus** version.

```
cd ceph-ansible
git checkout stable-5.0
```

Install Python pip.

```
sudo yum install python3-pip
```

Use pip and the provided *requirements.txt* to install Ansible and other needed Python libraries:

```
sudo pip3 install -r requirements.txt
```

Ensure */usr/local/bin* path is added to PATH.

```
$ echo "PATH=\$PATH:/usr/local/bin" >>~/.bashrc
$ source ~/.bashrc
```

Confirm Ansible version installed.

```
$ ansible --version
ansible 2.9.7
  config file = /root/ceph-ansible/ansible.cfg
  configured module search path = ['/root/ceph-ansible/library']
  ansible python module location = /usr/local/lib/python3.6/site-packages/ansible
  executable location = /usr/local/bin/ansible
  python version = 3.6.8 (default, Nov 21 2019, 19:31:34) [GCC 8.3.1 20190507 (Red Hat 8.3.1-4)]
```

Copy SSH Public Key to all nodes

Set SSH key-pair on your Ceph Admin Node and copy the public key to **all storage Nodes**.

```
$ ssh-keygen

-- Copy pubkey, example:
for host in cephmon01 cephmon02 cephmon03 cephosd01 cephosd02 cephosd03; do
 ssh-copy-id root@$host
done
```

Create ssh configuration file on the Admin node for all storage nodes.

```
# This is my ssh config file
$ vi ~/.ssh/config
Host cephadmin
    Hostname 192.168.10.10
    User root
Host cephmon01
    Hostname 192.168.10.11
    User root
Host cephmon02
    Hostname 192.168.10.12
    User root
Host cephmon03
    Hostname 192.168.10.13
    User root
Host cephosd01
    Hostname 192.168.10.14
    User root
Host cephosd02
    Hostname 192.168.10.15
    User root
Host cephosd03
    Hostname 192.168.10.16
    User root
```

- Replace Hostname values with the **IP addresses** of the nodes and **User** value with the remote user you're installing as.

When not using root for SSH

For normal user installations, enable the remote user **on all storage the nodes** to perform passwordless sudo.

```
echo -e 'Defaults:user !requiretty\nusername ALL = (root) NOPASSWD:ALL' | sudo tee /etc/sudoers.d
/ceph
sudo chmod 440 /etc/sudoers.d/ceph
```

Where **username** is to be replaced with the name of user configured in ~/**.ssh**/**config** file.

Configure Ansible Inventory and Playbook

Create Ceph Cluster group variables file on the admin Node

```
cd ceph-ansible
cp group_vars/all.yml.sample  group_vars/all.yml
vim group_vars/all.yml
```

Edit the file to configure your ceph cluster

```
ceph_release_num: 15
cluster: ceph

# Inventory host group variables
mon_group_name: mons
osd_group_name: osds
rgw_group_name: rgws
mds_group_name: mdss
nfs_group_name: nfss
rbdmirror_group_name: rbdmirrors
client_group_name: clients
iscsi_gw_group_name: iscsigws
mgr_group_name: mgrs
rgwloadbalancer_group_name: rgwloadbalancers
grafana_server_group_name: grafana-server

# Firewalld / NTP
configure_firewall: True
ntp_service_enabled: true
ntp_daemon_type: chronyd

# Ceph packages
ceph_origin: repository
ceph_repository: community
ceph_repository_type: cdn
ceph_stable_release: octopus

# Interface options
monitor_interface: eth0
radosgw_interface: eth0

# DASHBOARD
dashboard_enabled: True
dashboard_protocol: http
dashboard_admin_user: admin
dashboard_admin_password: St0ngAdminp@ass

grafana_admin_user: admin
grafana_admin_password: St0ngAdminp@ass
```

If you have separate networks for Cluster and Public network, define them accordingly.

```
public_network: "192.168.3.0/24"
cluster_network: "192.168.4.0/24"
```

Configure other parameters as you see fit.

Set OSD Devices.

I have three OSD nodes and each have one raw block devices – /**dev**/**sdb**

```
$ lsblk
NAME    MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
sda       8:0    0 76.3G  0 disk
├─sda1    8:1    0 76.2G  0 part /
├─sda14   8:14   0    1M  0 part
└─sda15   8:15   0   64M  0 part /boot/efi
sdb       8:16   0   50G  0 disk
sr0      11:0    1 1024M  0 rom
```

List your OSD raw block devices to be used.

```
$ cp group_vars/osds.yml.sample group_vars/osds.yml
$ vim group_vars/osds.yml
copy_admin_key: true
devices:
  - /dev/sdb
```

Create a new ceph nodes ansible inventory:

```
vim hosts
```

Properly set your inventory file. Below is my inventory. Modify inventory groups the way you want services installed in your cluster nodes.

```
# Ceph admin user for SSH and Sudo
[all:vars]
ansible_ssh_user=root
ansible_become=true
```

```
ansible_become_method=sudo
ansible_become_user=root

# Ceph Monitor Nodes
[mons]
cephmon01
cephmon02
cephmon03

# MDS Nodes
[mdss]
cephmon01
cephmon02
cephmon03

# RGW
[rgws]
cephmon01
cephmon02
cephmon03

# Manager Daemon Nodes
[mgrs]
cephmon01
cephmon02
cephmon03

# set OSD (Object Storage Daemon) Node
[osds]
cephosd01
cephosd02
cephosd03

# Grafana server
[grafana-server]
cephosd01
```

Step 3: Deploy Ceph 15 (Octopus) Cluster on CentOS 8

Create Playbook file by copying a sample playbook at the root of the *ceph-ansible* project called *site.yml.sample*.

```
cp site.yml.sample site.yml
```

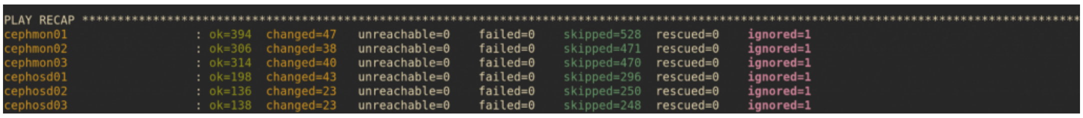
Run Playbook.

```
ansible-playbook -i hosts site.yml
```

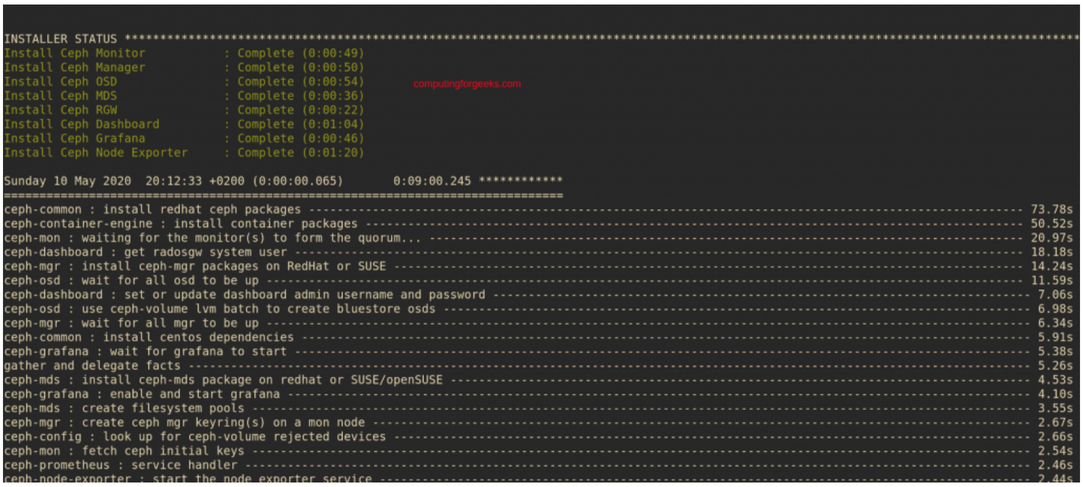
If installation was successful, a health check should return OK.

```
...
TASK [show ceph status for cluster ceph]
********************************************************************************************************
Sunday 10 May 2020  20:12:33 +0200 (0:00:00.721)       0:09:00.180 ************
ok: [cephmon01 -> cephmon01] =>
  msg:
  - '  cluster:'
  - '    id:     b64fac77-df30-4def-8e3c-1935ef9f0ef3'
  - '    health: HEALTH_OK'
  - ' '
  - '  services:'
  - '    mon: 3 daemons, quorum ceph-mon-02,ceph-mon-03,ceph-mon-01 (age 6m)'
  - '    mgr: ceph-mon-03(active, since 38s), standbys: ceph-mon-02, ceph-mon-01'
  - '    mds: cephfs:1 {0=ceph-mon-02=up:active} 2 up:standby'
  - '    osd: 3 osds: 3 up (since 4m), 3 in (since 4m)'
  - '    rgw: 3 daemons active (ceph-mon-01.rgw0, ceph-mon-02.rgw0, ceph-mon-03.rgw0)'
  - ' '
  - '  task status:'
  - '    scrub status:'
  - '        mds.ceph-mon-02: idle'
  - ' '
  - '  data:'
  - '    pools:   7 pools, 132 pgs'
  - '    objects: 215 objects, 9.9 KiB'
  - '    usage:   3.0 GiB used, 147 GiB / 150 GiB avail'
  - '    pgs:     0.758% pgs not active'
  - '             131 active+clean'
  - '             1   peering'
  - ' '
  - '  io:'
  - '    client:   3.5 KiB/s rd, 402 B/s wr, 3 op/s rd, 0 op/s wr'
  - ' '
....
```

This is a screenshot of my installation output once it has been completed.



```
PLAY RECAP ************************************************************************************************************************
cephmon01                  : ok=394  changed=47   unreachable=0    failed=0    skipped=528  rescued=0    ignored=1
cephmon02                  : ok=306  changed=38   unreachable=0    failed=0    skipped=471  rescued=0    ignored=1
cephmon03                  : ok=314  changed=40   unreachable=0    failed=0    skipped=470  rescued=0    ignored=1
cephosd01                  : ok=198  changed=43   unreachable=0    failed=0    skipped=296  rescued=0    ignored=1
cephosd02                  : ok=136  changed=23   unreachable=0    failed=0    skipped=250  rescued=0    ignored=1
cephosd03                  : ok=138  changed=23   unreachable=0    failed=0    skipped=248  rescued=0    ignored=1
```



```
INSTALLER STATUS *************************************************************************************************************************************
Install Ceph Monitor           : Complete (0:00:49)
Install Ceph Manager           : Complete (0:00:50)
Install Ceph OSD               : Complete (0:00:54)
Install Ceph MDS               : Complete (0:00:36)
Install Ceph RGW               : Complete (0:00:22)
Install Ceph Dashboard         : Complete (0:01:04)
Install Ceph Grafana           : Complete (0:00:46)
Install Ceph Node Exporter     : Complete (0:01:20)

Sunday 10 May 2020  20:12:33 +0200 (0:00:00.065)       0:09:00.245 ************
===============================================================================
ceph-common : install redhat ceph packages ---------------------------------------------------------------------------------------------------- 73.78s
ceph-container-engine : install container packages -------------------------------------------------------------------------------------------- 50.52s
ceph-mon : waiting for the monitor(s) to form the quorum... ----------------------------------------------------------------------------------- 20.97s
ceph-dashboard : get radosgw system user ------------------------------------------------------------------------------------------------------ 18.18s
ceph-mgr : install ceph-mgr packages on RedHat or SUSE ---------------------------------------------------------------------------------------- 14.24s
ceph-osd : wait for all osd to be up ---------------------------------------------------------------------------------------------------------- 11.59s
ceph-dashboard : set or update dashboard admin username and password --------------------------------------------------------------------------- 7.06s
ceph-osd : use ceph-volume lvm batch to create bluestore osds ---------------------------------------------------------------------------------- 6.98s
ceph-mgr : wait for all mgr to be up ----------------------------------------------------------------------------------------------------------- 6.34s
ceph-common : install centos dependencies ------------------------------------------------------------------------------------------------------ 5.91s
ceph-grafana : wait for grafana to start ------------------------------------------------------------------------------------------------------- 5.38s
gather and delegate facts ---------------------------------------------------------------------------------------------------------------------- 5.26s
ceph-mds : install ceph-mds package on redhat or SUSE/openSUSE --------------------------------------------------------------------------------- 4.53s
ceph-grafana : enable and start grafana -------------------------------------------------------------------------------------------------------- 4.10s
ceph-mds : create filesystem pools ------------------------------------------------------------------------------------------------------------- 3.55s
ceph-mgr : create ceph mgr keyring(s) on a mon node -------------------------------------------------------------------------------------------- 2.67s
ceph-config : look up for ceph-volume rejected devices ----------------------------------------------------------------------------------------- 2.66s
ceph-mon : fetch ceph initial keys ------------------------------------------------------------------------------------------------------------- 2.54s
ceph-prometheus : service handler -------------------------------------------------------------------------------------------------------------- 2.46s
ceph-node-exporter : start the node exporter service ------------------------------------------------------------------------------------------- 2.44s
```

Step 4: Validate Ceph Cluster Installation on CentOS 8

Login to one of the cluster nodes and do some validations to confirm installation of Ceph Storage Cluster on CentOS 8 was successful.

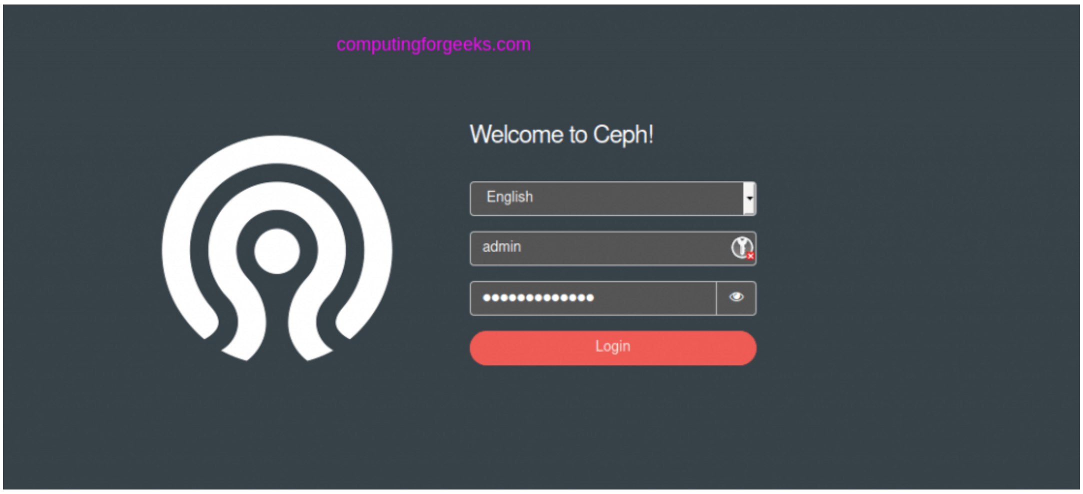
```
$ ssh root@ceph-mon-01
# ceph -s
  cluster:
    id:     b64fac77-df30-4def-8e3c-1935ef9f0ef3
    health: HEALTH_OK

  services:
    mon: 3 daemons, quorum ceph-mon-02,ceph-mon-03,ceph-mon-01 (age 22m)
    mgr: ceph-mon-03(active, since 16m), standbys: ceph-mon-02, ceph-mon-01
    mds: cephfs:1 {0=ceph-mon-02=up:active} 2 up:standby
    osd: 3 osds: 3 up (since 20m), 3 in (since 20m)
    rgw: 3 daemons active (ceph-mon-01.rgw0, ceph-mon-02.rgw0, ceph-mon-03.rgw0)

  task status:
    scrub status:
        mds.ceph-mon-02: idle

  data:
    pools:   7 pools, 121 pgs
    objects: 215 objects, 11 KiB
    usage:   3.1 GiB used, 147 GiB / 150 GiB avail
    pgs:     121 active+clean
```

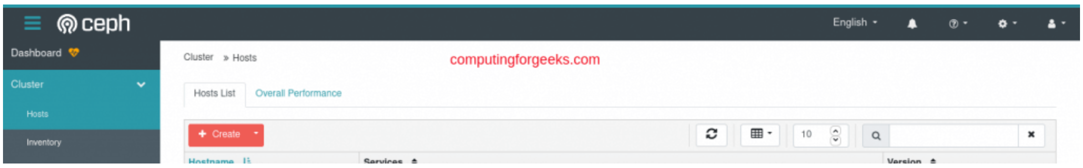
You can access Ceph Dashboard on the active MGR node.

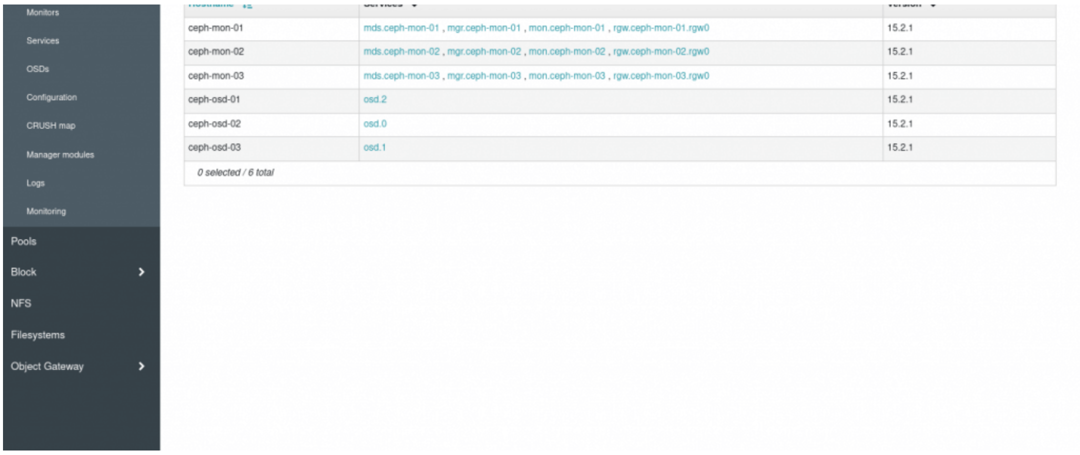


Login with credentials configured in **group_vars/all.yml** file. For me these are:

```
dashboard_admin_user: admin
dashboard_admin_password: St0ngAdminp@ass
```

You can then create more users with varying access level at the cluster.

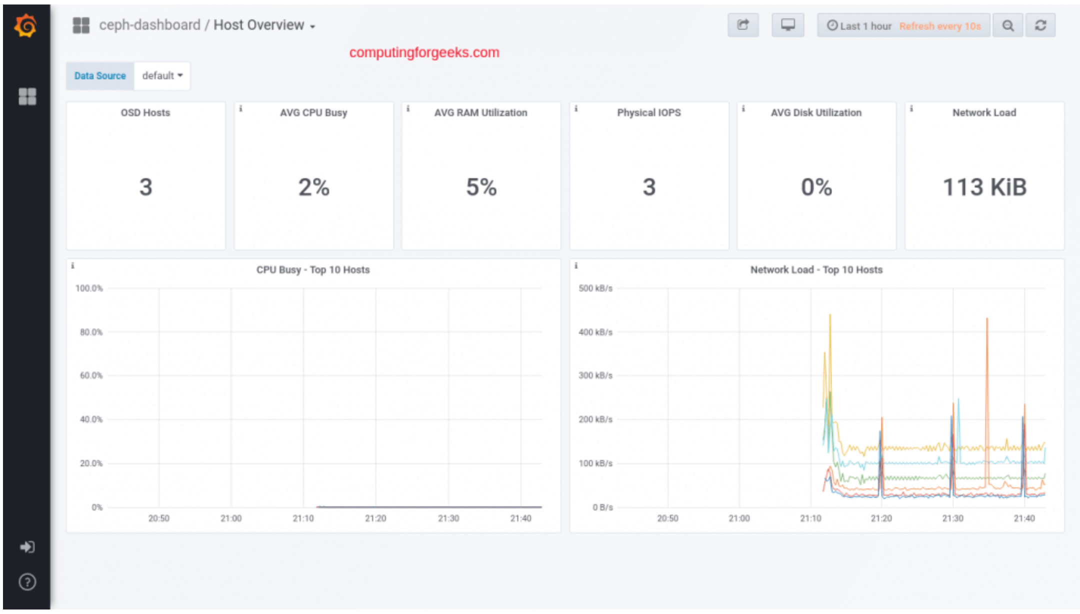




Hostname	Services	Version
ceph-mon-01	mds.ceph-mon-01 , mgr.ceph-mon-01 , mon.ceph-mon-01 , rgw.ceph-mon-01.rgw0	15.2.1
ceph-mon-02	mds.ceph-mon-02 , mgr.ceph-mon-02 , mon.ceph-mon-02 , rgw.ceph-mon-02.rgw0	15.2.1
ceph-mon-03	mds.ceph-mon-03 , mgr.ceph-mon-03 , mon.ceph-mon-03 , rgw.ceph-mon-03.rgw0	15.2.1
ceph-osd-01	osd.2	15.2.1
ceph-osd-02	osd.0	15.2.1
ceph-osd-03	osd.1	15.2.1

0 selected / 6 total

Grafana Dashboard can be accessed on the Node you set for **grafana-server** group name. The service should be listening on port **3000** by default.



Use Access credentials configured to access admin console.

```
grafana_admin_user: admin
grafana_admin_password: St0ngAdminp@ass
```

Day-2 Operations

ceph-ansible provides a set of playbook in `infrastructure-playbooks` directory in order to perform some basic day-2 operations.

- Adding osd(s)
- Shrinking osd(s)
- Purging the cluster

Reference:

- OSD Scenario
- Ceph-ansible documentation

Here are some more useful guides on Ceph:

Enable and Configure REST API Access in Ceph Object Storage

Create a Pool in Ceph Storage Cluster

How To Configure AWS S3 CLI for Ceph Object Gateway Storage

Ceph Persistent Storage for Kubernetes with Cephfs

Persistent Storage for Kubernetes with Ceph RBD

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