



# Red Hat OpenShift Container Storage 4.6

## Deploying OpenShift Container Storage using Amazon Web Services

How to install and set up OpenShift Container Storage on OpenShift Container  
Platform AWS Clusters



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How to install and set up OpenShift Container Storage on OpenShift Container Platform AWS Clusters

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## Abstract

Read this document for instructions on installing Red Hat OpenShift Container Storage 4.6 using Amazon Web Services for local or cloud storage.

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## PREFACE

Red Hat OpenShift Container Storage 4.6 supports deployment on existing Red Hat OpenShift Container Platform (RHOCP) AWS clusters in connected or disconnected environments along with out-of-the-box support for proxy environments.



### NOTE

Only internal OpenShift Container Storage clusters are supported on AWS. See [Planning your deployment](#) for more information about deployment requirements.

To deploy OpenShift Container Storage in internal mode, follow the appropriate deployment process for your environment:

- [Deploy using dynamic storage devices](#)
- [Deploy using local storage devices](#) [Technology Preview]

## CHAPTER 1. DEPLOY USING DYNAMIC STORAGE DEVICES

Deploying OpenShift Container Storage on OpenShift Container Platform using dynamic storage devices provided by AWS EBS (type: gp2) provides you with the option to create internal cluster resources. This will result in the internal provisioning of the base services, which helps to make additional storage classes available to applications.



### NOTE

Only internal OpenShift Container Storage clusters are supported on AWS. See [Planning your deployment](#) for more information about deployment requirements.

1. For Red Hat Enterprise Linux based hosts for worker nodes in a user provisioned infrastructure (UPI), enable the container access to the underlying file system. Follow the instructions on [enable file system access for containers on Red Hat Enterprise Linux based nodes](#) .



### NOTE

Skip this step for Red Hat Enterprise Linux CoreOS (RHCOS).

2. [Install the Red Hat OpenShift Container Storage Operator](#) .
3. [Create the OpenShift Container Storage Cluster Service](#) .

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

Deploying OpenShift Container Storage on an OpenShift Container Platform with worker nodes 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
```

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

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

## 1.2. INSTALLING RED HAT OPENSIFT CONTAINER STORAGE OPERATOR

You can install Red Hat OpenShift Container Storage Operator using the Red Hat OpenShift Container Platform Operator Hub. For information about the hardware and software requirements, see [Planning your deployment](#).

### Prerequisites

- You must be logged into the OpenShift Container Platform (RHOC) cluster.
- You must have at least three worker nodes in the RHOC cluster.



### 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=
```

- Taint a node as **infra** to ensure only Red Hat OpenShift Container Storage resources are scheduled on that node. This helps you save on subscription costs. For more information, see [How to use dedicated worker nodes for Red Hat OpenShift Container Storage](#) chapter in *Managing and Allocating Storage Resources* guide.

### Procedure

- Click **Operators** → **OperatorHub** in the left pane of the OpenShift Web Console.
- Use **Filter by keyword** text box or the filter list to search for OpenShift Container Storage from the list of operators.
- Click **OpenShift Container Storage**.
- On the **OpenShift Container Storage operator** page, click **Install**.
- On the **Install Operator** page, ensure the following options are selected by default::
  - Update Channel as **stable-4.6**
  - Installation Mode as **A specific namespace on the cluster**
  - Installed Namespace as **Operator recommended namespace openshift-storage**. If Namespace **openshift-storage** does not exist, it will be created during the operator installation.

- d. Select **Enable operator recommended cluster monitoring on this namespace** checkbox as this is required for cluster monitoring.
- e. 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 **Manual approval required** page, you can either click **Approve** or **View Installed Operators in namespace openshift-storage** to install the operator.

**IMPORTANT**

Before you click either of the options, wait for a few minutes on the **Manual approval required** page until the install plan gets loaded in the window.

**IMPORTANT**

If you choose to click **Approve**, you must review the install plan before you proceed.

- If you click **Approve**.
  - Wait for a few minutes while the OpenShift Container Storage Operator is getting installed.

- On the **Installed operator - ready for use** page, click **View Operator**.
- Ensure the **Project** is **openshift-storage**. By default, the **Project** is **openshift-storage**.
- Click **Operators → Installed Operators**
- Wait for the **Status** of **OpenShift Container Storage** to change to **Succeeded**.
- If you click **View Installed Operators** in namespace **openshift-storage**.
  - On the **Installed Operators** page, click **ocs-operator**.
  - On the **Subscription Details** page, click the **Install Plan** link.
  - On the **InstallPlan Details** page, click **Preview Install Plan**.
  - Review the install plan and click **Approve**.
  - Wait for the **Status** of the **Components** to change from **Unknown** to either **Created** or **Present**.
  - Click **Operators → Installed Operators**
  - Ensure the **Project** is **openshift-storage**. By default, the **Project** is **openshift-storage**.
  - Wait for the **Status** of **OpenShift Container Storage** to change to **Succeeded**.

#### Verification steps

- Verify that **OpenShift Container Storage** Operator shows a green tick indicating successful installation.
- Click **View Installed Operators** in namespace **openshift-storage** link to verify that OpenShift Container Storage Operator shows the **Status** as **Succeeded** on the Installed Operators dashboard.

### 1.3. CREATING AN OPENSIFT CONTAINER STORAGE CLUSTER SERVICE IN INTERNAL MODE

Use this procedure to create an OpenShift Container Storage Cluster Service after you install the OpenShift Container Storage operator.

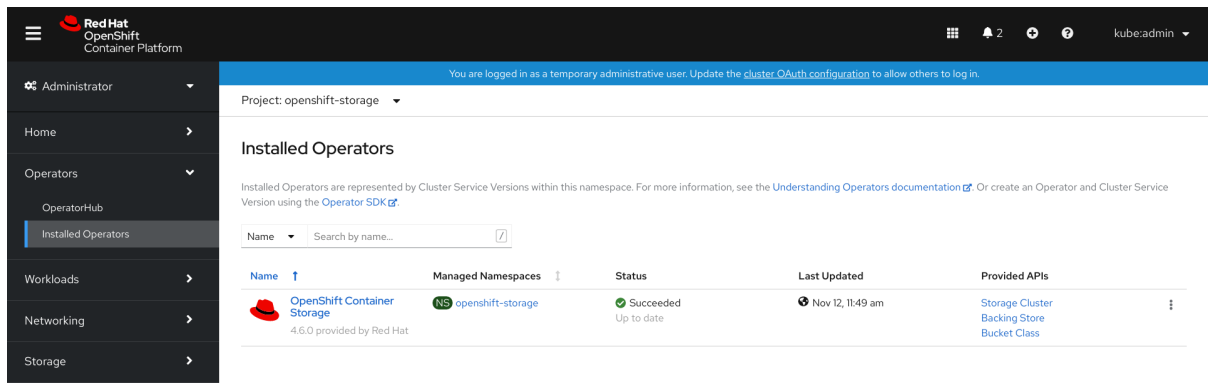
#### Prerequisites

- The 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

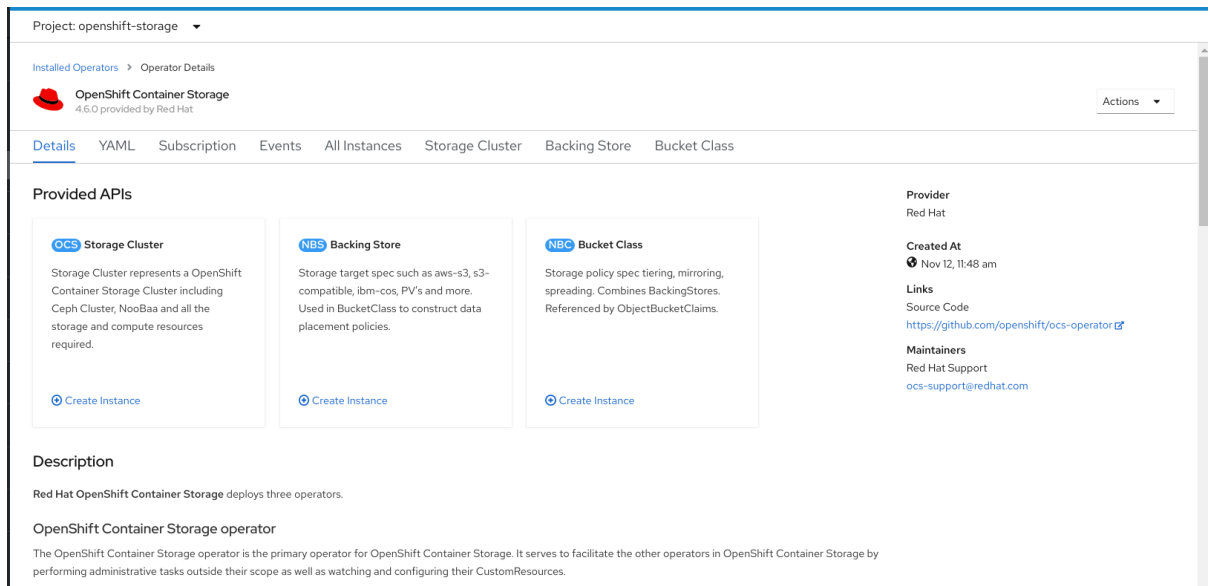
1. Click **Operators → Installed Operators** to view all the installed operators. Ensure that the **Project** selected is **openshift-storage**.

Figure 1.1. OpenShift Container Storage Operator page



2. Click **OpenShift Container Storage**.

Figure 1.2. Details tab of OpenShift Container Storage



3. Click **Create Instance** link of Storage Cluster.

Figure 1.3. Create Storage Cluster page

Project: openshift-storage ▾

---

[OpenShift Container Storage](#) > Create Storage Cluster

## Create Storage Cluster

OCS runs as a cloud-native service for optimal integration with applications in need of storage, and handles the scenes such as provisioning and management.

---

Select Mode:  Internal  Internal - Attached Devices  External

---

i A bucket will be created to provide the OCS Service.

### Capacity

Storage Class ?

SC gp2 ▾

OCS Service Capacity ?

4 TiB ▾

### Encryption

Enable data encryption for the OCS storage cluster

Enabled

### Nodes

Select at least 3 nodes, preferably in 3 different zones. It is recommended to start with at least 14 CPUs and 34 GiB per node. The selected nodes will be labeled with `cluster.ocs.openshift.io/openshift-storage=""` (unless they are already labeled). 3 of the selected nodes will be used for initial deployment. The remaining nodes will be used by OpenShift as scheduling targets for OCS scaling.

Name ▾  /

<input checked="" type="checkbox"/>	Name	Role	Location	CPU	Memory
<input checked="" type="checkbox"/>	<span style="color: #007bff; font-weight: bold;">N</span> ip-10-0-154-195.us-east-2.compute.internal	worker	us-east-2a	16	61.03 GiB
<input checked="" type="checkbox"/>	<span style="color: #007bff; font-weight: bold;">N</span> ip-10-0-184-22.us-east-2.compute.internal	worker	us-east-2b	16	60.37 GiB
<input checked="" type="checkbox"/>	<span style="color: #007bff; font-weight: bold;">N</span> ip-10-0-200-66.us-east-2.compute.internal	worker	us-east-2c	16	60.37 GiB

3 nodes selected

Create
Cancel

4. On the **Create Storage Cluster** page, ensure that the following options are selected:
  - a. In the **Select Mode** section, **Internal** mode is selected by default.

- b. **Storage Class** is set by default to **gp2** for AWS.
- c. Select **OpenShift Container Storage Service Capacity** from drop down list.

**NOTE**

Once you select the initial storage capacity, cluster expansion will only be performed using the selected usable capacity (times 3 of raw storage).

- d. **(Optional)** In the **Encryption** section, set the toggle to **Enabled** to enable data encryption on the cluster.
- e. In the **Nodes** section, select at least three worker nodes from the available list for the use of OpenShift Container Storage service.  
For cloud platforms with multiple availability zones, ensure that the Nodes are spread across different Locations/availability zones.

**NOTE**

To find specific worker nodes in the cluster, you can filter nodes on the basis of Name or Label.

- Name allows you to search by name of the node
- Label allows you to search by selecting the predefined label

If the nodes selected do not match the OpenShift Container Storage cluster requirement of an aggregated 30 CPUs and 72 GiB of RAM, a minimal cluster will be deployed. For minimum starting node requirements, see [Resource requirements](#) section in Planning guide.

5. Click **Create**.

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

**Verification steps**

1. Verify that the final **Status** of the installed storage cluster shows as **Phase: Ready** with a green tick mark.
  - Click **Operators → Installed Operators → Storage Cluster** link to view the storage cluster installation status.
  - Alternatively, when you are on the Operator **Details** tab, you can click on the **Storage Cluster** tab to view the status.
2. To verify that all components for OpenShift Container Storage are successfully installed, see [Verifying your OpenShift Container Storage installation](#).

## CHAPTER 2. DEPLOYING USING LOCAL STORAGE DEVICES

Deploying OpenShift Container Storage on OpenShift Container Platform using local storage devices provides you with the option to create internal cluster resources. This will result in the internal provisioning of the base services, which helps to make additional storage classes available to applications.

Use this section to deploy OpenShift Container Storage on Amazon EC2 storage optimized I3 where OpenShift Container Platform is already installed.



### IMPORTANT

Installing OpenShift Container Storage on Amazon EC2 storage optimized I3 instances using the 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.

## 2.1. OVERVIEW OF DEPLOYING WITH INTERNAL LOCAL STORAGE

To deploy Red Hat OpenShift Container Storage using local storage, follow these steps:

1. Understand the [requirements for installing OpenShift Container Storage using local storage devices](#).
2. For Red Hat Enterprise Linux based hosts for worker nodes, [enable file system access for containers on Red Hat Enterprise Linux based nodes](#).



### NOTE

Skip this step for Red Hat Enterprise Linux CoreOS (RHCOS).

3. [Install the Red Hat OpenShift Container Storage Operator](#) .
4. [Install Local Storage Operator](#) .
5. [Find the available storage devices](#) .
6. [Create OpenShift Container Storage cluster service on Amazon EC2 storage optimized - i3en.2xlarge instance type](#).

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

- You must upgrade to a latest version of OpenShift Container Platform 4.6 before deploying OpenShift Container Storage 4.6. For information, see [Updating OpenShift Container Platform clusters](#) guide.
- The Local Storage Operator version must match the Red Hat OpenShift Container Platform version in order to have the Local Storage Operator fully supported with Red Hat OpenShift

Container Storage. The Local Storage Operator does not get upgraded when Red Hat OpenShift Container Platform is upgraded.

- 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 selected nodes must have at least one raw block device available to be used by OpenShift Container Storage.
  - The devices you use must be empty; the disks must not include physical volumes (PVs), volume groups (VGs), or logical volumes (LVs) remaining on the disk.
- For minimum starting node requirements, see [Resource requirements](#) section in Planning guide.
- You must have a minimum of three labeled nodes.
  - Ensure that the Nodes are spread across different Locations/Availability Zones for a multiple availability zones platform.
  - Each 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 <NodeNames> cluster.ocs.openshift.io/openshift-storage="
```

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

Deploying OpenShift Container Storage on an OpenShift Container Platform with worker nodes 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
```

## 2.4. INSTALLING RED HAT OPENSIFT CONTAINER STORAGE OPERATOR

You can install Red Hat OpenShift Container Storage Operator using the Red Hat OpenShift Container Platform Operator Hub. For information about the hardware and software requirements, see [Planning your deployment](#).

### Prerequisites

- You must be logged into the OpenShift Container Platform (RHOC) cluster.
- You must have at least three worker nodes in the RHOC cluster.



### 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=
```

- Taint a node as **infra** to ensure only Red Hat OpenShift Container Storage resources are scheduled on that node. This helps you save on subscription costs. For more information, see [How to use dedicated worker nodes for Red Hat OpenShift Container Storage](#) chapter in *Managing and Allocating Storage Resources* guide.

### Procedure

1. Click **Operators** → **OperatorHub** in the left pane of the OpenShift Web Console.
2. Use **Filter by keyword** text box or the filter list to search for OpenShift Container Storage from the list of operators.
3. Click **OpenShift Container Storage**.
4. On the **OpenShift Container Storage operator** page, click **Install**.
5. On the **Install Operator** page, ensure the following options are selected by default::
  - a. Update Channel as **stable-4.6**
  - b. Installation Mode as **A specific namespace on the cluster**
  - c. Installed Namespace as **Operator recommended namespace openshift-storage**. If Namespace **openshift-storage** does not exist, it will be created during the operator installation.

- d. Select **Enable operator recommended cluster monitoring on this namespace** checkbox as this is required for cluster monitoring.
- e. 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 **Manual approval required** page, you can either click **Approve** or **View Installed Operators in namespace openshift-storage** to install the operator.

**IMPORTANT**

Before you click either of the options, wait for a few minutes on the **Manual approval required** page until the install plan gets loaded in the window.

**IMPORTANT**

If you choose to click **Approve**, you must review the install plan before you proceed.

- If you click **Approve**.
  - Wait for a few minutes while the OpenShift Container Storage Operator is getting installed.

- On the **Installed operator - ready for use** page, click **View Operator**.
- Ensure the **Project** is **openshift-storage**. By default, the **Project** is **openshift-storage**.
- Click **Operators → Installed Operators**
- Wait for the **Status** of **OpenShift Container Storage** to change to **Succeeded**.
- If you click **View Installed Operators** in namespace **openshift-storage**.
  - On the **Installed Operators** page, click **ocs-operator**.
  - On the **Subscription Details** page, click the **Install Plan** link.
  - On the **InstallPlan Details** page, click **Preview Install Plan**.
  - Review the install plan and click **Approve**.
  - Wait for the **Status** of the **Components** to change from **Unknown** to either **Created** or **Present**.
  - Click **Operators → Installed Operators**
  - Ensure the **Project** is **openshift-storage**. By default, the **Project** is **openshift-storage**.
  - Wait for the **Status** of **OpenShift Container Storage** to change to **Succeeded**.

### Verification steps

- Verify that **OpenShift Container Storage** Operator shows a green tick indicating successful installation.
- Click **View Installed Operators** in namespace **openshift-storage** link to verify that OpenShift Container Storage Operator shows the **Status** as **Succeeded** on the Installed Operators dashboard.

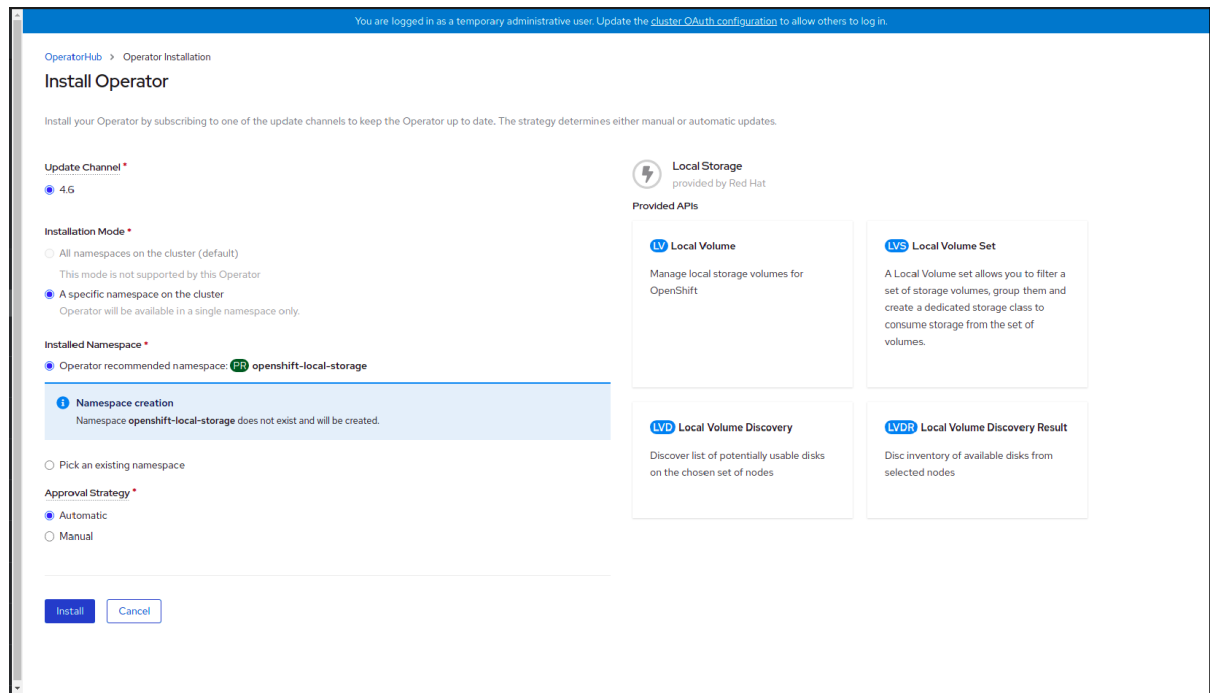
## 2.5. INSTALLING LOCAL STORAGE OPERATOR

Use this procedure to install the Local Storage Operator from the Operator Hub before creating OpenShift Container Storage clusters on local storage devices.

### Procedure

1. Log in to the OpenShift Web Console.
2. Click **Operators → OperatorHub**.
3. Type **local storage** in the **Filter by keyword...** box to search for **Local Storage** operator from the list of operators and click on it.
4. Click **Install**.

Figure 2.1. Install Operator page



5. Set the following options on the **Install Operator** page:
  - a. Update Channel as **4.6**
  - b. Installation Mode as **A specific namespace on the cluster**
  - c. Installed Namespace as **Operator recommended namespace openshift-local-storage**.
  - d. Approval Strategy as **Automatic**
6. Click **Install**.
7. Verify that the Local Storage Operator shows the Status as **Succeeded**.

## 2.6. FINDING AVAILABLE STORAGE DEVICES

Use this procedure to identify the device names for each of the three or more nodes that you have labeled with the OpenShift Container Storage label **cluster.ocs.openshift.io/openshift-storage=** before creating PVs.

### Procedure

1. List and verify the name of the 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
```

2. Log in to each 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/<node name>
```

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
xvda                                202:0   0 120G  0 disk
|-xvda1                             202:1   0  384M  0 part /boot
|-xvda2                             202:2   0  127M  0 part /boot/efi
|-xvda3                             202:3   0    1M  0 part
`-xvda4                             202:4   0 119.5G  0 part
   `--coreos-luks-root-nocrypt 253:0   0 119.5G  0 dm  /sysroot
nvme0n1                             259:0   0  2.3T  0 disk
nvme1n1                             259:1   0  2.3T  0 disk
```

In this example, for the selected node, the local devices available are **nvme0n1** and **nvme1n1**.

3. Identify the unique ID for each of the devices selected in Step 2.

```
sh-4.4# ls -l /dev/disk/by-id/ | grep Storage
lrwxrwxrwx. 1 root root 13 Mar 17 16:24 nvme-
Amazon_EC2_NVMe_Instance_Storage_AWS10382E5D7441494EC -> ../../nvme0n1
lrwxrwxrwx. 1 root root 13 Mar 17 16:24 nvme-
Amazon_EC2_NVMe_Instance_Storage_AWS60382E5D7441494EC -> ../../nvme1n1
```

In the example above, the IDs for the two local devices are

- nvme0n1: nvme-Amazon\_EC2\_NVMe\_Instance\_Storage\_AWS10382E5D7441494EC
  - nvme1n1: nvme-Amazon\_EC2\_NVMe\_Instance\_Storage\_AWS60382E5D7441494EC
4. Repeat the above step to identify the device ID for all the other nodes that have the storage devices to be used by OpenShift Container Storage. See this [Knowledge Base article](#) for more details.

## 2.7. 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 will:

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

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.

When you are using the ephemeral storage of Amazon EC2 I3

- 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.

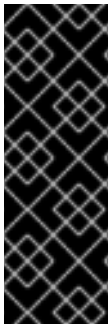


### WARNING

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 of Amazon EC2 I3 only in following scenarios:

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



### 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.

### 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}{"\n"}'
```

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: openshift-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 I3 instance has two disks and this example uses both disks on each node.

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 openshift-local-storage get pods
```

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 to the example in the [Finding available storage devices](#) section that shows two available storage devices per worker node with a size 2.3 TiB 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 for the new **StorageClass** that is now present when the **LocalVolume** CR is created. This **StorageClass** is used to provide the **StorageCluster** PVCs in the following steps.

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

Example output:

NAME	PROVISIONER	RECLAIMPOLICY
VOLUMEBINDINGMODE	ALLOWVOLUMEEXPANSION	AGE
localblock	kubernetes.io/no-provisioner	Delete
WaitForFirstConsumer	false	15m

6. Create the **StorageCluster** CR that uses the **localblock** StorageClass to consume the PVs created by the Local Storage Operator.

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
monDataDirHostPath: /var/lib/rook
storageDeviceSets:
- count: 2
  dataPVCTemplate:
    spec:
      accessModes:
      - ReadWriteOnce
      resources:
        requests:
          storage: 2328Gi
        storageClassName: localblock
        volumeMode: Block
    name: ocs-deviceSet
    placement: {}
    portable: false
    replica: 3
    resources:
      limits:
        cpu: 2
        memory: 5Gi
      requests:
        cpu: 1
        memory: 5Gi

```



### 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 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 your OpenShift Container Storage installation](#) .

## CHAPTER 3. VERIFYING OPENSIFT CONTAINER STORAGE DEPLOYMENT FOR INTERNAL MODE

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 expected number of pods for each component and how it varies depending on the number of nodes, see [Table 3.1, "Pods corresponding to OpenShift Container storage 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 OpenShift Container storage cluster**

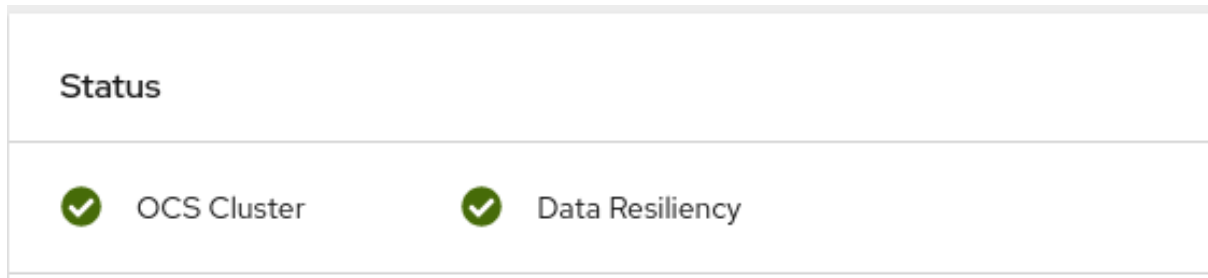
Component	Corresponding pods
OpenShift Container Storage Operator	<ul style="list-style-type: none"> <li>● <b>ocs-operator-*</b> (1 pod on any worker node)</li> <li>● <b>ocs-metrics-exporter-*</b></li> </ul>
Rook-ceph Operator	<b>rook-ceph-operator-*</b> (1 pod on any worker node)
Multicloud Object Gateway	<ul style="list-style-type: none"> <li>● <b>noobaa-operator-*</b> (1 pod on any worker node)</li> <li>● <b>noobaa-core-*</b> (1 pod on any storage node)</li> <li>● <b>noobaa-db-*</b> (1 pod on any storage node)</li> <li>● <b>noobaa-endpoint-*</b> (1 pod on any storage node)</li> </ul>
MON	<b>rook-ceph-mon-*</b> (3 pods distributed across storage nodes)

Component	Corresponding pods
MGR	<b>rook-ceph-mgr-*</b> (1 pod on any storage node)
MDS	<b>rook-ceph-mds-ocs-storagecluster-cephfilesystem-*</b> (2 pods distributed across storage nodes)
CSI	<ul style="list-style-type: none"> <li>● <b>cephfs</b> <ul style="list-style-type: none"> <li>○ <b>csi-cephfsplugin-*</b> (1 pod on each worker node)</li> <li>○ <b>csi-cephfsplugin-provisioner-*</b> (2 pods distributed across worker nodes)</li> </ul> </li> <li>● <b>rbd</b> <ul style="list-style-type: none"> <li>○ <b>csi-rbdplugin-*</b> (1 pod on each worker node)</li> <li>○ <b>csi-rbdplugin-provisioner-*</b> (2 pods distributed across worker nodes)</li> </ul> </li> </ul>
rook-ceph-crashcollector	<b>rook-ceph-crashcollector-*</b> (1 pod on each storage node)
OSD	<ul style="list-style-type: none"> <li>● <b>rook-ceph-osd-*</b> (1 pod for each device)</li> <li>● <b>rook-ceph-osd-prepare-ocs-deviceset-*</b> (1 pod for each device)</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* and *Data Resiliency* 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 as follows:

**Service Name**

OpenShift Container Storage

**Cluster Name**

ocs-storagecluster

**Provider**

AWS

**Mode**

Internal

**Version**

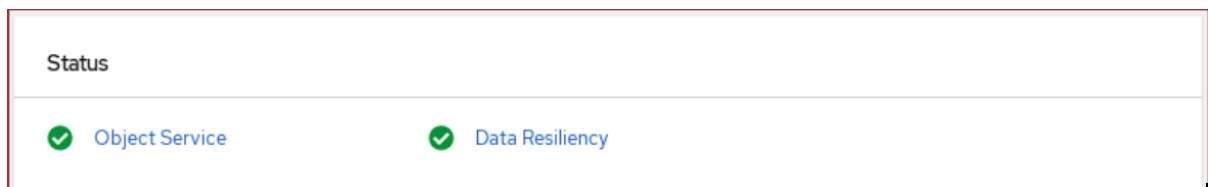
ocs-operator-4.6.0

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

### 3.3. 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 both *Object Service* and *Data Resiliency* are in **Ready** state (green tick).

Figure 3.2. Health status card in Object Service Overview Dashboard



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

**Service Name**

OpenShift Container Storage

**System Name**

Multicloud Object Gateway

**Provider**

AWS

**Version**

ocs-operator-4.6.0

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

### 3.4. VERIFYING THAT THE OPENSIFT CONTAINER STORAGE SPECIFIC STORAGE CLASSES EXIST

To verify the storage classes exists in the cluster:

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

## CHAPTER 4. UNINSTALLING OPENSIFT CONTAINER STORAGE

### 4.1. UNINSTALLING OPENSIFT CONTAINER STORAGE IN INTERNAL MODE

Use the steps in this section to uninstall OpenShift Container Storage.

#### Uninstall Annotations

Annotations on the Storage Cluster are used to change the behavior of the uninstall process. To define the uninstall behavior, the following two annotations have been introduced in the storage cluster:

- **uninstall.ocs.openshift.io/cleanup-policy: delete**
- **uninstall.ocs.openshift.io/mode: graceful**

The below table provides information on the different values that can be used with these annotations:

**Table 4.1. uninstall.ocs.openshift.io uninstall annotations descriptions**

Annotation	Value	Default	Behavior
cleanup-policy	delete	Yes	Rook cleans up the physical drives and the <b>DataDirHostPath</b>
cleanup-policy	retain	No	Rook does <b>not</b> clean up the physical drives and the <b>DataDirHostPath</b>
mode	graceful	Yes	Rook and NooBaa <b>pauses</b> the uninstall process until the PVCs and the OBCs are removed by the administrator/user
mode	forced	No	Rook and NooBaa proceeds with uninstall even if PVCs/OBCs provisioned using Rook and NooBaa exist respectively.

You can change the cleanup policy or the uninstall mode by editing the value of the annotation by using the following commands:

```
$ oc annotate storagecluster -n openshift-storage ocs-storagecluster
uninstall.ocs.openshift.io/cleanup-policy="retain" --overwrite
storagecluster.ocs.openshift.io/ocs-storagecluster annotated
```

```
$ oc annotate storagecluster -n openshift-storage ocs-storagecluster
uninstall.ocs.openshift.io/mode="forced" --overwrite
storagecluster.ocs.openshift.io/ocs-storagecluster annotated
```

## Prerequisites

- Ensure that the OpenShift Container Storage cluster is in a healthy state. The uninstall process can fail when some of the pods are not terminated successfully due to insufficient resources or nodes. In case the cluster is in an unhealthy state, contact Red Hat Customer Support before uninstalling OpenShift Container Storage.
- Ensure that applications are not consuming persistent volume claims (PVCs) or object bucket claims (OBCs) using the storage classes provided by OpenShift Container Storage.
- If any custom resources (such as custom storage classes, cephblockpools) were created by the admin, they must be deleted by the admin after removing the resources which consumed them.

## Procedure

1. Delete the volume snapshots that are using OpenShift Container Storage.

- a. List the volume snapshots from all the namespaces.

```
$ oc get volumesnapshot --all-namespaces
```

- b. From the output of the previous command, identify and delete the volume snapshots that are using OpenShift Container Storage.

```
$ oc delete volumesnapshot <VOLUME-SNAPSHOT-NAME> -n <NAMESPACE>
```

2. Delete PVCs and OBCs that are using OpenShift Container Storage.

In the default uninstall mode (graceful), the uninstaller waits till all the PVCs and OBCs that use OpenShift Container Storage are deleted.

If you wish to delete the Storage Cluster without deleting the PVCs beforehand, you may set the uninstall mode annotation to "forced" and skip this step. Doing so will result in orphan PVCs and OBCs in the system.

- a. Delete OpenShift Container Platform monitoring stack PVCs using OpenShift Container Storage.  
See [Section 4.2, "Removing monitoring stack from OpenShift Container Storage"](#)
- b. Delete OpenShift Container Platform Registry PVCs using OpenShift Container Storage.  
See [Section 4.3, "Removing OpenShift Container Platform registry from OpenShift Container Storage"](#)
- c. Delete OpenShift Container Platform logging PVCs using OpenShift Container Storage.  
See [Section 4.4, "Removing the cluster logging operator from OpenShift Container Storage"](#)
- d. Delete other PVCs and OBCs provisioned using OpenShift Container Storage.
  - Given below is a sample script to identify the PVCs and OBCs provisioned using OpenShift Container Storage. The script ignores the PVCs that are used internally by OpenShift Container Storage.

```
#!/bin/bash

RBD_PROVISIONER="openshift-storage.rbd.csi.ceph.com"
CEPHFS_PROVISIONER="openshift-storage.cephfs.csi.ceph.com"
NOOBAA_PROVISIONER="openshift-storage.noobaa.io/obc"
RGW_PROVISIONER="openshift-storage.ceph.rook.io/bucket"

NOOBAA_DB_PVC="noobaa-db"
NOOBAA_BACKINGSTORE_PVC="noobaa-default-backing-store-noobaa-pvc"

# Find all the OCS StorageClasses
OCS_STORAGECLASSES=$(oc get storageclasses | grep -e
"$RBD_PROVISIONER" -e "$CEPHFS_PROVISIONER" -e
"$NOOBAA_PROVISIONER" -e "$RGW_PROVISIONER" | awk '{print $1}')

# List PVCs in each of the StorageClasses
for SC in $OCS_STORAGECLASSES
do
    echo
    "=====
=="
    echo "$SC StorageClass PVCs and OBCs"
    echo
    "=====
=="
    oc get pvc --all-namespaces --no-headers 2>/dev/null | grep $SC | grep -v -e
"$NOOBAA_DB_PVC" -e "$NOOBAA_BACKINGSTORE_PVC"
    oc get obc --all-namespaces --no-headers 2>/dev/null | grep $SC
    echo
done
```

**NOTE**

Omit **RGW\_PROVISIONER** for cloud platforms.

- Delete the OBCs.

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

- Delete the PVCs.

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

**NOTE**

Ensure that you have removed any custom backing stores, bucket classes, etc., created in the cluster.

3. Delete the Storage Cluster object and wait for the removal of the associated resources.

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



4. Check for cleanup pods if the **uninstall.ocs.openshift.io/cleanup-policy** was set to **delete**(default) and ensure that their status is **Completed**.

```
$ oc get pods -n openshift-storage | grep -i cleanup
NAME                                READY STATUS RESTARTS AGE
cluster-cleanup-job-<xx>            0/1   Completed 0      8m35s
cluster-cleanup-job-<yy>            0/1   Completed 0      8m35s
cluster-cleanup-job-<zz>            0/1   Completed 0      8m35s
```

5. Confirm that the directory **/var/lib/rook** is now empty. This directory will be empty only if the **uninstall.ocs.openshift.io/cleanup-policy** annotation was set to **delete**(default).

```
$ 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 ls -l /var/lib/rook; done
```

6. If encryption was enabled at the time of install, remove **dm-crypt** managed **device-mapper** mapping from OSD devices on all the OpenShift Container Storage nodes.
  - a. Create a **debug** pod and **chroot** to the host on the storage node.

```
$ oc debug node/<node name>
$ chroot /host
```

- b. Get Device names and make note of the OpenShift Container Storage devices.

```
$ dmsetup ls
ocs-deviceset-0-data-0-57snx-block-dmccrypt (253:1)
```

- c. Remove the mapped device.

```
$ cryptsetup luksClose --debug --verbose ocs-deviceset-0-data-0-57snx-block-dmccrypt
```

If the above command gets stuck due to insufficient privileges, run the following commands:

- Press **CTRL+Z** to exit the above command.
- Find PID of the **cryptsetup** process which was stuck.

```
$ ps
```

Example output:

```
PID TTY TIME CMD
778825 ? 00:00:00 cryptsetup
```

Take a note of the **PID** number to kill. In this example, **PID** is **778825**.

- Terminate the process using **kill** command.

```
$ kill -9 <PID>
```

- Verify that the device name is removed.

```
$ dmsetup ls
```

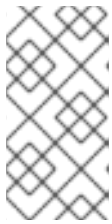
- Delete the namespace and wait till the deletion is complete. You will need to switch to another project if **openshift-storage** is the active project.

For example:

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

The project is deleted if the following command returns a **NotFound** error.

```
$ oc get project openshift-storage
```



#### NOTE

While uninstalling OpenShift Container Storage, if namespace is not deleted completely and remains in **Terminating** state, perform the steps in [Troubleshooting and deleting remaining resources during Uninstall](#) to identify objects that are blocking the namespace from being terminated.

- Delete local storage operator configurations if you have deployed OpenShift Container Storage using local storage devices. See [Removing local storage operator configurations](#).
- Unlabel the storage nodes.

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

- Remove the OpenShift Container Storage taint if the nodes were tainted.

```
$ oc adm taint nodes --all node.ocs.openshift.io/storage-
```

- Confirm all PVs provisioned using OpenShift Container Storage are deleted. If there is any PV left in the **Released** state, delete it.

```
$ oc get pv
$ oc delete pv <pv name>
```

- Delete the Multicloud Object Gateway storageclass.

```
$ oc delete storageclass openshift-storage.noobaa.io --wait=true --timeout=5m
```

- 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 storageclusters.ocs.openshift.io
cephclients.ceph.rook.io cephobjectrealms.ceph.rook.io cephobjectzonegroups.ceph.rook.io
cephobjectzones.ceph.rook.io cephrbdmirrors.ceph.rook.io --wait=true --timeout=5m
```

14. To ensure that OpenShift Container Storage is uninstalled completely, on the OpenShift Container Platform Web Console,
  - a. Click **Home** → **Overview** to access the dashboard.
  - b. Verify that the Persistent Storage and Object Service tabs no longer appear next to the **Cluster** tab.

### 4.1.1. Removing local storage operator configurations

Use the instructions in this section only if you have deployed OpenShift Container Storage using local storage devices.



#### NOTE

For OpenShift Container Storage deployments only using **localvolume** resources, go directly to step 8.

#### Procedure

1. Identify the **LocalVolumeSet** and the corresponding **StorageClassName** being used by OpenShift Container Storage.
2. Set the variable `SC` to the **StorageClass** providing the **LocalVolumeSet**.

```
$ export SC="<StorageClassName>"
```

3. Delete the **LocalVolumeSet**.

```
$ oc delete localvolumesets.local.storage.openshift.io <name-of-volumeset> -n openshift-local-storage
```

4. Delete the local storage PVs for the given **StorageClassName**.

```
$ oc get pv | grep $SC | awk '{print $1}' | xargs oc delete pv
```

5. Delete the **StorageClassName**.

```
$ oc delete sc $SC
```

6. Delete the symlinks created by the **LocalVolumeSet**.

```
[[ ! -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
```

7. Delete **LocalVolumeDiscovery**.

```
$ oc delete localvolumediscovery.local.storage.openshift.io/auto-discover-devices -n openshift-local-storage
```

8. Removing **LocalVolume** resources (if any).

Use the following steps to remove the **LocalVolume** resources that were used to provision PVs in the current or previous OpenShift Container Storage version. Also, ensure that these resources are not being used by other tenants on the cluster.

For each of the local volumes, do the following:

- a. Identify the **LocalVolume** and the corresponding **StorageClassName** being used by OpenShift Container Storage.
- b. Set the variable LV to the name of the LocalVolume and variable SC to the name of the StorageClass  
For example:

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

- c. Delete the local volume resource.

```
$ oc delete localvolume -n openshift-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/node-xxx-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/node-yyy-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/node-zzz-debug ...
To use host binaries, run `chroot /host`
removed '/mnt/local-storage/localblock/nvme2n1'
removed directory '/mnt/local-storage/localblock'
```

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

## 4.2. REMOVING MONITORING STACK FROM OPENSIFT CONTAINER STORAGE

Use this section to clean up the 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

1. 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	STATUS	VOLUME
CAPACITY	ACCESS MODES	STORAGECLASS
		AGE
persistentvolumeclaim/my-alertmanager-claim-alertmanager-main-0	Bound	pvc-0d519c4f-15a5-11ea-baa0-026d231574aa
40Gi	RWO	ocs-storagecluster-ceph-rbd
		8d
persistentvolumeclaim/my-alertmanager-claim-alertmanager-main-1	Bound	pvc-0d5a9825-15a5-11ea-baa0-026d231574aa
40Gi	RWO	ocs-storagecluster-ceph-

```

rbd 8d
persistentvolumeclaim/my-alertmanager-claim-alertmanager-main-2 Bound pvc-
0d6413dc-15a5-11ea-baa0-026d231574aa 40Gi RWO ocs-storagecluster-ceph-
rbd 8d
persistentvolumeclaim/my-prometheus-claim-prometheus-k8s-0 Bound pvc-0b7c19b0-
15a5-11ea-baa0-026d231574aa 40Gi RWO ocs-storagecluster-ceph-rbd 8d
persistentvolumeclaim/my-prometheus-claim-prometheus-k8s-1 Bound pvc-0b8aed3f-
15a5-11ea-baa0-026d231574aa 40Gi RWO 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. 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
```

## 4.3. 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 [image registry](#)

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

### Prerequisites

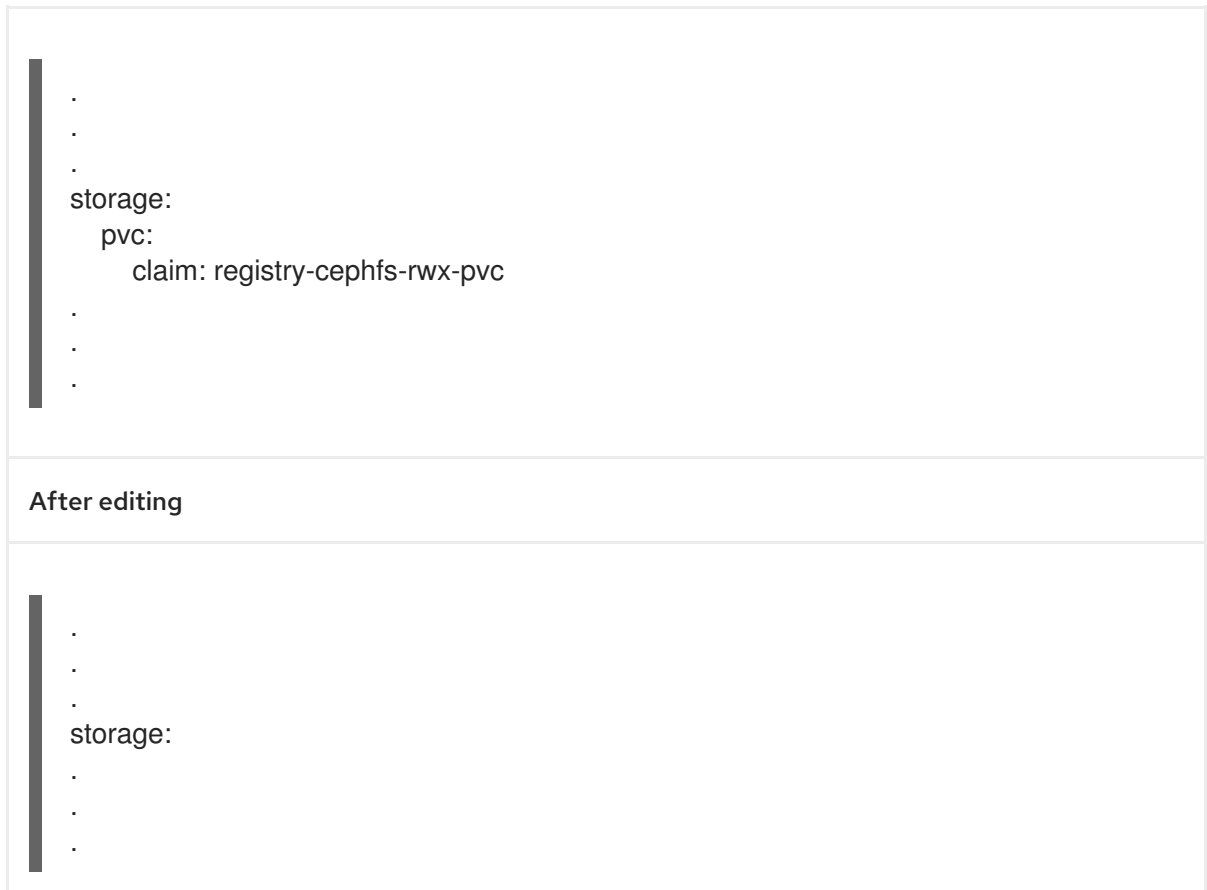
- The image registry should have been configured to use an OpenShift Container Storage PVC.

### 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
```

Before editing



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
```

## 4.4. 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 the **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
```