



# Red Hat OpenShift Container Storage 4.4

## Deploying OpenShift Container Storage

How to install and set up your environment



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How to install and set up your environment

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## Abstract

Read this document for instructions on installing Red Hat OpenShift Container Storage 4.4.

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## PREFACE

OpenShift Container Storage 4.4 installation is supported only on existing Red Hat OpenShift Container Platform (OCP) worker nodes.

# CHAPTER 1. DEPLOYING OPENSIFT CONTAINER STORAGE ON OPENSIFT CONTAINER PLATFORM

The deployment process consists of two main parts:

1. Install the OpenShift Container Storage Operator by following the instructions in [Section 1.1, “Installing Red Hat OpenShift Container Storage Operator using the Operator Hub”](#).
2. Create the OpenShift Container Storage service by following the instructions in [Section 1.2, “Creating an OpenShift Container Storage service”](#).



## NOTE

- When you install OpenShift Container Storage in a restricted network environment, you need to apply a custom Network Time Protocol (NTP) configuration to the nodes, because by default, internet connectivity is assumed in OpenShift Container Platform and **chronyd** is configured to use **\*.rhel.pool.ntp.org** servers. See [Red Hat Knowledgebase article](#) and [Configuring chrony time service](#) for more details.
- **PodDisruptionBudget** alert, which is an OpenShift Container Platform alert, will start to appear for object storage devices (OSDs) after the deployment. You can ignore this alert. Also, you can silence this alert by following the instructions in [Managing cluster alerts](#) section of the OpenShift Container Platform documentation. For instructions on how to do so, see the [Managing cluster alerts](#) sections of the Red Hat OpenShift Container Platform documentation. For more information, see [Red Hat Knowledgebase article](#).

For Red Hat Enterprise Linux based hosts in a user provisioned infrastructure (UPI), you need to enable container access to the underlying file system by following the instructions in [Section 1.3, “Enabling file system access for containers on Red Hat Enterprise Linux based nodes”](#).

## 1.1. INSTALLING RED HAT OPENSIFT CONTAINER STORAGE OPERATOR USING THE OPERATOR HUB

You can install Red Hat OpenShift Container Storage using the Red Hat OpenShift Container Platform Operator Hub on Amazon Web Services (AWS) and VMware vSphere platforms. For information about the hardware and software requirements, see [Planning your deployment](#) guide.

### Prerequisites

- Log in to OpenShift Container Platform cluster.
- You must have at least three worker nodes in the OpenShift Container Platform cluster.
- You must create a namespace called **openshift-storage** as follows:
  1. Click **Administration** → **Namespaces** in the left pane of the OpenShift Web Console.
  2. Click **Create Namespace**.
  3. In the Create Namespace dialog box, enter **openshift-storage** for Name and **openshift.io/cluster-monitoring=true** for Labels. This label is required to get the dashboards.



4. Select **No restrictions** option for **Default Network Policy**.
5. Click **Create**.



#### NOTE

When you need to override the cluster-wide default node selector for OpenShift Container Storage, you can use the following command in command line interface to specify a blank node selector for the **openshift-storage** namespace:

```
$ oc annotate namespace openshift-storage openshift.io/node-selector=
```

#### Procedure

1. Click **Operators** → **OperatorHub** in the left pane of the OpenShift Web Console.
2. Click on **OpenShift Container Storage**.  
You can use the **Filter by keyword** text box or the filter list to search for OpenShift Container Storage from the list of operators.
3. On the **OpenShift Container Storage operator** page, click **Install**.
4. On the **Install Operator** page, ensure the following options are selected:
  - a. Update Channel as **stable-4.4**
  - b. Installation Mode as **A specific namespace on the cluster**
  - c. Installed Namespace as **Operator recommended namespace PR openshift-storage**. If Namespace **openshift-storage** does not exist, it will be created during the operator installation.
  - d. Select **Approval Strategy** as **Automatic** or **Manual**. Approval Strategy is set to **Automatic** by default.
    - **Approval Strategy** as **Automatic**.



#### NOTE

When you select the Approval Strategy as **Automatic**, approval is not required either during fresh installation or when updating to the latest version of OpenShift Container Storage.

- i. Click **Install**
- ii. Wait for the install to initiate. This may take up to 20 minutes.
- iii. Click **Operators** → **Installed Operators**
- iv. Ensure the **Project** is **openshift-storage**. By default, the **Project** is **openshift-storage**.
- v. Wait for the **Status** of **OpenShift Container Storage** to change to **Succeeded**.
  - **Approval Strategy** as **Manual**.

**NOTE**

When you select the Approval Strategy as **Manual**, approval is required during fresh installation or when updating to the latest version of OpenShift Container Storage.

- i. Click **Install**
- ii. On the **Installed Operators** page, click **ocs-operator**.
- iii. On the **Subscription Details** page, click the **Install Plan** link.
- iv. On the **InstallPlan Details** page, click **Preview Install Plan**
- v. Review the install plan and click **Approve**.
- vi. Wait for the **Status** of the **Components** to change from **Unknown** to either **Created** or **Present**.
- vii. Click **Operators → Installed Operators**
- viii. Ensure the **Project** is **openshift-storage**. By default, the **Project** is **openshift-storage**.
- ix. Wait for the **Status** of **OpenShift Container Storage** to change to **Succeeded**.

**Verification steps**

- Verify that **OpenShift Container Storage** Operator show the Status as **Succeeded**.

## 1.2. CREATING AN OPENSIFT CONTAINER STORAGE SERVICE

You need to create a new OpenShift Container Storage service after you install OpenShift Container Storage operator.

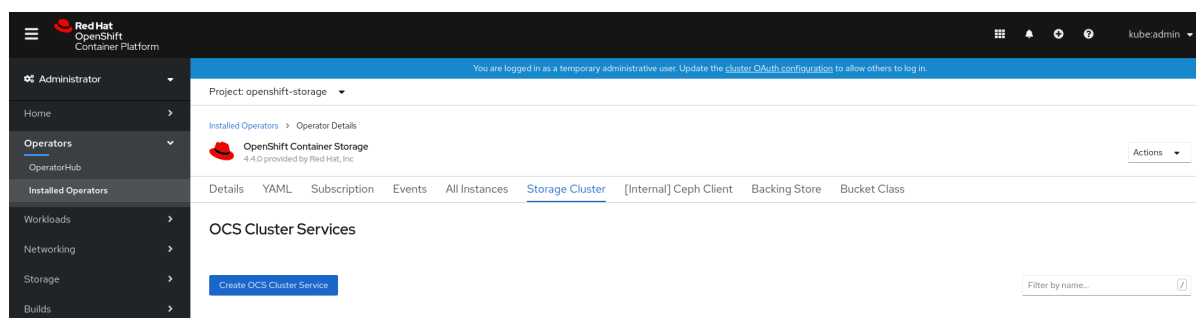
**Prerequisites**

- OpenShift Container Storage operator must be installed from the Operator Hub. For more information, see [Installing OpenShift Container Storage Operator using the Operator Hub](#) .

**Procedure**

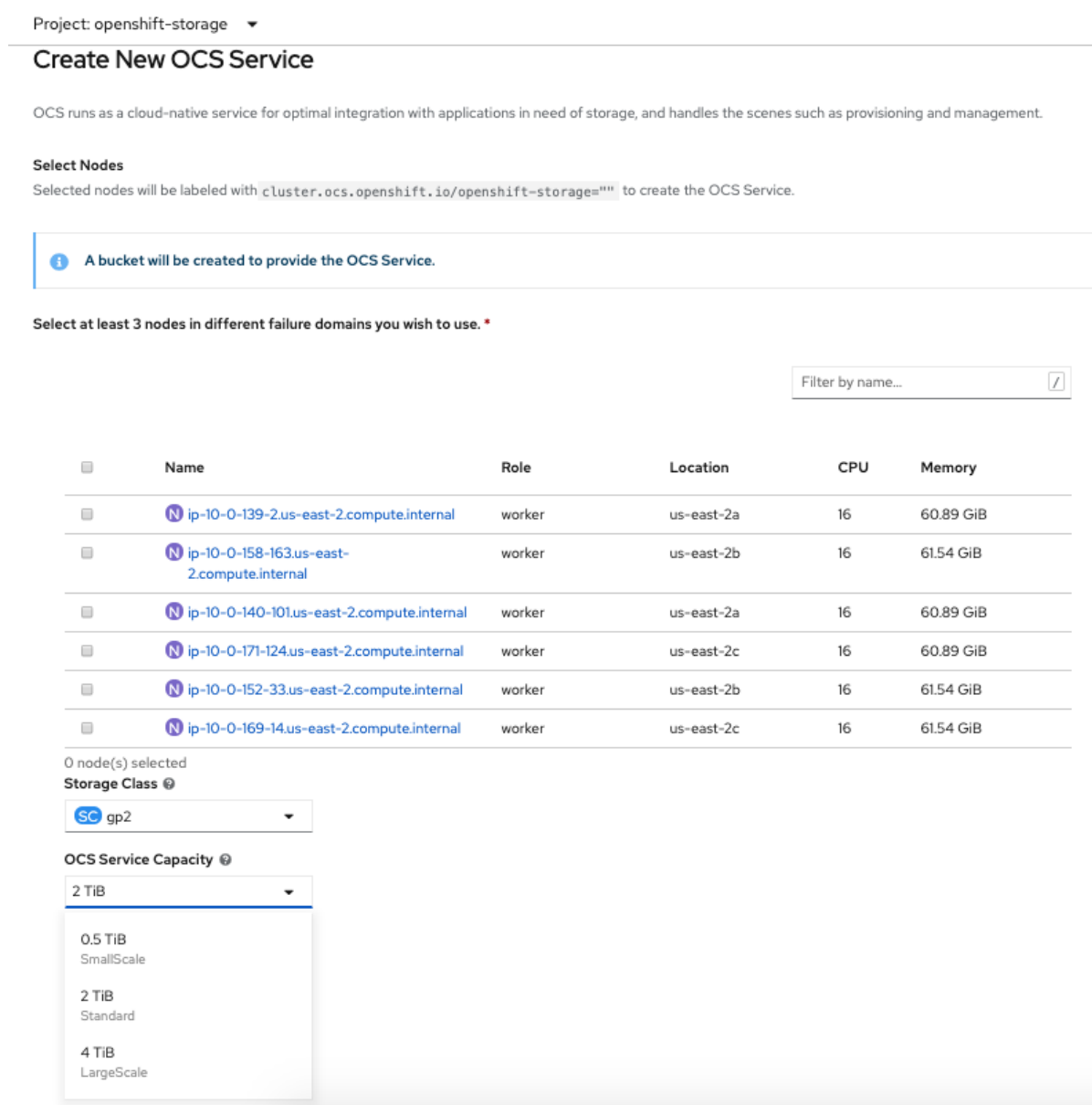
1. Click **Operators → Installed Operators** from the left pane of the OpenShift Web Console to view the installed operators.
2. On the Installed Operator page, select **openshift-storage** from the **Project** drop down list to switch to the **openshift-storage** project.
3. Click **OpenShift Container Storage** operator.  
OpenShift Container Storage operator creates a *OCSInitialization* resource automatically.
4. On the OpenShift Container Storage operator page, scroll right and click the **Storage Cluster** tab.

Figure 1.1. OpenShift Container Storage Operator page



5. On the **OCS Cluster Services** page, click **Create OCS Cluster Service**

Figure 1.2. Create New OCS Service page



6. On the **Create New OCS Service** page, perform the following:
  - a. Select at least three worker nodes from the available list of nodes for the use of OpenShift Container Storage service. Ensure that the nodes are in different **Location**.
  - b. **Storage Class** is set by default depending on the platform. **gp2** is the default storage class for AWS and **thin** is the default storage class for VMware.

- c. Select **OCS Service Capacity** from the drop down list.

**NOTE**

Once you select the initial storage capacity here, you can add more capacity only in this increment.

7. Click **Create**.

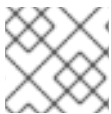
The **Create** button is enabled only after you select three nodes. A new storage cluster of three volumes will be created with one volume per worker node. The default configuration uses a replication factor of 3.

**Verification steps**

- To verify that OpenShift Container Storage is successfully installed, see [Verifying OpenShift Container Storage deployment](#).

## 1.3. ENABLING FILE SYSTEM ACCESS FOR CONTAINERS ON RED HAT ENTERPRISE LINUX BASED NODES

Deploying OpenShift Container Platform on a Red Hat Enterprise Linux base in a user provisioned infrastructure (UPI) does not automatically provide container access to the underlying Ceph file system.

**NOTE**

This process is not necessary for hosts based on Red Hat Enterprise Linux CoreOS.

**Procedure**

Perform the following steps on each node in your cluster.

1. Log in to the Red Hat Enterprise Linux based node and open a terminal.
2. Verify that the node has access to the `rhel-7-server-extras-rpms` repository.

```
# subscription-manager repos --list-enabled | grep rhel-7-server
```

If you do not see both **rhel-7-server-rpms** and **rhel-7-server-extras-rpms** in the output, or if there is no output, run the following commands to enable each repository.

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

3. Install the required packages.

```
# yum install -y policycoreutils container-selinux
```

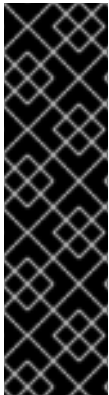
4. Persistently enable container use of the Ceph file system in SELinux.

```
# setsebool -P container_use_cephfs on
```

5. Verify that containers can now access OpenShift Container Storage hosted on this node.

## CHAPTER 2. DEPLOYING OPENSIFT CONTAINER STORAGE USING LOCAL STORAGE DEVICES

Use this section to deploy OpenShift Container Storage on bare metal, Amazon EC2 storage optimized I3, and VMware infrastructures where OpenShift Container Platform is already installed.



### IMPORTANT

Installing OpenShift Container Storage on Amazon EC2 storage optimized I3 instance using local storage operator is a Technology Preview feature. Technology Preview features are not supported with Red Hat production service level agreements (SLAs) and might not be functionally complete. Red Hat does not recommend using them in production. These features provide early access to upcoming product features, enabling customers to test functionality and provide feedback during the development process. Red Hat OpenShift Container Storage deployment assumes a new cluster, without any application or other workload running on the 3 worker nodes. Applications should run on additional worker nodes.

To deploy OpenShift Container Storage using local storage devices, perform the following steps:

1. Understand the [requirements for installing OpenShift Container Storage using local storage devices](#).
2. [Install Red Hat OpenShift Container Storage Operator](#) .
3. [Install Local Storage Operator](#) .
4. [Find the available storage devices](#) .
5. Create OpenShift Container Storage cluster based on your requirement:
  - For Amazon EC2, follow the instructions in [Creating OpenShift Container Storage cluster on Amazon EC2](#).
  - For VMware, follow the instructions in [Creating OpenShift Container Storage cluster on VMware](#).
  - For bare metal, follow the instructions in [Creating OpenShift Container Storage cluster on bare metal](#).

### 2.1. REQUIREMENTS FOR INSTALLING OPENSIFT CONTAINER STORAGE USING LOCAL STORAGE DEVICES

- You must have at least three OpenShift Container Platform worker nodes in the cluster with locally attached storage devices on each of them.
  - Each of the three worker nodes must have at least one raw block device available to be used by OpenShift Container Storage.
  - For minimum starting node requirements, see [Node Requirements](#) section in Planning guide.
  - The devices to be used must be empty, that is, there should be no PVs, VGs, or LVs remaining on the disks.
- You must have a minimum of three labeled nodes.

- Each worker node that has local storage devices to be used by OpenShift Container Storage must have a specific label to deploy OpenShift Container Storage pods. To label the nodes, use the following command:

```
$ oc label nodes <NodeName> cluster.ocs.openshift.io/openshift-storage="
```

- There should not be any storage providers managing locally mounted storage on the storage nodes that would conflict with the use of Local Storage Operator for Red Hat OpenShift Container Storage.
- Local Storage Operator version must match with the Red Hat OpenShift Container Platform version in order to have the Local Storage Operator fully supported with Red Hat OpenShift Container Storage. Local Storage Operator does not get upgraded when Red Hat OpenShift Container Platform is upgraded.

## 2.2. INSTALLING RED HAT OPENSIFT CONTAINER STORAGE OPERATOR USING THE OPERATOR HUB

You can install Red Hat OpenShift Container Storage using the Red Hat OpenShift Container Platform Operator Hub on Amazon Web Services (AWS) and VMware vSphere platforms. For information about the hardware and software requirements, see [Planning your deployment](#) guide.

### Prerequisites

- Log in to OpenShift Container Platform cluster.
- You must have at least three worker nodes in the OpenShift Container Platform cluster.
- You must create a namespace called **openshift-storage** as follows:
  - Click **Administration** → **Namespaces** in the left pane of the OpenShift Web Console.
  - Click **Create Namespace**.
  - In the Create Namespace dialog box, enter **openshift-storage** for Name and **openshift.io/cluster-monitoring=true** for Labels. This label is required to get the dashboards.
  - Select **No restrictions** option for **Default Network Policy**.
  - Click **Create**.



### NOTE

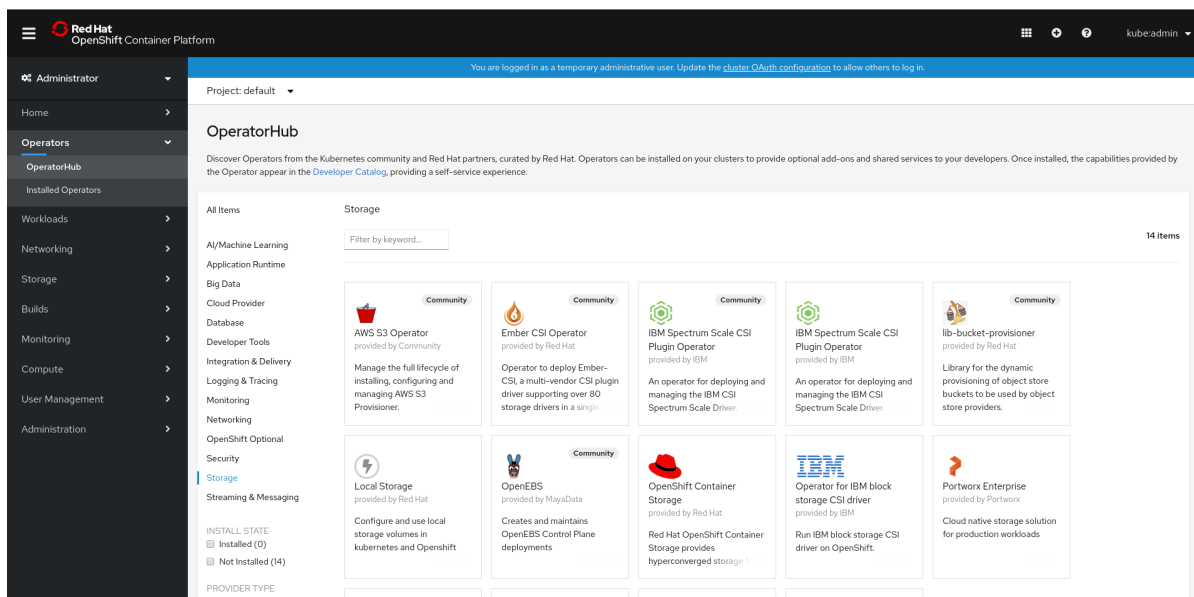
When you need to override the cluster-wide default node selector for OpenShift Container Storage, you can use the following command in command line interface to specify a blank node selector for the **openshift-storage** namespace:

```
$ oc annotate namespace openshift-storage openshift.io/node-selector=
```

### Procedure

- Click **Operators** → **OperatorHub** in the left pane of the OpenShift Web Console.

Figure 2.1. List of operators in the Operator Hub



2. Search for **OpenShift Container Storage** from the list of operators and click on it.
3. On the OpenShift Container Storage operator page, click **Install**.
4. On the Create Operator Subscription page:

Figure 2.2. Create Operator Subscription page

OperatorHub &gt; Operator Subscription

## Create Operator Subscription

Install your Operator by subscribing to one of the update channels to keep the Operator up to date. The strategy determines either manual or automatic updates.

### Installation Mode \*

- All namespaces on the cluster (default)

This mode is not supported by this Operator

- A specific namespace on the cluster

Operator will be available in a single namespace only.

### Update Channel \*

- stable-4.2
- stable-4.3
- stable-4.4

### Approval Strategy \*

- Automatic
- Manual

Subscribe

Cancel

 **OpenShift Container Storage**  
provided by Red Hat, Inc

#### Provided APIs

##### **OCS** [Internal] OCS Initialization

[This resource is not intended to be created or managed by users.] OCS Initialization represents the initial data to be created when the OCS operator is installed.

##### **SCI** [Internal] StorageCluster Initialization

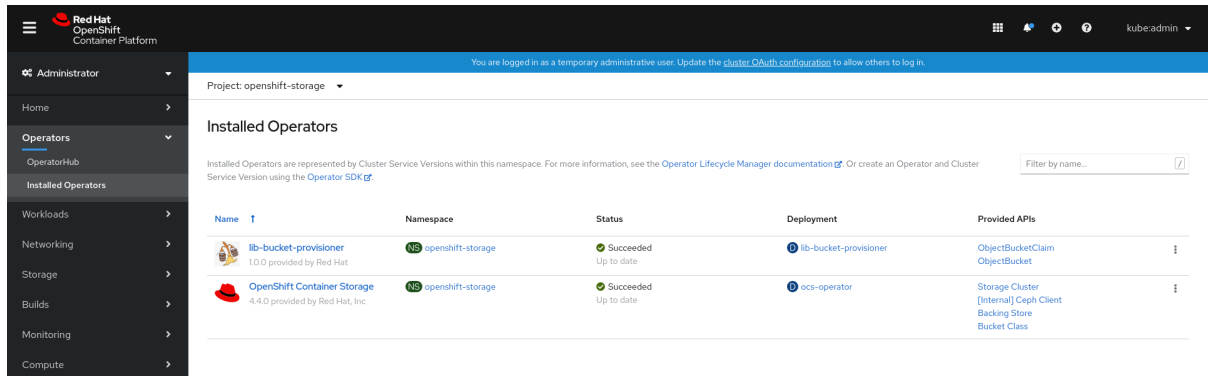
[This resource is not intended to be created or managed by users.] StorageCluster Initialization represents a set of tasks the OCS operator wants to implement for every StorageCluster it encounters.

- a. Select **A specific namespace on the cluster** for the Installation Mode option.
  - Select **openshift-storage** namespace from the drop down menu.
- b. Select **stable-4.4** as the update channel.
- c. Select an Approval Strategy:

- **Automatic** specifies that you want OpenShift Container Platform to upgrade OpenShift Container Storage automatically.
- **Manual** specifies that you want to have control to upgrade OpenShift Container Storage manually.

5. Click **Subscribe**.

Figure 2.3. Installed operators



The Installed Operators page is displayed with the status of the operator.

### Verification steps

- Verify that **OpenShift Container Storage** Operator show the Status as **Succeeded**.

## 2.3. INSTALLING LOCAL STORAGE OPERATOR

Use this procedure to install Local Storage Operator from the Operator Hub before creating OpenShift Container Storage clusters on local storage devices in Amazon EC2 I3, VMware, and bare metal infrastructures.

### Prerequisites

- Create a namespace called **local-storage** as follows:
  - Click **Administration** → **Namespaces** in the left pane of the OpenShift Web Console.
  - Click **Create Namespace**.
  - In the Create Namespace dialog box, enter **local-storage** for Name.
  - Select **No restrictions** option for **Default Network Policy**.
  - Click **Create**.

### Procedure

1. Click **Operators** → **OperatorHub** in the left pane of the OpenShift Web Console.
2. Search for **Local Storage Operator** from the list of operators and click on it.
3. Click **Install**.



Figure 2.4. Create Operator Subscription page

OperatorHub > Operator Subscription

## Create Operator Subscription

Install your Operator by subscribing to one of the update channels to keep the Operator up to date. The strategy determines either manual or automatic updates.

**Installation Mode \***

- All namespaces on the cluster (default)  
This mode is not supported by this Operator
- A specific namespace on the cluster  
Operator will be available in a single namespace only.

**Installed Namespace \***

local-storage

**Update Channel \***

- 4.2
- 4.2-s390x
- 4.3
- 4.4

**Approval Strategy \***

- Automatic
- Manual

**Local Storage**  
provided by Red Hat

**Provided APIs**

- LV Local Volume**  
Manage local storage volumes for OpenShift

- Select **A specific namespace on the cluster** for the Installation Mode option.
  - Select **local-storage** namespace from the drop down menu.
- Select a desired value for the **Update Channel** option.
- Select the desired **Approval Strategy**.
- Click **Subscribe**.
- Verify that the Local Storage Operator show the Status as **Succeeded**.

## 2.4. FINDING AVAILABLE STORAGE DEVICES

Use this procedure to identify the device name for each of the three or more worker nodes that you have labeled with OpenShift Container Storage label, **cluster.ocs.openshift.io/openshift-storage=** before creating PVs for bare metal, Amazon EC2 I3, or VMware storage devices.

### Procedure

- List and verify the name of the worker nodes with the OpenShift Container Storage label.

```
$ oc get nodes -l cluster.ocs.openshift.io/openshift-storage=
```

Example output:

```
NAME                                STATUS ROLES  AGE  VERSION
ip-10-0-135-71.us-east-2.compute.internal Ready  worker  6h45m v1.16.2
ip-10-0-145-125.us-east-2.compute.internal Ready  worker  6h45m v1.16.2
ip-10-0-160-91.us-east-2.compute.internal Ready  worker  6h45m v1.16.2
```

- Log in to each worker node that is used for OpenShift Container Storage resources and find the unique **by-id** device name for each available raw block device.

```
$ oc debug node/<Nodename>
```

Example output:

```
$ oc debug node/ip-10-0-135-71.us-east-2.compute.internal
Starting pod/ip-10-0-135-71us-east-2computeinternal-debug ...
To use host binaries, run `chroot /host`
Pod IP: 10.0.135.71
If you don't see a command prompt, try pressing enter.
sh-4.2# chroot /host
sh-4.4# lsblk
NAME                                MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
nvme1n1                             259:0  0  2.3T 0 disk
nvme2n1                             259:1  0  2.3T 0 disk
nvme0n1                             259:2  0  120G 0 disk
|-nvme0n1p1                         259:3  0   384M 0 part /boot
|-nvme0n1p2                         259:4  0   127M 0 part /boot/efi
|-nvme0n1p3                         259:5  0    1M 0 part
`-nvme0n1p4                         259:6  0  119.5G 0 part
`-coreos-luks-root-nocrypt 253:0  0  119.5G 0 dm  /sysroot
```

In this example, the local devices available are **nvme1n1** and **nvme2n1**.

- Find the unique **by-id** device name depending on the hardware serial number for each device.

```
sh-4.4# ls -l /dev/disk/by-id/ | grep Storage
lrwxrwxrwx. 1 root root 13 Jun 26 07:29 nvme-
Amazon_EC2_NVMe_Instance_Storage_AWS1924C57D4F1FC5236 -> ../../nvme2n1
lrwxrwxrwx. 1 root root 13 Jun 26 07:29 nvme-
Amazon_EC2_NVMe_Instance_Storage_AWS22ABDB45A3BC9028F -> ../../nvme1n1
```

In this example, the local devices available are **nvme1n1** and **nvme2n1** with a size of 2.3 TiB

For each worker node that has the OpenShift Container Storage label (a minimum of three), you need to find the unique **by-id** device names. In this example, the **by-id** device names are:

- nvme-Amazon\_EC2\_NVMe\_Instance\_Storage\_AWS1924C57D4F1FC5236**
- nvme-Amazon\_EC2\_NVMe\_Instance\_Storage\_AWS22ABDB45A3BC9028F**



#### NOTE

You must repeat finding the device name **by-id** for all the other nodes that have the storage devices to be used by OpenShift Container Storage. See <https://access.redhat.com/solutions/4928841> for more details.

## 2.5. CREATING OPENSIFT CONTAINER STORAGE CLUSTER ON AMAZON EC2 STORAGE OPTIMIZED - I3EN.2XLARGE INSTANCE TYPE

Use this procedure to create OpenShift Container Storage cluster on Amazon EC2 (storage optimized - i3en.2xlarge instance type) infrastructure, which involves:

1. Creating PVs by using the **LocalVolume** CR
2. Creating a new **StorageClass**



### IMPORTANT

Installing OpenShift Container Storage on Amazon EC2 storage optimized - i3en.2xlarge instance using local storage operator is a Technology Preview feature. Technology Preview features are not supported with Red Hat production service level agreements (SLAs) and might not be functionally complete. Red Hat does not recommend using them in production. These features provide early access to upcoming product features, enabling customers to test functionality and provide feedback during the development process. Red Hat OpenShift Container Storage deployment assumes a new cluster, without any application or other workload running on the 3 worker nodes. Applications should run on additional worker nodes.

The Amazon EC2 storage optimized - i3en.2xlarge instance type includes two non-volatile memory express (NVMe) disks. The example in this procedure illustrates the use of both the disks that the instance type comes with.



### WARNING

It is not recommended to use ephemeral storage of Amazon EC2 I3 for OpenShift Container Storage persistent data, because stopping all the three nodes can cause data loss. It is recommended to use ephemeral storage only in scenarios such as the following:

- Cloud burst where data is copied from another location for a specific data crunching, which is limited in time
- Development or testing environment

When you are using the ephemeral storage of Amazon EC2 I3, it is recommended to:

- Use three availability zones to decrease the risk of losing all the data
- Limit the number of users with **ec2:StopInstances** permissions to avoid instance shutdown by mistake

### Prerequisites

- Ensure that all the requirements in the [Requirements for installing OpenShift Container Storage using local storage devices](#) section are met.
- Verify your OpenShift Container Platform worker nodes are labeled for OpenShift Container Storage, which is used as the **nodeSelector**.

```
$ oc get nodes -l cluster.ocs.openshift.io/openshift-storage -o jsonpath='{range .items[*]}
{.metadata.name}'
```

Example output:

```
ip-10-0-135-71.us-east-2.compute.internal
ip-10-0-145-125.us-east-2.compute.internal
ip-10-0-160-91.us-east-2.compute.internal
```

## Procedure

1. Create local persistent volumes (PVs) on the storage nodes using **LocalVolume** custom resource (CR).

Example of **LocalVolume** CR **local-storage-block.yaml** using OpenShift Storage Container label as node selector and **by-id** device identifier:

```
apiVersion: local.storage.openshift.io/v1
kind: LocalVolume
metadata:
  name: local-block
  namespace: local-storage
  labels:
    app: ocs-storagecluster
spec:
  tolerations:
    - key: "node.ocs.openshift.io/storage"
      value: "true"
      effect: NoSchedule
  nodeSelector:
    nodeSelectorTerms:
      - matchExpressions:
          - key: cluster.ocs.openshift.io/openshift-storage
            operator: In
            values:
              - ""
  storageClassDevices:
    - storageClassName: localblock
      volumeMode: Block
      devicePaths:
        - /dev/disk/by-id/nvme-
        Amazon_EC2_NVMe_Instance_Storage_AWS10382E5D7441494EC # <-- modify this line
        - /dev/disk/by-id/nvme-
        Amazon_EC2_NVMe_Instance_Storage_AWS1F45C01D7E84FE3E9 # <-- modify this line
        - /dev/disk/by-id/nvme-
        Amazon_EC2_NVMe_Instance_Storage_AWS136BC945B4ECB9AE4 # <-- modify this line
        - /dev/disk/by-id/nvme-
        Amazon_EC2_NVMe_Instance_Storage_AWS10382E5D7441464EP # <-- modify this line
        - /dev/disk/by-id/nvme-
        Amazon_EC2_NVMe_Instance_Storage_AWS1F45C01D7E84F43E7 # <-- modify this line
        - /dev/disk/by-id/nvme-
        Amazon_EC2_NVMe_Instance_Storage_AWS136BC945B4ECB9AE8 # <-- modify this line
```

Each Amazon EC2 i3en.2xlarge instance has two disks and this example uses both the disks.

2. Create the **LocalVolume** CR.

```
$ oc create -f local-storage-block.yaml
```

Example output:

```
localvolume.local.storage.openshift.io/local-block created
```

3. Check if the pods are created.

```
$ oc -n local-storage get pods
```

Example output:

NAME	READY	STATUS	RESTARTS	AGE
local-block-local-diskmaker-59rmn	1/1	Running	0	15m
local-block-local-diskmaker-6n7ct	1/1	Running	0	15m
local-block-local-diskmaker-jwtsn	1/1	Running	0	15m
local-block-local-provisioner-6ssxc	1/1	Running	0	15m
local-block-local-provisioner-swwvx	1/1	Running	0	15m
local-block-local-provisioner-zmv5j	1/1	Running	0	15m
local-storage-operator-7848bbd595-686dg	1/1	Running	0	15m

4. Check if the PVs are created.

You must see a new PV for each of the local storage devices on the three worker nodes. Refer the example in the [Finding available storage devices](#) section that shows two available storage devices per worker node with a size 2328Gi for each node.

```
$ oc get pv
```

Example output:

NAME	CAPACITY	ACCESS MODES	RECLAIM POLICY	STATUS	CLAIM
STORAGECLASS	REASON	AGE			
local-pv-1a46bc79	2328Gi	RWO	Delete	Available	localblock 14m
local-pv-429d90ee	2328Gi	RWO	Delete	Available	localblock 14m
local-pv-4d0a62e3	2328Gi	RWO	Delete	Available	localblock 14m
local-pv-55c05d76	2328Gi	RWO	Delete	Available	localblock 14m
local-pv-5c7b0990	2328Gi	RWO	Delete	Available	localblock 14m
local-pv-a6b283b	2328Gi	RWO	Delete	Available	localblock 14m

5. Check if a new **StorageClass** is created due to the creation of **LocalVolume** CR. This **StorageClass** is used while creating **StorageCluster** to create PVCs.

```
$ oc get sc | grep localblock
```

Example output:

NAME	PROVISIONER	RECLAIMPOLICY
VOLUMEBINDINGMODE	ALLOWVOLUMEEXPANSION	AGE
localblock	kubernetes.io/no-provisioner	Delete
WaitForFirstConsumer	false	3h47m

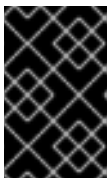
6. Create **StorageCluster** CR that uses the **localblock** StorageClass and the PVs that are created.

Example of **StorageCluster** CR **ocs-cluster-service.yaml** using **monDataDirHostPath** and **localblock** StorageClass.

```

apiVersion: ocs.openshift.io/v1
kind: StorageCluster
metadata:
  name: ocs-storagecluster
  namespace: openshift-storage
spec:
  manageNodes: false
  resources:
    mds:
      limits:
        cpu: 3
        memory: 8Gi
      requests:
        cpu: 1
        memory: 8Gi
    noobaa-core:
      limits:
        cpu: 2
        memory: 8Gi
      requests:
        cpu: 1
        memory: 8Gi
    noobaa-db:
      limits:
        cpu: 2
        memory: 8Gi
      requests:
        cpu: 1
        memory: 8Gi
  monDataDirHostPath: /var/lib/rook
  storageDeviceSets:
    - count: 2
      dataPVCTemplate:
        spec:
          accessModes:
            - ReadWriteOnce
          resources:
            requests:
              storage: 2328Gi
          storageClassName: localblock
          volumeMode: Block
        name: ocs-device-set
        placement: {}
        portable: false
        replica: 3
        resources: {}

```



### IMPORTANT

To ensure that the OSDs have a guaranteed size across the nodes, the storage size for **storageDeviceSets** must be specified as less than or equal to the size of the desired PVs created on the nodes.

7. Create **StorageCluster** CR.

```
$ oc create -f ocs-cluster-service.yaml
```

Example output

```
storagecluster.ocs.openshift.io/ocs-cluster-service created
```

### Verification steps

See [Verifying OpenShift Container Storage deployment](#).

## 2.6. CREATING OPENSIFT CONTAINER STORAGE CLUSTER ON VMWARE

Use this procedure to create storage cluster on VMware infrastructure.

VMware supports the following three types of local storage:

- Virtual machine disk (VMDK)
- Raw device mapping (RDM)
- VMDirectPath I/O

### Prerequisites

- Ensure that all the requirements in the [Requirements for installing OpenShift Container Storage using local storage devices](#) section are met.
- You must have three worker nodes with the same storage type and size attached to each node to use local storage devices on VMware.
- For VMs on VMware, ensure the **disk.EnableUUID** option is set to **TRUE**. You need to have vCenter account privileges to configure the VMs. For more information, see [Required vCenter account privileges](#). To set the **disk.EnableUUID** option, use the **Advanced** option of the **VM Options** in the **Customize hardware** tab. For more information, see [Creating Red Hat Enterprise Linux CoreOS \(RHCOS\) machines in vSphere](#).
- Verify your OpenShift Container Platform worker nodes are labeled for OpenShift Container Storage:

```
$ oc get nodes -l cluster.ocs.openshift.io/openshift-storage -o jsonpath='{range .items[*]}{.metadata.name}\n'}
```

To identify storage devices on each node, refer to [Finding available storage devices](#).

### Procedure

1. Create the LocalVolume CR for block PVs.

Example of **LocalVolume** CR **local-storage-block.yaml** using OpenShift Container Storage label as node selector:

```
apiVersion: local.storage.openshift.io/v1
```

```

kind: LocalVolume
metadata:
  name: local-block
  namespace: local-storage
  labels:
    app: ocs-storagecluster
spec:
  nodeSelector:
    nodeSelectorTerms:
      - matchExpressions:
          - key: cluster.ocs.openshift.io/openshift-storage
            operator: In
            values:
              - ""
  storageClassDevices:
    - storageClassName: localblock
      volumeMode: Block
      devicePaths:
        - /dev/disk/by-id/scsi-36000c2991c27c2e5ba7c47d1e4352de2 # <-- modify this line
        - /dev/disk/by-id/scsi-36000c29682ca9e347926406711f3dc4e # <-- modify this line
        - /dev/disk/by-id/scsi-36000c296aaf03a9b1e4b01d086bc6348 # <-- modify this line

```

2. Create **LocalVolume** CR for block PVs.

```
$ oc create -f local-storage-block.yaml
```

Example output:

```
localvolume.local.storage.openshift.io/local-block created
```

3. Check if the pods are created.

```
$ oc -n local-storage get pods
```

Example output:

```

NAME                                READY  STATUS   RESTARTS  AGE
local-block-local-diskmaker-5brzv    1/1    Running  0         31s
local-block-local-diskmaker-8sxcs    1/1    Running  0         31s
local-block-local-diskmaker-s7s9p    1/1    Running  0         31s
local-block-local-provisioner-9cbw8  1/1    Running  0         31s
local-block-local-provisioner-cpddv  1/1    Running  0         31s
local-block-local-provisioner-f6h7h  1/1    Running  0         31s
local-storage-operator-75b9776b75-vwdzh 1/1    Running  0         2m47s

```

4. Check the new **localblock** StorageClass.

```
$ oc get sc | grep localblock
```

Example output:

```

NAME          PROVISIONER          RECLAIMPOLICY
VOLUMEBINDINGMODE ALLOWVOLUMEEXPANSION  AGE
localblock    kubernetes.io/no-provisioner Delete

```



```
WaitForFirstConsumer false 3h47m
```

- Check the PVs that are created with the **Available** status.

```
$ oc get pv
```

Example output:

NAME	CAPACITY	ACCESS MODES	RECLAIM POLICY	STATUS	CLAIM
local-pv-150fdc87	2TiB	RWO	Delete	Available	localblock
local-pv-183bfc0a	2TiB	RWO	Delete	Available	localblock
local-pv-b2f5cb25	2TiB	RWO	Delete	Available	localblock

In this example, three PVs are used for OSD storage.

- Create **StorageCluster** CR **ocs-cluster-service-VMware.yaml** that uses the **monDataDirHostPath** and **localblock** StorageClass.

```
apiVersion: ocs.openshift.io/v1
kind: StorageCluster
metadata:
  name: ocs-storagecluster
  namespace: openshift-storage
spec:
  manageNodes: false
  monDataDirHostPath: /var/lib/rook
  storageDeviceSets:
    - count: 1
      dataPVCTemplate:
        spec:
          accessModes:
            - ReadWriteOnce
          resources:
            requests:
              storage: 2Ti
          storageClassName: localblock
          volumeMode: Block
      name: ocs-device-set
      placement: {}
      portable: false
      replica: 3
      resources: {}
```



### IMPORTANT

To ensure that the OSDs have a guaranteed size across the nodes, the storage size for **storageDeviceSets** must be specified as less than or equal to the size of the desired PVs created on the nodes.

- Create **StorageCluster** CR.

```
$ oc create -f ocs-cluster-service-VMware.yaml
```

Example output:

```
storagecluster.ocs.openshift.io/ocs-storagecluster created
```

## Verification steps

See [Verifying OpenShift Container Storage deployment](#) .

## 2.7. CREATING OPENSIFT CONTAINER STORAGE CLUSTER ON BARE METAL

### Prerequisites

- Ensure that all the requirements in the [Requirements for installing OpenShift Container Storage using local storage devices](#) section are met.
- You must have three worker nodes with the same storage type and size attached to each node (for example, 2TB NVMe hard drive) to use local storage devices on bare metal.
- Verify your OpenShift Container Platform worker nodes are labeled for OpenShift Container Storage:

```
$ oc get nodes -l cluster.ocs.openshift.io/openshift-storage -o jsonpath='{range .items[*]}{.metadata.name}\n'}
```

To identify storage devices on each node, refer to [Finding available storage devices](#) .

### Procedure

1. Create **LocalVolume** CR for block PVs.  
Example of **LocalVolume** CR **local-storage-block.yaml** using OCS label as node selector.

```
apiVersion: local.storage.openshift.io/v1
kind: LocalVolume
metadata:
  name: local-block
  namespace: local-storage
labels:
  app: ocs-storagecluster
spec:
  nodeSelector:
    nodeSelectorTerms:
    - matchExpressions:
      - key: cluster.ocs.openshift.io/openshift-storage
        operator: In
        values:
        - ""
  storageClassDevices:
    - storageClassName: localblock
      volumeMode: Block
      devicePaths:
```

```

- /dev/disk/by-id/nvme-INTEL_SSDPEKKA128G7_BTPY81260978128A # <-- modify
this line
- /dev/disk/by-id/nvme-INTEL_SSDPEKKA128G7_BTPY80440W5U128A # <-- modify
this line
- /dev/disk/by-id/nvme-INTEL_SSDPEKKA128G7_BTPYB85AABDE128A # <-- modify
this line
- /dev/disk/by-id/nvme-INTEL_SSDPEKKA128G7_BTPY0A60CB81128A # <-- modify
this line
- /dev/disk/by-id/nvme-INTEL_SSDPEKKA128G7_BTPY0093D45E128A # <-- modify
this line
- /dev/disk/by-id/nvme-INTEL_SSDPEKKA128G7_BTPYE46F6060128A # <-- modify
this line

```

2. Create the **LocalVolume** CR for block PVs.

```
$ oc create -f local-storage-block.yaml
```

3. Check if the pods are created.

```
$ oc -n local-storage get pods
```

4. Check if the PVs are created.

```
$ oc get pv
```

Example output:

NAME	CAPACITY	ACCESS MODES	RECLAIM POLICY	STATUS	CLAIM
local-pv-150fdc87	2Ti	RWO	Delete	Available	localblock
2m11s					
local-pv-183bfc0a	2Ti	RWO	Delete	Available	localblock
2m11s					
local-pv-b2f5cb25	2Ti	RWO	Delete	Available	localblock
2m21s					

5. Check for the new **localblock StorageClass**.

```
$ oc get sc|egrep -e "localblock|NAME"
```

Example output:

NAME	PROVISIONER	RECLAIMPOLICY
localblock	kubernetes.io/no-provisioner	Delete

VOLUMEBINDINGMODE	ALLOWVOLUMEEXPANSION	AGE
WaitForFirstConsumer	false	4d23h

6. Create **StorageCluster** CR that uses the **localblock** StorageClass and the three PVs that are created.
7. Example of **StorageCluster** CR **cluster-service-metal.yaml** using **monDataDirHostPath** and **localblock** StorageClass.

-

```

apiVersion: ocs.openshift.io/v1
kind: StorageCluster
metadata:
  name: ocs-storagecluster
  namespace: openshift-storage
spec:
  manageNodes: false
  monDataDirHostPath: /var/lib/rook
  storageDeviceSets:
  - count: 2
    dataPVCTemplate:
      spec:
        accessModes:
        - ReadWriteOnce
        resources:
          requests:
            storage: 2Ti
        storageClassName: localblock
        volumeMode: Block
      name: ocs-device-set
      placement: {}
      portable: false
      replica: 3
      resources: {}

```



### IMPORTANT

To ensure that the OSDs have a guaranteed size across the nodes, the storage size for **storageDeviceSets** must be specified as less than or equal to the size of the desired PVs created on the nodes.

8. Create the **StorageCluster** CR.

```
$ oc create -f cluster-service-metal.yaml
```

Example output:

```
storagecluster.ocs.openshift.io/ocs-storagecluster created
```

### Verification steps

See [Verifying OpenShift Container Storage deployment](#) .

## CHAPTER 3. VERIFYING OPENSIFT CONTAINER STORAGE DEPLOYMENT

Use this section to verify that OpenShift Container Storage is deployed correctly.

### 3.1. VERIFYING THE STATE OF THE PODS

To determine if OpenShift Container Storage is deployed successfully, you can verify that the pods are in **running** state.

#### Procedure

1. Click **Workloads** → **Pods** from the left pane of the OpenShift Web Console.
2. Select **openshift-storage** from the **Project** drop down list.  
For more information on the amount of pods to expect for each component and how the amount of pods varies depending on the number of nodes and OSDs, see [Table 3.1, "Pods corresponding to storage components for a three worker node cluster"](#)
3. Verify that the following pods are in running and completed state by clicking on the **Running** and the **Completed** tabs:

**Table 3.1. Pods corresponding to storage components for a three worker node cluster**

Component	No. of pods	Name of the pod
Number of pods that you must see for the following components:		
OpenShift Container Storage Operator	1	<b>ocs-operator-*</b>
Rook-ceph Operator	1	<b>rook-ceph-operator-*</b>
Multicloud Object Gateway	4	<ul style="list-style-type: none"> <li>● <b>noobaa-operator-*</b></li> <li>● <b>noobaa-core-*</b></li> <li>● <b>nooba-db-*</b></li> <li>● <b>noobaa-endpoint-*</b></li> </ul>
Mon	3	<ul style="list-style-type: none"> <li>● <b>rook-ceph-mon-*</b></li> <li>● <b>rook-ceph-mon-*</b></li> <li>● <b>rook-ceph-mon-*</b> (on different nodes)</li> </ul>
rook-ceph-mgr	1	<b>rook-ceph-mgr-*</b> (on storage node)

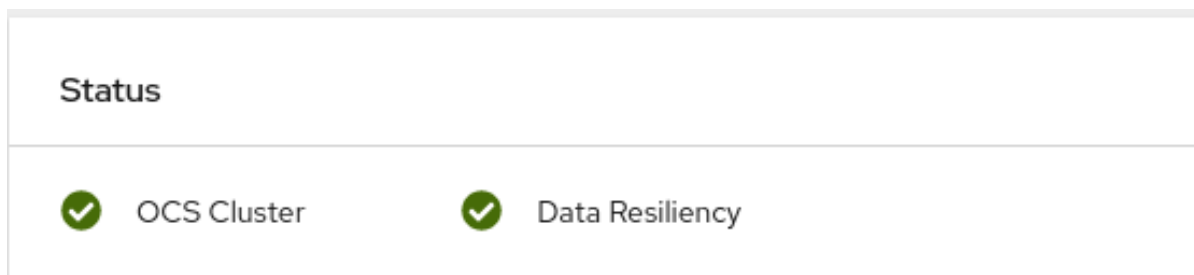
Component	No. of pods	Name of the pod
MDS	2	<b>rook-ceph-mds-ocs-storagecluster-cephfilesystem-*</b> (2 pods on different storage nodes)
lib-bucket-provisioner	1	<b>lib-bucket-provisioner--*</b> (on any node)
Number of pods for CSI vary depending on the number of nodes selected as storage nodes (a minimum of 3 nodes)		
CSI	10	<ul style="list-style-type: none"> <li>● <b>cephfs</b> (at least 5 pods) <ul style="list-style-type: none"> <li>○ <b>csi-cephfsplugin-*</b> (1 on each node where storage is consumed, that is, 3 pods on different nodes)</li> <li>○ <b>csi-cephfsplugin-provisioner-*</b> (2 pods on different storage nodes if available)</li> </ul> </li> <li>● <b>rbd</b> (at least 5 pods in total) <ul style="list-style-type: none"> <li>○ <b>csi-rbdplugin-*</b> (one on each node where storage is consumed, that is, 3 pods on different nodes)</li> <li>○ <b>csi-rbdplugin-provisioner-*</b> (2 pods on different storage nodes if available)</li> </ul> </li> </ul>
rook-ceph-drain-canary	3	<b>rook-ceph-drain-canary-*</b> (3 pods, that is, one on each storage node)
rook-ceph-crashcollector	3	<b>rook-ceph-crashcollector-*</b> (3 pods)
Number of OSDs vary depending on <b>Count</b> and <b>Replica</b> defined for each StorageDeviceSet in StorageCluster.		
OSD	6	<ul style="list-style-type: none"> <li>● <b>rook-ceph-osd-*</b> (3 pods across different nodes)</li> <li>● <b>rook-ceph-osd-prepare-ocs-deviceset-*</b> (3 pods across different nodes)</li> </ul>

### 3.2. VERIFYING THE OPENSIFT CONTAINER STORAGE CLUSTER IS HEALTHY

- Click **Home** → **Overview** from the left pane of the OpenShift Web Console and click **Persistent Storage** tab.

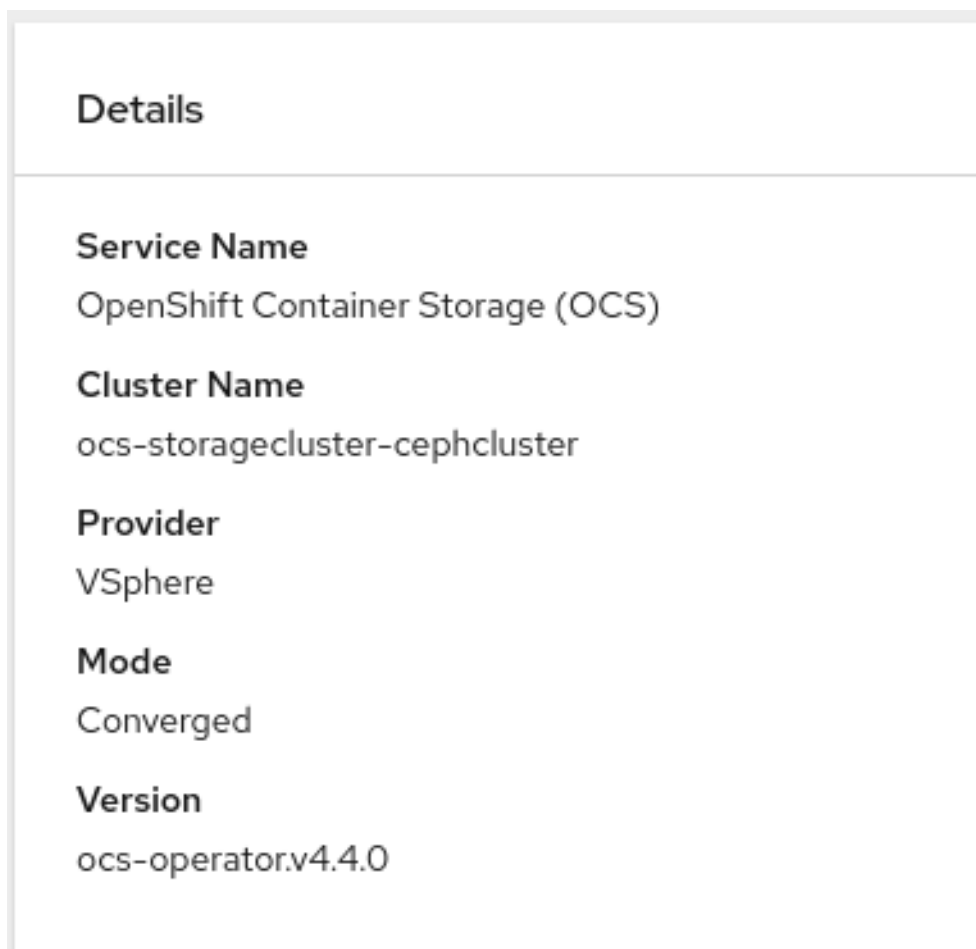
In the **Status card**, verify that *OCS Cluster* has a green tick mark as shown in the following image:

Figure 3.1. Health status card in Persistent Storage Overview Dashboard



In the **Details card**, verify that the cluster information is displayed appropriately as follows:

Figure 3.2. Details card in Persistent Storage Overview Dashboard



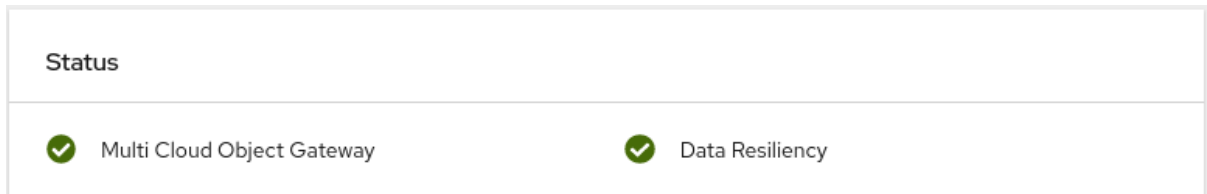
For more information on verifying the health of OpenShift Container Storage cluster using the persistent storage dashboard, see [Monitoring OpenShift Container Storage](#).

### 3.2.1. Verifying the Multicloud Object Gateway is healthy

- Click **Home** → **Overview** from the left pane of the OpenShift Web Console and click the **Object Service** tab.

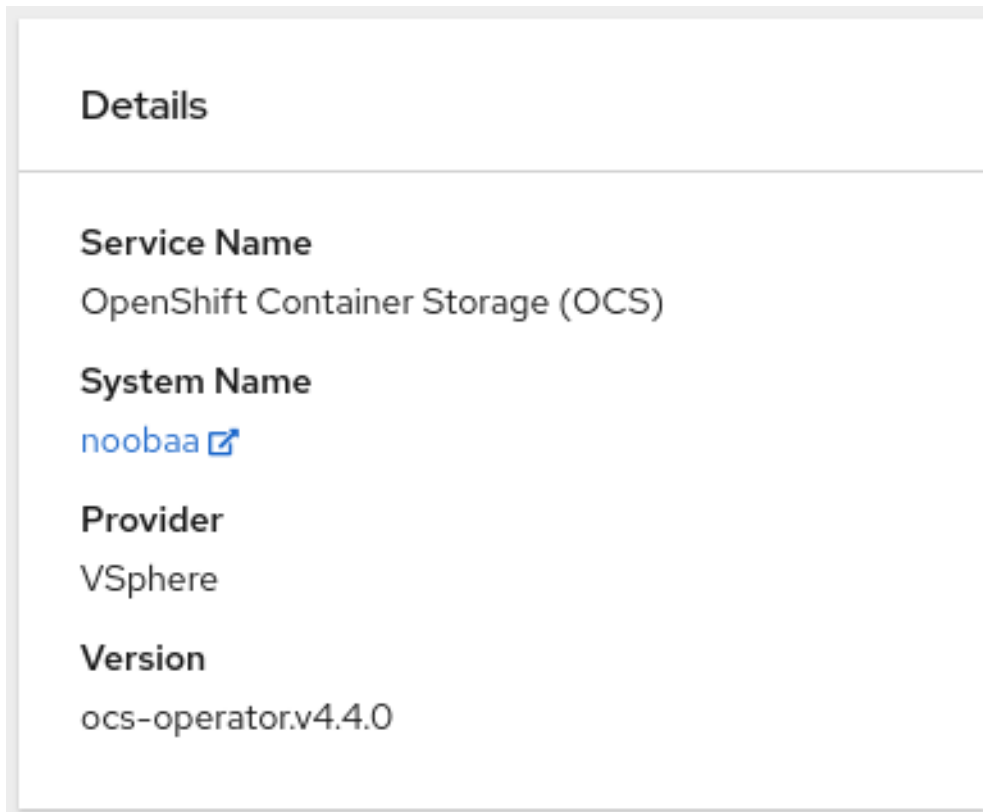
In the **Status card**, verify that the Multicloud Object Gateway (MCG) storage displays a green tick icon as shown in following image:

Figure 3.3. Health status card in Object Service Overview Dashboard



In the **Details card**, verify that the MCG information is displayed appropriately as follows:

Figure 3.4. Details card in Object Service Overview Dashboard



For more information on verifying the health of OpenShift Container Storage cluster using the object service dashboard, see [Monitoring OpenShift Container Storage](#).

### 3.2.2. Verifying that the storage classes are created and listed

You can verify that the storage classes are created and listed as follows:

- Click **Storage → Storage Classes** from the left pane of the OpenShift Web Console. Verify that the following three storage classes are created with the OpenShift Container Storage cluster creation:
  - **ocs-storagecluster-ceph-rbd**
  - **ocs-storagecluster-cephfs**
  - **openshift-storage.noobaa.io**







You are logged in as a temporary administrative user. Update the [cluster OAuth configuration](#) to allow others to log in.

## Storage Classes

Create Storage Class

Filter by name...

Name ↑	Provisioner ↓	Reclaim Policy ↓
 ocs-storagecluster-ceph-rbd	openshift-storage.rbd.csi.ceph.com	Delete ⋮
 ocs-storagecluster-cephfs	openshift-storage.cephfs.csi.ceph.com	Delete ⋮
 openshift-storage.noobaa.io	openshift-storage.noobaa.io/obc	Delete ⋮
 thin - Default	kubernetes.io/vsphere-volume	Delete ⋮

## CHAPTER 4. UNINSTALLING OPENSIFT CONTAINER STORAGE

Use the steps in this section to uninstall OpenShift Container Storage instead of the **Uninstall** option from the user interface.

### Prerequisites

- Make sure that the OpenShift Container Storage cluster is in healthy state. The deletion might fail if some of the pods are not terminated successfully due to insufficient resources or nodes. In case the cluster is in unhealthy state, you should contact Red Hat Customer Support before uninstalling OpenShift Container Storage.
- Delete any applications that are consuming persistent volume claims (PVCs) or object bucket claims (OBCs) based on the OpenShift Container Storage storage classes and then delete PVCs and OBCs that are using OpenShift Container Storage storage classes.

### Procedure

1. List the storage classes and take a note of the storage classes with the following storage class provisioners:

- **openshift-storage.rbd.csi.ceph.com**
- **openshift-storage.cephfs.csi.ceph.com**
- **openshift-storage.noobaa.io/obc**

For example:

```
$ oc get storageclasses
NAME                                PROVISIONER                                AGE
gp2 (default)                       kubernetes.io/aws-ebs                       23h
ocs-storagecluster-ceph-rbd         openshift-storage.rbd.csi.ceph.com         22h
ocs-storagecluster-cephfs          openshift-storage.cephfs.csi.ceph.com      22h
openshift-storage.noobaa.io         openshift-storage.noobaa.io/obc           22h
```

2. Query for PVCs and OBCs that are using the storage class provisioners listed in the previous step.

```
$ oc get pvc -o=jsonpath='{range .items[?(@.spec.storageClassName=="ocs-storagecluster-ceph-rbd")]}'{"Name: "}{@.metadata.name}" Namespace: "}{@.metadata.namespace}" Labels: "}{@.metadata.labels}"{"\n"}{"end}" --all-namespaces|awk '! ( /Namespace: openshift-storage/ && /app:noobaa/ )'
```

```
$ oc get pvc -o=jsonpath='{range .items[?(@.spec.storageClassName=="ocs-storagecluster-cephfs")]}'{"Name: "}{@.metadata.name}" Namespace: "}{@.metadata.namespace}"{"\n"}{"end}" --all-namespaces
```

```
$ oc get obc -o=jsonpath='{range .items[?(@.spec.storageClassName=="openshift-storage.noobaa.io")]}'{"Name: "}{@.metadata.name}" Namespace: "}{@.metadata.namespace}"{"\n"}{"end}" --all-namespaces
```

**NOTE**

Ignore any NooBaa PVCs in the **openshift-storage** namespace.

3. Follow these instructions to ensure that the PVCs listed in the previous step are deleted:
  - a. Determine the pod that is consuming the PVC.
  - b. Identify the controlling object such as a **Deployment**, **StatefulSet**, **DeamonSet**, **Job**, or a custom controller.  
Each object has a metadata field known as **OwnerReference**. This is a list of associated objects. The **OwnerReference** with the **controller** field set to **true** will point to controlling objects such as **ReplicaSet**, **StatefulSet**, **DaemonSet** and so on.
  - c. Ensure that the object is safe to delete by asking the owner of the project and then delete it.
  - d. Delete the PVCs and OBCs.

```
$ oc delete pvc <pvc name> -n <project-name>
$ oc delete obc <obc name> -n <project name>
```

If you have created any PVCs as a part of configuring the monitoring stack, cluster logging operator, or prometheus registry, then you must perform the clean up steps provided in the following sections as required:

- [Section 4.1, "Removing monitoring stack from OpenShift Container Storage"](#)
- [Section 4.2, "Removing OpenShift Container Platform registry from OpenShift Container Storage"](#)
- [Section 4.3, "Removing the cluster logging operator from OpenShift Container Storage"](#)

4. List and note the backing local volume objects. If no results found, then skip step 8 & 9.

```
$ for sc in $(oc get storageclass|grep 'kubernetes.io/no-provisioner' |grep -E $(oc get
storagecluster -n openshift-storage -o jsonpath='{
.items[*].spec.storageDeviceSets[*].dataPVCTemplate.spec.storageClassName}' | sed 's/
/|g')| awk '{ print $1 }');
do
  echo -n "StorageClass: $sc ";
  oc get storageclass $sc -o jsonpath="{ 'LocalVolume: ' }{
.metadata.labels['local\.storage\.openshift\.io/owner-name'] } { '\n' }";
done
```

**Example output**

```
StorageClass: localblock LocalVolume: local-block
```

5. Delete the **StorageCluster** object.

```
$ oc delete -n openshift-storage storagecluster --all --wait=true
```

6. Delete the namespace and wait till the deletion is complete.

```
$ oc delete project openshift-storage --wait=true --timeout=5m
```



### NOTE

You will need to switch to another project if openshift-storage was the active project.

### For example

```
$ oc project default
```

- Clean up the storage operator artifacts on each node.

```
$ for i in $(oc get node -l cluster.ocs.openshift.io/openshift-storage= -o jsonpath='{.items[*].metadata.name}'); do oc debug node/${i} -- chroot /host rm -rfv /var/lib/rook; done
```

Ensure you can see **removed directory** `/var/lib/rook` in the output.

### Example output

```
Starting pod/ip-10-0-134-65us-east-2computeinternal-debug ...
To use host binaries, run `chroot /host`
removed '/var/lib/rook/openshift-storage/log/ocs-deviceset-2-0-gk22s/ceph-volume.log'
removed directory '/var/lib/rook/openshift-storage/log/ocs-deviceset-2-0-gk22s'
removed '/var/lib/rook/openshift-storage/log/ceph-osd.2.log'
removed '/var/lib/rook/openshift-storage/log/ceph-volume.log'
removed directory '/var/lib/rook/openshift-storage/log'
removed directory '/var/lib/rook/openshift-storage/crash/posted'
removed directory '/var/lib/rook/openshift-storage/crash'
removed '/var/lib/rook/openshift-storage/client.admin.keyring'
removed '/var/lib/rook/openshift-storage/openshift-storage.config'
removed directory '/var/lib/rook/openshift-storage'
removed '/var/lib/rook/osd2/openshift-storage.config'
removed directory '/var/lib/rook/osd2'
removed directory '/var/lib/rook'
```

```
Removing debug pod ...
Starting pod/ip-10-0-155-149us-east-2computeinternal-debug ...
.
.
removed directory '/var/lib/rook'
```

```
Removing debug pod ...
Starting pod/ip-10-0-162-89us-east-2computeinternal-debug ...
.
.
removed directory '/var/lib/rook'
```

```
Removing debug pod ...
```

- Delete the local volume created during the deployment and for each of the local volumes listed in step 4.

For each of the local volumes, do the following:

- a. Set the variable **LV** to the name of the LocalVolume and variable **SC** to name of the StorageClass.

### For example

```
$ LV=local-block
$ SC=localblock
```

- b. List and note the devices to be cleaned up later.

```
$ oc get localvolume -n local-storage $LV -o jsonpath='{
.spec.storageClassDevices[*].devicePaths[*]}'
```

### Example output

```
/dev/disk/by-id/nvme-Amazon_Elastic_Block_Store_vol078f5cdde09efc165 /dev/disk/by-
id/nvme-Amazon_Elastic_Block_Store_vol0defc1d5e2dd07f9e /dev/disk/by-id/nvme-
Amazon_Elastic_Block_Store_vol0c8e82a3beeb7b7e5
```

- c. Delete the local volume resource.

```
$ oc delete localvolume -n local-storage --wait=true $LV
```

- d. Delete the remaining PVs and StorageClasses if they exist.

```
$ oc delete pv -l storage.openshift.com/local-volume-owner-name=${LV} --wait --
timeout=5m
$ oc delete storageclass $SC --wait --timeout=5m
```

- e. Clean up the artifacts from the storage nodes for that resource.

```
$ [[ ! -z $SC ]] && for i in $(oc get node -l cluster.ocs.openshift.io/openshift-storage= -o
jsonpath='{.items[*].metadata.name}'); do oc debug node/${i} -- chroot /host rm -rfv
/mnt/local-storage/${SC}/; done
```

### Example output

```
Starting pod/ip-10-0-141-2us-east-2computeinternal-debug ...
To use host binaries, run `chroot /host`
removed '/mnt/local-storage/localblock/nvme2n1'
removed directory '/mnt/local-storage/localblock'
```

```
Removing debug pod ...
Starting pod/ip-10-0-144-55us-east-2computeinternal-debug ...
To use host binaries, run `chroot /host`
removed '/mnt/local-storage/localblock/nvme2n1'
removed directory '/mnt/local-storage/localblock'
```

```
Removing debug pod ...
Starting pod/ip-10-0-175-34us-east-2computeinternal-debug ...
To use host binaries, run `chroot /host`
removed '/mnt/local-storage/localblock/nvme2n1'
```

```
removed directory '/mnt/local-storage/localblock'
```

```
Removing debug pod ...
```

9. Wipe the disks for each of the local volumes listed in step 4 so that they can be reused.

a. List the storage nodes.

```
$ oc get nodes -l cluster.ocs.openshift.io/openshift-storage=
```

### Example output

```
NAME                                STATUS ROLES  AGE  VERSION
ip-10-0-134-65.us-east-2.compute.internal  Ready  worker  4h45m  v1.17.1
ip-10-0-155-149.us-east-2.compute.internal  Ready  worker  4h46m  v1.17.1
ip-10-0-162-89.us-east-2.compute.internal  Ready  worker  4h45m  v1.17.1
```

b. Obtain the node console and execute **chroot /host** command when the prompt appears.

```
$ oc debug node/ip-10-0-134-65.us-east-2.compute.internal
Starting pod/ip-10-0-134-65us-east-2computeinternal-debug ...
To use host binaries, run `chroot /host`
Pod IP: 10.0.134.65
If you don't see a command prompt, try pressing enter.
sh-4.2# chroot /host
```

c. Store the disk paths gathered in step 8(ii) in the **DISKS** variable within quotes.

```
sh-4.2# DISKS="/dev/disk/by-id/nvme-
Amazon_Elastic_Block_Store_vol078f5cdde09efc165 /dev/disk/by-id/nvme-
Amazon_Elasti_Block_Store_vol0defc1d5e2dd07f9e /dev/disk/by-id/nvme-
Amazon_Elastic_Block_Store_vol0c8e82a3beeb7b7e5"
```

d. Run **sgdisk --zap-all** on all the disks:

```
sh-4.4# for disk in $DISKS; do sgdisk --zap-all $disk;done
```

### Example output

```
Problem opening /dev/disk/by-id/nvme-
Amazon_Elastic_Block_Store_vol078f5cdde09efc165 for reading! Error is 2.
The specified file does not exist!
Problem opening " for writing! Program will now terminate.
Warning! MBR not overwritten! Error is 2!
Problem opening /dev/disk/by-id/nvme-
Amazon_Elasti_Block_Store_vol0defc1d5e2dd07f9e for reading! Error is 2.
The specified file does not exist!
Problem opening " for writing! Program will now terminate.
Warning! MBR not overwritten! Error is 2!
Creating new GPT entries.
GPT data structures destroyed! You may now partition the disk using fdisk or
other utilities.
```

**NOTE**

Ignore file-not-found warnings as they refer to disks that are on other machines.

- e. Exit the shell and repeat for the other nodes.

```
sh-4.4# exit
exit
sh-4.2# exit
exit

Removing debug pod ...
```

10. Delete the storage classes with an **openshift-storage** provisioner listed in step 1.

```
$ oc delete storageclass <storageclass-name> --wait=true --timeout=5m
```

For example:

```
$ oc delete storageclass ocs-storagecluster-ceph-rbd ocs-storagecluster-cephfs openshift-storage.noobaa.io --wait=true --timeout=5m
```

11. Unlabel the storage nodes.

```
$ oc label nodes --all cluster.ocs.openshift.io/openshift-storage-
$ oc label nodes --all topology.rook.io/rack-
```

**NOTE**

You can ignore the warnings displayed for the unlabeled nodes such as **label <label> not found**.

12. Remove **CustomResourceDefinitions**.

```
$ oc delete crd backingstores.noobaa.io bucketclasses.noobaa.io
cephblockpools.ceph.rook.io cephclusters.ceph.rook.io cephfilesystems.ceph.rook.io
cephnfses.ceph.rook.io cephobjectstores.ceph.rook.io cephobjectstoreusers.ceph.rook.io
noobaas.noobaa.io ocsinitializations.ocs.openshift.io
storageclusterinitializations.ocs.openshift.io storageclusters.ocs.openshift.io --wait=true --
timeout=5m
```

**NOTE**

Uninstalling OpenShift Container Storage clusters on AWS deletes all the OpenShift Container Storage data stored on the target buckets, however, neither the target buckets created by the user nor the ones that were automatically created during the OpenShift Container Storage installation get deleted and the data that does not belong to OpenShift Container Storage remains on these target buckets.

- To make sure that OpenShift Container Storage is uninstalled, verify that the openshift-storage namespace no longer exists and the storage dashboard no longer appears in the UI.



## NOTE

While uninstalling OpenShift Container Storage, if namespace is not deleted completely and remains in **Terminating** state, perform the steps in the article <https://access.redhat.com/solutions/3881901> to identify objects that are blocking the namespace from being terminated. OpenShift objects such as **Cephcluster**, **StorageCluster**, **NooBaa**, and **PVC** that have the finalizers might be the cause for the namespace to be in **Terminating** state. If PVC has a finalizer, force delete the associated pod to remove the finalizer.

## 4.1. REMOVING MONITORING STACK FROM OPENSIFT CONTAINER STORAGE

Use this section to clean up monitoring stack from OpenShift Container Storage.

The PVCs that are created as a part of configuring the monitoring stack are in the **openshift-monitoring** namespace.

### Prerequisites

- PVCs are configured to use OpenShift Container Platform monitoring stack. For information, see [configuring monitoring stack](#).

### Procedure

- List the pods and PVCs that are currently running in the **openshift-monitoring** namespace.

```
$ oc get pod,pvc -n openshift-monitoring
```

NAME	READY	STATUS	RESTARTS	AGE
pod/alertmanager-main-0	3/3	Running	0	8d
pod/alertmanager-main-1	3/3	Running	0	8d
pod/alertmanager-main-2	3/3	Running	0	8d
pod/cluster-monitoring-operator-84457656d-pkrxm	1/1	Running	0	8d
pod/grafana-79ccf6689f-2ll28	2/2	Running	0	8d
pod/kube-state-metrics-7d86fb966-rvd9w	3/3	Running	0	8d
pod/node-exporter-25894	2/2	Running	0	8d
pod/node-exporter-4dsd7	2/2	Running	0	8d
pod/node-exporter-6p4zc	2/2	Running	0	8d
pod/node-exporter-jbjvg	2/2	Running	0	8d
pod/node-exporter-jj4t5	2/2	Running	0	6d18h
pod/node-exporter-k856s	2/2	Running	0	6d18h
pod/node-exporter-rf8gn	2/2	Running	0	8d
pod/node-exporter-rmb5m	2/2	Running	0	6d18h
pod/node-exporter-zj7kx	2/2	Running	0	8d
pod/openshift-state-metrics-59dbd4f654-4clng	3/3	Running	0	8d
pod/prometheus-adapter-5df5865596-k8dzn	1/1	Running	0	7d23h
pod/prometheus-adapter-				



```

5df5865596-n2gj9      1/1  Running 0    7d23h
pod/prometheus-k8s-0   6/6  Running 1     8d
pod/prometheus-k8s-1   6/6  Running 1     8d
pod/prometheus-operator-
55cfb858c9-c4zd9      1/1  Running 0    6d21h
pod/telemeter-client-
78fc8fc97d-2rgfp      3/3  Running 0     8d

```

NAME	CAPACITY	ACCESS MODES	STATUS	VOLUME	STORAGECLASS	AGE
persistentvolumeclaim/my-alertmanager-claim-alertmanager-main-0	15a5-11ea-baa0-026d231574aa	40Gi	Running	0	ocs-storagecluster-ceph-rbd	8d
persistentvolumeclaim/my-alertmanager-claim-alertmanager-main-1	0d5a9825-15a5-11ea-baa0-026d231574aa	40Gi	Running	1	ocs-storagecluster-ceph-rbd	8d
persistentvolumeclaim/my-alertmanager-claim-alertmanager-main-2	0d6413dc-15a5-11ea-baa0-026d231574aa	40Gi	Running	0	ocs-storagecluster-ceph-rbd	8d
persistentvolumeclaim/my-prometheus-claim-prometheus-k8s-0	15a5-11ea-baa0-026d231574aa	40Gi	Running	0	ocs-storagecluster-ceph-rbd	8d
persistentvolumeclaim/my-prometheus-claim-prometheus-k8s-1	15a5-11ea-baa0-026d231574aa	40Gi	Running	1	ocs-storagecluster-ceph-rbd	8d

2. Edit the monitoring **configmap**.

```
$ oc -n openshift-monitoring edit configmap cluster-monitoring-config
```

3. Remove any **config** sections that reference the OpenShift Container Storage storage classes as shown in the following example and save it.

Before editing

```
.  
. .  
apiVersion: v1  
data:  
  config.yaml: |  
    alertmanagerMain:  
      volumeClaimTemplate:  
        metadata:  
          name: my-alertmanager-claim  
        spec:  
          resources:  
            requests:  
              storage: 40Gi  
          storageClassName: ocs-storagecluster-ceph-rbd  
  prometheusK8s:  
    volumeClaimTemplate:  
      metadata:  
        name: my-prometheus-claim  
      spec:  
        resources:  
          requests:  
            storage: 40Gi  
        storageClassName: ocs-storagecluster-ceph-rbd  
kind: ConfigMap  
metadata:  
  creationTimestamp: "2019-12-02T07:47:29Z"  
  name: cluster-monitoring-config  
  namespace: openshift-monitoring  
  resourceVersion: "22110"  
  selfLink: /api/v1/namespaces/openshift-monitoring/configmaps/cluster-monitoring-config  
  uid: fd6d988b-14d7-11ea-84ff-066035b9efa8  
  
. . .
```

After editing

```

.
.
.
apiVersion: v1
data:
  config.yaml: |
kind: ConfigMap
metadata:
  creationTimestamp: "2019-11-21T13:07:05Z"
  name: cluster-monitoring-config
  namespace: openshift-monitoring
  resourceVersion: "404352"
  selfLink: /api/v1/namespaces/openshift-monitoring/configmaps/cluster-monitoring-config
  uid: d12c796a-0c5f-11ea-9832-063cd735b81c
.
.
.

```

In this example, **alertmanagerMain** and **prometheusK8s** monitoring components are using the OpenShift Container Storage PVCs.

#### 4. List the pods consuming the PVC.

In this example, the **alertmanagerMain** and **prometheusK8s** pods that were consuming the PVCs are in the **Terminating** state. You can delete the PVCs once these pods are no longer using OpenShift Container Storage PVC.

```

$ oc get pod,pvc -n openshift-monitoring
NAME                                READY STATUS   RESTARTS AGE
pod/alertmanager-main-0             3/3 Terminating 0    10h
pod/alertmanager-main-1             3/3 Terminating 0    10h
pod/alertmanager-main-2             3/3 Terminating 0    10h
pod/cluster-monitoring-operator-84cd9df668-zhjfn 1/1 Running    0    18h
pod/grafana-5db6fd97f8-pmtbf        2/2 Running    0    10h
pod/kube-state-metrics-895899678-z2r9q 3/3 Running    0    10h
pod/node-exporter-4njxv             2/2 Running    0    18h
pod/node-exporter-b8ckz             2/2 Running    0    11h
pod/node-exporter-c2vp5             2/2 Running    0    18h
pod/node-exporter-cq65n             2/2 Running    0    18h
pod/node-exporter-f5sm7             2/2 Running    0    11h
pod/node-exporter-f852c             2/2 Running    0    18h
pod/node-exporter-l9zn7             2/2 Running    0    11h
pod/node-exporter-ngbs8             2/2 Running    0    18h
pod/node-exporter-rv4v9             2/2 Running    0    18h
pod/openshift-state-metrics-77d5f699d8-69q5x 3/3 Running    0    10h
pod/prometheus-adapter-765465b56-4tbxx 1/1 Running    0    10h
pod/prometheus-adapter-765465b56-s2qg2 1/1 Running    0    10h
pod/prometheus-k8s-0                6/6 Terminating 1    9m47s
pod/prometheus-k8s-1                6/6 Terminating 1    9m47s
pod/prometheus-operator-cbfd89f9-ldnwc 1/1 Running    0    43m
pod/telemeter-client-7b5ddb4489-2xfpz 3/3 Running    0    10h

```

```

NAME                                STATUS VOLUME
CAPACITY ACCESS MODES STORAGECLASS AGE

```

```

persistentvolumeclaim/ocs-alertmanager-claim-alertmanager-main-0 Bound pvc-
2eb79797-1fed-11ea-93e1-0a88476a6a64 40Gi RWO ocs-storagecluster-ceph-
rbd 19h
persistentvolumeclaim/ocs-alertmanager-claim-alertmanager-main-1 Bound pvc-
2eb79797-1fed-11ea-93e1-0a88476a6a64 40Gi RWO ocs-storagecluster-ceph-
rbd 19h
persistentvolumeclaim/ocs-alertmanager-claim-alertmanager-main-2 Bound pvc-2ec6a9cf-
1fed-11ea-93e1-0a88476a6a64 40Gi RWO ocs-storagecluster-ceph-rbd 19h
persistentvolumeclaim/ocs-prometheus-claim-prometheus-k8s-0 Bound pvc-3162a80c-
1fed-11ea-93e1-0a88476a6a64 40Gi RWO ocs-storagecluster-ceph-rbd 19h
persistentvolumeclaim/ocs-prometheus-claim-prometheus-k8s-1 Bound pvc-
316e99e2-1fed-11ea-93e1-0a88476a6a64 40Gi RWO ocs-storagecluster-ceph-
rbd 19h

```

5. Delete relevant PVCs. Make sure you delete all the PVCs that are consuming the storage classes.

```
$ oc delete -n openshift-monitoring pvc <pvc-name> --wait=true --timeout=5m
```

## 4.2. REMOVING OPENSIFT CONTAINER PLATFORM REGISTRY FROM OPENSIFT CONTAINER STORAGE

Use this section to clean up OpenShift Container Platform registry from OpenShift Container Storage. If you want to configure an alternative storage, see: [https://access.redhat.com/documentation/en-us/openshift\\_container\\_platform/4.4/html-single/registry/architecture-component-imageregistry](https://access.redhat.com/documentation/en-us/openshift_container_platform/4.4/html-single/registry/architecture-component-imageregistry)

The PVCs that are created as a part of configuring OpenShift Container Platform registry are in the **openshift-image-registry** namespace.

### Prerequisites

- The image registry should have been configured to use an OpenShift Container Storage PVC.

### Procedure

1. Edit the **configs.imageregistry.operator.openshift.io** object and remove the content in the **storage** section.

```
$ oc edit configs.imageregistry.operator.openshift.io
```

- For AWS:

#### Before editing

```

.
.
storage:
  pvc:
    claim: registry-cephfs-rwx-pvc
.
.

```

After editing
<pre> . . storage: . . </pre>

In this example, the PVC is called **registry-cephfs-rwx-pvc**, which is now safe to delete.

- For VMware and baremetal:

Before editing
<pre> . . storage:   pvc:     claim: registry-cephfs-rwx-pvc . . </pre>
After editing
<pre> . . storage:   emptyDir: {} . . </pre>

In this example, the PVC is called **registry-cephfs-rwx-pvc**, which is now safe to delete.

2. Delete the PVC.

```
$ oc delete pvc <pvc-name> -n openshift-image-registry --wait=true --timeout=5m
```

### 4.3. REMOVING THE CLUSTER LOGGING OPERATOR FROM OPENSIFT CONTAINER STORAGE

Use this section to clean up the cluster logging operator from OpenShift Container Storage.

The PVCs that are created as a part of configuring cluster logging operator are in **openshift-logging** namespace.

#### Prerequisites

- The cluster logging instance should have been configured to use OpenShift Container Storage PVCs.

### Procedure

1. Remove the **ClusterLogging** instance in the namespace.

```
$ oc delete clusterlogging instance -n openshift-logging --wait=true --timeout=5m
```

The PVCs in the **openshift-logging** namespace are now safe to delete.

2. Delete PVCs.

```
$ oc delete pvc <pvc-name> -n openshift-logging --wait=true --timeout=5m
```