Red Hat OpenShift Container Storage 4.5

Managing OpenShift Container Storage

Instructions for cluster and storage administrators

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Abstract

This document covers instructions for managing an OpenShift Container Storage cluster.

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CHAPTER 1. OVERVIEW

Managing OpenShift Container Storage is written to help administrators understand how to manage and administer their Red Hat OpenShift Container Storage cluster.

Most management tasks focus on a single resource. This document is divided into chapters based on the resource that an administrator is trying to modify:

- Chapter 2, *Configure storage for OpenShift Container Platform services* shows you how to use OpenShift Container Storage for core OpenShift Container Platform services.
- Chapter 3, *Backing OpenShift Container Platform applications with OpenShift Container Storage* provides information about how to configure OpenShift Container Platform applications to use OpenShift Container Storage.
- Chapter 4, *Scaling storage nodes* provides information about scaling storage capacity of OpenShift Container Storage nodes.
- Chapter 5, *Managing Persistent Volume Claims* provides information about managing Persistent Volume Claim requests, and automating the fulfillment of those requests.
- Chapter 6, *Managing container storage interface (CSI) component placements* provides information about setting tolerations to bring up container storage interface component on the nodes.
- Chapter 7, *Multicloud Object Gateway* provides information about the Multicloud Object Gateway.
- Chapter 9, *Replacing storage nodes for OpenShift Container Storage* shows you how to replace an operational or failed node on AWS UPI, AWS IPI, and VMware UPI for OpenShift Container Storage.
- Chapter 10, *Replacing a storage device* provides instructions for replacing a device for OpenShift Container Storage deployed dynamically of VMware infrastructure and OpenShift Container Storage deployed using local storage devices.
- Chapter 11, *Updating OpenShift Container Storage* provides instructions for upgrading your OpenShift Container Storage cluster.

CHAPTER 2. CONFIGURE STORAGE FOR OPENSHIFT CONTAINER PLATFORM SERVICES

You can use OpenShift Container Storage to provide storage for OpenShift Container Platform services such as image registry, monitoring, and logging.

The process for configuring storage for these services depends on the infrastructure used in your OpenShift Container Storage deployment.

> **WARNING**
>
> Always ensure that you have plenty of storage capacity for these services. If the storage for these critical services runs out of space, the cluster becomes inoperable and very difficult to recover.
>
> Red Hat recommends configuring shorter curation and retention intervals for these services. See Configuring the Curator schedule and the *Modifying retention time for Prometheus metrics data* sub section of Configuring persistent storage in the OpenShift Container Platform documentation for details.
>
> If you do run out of storage space for these services, contact Red Hat Customer Support.

2.1. CONFIGURING IMAGE REGISTRY TO USE OPENSHIFT CONTAINER STORAGE

OpenShift Container Platform provides a built in Container Image Registry which runs as a standard workload on the cluster. A registry is typically used as a publication target for images built on the cluster as well as a source of images for workloads running on the cluster.

Follow the instructions in this section to configure OpenShift Container Storage as storage for the Container Image Registry. On AWS, it is not required to change the storage for the registry. However, it is recommended to change the storage to OpenShift Container Storage Persistent Volume for vSphere and Baremetal platforms.

> **WARNING**
>
> This process does not migrate data from an existing image registry to the new image registry. If you already have container images in your existing registry, back up your registry before you complete this process, and re-register your images when this process is complete.

Prerequisites

- You have administrative access to OpenShift Web Console.

- OpenShift Container Storage Operator is installed and running in the **openshift-storage** namespace. In OpenShift Web Console, click **Operators → Installed Operators** to view installed operators.
- Image Registry Operator is installed and running in the **openshift-image-registry** namespace. In OpenShift Web Console, click **Administration → Cluster Settings → Cluster Operators** to view cluster operators.
- A storage class with provisioner **openshift-storage.cephfs.csi.ceph.com** is available. In OpenShift Web Console, click **Storage → Storage Classes**to view available storage classes.

Procedure

1. **Create a Persistent Volume Claim for the Image Registry to use.**
    a. In OpenShift Web Console, click **Storage → Persistent Volume Claims**.
    b. Set the **Project** to **openshift-image-registry**.
    c. Click **Create Persistent Volume Claim**
        i. From the list of available storage classes retrieved above, specify the **Storage Class** with the provisioner **openshift-storage.cephfs.csi.ceph.com**.
        ii. Specify the Persistent Volume Claim **Name**, for example, **ocs4registry**.
        iii. Specify an **Access Mode** of **Shared Access (RWX)**.
        iv. Specify a **Size** of at least 100 GB.
        v. Click **Create**.
        Wait until the status of the new Persistent Volume Claim is listed as **Bound**.
2. **Configure the cluster's Image Registry to use the new Persistent Volume Claim.**
    a. Click **Administration →Custom Resource Definitions**.
    b. Click the **Config** custom resource definition associated with the **imageregistry.operator.openshift.io** group.
    c. Click the **Instances** tab.
    d. Beside the cluster instance, click the **Action Menu (⋮) → Edit Config**.
    e. Add the new Persistent Volume Claim as persistent storage for the Image Registry.
        i. Add the following under **spec:**, replacing the existing **storage:** section if necessary.

```
storage:
  pvc:
    claim: <new-pvc-name>
```

For example:

```
storage:
  pvc:
    claim: ocs4registry
```

ii. Click **Save**.

3. **Verify that the new configuration is being used.**

   a. Click **Workloads** → **Pods**.

   b. Set the **Project** to **openshift-image-registry**.

   c. Verify that the new **image-registry-*** pod appears with a status of **Running**, and that the previous **image-registry-*** pod terminates.

   d. Click the new **image-registry-*** pod to view pod details.

   e. Scroll down to **Volumes** and verify that the **registry-storage** volume has a **Type** that matches your new Persistent Volume Claim, for example, **ocs4registry**.

2.2. CONFIGURING MONITORING TO USE OPENSHIFT CONTAINER STORAGE

OpenShift Container Storage provides a monitoring stack that is comprised of Prometheus and AlertManager.

Follow the instructions in this section to configure OpenShift Container Storage as storage for the monitoring stack.

> **IMPORTANT**
>
> Monitoring will not function if it runs out of storage space. Always ensure that you have plenty of storage capacity for monitoring.
>
> Red Hat recommends configuring a short retention intervals for this service. See the *Modifying retention time for Prometheus metrics data* sub section of Configuring persistent storage in the OpenShift Container Platform documentation for details.

Prerequisites

- You have administrative access to OpenShift Web Console.
- OpenShift Container Storage Operator is installed and running in the **openshift-storage** namespace. In OpenShift Web Console, click **Operators → Installed Operators** to view installed operators.
- Monitoring Operator is installed and running in the **openshift-monitoring** namespace. In OpenShift Web Console, click **Administration → Cluster Settings → Cluster Operators** to view cluster operators.
- A storage class with provisioner **openshift-storage.rbd.csi.ceph.com** is available. In OpenShift Web Console, click **Storage → Storage Classes**to view available storage classes.

Procedure

1. In OpenShift Web Console, go to **Workloads** → **Config Maps**.
2. Set the **Project** dropdown to **openshift-monitoring**.

3. Click **Create Config Map**.

4. Define a new **cluster-monitoring-config** Config Map using the following example.
   Replace the content in angle brackets (**<**, **>**) with your own values, for example, **retention: 24h** or **storage: 40Gi**.

   Replace the **storageClassName** with the **storageclass** that uses the provisioner **openshift-storage.rbd.csi.ceph.com**. In the example given below the name of the **storageclass** is **ocs-storagecluster-ceph-rbd**.

   ### Example cluster-monitoring-config Config Map

   ```
   apiVersion: v1
   kind: ConfigMap
   metadata:
     name: cluster-monitoring-config
     namespace: openshift-monitoring
   data:
     config.yaml: |
         prometheusK8s:
           retention: <time to retain monitoring files, e.g. 24h>
           volumeClaimTemplate:
             metadata:
               name: ocs-prometheus-claim
             spec:
               storageClassName: ocs-storagecluster-ceph-rbd
               resources:
                 requests:
                   storage: <size of claim, e.g. 40Gi>
         alertmanagerMain:
           volumeClaimTemplate:
             metadata:
               name: ocs-alertmanager-claim
             spec:
               storageClassName: ocs-storagecluster-ceph-rbd
               resources:
                 requests:
                   storage: <size of claim, e.g. 40Gi>
   ```

5. Click **Create** to save and create the Config Map.

Verification steps

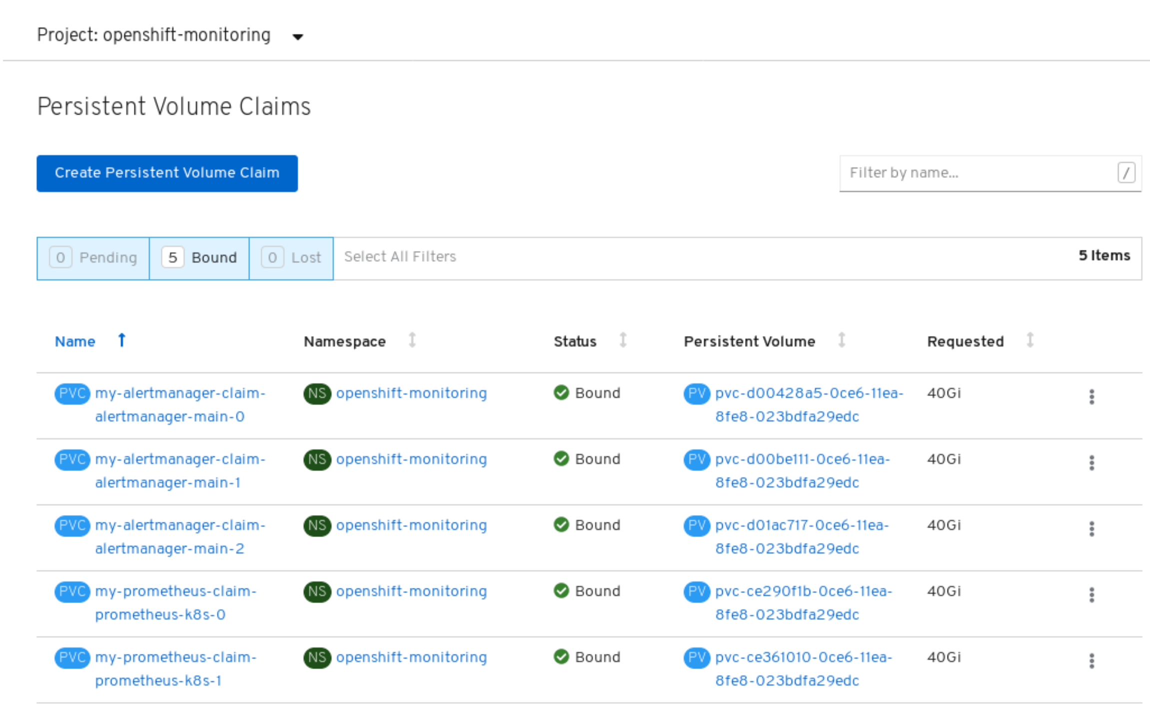
1. Verify that the Persistent Volume Claims are bound to the pods.

   a. Go to **Storage → Persistent Volume Claims**

   b. Set the **Project** dropdown to **openshift-monitoring**.

   c. Verify that 5 Persistent Volume Claims are visible with a state of **Bound**, attached to three **alertmanager-main-*** pods, and two **prometheus-k8s-*** pods.

      #### Monitoring storage created and bound

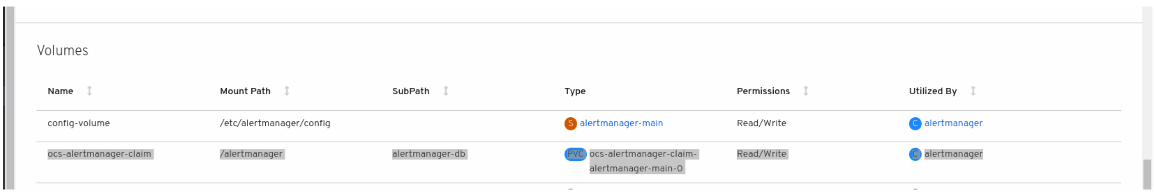


2. Verify that the new **alertmanager-main-*** pods appear with a state of **Running**.

    a. Click the new **alertmanager-main-*** pods to view the pod details.

    b. Scroll down to **Volumes** and verify that the volume has a **Type**, **ocs-alertmanager-claim** that matches one of your new Persistent Volume Claims, for example, **ocs-alertmanager-claim-alertmanager-main-0**.

    Persistent Volume Claims attached to alertmanager-main-* pod

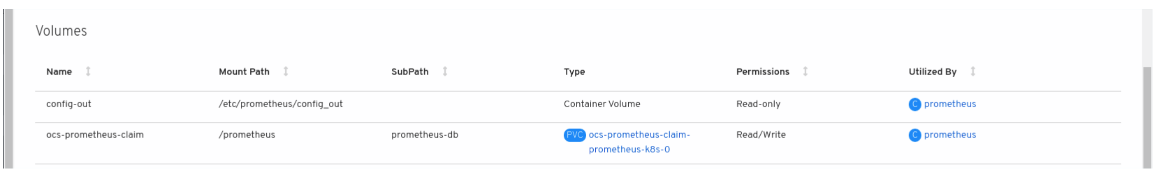


3. Verify that the new **prometheus-k8s-*** pods appear with a state of **Running**.

    a. Click the new **prometheus-k8s-*** pods to view the pod details.

    b. Scroll down to **Volumes** and verify that the volume has a **Type**, **ocs-prometheus-claim** that matches one of your new Persistent Volume Claims, for example, **ocs-prometheus-claim-prometheus-k8s-0**.

    Persistent Volume Claims attached to prometheus-k8s-* pod



2.3. CLUSTER LOGGING FOR OPENSHIFT CONTAINER STORAGE

You can deploy cluster logging to aggregate logs for a range of OpenShift Container Platform services. For information about how to deploy cluster logging, see Deploying cluster logging.

Upon initial OpenShift Container Platform deployment, OpenShift Container Storage is not configured by default and the OpenShift Container Platform cluster will solely rely on default storage available from the nodes. You can edit the default configuration of OpenShift logging (ElasticSearch) to be backed by OpenShift Container Storage to have OpenShift Container Storage backed logging (Elasticsearch).

IMPORTANT

Always ensure that you have plenty of storage capacity for these services. If you run out of storage space for these critical services, the logging application becomes inoperable and very difficult to recover.

Red Hat recommends configuring shorter curation and retention intervals for these services. See Cluster logging curator in the OpenShift Container Platform documentation for details.

If you run out of storage space for these services, contact Red Hat Customer Support.

2.3.1. Configuring persistent storage

You can configure a persistent storage class and size for the Elasticsearch cluster using the storage class name and size parameters. The Cluster Logging Operator creates a Persistent Volume Claim for each data node in the Elasticsearch cluster based on these parameters. For example:

```
spec:
    logStore:
      type: "elasticsearch"
      elasticsearch:
        nodeCount: 3
        storage:
          storageClassName: "ocs-storagecluster-ceph-rbd”
          size: "200G"
```

This example specifies that each data node in the cluster will be bound to a Persistent Volume Claim that requests **200GiB** of **ocs-storagecluster-ceph-rbd** storage. Each primary shard will be backed by a single replica. A copy of the shard is replicated across all the nodes and are always available and the copy can be recovered if at least two nodes exist due to the single redundancy policy. For information about Elasticsearch replication policies, see *Elasticsearch replication policy* in About deploying and configuring cluster logging.

NOTE

Omission of the storage block will result in a deployment backed by default storage. For example:

```
spec:
    logStore:
      type: "elasticsearch"
      elasticsearch:
        nodeCount: 3
        storage: {}
```

For more information, see Configuring cluster logging.

2.3.2. Configuring cluster logging to use OpenShift Container Storage

Follow the instructions in this section to configure OpenShift Container Storage as storage for the OpenShift cluster logging.

> **NOTE**
>
> You can obtain all the logs when you configure logging for the first time in OpenShift Container Storage. However, after you uninstall and reinstall logging, the old logs are removed and only the new logs are processed.

Prerequisites

- You have administrative access to OpenShift Web Console.
- OpenShift Container Storage Operator is installed and running in the **openshift-storage** namespace.
- Cluster logging Operator is installed and running in the **openshift-logging** namespace.

Procedure

1. Click **Administration → Custom Resource Definitions**from the left pane of the OpenShift Web Console.
2. On the Custom Resource Definitions page, click **ClusterLogging**.
3. On the Custom Resource Definition Overview page, select **View Instances** from the Actions menu or click the **Instances** Tab.
4. On the Cluster Logging page, click **Create Cluster Logging**.
   You might have to refresh the page to load the data.
5. In the YAML, replace the **storageClassName** with the **storageclass** that uses the provisioner **openshift-storage.rbd.csi.ceph.com**. In the example given below the name of the **storageclass** is **ocs-storagecluster-ceph-rbd**:

```
apiVersion: "logging.openshift.io/v1"
kind: "ClusterLogging"
metadata:
  name: "instance"
  namespace: "openshift-logging"
spec:
  managementState: "Managed"
  logStore:
    type: "elasticsearch"
    elasticsearch:
      nodeCount: 3
      storage:
        storageClassName: ocs-storagecluster-ceph-rbd
        size: 200G
      redundancyPolicy: "SingleRedundancy"
  visualization:
    type: "kibana"
    kibana:
      replicas: 1
```

```
curation:
  type: "curator"
  curator:
    schedule: "30 3 * * *"
collection:
  logs:
    type: "fluentd"
    fluentd: {}
```

6. Click **Save**.

Verification steps

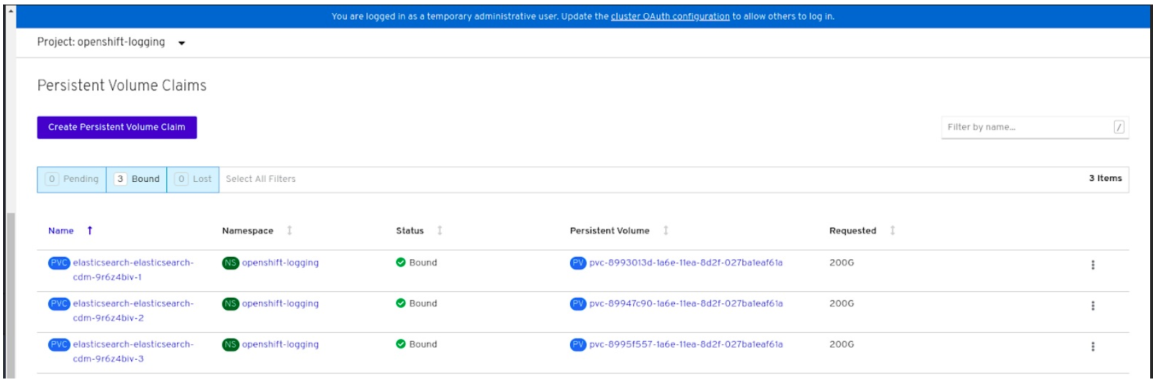
1. Verify that the Persistent Volume Claims are bound to the **elasticsearch** pods.

    a. Go to **Storage → Persistent Volume Claims**.

    b. Set the **Project** dropdown to **openshift-logging**.

    c. Verify that Persistent Volume Claims are visible with a state of **Bound**, attached to **elasticsearch-*** pods.

    Figure 2.1. Cluster logging created and bound

2. Verify that the new cluster logging is being used.

    a. Click **Workload → Pods**.

    b. Set the Project to **openshift-logging**.

    c. Verify that the new **elasticsearch-*** pods appear with a state of **Running**.

    d. Click the new **elasticsearch-*** pod to view pod details.

    e. Scroll down to **Volumes** and verify that the elasticsearch volume has a **Type** that matches your new Persistent Volume Claim, for example, **elasticsearch-elasticsearch-cdm-9r624biv-3**.

    f. Click the Persistent Volume Claim name and verify the storage class name in the PersistenVolumeClaim Overview page.

NOTE

Make sure to use a shorter curator time to avoid PV full scenario on PVs attached to Elasticsearch pods.

You can configure Curator to delete Elasticsearch data based on retention settings. It is recommended that you set the following default index data retention of 5 days as a default.

```
config.yaml: |
    openshift-storage:
      delete:
        days: 5
```

For more details, see Curation of Elasticsearch Data .

NOTE

To uninstall the cluster logging backed by Persistent Volume Claim, use the procedure removing the cluster logging operator from OpenShift Container Storage in the uninstall chapter of the respective deployment guide.

CHAPTER 3. BACKING OPENSHIFT CONTAINER PLATFORM APPLICATIONS WITH OPENSHIFT CONTAINER STORAGE

You cannot directly install OpenShift Container Storage during the OpenShift Container Platform installation. However, you can install OpenShift Container Storage on an existing OpenShift Container Platform by using the Operator Hub and then configure the OpenShift Container Platform applications to be backed by OpenShift Container Storage.

Prerequisites

- OpenShift Container Platform is installed and you have administrative access to OpenShift Web Console.
- OpenShift Container Storage is installed and running in the **openshift-storage** namespace.

Procedure

1. In the OpenShift Web Console, perform one of the following:
    - Click **Workloads → Deployments**.
      In the Deployments page, you can do one of the following:
        - Select any existing deployment and click **Add Storage** option from the **Action** menu (⋮).
        - Create a new deployment and then add storage.
            i. Click **Create Deployment** to create a new deployment.
            ii. Edit the **YAML** based on your requirement to create a deployment.
            iii. Click **Create**.
            iv. Select **Add Storage** from the **Actions** drop down menu on the top right of the page.
    - Click **Workloads → Deployment Configs**
      In the Deployment Configs page, you can do one of the following:
        - Select any existing deployment and click **Add Storage** option from the **Action** menu (⋮).
        - Create a new deployment and then add storage.
            i. Click **Create Deployment Config** to create a new deployment.
            ii. Edit the **YAML** based on your requirement to create a deployment.
            iii. Click **Create**.
            iv. Select **Add Storage** from the **Actions** drop down menu on the top right of the page.
2. In the Add Storage page, you can choose one of the following options:
    - Click the **Use existing claim** option and select a suitable PVC from the drop down list.

- Click the **Create new claim** option.
    a. Select the appropriate **CephFS** or **RBD** storage class from the **Storage Class** drop down list.
    b. Provide a name for the Persistent Volume Claim.
    c. Select ReadWriteOnce (RWO) or ReadWriteMany (RWX) access mode.

    > **NOTE**
    >
    > ReadOnlyMany (ROX) is deactivated as it is not supported.

    d. Select the size of the desired storage capacity.

    > **NOTE**
    >
    > You cannot resize the storage capacity after the creation of Persistent Volume Claim.

3. Specify the mount path and subpath (if required) for the mount path volume inside the container.
4. Click **Save**.

Verification steps

1. Depending on your configuration, perform one of the following:
    - Click **Workloads → Deployments**.
    - Click **Workloads → Deployment Configs**
2. Set the Project as required.
3. Click the deployment for you which you added storage to view the deployment details.
4. Scroll down to **Volumes** and verify that your deployment has a **Type** that matches the Persistent Volume Claim that you assigned.
5. Click the Persistent Volume Claim name and verify the storage class name in the PersistenVolumeClaim Overview page.

CHAPTER 4. SCALING STORAGE NODES

To scale the storage capacity of OpenShift Container Storage in internal mode, you can do either of the following:

- **Scale up storage nodes** - Add storage capacity to the existing Red Hat OpenShift Container Storage worker nodes
- **Scale out storage nodes** - Add new worker nodes containing storage capacity

For scaling your storage in external mode, see Red Hat Ceph Storage documentation .

4.1. REQUIREMENTS FOR SCALING STORAGE NODES

Before you proceed to scale the storage nodes, refer to the following sections to understand the node requirements for your specific Red Hat OpenShift Container Storage instance:

- Platform requirements
- Storage device requirements
  - Dynamic storage devices
  - Local storage devices
  - Capacity planning

IMPORTANT

Always ensure that you have plenty of storage capacity.

If storage ever fills completely, it is not possible to add capacity or delete or migrate content away from the storage to free up space. Completely full storage is very difficult to recover.

Capacity alerts are issued when cluster storage capacity reaches 75% (near-full) and 85% (full) of total capacity. Always address capacity warnings promptly, and review your storage regularly to ensure that you do not run out of storage space.

If you do run out of storage space completely, contact Red Hat Customer Support.

4.1.1. Supported Deployments for Red Hat OpenShift Container Storage

- User-provisioned infrastructure:
  - Amazon Web Services (AWS)
  - VMware
  - Bare metal
- Installer-provisioned infrastructure:
  - Amazon Web Services (AWS)

4.2. SCALING UP STORAGE CAPACITY

Depending on the type of your deployment, you can choose one of the following procedures to scale up storage capacity.

- For AWS or VMware infrastructures using dynamic or automated provisioning of storage devices, see Section 4.2.1, “Scaling up storage by adding capacity to your OpenShift Container Storage nodes on AWS or VMware infrastructure”
- For bare metal, Amazon EC2 I3, or VMware infrastructures using local storage devices, see Section 4.2.2, “Scaling up storage by adding capacity to your OpenShift Container Storage nodes using local storage devices”

4.2.1. Scaling up storage by adding capacity to your OpenShift Container Storage nodes on AWS or VMware infrastructure

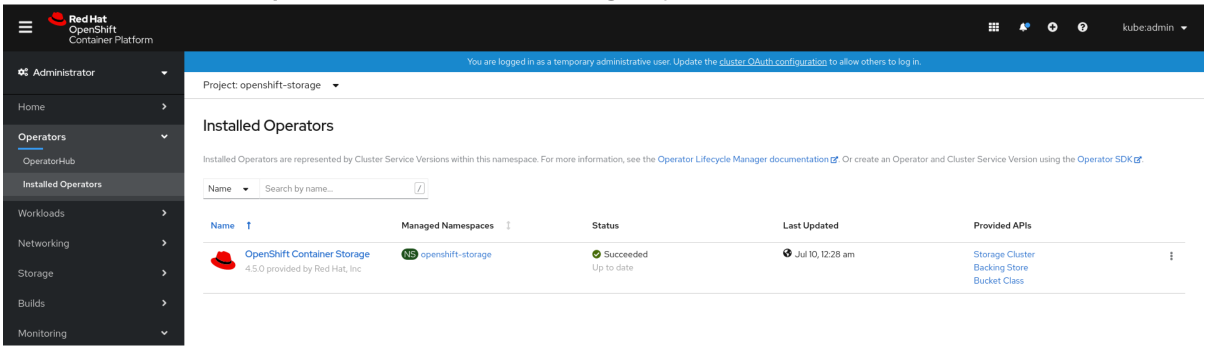
Use this procedure to add storage capacity and performance to your configured Red Hat OpenShift Container Storage worker nodes.

Prerequisites

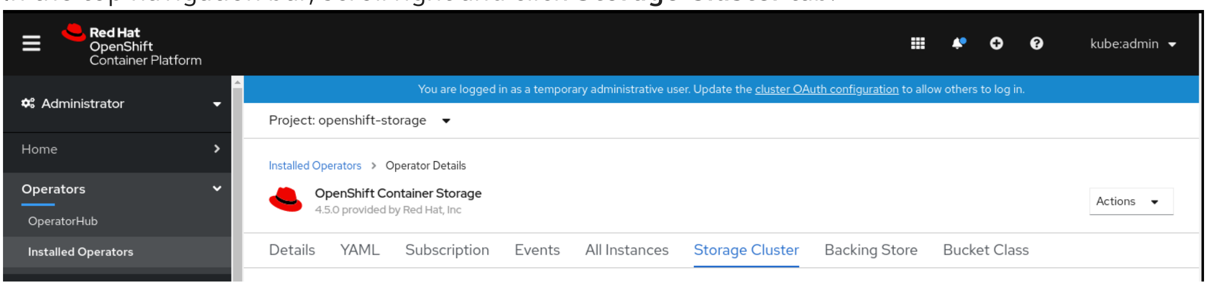
- A running OpenShift Container Storage Platform
- Administrative privileges on the OpenShift Web Console

Procedure

1. Navigate to the OpenShift Web Console.
2. Click on **Operators** on the left navigation bar.
3. Select **Installed Operators**.
4. In the window, click **OpenShift Container Storage** Operator:

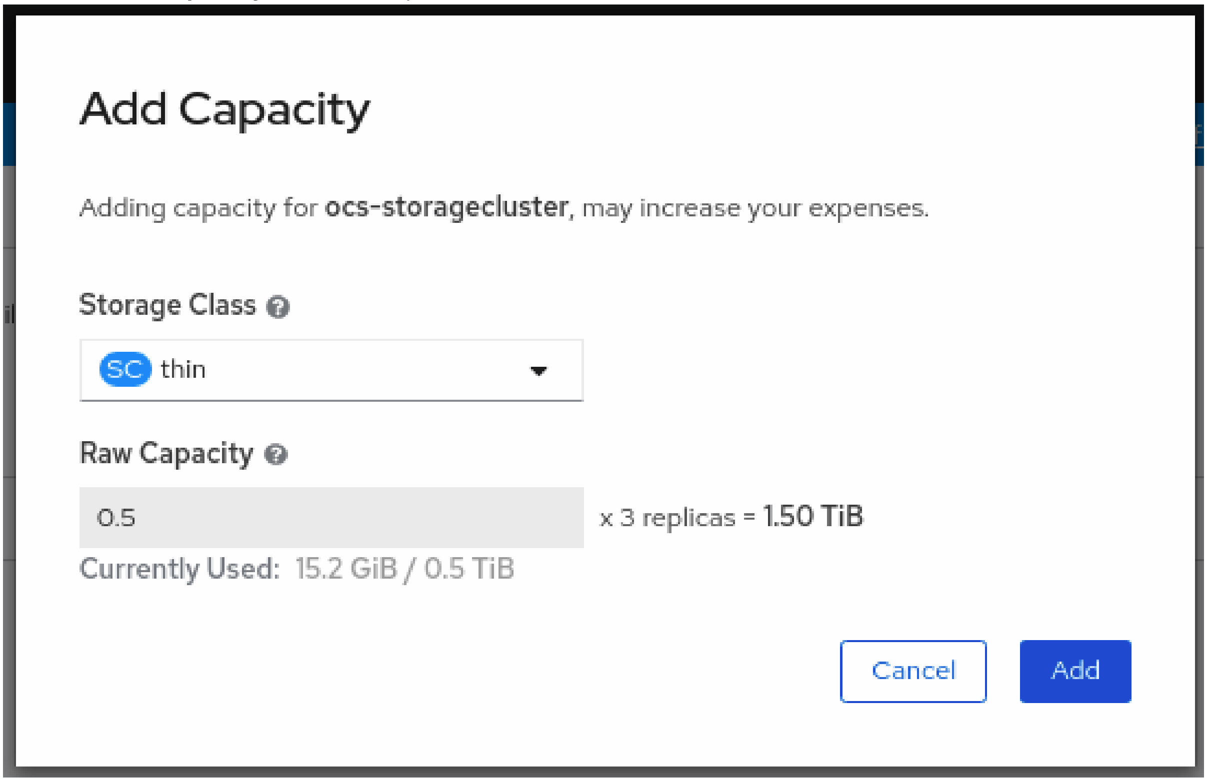


5. In the top navigation bar, scroll right and click **Storage Cluster** tab.



6. The visible list should have only one item. Click (⋮) on the far right to extend the options menu.

7. Select **Add Capacity** from the options menu.



From this dialog box, you can set the requested additional capacity and the storage class. **Add capacity** will show the capacity selected at the time of installation and will allow to add the capacity only in this increment. On AWS, the storage class should be set to **gp2**. On VMware, the storage class should be set to **thin**.

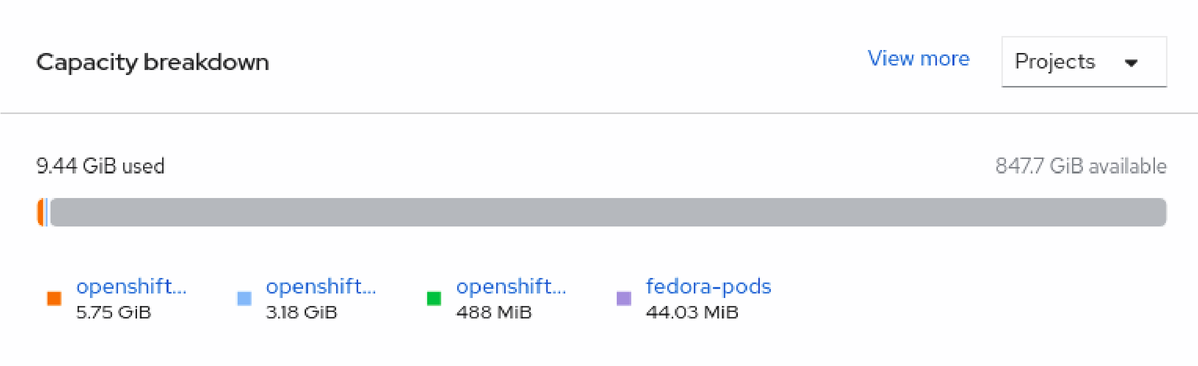
NOTE

The effectively provisioned capacity will be three times as much as what you see in the **Raw Capacity** field because OpenShift Container Storage uses a replica count of 3.

8. Once you are done with your setting, click **Add**. You might need to wait a couple of minutes for the storage cluster to reach **Ready** state.

Verification steps

1. Navigate to **Overview → Persistent Storage** tab, then check the **Capacity breakdown** card.



2. Note that the capacity increases based on your selections.

IMPORTANT

As of OpenShift Container Storage 4.2, cluster reduction, whether by reducing OSDs or nodes, is not supported.

4.2.2. Scaling up storage by adding capacity to your OpenShift Container Storage nodes using local storage devices

Use this procedure to add storage capacity (additional storage devices) to your configured local storage based OpenShift Container Storage worker nodes on bare metal, and VMware infrastructures.

IMPORTANT

Scaling up storage on Amazon EC2 I3 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.

NOTE

For Amazon EC2 I3 infrastructure, adding nodes is the only option for adding capacity, as deployment is done using both the available NVMe devices.

Prerequisites

- You must be logged into OpenShift Container Platform cluster.
- You must have installed local storage operator. Use the following procedures, see
  - Installing Local Storage Operator on bare metal
  - Installing Local Storage Operator on vSphere cluster
- You must have three OpenShift Container Platform worker nodes with the same storage type and size attached to each node (for example, 2TB NVMe drive) as the original OCS StorageCluster was created with.

Procedure

1. To add storage capacity to OpenShift Container Platform nodes with OpenShift Container Storage installed, you need to
   a. Find the unique **by-id** identifier for available devices that you want to add, that is, a minimum of one device per worker node. You can follow the procedure for finding available storage devices in the respective deployment guide.

      NOTE

      Make sure you perform this process for all the existing nodes (minimum of 3) for which you want to add storage.

   b. Add the unique device ID to the **LocalVolume** custom resource (CR).

```
$ oc edit -n local-storage localvolume local-block
```

Example output:

```
spec:
  logLevel: Normal
  managementState: Managed
  nodeSelector:
    nodeSelectorTerms:
    - matchExpressions:
      - key: cluster.ocs.openshift.io/openshift-storage
        operator: In
        values:
        - ""
  storageClassDevices:
  - devicePaths:
    - /dev/disk/by-id/nvme-INTEL_SSDPE2KX010T7_PHLF733402P51P0GGN
    - /dev/disk/by-id/nvme-INTEL_SSDPE2KX010T7_PHLF733402LM1P0GGN
    - /dev/disk/by-id/nvme-INTEL_SSDPE2KX010T7_PHLF733402M21P0GGN
    - /dev/disk/by-id/nvme-INTEL_SSDPE2KX010T7_PHLF733402B71P0GGN    # newly
added device by-id
    - /dev/disk/by-id/nvme-INTEL_SSDPE2KX010T7_PHLF733402A31P0GGN    # newly
added device by-id
    - /dev/disk/by-id/nvme-INTEL_SSDPE2KX010T7_PHLF733402Q71P0GGN    # newly
added device by-id
    storageClassName: localblock
    volumeMode: Block
```

Make sure to save the changes after editing the CR.

Example output:

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

You can see in this CR that new devices using **by-id** have been added. Each new device maps to one NVMe device on the three worker nodes.

- **nvme-INTEL_SSDPE2KX010T7_PHLF733402B71P0GGN**
- **nvme-INTEL_SSDPE2KX010T7_PHLF733402A31P0GGN**
- **nvme-INTEL_SSDPE2KX010T7_PHLF733402Q71P0GGN**

2. Display the newly created PVs with **storageclass** name used in **localVolume** CR.

```
$ oc get pv | grep localblock | grep Available
```

Example output:

```
local-pv-5ee61dcc   931Gi   RWO    Delete  Available   localblock     2m35s
local-pv-b1fa607a   931Gi   RWO    Delete  Available   localblock     2m27s
local-pv-e971c51d   931Gi   RWO    Delete  Available   localblock     2m22s
...
```

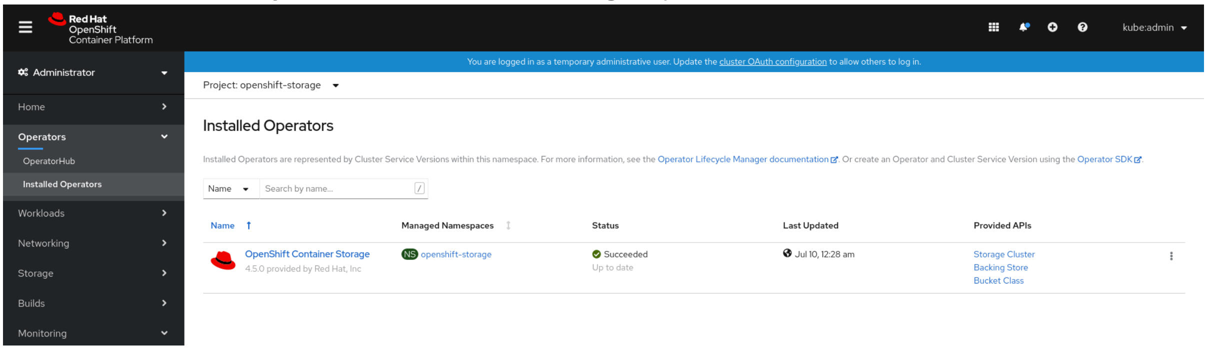
There are three more available PVs of same size which will be used for new OSDs.

3. Navigate to the OpenShift Web Console.

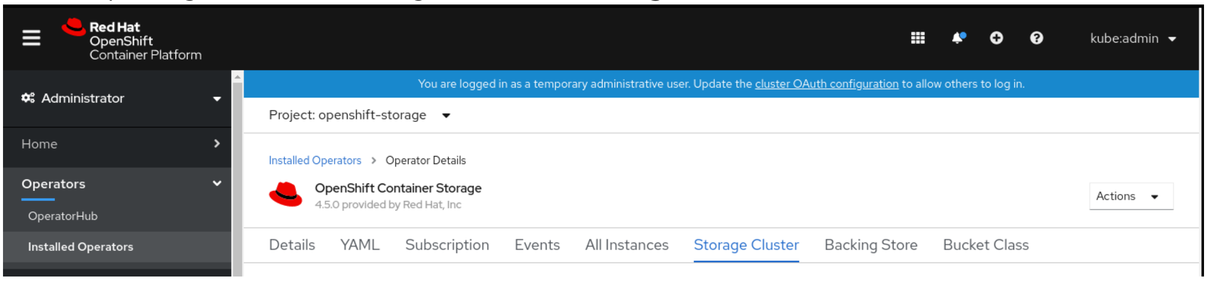
4. Click on **Operators** on the left navigation bar.

5. Select **Installed Operators**.

6. In the window, click **OpenShift Container Storage** Operator:

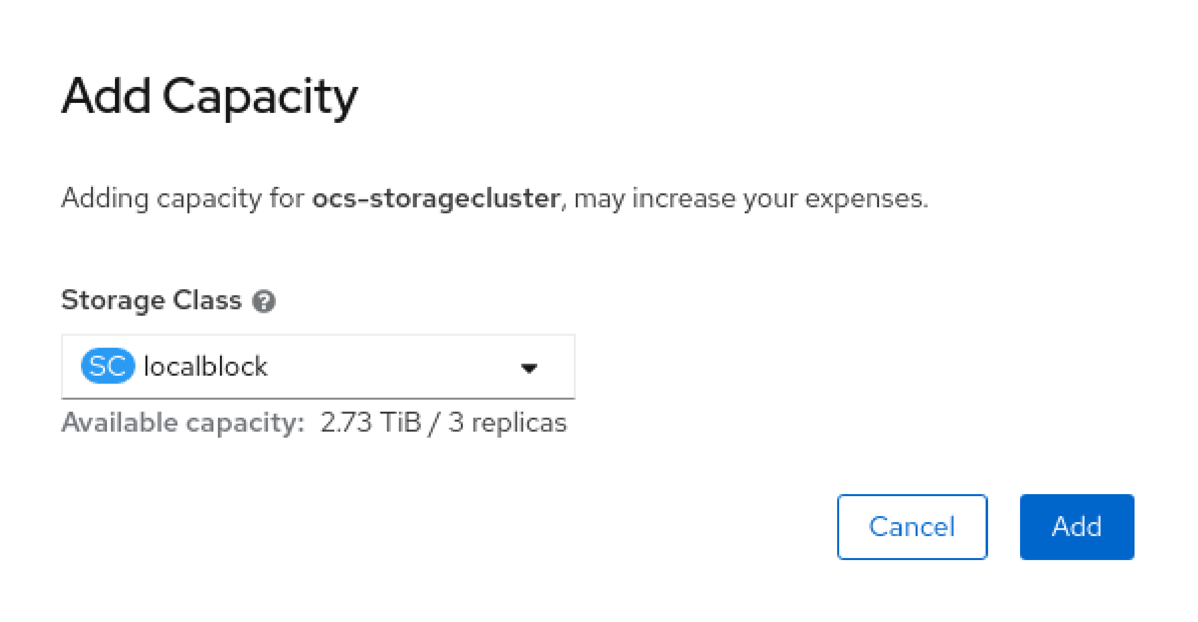


7. In the top navigation bar, scroll right and click **Storage Cluster** tab.



8. The visible list should have only one item. Click (⋮) on the far right to extend the options menu.

9. Select **Add Capacity** from the options menu.



From this dialog box, set the **Storage Class** name to the name used in the **localVolume** CR. Available Capacity displayed is based on the local disks available in storage class.

10. Once you are done with your setting, click **Add**. You might need to wait a couple of minutes for the storage cluster to reach **Ready** state.

11. Verify that the new OSDs and their corresponding new PVCs are created.

```
$ oc get -n openshift-storage pods -l app=rook-ceph-osd
```

Example output:

```
NAME                              READY   STATUS    RESTARTS   AGE
rook-ceph-osd-0-77c4fdb758-qshw4   1/1     Running   0          1h
rook-ceph-osd-1-8645c5fbb6-656ks   1/1     Running   0          1h
rook-ceph-osd-2-86895b854f-r4gt6   1/1     Running   0          1h
rook-ceph-osd-3-dc7f787dd-gdnsz    1/1     Running   0          10m
rook-ceph-osd-4-554b5c46dd-hbf9t   1/1     Running   0          10m
rook-ceph-osd-5-5cf94c4448-k94j6   1/1     Running   0          10m
```

In the above example, osd-3, osd-4, and osd-5 are the newly added pods to the OpenShift Container Storage cluster.

```
$ oc get pvc -n openshift-storage |grep localblock
```

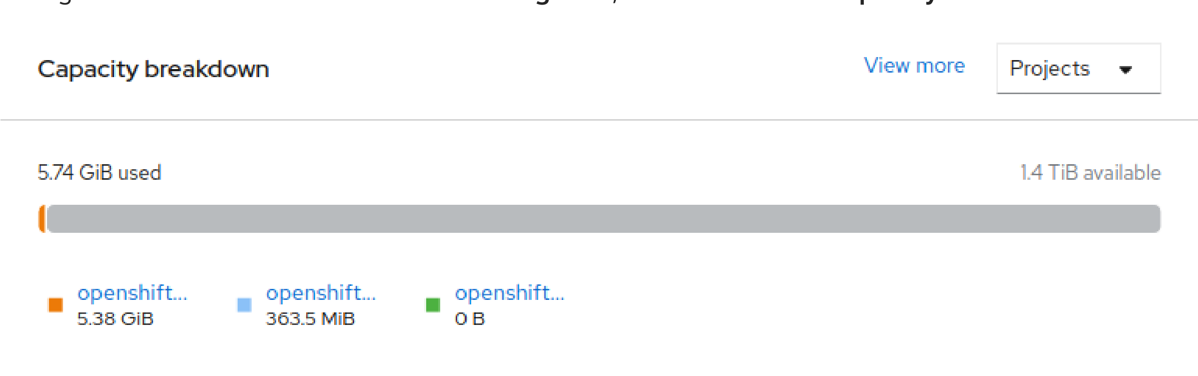
Example output:

```
ocs-deviceset-0-0-qc29m   Bound   local-pv-fc5562d3   931Gi   RWO  localblock  1h
ocs-deviceset-0-1-qdmrl   Bound   local-pv-b1fa607a   931Gi   RWO  localblock  10m
ocs-deviceset-1-0-mpwmk   Bound   local-pv-58cdd0bc   931Gi   RWO  localblock  1h
ocs-deviceset-1-1-85892   Bound   local-pv-e971c51d   931Gi   RWO  localblock  10m
ocs-deviceset-2-0-rll47   Bound   local-pv-29d8ad8d   931Gi   RWO  localblock  1h
ocs-deviceset-2-1-cgth2   Bound   local-pv-5ee61dcc   931Gi   RWO  localblock  10m
```

In the above example, we see three new PVCs are created.

Verification steps

1. Navigate to **Overview → Persistent Storage** tab, then check the **Capacity breakdown** card.



Note that the capacity increases based on your selections.

> **IMPORTANT**
>
> OpenShift Container Storage does not support cluster reduction either by reducing OSDs or reducing nodes.

4.3. SCALING OUT STORAGE CAPACITY

To scale out storage capacity, you need to perform the following steps:

- Add a new node
- Verify that the new node is added successfully
- Scale up the storage capacity

4.3.1. Adding a node

You can add nodes to increase the storage capacity when existing worker nodes are already running at their maximum supported OSDs, which is increment of 3 OSDs of the capacity selected during initial configuration.

Depending on the type of your deployment, you can choose one of the following procedures to add a storage node:

- For AWS installer-provisioned infrastructure, see Section 4.3.1.1, "Adding a node on an AWS installer-provisioned infrastructure"
- For AWS or VMware user-provisioned infrastructure, see Section 4.3.1.2, "Adding a node on an AWS or a VMware user-provisioned infrastructure"
- For bare metal, Amazon EC2 I3, or VMware infrastructures, see Section 4.3.1.3, "Adding a node using a local storage device"

4.3.1.1. Adding a node on an AWS installer-provisioned infrastructure

Prerequisites

- You must be logged into OpenShift Container Platform (OCP) cluster.

Procedure

1. Navigate to **Compute → Machine Sets**.
2. On the machine set where you want to add nodes, select **Edit Machine Count**
3. Add the amount of nodes, and click **Save**.
4. Click **Compute → Nodes** and confirm if the new node is in **Ready** state.
5. Apply the OpenShift Container Storage label to the new node.
   a. For the new node, **Action menu (⋮) → Edit Labels**.
   b. Add **cluster.ocs.openshift.io/openshift-storage** and click **Save**.

NOTE

It is recommended to add 3 nodes each in different zones. You must add 3 nodes and perform this procedure for all of them.

Verification steps

To verify that the new node is added, see Section 4.3.2, "Verifying the addition of a new node" .

4.3.1.2. Adding a node on an AWS or a VMware user-provisioned infrastructure

Prerequisites

- You must be logged into OpenShift Container Platform (OCP) cluster.

Procedure

1. Depending on whether you are adding a node on an AWS user provisioned infrastructure or a VMware user-provisioned infrastructure, perform the following steps:
   - For AWS
     a. Create a new AWS machine instance with the required infrastructure. See Platform requirements.
     b. Create a new OpenShift Container Platform node using the new AWS machine instance.
   - For VMware:
     a. Create a new VM on vSphere with the required infrastructure. See Platform requirements.
     b. Create a new OpenShift Container Platform worker node using the new VM.
2. Check for certificate signing requests (CSRs) related to OpenShift Container Storage that are in **Pending** state:

```
$ oc get csr
```

3. Approve all required OpenShift Container Storage CSRs for the new node:

```
$ oc adm certificate approve <Certificate_Name>
```

4. Click **Compute → Nodes**, confirm if the new node is in **Ready** state.
5. Apply the OpenShift Container Storage label to the new node using any one of the following:

   From User interface

   a. For the new node, click **Action Menu (⋮) → Edit Labels**
   b. Add **cluster.ocs.openshift.io/openshift-storage** and click **Save**.

   From Command line interface

   - Execute the following command to apply the OpenShift Container Storage label to the new node:

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

> **NOTE**
>
> It is recommended to add 3 nodes each in different zones. You must add 3 nodes and perform this procedure for all of them.

Verification steps

To verify that the new node is added, see Section 4.3.2, "Verifying the addition of a new node" .

4.3.1.3. Adding a node using a local storage device

Use this procedure to add a node on bare metal, Amazon EC2, and VMware infrastructures.

> **IMPORTANT**
>
> Scaling storage nodes for Amazon EC2 infrastructure 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

- You must be logged into OpenShift Container Platform (OCP) cluster.
- You must have three OpenShift Container Platform worker nodes with the same storage type and size attached to each node (for example, 2TB NVMe drive) as the original OCS StorageCluster was created with.

Procedure

1. Depending on whether you are adding a node on bare metal, Amazon EC2, or VMware infrastructure, perform the following steps:
   - For Amazon EC2
     a. Create a new Amazon EC2 I3 machine instance with the required infrastructure. See Creating a MachineSet in AWS and Platform requirements.
     b. Create a new OpenShift Container Platform node using the new Amazon EC2 I3 machine instance.
   - For VMware:
     a. Create a new VM on vSphere with the required infrastructure. See Platform requirements.
     b. Create a new OpenShift Container Platform worker node using the new VM.
   - For bare metal:
     a. Get a new bare metal machine with the required infrastructure. See Platform requirements.
     b. Create a new OpenShift Container Platform node using the new bare metal machine.
2. Check for certificate signing requests (CSRs) related to OpenShift Container Storage that are in **Pending** state:

```
$ oc get csr
```

3. Approve all required OpenShift Container Storage CSRs for the new node:

```
$ oc adm certificate approve <Certificate_Name>
```

4. Click **Compute → Nodes**, confirm if the new node is in **Ready** state.

5. Apply the OpenShift Container Storage label to the new node using any one of the following:

From User interface

a. For the new node, click **Action Menu (⋮) → Edit Labels**

b. Add **cluster.ocs.openshift.io/openshift-storage** and click **Save**.

From Command line interface

- Execute the following command to apply the OpenShift Container Storage label to the new node:

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

> **NOTE**
>
> It is recommended to add 3 nodes each in different zones. You must add 3 nodes and perform this procedure for all of them.

Verification steps

To verify that the new node is added, see Section 4.3.2, “Verifying the addition of a new node” .

4.3.2. Verifying the addition of a new node

1. Execute the following command and verify that the new node is present in the output:

```
$ oc get nodes --show-labels | grep cluster.ocs.openshift.io/openshift-storage= |cut -d' ' -f1
```

2. Click **Workloads → Pods**, confirm that at least the following pods on the new node are in **Running** state:

   - **csi-cephfsplugin-***
   - **csi-rbdplugin-***

4.3.3. Scaling up storage capacity

To scale up storage capacity, see Scaling up storage by adding capacity .

CHAPTER 5. MANAGING PERSISTENT VOLUME CLAIMS

5.1. CONFIGURING APPLICATION PODS TO USE OPENSHIFT CONTAINER STORAGE

Follow the instructions in this section to configure OpenShift Container Storage as storage for an application pod.

Prerequisites

- You have administrative access to OpenShift Web Console.
- OpenShift Container Storage Operator is installed and running in the **openshift-storage** namespace. In OpenShift Web Console, click **Operators → Installed Operators** to view installed operators.
- The default storage classes provided by OpenShift Container Storage are available. In OpenShift Web Console, click **Storage → Storage Classes** to view default storage classes.

Procedure

1. **Create a Persistent Volume Claim (PVC) for the application to use.**
   a. In OpenShift Web Console, click **Storage → Persistent Volume Claims**
   b. Set the **Project** for the application pod.
   c. Click **Create Persistent Volume Claim**
      i. Specify a **Storage Class** provided by OpenShift Container Storage.
      ii. Specify the PVC **Name**, for example, **myclaim**.
      iii. Select the required **Access Mode**.
      iv. Specify a **Size** as per application requirement.
      v. Click **Create** and wait until the PVC is in **Bound** status.
2. **Configure a new or existing application pod to use the new PVC.**
   - For a new application pod, perform the following steps:
      i. Click **Workloads →Pods**.
      ii. Create a new application pod.
      iii. Under the **spec:** section, add **volume:** section to add the new PVC as a volume for the application pod.

```
volumes:
  - name: <volume_name>
    persistentVolumeClaim:
      claimName: <pvc_name>
```

For example:

```
volumes:
  - name: mypd
    persistentVolumeClaim:
      claimName: myclaim
```

- For an existing application pod, perform the following steps:

    i. Click **Workloads →Deployment Configs**.

    ii. Search for the required deployment config associated with the application pod.

    iii. Click on its **Action menu (⋮) → Edit Deployment Config**.

    iv. Under the **spec:** section, add **volume:** section to add the new PVC as a volume for the application pod and click **Save**.

```
volumes:
  - name: <volume_name>
    persistentVolumeClaim:
      claimName: <pvc_name>
```

For example:

```
volumes:
  - name: mypd
    persistentVolumeClaim:
      claimName: myclaim
```

3. **Verify that the new configuration is being used.**

    a. Click **Workloads → Pods**.

    b. Set the **Project** for the application pod.

    c. Verify that the application pod appears with a status of **Running**.

    d. Click the application pod name to view pod details.

    e. Scroll down to **Volumes** section and verify that the volume has a **Type** that matches your new Persistent Volume Claim, for example, **myclaim**.

5.2. VIEWING PERSISTENT VOLUME CLAIM REQUEST STATUS

Use this procedure to view the status of a PVC request.

Prerequisites

- Administrator access to OpenShift Container Storage.

Procedure

1. Log in to OpenShift Web Console.

2. Click **Storage → Persistent Volume Claims**

3. Search for the required PVC name by using the **Filter** textbox. You can also filter the list of PVCs by Name or Label to narrow down the list

4. Check the **Status** column corresponding to the required PVC.

5. Click the required **Name** to view the PVC details.

5.3. REVIEWING PERSISTENT VOLUME CLAIM REQUEST EVENTS

Use this procedure to review and address Persistent Volume Claim (PVC) request events.

Prerequisites

- Administrator access to OpenShift Web Console.

Procedure

1. Log in to OpenShift Web Console.

2. Click **Home** → **Overview** → **Persistent Storage**

3. Locate the **Inventory** card to see the number of PVCs with errors.

4. Click **Storage** → **Persistent Volume Claims**

5. Search for the required PVC using the **Filter** textbox.

6. Click on the PVC name and navigate to **Events**

7. Address the events as required or as directed.

5.4. EXPANDING PERSISTENT VOLUME CLAIMS

OpenShift Container Storage 4.5 introduces the ability to expand Persistent Volume Claims as a Technology Preview feature providing more flexibility in the management of persistent storage resources.

Expansion is supported for the following Persistent Volumes:

- PVC with ReadWriteOnce (RWO) and ReadWriteMany (RWX) access that is based on Ceph File System (CephFS) for volume mode **Filesystem**.

- PVC with ReadWriteOnce (RWO) access that is based on Ceph RADOS Block Devices (RBDs) with volume mode **Filesystem**.

- PVC with ReadWriteOnce (RWO) access that is based on Ceph RADOS Block Devices (RBDs) with volume mode **Block**.

IMPORTANT

Expanding Persistent Volumes 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.

For more informaton, see Technology Preview Features Support Scope .

WARNING

OSD and MON PVC expansion is not supported by Red Hat.

NOTE

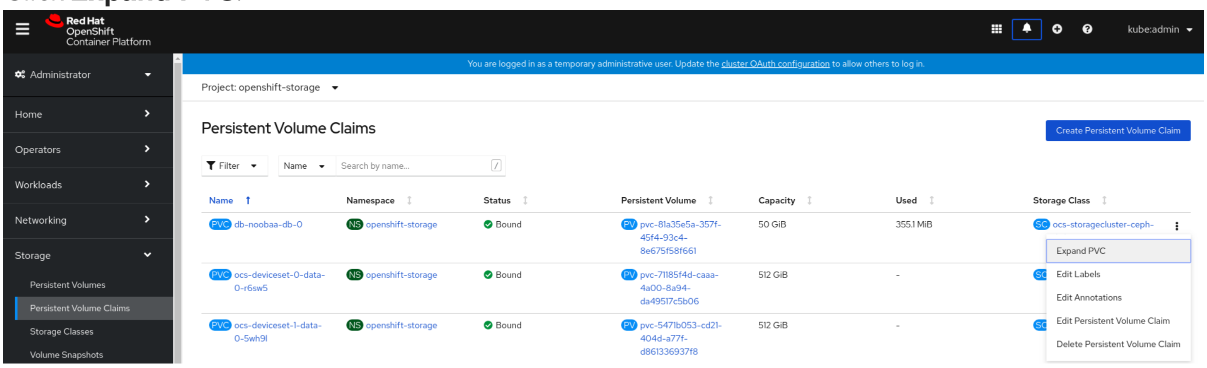
This Technology Preview feature is only available with fresh installations of OpenShift Container Storage version 4.5. It does not apply to clusters upgraded from previous OpenShift Container Storage releases.

Prerequisites

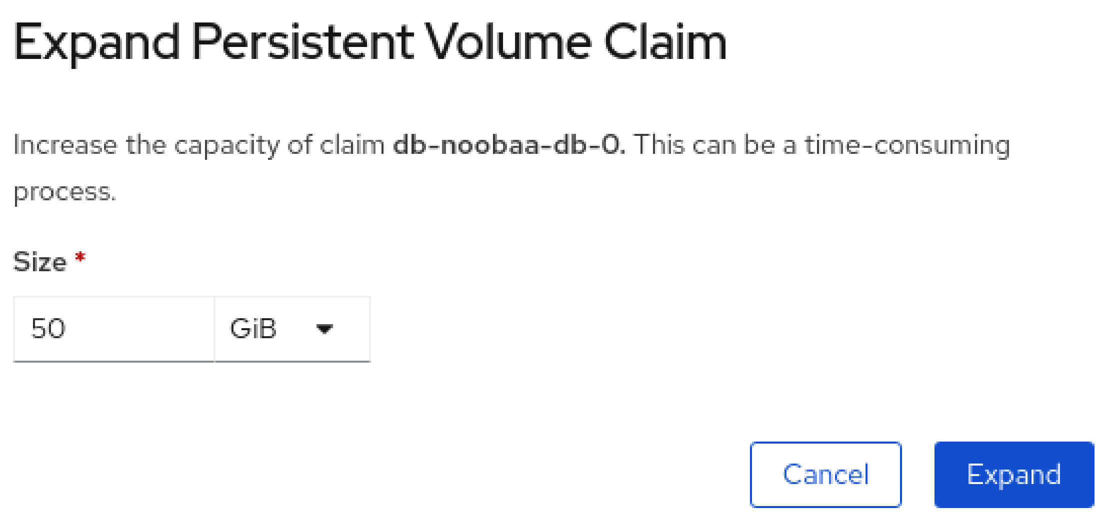
- Administrator access to OpenShift Web Console.

Procedure

1. In OpenShift Web Console, navigate to **Storage → Persistent Volume Claims**.
2. Click the Action Menu (⋮) next to the Persistent Volume Claim you want to expand.
3. Click **Expand PVC**:



4. Select the new size of the Persistent Volume Claim, then click **Expand**:



5. To verify the expansion, navigate to the PVC's details page and verify the **Capacity** field has the correct size requested.

> **NOTE**
>
> When expanding PVCs based on Ceph RADOS Block Devices (RBDs), if the PVC is not already attached to a pod the **Condition type** is **FileSystemResizePending** in the PVC's details page. Once the volume is mounted, Filesystem resize succeeds and the new size is reflected in the **Capacity** field.

5.5. DYNAMIC PROVISIONING

5.5.1. About dynamic provisioning

The StorageClass resource object describes and classifies storage that can be requested, as well as provides a means for passing parameters for dynamically provisioned storage on demand. StorageClass objects can also serve as a management mechanism for controlling different levels of storage and access to the storage. Cluster Administrators (**cluster-admin**) or Storage Administrators (**storage-admin**) define and create the StorageClass objects that users can request without needing any intimate knowledge about the underlying storage volume sources.

The OpenShift Container Platform persistent volume framework enables this functionality and allows administrators to provision a cluster with persistent storage. The framework also gives users a way to request those resources without having any knowledge of the underlying infrastructure.

Many storage types are available for use as persistent volumes in OpenShift Container Platform. While all of them can be statically provisioned by an administrator, some types of storage are created dynamically using the built-in provider and plug-in APIs.

5.5.2. Dynamic provisioning in OpenShift Container Storage

Red Hat OpenShift Container Storage is software-defined storage that is optimised for container environments. It runs as an operator on OpenShift Container Platform to provide highly integrated and simplified persistent storage management for containers.

OpenShift Container Storage supports a variety of storage types, including:

- Block storage for databases
- Shared file storage for continuous integration, messaging, and data aggregation
- Object storage for archival, backup, and media storage

Version 4.5 uses Red Hat Ceph Storage to provide the file, block, and object storage that backs persistent volumes, and Rook.io to manage and orchestrate provisioning of persistent volumes and claims. NooBaa provides object storage, and its Multicloud Gateway allows object federation across multiple cloud environments (available as a Technology Preview).

In OpenShift Container Storage 4.5, the Red Hat Ceph Storage Container Storage Interface (CSI) driver for RADOS Block Device (RBD) and Ceph File System (CephFS) handles the dynamic provisioning requests. When a PVC request comes in dynamically, the CSI driver has the following options:

- Create a PVC with ReadWriteOnce (RWO) and ReadWriteMany (RWX) access that is based on Ceph RBDs with volume mode **Block**
- Create a PVC with ReadWriteOnce (RWO) access that is based on Ceph RBDs with volume mode **Filesystem**
- Create a PVC with ReadWriteOnce (RWO) and ReadWriteMany (RWX) access that is based on CephFS for volume mode **Filesystem**

The judgement of which driver (RBD or CephFS) to use is based on the entry in the **storageclass.yaml** file.

5.5.3. Available dynamic provisioning plug-ins

OpenShift Container Platform provides the following provisioner plug-ins, which have generic implementations for dynamic provisioning that use the cluster’s configured provider’s API to create new storage resources:

Storage type	Provisioner plug-in name	Notes
OpenStack Cinder	**kubernetes.io/cinder**	
AWS Elastic Block Store (EBS)	**kubernetes.io/aws-ebs**	For dynamic provisioning when using multiple clusters in different zones, tag each node with **Key=kubernetes.io/cluster/<cluster_name>,Value=<cluster_id>** where **<cluster_name>** and **<cluster_id>** are unique per cluster.
AWS Elastic File System (EFS)		Dynamic provisioning is accomplished through the EFS provisioner pod and not through a provisioner plug-in.

Storage type	Provisioner plug-in name	Notes
Azure Disk	**kubernetes.io/azure-disk**	
Azure File	**kubernetes.io/azure-file**	The **persistent-volume-binder** ServiceAccount requires permissions to create and get Secrets to store the Azure storage account and keys.
GCE Persistent Disk (gcePD)	**kubernetes.io/gce-pd**	In multi-zone configurations, it is advisable to run one OpenShift Container Platform cluster per GCE project to avoid PVs from being created in zones where no node in the current cluster exists.
VMware vSphere	**kubernetes.io/vsphere-volume**	

IMPORTANT

Any chosen provisioner plug-in also requires configuration for the relevant cloud, host, or third-party provider as per the relevant documentation.

CHAPTER 6. MANAGING CONTAINER STORAGE INTERFACE (CSI) COMPONENT PLACEMENTS

Each cluster consists of a number of dedicated nodes such as **infra** and **storage** nodes. However, an **infra** node with a custom taint will not be able to use OpenShift Container Storage Persistent Volume Claims (PVCs) on the node. So, if you want to use such nodes, you can set tolerations to bring up **csi-plugins** on the nodes. For more information, see https://access.redhat.com/solutions/4827161.

Procedure

1. Edit the configmap to add the toleration for the custom taint. Remember to save before exiting the editor.

```
$ oc edit configmap rook-ceph-operator-config -n openshift-storage
```

2. Display the **configmap** to check the added toleration.

```
$ oc get configmap rook-ceph-operator-config -n openshift-storage -o yaml
```

Example output of the added toleration for the taint, **nodetype=infra:NoSchedule** :

```
apiVersion: v1
data:
[...]
  CSI_PLUGIN_TOLERATIONS: |
    - effect: NoSchedule
      key: nodetype
      operator: Equal
      value: infra
    - effect: NoSchedule
      key: node.ocs.openshift.io/storage
      operator: Exists
[...]
kind: ConfigMap
metadata:
[...]
```

3. Restart the **rook-ceph-operator** if the **csi-cephfsplugin-*** and **csi-rbdplugin-*** pods fail to come up on their own on the infra nodes.

```
$ oc delete -n openshift-storage pod <name of the rook_ceph_operator pod>
```

Example :

```
$ oc delete -n openshift-storage pod rook-ceph-operator-5446f9b95b-jrn2j

pod "rook-ceph-operator-5446f9b95b-jrn2j" deleted
```

Verification step

Verify that the **csi-cephfsplugin-*** and **csi-rbdplugin-*** pods are running on the **infra** nodes.

CHAPTER 7. MULTICLOUD OBJECT GATEWAY

7.1. ABOUT THE MULTICLOUD OBJECT GATEWAY

The Multicloud Object Gateway (MCG) is a lightweight object storage service for OpenShift, allowing users to start small and then scale as needed on-premise, in multiple clusters, and with cloud-native storage.

7.2. ACCESSING THE MULTICLOUD OBJECT GATEWAY WITH YOUR APPLICATIONS

You can access the object service with any application targeting AWS S3 or code that uses AWS S3 Software Development Kit (SDK). Applications need to specify the MCG endpoint, an access key, and a secret access key. You can use your terminal or the MCG CLI to retrieve this information.

For information on accessing the RADOS Object Gateway S3 endpoint, see Chapter 8, *Accessing the RADOS Object Gateway S3 endpoint*.

Prerequisites

- A running OpenShift Container Storage Platform
- Download the MCG command-line interface for easier management:

  ```
  # subscription-manager repos --enable=rh-ocs-4-for-rhel-8-x86_64-rpms
  # yum install mcg
  ```

- Alternatively, you can install the **mcg** package from the OpenShift Container Storage RPMs found at Download RedHat OpenShift Container Storage page .

You can access the relevant endpoint, access key, and secret access key two ways:

- Section 7.2.1, “Accessing the Multicloud Object Gateway from the terminal”
- Section 7.2.2, “Accessing the Multicloud Object Gateway from the MCG command-line interface”

7.2.1. Accessing the Multicloud Object Gateway from the terminal

Procedure

Run the **describe** command to view information about the MCG endpoint, including its access key (**AWS_ACCESS_KEY_ID** value) and secret access key (**AWS_SECRET_ACCESS_KEY** value):

```
# oc describe noobaa -n openshift-storage
```

The output will look similar to the following:

```
Name:         noobaa
Namespace:    openshift-storage
Labels:       <none>
Annotations:  <none>
API Version:  noobaa.io/v1alpha1
```

```
Kind:         NooBaa
Metadata:
  Creation Timestamp:  2019-07-29T16:22:06Z
  Generation:          1
  Resource Version:    6718822
  Self Link:           /apis/noobaa.io/v1alpha1/namespaces/openshift-storage/noobaas/noobaa
  UID:                 019cfb4a-b21d-11e9-9a02-06c8de012f9e
Spec:
Status:
  Accounts:
    Admin:
      Secret Ref:
        Name:          noobaa-admin
        Namespace:     openshift-storage
  Actual Image:        noobaa/noobaa-core:4.0
  Observed Generation:  1
  Phase:               Ready
  Readme:

  Welcome to NooBaa!
  -----------------

  Welcome to NooBaa!
    -----------------
    NooBaa Core Version:
    NooBaa Operator Version:

    Lets get started:

    1. Connect to Management console:

      Read your mgmt console login information (email & password) from secret: "noobaa-admin".

        kubectl get secret noobaa-admin -n openshift-storage -o json | jq '.data|map_values(@base64d)'

      Open the management console service - take External IP/DNS or Node Port or use port
forwarding:

        kubectl port-forward -n openshift-storage service/noobaa-mgmt 11443:443 &
        open https://localhost:11443

    2. Test S3 client:

      kubectl port-forward -n openshift-storage service/s3 10443:443 &
1
      NOOBAA_ACCESS_KEY=$(kubectl get secret noobaa-admin -n openshift-storage -o json | jq -r
'.data.AWS_ACCESS_KEY_ID|@base64d')
2
      NOOBAA_SECRET_KEY=$(kubectl get secret noobaa-admin -n openshift-storage -o json | jq -r
'.data.AWS_SECRET_ACCESS_KEY|@base64d')
      alias s3='AWS_ACCESS_KEY_ID=$NOOBAA_ACCESS_KEY
AWS_SECRET_ACCESS_KEY=$NOOBAA_SECRET_KEY aws --endpoint https://localhost:10443 --
no-verify-ssl s3'
      s3 ls
```

```
    Services:
      Service Mgmt:
        External DNS:
          https://noobaa-mgmt-openshift-storage.apps.mycluster-cluster.qe.rh-ocs.com
          https://a3406079515be11eaa3b70683061451e-1194613580.us-east-
2.elb.amazonaws.com:443
        Internal DNS:
          https://noobaa-mgmt.openshift-storage.svc:443
        Internal IP:
          https://172.30.235.12:443
        Node Ports:
          https://10.0.142.103:31385
        Pod Ports:
          https://10.131.0.19:8443
      serviceS3:
        External DNS: (3)
          https://s3-openshift-storage.apps.mycluster-cluster.qe.rh-ocs.com
          https://a340f4e1315be11eaa3b70683061451e-943168195.us-east-2.elb.amazonaws.com:443
        Internal DNS:
          https://s3.openshift-storage.svc:443
        Internal IP:
          https://172.30.86.41:443
        Node Ports:
          https://10.0.142.103:31011
        Pod Ports:
          https://10.131.0.19:6443
```

1. access key (**AWS_ACCESS_KEY_ID** value)
2. secret access key (**AWS_SECRET_ACCESS_KEY** value)
3. MCG endpoint

NOTE

The output from the **oc describe noobaa** command lists the internal and external DNS names that are available. When using the internal DNS, the traffic is free. The external DNS uses Load Balancing to process the traffic, and therefore has a cost per hour.

7.2.2. Accessing the Multicloud Object Gateway from the MCG command-line interface

Prerequisites

- Download the MCG command-line interface:

```
# subscription-manager repos --enable=rh-ocs-4-for-rhel-8-x86_64-rpms
# yum install mcg
```

Procedure

Run the **status** command to access the endpoint, access key, and secret access key:

```
noobaa status -n openshift-storage
```

The output will look similar to the following:

```
INFO[0000] Namespace: openshift-storage
INFO[0000]
INFO[0000] CRD Status:
INFO[0003]   Exists: CustomResourceDefinition "noobaas.noobaa.io"
INFO[0003]   Exists: CustomResourceDefinition "backingstores.noobaa.io"
INFO[0003]   Exists: CustomResourceDefinition "bucketclasses.noobaa.io"
INFO[0004]   Exists: CustomResourceDefinition "objectbucketclaims.objectbucket.io"
INFO[0004]   Exists: CustomResourceDefinition "objectbuckets.objectbucket.io"
INFO[0004]
INFO[0004] Operator Status:
INFO[0004]   Exists: Namespace "openshift-storage"
INFO[0004]   Exists: ServiceAccount "noobaa"
INFO[0005]   Exists: Role "ocs-operator.v0.0.271-6g45f"
INFO[0005]   Exists: RoleBinding "ocs-operator.v0.0.271-6g45f-noobaa-f9vpj"
INFO[0006]   Exists: ClusterRole "ocs-operator.v0.0.271-fjhgh"
INFO[0006]   Exists: ClusterRoleBinding "ocs-operator.v0.0.271-fjhgh-noobaa-pdxn5"
INFO[0006]   Exists: Deployment "noobaa-operator"
INFO[0006]
INFO[0006] System Status:
INFO[0007]   Exists: NooBaa "noobaa"
INFO[0007]   Exists: StatefulSet "noobaa-core"
INFO[0007]   Exists: Service "noobaa-mgmt"
INFO[0008]   Exists: Service "s3"
INFO[0008]   Exists: Secret "noobaa-server"
INFO[0008]   Exists: Secret "noobaa-operator"
INFO[0008]   Exists: Secret "noobaa-admin"
INFO[0009]   Exists: StorageClass "openshift-storage.noobaa.io"
INFO[0009]   Exists: BucketClass "noobaa-default-bucket-class"
INFO[0009]   (Optional) Exists: BackingStore "noobaa-default-backing-store"
INFO[0010]   (Optional) Exists: CredentialsRequest "noobaa-cloud-creds"
INFO[0010]   (Optional) Exists: PrometheusRule "noobaa-prometheus-rules"
INFO[0010]   (Optional) Exists: ServiceMonitor "noobaa-service-monitor"
INFO[0011]   (Optional) Exists: Route "noobaa-mgmt"
INFO[0011]   (Optional) Exists: Route "s3"
INFO[0011]   Exists: PersistentVolumeClaim "db-noobaa-core-0"
INFO[0011]   System Phase is "Ready"
INFO[0011]   Exists:  "noobaa-admin"

#------------------#
#- Mgmt Addresses -#
#------------------#

ExternalDNS : [https://noobaa-mgmt-openshift-storage.apps.mycluster-cluster.qe.rh-ocs.com
https://a3406079515be11eaa3b70683061451e-1194613580.us-east-2.elb.amazonaws.com:443]
ExternalIP  : []
NodePorts   : [https://10.0.142.103:31385]
InternalDNS : [https://noobaa-mgmt.openshift-storage.svc:443]
InternalIP  : [https://172.30.235.12:443]
PodPorts    : [https://10.131.0.19:8443]

#--------------------#
```

```
#- Mgmt Credentials -#
#--------------------#

email    : admin@noobaa.io
password : HKLbH1rSuVU0I/souIkSiA==

#----------------#
#- S3 Addresses -#
#----------------#

(1)
ExternalDNS : [https://s3-openshift-storage.apps.mycluster-cluster.qe.rh-ocs.com
https://a340f4e1315be11eaa3b70683061451e-943168195.us-east-2.elb.amazonaws.com:443]
ExternalIP  : []
NodePorts   : [https://10.0.142.103:31011]
InternalDNS : [https://s3.openshift-storage.svc:443]
InternalIP  : [https://172.30.86.41:443]
PodPorts    : [https://10.131.0.19:6443]

#------------------#
#- S3 Credentials -#
#------------------#

(2)
AWS_ACCESS_KEY_ID     : jVmAsu9FsvRHYmfjTiHV
(3)
AWS_SECRET_ACCESS_KEY : E//420VNedJfATvVSmDz6FMtsSAzuBv6z180PT5c

#------------------#
#- Backing Stores -#
#------------------#

NAME                         TYPE     TARGET-BUCKET                                             PHASE   AGE
noobaa-default-backing-store   aws-s3   noobaa-backing-store-15dc896d-7fe0-4bed-9349-
5942211b93c9   Ready   141h35m32s

#------------------#
#- Bucket Classes -#
#------------------#

NAME                          PLACEMENT                                                          PHASE   AGE
noobaa-default-bucket-class   {Tiers:[{Placement: BackingStores:[noobaa-default-backing-store]}]}
Ready   141h35m33s

#-----------------#
#- Bucket Claims -#
#-----------------#

No OBC's found.
```

1. endpoint
2. access key
3. secret access key

You now have the relevant endpoint, access key, and secret access key in order to connect to your applications.

Example 7.1. Example

If AWS S3 CLI is the application, the following command will list buckets in OCS:

```
AWS_ACCESS_KEY_ID=<AWS_ACCESS_KEY_ID>
AWS_SECRET_ACCESS_KEY=<AWS_SECRET_ACCESS_KEY>
aws --endpoint <ENDPOINT> --no-verify-ssl s3 ls
```

7.3. ALLOWING USER ACCESS TO THE MULTICLOUD OBJECT GATEWAY CONSOLE

To allow access to the Multicloud Object Gateway Console to a user, ensure that the user meets the following conditions:

- User is in **cluster-admins** group.
- User is in **system:cluster-admins** virtual group.

Prerequisites

- A running OpenShift Container Storage Platform.

Procedure

1. Enable access to the Multicloud Object Gateway console.
   Perform the following steps once on the cluster :
   a. Create a **cluster-admins** group.

      ```
      # oc adm groups new cluster-admins
      ```

   b. Bind the group to the **cluster-admin** role.

      ```
      # oc adm policy add-cluster-role-to-group cluster-admin cluster-admins
      ```

2. Add or remove users from the **cluster-admins** group to control access to the Multicloud Object Gateway console.
   - To add a set of users to the **cluster-admins** group :

     ```
     # oc adm groups add-users cluster-admins <user-name> <user-name> <user-name>...
     ```

     where **<user-name>** is the name of the user to be added.

     NOTE

     If you are adding a set of users to the **cluster-admins** group, you do not need to bind the newly added users to the cluster-admin role to allow access to the OpenShift Container Storage dashboard.

- To remove a set of users from the **cluster-admins** group :

  ```
  # oc adm groups remove-users cluster-admins <user-name> <user-name> <user-name>...
  ```

  where **<user-name>** is the name of the user to be removed.

Verification steps

1. On the OpenShift Web Console, login as a user with access permission to Multicloud Object Gateway Console.
2. Navigate to **Home** → **Overview** → **Persistent Storage** tab → select the **noobaa** link .
3. On the Multicloud Object Gateway Console, login as the same user with access permission.
4. Click **Allow selected permissions**.

7.4. ADDING STORAGE RESOURCES FOR HYBRID OR MULTICLOUD

7.4.1. Creating a new backing store

Use this procedure to create a new backing store in OpenShift Container Storage.

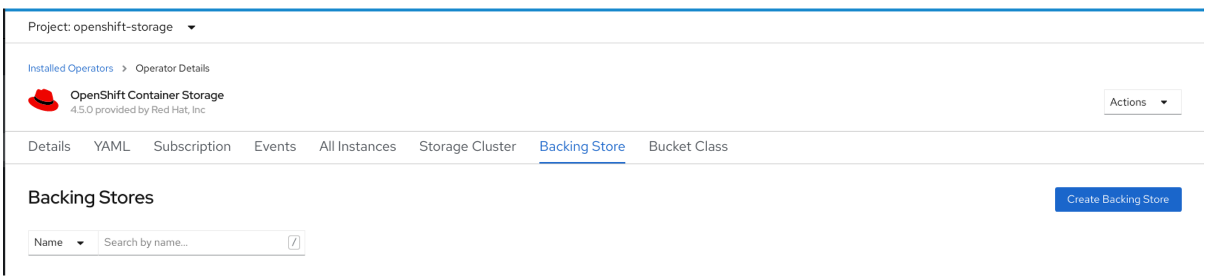
Prerequisites

- Administrator access to OpenShift.

Procedure

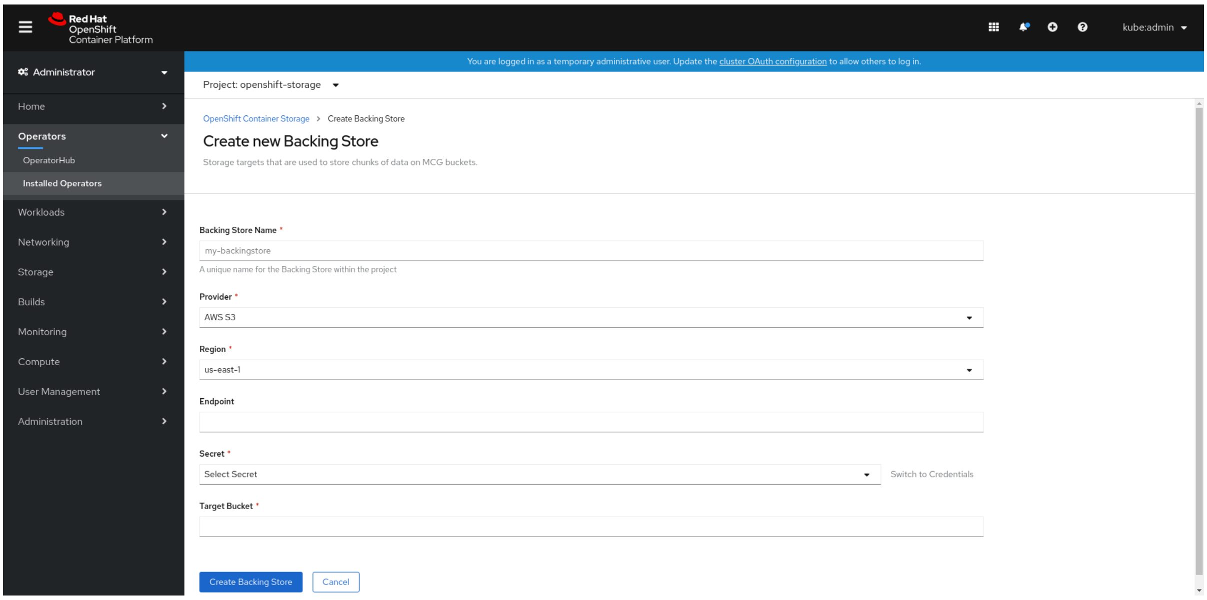
1. Click **Operators** → **Installed Operators** from the left pane of the OpenShift Web Console to view the installed operators.
2. Click **OpenShift Container Storage** Operator.
3. On the OpenShift Container Storage Operator page, scroll right and click the **Backing Store** tab.

Figure 7.1. OpenShift Container Storage Operator page with backing store tab



4. Click **Create Backing Store**.

Figure 7.2. Create Backing Store page



5. On the Create New Backing Store page, perform the following:

    a. Enter a **Backing Store Name**.

    b. Select a **Provider**.

    c. Select a **Region**.

    d. Enter an **Endpoint**. This is optional.

    e. Select a **Secret** from drop down list, or create your own secret. Optionally, you can **Switch to Credentials** view which lets you fill in the required secrets.
    For more information on creating an OCP secret, see the section Creating the secret in the Openshift Container Platform documentation.

    Each backingstore requires a different secret. For more information on creating the secret for a particular backingstore, see the Section 7.4.2, "Adding storage resources for hybrid or Multicloud using the MCG command line interface" and follow the procedure for the addition of storage resources using a YAML.

    > **NOTE**
    >
    > This menu is relevant for all providers except Google Cloud and local PVC.

    f. Enter **Target bucket**. The target bucket is a container storage that is hosted on the remote cloud service. It allows you to create a connection that tells MCG that it can use this bucket for the system.

6. Click **Create Backing Store**.

Verification steps

1. Click **Operators → Installed Operators**.

2. Click **OpenShift Container Storage** Operator.

3. Search for the new backing store or click **Backing Store** tab to view all the backing stores.

7.4.2. Adding storage resources for hybrid or Multicloud using the MCG command line interface

The Multicloud Object Gateway (MCG) simplifies the process of spanning data across cloud provider and clusters.

You must add a backing storage that can be used by the MCG.

Depending on the type of your deployment, you can choose one of the following procedures to create a backing storage:

- For creating an AWS-backed backingstore, see Section 7.4.2.1, “Creating an AWS-backed backingstore”
- For creating an IBM COS-backed backingstore, see Section 7.4.2.2, “Creating an IBM COS-backed backingstore”
- For creating an Azure-backed backingstore, see Section 7.4.2.3, “Creating an Azure-backed backingstore”
- For creating a GCP-backed backingstore, see Section 7.4.2.4, “Creating a GCP-backed backingstore”
- For creating a local Persistent Volume-backed backingstore, see Section 7.4.2.5, “Creating a local Persistent Volume-backed backingstore”

For VMware deployments, skip to Section 7.4.3, “Creating an s3 compatible Multicloud Object Gateway backingstore” for further instructions.

7.4.2.1. Creating an AWS-backed backingstore

Prerequisites

- Download the Multicloud Object Gateway (MCG) command-line interface:

```
# subscription-manager repos --enable=rh-ocs-4-for-rhel-8-x86_64-rpms
# yum install mcg
```

- Alternatively, you can install the **mcg** package from the OpenShift Container Storage RPMs found here https://access.redhat.com/downloads/content/547/ver=4/rhel---8/4/x86_64/packages

Procedure

1. From the MCG command-line interface, run the following command:

```
noobaa backingstore create <backingstore_name> --access-key=<AWS ACCESS KEY> --
secret-key=<AWS SECRET ACCESS KEY> --target-bucket <bucket-name>
```

a. Replace **<backingstore_name>** with the name of the backingstore.

b. Replace **<AWS ACCESS KEY>** and **<AWS SECRET ACCESS KEY>** with an AWS access key ID and secret access key you created for this purpose.

c. Replace **<bucket-name>** with an existing AWS bucket name. This argument tells Multicloud Object Gateway which bucket to use as a target bucket for its backing store, and subsequently, data storage and administration.
The output will be similar to the following:

```
INFO[0001]   Exists: NooBaa "noobaa"
INFO[0002]   Created: BackingStore "aws-resource"
INFO[0002]   Created: Secret "backing-store-secret-aws-resource"
```

You can also add storage resources using a YAML:

1. Create a secret with the credentials:

```
apiVersion: v1
kind: Secret
metadata:
  name: <backingstore-secret-name>
type: Opaque
data:
  AWS_ACCESS_KEY_ID: <AWS ACCESS KEY ID ENCODED IN BASE64>
  AWS_SECRET_ACCESS_KEY: <AWS SECRET ACCESS KEY ENCODED IN BASE64>
```

   a. You must supply and encode your own AWS access key ID and secret access key using Base64, and use the results in place of **<AWS ACCESS KEY ID ENCODED IN BASE64>** and **<AWS SECRET ACCESS KEY ENCODED IN BASE64>**.

   b. Replace **<backingstore-secret-name>** with a unique name.

2. Apply the following YAML for a specific backing store:

```
apiVersion: noobaa.io/v1alpha1
kind: BackingStore
metadata:
  finalizers:
  - noobaa.io/finalizer
  labels:
    app: noobaa
  name: bs
  namespace: openshift-storage
spec:
  awsS3:
    secret:
      name: <backingstore-secret-name>
      namespace: noobaa
    targetBucket: <bucket-name>
  type: aws-s3
```

   a. Replace **<bucket-name>** with an existing AWS bucket name. This argument tells Multicloud Object Gateway which bucket to use as a target bucket for its backing store, and subsequently, data storage and administration.

   b. Replace **<backingstore-secret-name>** with the name of the secret created in the previous step.

7.4.2.2. Creating an IBM COS-backed backingstore

Prerequisites

- Download the Multicloud Object Gateway (MCG) command-line interface:

```
# subscription-manager repos --enable=rh-ocs-4-for-rhel-8-x86_64-rpms
# yum install mcg
```

- Alternatively, you can install the **mcg** package from the OpenShift Container Storage RPMs found here https://access.redhat.com/downloads/content/547/ver=4/rhel---8/4/x86_64/packages

Procedure

1. From the MCG command-line interface, run the following command:

```
noobaa backingstore create ibm-cos <backingstore_name> --access-key=<IBM ACCESS
KEY> --secret-key=<IBM SECRET ACCESS KEY> --endpoint=<IBM COS ENDPOINT> --
target-bucket <bucket-name>
```

   a. Replace **<backingstore_name>** with the name of the backingstore.

   b. Replace **<IBM ACCESS KEY>**, **<IBM SECRET ACCESS KEY>**, **<IBM COS ENDPOINT>** with an IBM access key ID, secret access key and the appropriate regional endpoint that corresponds to the location of the existing IBM bucket.
   To generate the above keys on IBM cloud, you must include HMAC credentials while creating the service credentials for your target bucket.

   c. Replace **<bucket-name>** with an existing IBM bucket name. This argument tells Multicloud Object Gateway which bucket to use as a target bucket for its backing store, and subsequently, data storage and administration.
   The output will be similar to the following:

```
INFO[0001]   Exists: NooBaa "noobaa"
INFO[0002]   Created: BackingStore "ibm-resource"
INFO[0002]   Created: Secret "backing-store-secret-ibm-resource"
```

You can also add storage resources using a YAML:

1. Create a secret with the credentials:

```
apiVersion: v1
kind: Secret
metadata:
  name: <backingstore-secret-name>
type: Opaque
data:
  IBM_COS_ACCESS_KEY_ID: <IBM COS ACCESS KEY ID ENCODED IN BASE64>
  IBM_COS_SECRET_ACCESS_KEY: <IBM COS SECRET ACCESS KEY ENCODED IN
BASE64>
```

   a. You must supply and encode your own IBM COS access key ID and secret access key using Base64, and use the results in place of **<IBM COS ACCESS KEY ID ENCODED IN BASE64>** and **<IBM COS SECRET ACCESS KEY ENCODED IN BASE64>**.

   b. Replace **<backingstore-secret-name>** with a unique name.

2. Apply the following YAML for a specific backing store:

```
apiVersion: noobaa.io/v1alpha1
kind: BackingStore
metadata:
  finalizers:
  - noobaa.io/finalizer
  labels:
    app: noobaa
  name: bs
  namespace: openshift-storage
spec:
  ibmCos:
    endpoint: <endpoint>
    secret:
      name: <backingstore-secret-name>
      namespace: openshift-storage
    targetBucket: <bucket-name>
  type: ibm-cos
```

   a. Replace **<bucket-name>** with an existing IBM COS bucket name. This argument tells Multicloud Object Gateway which bucket to use as a target bucket for its backing store, and subsequently, data storage and administration.

   b. Replace **<endpoint>** with a regional endpoint that corresponds to the location of the existing IBM bucket name. This argument tells Multicloud Object Gateway which endpoint to use for its backing store, and subsequently, data storage and administration.

   c. Replace **<backingstore-secret-name>** with the name of the secret created in the previous step.

7.4.2.3. Creating an Azure-backed backingstore

Prerequisites

- Download the Multicloud Object Gateway (MCG) command-line interface:

```
# subscription-manager repos --enable=rh-ocs-4-for-rhel-8-x86_64-rpms
# yum install mcg
```

- Alternatively, you can install the **mcg** package from the OpenShift Container Storage RPMs found here https://access.redhat.com/downloads/content/547/ver=4/rhel---8/4/x86_64/packages

Procedure

1. From the MCG command-line interface, run the following command:

```
noobaa backingstore create azure-blob <backingstore_name> --account-key=<AZURE
ACCOUNT KEY> --account-name=<AZURE ACCOUNT NAME> --target-blob-container
<blob container name>
```

   a. Replace **<backingstore_name>** with the name of the backingstore.

b. Replace **<AZURE ACCOUNT KEY>** and **<AZURE ACCOUNT NAME>** with an AZURE account key and account name you created for this purpose.

c. Replace **<blob container name>** with an existing Azure blob container name. This argument tells Multicloud Object Gateway which bucket to use as a target bucket for its backing store, and subsequently, data storage and administration.
The output will be similar to the following:

```
INFO[0001]   Exists: NooBaa "noobaa"
INFO[0002]   Created: BackingStore "azure-resource"
INFO[0002]   Created: Secret "backing-store-secret-azure-resource"
```

You can also add storage resources using a YAML:

1. Create a secret with the credentials:

```
apiVersion: v1
kind: Secret
metadata:
  name: <backingstore-secret-name>
type: Opaque
data:
  AccountName: <AZURE ACCOUNT NAME ENCODED IN BASE64>
  AccountKey: <AZURE ACCOUNT KEY ENCODED IN BASE64>
```

a. You must supply and encode your own Azure Account Name and Account Key using Base64, and use the results in place of **<AZURE ACCOUNT NAME ENCODED IN BASE64>** and **<AZURE ACCOUNT KEY ENCODED IN BASE64>**.

b. Replace **<backingstore-secret-name>** with a unique name.

2. Apply the following YAML for a specific backing store:

```
apiVersion: noobaa.io/v1alpha1
kind: BackingStore
metadata:
  finalizers:
  - noobaa.io/finalizer
  labels:
    app: noobaa
  name: bs
  namespace: openshift-storage
spec:
  azureBlob:
    secret:
      name: <backingstore-secret-name>
      namespace: openshift-storage
    targetBlobContainer: <blob-container-name>
  type: azure-blob
```

a. Replace **<blob-container-name>** with an existing Azure blob container name. This argument tells Multicloud Object Gateway which bucket to use as a target bucket for its backing store, and subsequently, data storage and administration.

b. Replace **<backingstore-secret-name>** with the name of the secret created in the previous step.

7.4.2.4. Creating a GCP-backed backingstore

Prerequisites

- Download the Multicloud Object Gateway (MCG) command-line interface:

```
# subscription-manager repos --enable=rh-ocs-4-for-rhel-8-x86_64-rpms
# yum install mcg
```

- Alternatively, you can install the **mcg** package from the OpenShift Container Storage RPMs found here https://access.redhat.com/downloads/content/547/ver=4/rhel---8/4/x86_64/packages

Procedure

1. From the MCG command-line interface, run the following command:

```
noobaa backingstore create google-cloud-storage <backingstore_name> --private-key-json-file=<PATH TO GCP PRIVATE KEY JSON FILE> --target-bucket <GCP bucket name>
```

a. Replace **<backingstore_name>** with the name of the backingstore.

b. Replace **<PATH TO GCP PRIVATE KEY JSON FILE>** with a path to your GCP private key created for this purpose.

c. Replace **<GCP bucket name>** with an existing GCP object storage bucket name. This argument tells Multicloud Object Gateway which bucket to use as a target bucket for its backing store, and subsequently, data storage and administration.
The output will be similar to the following:

```
INFO[0001]   Exists: NooBaa "noobaa"
INFO[0002]   Created: BackingStore "google-gcp"
INFO[0002]   Created: Secret "backing-store-google-cloud-storage-gcp"
```

You can also add storage resources using a YAML:

1. Create a secret with the credentials:

```
apiVersion: v1
kind: Secret
metadata:
  name: <backingstore-secret-name>
type: Opaque
data:
  GoogleServiceAccountPrivateKeyJson: <GCP PRIVATE KEY ENCODED IN BASE64>
```

a. You must supply and encode your own GCP service account private key using Base64, and use the results in place of **<GCP PRIVATE KEY ENCODED IN BASE64>**.

b. Replace <backingstore-secret-name> with a unique name.

2. Apply the following YAML for a specific backing store:

```
apiVersion: noobaa.io/v1alpha1
kind: BackingStore
metadata:
  finalizers:
  - noobaa.io/finalizer
  labels:
    app: noobaa
  name: bs
  namespace: openshift-storage
spec:
  googleCloudStorage:
    secret:
      name: <backingstore-secret-name>
      namespace: openshift-storage
    targetBucket: <target bucket>
  type: google-cloud-storage
```

   a. Replace **<target bucket>** with an existing Google storage bucket. This argument tells Multicloud Object Gateway which bucket to use as a target bucket for its backing store, and subsequently, data storage and administration.

   b. Replace **<backingstore-secret-name>** with the name of the secret created in the previous step.

7.4.2.5. Creating a local Persistent Volume-backed backingstore

Prerequisites

- Download the Multicloud Object Gateway (MCG) command-line interface:

```
# subscription-manager repos --enable=rh-ocs-4-for-rhel-8-x86_64-rpms
# yum install mcg
```

- Alternatively, you can install the **mcg** package from the OpenShift Container Storage RPMs found here https://access.redhat.com/downloads/content/547/ver=4/rhel---8/4/x86_64/packages

Procedure

1. From the MCG command-line interface, run the following command:

```
noobaa backingstore create  pv-pool <backingstore_name> --num-volumes=<NUMBER OF VOLUMES>  --pv-size-gb=<VOLUME SIZE> --storage-class=<LOCAL STORAGE CLASS>
```

   a. Replace **<backingstore_name>** with the name of the backingstore.

   b. Replace **<NUMBER OF VOLUMES>** with the number of volumes you would like to create.

   c. Replace **<VOLUME SIZE>** with the required size, in GB, of each volume

   d. Replace **<LOCAL STORAGE CLASS>** with the local storage class, recommended to use ocs-storagecluster-ceph-rbd

The output will be similar to the following:

```
INFO[0001]   Exists: NooBaa "noobaa"
INFO[0002]   Exists: BackingStore "local-mcg-storage"
```

You can also add storage resources using a YAML:

1. Apply the following YAML for a specific backing store:

```
apiVersion: noobaa.io/v1alpha1
kind: BackingStore
metadata:
  finalizers:
  - noobaa.io/finalizer
  labels:
    app: noobaa
  name: <backingstore_name>
  namespace: openshift-storage
spec:
   pvPool:
    numVolumes: <NUMBER OF VOLUMES>
    resources:
      requests:
        storage: <VOLUME SIZE>
    storageClass: <LOCAL STORAGE CLASS>
  type: pv-pool
```

   a. Replace **<backingstore_name>** with the name of the backingstore.

   b. Replace **<NUMBER OF VOLUMES>** with the number of volumes you would like to create.

   c. Replace **<VOLUME SIZE>** with the required size, in GB, of each volume. Note that the letter G should remain

   d. Replace **<LOCAL STORAGE CLASS>** with the local storage class, recommended to use ocs-storagecluster-ceph-rbd

7.4.3. Creating an s3 compatible Multicloud Object Gateway backingstore

The Multicloud Object Gateway can use any S3 compatible object storage as a backing store, for example, Red Hat Ceph Storage's RADOS Gateway (RGW). The following procedure shows how to create an S3 compatible Multicloud Object Gateway backing store for Red Hat Ceph Storage's RADOS Gateway. Note that when RGW is deployed, Openshift Container Storage operator creates an S3 compatible backingstore for Multicloud Object Gateway automatically.

Procedure

1. From the Multicloud Object Gateway (MCG) command-line interface, run the following NooBaa command:

```
noobaa backingstore create s3-compatible rgw-resource --access-key=<RGW ACCESS
KEY> --secret-key=<RGW SECRET KEY> --target-bucket=<bucket-name> --
endpoint=http://rook-ceph-rgw-ocs-storagecluster-cephobjectstore.openshift-
storage.svc.cluster.local:80
```

a. To get the **<RGW ACCESS KEY>** and **<RGW SECRET KEY>**, run the following command using your RGW user secret name:

```
oc get secret <RGW USER SECRET NAME> -o yaml
```

b. Decode the access key ID and the access key from Base64 and keep them.

c. Replace **<RGW USER ACCESS KEY>** and **<RGW USER SECRET ACCESS KEY>** with the appropriate, decoded data from the previous step.

d. Replace **<bucket-name>** with an existing RGW bucket name. This argument tells Multicloud Object Gateway which bucket to use as a target bucket for its backing store, and subsequently, data storage and administration.
The output will be similar to the following:

```
INFO[0001]	Exists: NooBaa "noobaa"
INFO[0002]	Created: BackingStore "rgw-resource"
INFO[0002]	Created: Secret "backing-store-secret-rgw-resource"
```

You can also create the backingstore using a YAML:

1. Create a **CephObjectStore** user. This also creates a secret containing the RGW credentials:

```
apiVersion: ceph.rook.io/v1
kind: CephObjectStoreUser
metadata:
  name: <RGW-Username>
  namespace: openshift-storage
spec:
  store: ocs-storagecluster-cephobjectstore
  displayName: "<Display-name>"
```

a. Replace **<RGW-Username>** and **<Display-name>** with a unique username and display name.

2. Apply the following YAML for an S3-Compatible backing store:

```
apiVersion: noobaa.io/v1alpha1
kind: BackingStore
metadata:
  finalizers:
  - noobaa.io/finalizer
  labels:
    app: noobaa
  name: <backingstore-name>
  namespace: openshift-storage
spec:
  s3Compatible:
    endpoint: http://rook-ceph-rgw-ocs-storagecluster-cephobjectstore.openshift-
storage.svc.cluster.local:80
    secret:
      name: <backingstore-secret-name>
      namespace: openshift-storage
```

```
    signatureVersion: v4
    targetBucket: <RGW-bucket-name>
  type: s3-compatible
```

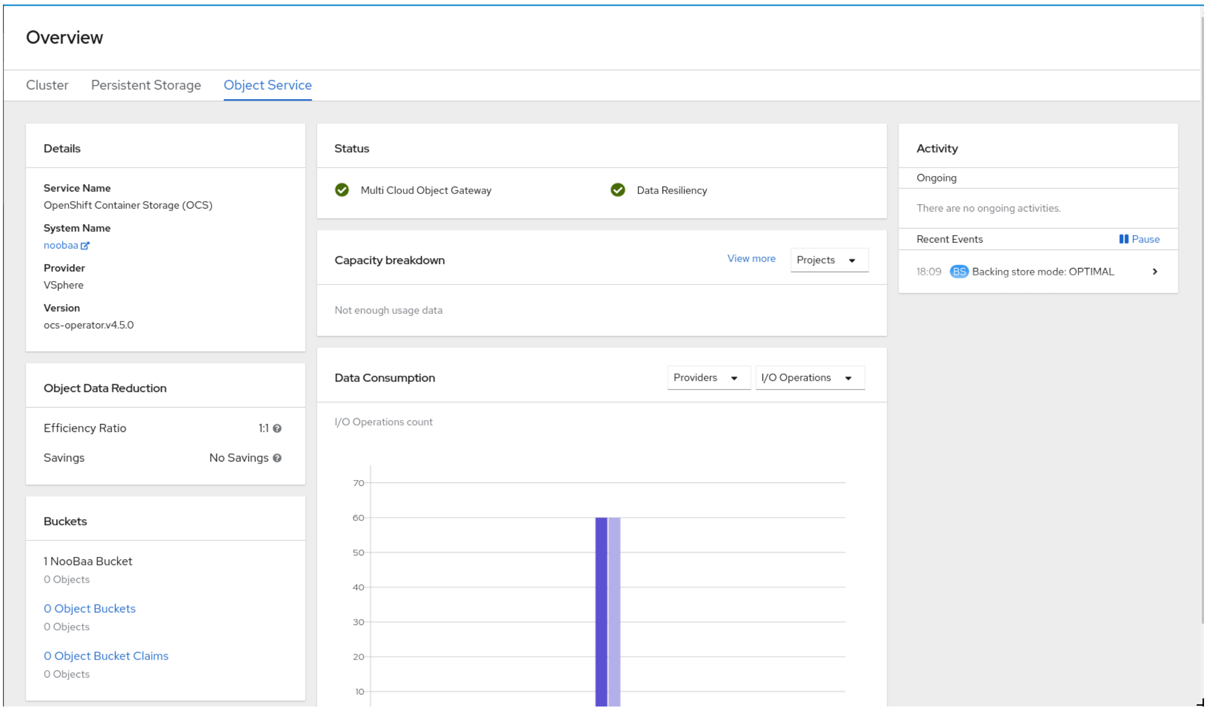
a. Replace **<backingstore-secret-name>** with the name of the secret that was created with **CephObjectStore** in the previous step.

b. Replace **<bucket-name>** with an existing RGW bucket name. This argument tells Multicloud Object Gateway which bucket to use as a target bucket for its backing store, and subsequently, data storage and administration.

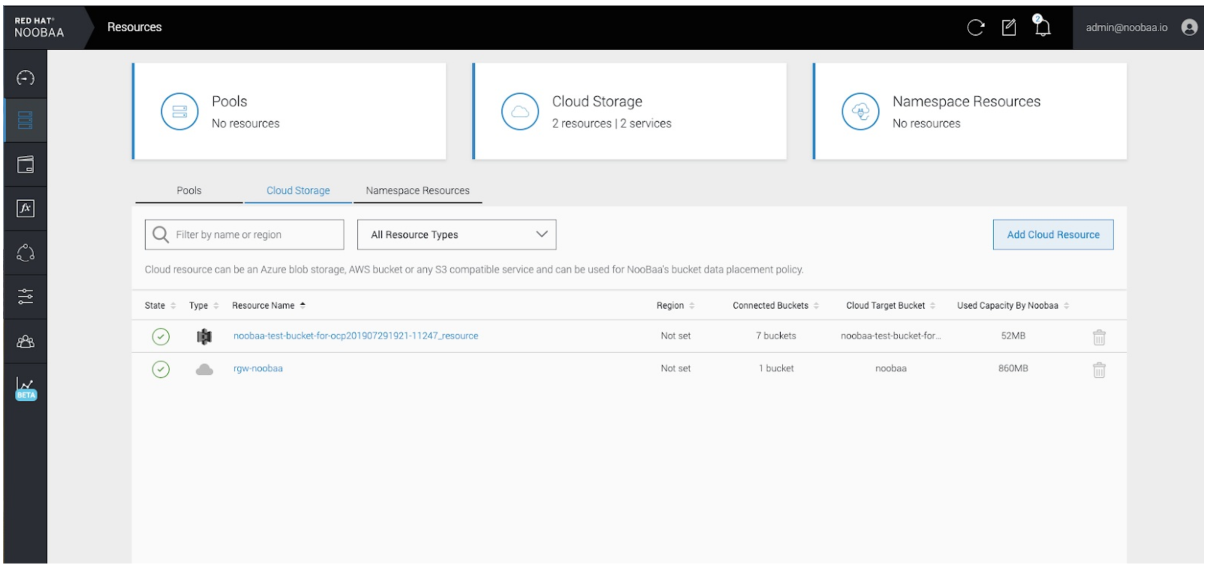
7.4.4. Adding storage resources for hybrid and Multicloud using the user interface

Procedure

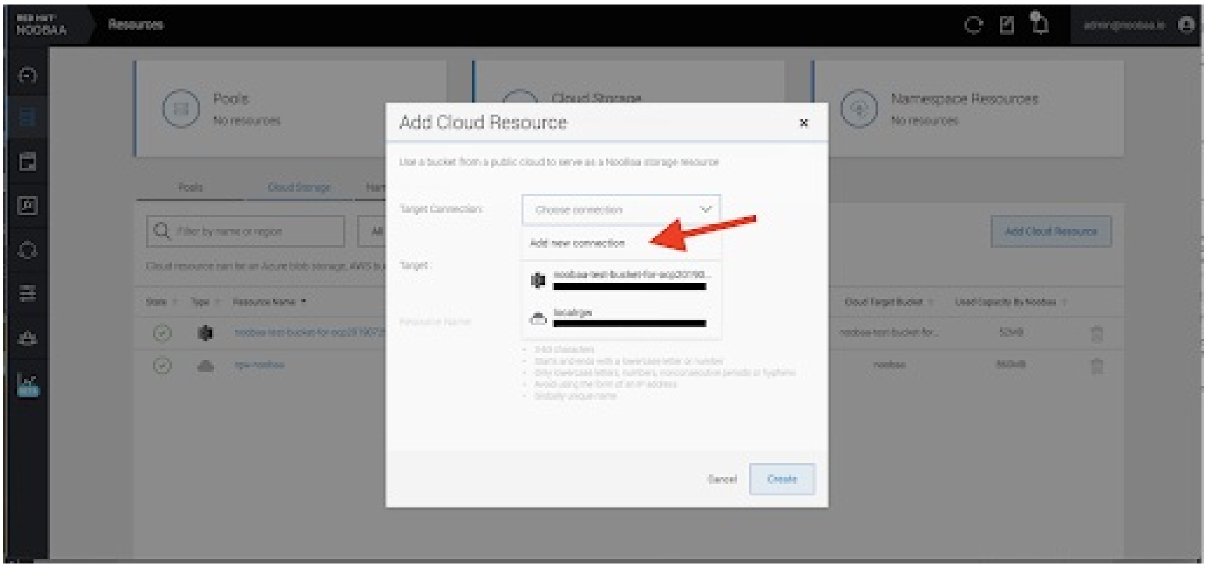
1. In your OpenShift Storage console, navigate to **Overview → Object Service →** select the **noobaa** link:



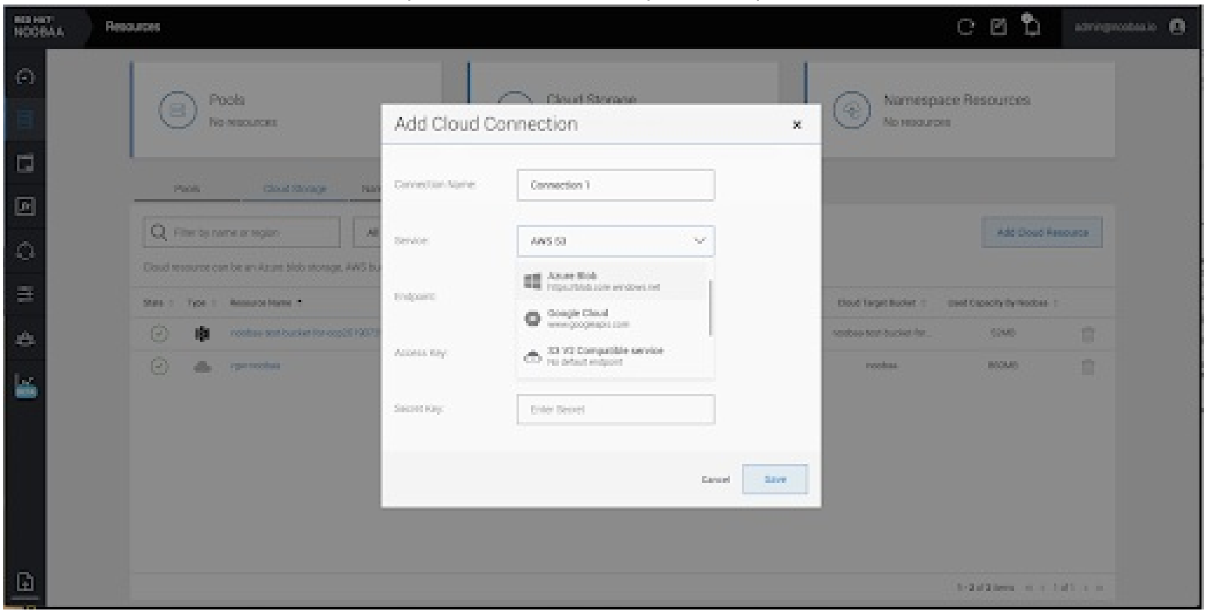
2. Select the **Resources** tab in the left, highlighted below. From the list that populates, select **Add Cloud Resource**:



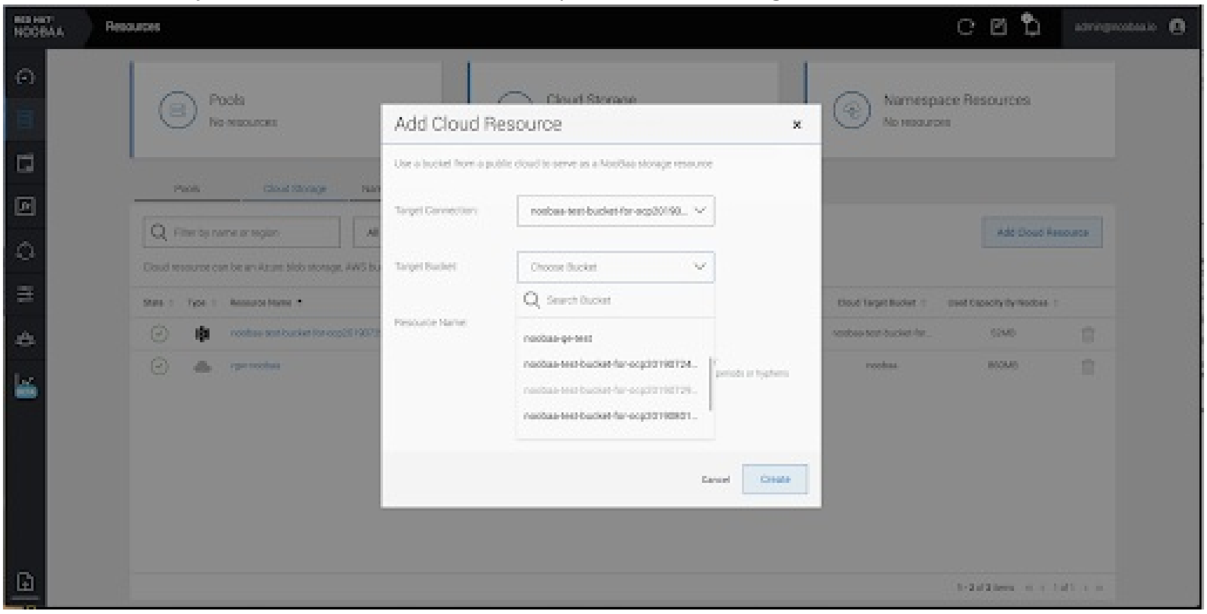
3. Select **Add new connection**:



4. Select the relevant native cloud provider or S3 compatible option and fill in the details:



5. Select the newly created connection and map it to the existing bucket:



6. Repeat these steps to create as many backing stores as needed.

> **NOTE**
>
> Resources created in NooBaa UI cannot be used by OpenShift UI or MCG CLI.

7.4.5. Creating a new bucket class

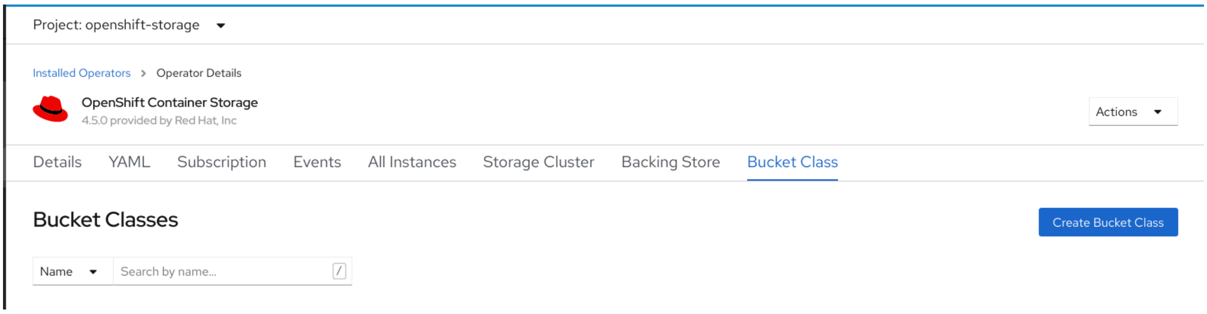
Bucket class is a CRD representing a class of buckets that defines tiering policies and data placements for an Object Bucket Class (OBC).

Use this procedure to create a bucket class in OpenShift Container Storage.

Procedure

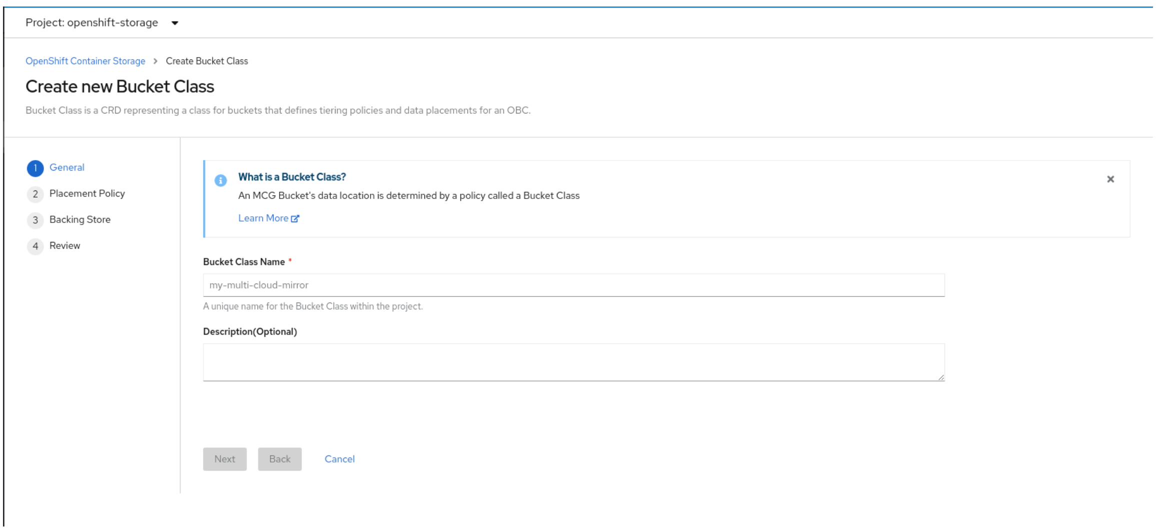
1. Click **Operators → Installed Operators** from the left pane of the OpenShift Web Console to view the installed operators.
2. Click **OpenShift Container Storage** Operator.
3. On the OpenShift Container Storage Operator page, scroll right and click the **Bucket Class** tab.

Figure 7.3. OpenShift Container Storage Operator page with Bucket Class tab



4. Click **Create Bucket Class**.
5. On the Create new Bucket Class page, perform the following:
   a. Enter a **Bucket Class Name** and click **Next**.

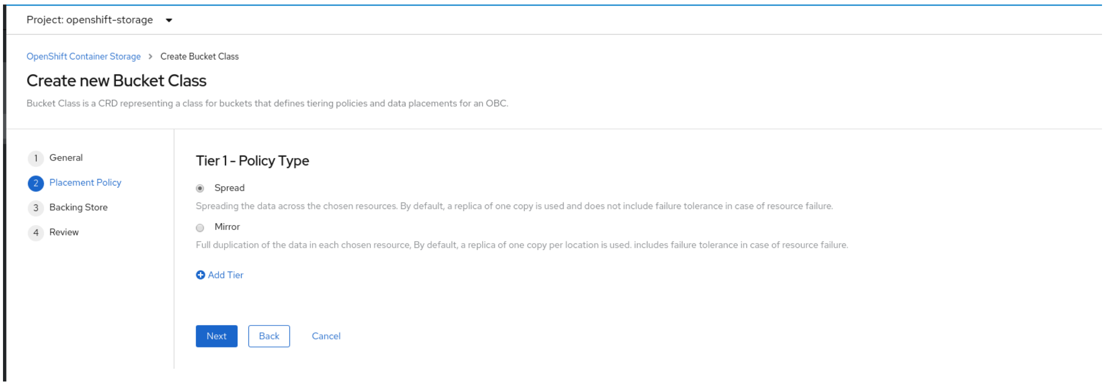
Figure 7.4. Create Bucket Class page



b. In Placement Policy, select **Tier 1 - Policy Type**and click **Next**. You can choose either one of the options as per your requirements.

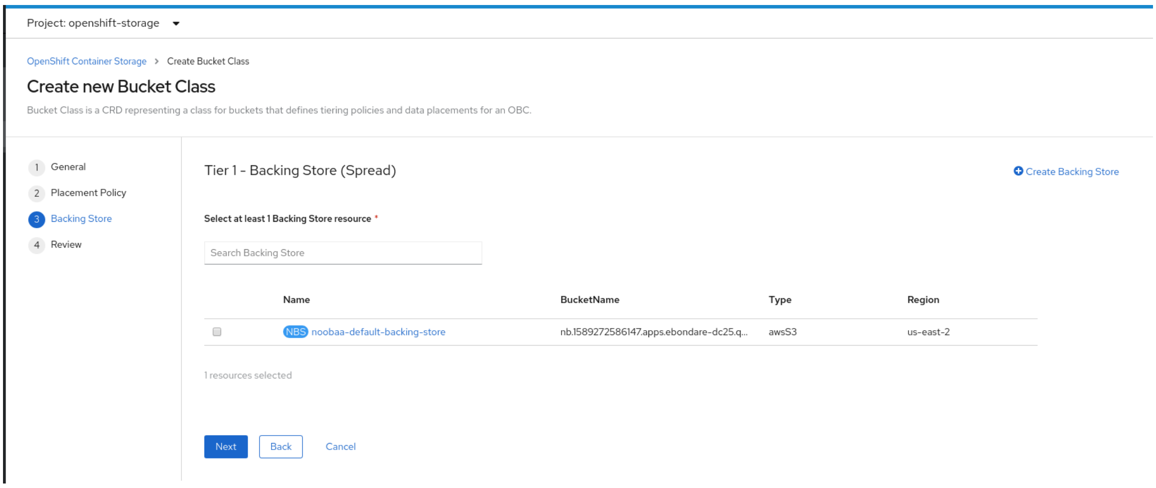
- **Spread** allows spreading of the data across the chosen resources.
- **Mirror** allows full duplication of the data across the chosen resources.
- Click **Add Tier** to add another policy tier.

Figure 7.5. Tier 1 - Policy Type selection page



c. Select atleast one **Backing Store** resource from the available list if you have selected Tier 1 - Policy Type as Spread and click **Next**. Alternatively, you can also create a new backing store.

Figure 7.6. Tier 1 - Backing Store selection page

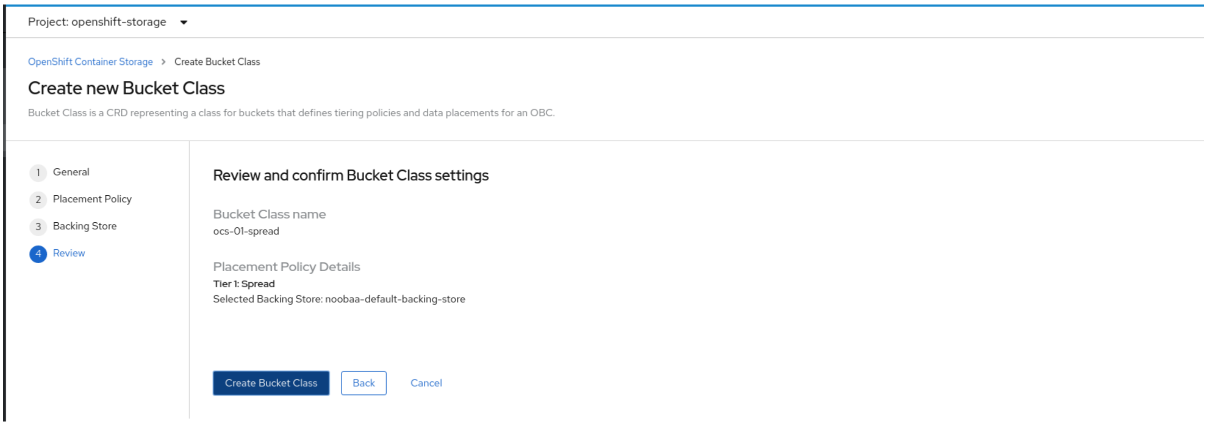


NOTE

You need to select atleast 2 backing stores when you select Policy Type as Mirror in previous step.

a. Review and confirm Bucket Class settings.

Figure 7.7. Bucket class settings review page



b. Click **Create Bucket Class**.

Verification steps

1. Click **Operators → Installed Operators**.
2. Click **OpenShift Container Storage** Operator.
3. Search for the new Bucket Class or click **Bucket Class** tab to view all the Bucket Classes.

7.5. MIRRORING DATA FOR HYBRID AND MULTICLOUD BUCKETS

The Multicloud Object Gateway (MCG) simplifies the process of spanning data across cloud provider and clusters.

Prerequisites

- You must first add a backing storage that can be used by the MCG, see Section 7.4, "Adding storage resources for hybrid or Multicloud".

Then you create a bucket class that reflects the data management policy, mirroring.

Procedure

You can set up mirroring data three ways:

- Section 7.5.1, "Creating bucket classes to mirror data using the MCG command-line-interface"
- Section 7.5.2, "Creating bucket classes to mirror data using a YAML"
- Section 7.5.3, "Configuring buckets to mirror data using the user interface"

7.5.1. Creating bucket classes to mirror data using the MCG command-line-interface

1. From the MCG command-line interface, run the following command to create a bucket class with a mirroring policy:

```
$ noobaa bucketclass create mirror-to-aws --backingstores=azure-resource,aws-resource --
placement Mirror
```

2. Set the newly created bucket class to a new bucket claim, generating a new bucket that will be mirrored between two locations:

```
$ noobaa obc create  mirrored-bucket --bucketclass=mirror-to-aws
```

7.5.2. Creating bucket classes to mirror data using a YAML

1. Apply the following YAML. This YAML is a hybrid example that mirrors data between local Ceph storage and AWS:

```
apiVersion: noobaa.io/v1alpha1
kind: BucketClass
metadata:
  name: hybrid-class
  labels:
    app: noobaa
spec:
  placementPolicy:
    tiers:
      - tier:
          mirrors:
            - mirror:
                spread:
                  - cos-east-us
            - mirror:
                spread:
                  - noobaa-test-bucket-for-ocp201907291921-11247_resource
```

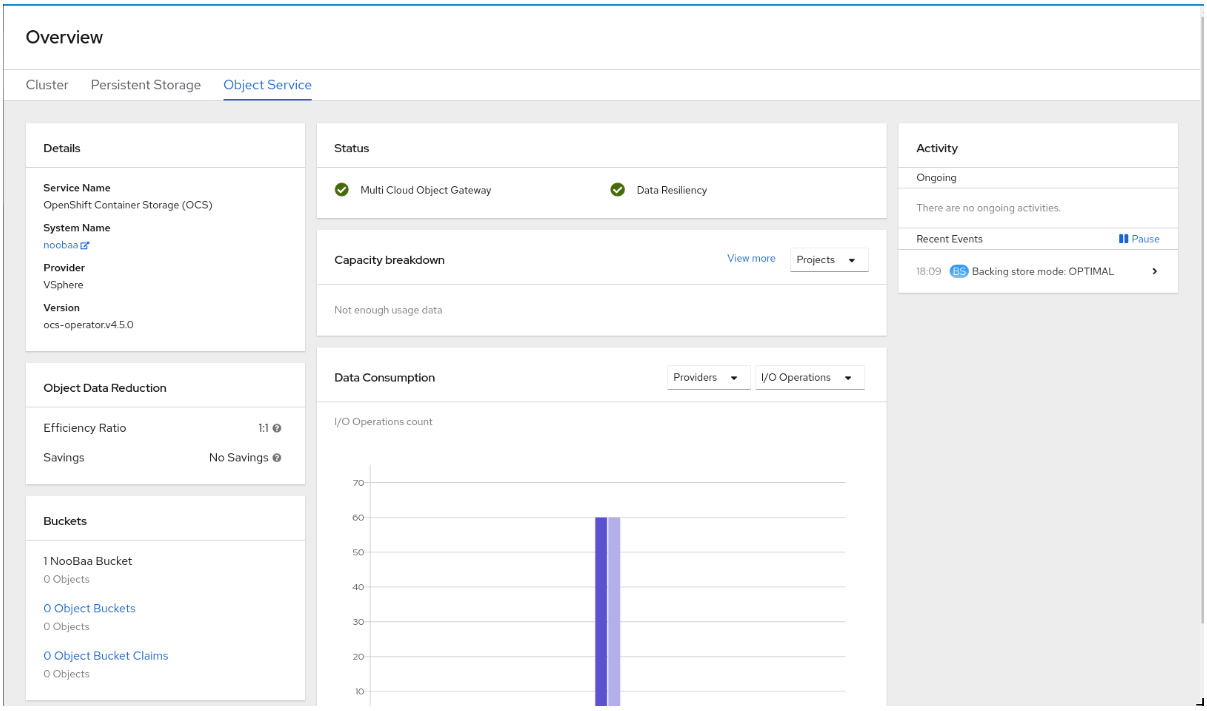
2. Add the following lines to your standard Object Bucket Claim (OBC):

```
additionalConfig:
  bucketclass: mirror-to-aws
```

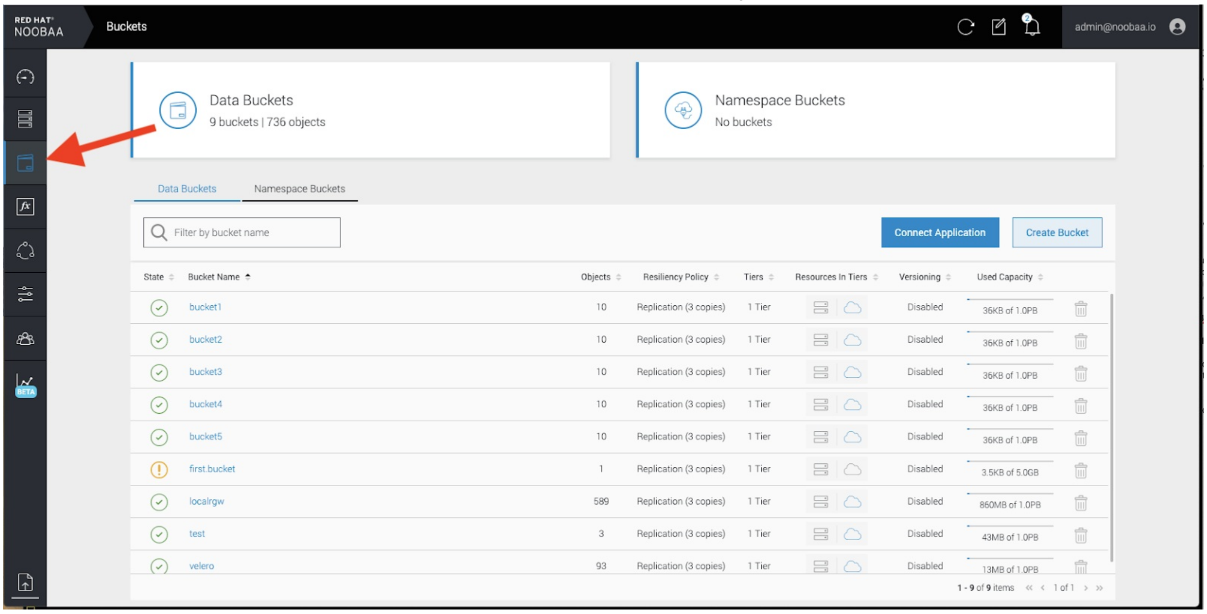
For more information about OBCs, see Section 7.7, “Object Bucket Claim”.

7.5.3. Configuring buckets to mirror data using the user interface

1. In your OpenShift Storage console, navigate to **Overview** → **Object Service** → select the **noobaa** link:

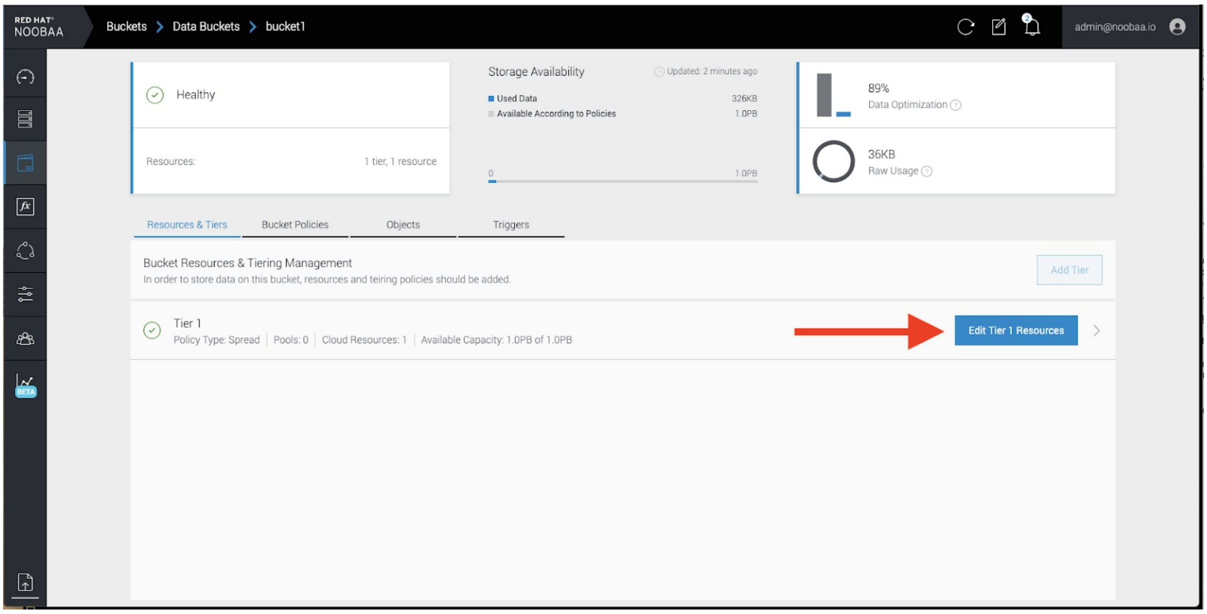


2. Click the **buckets** icon on the left side. You will see a list of your buckets:

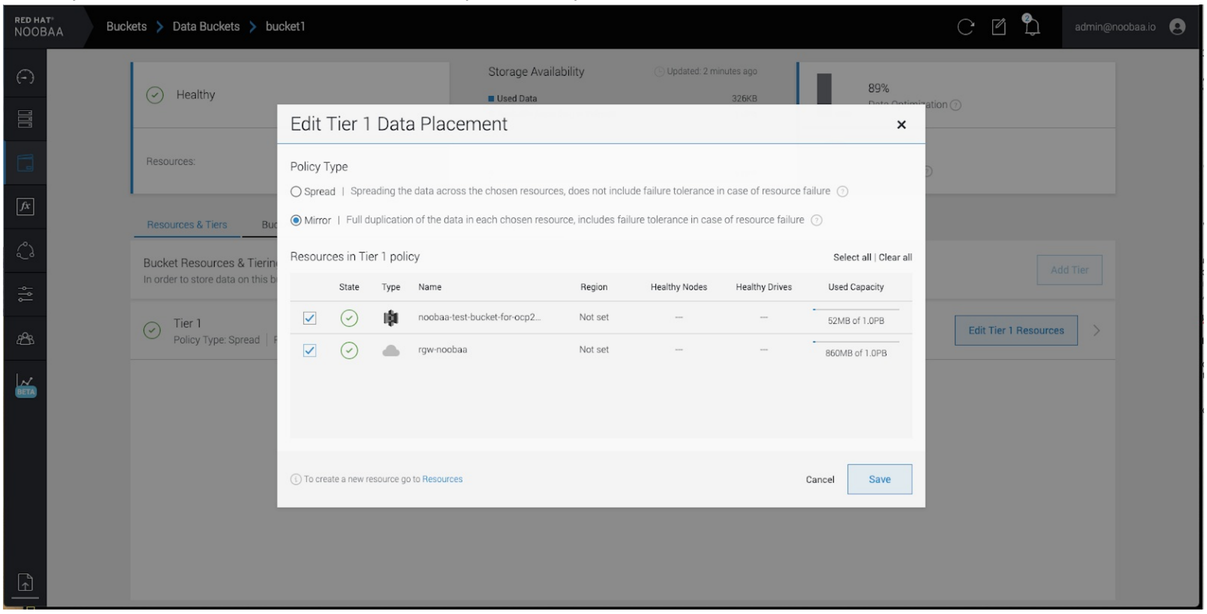


3. Click the bucket you want to update.

4. Click **Edit Tier 1 Resources**:



5. Select **Mirror** and check the relevant resources you want to use for this bucket. In the following example, we mirror data between on prem Ceph RGW to AWS:



6. Click **Save**.

> **NOTE**
>
> Resources created in NooBaa UI cannot be used by OpenShift UI or MCG CLI.

7.6. BUCKET POLICIES IN THE MULTICLOUD OBJECT GATEWAY

OpenShift Container Storage supports AWS S3 bucket policies. Bucket policies allow you to grant users access permissions for buckets and the objects in them.

7.6.1. About bucket policies

Bucket policies are an access policy option available for you to grant permission to your AWS S3 buckets and objects. Bucket policies use JSON-based access policy language. For more information about access policy language, see AWS Access Policy Language Overview .

7.6.2. Using bucket policies

Prerequisites

- A running OpenShift Container Storage Platform
- Access to the Multicloud Object Gateway, see Section 7.2, "Accessing the Multicloud Object Gateway with your applications"

Procedure

To use bucket policies in the Multicloud Object Gateway:

1. Create the bucket policy in JSON format. See the following example:

```
{
    "Version": "NewVersion",
    "Statement": [
        {
            "Sid": "Example",
            "Effect": "Allow",
            "Principal": [
                    "john.doe@example.com"
            ],
            "Action": [
                "s3:GetObject"
            ],
            "Resource": [
                "arn:aws:s3:::john_bucket"
            ]
        }
    ]
}
```

   There are many available elements for bucket policies. For details on these elements and examples of how they can be used, see AWS Access Policy Language Overview .

   For more examples of bucket policies, see AWS Bucket Policy Examples .

   Instructions for creating S3 users can be found in Section 7.6.3, "Creating an AWS S3 user in the Multicloud Object Gateway".

2. Using AWS S3 client, use the **put-bucket-policy** command to apply the bucket policy to your S3 bucket:

```
# aws --endpoint ENDPOINT --no-verify-ssl s3api put-bucket-policy --bucket MyBucket --
policy BucketPolicy
```

   Replace ***ENDPOINT*** with the S3 endpoint

   Replace ***MyBucket*** with the bucket to set the policy on

   Replace ***BucketPolicy*** with the bucket policy JSON file

   Add **--no-verify-ssl** if you are using the default self signed certificates

For example:

```
# aws --endpoint https://s3-openshift-storage.apps.gogo44.noobaa.org --no-verify-ssl s3api put-bucket-policy -bucket MyBucket --policy file://BucketPolicy
```

For more information on the **put-bucket-policy** command, see the AWS CLI Command Reference for put-bucket-policy.

> **NOTE**
>
> The principal element specifies the user that is allowed or denied access to a resource, such as a bucket. Currently, Only NooBaa accounts can be used as principals. In the case of object bucket claims, NooBaa automatically create an account **obc-account.<generated bucket name>@noobaa.io**.

> **NOTE**
>
> Bucket policy conditions are not supported.

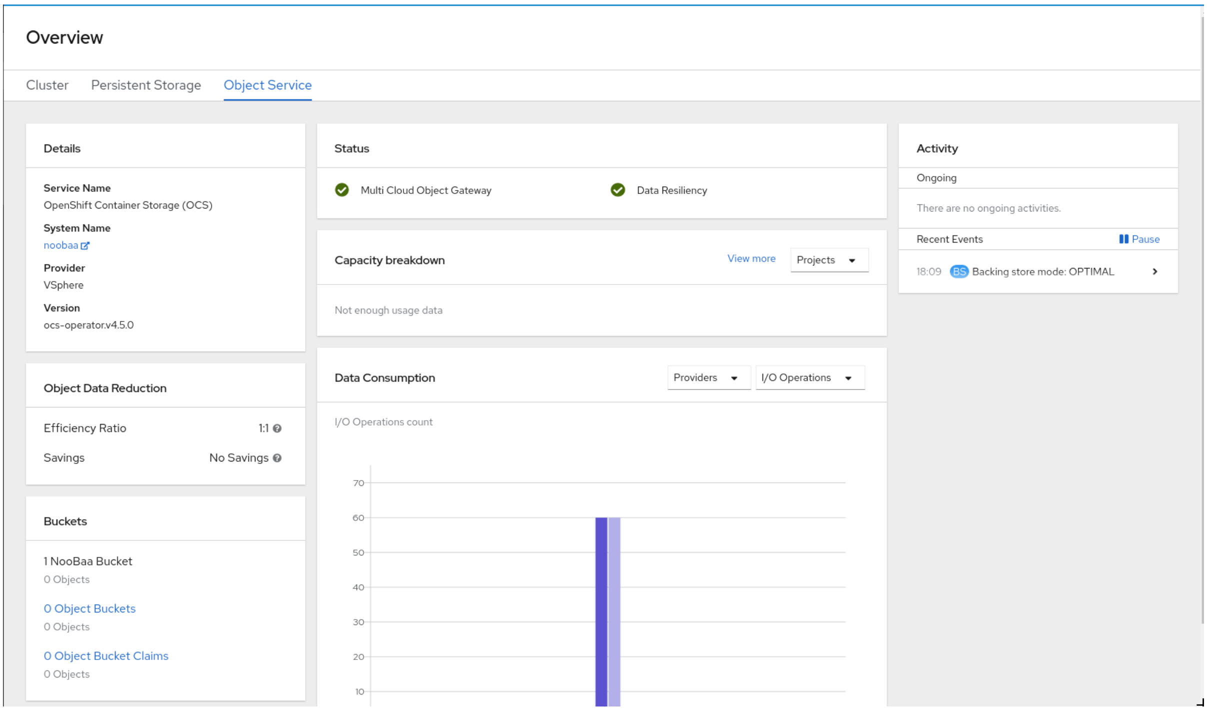
7.6.3. Creating an AWS S3 user in the Multicloud Object Gateway

Prerequisites

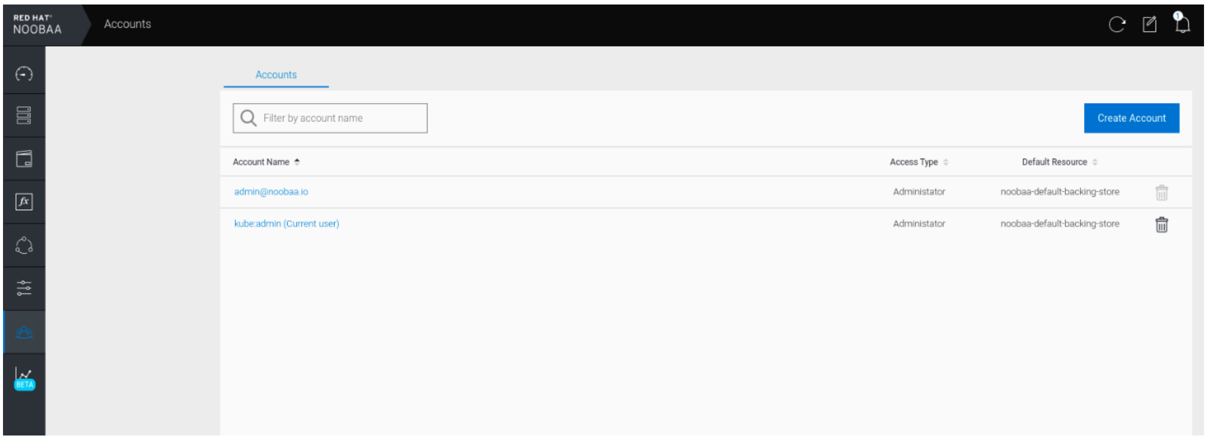
- A running OpenShift Container Storage Platform
- Access to the Multicloud Object Gateway, see Section 7.2, “Accessing the Multicloud Object Gateway with your applications”

Procedure

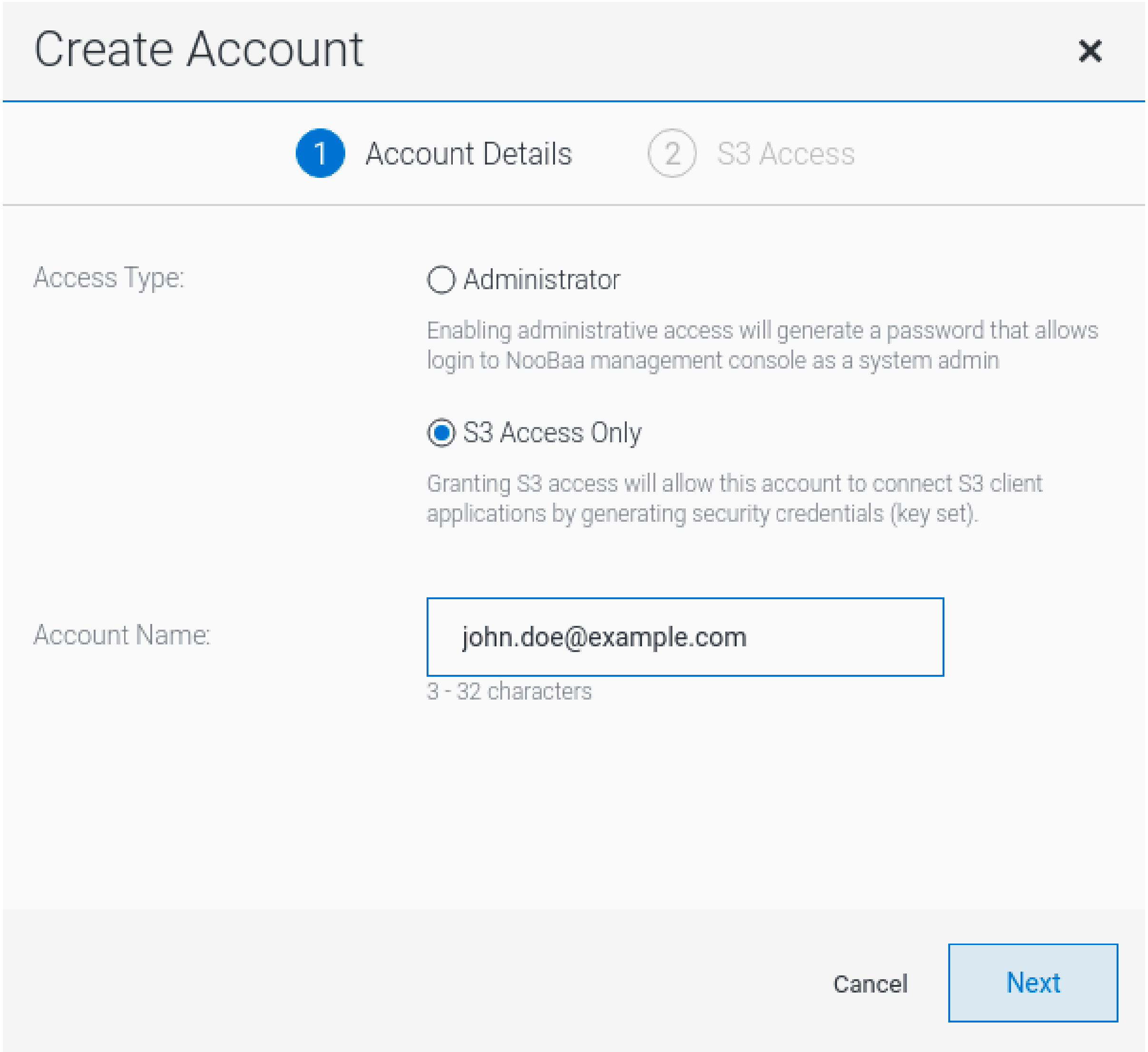
1. In your OpenShift Storage console, navigate to **Overview** → **Object Service** → select the **noobaa** link:



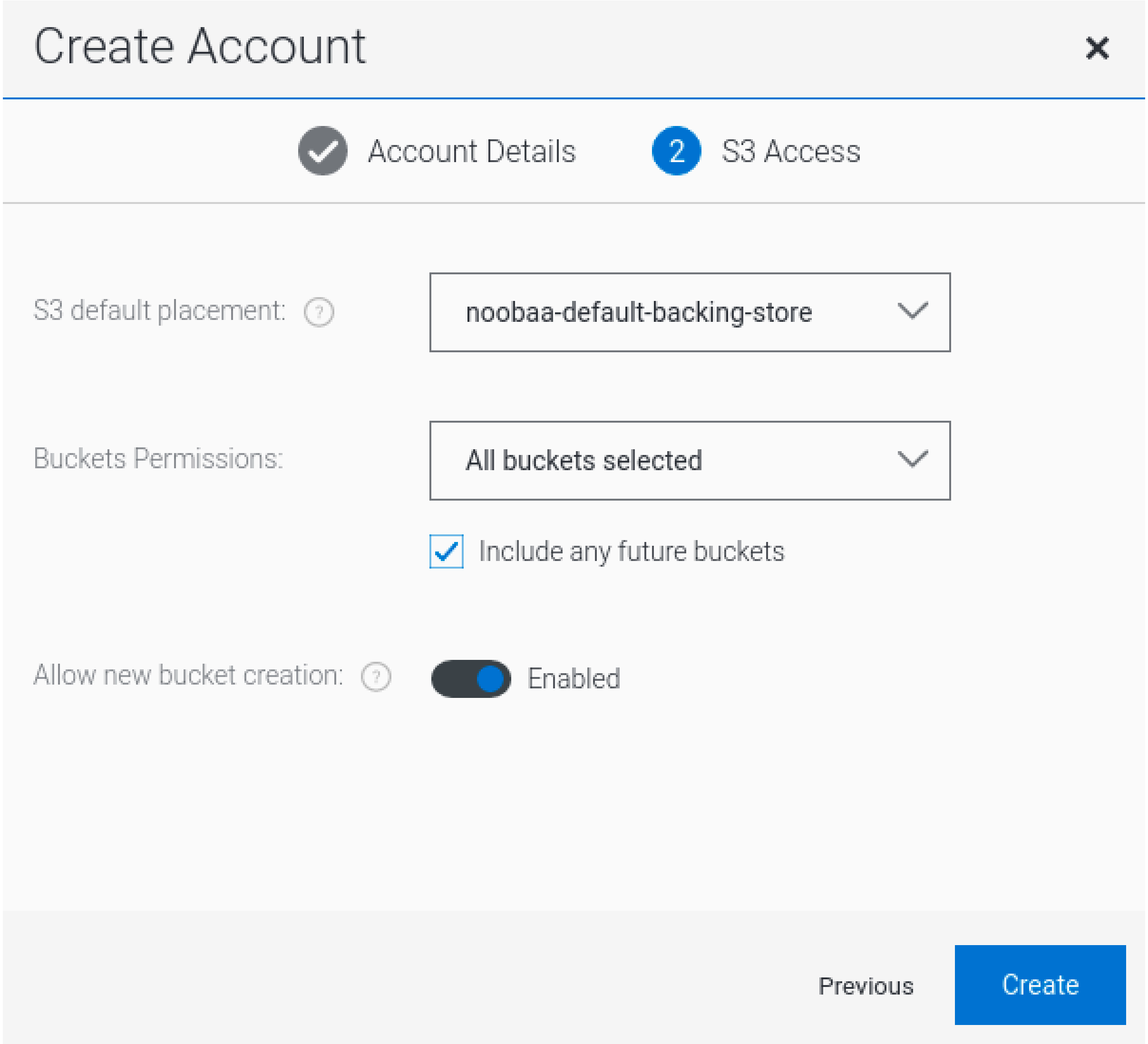
2. Under the **Accounts** tab, click **Create Account**



3. Select **S3 Access Only**, provide the **Account Name**, for example, john.doe@example.com. Click Next:



4. Select **S3 default placement**, for example, noobaa-default-backing-store. Select **Buckets Permissions**. A specific bucket or all buckets can be selected. Click **Create**:



7.7. OBJECT BUCKET CLAIM

An Object Bucket Claim can be used to request an S3 compatible bucket backend for your workloads.

You can create an Object Bucket Claim three ways:

- Section 7.7.1, “Dynamic Object Bucket Claim”
- Section 7.7.2, “Creating an Object Bucket Claim using the command line interface”
- Section 7.7.3, “Creating an Object Bucket Claim using the OpenShift Web Console”

An object bucket claim creates a new bucket and an application account in NooBaa with permissions to the bucket, including a new access key and secret access key. The application account is allowed to access only a single bucket and can’t create new buckets by default.

7.7.1. Dynamic Object Bucket Claim

Similar to Persistent Volumes, you can add the details of the Object Bucket claim to your application’s YAML, and get the object service endpoint, access key, and secret access key available in a configuration map and secret. It is easy to read this information dynamically into environment variables of your application.

Procedure

1. Add the following lines to your application YAML:

```
apiVersion: objectbucket.io/v1alpha1
kind: ObjectBucketClaim
metadata:
  name: <obc-name>
spec:
  generateBucketName: <obc-bucket-name>
  storageClassName: openshift-storage.noobaa.io
```

   These lines are the Object Bucket Claim itself.

   a. Replace **<obc-name>** with the a unique Object Bucket Claim name.

   b. Replace **<obc-bucket-name>** with a unique bucket name for your Object Bucket Claim.

2. You can add more lines to the YAML file to automate the use of the Object Bucket Claim. The example below is the mapping between the bucket claim result, which is a configuration map with data and a secret with the credentials. This specific job will claim the Object Bucket from NooBaa, which will create a bucket and an account.

```
apiVersion: batch/v1
kind: Job
metadata:
  name: testjob
spec:
  template:
    spec:
      restartPolicy: OnFailure
      containers:
        - image: <your application image>
          name: test
          env:
            - name: BUCKET_NAME
              valueFrom:
                configMapKeyRef:
                  name: <obc-name>
                  key: BUCKET_NAME
            - name: BUCKET_HOST
              valueFrom:
                configMapKeyRef:
                  name: <obc-name>
                  key: BUCKET_HOST
            - name: BUCKET_PORT
              valueFrom:
                configMapKeyRef:
                  name: <obc-name>
                  key: BUCKET_PORT
            - name: AWS_ACCESS_KEY_ID
              valueFrom:
                secretKeyRef:
                  name: <obc-name>
                  key: AWS_ACCESS_KEY_ID
            - name: AWS_SECRET_ACCESS_KEY
```

```
          valueFrom:
            secretKeyRef:
              name: <obc-name>
              key: AWS_SECRET_ACCESS_KEY
```

a. Replace all instances of <obc-name> with your Object Bucket Claim name.

b. Replace <your application image> with your application image.

3. Apply the updated YAML file:

```
# oc apply -f <yaml.file>
```

a. Replace **<yaml.file>** with the name of your YAML file.

4. To view the new configuration map, run the following:

```
# oc get cm <obc-name> -o yaml
```

a. Replace **obc-name** with the name of your Object Bucket Claim.
You can expect the following environment variables in the output:

- **BUCKET_HOST** - Endpoint to use in the application
- **BUCKET_PORT** - The port available for the application
  - The port is related to the **BUCKET_HOST**. For example, if the **BUCKET_HOST** is https://my.example.com, and the **BUCKET_PORT** is 443, the endpoint for the object service would be https://my.example.com:443.
- **BUCKET_NAME** - Requested or generated bucket name
- **AWS_ACCESS_KEY_ID** - Access key that is part of the credentials
- **AWS_SECRET_ACCESS_KEY** - Secret access key that is part of the credentials

7.7.2. Creating an Object Bucket Claim using the command line interface

When creating an Object Bucket Claim using the command-line interface, you get a configuration map and a Secret that together contain all the information your application needs to use the object storage service.

Prerequisites

- Download the MCG command-line interface:

```
# subscription-manager repos --enable=rh-ocs-4-for-rhel-8-x86_64-rpms
# yum install mcg
```

Procedure

1. Use the command-line interface to generate the details of a new bucket and credentials. Run the following command:

```
# noobaa obc create <obc-name> -n openshift-storage
```

–

Replace **<obc-name>** with a unique Object Bucket Claim name, for example, **myappobc**.

Additionally, you can use the **--app-namespace** option to specify the namespace where the Object Bucket Claim configuration map and secret will be created, for example, **myapp-namespace**.

Example output:

```
INFO[0001]   Created: ObjectBucketClaim "test21obc"
```

The MCG command-line-interface has created the necessary configuration and has informed OpenShift about the new OBC.

2. Run the following command to view the Object Bucket Claim:

```
# oc get obc -n openshift-storage
```

Example output:

```
NAME        STORAGE-CLASS                 PHASE   AGE
test21obc   openshift-storage.noobaa.io   Bound   38s
```

3. Run the following command to view the YAML file for the new Object Bucket Claim:

```
# oc get obc test21obc -o yaml -n openshift-storage
```

Example output:


```
apiVersion: objectbucket.io/v1alpha1
kind: ObjectBucketClaim
metadata:
  creationTimestamp: "2019-10-24T13:30:07Z"
  finalizers:
  - objectbucket.io/finalizer
  generation: 2
  labels:
    app: noobaa
    bucket-provisioner: openshift-storage.noobaa.io-obc
    noobaa-domain: openshift-storage.noobaa.io
  name: test21obc
  namespace: openshift-storage
  resourceVersion: "40756"
  selfLink: /apis/objectbucket.io/v1alpha1/namespaces/openshift-
storage/objectbucketclaims/test21obc
  uid: 64f04cba-f662-11e9-bc3c-0295250841af
spec:
  ObjectBucketName: obc-openshift-storage-test21obc
  bucketName: test21obc-933348a6-e267-4f82-82f1-e59bf4fe3bb4
  generateBucketName: test21obc
  storageClassName: openshift-storage.noobaa.io
status:
  phase: Bound
```

4. Inside of your **openshift-storage** namespace, you can find the configuration map and the secret to use this Object Bucket Claim. The CM and the secret have the same name as the Object Bucket Claim. To view the secret:

```
# oc get -n openshift-storage secret test21obc -o yaml
```

Example output:


```
Example output:
apiVersion: v1
data:
  AWS_ACCESS_KEY_ID: c0M0R2xVanF3ODR3bHBkVW94cmY=
  AWS_SECRET_ACCESS_KEY:
Wi9kcFluSWxHRzlWaFlzNk1hc0xma2JXcjM1MVhqa051SlBleXpmOQ==
kind: Secret
metadata:
  creationTimestamp: "2019-10-24T13:30:07Z"
  finalizers:
  - objectbucket.io/finalizer
  labels:
    app: noobaa
    bucket-provisioner: openshift-storage.noobaa.io-obc
    noobaa-domain: openshift-storage.noobaa.io
  name: test21obc
  namespace: openshift-storage
  ownerReferences:
  - apiVersion: objectbucket.io/v1alpha1
    blockOwnerDeletion: true
    controller: true
    kind: ObjectBucketClaim
    name: test21obc
    uid: 64f04cba-f662-11e9-bc3c-0295250841af
  resourceVersion: "40751"
  selfLink: /api/v1/namespaces/openshift-storage/secrets/test21obc
  uid: 65117c1c-f662-11e9-9094-0a5305de57bb
type: Opaque
```


The secret gives you the S3 access credentials.

5. To view the configuration map:

```
# oc get -n openshift-storage cm test21obc -o yaml
```

Example output:


```
apiVersion: v1
data:
  BUCKET_HOST: 10.0.171.35
  BUCKET_NAME: test21obc-933348a6-e267-4f82-82f1-e59bf4fe3bb4
  BUCKET_PORT: "31242"
  BUCKET_REGION: ""
  BUCKET_SUBREGION: ""
kind: ConfigMap
metadata:
  creationTimestamp: "2019-10-24T13:30:07Z"
```

```
finalizers:
- objectbucket.io/finalizer
labels:
  app: noobaa
  bucket-provisioner: openshift-storage.noobaa.io-obc
  noobaa-domain: openshift-storage.noobaa.io
name: test21obc
namespace: openshift-storage
ownerReferences:
- apiVersion: objectbucket.io/v1alpha1
  blockOwnerDeletion: true
  controller: true
  kind: ObjectBucketClaim
  name: test21obc
  uid: 64f04cba-f662-11e9-bc3c-0295250841af
resourceVersion: "40752"
selfLink: /api/v1/namespaces/openshift-storage/configmaps/test21obc
uid: 651c6501-f662-11e9-9094-0a5305de57bb
```

The configuration map contains the S3 endpoint information for your application.

7.7.3. Creating an Object Bucket Claim using the OpenShift Web Console

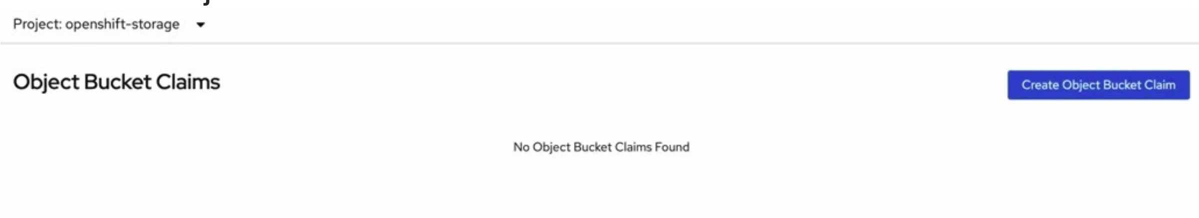
You can create an Object Bucket Claim (OBC) using the OpenShift Web Console.

Prerequisites

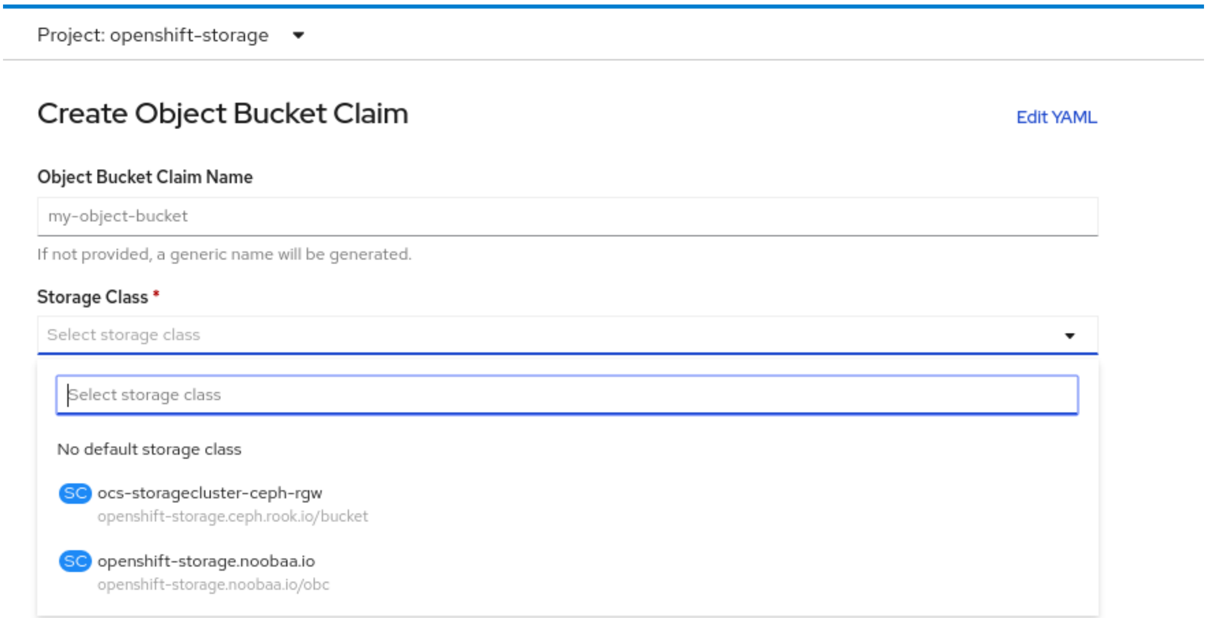
- Administrative access to the OpenShift Web Console.
- In order for your applications to communicate with the OBC, you need to use the configmap and secret. For more information about this, see Section 7.7.1, "Dynamic Object Bucket Claim" .

Procedure

1. Log into the OpenShift Web Console.
2. On the left navigation bar, click **Storage → Object Bucket Claims**.
3. Click **Create Object Bucket Claim**



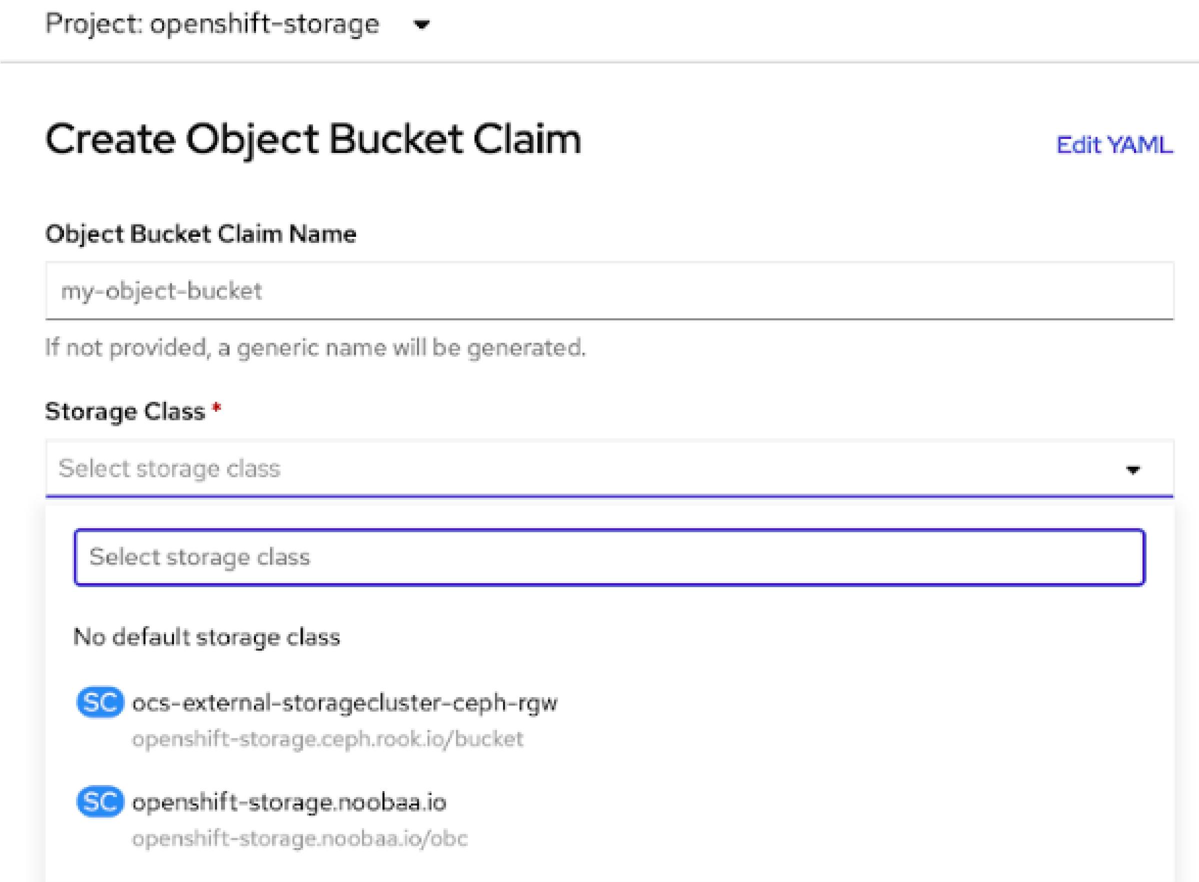
4. Enter a name for your object bucket claim and select the appropriate storage class based on your deployment, internal or external, from the dropdown menu:
Internal mode



The following storage classes, which were created after deployment, are available for use:

- **ocs-storagecluster-ceph-rgw** uses the Ceph Object Gateway (RGW)
- **openshift-storage.noobaa.io** uses the Multicloud Object Gateway

External mode



The following storage classes, which were created after deployment, are available for use:

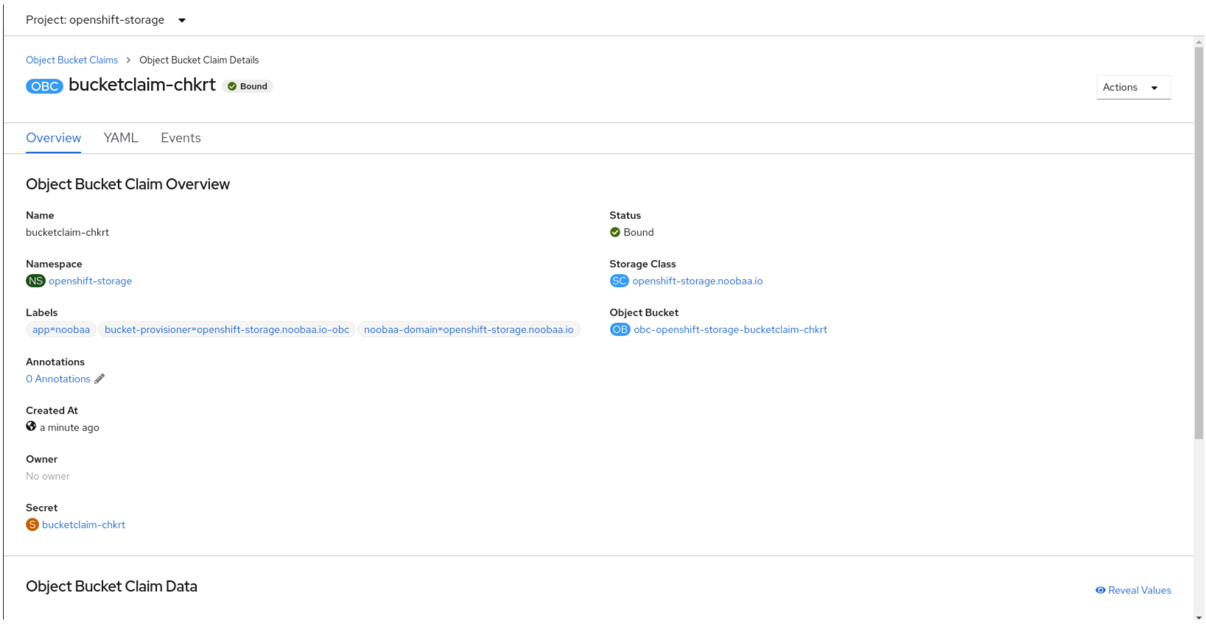
- **ocs-external-storagecluster-ceph-rgw** uses the Ceph Object Gateway (RGW)

- **openshift-storage.noobaa.io** uses the Multicloud Object Gateway

NOTE

The RGW OBC storage class is only available with fresh installations of OpenShift Container Storage version 4.5. It does not apply to clusters upgraded from previous OpenShift Container Storage releases.

5. Click **Create**.
   Once you create the OBC, you are redirected to its detail page:



Additional Resources

- Section 7.7, "Object Bucket Claim"

7.7.4. Attaching an Object Bucket Claim to a deployment

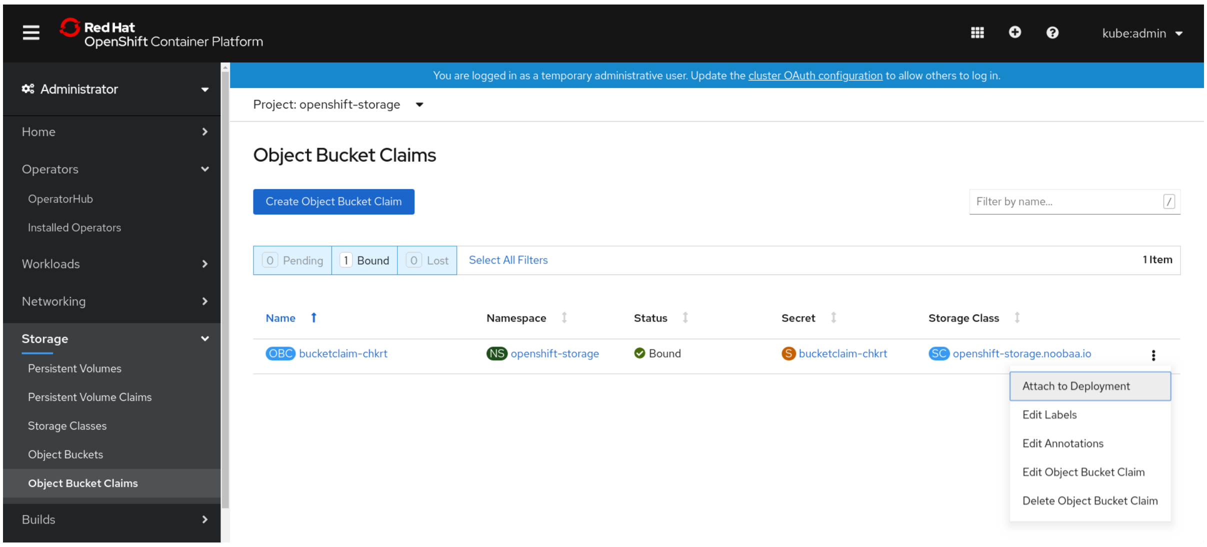
Once created, Object Bucket Claims (OBCs) can be attached to specific deployments.

Prerequisites

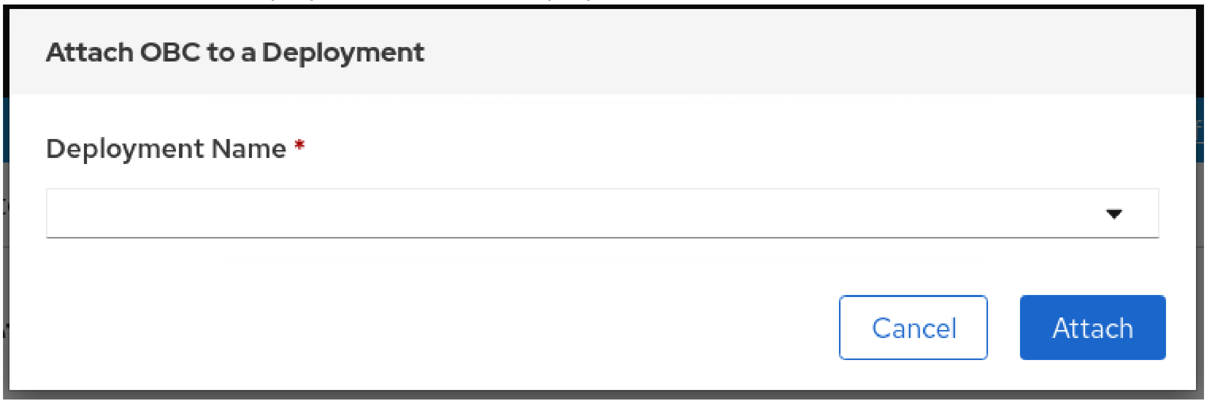
- Administrative access to the OpenShift Web Console.

Procedure

1. On the left navigation bar, click **Storage → Object Bucket Claims**.
2. Click the action menu (⋮) next to the OBC you created.
3. From the drop down menu, select **Attach to Deployment**



4. Select the desired deployment from the Deployment Name list, then click **Attach**:



Additional Resources

- Section 7.7, "Object Bucket Claim"

7.7.5. Viewing object buckets using the OpenShift Web Console

You can view the details of object buckets created for Object Bucket Claims (OBCs) using the OpenShift Web Console.

Prerequisites

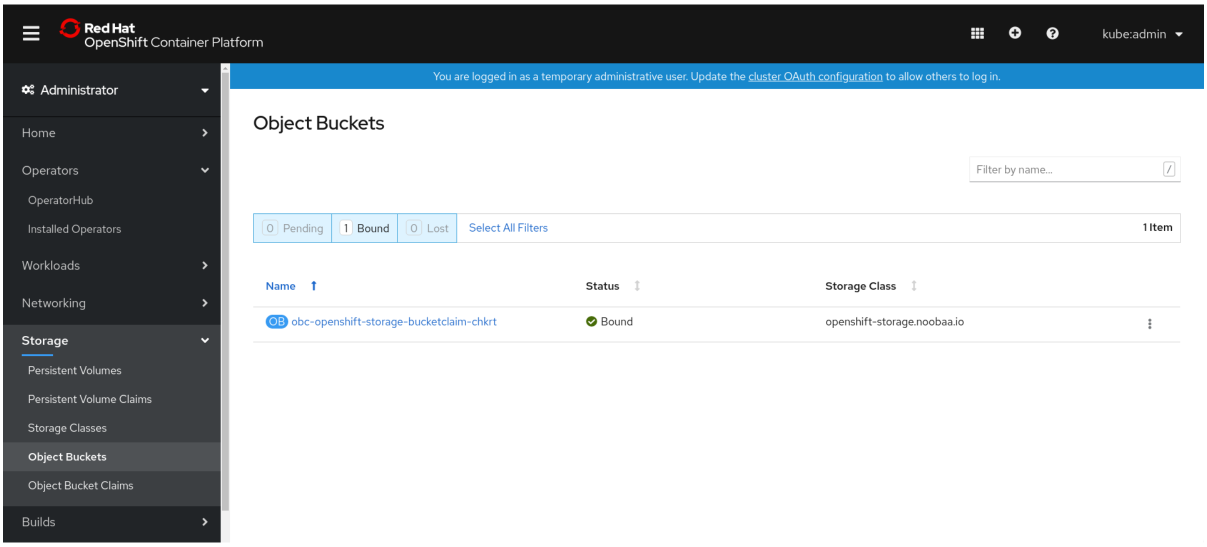
- Administrative access to the OpenShift Web Console.

Procedure

To view the object bucket details:

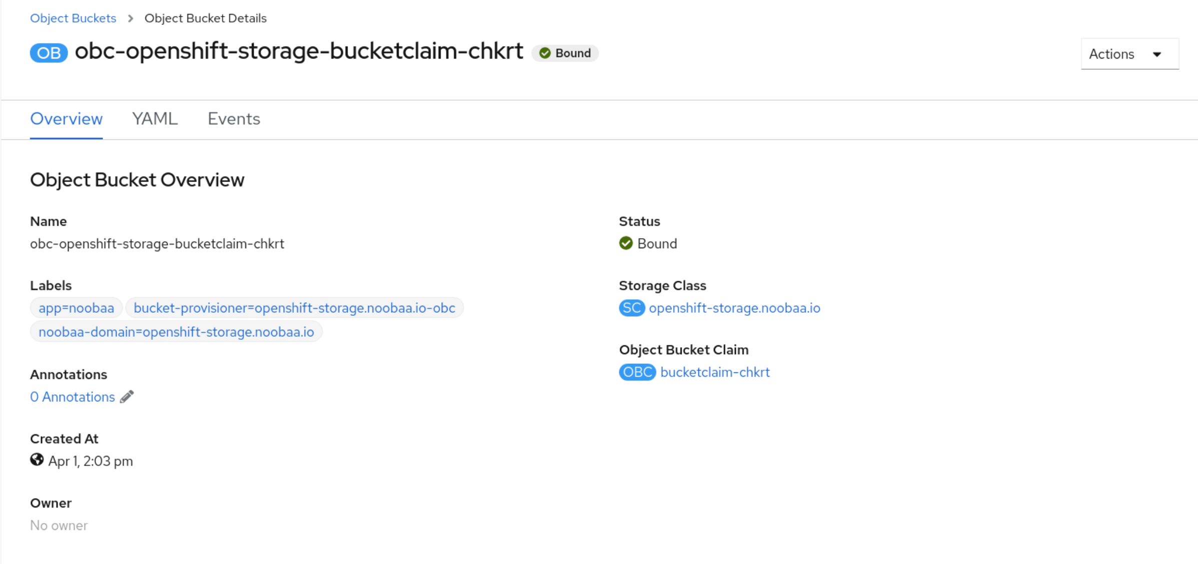
1. Log into the OpenShift Web Console.

2. On the left navigation bar, click **Storage → Object Buckets**:



You can also navigate to the details page of a specific OBC and click the **Resource** link to view the object buckets for that OBC.

3. Select the object bucket you want to see details for. You are navigated to the object bucket's details page:



Additional Resources

- Section 7.7, "Object Bucket Claim"

7.7.6. Deleting Object Bucket Claims

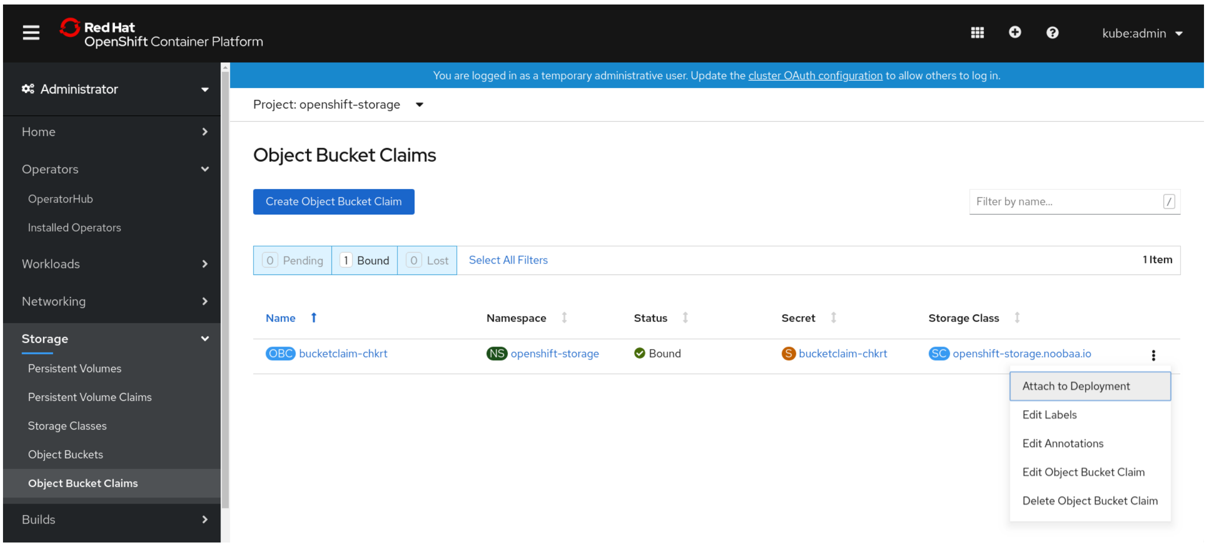
Prerequisites

- Administrative access to the OpenShift Web Console.

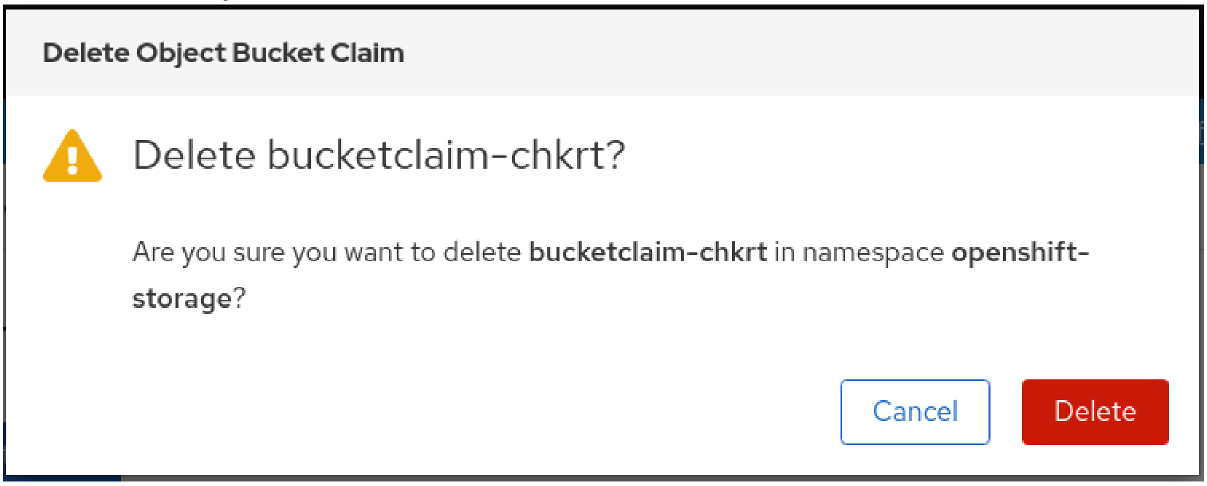
Procedure

1. On the left navigation bar, click **Storage → Object Bucket Claims**.

2. click on the action menu (⋮) next to the Object Bucket Claim you want to delete.



3. Select **Delete Object Bucket Claim** from menu.



4. Click **Delete**.

Additional Resources

- Section 7.7, "Object Bucket Claim"

7.8. SCALING MULTICLOUD OBJECT GATEWAY PERFORMANCE BY ADDING ENDPOINTS

The Multicloud Object Gateway performance may vary from one environment to another. In some cases, specific applications require faster performance which can be easily addressed by scaling S3 endpoints, which is a Technology Preview feature.

The Multicloud Object Gateway resource pool is a group of NooBaa daemon containers that provide two types of services enabled by default:

- Storage service
- S3 endpoint service

IMPORTANT

Scaling Multicloud Object Gateway performance by adding endpoints 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.

For more information, see Technology Preview Features Support Scope.

7.8.1. S3 endpoints in the Multicloud Object Gateway

The S3 endpoint is a service that every Multicloud Object Gateway provides by default that handles the heavy lifting data digestion in the Multicloud Object Gateway. The endpoint service handles the inline data chunking, deduplication, compression, and encryption, and it accepts data placement instructions from the Multicloud Object Gateway.

7.8.2. Scaling with storage nodes

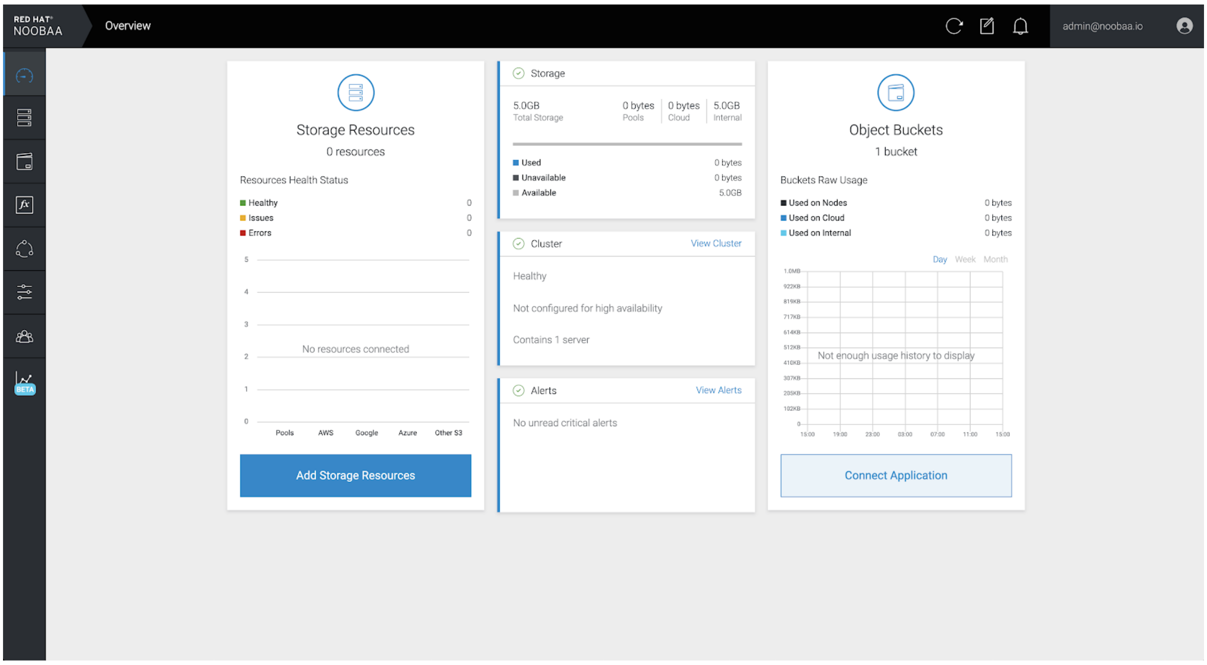
Prerequisites

- A running OpenShift Container Storage cluster on OpenShift Container Platform with access to the Multicloud Object Gateway.

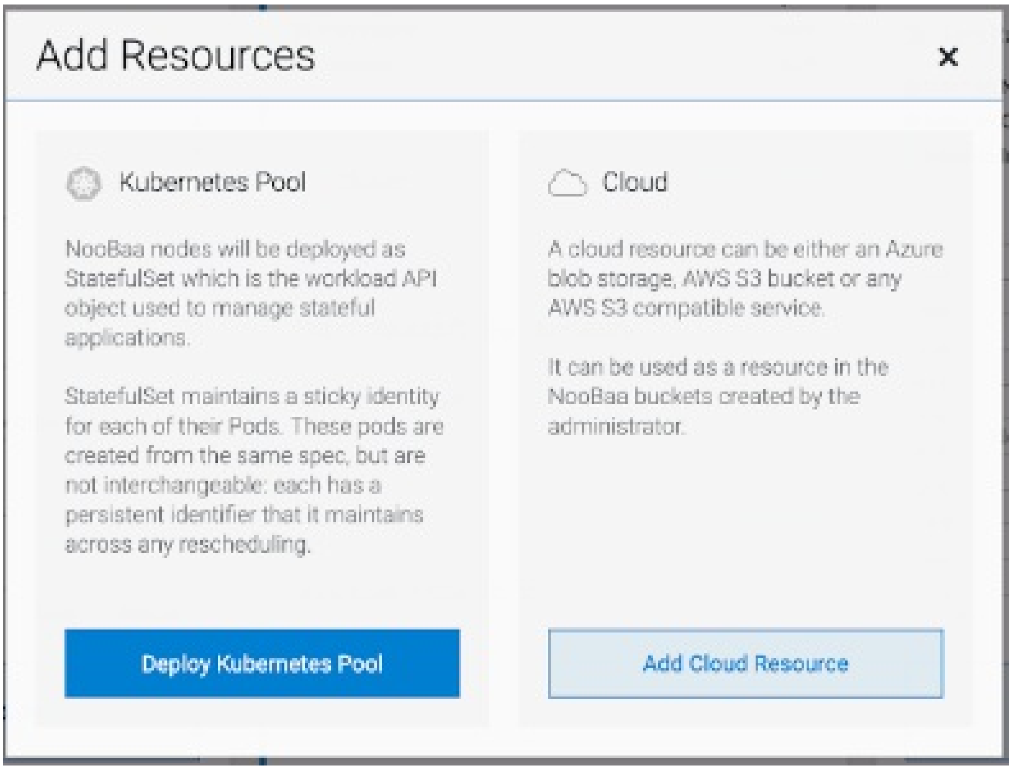
A storage node in the Multicloud Object Gateway is a NooBaa daemon container attached to one or more Persistent Volumes and used for local object service data storage. NooBaa daemons can be deployed on Kubernetes nodes. This can be done by creating a Kubernetes pool consisting of StatefulSet pods.

Procedure

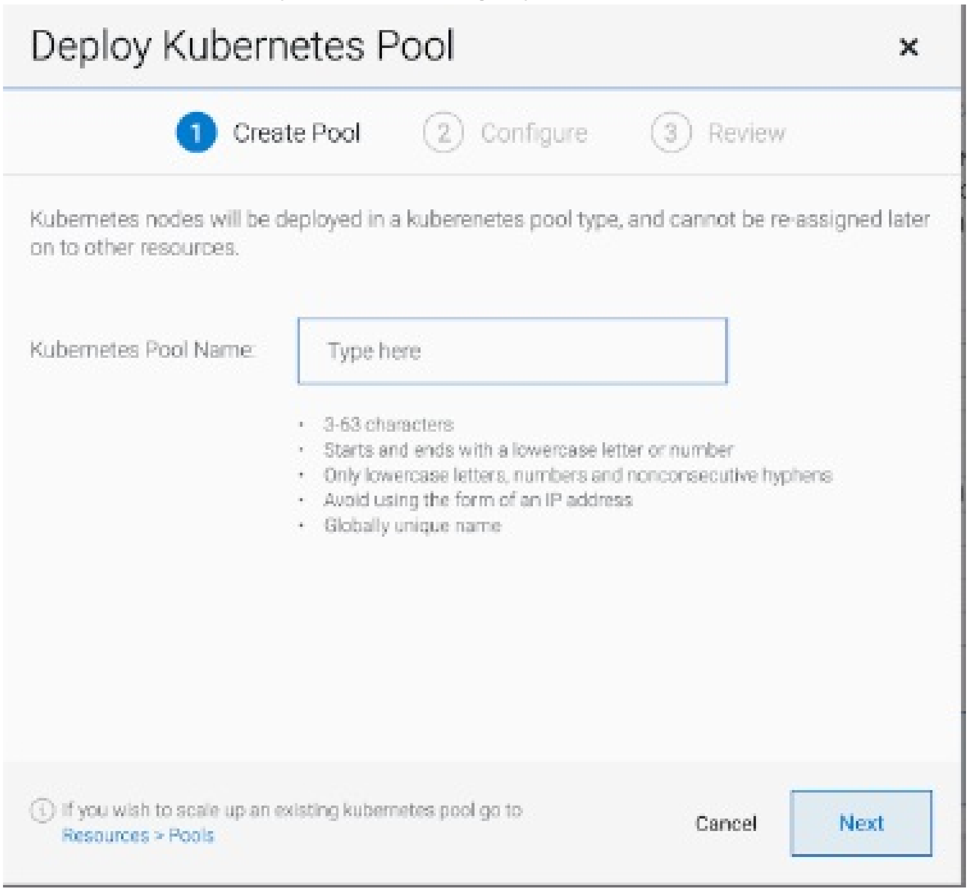
1. In the Multicloud Object Gateway user interface, from the **Overview** page, click **Add Storage Resources**:



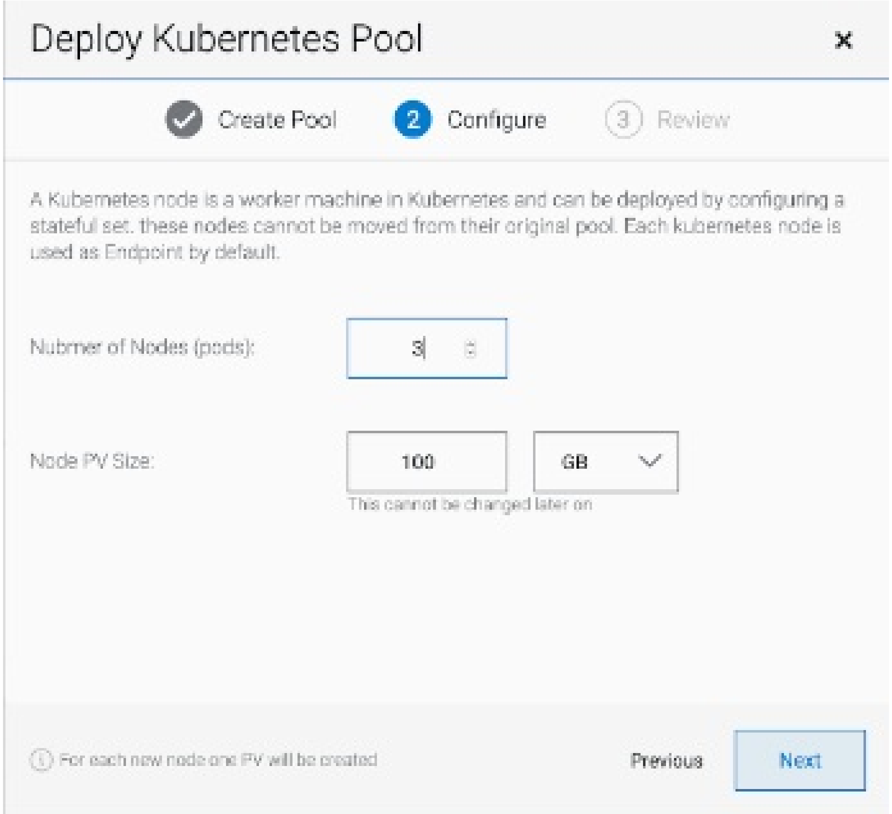
2. In the window, click **Deploy Kubernetes Pool**.



3. In the **Create Pool** step create the target pool for the future installed nodes.

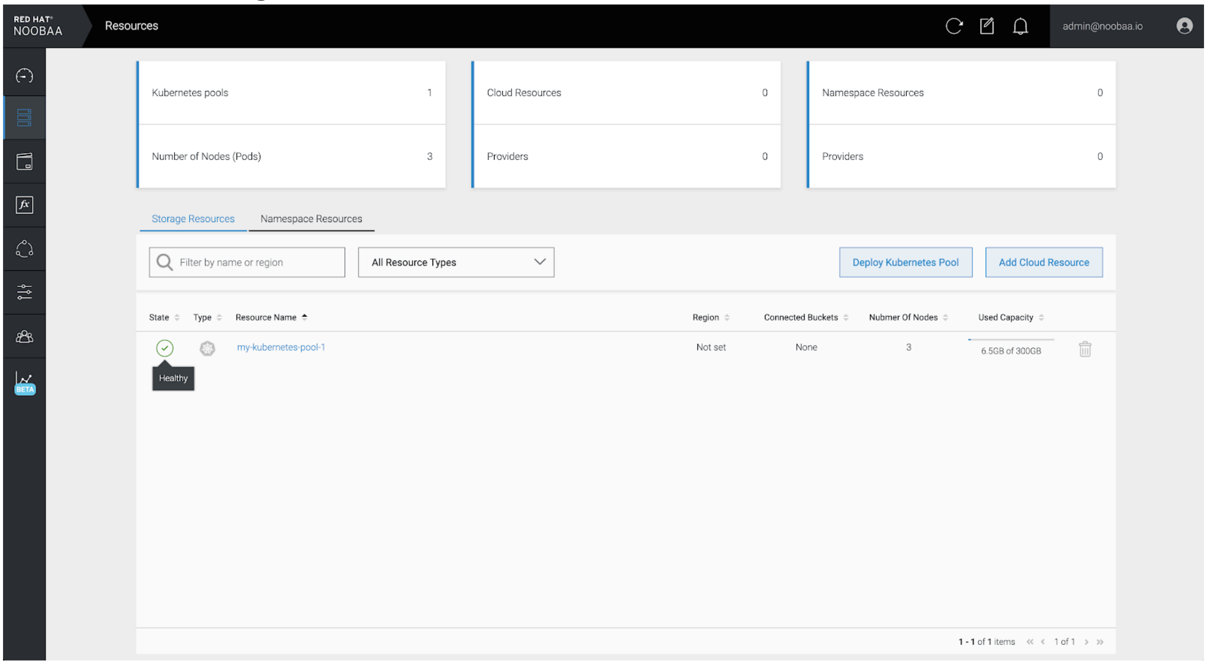


4. In the **Configure** step, configure the number of requested pods and the size of each PV. For each new pod, one PV is be created.



5. In the **Review** step, you can find the details of the new pool and select the deployment method you wish to use: local or external deployment. If local deployment is selected, the Kubernetes nodes will deploy within the cluster. If external deployment is selected, you will be provided with a YAML file to run externally.

6. All nodes will be assigned to the pool you chose in the first step, and can be found under **Resources → Storage resources→ Resource name**:



CHAPTER 8. ACCESSING THE RADOS OBJECT GATEWAY S3 ENDPOINT

Users can access the RADOS Object Gateway (RGW) endpoint directly.

Prerequisites

- A running OpenShift Container Storage Platform

Procedure

1. Run **oc get service** command to get the RGW service name.

```
$ oc get service

NAME                                        TYPE
rook-ceph-rgw-ocs-storagecluster-cephobjectstore   ClusterIP

CLUSTER-IP      EXTERNAL-IP   PORT(S)    AGE
172.30.99.207    <none>        80/TCP     4d15h
```

2. Run **oc expose** command to expose the RGW service.

```
$ oc expose svc/<RGW service name> --hostname=<route name>
```

Replace **<RGW-service name>** with the RGW service name from the previous step.

Replace **<route name>** with a route you want to create for the RGW service.

For example:

```
$ oc expose svc/rook-ceph-rgw-ocs-storagecluster-cephobjectstore --hostname=rook-ceph-
rgw-ocs.ocp.host.example.com
```

3. Run **oc get route** command to confirm **oc expose** is successful and there is an RGW route.

```
$ oc get route

NAME                                        HOST/PORT                          PATH
rook-ceph-rgw-ocs-storagecluster-cephobjectstore   rook-ceph-rgw-
ocsocp.host.example.com

SERVICES                                        PORT       TERMINATION   WILDCARD
rook-ceph-rgw-ocs-storagecluster-cephobjectstore   http        <none>
```

Verify

- To verify the **ENDPOINT**, run the following command:

```
aws s3 --no-verify-ssl --endpoint <ENDPOINT> ls
```

Replace **<ENDPOINT>** with the route that you get from the command in the above step 3.

For example:

```
$ aws s3 --no-verify-ssl --endpoint http://rook-ceph-rgw-ocs.ocp.host.example.com ls
```

NOTE

To get the access key and secret of the default user **ocs-storagecluster-cephobjectstoreuser**, run the following commands:

- Access key:

```
$ oc get secret rook-ceph-object-user-ocs-storagecluster-cephobjectstore-ocs-storagecluster-cephobjectstoreuser  -o yaml | grep -w "AccessKey:" | head -n1 | awk '{print $2}' | base64 --decode
```

- Secret key:

```
$ oc get secret rook-ceph-object-user-ocs-storagecluster-cephobjectstore-ocs-storagecluster-cephobjectstoreuser  -o yaml | grep -w "SecretKey:" | head -n1 | awk '{print $2}' | base64 --decode
```

CHAPTER 9. REPLACING STORAGE NODES FOR OPENSHIFT CONTAINER STORAGE

For OpenShift Container Storage, node replacement can be performed proactively for an operational node and reactively for a failed node for the following deployments:

- For Amazon Web Services (AWS)
  - User-provisioned infrastructure
  - Installer-provisioned infrastructure
- For VMware
  - User-provisioned infrastructure
- For local storage devices
  - Bare metal
  - Amazon EC2 I3
  - VMware
- For replacing your storage nodes in external mode, see Red Hat Ceph Storage documentation .

9.1. OPENSHIFT CONTAINER STORAGE DEPLOYED ON AWS

9.1.1. Replacing an operational AWS node on user-provisioned infrastructure

Perform this procedure to replace an operational node on AWS user-provisioned infrastructure.

Procedure

1. Identify the node that needs to be replaced.
2. Mark the node as unschedulable using the following command:

```
$ oc adm cordon <node_name>
```

3. Drain the node using the following command:

```
$ oc adm drain <node_name> --force --delete-local-data --ignore-daemonsets
```

IMPORTANT

This activity may take at least 5-10 minutes or more. Ceph errors generated during this period are temporary and are automatically resolved when the new node is labeled and functional.

4. Delete the node using the following command:

```
$ oc delete nodes <node_name>
```

5. Create a new AWS machine instance with the required infrastructure. See Platform requirements.

6. Create a new OpenShift Container Platform node using the new AWS machine instance.

7. Check for certificate signing requests (CSRs) related to OpenShift Container Platform that are in **Pending** state:

```
$ oc get csr
```

8. Approve all required OpenShift Container Platform CSRs for the new node:

```
$ oc adm certificate approve <Certificate_Name>
```

9. Click **Compute → Nodes**, confirm if the new node is in **Ready** state.

10. Apply the OpenShift Container Storage label to the new node using any one of the following:

From User interface

a. For the new node, click **Action Menu (⋮) → Edit Labels**

b. Add **cluster.ocs.openshift.io/openshift-storage** and click **Save**.

From Command line interface

- Execute the following command to apply the OpenShift Container Storage label to the new node:

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

Verification steps

1. Execute the following command and verify that the new node is present in the output:

```
$ oc get nodes --show-labels | grep cluster.ocs.openshift.io/openshift-storage= |cut -d' ' -f1
```

2. Click **Workloads → Pods**, confirm that at least the following pods on the new node are in **Running** state:

   - **csi-cephfsplugin-***
   - **csi-rbdplugin-***

3. Verify that all other required OpenShift Container Storage pods are in **Running** state.

4. If verification steps fail, kindly contact Red Hat Support.

9.1.2. Replacing an operational AWS node on installer-provisioned infrastructure

Use this procedure to replace an operational node on AWS installer-provisioned infrastructure (IPI).

Procedure

1. Log in to OpenShift Web Console and click **Compute → Nodes**.
2. Identify the node that needs to be replaced. Take a note of its **Machine Name**.
3. Mark the node as unschedulable using the following command:

```
$ oc adm cordon <node_name>
```

4. Drain the node using the following command:

```
$ oc adm drain <node_name> --force --delete-local-data --ignore-daemonsets
```

IMPORTANT

This activity may take at least 5-10 minutes or more. Ceph errors generated during this period are temporary and are automatically resolved when the new node is labeled and functional.

5. Click **Compute → Machines**. Search for the required machine.
6. Besides the required machine, click the **Action menu (⋮) → Delete Machine**.
7. Click **Delete** to confirm the machine deletion. A new machine is automatically created.
8. Wait for new machine to start and transition into **Running** state.

IMPORTANT

This activity may take at least 5-10 minutes or more.

9. Click **Compute → Nodes**, confirm if the new node is in **Ready** state.
10. Apply the OpenShift Container Storage label to the new node using any one of the following:

From User interface

a. For the new node, click **Action Menu (⋮) → Edit Labels**

b. Add **cluster.ocs.openshift.io/openshift-storage** and click **Save**.

From Command line interface

- Execute the following command to apply the OpenShift Container Storage label to the new node:

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

Verification steps

1. Execute the following command and verify that the new node is present in the output:

```
$ oc get nodes --show-labels | grep cluster.ocs.openshift.io/openshift-storage= |cut -d' ' -f1
```

2. Click **Workloads → Pods**, confirm that at least the following pods on the new node are in **Running** state:
   - **csi-cephfsplugin-***
   - **csi-rbdplugin-***
3. Verify that all other required OpenShift Container Storage pods are in **Running** state.
4. If verification steps fail, kindly contact Red Hat Support .

9.1.3. Replacing a failed AWS node on user-provisioned infrastructure

Perform this procedure to replace a failed node which is not operational on AWS user-provisioned infrastructure (UPI) for OpenShift Container Storage.

Procedure

1. Identify the AWS machine instance of the node that needs to be replaced.
2. Log in to AWS and terminate the identified AWS machine instance.
3. Create a new AWS machine instance with the required infrastructure. See platform requirements.
4. Create a new OpenShift Container Platform node using the new AWS machine instance.
5. Check for certificate signing requests (CSRs) related to OpenShift Container Platform that are in **Pending** state:

```
$ oc get csr
```

6. Approve all required OpenShift Container Platform CSRs for the new node:

```
$ oc adm certificate approve <Certificate_Name>
```

7. Click **Compute → Nodes**, confirm if the new node is in **Ready** state.
8. Apply the OpenShift Container Storage label to the new node using any one of the following:

   From User interface

   a. For the new node, click **Action Menu (⋮) → Edit Labels**
   b. Add **cluster.ocs.openshift.io/openshift-storage** and click **Save**.

   From Command line interface

   - Execute the following command to apply the OpenShift Container Storage label to the new node:

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

Verification steps

1. Execute the following command and verify that the new node is present in the output:

```
$ oc get nodes --show-labels | grep cluster.ocs.openshift.io/openshift-storage= |cut -d' ' -f1
```

2. Click **Workloads → Pods**, confirm that at least the following pods on the new node are in **Running** state:
   - **csi-cephfsplugin-***
   - **csi-rbdplugin-***
3. Verify that all other required OpenShift Container Storage pods are in **Running** state.
4. If verification steps fail, contact Red Hat Support.

9.1.4. Replacing a failed AWS node on installer-provisioned infrastructure

Perform this procedure to replace a failed node which is not operational on AWS installer-provisioned infrastructure (IPI) for OpenShift Container Storage.

Procedure

1. Log in to OpenShift Web Console and click **Compute → Nodes**.
2. Identify the faulty node and click on its **Machine Name**.
3. Click **Actions → Edit Annotations**, and click **Add More**.
4. Add **machine.openshift.io/exclude-node-draining** and click **Save**.
5. Click **Actions → Delete Machine**, and click **Delete**.
6. A new machine is automatically created, wait for new machine to start.

   IMPORTANT

   This activity may take at least 5-10 minutes or more. Ceph errors generated during this period are temporary and are automatically resolved when the new node is labeled and functional.

7. Click **Compute → Nodes**, confirm if the new node is in **Ready** state.
8. Apply the OpenShift Container Storage label to the new node using any one of the following:

   From User interface

   a. For the new node, click **Action Menu (⋮) → Edit Labels**
   b. Add **cluster.ocs.openshift.io/openshift-storage** and click **Save**.

   From Command line interface

   - Execute the following command to apply the OpenShift Container Storage label to the new node:

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

9. Execute the following command and verify that the new node is present in the output:

```
$ oc get nodes --show-labels | grep cluster.ocs.openshift.io/openshift-storage= |cut -d' ' -f1
```

10. Click **Workloads → Pods**, confirm that at least the following pods on the new node are in **Running** state:
    - **csi-cephfsplugin-***
    - **csi-rbdplugin-***
11. Verify that all other required OpenShift Container Storage pods are in **Running** state.
12. If verification steps fail, kindly contact Red Hat Support .

9.2. OPENSHIFT CONTAINER STORAGE DEPLOYED ON VMWARE

9.2.1. Replacing an operational VMware node on user-provisioned infrastructure

Perform this procedure to replace an operational node on VMware user-provisioned infrastructure (UPI).

Procedure

1. Identify the node and its VM that needs to be replaced.
2. Mark the node as unschedulable using the following command:

```
$ oc adm cordon <node_name>
```

3. Drain the node using the following command:

```
$ oc adm drain <node_name> --force --delete-local-data --ignore-daemonsets
```

> **IMPORTANT**
>
> This activity may take at least 5-10 minutes or more. Ceph errors generated during this period are temporary and are automatically resolved when the new node is labeled and functional.

4. Delete the node using the following command:

```
$ oc delete nodes <node_name>
```

5. Log in to vSphere and terminate the identified VM.

> **IMPORTANT**
>
> VM should be deleted only from the inventory and not from the disk.

6. Create a new VM on vSphere with the required infrastructure. See Platform requirements.

7. Create a new OpenShift Container Platform worker node using the new VM.

8. Check for certificate signing requests (CSRs) related to OpenShift Container Platform that are in **Pending** state:

```
$ oc get csr
```

9. Approve all required OpenShift Container Platform CSRs for the new node:

```
$ oc adm certificate approve <Certificate_Name>
```

10. Click **Compute → Nodes**, confirm if the new node is in **Ready** state.

11. Apply the OpenShift Container Storage label to the new node using any one of the following:

    From User interface

    a. For the new node, click **Action Menu (⋮) → Edit Labels**

    b. Add **cluster.ocs.openshift.io/openshift-storage** and click **Save**.

    From Command line interface

    - Execute the following command to apply the OpenShift Container Storage label to the new node:

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

Verification steps

1. Execute the following command and verify that the new node is present in the output:

```
$ oc get nodes --show-labels | grep cluster.ocs.openshift.io/openshift-storage= |cut -d' ' -f1
```

2. Click **Workloads → Pods**, confirm that at least the following pods on the new node are in **Running** state:

    - **csi-cephfsplugin-***
    - **csi-rbdplugin-***

3. Verify that all other required OpenShift Container Storage pods are in **Running** state.

4. If verification steps fail, kindly contact Red Hat Support .

9.2.2. Replacing a failed VMware node on user-provisioned infrastructure

Perform this procedure to replace a failed node on VMware user-provisioned infrastructure (UPI).

Procedure

1. Identify the node and its VM that needs to be replaced.

2. Delete the node using the following command:

```
$ oc delete nodes <node_name>
```

3. Log in to vSphere and terminate the identified VM.

> **IMPORTANT**
>
> VM should be deleted only from the inventory and not from the disk.

4. Create a new VM on vSphere with the required infrastructure. See Platform requirements.
5. Create a new OpenShift Container Platform worker node using the new VM.
6. Check for certificate signing requests (CSRs) related to OpenShift Container Platform that are in **Pending** state:

```
$ oc get csr
```

7. Approve all required OpenShift Container Platform CSRs for the new node:

```
$ oc adm certificate approve <Certificate_Name>
```

8. Click **Compute → Nodes**, confirm if the new node is in **Ready** state.
9. Apply the OpenShift Container Storage label to the new node using any one of the following:

   From User interface

   a. For the new node, click **Action Menu (⋮) → Edit Labels**

   b. Add **cluster.ocs.openshift.io/openshift-storage** and click **Save**.

   From Command line interface

   - Execute the following command to apply the OpenShift Container Storage label to the new node:

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

Verification steps

1. Execute the following command and verify that the new node is present in the output:

```
$ oc get nodes --show-labels | grep cluster.ocs.openshift.io/openshift-storage= |cut -d' ' -f1
```

2. Click **Workloads → Pods**, confirm that at least the following pods on the new node are in **Running** state:
   - **csi-cephfsplugin-***
   - **csi-rbdplugin-***

3. Verify that all other required OpenShift Container Storage pods are in **Running** state.

4. If verification steps fail, kindly contact Red Hat Support.

9.3. OPENSHIFT CONTAINER STORAGE DEPLOYED USING LOCAL STORAGE DEVICES

9.3.1. Replacing storage nodes on bare metal infrastructure

- To replace an operational node, see Section 9.3.1.1, "Replacing an operational node on bare metal user-provisioned infrastructure"

- To replace a failed node, see Section 9.3.1.2, "Replacing a failed node on bare metal user-provisioned infrastructure"

9.3.1.1. Replacing an operational node on bare metal user-provisioned infrastructure

Prerequisites

- You must be logged into the OpenShift Container Platform (OCP) cluster.

Procedure

1. Identify the node and get labels on the node to be replaced. Make a note of the rack label.

```
$ oc get nodes --show-labels | grep <node_name>
```

2. Identify the mon (if any) and object storage device (OSD) pods that are running in the node to be replaced.

```
$ oc get pods -n openshift-storage -o wide | grep -i <node_name>
```

3. Scale down the deployments of the pods identified in the previous step.
For example:

```
$ oc scale deployment rook-ceph-mon-c --replicas=0 -n openshift-storage
$ oc scale deployment rook-ceph-osd-0 --replicas=0 -n openshift-storage
$ oc scale deployment --selector=app=rook-ceph-crashcollector,node_name=<node_name>
--replicas=0 -n openshift-storage
```

4. Mark the nodes as unschedulable.

```
$ oc adm cordon <node_name>
```

5. Drain the node.

```
$ oc adm drain <node_name> --force --delete-local-data --ignore-daemonsets
```

6. Delete the node.

```
$ oc delete node <node_name>
```

7. Get a new bare metal machine with required infrastructure. See Installing a cluster on bare metal.

8. Create a new OpenShift Container Platform node using the new bare metal machine.

9. Check for certificate signing requests (CSRs) related to OpenShift Container Storage that are in **Pending** state:

```
$ oc get csr
```

10. Approve all required OpenShift Container Storage CSRs for the new node:

```
$ oc adm certificate approve <Certificate_Name>
```

11. Click **Compute → Nodes** in OpenShift Web Console, confirm if the new node is in **Ready** state.

12. Apply the OpenShift Container Storage label to the new node using any one of the following:

From User interface

a. For the new node, click **Action Menu (⋮) → Edit Labels**

b. Add **cluster.ocs.openshift.io/openshift-storage** and click **Save**.

From Command line interface

- Execute the following command to apply the OpenShift Container Storage label to the new node:

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

13. Add the local storage devices available in these worker nodes to the OpenShift Container Storage StorageCluster.

a. Add a new disk entry to **LocalVolume** CR.
Edit **LocalVolume** CR and remove or comment out failed **device /dev/disk/by-id/{id}** and add the new **/dev/disk/by-id/{id}**. In this example, the new device is **/dev/disk/by-id/nvme-INTEL_SSDPEKKA128G7_BTPYB89THF49128A**.

```
# oc get -n local-storage localvolume
NAME          AGE
local-block   25h
```

```
# oc edit -n local-storage localvolume local-block
```

Example output:

```
[...]
    storageClassDevices:
    - devicePaths:
      - /dev/disk/by-id/nvme-INTEL_SSDPEKKA128G7_BTPY81260978128A
      - /dev/disk/by-id/nvme-INTEL_SSDPEKKA128G7_BTPY80440W5U128A
      - /dev/disk/by-id/nvme-INTEL_SSDPEKKA128G7_BTPYB85AABDE128A
      - /dev/disk/by-id/nvme-INTEL_SSDPEKKA128G7_BTPYB89THF49128A
```

```
    storageClassName: localblock
    volumeMode: Block
[...]
```

Make sure to save the changes after editing the CR.

b. Display PVs with **localblock**.

```
$ oc get pv | grep localblock
```

Example output:

```
local-pv-3e8964d3                          931Gi     RWO          Delete          Bound
openshift-storage/ocs-deviceset-2-0-79j94   localblock                             25h
local-pv-414755e0                          931Gi     RWO          Delete          Bound
openshift-storage/ocs-deviceset-1-0-959rp   localblock                             25h
local-pv-b481410                          931Gi     RWO          Delete          Available
localblock                            3m24s
local-pv-d9c5cbd6                          931Gi     RWO          Delete          Bound
openshift-storage/ocs-deviceset-0-0-nvs68   localblock
```

14. Delete the PV associated with the failed node.

a. Identify the **DeviceSet** associated with the OSD to be replaced.

```
# osd_id_to_remove=0
# oc get -n openshift-storage -o yaml deployment rook-ceph-osd-${osd_id_to_remove} |
grep ceph.rook.io/pvc
```

where, **osd_id_to_remove** is the integer in the pod name immediately after the **rook-ceph-osd prefix**. In this example, the deployment name is **rook-ceph-osd-0**.

Example output:

```
ceph.rook.io/pvc: ocs-deviceset-0-0-nvs68
ceph.rook.io/pvc: ocs-deviceset-0-0-nvs68
```

In this example, the PVC name is **ocs-deviceset-0-0-nvs68**.

b. Identify the PV associated with the PVC.

```
# oc get -n openshift-storage pvc ocs-deviceset-<x>-<y>-<pvc-suffix>
```

where, **x**, **y**, and **pvc-suffix** are the values in the **DeviceSet** identified in the previous step.

Example output:

```
NAME                    STATUS      VOLUME          CAPACITY   ACCESS MODES
STORAGECLASS   AGE
ocs-deviceset-0-0-nvs68   Bound    local-pv-d9c5cbd6   931Gi      RWO            localblock
24h
```

In this example, the associated PV is **local-pv-d9c5cbd6**.

c. Delete the PVC.

```
# oc delete pvc <pvc-name> -n openshift-storage
```

d. Delete the PV.

```
# oc delete pv local-pv-d9c5cbd6
```

Example output:

```
persistentvolume "local-pv-d9c5cbd6" deleted
```

15. Remove the failed OSD from the cluster.

```
# oc process -n openshift-storage ocs-osd-removal -p
FAILED_OSD_ID=${osd_id_to_remove} | oc create -f -
```

16. Verify that the OSD is removed successfully by checking the status of the **ocs-osd-removal** pod. A status of **Completed** confirms that the OSD removal job succeeded.

```
# oc get pod -l job-name=ocs-osd-removal-${osd_id_to_remove} -n openshift-storage
```

NOTE

If **ocs-osd-removal** fails and the pod is not in the expected **Completed** state, check the pod logs for further debugging. For example:

```
# oc logs -l job-name=ocs-osd-removal-${osd_id_to_remove} -n openshift-
storage --tail=-1
```

17. Delete OSD pod deployment and crashcollector pod deployment.

```
$ oc delete deployment rook-ceph-osd-${osd_id_to_remove} -n openshift-storage
$ oc delete deployment --selector=app=rook-ceph-crashcollector,node_name=
<old_node_name> -n openshift-storage
```

18. Deploy the new OSD by restarting the **rook-ceph-operator** to force operator reconciliation.

```
# oc get -n openshift-storage pod -l app=rook-ceph-operator
```

Example output:

```
NAME                                READY   STATUS    RESTARTS   AGE
rook-ceph-operator-6f74fb5bff-2d982   1/1     Running   0          1d20h
```

a. Delete the **rook-ceph-operator**.

```
# oc delete -n openshift-storage pod rook-ceph-operator-6f74fb5bff-2d982
```

Example output:

```
pod "rook-ceph-operator-6f74fb5bff-2d982" deleted
```

b. Verify that the **rook-ceph-operator** pod is restarted.

```
# oc get -n openshift-storage pod -l app=rook-ceph-operator
```

Example output:

```
NAME                                READY   STATUS    RESTARTS   AGE
rook-ceph-operator-6f74fb5bff-7mvrq   1/1     Running   0          66s
```

Creation of the new OSD and **mon** might take several minutes after the operator restarts.

19. Delete the **ocs-osd-removal** job.

```
# oc delete job ocs-osd-removal-${osd_id_to_remove}
```

Example output:

```
job.batch "ocs-osd-removal-0" deleted
```

Verification steps

1. Execute the following command and verify that the new node is present in the output:

```
$ oc get nodes --show-labels | grep cluster.ocs.openshift.io/openshift-storage= |cut -d' ' -f1
```

2. Click **Workloads → Pods**, confirm that at least the following pods on the new node are in **Running** state:

- **csi-cephfsplugin-***
- **csi-rbdplugin-***

3. Verify that all other required OpenShift Container Storage pods are in **Running** state. Make sure that the new incremental **mon** is created and is in the **Running** state.

```
$ oc get pod -n openshift-storage | grep mon
```

Example output:

```
rook-ceph-mon-c-64556f7659-c2ngc                 1/1     Running     0          6h14m
rook-ceph-mon-d-7c8b74dc4d-tt6hd                 1/1     Running     0          4h24m
rook-ceph-mon-e-57fb8c657-wg5f2                  1/1     Running     0          162m
```

OSD and Mon might take several minutes to get to the **Running** state.

4. If verification steps fail, contact Red Hat Support.

9.3.1.2. Replacing a failed node on bare metal user-provisioned infrastructure

Prerequisites

- You must be logged into the OpenShift Container Platform (OCP) cluster.

Procedure

1. Identify the node and get labels on the node to be replaced. Make a note of the rack label.

```
$ oc get nodes --show-labels | grep <node_name>
```

2. Identify the mon (if any) and object storage device (OSD) pods that are running in the node to be replaced.

```
$ oc get pods -n openshift-storage -o wide | grep -i <node_name>
```

3. Scale down the deployments of the pods identified in the previous step.
For example:

```
$ oc scale deployment rook-ceph-mon-c --replicas=0 -n openshift-storage
$ oc scale deployment rook-ceph-osd-0 --replicas=0 -n openshift-storage
$ oc scale deployment --selector=app=rook-ceph-crashcollector,node_name=<node_name>
--replicas=0 -n openshift-storage
```

4. Mark the node as unschedulable.

```
$ oc adm cordon <node_name>
```

5. Remove the pods which are in Terminating state

```
$ oc get pods -A -o wide | grep -i <node_name> |  awk '{if ($4 == "Terminating") system ("oc -
n " $1 " delete pods " $2  " --grace-period=0 " " --force ")}'
```

6. Drain the node.

```
$ oc adm drain <node_name> --force --delete-local-data --ignore-daemonsets
```

7. Delete the node.

```
$ oc delete node <node_name>
```

8. Get a new bare metal machine with required infrastructure. See Installing a cluster on bare metal.

9. Create a new OpenShift Container Platform node using the new bare metal machine.

10. Check for certificate signing requests (CSRs) related to OpenShift Container Storage that are in **Pending** state:

```
$ oc get csr
```

11. Approve all required OpenShift Container Storage CSRs for the new node:

```
$ oc adm certificate approve <Certificate_Name>
```

12. Click **Compute → Nodes** in OpenShift Web Console, confirm if the new node is in **Ready** state.

13. Apply the OpenShift Container Storage label to the new node using any one of the following:

    From User interface

    a. For the new node, click **Action Menu (⋮) → Edit Labels**

    b. Add **cluster.ocs.openshift.io/openshift-storage** and click **Save**.

    From Command line interface

    - Execute the following command to apply the OpenShift Container Storage label to the new node:

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

14. Add the local storage devices available in these worker nodes to the OpenShift Container Storage StorageCluster.

    a. Add a new disk entry to **LocalVolume** CR.
    Edit **LocalVolume** CR and remove or comment out failed **device /dev/disk/by-id/{id}** and add the new **/dev/disk/by-id/{id}**. In this example, the new device is **/dev/disk/by-id/nvme-INTEL_SSDPEKKA128G7_BTPYB89THF49128A**.

    ```
    # oc get -n local-storage localvolume
    NAME          AGE
    local-block   25h
    ```

    ```
    # oc edit -n local-storage localvolume local-block
    ```

    Example output:

    ```
    [...]
        storageClassDevices:
        - devicePaths:
          - /dev/disk/by-id/nvme-INTEL_SSDPEKKA128G7_BTPY81260978128A
          - /dev/disk/by-id/nvme-INTEL_SSDPEKKA128G7_BTPY80440W5U128A
          - /dev/disk/by-id/nvme-INTEL_SSDPEKKA128G7_BTPYB85AABDE128A
          - /dev/disk/by-id/nvme-INTEL_SSDPEKKA128G7_BTPYB89THF49128A
          storageClassName: localblock
          volumeMode: Block
    [...]
    ```

    Make sure to save the changes after editing the CR.

    b. Display PVs with **localblock**.

    ```
    $ oc get pv | grep localblock
    ```

    Example output:

    ```
    local-pv-3e8964d3                    931Gi    RWO          Delete          Bound
    openshift-storage/ocs-deviceset-2-0-79j94   localblock                       25h
    ```

```
local-pv-414755e0                    931Gi     RWO        Delete         Bound
openshift-storage/ocs-deviceset-1-0-959rp   localblock                    25h
local-pv-b481410                     931Gi     RWO        Delete         Available
localblock                     3m24s
local-pv-d9c5cbd6                    931Gi     RWO        Delete         Bound
openshift-storage/ocs-deviceset-0-0-nvs68   localblock
```

15. Delete the PV associated with the failed node.

    a. Identify the **DeviceSet** associated with the OSD to be replaced.

    ```
    # osd_id_to_remove=0
    # oc get -n openshift-storage -o yaml deployment rook-ceph-osd-${osd_id_to_remove} |
    grep ceph.rook.io/pvc
    ```

    where, **osd_id_to_remove** is the integer in the pod name immediately after the **rook-ceph-osd prefix**. In this example, the deployment name is **rook-ceph-osd-0**.

    Example output:

    ```
    ceph.rook.io/pvc: ocs-deviceset-0-0-nvs68
    ceph.rook.io/pvc: ocs-deviceset-0-0-nvs68
    ```

    In this example, the PVC name is **ocs-deviceset-0-0-nvs68**.

    b. Identify the PV associated with the PVC.

    ```
    # oc get -n openshift-storage pvc ocs-deviceset-<x>-<y>-<pvc-suffix>
    ```

    where, **x**, **y**, and **pvc-suffix** are the values in the **DeviceSet** identified in the previous step.

    Example output:

    ```
    NAME                    STATUS     VOLUME         CAPACITY   ACCESS MODES
    STORAGECLASS   AGE
    ocs-deviceset-0-0-nvs68   Bound   local-pv-d9c5cbd6   931Gi      RWO          localblock
    24h
    ```

    In this example, the associated PV is **local-pv-d9c5cbd6**.

    c. Delete the PVC.

    ```
    # oc delete pvc <pvc-name> -n openshift-storage
    ```

    d. Delete the PV.

    ```
    # oc delete pv local-pv-d9c5cbd6
    ```

    Example output:

    ```
    persistentvolume "local-pv-d9c5cbd6" deleted
    ```

16. Remove the failed OSD from the cluster.

```
# oc process -n openshift-storage ocs-osd-removal -p
FAILED_OSD_ID=${osd_id_to_remove} | oc create -f -
```

17. Verify that the OSD is removed successfully by checking the status of the **ocs-osd-removal** pod. A status of **Completed** confirms that the OSD removal job succeeded.

```
# oc get pod -l job-name=ocs-osd-removal-${osd_id_to_remove} -n openshift-storage
```

> **NOTE**
>
> If **ocs-osd-removal** fails and the pod is not in the expected **Completed** state, check the pod logs for further debugging. For example:
>
> ```
> # oc logs -l job-name=ocs-osd-removal-${osd_id_to_remove} -n openshift-
> storage --tail=-1
> ```

18. Delete OSD pod deployment and crashcollector pod deployment.

```
$ oc delete deployment rook-ceph-osd-${osd_id_to_remove} -n openshift-storage
$ oc delete deployment --selector=app=rook-ceph-crashcollector,node_name=
<old_node_name> -n openshift-storage
```

19. Deploy the new OSD by restarting the **rook-ceph-operator** to force operator reconciliation.

```
# oc get -n openshift-storage pod -l app=rook-ceph-operator
```

Example output:

```
NAME                                  READY   STATUS    RESTARTS   AGE
rook-ceph-operator-6f74fb5bff-2d982   1/1     Running   0          1d20h
```

a. Delete the **rook-ceph-operator**.

```
# oc delete -n openshift-storage pod rook-ceph-operator-6f74fb5bff-2d982
```

Example output:

```
pod "rook-ceph-operator-6f74fb5bff-2d982" deleted
```

b. Verify that the **rook-ceph-operator** pod is restarted.

```
# oc get -n openshift-storage pod -l app=rook-ceph-operator
```

Example output:

```
NAME                                  READY   STATUS    RESTARTS   AGE
rook-ceph-operator-6f74fb5bff-7mvrq   1/1     Running   0          66s
```

Creation of the new OSD and **mon** might take several minutes after the operator restarts.

20. Delete the **ocs-osd-removal** job.

```
# oc delete job ocs-osd-removal-${osd_id_to_remove}
```

Example output:

```
job.batch "ocs-osd-removal-0" deleted
```

Verification steps

1. Execute the following command and verify that the new node is present in the output:

```
$ oc get nodes --show-labels | grep cluster.ocs.openshift.io/openshift-storage= |cut -d' ' -f1
```

2. Click **Workloads → Pods**, confirm that at least the following pods on the new node are in **Running** state:
   - **csi-cephfsplugin-***
   - **csi-rbdplugin-***
3. Verify that all other required OpenShift Container Storage pods are in **Running** state.
   Make sure that the new incremental **mon** is created and is in the **Running** state.

```
$ oc get pod -n openshift-storage | grep mon
```

Example output:

```
rook-ceph-mon-c-64556f7659-c2ngc                1/1     Running     0          6h14m
rook-ceph-mon-d-7c8b74dc4d-tt6hd                1/1     Running     0          4h24m
rook-ceph-mon-e-57fb8c657-wg5f2                 1/1     Running     0          162m
```

OSD and Mon might take several minutes to get to the **Running** state.

4. If verification steps fail, contact Red Hat Support.

9.3.2. Replacing storage nodes on Amazon EC2 infrastructure

- To replace an operational Amazon EC2 node on user-provisioned and installer provisioned infrastructures, see:
  - Section 9.3.2.1, “Replacing an operational Amazon EC2 node on user-provisioned infrastructure”
  - Section 9.3.2.2, “Replacing an operational Amazon EC2 node on installer-provisioned infrastructure”
- To replace a failed Amazon EC2 node on user-provisioned and installer provisioned infrastructures, see:
  - Section 9.3.2.3, “Replacing a failed Amazon EC2 node on user-provisioned infrastructure”
  - Section 9.3.2.4, “Replacing a failed Amazon EC2 node on installer-provisioned infrastructure”

9.3.2.1. Replacing an operational Amazon EC2 node on user-provisioned infrastructure

Perform this procedure to replace an operational node on Amazon EC2 I3 user-provisioned infrastructure (UPI).

IMPORTANT

Replacing storage nodes in Amazon EC2 I3 infrastructure 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

- You must be logged into the OpenShift Container Platform (OCP) cluster.

Procedure

1. Identify the node and get labels on the node to be replaced.

```
$ oc get nodes --show-labels | grep <node_name>
```

2. Identify the mon (if any) and OSDs that are running in the node to be replaced.

```
$ oc get pods -n openshift-storage -o wide | grep -i <node_name>
```

3. Scale down the deployments of the pods identified in the previous step.
   For example:

```
$ oc scale deployment rook-ceph-mon-c --replicas=0 -n openshift-storage
$ oc scale deployment rook-ceph-osd-0 --replicas=0 -n openshift-storage
$ oc scale deployment --selector=app=rook-ceph-crashcollector,node_name=<node_name>
--replicas=0 -n openshift-storage
```

4. Mark the nodes as unschedulable.

```
$ oc adm cordon <node_name>
```

5. Drain the node.

```
$ oc adm drain <node_name> --force --delete-local-data --ignore-daemonsets
```

6. Delete the node.

```
$ oc delete node <node_name>
```

7. Create a new Amazon EC2 I3 machine instance with the required infrastructure. See Supported Infrastructure and Platforms.

8. Create a new OpenShift Container Platform node using the new Amazon EC2 I3 machine instance.

9. Check for certificate signing requests (CSRs) related to OpenShift Container Platform that are in Pending state:

```
$ oc get csr
```

10. Approve all required OpenShift Container Platform CSRs for the new node:

```
$ oc adm certificate approve <Certificate_Name>
```

11. Click **Compute → Nodes** in the OpenShift web console. Confirm if the new node is in **Ready** state.

12. Apply the OpenShift Container Storage label to the new node using any one of the following:

    From User interface

    a. For the new node, click **Action Menu (⋮) → Edit Labels**.

    b. Add **cluster.ocs.openshift.io/openshift-storage** and click **Save**.

    From Command line interface

    - Execute the following command to apply the OpenShift Container Storage label to the new node:

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

13. Add the local storage devices available in the new worker node to the OpenShift Container Storage StorageCluster.

    a. Add the new disk entries to LocalVolume CR.
    Edit **LocalVolume** CR. You can either remove or comment out the failed device **/dev/disk/by-id/{id}** and add the new **/dev/disk/by-id/{id}**.

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

Example output:

```
NAME          AGE
local-block   25h
```

```
$ oc edit -n local-storage localvolume local-block
```

Example output:

```
[...]
    storageClassDevices:
    - devicePaths:
      - /dev/disk/by-id/nvme-
Amazon_EC2_NVMe_Instance_Storage_AWS10382E5D7441494EC
      - /dev/disk/by-id/nvme-
Amazon_EC2_NVMe_Instance_Storage_AWS1F45C01D7E84FE3E9
      - /dev/disk/by-id/nvme-
```

```
Amazon_EC2_NVMe_Instance_Storage_AWS136BC945B4ECB9AE4
      - /dev/disk/by-id/nvme-
Amazon_EC2_NVMe_Instance_Storage_AWS10382E5D7441464EP
  #   - /dev/disk/by-id/nvme-
Amazon_EC2_NVMe_Instance_Storage_AWS1F45C01D7E84F43E7
  #   - /dev/disk/by-id/nvme-
Amazon_EC2_NVMe_Instance_Storage_AWS136BC945B4ECB9AE8
      - /dev/disk/by-id/nvme-
Amazon_EC2_NVMe_Instance_Storage_AWS6F45C01D7E84FE3E9
      - /dev/disk/by-id/nvme-
Amazon_EC2_NVMe_Instance_Storage_AWS636BC945B4ECB9AE4
      storageClassName: localblock
      volumeMode: Block
[...]
```

Make sure to save the changes after editing the CR.

You can see that in this CR the below two new devices using by-id have been added.

- **nvme-Amazon_EC2_NVMe_Instance_Storage_AWS6F45C01D7E84FE3E9**
- **nvme-Amazon_EC2_NVMe_Instance_Storage_AWS636BC945B4ECB9AE4**

b. Display PVs with **localblock**.

```
$ oc get pv | grep localblock
```

Example output:

```
local-pv-3646185e   2328Gi  RWO     Delete      Available
localblock  9s
local-pv-3933e86    2328Gi  RWO     Delete      Bound       openshift-storage/ocs-
deviceset-2-1-v9jp4   localblock  5h1m
local-pv-8176b2bf   2328Gi  RWO     Delete      Bound       openshift-storage/ocs-
deviceset-0-0-nvs68   localblock  5h1m
local-pv-ab7cabb3   2328Gi  RWO     Delete      Available
localblock  9s
local-pv-ac52e8a    2328Gi  RWO     Delete      Bound       openshift-storage/ocs-
deviceset-1-0-knrgr   localblock  5h1m
local-pv-b7e6fd37   2328Gi  RWO     Delete      Bound       openshift-storage/ocs-
deviceset-2-0-rdm7m   localblock  5h1m
local-pv-cb454338   2328Gi  RWO     Delete      Bound       openshift-storage/ocs-
deviceset-0-1-h9hfm   localblock  5h1m
local-pv-da5e3175   2328Gi  RWO     Delete      Bound       openshift-storage/ocs-
deviceset-1-1-g97lq   localblock  5h
...
```

14. Delete each PV and OSD associated with the failed node using the following steps.

a. Identify the DeviceSet associated with the OSD to be replaced.

```
$ osd_id_to_remove=0
$ oc get -n openshift-storage -o yaml deployment rook-ceph-osd-${osd_id_to_remove} |
grep ceph.rook.io/pvc
```

where, **osd_id_to_remove** is the integer in the pod name immediately after the **rook-ceph-osd** prefix. In this example, the deployment name is **rook-ceph-osd-0**.

Example output:

```
ceph.rook.io/pvc: ocs-deviceset-0-0-nvs68
ceph.rook.io/pvc: ocs-deviceset-0-0-nvs68
```

b. Identify the PV associated with the PVC.

```
$ oc get -n openshift-storage pvc ocs-deviceset-<x>-<y>-<pvc-suffix>
```

where, **x**, **y**, and **pvc-suffix** are the values in the DeviceSet identified in an earlier step.

Example output:

```
NAME                      STATUS   VOLUME              CAPACITY   ACCESS MODES
STORAGECLASS   AGE
ocs-deviceset-0-0-nvs68   Bound    local-pv-8176b2bf   2328Gi     RWO          localblock
4h49m
```

In this example, the associated PV is **local-pv-8176b2bf**.

c. Delete the PVC which was identified in earlier steps. In this example, the PVC name is **ocs-deviceset-0-0-nvs68**.

```
$ oc delete pvc ocs-deviceset-0-0-nvs68 -n openshift-storage
```

Example output:

```
persistentvolumeclaim "ocs-deviceset-0-0-nvs68" deleted
```

d. Delete the PV which was identified in earlier steps. In this example, the PV name is **local-pv-8176b2bf**.

```
$ oc delete pv local-pv-8176b2bf
```

Example output:

```
persistentvolume "local-pv-8176b2bf" deleted
```

e. Remove the failed OSD from the cluster.

```
$ oc process -n openshift-storage ocs-osd-removal -p
FAILED_OSD_ID=${osd_id_to_remove} | oc create -f -
```

f. Verify that the OSD is removed successfully by checking the status of the **ocs-osd-removal** pod. A status of **Completed** confirms that the OSD removal job succeeded.

```
# oc get pod -l job-name=ocs-osd-removal-${osd_id_to_remove} -n openshift-storage
```

> **NOTE**
>
> If ocs-osd-removal fails and the pod is not in the expected Completed state, check the pod logs for further debugging. For example:
>
> ```
> # oc logs -l job-name=ocs-osd-removal-${osd_id_to_remove} -n openshift-storage --tail=-1
> ```

g. Delete the OSD pod deployment.

```
$ oc delete deployment rook-ceph-osd-${osd_id_to_remove} -n openshift-storage
```

15. Delete **crashcollector** pod deployment identified in an earlier step.

```
$ oc delete deployment --selector=app=rook-ceph-crashcollector,node_name=
<old_node_name> -n openshift-storage
```

16. Deploy the new OSD by restarting the **rook-ceph-operator** to force operator reconciliation.

```
$ oc get -n openshift-storage pod -l app=rook-ceph-operator
```

Example output:

```
NAME                                  READY   STATUS    RESTARTS   AGE
rook-ceph-operator-6f74fb5bff-2d982   1/1     Running   0          5h3m
```

a. Delete the **rook-ceph-operator**.

```
$ oc delete -n openshift-storage pod rook-ceph-operator-6f74fb5bff-2d982
```

Example output:

```
pod "rook-ceph-operator-6f74fb5bff-2d982" deleted
```

b. Verify that the **rook-ceph-operator** pod is restarted.

```
$ oc get -n openshift-storage pod -l app=rook-ceph-operator
```

Example output:

```
NAME                                  READY   STATUS    RESTARTS   AGE
rook-ceph-operator-6f74fb5bff-7mvrq   1/1     Running   0          66s
```

Creation of the new OSD may take several minutes after the operator starts.

17. Delete the **ocs-osd-removal** job(s).

```
$ oc delete job ocs-osd-removal-${osd_id_to_remove}
```

Example output:

```
job.batch "ocs-osd-removal-0" deleted
```

Verification steps

1. Execute the following command and verify that the new node is present in the output:

```
$ oc get nodes --show-labels | grep cluster.ocs.openshift.io/openshift-storage= |cut -d' ' -f1
```

2. Click **Workloads → Pods**, confirm that at least the following pods on the new node are in Running state:

   - **csi-cephfsplugin-***
   - **csi-rbdplugin-***

3. Verify that all other required OpenShift Container Storage pods are in **Running** state. Also, ensure that the new incremental **mon** is created and is in the **Running** state.

```
$ oc get pod -n openshift-storage | grep mon
```

   Example output:

```
rook-ceph-mon-a-64556f7659-c2ngc    1/1     Running     0   5h1m
rook-ceph-mon-b-7c8b74dc4d-tt6hd    1/1     Running     0   5h1m
rook-ceph-mon-d-57fb8c657-wg5f2     1/1     Running     0   27m
```

   OSDs and mon's might take several minutes to get to the **Running** state.

4. If verification steps fail, contact Red Hat Support.

9.3.2.2. Replacing an operational Amazon EC2 node on installer-provisioned infrastructure

Use this procedure to replace an operational node on Amazon EC2 I3 installer-provisioned infrastructure (IPI).

> **IMPORTANT**
>
> Replacing storage nodes in Amazon EC2 I3 infrastructure 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

- You must be logged into the OpenShift Container Platform (OCP) cluster.

Procedure

1. Log in to OpenShift Web Console and click **Compute → Nodes**.
2. Identify the node that needs to be replaced. Take a note of its Machine Name.
3. Get labels on the node to be replaced.

```
$ oc get nodes --show-labels | grep <node_name>
```

4. Identify the mon (if any) and OSDs that are running in the node to be replaced.

```
$ oc get pods -n openshift-storage -o wide | grep -i <node_name>
```

5. Scale down the deployments of the pods identified in the previous step.
   For example:

```
$ oc scale deployment rook-ceph-mon-c --replicas=0 -n openshift-storage
$ oc scale deployment rook-ceph-osd-0 --replicas=0 -n openshift-storage
$ oc scale deployment --selector=app=rook-ceph-crashcollector,node_name=<node_name>
--replicas=0 -n openshift-storage
```

6. Mark the nodes as unschedulable.

```
$ oc adm cordon <node_name>
```

7. Drain the node.

```
$ oc adm drain <node_name> --force --delete-local-data --ignore-daemonsets
```

8. Click **Compute → Machines**. Search for the required machine.

9. Besides the required machine, click the **Action menu (⋮) → Delete Machine**

10. Click **Delete** to confirm the machine deletion. A new machine is automatically created.

11. Wait for the new machine to start and transition into Running state.

IMPORTANT

This activity may take at least 5-10 minutes or more.

12. Click **Compute → Nodes** in the OpenShift web console. Confirm if the new node is in **Ready** state.

13. Apply the OpenShift Container Storage label to the new node using any one of the following:

From User interface

   a. For the new node, click **Action Menu (⋮) → Edit Labels**

   b. Add **cluster.ocs.openshift.io/openshift-storage** and click **Save**.

From Command line interface

- Execute the following command to apply the OpenShift Container Storage label to the new node:

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

14. Add the local storage devices available in the new worker node to the OpenShift Container Storage StorageCluster.

    a. Add the new disk entries to LocalVolume CR.
    Edit **LocalVolume** CR. You can either remove or comment out the failed device **/dev/disk/by-id/{id}** and add the new **/dev/disk/by-id/{id}**.

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

    Example output:

    ```
    NAME          AGE
    local-block   25h
    ```

    ```
    $ oc edit -n local-storage localvolume local-block
    ```

    Example output:

    ```
    [...]
      storageClassDevices:
      - devicePaths:
        - /dev/disk/by-id/nvme-
    Amazon_EC2_NVMe_Instance_Storage_AWS10382E5D7441494EC
        - /dev/disk/by-id/nvme-
    Amazon_EC2_NVMe_Instance_Storage_AWS1F45C01D7E84FE3E9
        - /dev/disk/by-id/nvme-
    Amazon_EC2_NVMe_Instance_Storage_AWS136BC945B4ECB9AE4
        - /dev/disk/by-id/nvme-
    Amazon_EC2_NVMe_Instance_Storage_AWS10382E5D7441464EP
     #   - /dev/disk/by-id/nvme-
    Amazon_EC2_NVMe_Instance_Storage_AWS1F45C01D7E84F43E7
     #   - /dev/disk/by-id/nvme-
    Amazon_EC2_NVMe_Instance_Storage_AWS136BC945B4ECB9AE8
        - /dev/disk/by-id/nvme-
    Amazon_EC2_NVMe_Instance_Storage_AWS6F45C01D7E84FE3E9
        - /dev/disk/by-id/nvme-
    Amazon_EC2_NVMe_Instance_Storage_AWS636BC945B4ECB9AE4
        storageClassName: localblock
        volumeMode: Block
    [...]
    ```

    Make sure to save the changes after editing the CR.

    You can see that in this CR the below two new devices using by-id have been added.

    - **nvme-Amazon_EC2_NVMe_Instance_Storage_AWS6F45C01D7E84FE3E9**
    - **nvme-Amazon_EC2_NVMe_Instance_Storage_AWS636BC945B4ECB9AE4**

    b. Display PVs with **localblock**.

    ```
    $ oc get pv | grep localblock
    ```

    Example output:

    –

```
local-pv-3646185e   2328Gi  RWO    Delete     Available
localblock  9s
local-pv-3933e86    2328Gi  RWO    Delete     Bound      openshift-storage/ocs-
deviceset-2-1-v9jp4   localblock  5h1m
local-pv-8176b2bf   2328Gi  RWO    Delete     Bound      openshift-storage/ocs-
deviceset-0-0-nvs68   localblock  5h1m
local-pv-ab7cabb3   2328Gi  RWO    Delete     Available
localblock  9s
local-pv-ac52e8a    2328Gi  RWO    Delete     Bound      openshift-storage/ocs-
deviceset-1-0-knrgr   localblock  5h1m
local-pv-b7e6fd37   2328Gi  RWO    Delete     Bound      openshift-storage/ocs-
deviceset-2-0-rdm7m   localblock  5h1m
local-pv-cb454338   2328Gi  RWO    Delete     Bound      openshift-storage/ocs-
deviceset-0-1-h9hfm   localblock  5h1m
local-pv-da5e3175   2328Gi  RWO    Delete     Bound      openshift-storage/ocs-
deviceset-1-1-g97lq   localblock  5h
...
```

15. Delete each PV and OSD associated with the failed node using the following steps.

    a. Identify the DeviceSet associated with the OSD to be replaced.

    ```
    $ osd_id_to_remove=0
    $ oc get -n openshift-storage -o yaml deployment rook-ceph-osd-${osd_id_to_remove} |
    grep ceph.rook.io/pvc
    ```

    where, **osd_id_to_remove** is the integer in the pod name immediately after the **rook-ceph-osd** prefix. In this example, the deployment name is **rook-ceph-osd-0**.

    Example output:

    ```
    ceph.rook.io/pvc: ocs-deviceset-0-0-nvs68
    ceph.rook.io/pvc: ocs-deviceset-0-0-nvs68
    ```

    b. Identify the PV associated with the PVC.

    ```
    $ oc get -n openshift-storage pvc ocs-deviceset-<x>-<y>-<pvc-suffix>
    ```

    where, **x**, **y**, and **pvc-suffix** are the values in the DeviceSet identified in an earlier step.

    Example output:

    ```
    NAME                    STATUS      VOLUME        CAPACITY   ACCESS MODES
    STORAGECLASS   AGE
    ocs-deviceset-0-0-nvs68   Bound   local-pv-8176b2bf   2328Gi      RWO          localblock
    4h49m
    ```

    In this example, the associated PV is **local-pv-8176b2bf**.

    c. Delete the PVC which was identified in earlier steps. In this example, the PVC name is **ocs-deviceset-0-0-nvs68**.

    ```
    $ oc delete pvc ocs-deviceset-0-0-nvs68 -n openshift-storage
    ```

Example output:

```
persistentvolumeclaim "ocs-deviceset-0-0-nvs68" deleted
```

d. Delete the PV which was identified in earlier steps. In this example, the PV name is **local-pv-8176b2bf**.

```
$ oc delete pv local-pv-8176b2bf
```

Example output:

```
persistentvolume "local-pv-8176b2bf" deleted
```

e. Remove the failed OSD from the cluster.

```
$ oc process -n openshift-storage ocs-osd-removal -p
FAILED_OSD_ID=${osd_id_to_remove} | oc create -f -
```

f. Verify that the OSD is removed successfully by checking the status of the **ocs-osd-removal** pod. A status of **Completed** confirms that the OSD removal job succeeded.

```
# oc get pod -l job-name=ocs-osd-removal-${osd_id_to_remove} -n openshift-storage
```

NOTE

If ocs-osd-removal fails and the pod is not in the expected Completed state, check the pod logs for further debugging. For example:

```
# oc logs -l job-name=ocs-osd-removal-${osd_id_to_remove} -n openshift-
storage --tail=-1
```

g. Delete the OSD pod deployment.

```
$ oc delete deployment rook-ceph-osd-${osd_id_to_remove} -n openshift-storage
```

16. Delete **crashcollector** pod deployment identified in an earlier step.

```
$ oc delete deployment --selector=app=rook-ceph-crashcollector,node_name=
<old_node_name> -n openshift-storage
```

17. Deploy the new OSD by restarting the **rook-ceph-operator** to force operator reconciliation.

```
$ oc get -n openshift-storage pod -l app=rook-ceph-operator
```

Example output:

```
NAME                                 READY   STATUS    RESTARTS   AGE
rook-ceph-operator-6f74fb5bff-2d982   1/1     Running   0          5h3m
```

a. Delete the **rook-ceph-operator**.

```
$ oc delete -n openshift-storage pod rook-ceph-operator-6f74fb5bff-2d982
```

Example output:

```
pod "rook-ceph-operator-6f74fb5bff-2d982" deleted
```

b. Verify that the **rook-ceph-operator** pod is restarted.

```
$ oc get -n openshift-storage pod -l app=rook-ceph-operator
```

Example output:

```
NAME                               READY   STATUS    RESTARTS   AGE
rook-ceph-operator-6f74fb5bff-7mvrq   1/1     Running   0          66s
```

Creation of the new OSD may take several minutes after the operator starts.

18. Delete the **ocs-osd-removal** job(s).

```
$ oc delete job ocs-osd-removal-${osd_id_to_remove}
```

Example output:

```
job.batch "ocs-osd-removal-0" deleted
```

Verification steps

1. Execute the following command and verify that the new node is present in the output:

```
$ oc get nodes --show-labels | grep cluster.ocs.openshift.io/openshift-storage= |cut -d' ' -f1
```

2. Click **Workloads → Pods**, confirm that at least the following pods on the new node are in Running state:

    - **csi-cephfsplugin-***
    - **csi-rbdplugin-***

3. Verify that all other required OpenShift Container Storage pods are in **Running** state. Also, ensure that the new incremental **mon** is created and is in the **Running** state.

```
$ oc get pod -n openshift-storage | grep mon
```

Example output:

```
rook-ceph-mon-a-64556f7659-c2ngc    1/1     Running     0   5h1m
rook-ceph-mon-b-7c8b74dc4d-tt6hd    1/1     Running     0   5h1m
rook-ceph-mon-d-57fb8c657-wg5f2     1/1     Running     0   27m
```

OSDs and mon's might take several minutes to get to the **Running** state.

4. If verification steps fail, contact Red Hat Support.

9.3.2.3. Replacing a failed Amazon EC2 node on user-provisioned infrastructure

The ephemeral storage of Amazon EC2 I3 for OpenShift Container Storage might cause data loss when there is an instance power off. Use this procedure to recover from such an instance power off on Amazon EC2 infrastructure.

> **IMPORTANT**
>
> Replacing storage nodes in Amazon EC2 I3 infrastructure 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

- You must be logged into the OpenShift Container Platform (OCP) cluster.

Procedure

1. Identify the node and get labels on the node to be replaced.

```
$ oc get nodes --show-labels | grep <node_name>
```

2. Identify the mon (if any) and OSDs that are running in the node to be replaced.

```
$ oc get pods -n openshift-storage -o wide | grep -i <node_name>
```

3. Scale down the deployments of the pods identified in the previous step.
   For example:

```
$ oc scale deployment rook-ceph-mon-c --replicas=0 -n openshift-storage
$ oc scale deployment rook-ceph-osd-0 --replicas=0 -n openshift-storage
$ oc scale deployment --selector=app=rook-ceph-crashcollector,node_name=<node_name>
--replicas=0 -n openshift-storage
```

4. Mark the nodes as unschedulable.

```
$ oc adm cordon <node_name>
```

5. Remove the pods which are in Terminating state.

```
$ oc get pods -A -o wide | grep -i <node_name> |  awk '{if ($4 == "Terminating") system ("oc -
n " $1 " delete pods " $2  " --grace-period=0 " " --force ")}'
```

6. Drain the node.

```
$ oc adm drain <node_name> --force --delete-local-data --ignore-daemonsets
```

7. Delete the node.

```
$ oc delete node <node_name>
```

▪

8. Create a new Amazon EC2 I3 machine instance with the required infrastructure. See Supported Infrastructure and Platforms.

9. Create a new OpenShift Container Platform node using the new Amazon EC2 I3 machine instance.

10. Check for certificate signing requests (CSRs) related to OpenShift Container Platform that are in Pending state:

```
$ oc get csr
```

11. Approve all required OpenShift Container Platform CSRs for the new node:

```
$ oc adm certificate approve <Certificate_Name>
```

12. Click **Compute → Nodes** in the OpenShift web console. Confirm if the new node is in **Ready** state.

13. Apply the OpenShift Container Storage label to the new node using any one of the following:

From User interface

a. For the new node, click **Action Menu (⋮) → Edit Labels**

b. Add **cluster.ocs.openshift.io/openshift-storage** and click **Save**.

From Command line interface

- Execute the following command to apply the OpenShift Container Storage label to the new node:

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

14. Add the local storage devices available in the new worker node to the OpenShift Container Storage StorageCluster.

a. Add the new disk entries to LocalVolume CR.
Edit **LocalVolume** CR. You can either remove or comment out the failed device **/dev/disk/by-id/{id}** and add the new **/dev/disk/by-id/{id}**.

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

Example output:

```
NAME          AGE
local-block   25h
```

```
$ oc edit -n local-storage localvolume local-block
```

Example output:

```
[...]
```

```
    storageClassDevices:
    - devicePaths:
      - /dev/disk/by-id/nvme-
Amazon_EC2_NVMe_Instance_Storage_AWS10382E5D7441494EC
      - /dev/disk/by-id/nvme-
Amazon_EC2_NVMe_Instance_Storage_AWS1F45C01D7E84FE3E9
      - /dev/disk/by-id/nvme-
Amazon_EC2_NVMe_Instance_Storage_AWS136BC945B4ECB9AE4
      - /dev/disk/by-id/nvme-
Amazon_EC2_NVMe_Instance_Storage_AWS10382E5D7441464EP
  #   - /dev/disk/by-id/nvme-
Amazon_EC2_NVMe_Instance_Storage_AWS1F45C01D7E84F43E7
  #   - /dev/disk/by-id/nvme-
Amazon_EC2_NVMe_Instance_Storage_AWS136BC945B4ECB9AE8
      - /dev/disk/by-id/nvme-
Amazon_EC2_NVMe_Instance_Storage_AWS6F45C01D7E84FE3E9
      - /dev/disk/by-id/nvme-
Amazon_EC2_NVMe_Instance_Storage_AWS636BC945B4ECB9AE4
      storageClassName: localblock
      volumeMode: Block
[...]
```

Make sure to save the changes after editing the CR.

You can see that in this CR the below two new devices using by-id have been added.

- **nvme-Amazon_EC2_NVMe_Instance_Storage_AWS6F45C01D7E84FE3E9**
- **nvme-Amazon_EC2_NVMe_Instance_Storage_AWS636BC945B4ECB9AE4**

b. Display PVs with **localblock**.

```
$ oc get pv | grep localblock
```

Example output:

```
local-pv-3646185e   2328Gi  RWO     Delete      Available
localblock  9s
local-pv-3933e86    2328Gi  RWO     Delete      Bound       openshift-storage/ocs-
deviceset-2-1-v9jp4   localblock  5h1m
local-pv-8176b2bf   2328Gi  RWO     Delete      Bound       openshift-storage/ocs-
deviceset-0-0-nvs68   localblock  5h1m
local-pv-ab7cabb3   2328Gi  RWO     Delete      Available
localblock  9s
local-pv-ac52e8a    2328Gi  RWO     Delete      Bound       openshift-storage/ocs-
deviceset-1-0-knrgr   localblock  5h1m
local-pv-b7e6fd37   2328Gi  RWO     Delete      Bound       openshift-storage/ocs-
deviceset-2-0-rdm7m   localblock  5h1m
local-pv-cb454338   2328Gi  RWO     Delete      Bound       openshift-storage/ocs-
deviceset-0-1-h9hfm   localblock  5h1m
local-pv-da5e3175   2328Gi  RWO     Delete      Bound       openshift-storage/ocs-
deviceset-1-1-g97lq   localblock  5h
...
```

15. Delete each PV and OSD associated with the failed node using the following steps.

a. Identify the DeviceSet associated with the OSD to be replaced.

```
$ osd_id_to_remove=0
$ oc get -n openshift-storage -o yaml deployment rook-ceph-osd-${osd_id_to_remove} |
grep ceph.rook.io/pvc
```

where, **osd_id_to_remove** is the integer in the pod name immediately after the **rook-ceph-osd** prefix. In this example, the deployment name is **rook-ceph-osd-0**.

Example output:

```
ceph.rook.io/pvc: ocs-deviceset-0-0-nvs68
ceph.rook.io/pvc: ocs-deviceset-0-0-nvs68
```

b. Identify the PV associated with the PVC.

```
$ oc get -n openshift-storage pvc ocs-deviceset-<x>-<y>-<pvc-suffix>
```

where, **x**, **y**, and **pvc-suffix** are the values in the DeviceSet identified in an earlier step.

Example output:

```
NAME                    STATUS     VOLUME       CAPACITY   ACCESS MODES
STORAGECLASS   AGE
ocs-deviceset-0-0-nvs68   Bound   local-pv-8176b2bf   2328Gi     RWO          localblock
4h49m
```

In this example, the associated PV is **local-pv-8176b2bf**.

c. Delete the PVC which was identified in earlier steps. In this example, the PVC name is **ocs-deviceset-0-0-nvs68**.

```
$ oc delete pvc ocs-deviceset-0-0-nvs68 -n openshift-storage
```

Example output:

```
persistentvolumeclaim "ocs-deviceset-0-0-nvs68" deleted
```

d. Delete the PV which was identified in earlier steps. In this example, the PV name is **local-pv-8176b2bf**.

```
$ oc delete pv local-pv-8176b2bf
```

Example output:

```
persistentvolume "local-pv-8176b2bf" deleted
```

e. Remove the failed OSD from the cluster.

```
$ oc process -n openshift-storage ocs-osd-removal -p
FAILED_OSD_ID=${osd_id_to_remove} | oc create -f -
```

f. Verify that the OSD is removed successfully by checking the status of the **ocs-osd-removal** pod. A status of **Completed** confirms that the OSD removal job succeeded.

```
# oc get pod -l job-name=ocs-osd-removal-${osd_id_to_remove} -n openshift-storage
```

NOTE

If ocs-osd-removal fails and the pod is not in the expected Completed state, check the pod logs for further debugging. For example:

```
# oc logs -l job-name=ocs-osd-removal-${osd_id_to_remove} -n openshift-
storage --tail=-1
```

g. Delete the OSD pod deployment.

```
$ oc delete deployment rook-ceph-osd-${osd_id_to_remove} -n openshift-storage
```

16. Delete **crashcollector** pod deployment identified in an earlier step.

```
$ oc delete deployment --selector=app=rook-ceph-crashcollector,node_name=
<old_node_name> -n openshift-storage
```

17. Deploy the new OSD by restarting the **rook-ceph-operator** to force operator reconciliation.

```
$ oc get -n openshift-storage pod -l app=rook-ceph-operator
```

Example output:

```
NAME                                  READY   STATUS    RESTARTS   AGE
rook-ceph-operator-6f74fb5bff-2d982   1/1     Running   0          5h3m
```

a. Delete the **rook-ceph-operator**.

```
$ oc delete -n openshift-storage pod rook-ceph-operator-6f74fb5bff-2d982
```

Example output:

```
pod "rook-ceph-operator-6f74fb5bff-2d982" deleted
```

b. Verify that the **rook-ceph-operator** pod is restarted.

```
$ oc get -n openshift-storage pod -l app=rook-ceph-operator
```

Example output:

```
NAME                                  READY   STATUS    RESTARTS   AGE
rook-ceph-operator-6f74fb5bff-7mvrq   1/1     Running   0          66s
```

Creation of the new OSD may take several minutes after the operator starts.

18. Delete the **ocs-osd-removal** job(s).

```
$ oc delete job ocs-osd-removal-${osd_id_to_remove}
```

Example output:

```
job.batch "ocs-osd-removal-0" deleted
```

Verification steps

1. Execute the following command and verify that the new node is present in the output:

```
$ oc get nodes --show-labels | grep cluster.ocs.openshift.io/openshift-storage= |cut -d' ' -f1
```

2. Click **Workloads → Pods**, confirm that at least the following pods on the new node are in Running state:

   - **csi-cephfsplugin-***
   - **csi-rbdplugin-***

3. Verify that all other required OpenShift Container Storage pods are in **Running** state. Also, ensure that the new incremental **mon** is created and is in the **Running** state.

```
$ oc get pod -n openshift-storage | grep mon
```

Example output:

```
rook-ceph-mon-a-64556f7659-c2ngc   1/1   Running   0   5h1m
rook-ceph-mon-b-7c8b74dc4d-tt6hd   1/1   Running   0   5h1m
rook-ceph-mon-d-57fb8c657-wg5f2    1/1   Running   0   27m
```

OSDs and mon's might take several minutes to get to the **Running** state.

4. If verification steps fail, contact Red Hat Support.

9.3.2.4. Replacing a failed Amazon EC2 node on installer-provisioned infrastructure

The ephemeral storage of Amazon EC2 I3 for OpenShift Container Storage might cause data loss when there is an instance power off. Use this procedure to recover from such an instance power off on Amazon EC2 infrastructure.

> **IMPORTANT**
>
> Replacing storage nodes in Amazon EC2 I3 infrastructure 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

- You must be logged into the OpenShift Container Platform (OCP) cluster.

Procedure

1. Log in to OpenShift Web Console and click **Compute → Nodes**.
2. Identify the node that needs to be replaced. Take a note of its Machine Name.
3. Get the labels on the node to be replaced.

```
$ oc get nodes --show-labels | grep <node_name>
```

4. Identify the mon (if any) and OSDs that are running in the node to be replaced.

```
$ oc get pods -n openshift-storage -o wide | grep -i <node_name>
```

5. Scale down the deployments of the pods identified in the previous step.
   For example:

```
$ oc scale deployment rook-ceph-mon-c --replicas=0 -n openshift-storage
$ oc scale deployment rook-ceph-osd-0 --replicas=0 -n openshift-storage
$ oc scale deployment --selector=app=rook-ceph-crashcollector,node_name=<node_name>
--replicas=0 -n openshift-storage
```

6. Mark the node as unschedulable.

```
$ oc adm cordon <node_name>
```

7. Remove the pods which are in Terminating state.

```
$ oc get pods -A -o wide | grep -i <node_name> |  awk '{if ($4 == "Terminating") system ("oc -
n " $1 " delete pods " $2  " --grace-period=0 " " --force ")}'
```

8. Drain the node.

```
$ oc adm drain <node_name> --force --delete-local-data --ignore-daemonsets
```

9. Click **Compute → Machines**. Search for the required machine.
10. Besides the required machine, click the **Action menu (⋮) → Delete Machine**
11. Click **Delete** to confirm the machine deletion. A new machine is automatically created.
12. Wait for the new machine to start and transition into Running state.

> **IMPORTANT**
>
> This activity may take at least 5-10 minutes or more.

13. Click **Compute → Nodes** in the OpenShift web console. Confirm if the new node is in **Ready** state.
14. Apply the OpenShift Container Storage label to the new node using any one of the following:

From User interface

a. For the new node, click **Action Menu (⋮) → Edit Labels**

b. Add **cluster.ocs.openshift.io/openshift-storage** and click **Save**.

From Command line interface

- Execute the following command to apply the OpenShift Container Storage label to the new node:

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

15. Add the local storage devices available in the new worker node to the OpenShift Container Storage StorageCluster.

a. Add the new disk entries to LocalVolume CR.
Edit **LocalVolume** CR. You can either remove or comment out the failed device **/dev/disk/by-id/{id}** and add the new **/dev/disk/by-id/{id}**.

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

Example output:

```
NAME          AGE
local-block   25h
```

```
$ oc edit -n local-storage localvolume local-block
```

Example output:

```
[...]
    storageClassDevices:
    - devicePaths:
      - /dev/disk/by-id/nvme-Amazon_EC2_NVMe_Instance_Storage_AWS10382E5D7441494EC
      - /dev/disk/by-id/nvme-Amazon_EC2_NVMe_Instance_Storage_AWS1F45C01D7E84FE3E9
      - /dev/disk/by-id/nvme-Amazon_EC2_NVMe_Instance_Storage_AWS136BC945B4ECB9AE4
      - /dev/disk/by-id/nvme-Amazon_EC2_NVMe_Instance_Storage_AWS10382E5D7441464EP
  #   - /dev/disk/by-id/nvme-Amazon_EC2_NVMe_Instance_Storage_AWS1F45C01D7E84F43E7
  #   - /dev/disk/by-id/nvme-Amazon_EC2_NVMe_Instance_Storage_AWS136BC945B4ECB9AE8
      - /dev/disk/by-id/nvme-Amazon_EC2_NVMe_Instance_Storage_AWS6F45C01D7E84FE3E9
      - /dev/disk/by-id/nvme-Amazon_EC2_NVMe_Instance_Storage_AWS636BC945B4ECB9AE4
      storageClassName: localblock
      volumeMode: Block
[...]
```

Make sure to save the changes after editing the CR.

You can see that in this CR the below two new devices using by-id have been added.

- **nvme-Amazon_EC2_NVMe_Instance_Storage_AWS6F45C01D7E84FE3E9**
- **nvme-Amazon_EC2_NVMe_Instance_Storage_AWS636BC945B4ECB9AE4**

b. Display PVs with **localblock**.

```
$ oc get pv | grep localblock
```

Example output:

```
local-pv-3646185e   2328Gi  RWO    Delete     Available
localblock  9s
local-pv-3933e86    2328Gi  RWO    Delete     Bound      openshift-storage/ocs-
deviceset-2-1-v9jp4   localblock  5h1m
local-pv-8176b2bf   2328Gi  RWO    Delete     Bound      openshift-storage/ocs-
deviceset-0-0-nvs68   localblock  5h1m
local-pv-ab7cabb3   2328Gi  RWO    Delete     Available
localblock  9s
local-pv-ac52e8a    2328Gi  RWO    Delete     Bound      openshift-storage/ocs-
deviceset-1-0-knrgr   localblock  5h1m
local-pv-b7e6fd37   2328Gi  RWO    Delete     Bound      openshift-storage/ocs-
deviceset-2-0-rdm7m   localblock  5h1m
local-pv-cb454338   2328Gi  RWO    Delete     Bound      openshift-storage/ocs-
deviceset-0-1-h9hfm   localblock  5h1m
local-pv-da5e3175   2328Gi  RWO    Delete     Bound      openshift-storage/ocs-
deviceset-1-1-g97lq   localblock  5h
...
```

16. Delete each PV and OSD associated with the failed node using the following steps.

a. Identify the DeviceSet associated with the OSD to be replaced.

```
$ osd_id_to_remove=0
$ oc get -n openshift-storage -o yaml deployment rook-ceph-osd-${osd_id_to_remove} |
grep ceph.rook.io/pvc
```

where, **osd_id_to_remove** is the integer in the pod name immediately after the **rook-ceph-osd** prefix. In this example, the deployment name is **rook-ceph-osd-0**.

Example output:

```
ceph.rook.io/pvc: ocs-deviceset-0-0-nvs68
ceph.rook.io/pvc: ocs-deviceset-0-0-nvs68
```

b. Identify the PV associated with the PVC.

```
$ oc get -n openshift-storage pvc ocs-deviceset-<x>-<y>-<pvc-suffix>
```

where, **x**, **y**, and **pvc-suffix** are the values in the DeviceSet identified in an earlier step.

Example output:

```
NAME                      STATUS     VOLUME          CAPACITY   ACCESS MODES
STORAGECLASS   AGE
ocs-deviceset-0-0-nvs68   Bound   local-pv-8176b2bf   2328Gi     RWO          localblock
4h49m
```

In this example, the associated PV is **local-pv-8176b2bf**.

c. Delete the PVC which was identified in earlier steps. In this example, the PVC name is **ocs-deviceset-0-0-nvs68**.

```
$ oc delete pvc ocs-deviceset-0-0-nvs68 -n openshift-storage
```

Example output:

```
persistentvolumeclaim "ocs-deviceset-0-0-nvs68" deleted
```

d. Delete the PV which was identified in earlier steps. In this example, the PV name is **local-pv-8176b2bf**.

```
$ oc delete pv local-pv-8176b2bf
```

Example output:

```
persistentvolume "local-pv-8176b2bf" deleted
```

e. Remove the failed OSD from the cluster.

```
$ oc process -n openshift-storage ocs-osd-removal -p
FAILED_OSD_ID=${osd_id_to_remove} | oc create -f -
```

f. Verify that the OSD is removed successfully by checking the status of the **ocs-osd-removal** pod. A status of **Completed** confirms that the OSD removal job succeeded.

```
# oc get pod -l job-name=ocs-osd-removal-${osd_id_to_remove} -n openshift-storage
```

NOTE

If ocs-osd-removal fails and the pod is not in the expected Completed state, check the pod logs for further debugging. For example:

```
# oc logs -l job-name=ocs-osd-removal-${osd_id_to_remove} -n openshift-
storage --tail=-1
```

g. Delete the OSD pod deployment.

```
$ oc delete deployment rook-ceph-osd-${osd_id_to_remove} -n openshift-storage
```

17. Delete **crashcollector** pod deployment identified in an earlier step.

```
$ oc delete deployment --selector=app=rook-ceph-crashcollector,node_name=
<old_node_name> -n openshift-storage
```

18. Deploy the new OSD by restarting the **rook-ceph-operator** to force operator reconciliation.

```
$ oc get -n openshift-storage pod -l app=rook-ceph-operator
```

Example output:

```
NAME                                  READY   STATUS    RESTARTS   AGE
rook-ceph-operator-6f74fb5bff-2d982   1/1     Running   0          5h3m
```

a. Delete the **rook-ceph-operator**.

```
$ oc delete -n openshift-storage pod rook-ceph-operator-6f74fb5bff-2d982
```

Example output:

```
pod "rook-ceph-operator-6f74fb5bff-2d982" deleted
```

b. Verify that the **rook-ceph-operator** pod is restarted.

```
$ oc get -n openshift-storage pod -l app=rook-ceph-operator
```

Example output:

```
NAME                                  READY   STATUS    RESTARTS   AGE
rook-ceph-operator-6f74fb5bff-7mvrq   1/1     Running   0          66s
```

Creation of the new OSD may take several minutes after the operator starts.

19. Delete the **ocs-osd-removal** job(s).

```
$ oc delete job ocs-osd-removal-${osd_id_to_remove}
```

Example output:

```
job.batch "ocs-osd-removal-0" deleted
```

Verification steps

1. Execute the following command and verify that the new node is present in the output:

```
$ oc get nodes --show-labels | grep cluster.ocs.openshift.io/openshift-storage= |cut -d' ' -f1
```

2. Click **Workloads → Pods**, confirm that at least the following pods on the new node are in Running state:

- **csi-cephfsplugin-***
- **csi-rbdplugin-***

3. Verify that all other required OpenShift Container Storage pods are in **Running** state. Also, ensure that the new incremental **mon** is created and is in the **Running** state.

```
$ oc get pod -n openshift-storage | grep mon
```

Example output:

```
rook-ceph-mon-a-64556f7659-c2ngc   1/1    Running    0  5h1m
rook-ceph-mon-b-7c8b74dc4d-tt6hd   1/1    Running    0  5h1m
rook-ceph-mon-d-57fb8c657-wg5f2    1/1    Running    0  27m
```

OSDs and mon's might take several minutes to get to the **Running** state.

4. If verification steps fail, contact Red Hat Support.

9.3.3. Replacing storage nodes on VMware infrastructure

- To replace an operational node, see Section 9.3.3.1, "Replacing an operational node on VMware user-provisioned infrastructure"
- To replace a failed node, see Section 9.3.3.2, "Replacing a failed node on VMware user-provisioned infrastructure"

9.3.3.1. Replacing an operational node on VMware user-provisioned infrastructure

Prerequisites

- You must be logged into the OpenShift Container Platform (OCP) cluster.

Procedure

1. Identify the node and get labels on the node to be replaced.

```
$ oc get nodes --show-labels | grep <node_name>
```

2. Identify the **mon** (if any) and OSDs that are running in the node to be replaced.

```
$ oc get pods -n openshift-storage -o wide | grep -i <node_name>
```

3. Scale down the deployments of the pods identified in the previous step.
For example:

```
$ oc scale deployment rook-ceph-mon-c --replicas=0 -n openshift-storage
$ oc scale deployment rook-ceph-osd-0 --replicas=0 -n openshift-storage
$ oc scale deployment --selector=app=rook-ceph-crashcollector,node_name=<node_name>
--replicas=0 -n openshift-storage
```

4. Mark the node as unschedulable.

```
$ oc adm cordon <node_name>
```

5. Drain the node.

```
$ oc adm drain <node_name> --force --delete-local-data --ignore-daemonsets
```

6. Delete the node.

```
$ oc delete node <node_name>
```

7. Log in to vSphere and terminate the identified VM.

8. Create a new VM on VMware with the required infrastructure. See Supported Infrastructure and Platforms.

9. Create a new OpenShift Container Platform worker node using the new VM.

10. Check for certificate signing requests (CSRs) related to OpenShift Container Platform that are in Pending state:

```
$ oc get csr
```

11. Approve all required OpenShift Container Platform CSRs for the new node:

```
$ oc adm certificate approve <Certificate_Name>
```

12. Click **Compute → Nodes** in OpenShift Web Console, confirm if the new node is in **Ready** state.

13. Apply the OpenShift Container Storage label to the new node using any one of the following:

    From User interface

    a. For the new node, click **Action Menu (⋮) → Edit Labels**

    b. Add **cluster.ocs.openshift.io/openshift-storage** and click **Save**.

    From Command line interface

    - Execute the following command to apply the OpenShift Container Storage label to the new node:

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

14. Add the local storage devices available in these worker nodes to the OpenShift Container Storage StorageCluster.

    a. Add a new disk entry to **LocalVolume** CR.
    Edit **LocalVolume** CR and remove or comment out failed device **/dev/disk/by-id/{id}** and add the new **/dev/disk/by-id/{id}**. In this example, the new device is **/dev/disk/by-id/nvme-eui.01000000010000005cd2e490020e5251**.

    ```
    # oc get -n local-storage localvolume
    ```

    Example output:

    ```
    NAME         AGE
    local-block  25h
    ```

    ```
    # oc edit -n local-storage localvolume local-block
    ```

Example output:

```
[...]
    storageClassDevices:
    - devicePaths:
      - /dev/disk/by-id/nvme-eui.01000000010000005cd2e4895e0e5251
      - /dev/disk/by-id/nvme-eui.01000000010000005cd2e4ea2f0f5251
  #   - /dev/disk/by-id/nvme-eui.01000000010000005cd2e4de2f0f5251
      - /dev/disk/by-id/nvme-eui.01000000010000005cd2e490020e5251
      storageClassName: localblock
      volumeMode: Block
[...]
```

Make sure to save the changes after editing the CR.

b. Display PVs with **localblock**.

```
$ oc get pv | grep localblock
```

Example output:

```
local-pv-3e8964d3                         1490Gi      RWO          Delete          Bound
openshift-storage/ocs-deviceset-2-0-79j94   localblock                           25h
local-pv-414755e0                         1490Gi      RWO          Delete          Bound
openshift-storage/ocs-deviceset-1-0-959rp   localblock                           25h
local-pv-b481410                          1490Gi      RWO          Delete          Available
localblock                        3m24s
local-pv-d9c5cbd6                         1490Gi      RWO          Delete          Bound
openshift-storage/ocs-deviceset-0-0-nvs68   localblock
```

15. Delete the PV associated with the failed node.

a. Identify the **DeviceSet** associated with the OSD to be replaced.

```
# osd_id_to_remove=0
# oc get -n openshift-storage -o yaml deployment rook-ceph-osd-${osd_id_to_remove} |
grep ceph.rook.io/pvc
```

where, **osd_id_to_remove** is the integer in the pod name immediately after the **rook-ceph-osd prefix**. In this example, the deployment name is **rook-ceph-osd-0**.

Example output:

```
ceph.rook.io/pvc: ocs-deviceset-0-0-nvs68
ceph.rook.io/pvc: ocs-deviceset-0-0-nvs68
```

In this example, the PVC name is **ocs-deviceset-0-0-nvs68**.

b. Identify the PV associated with the PVC.

```
# oc get -n openshift-storage pvc ocs-deviceset-<x>-<y>-<pvc-suffix>
```

where, **x**, **y**, and **pvc-suffix** are the values in the **DeviceSet** identified in the previous step.

Example output:

```
NAME                    STATUS      VOLUME          CAPACITY   ACCESS MODES
STORAGECLASS   AGE
ocs-deviceset-0-0-nvs68   Bound   local-pv-d9c5cbd6   1490Gi     RWO          localblock
24h
```

In this example, the associated PV is **local-pv-d9c5cbd6**.

c. Delete the PVC.

```
oc delete pvc <pvc-name> -n openshift-storage
```

d. Delete the PV.

```
# oc delete pv local-pv-d9c5cbd6
```

Example output:

```
persistentvolume "local-pv-d9c5cbd6" deleted
```

16. Remove the failed OSD from the cluster.

```
# oc process -n openshift-storage ocs-osd-removal -p
FAILED_OSD_ID=${osd_id_to_remove} | oc create -f -
```

17. Verify that the OSD is removed successfully by checking the status of the **ocs-osd-removal** pod. A status of **Completed** confirms that the OSD removal job succeeded.

```
# oc get pod -l job-name=ocs-osd-removal-${osd_id_to_remove} -n openshift-storage
```

NOTE

If ocs-osd-removal fails and the pod is not in the expected Completed state, check the pod logs for further debugging. For example:

```
# oc logs -l job-name=ocs-osd-removal-${osd_id_to_remove} -n openshift-
storage --tail=-1
```

18. Delete OSD pod deployment and crashcollector pod deployment.

```
$ oc delete deployment rook-ceph-osd-${osd_id_to_remove} -n openshift-storage
$ oc delete deployment --selector=app=rook-ceph-crashcollector,node_name=
<old_node_name> -n openshift-storage
```

19. Deploy the new OSD by restarting the **rook-ceph-operator** to force operator reconciliation.

```
# oc get -n openshift-storage pod -l app=rook-ceph-operator
```

Example output:

```
NAME                              READY   STATUS    RESTARTS   AGE
rook-ceph-operator-6f74fb5bff-2d982   1/1     Running   0          1d20h
```

a. Delete the **rook-ceph-operator**.

```
# oc delete -n openshift-storage pod rook-ceph-operator-6f74fb5bff-2d982
```

Example output:

```
pod "rook-ceph-operator-6f74fb5bff-2d982" deleted
```

b. Verify that the **rook-ceph-operator** pod is restarted.

```
# oc get -n openshift-storage pod -l app=rook-ceph-operator
```

Example output:

```
NAME                              READY   STATUS    RESTARTS   AGE
rook-ceph-operator-6f74fb5bff-7mvrq   1/1     Running   0          66s
```

Creation of the new OSD and **mon** might take several minutes after the operator restarts.

20. Delete the **ocs-osd-removal** job.

```
# oc delete job ocs-osd-removal-${osd_id_to_remove}
```

Example output:

```
job.batch "ocs-osd-removal-0" deleted
```

Verification steps

1. Execute the following command and verify that the new node is present in the output:

```
$ oc get nodes --show-labels | grep cluster.ocs.openshift.io/openshift-storage= |cut -d' ' -f1
```

2. Click **Workloads → Pods**, confirm that at least the following pods on the new node are in **Running** state:

- **csi-cephfsplugin-***
- **csi-rbdplugin-***

3. Verify that all other required OpenShift Container Storage pods are in Running state.
Ensure that the new incremental **mon** is created and is in the Running state.

```
$ oc get pod -n openshift-storage | grep mon
```

Example output:

```
rook-ceph-mon-c-64556f7659-c2ngc                 1/1     Running     0          6h14m
rook-ceph-mon-d-7c8b74dc4d-tt6hd                 1/1     Running     0          4h24m
rook-ceph-mon-e-57fb8c657-wg5f2                  1/1     Running     0          162m
```

OSD and Mon might take several minutes to get to the **Running** state.

4. If verification steps fail, contact Red Hat Support.

9.3.3.2. Replacing a failed node on VMware user-provisioned infrastructure

Prerequisites

- You must be logged into the OpenShift Container Platform (OCP) cluster.

Procedure

1. Identify the node and get labels on the node to be replaced.

```
$ oc get nodes --show-labels | grep <node_name>
```

2. Identify the **mon** (if any) and OSDs that are running in the node to be replaced.

```
$ oc get pods -n openshift-storage -o wide | grep -i <node_name>
```

3. Scale down the deployments of the pods identified in the previous step.
   For example:

```
$ oc scale deployment rook-ceph-mon-c --replicas=0 -n openshift-storage
$ oc scale deployment rook-ceph-osd-0 --replicas=0 -n openshift-storage
$ oc scale deployment --selector=app=rook-ceph-crashcollector,node_name=<node_name>
--replicas=0 -n openshift-storage
```

4. Mark the node as unschedulable.

```
$ oc adm cordon <node_name>
```

5. Remove the pods which are in Terminating state.

```
$ oc get pods -A -o wide | grep -i <node_name> |  awk '{if ($4 == "Terminating") system ("oc -
n " $1 " delete pods " $2  " --grace-period=0 " " --force ")}'
```

6. Drain the node.

```
$ oc adm drain <node_name> --force --delete-local-data --ignore-daemonsets
```

7. Delete the node.

```
$ oc delete node <node_name>
```

8. Log in to vSphere and terminate the identified VM.

9. Create a new VM on VMware with the required infrastructure. See Supported Infrastructure and Platforms.

10. Create a new OpenShift Container Platform worker node using the new VM.

11. Check for certificate signing requests (CSRs) related to OpenShift Container Platform that are in Pending state:

```
$ oc get csr
```

12. Approve all required OpenShift Container Platform CSRs for the new node:

```
$ oc adm certificate approve <Certificate_Name>
```

13. Click **Compute → Nodes** in OpenShift Web Console, confirm if the new node is in **Ready** state.

14. Apply the OpenShift Container Storage label to the new node using any one of the following:

    From User interface

    a. For the new node, click **Action Menu (⋮) → Edit Labels**

    b. Add **cluster.ocs.openshift.io/openshift-storage** and click **Save**.

    From Command line interface

    - Execute the following command to apply the OpenShift Container Storage label to the new node:

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

15. Add the local storage devices available in these worker nodes to the OpenShift Container Storage StorageCluster.

    a. Add a new disk entry to **LocalVolume** CR.
    Edit **LocalVolume** CR and remove or comment out failed device **/dev/disk/by-id/{id}** and add the new **/dev/disk/by-id/{id}**. In this example, the new device is **/dev/disk/by-id/nvme-eui.01000000010000005cd2e490020e5251**.

    ```
    # oc get -n local-storage localvolume
    ```

    Example output:

    ```
    NAME         AGE
    local-block   25h
    ```

    ```
    # oc edit -n local-storage localvolume local-block
    ```

    Example output:

    ```
    [...]
      storageClassDevices:
      - devicePaths:
    ```

```
        - /dev/disk/by-id/nvme-eui.01000000010000005cd2e4895e0e5251
        - /dev/disk/by-id/nvme-eui.01000000010000005cd2e4ea2f0f5251
    #   - /dev/disk/by-id/nvme-eui.01000000010000005cd2e4de2f0f5251
        - /dev/disk/by-id/nvme-eui.01000000010000005cd2e490020e5251
        storageClassName: localblock
        volumeMode: Block
[...]
```

Make sure to save the changes after editing the CR.

b. Display PVs with **localblock**.

```
$ oc get pv | grep localblock
```

Example output:

```
local-pv-3e8964d3                    1490Gi     RWO          Delete          Bound
openshift-storage/ocs-deviceset-2-0-79j94   localblock                        25h
local-pv-414755e0                    1490Gi     RWO          Delete          Bound
openshift-storage/ocs-deviceset-1-0-959rp   localblock                        25h
local-pv-b481410                     1490Gi     RWO          Delete          Available
localblock                     3m24s
local-pv-d9c5cbd6                    1490Gi     RWO          Delete          Bound
openshift-storage/ocs-deviceset-0-0-nvs68   localblock
```

16. Delete the PV associated with the failed node.

a. Identify the **DeviceSet** associated with the OSD to be replaced.

```
# osd_id_to_remove=0
# oc get -n openshift-storage -o yaml deployment rook-ceph-osd-${osd_id_to_remove} |
grep ceph.rook.io/pvc
```

where, **osd_id_to_remove** is the integer in the pod name immediately after the **rook-ceph-osd prefix**. In this example, the deployment name is **rook-ceph-osd-0**.

Example output:

```
ceph.rook.io/pvc: ocs-deviceset-0-0-nvs68
ceph.rook.io/pvc: ocs-deviceset-0-0-nvs68
```

In this example, the PVC name is **ocs-deviceset-0-0-nvs68**.

b. Identify the PV associated with the PVC.

```
# oc get -n openshift-storage pvc ocs-deviceset-<x>-<y>-<pvc-suffix>
```

where, **x**, **y**, and **pvc-suffix** are the values in the **DeviceSet** identified in the previous step.

Example output:

```
NAME                    STATUS      VOLUME         CAPACITY   ACCESS MODES
STORAGECLASS   AGE
ocs-deviceset-0-0-nvs68   Bound   local-pv-d9c5cbd6   1490Gi     RWO          localblock
```

```
24h
```

In this example, the associated PV is **local-pv-d9c5cbd6**.

c. Delete the PVC.

```
oc delete pvc <pvc-name> -n openshift-storage
```

d. Delete the PV.

```
# oc delete pv local-pv-d9c5cbd6
```

Example output:

```
persistentvolume "local-pv-d9c5cbd6" deleted
```

17. Remove the failed OSD from the cluster.

```
# oc process -n openshift-storage ocs-osd-removal -p
FAILED_OSD_ID=${osd_id_to_remove} | oc create -f -
```

18. Verify that the OSD is removed successfully by checking the status of the **ocs-osd-removal** pod. A status of **Completed** confirms that the OSD removal job succeeded.

```
# oc get pod -l job-name=ocs-osd-removal-${osd_id_to_remove} -n openshift-storage
```

NOTE

If ocs-osd-removal fails and the pod is not in the expected Completed state, check the pod logs for further debugging. For example:

```
# oc logs -l job-name=ocs-osd-removal-${osd_id_to_remove} -n openshift-
storage --tail=-1
```

19. Delete OSD pod deployment and crashcollector pod deployment.

```
$ oc delete deployment rook-ceph-osd-${osd_id_to_remove} -n openshift-storage
$ oc delete deployment --selector=app=rook-ceph-crashcollector,node_name=
<old_node_name> -n openshift-storage
```

20. Deploy the new OSD by restarting the **rook-ceph-operator** to force operator reconciliation.

```
# oc get -n openshift-storage pod -l app=rook-ceph-operator
```

Example output:

```
NAME                                READY   STATUS    RESTARTS   AGE
rook-ceph-operator-6f74fb5bff-2d982   1/1     Running   0          1d20h
```

a. Delete the **rook-ceph-operator**.

```
# oc delete -n openshift-storage pod rook-ceph-operator-6f74fb5bff-2d982
```

Example output:

```
pod "rook-ceph-operator-6f74fb5bff-2d982" deleted
```

b. Verify that the **rook-ceph-operator** pod is restarted.

```
# oc get -n openshift-storage pod -l app=rook-ceph-operator
```

Example output:

```
NAME                                  READY   STATUS    RESTARTS   AGE
rook-ceph-operator-6f74fb5bff-7mvrq   1/1     Running   0          66s
```

Creation of the new OSD and **mon** might take several minutes after the operator restarts.

21. Delete the`ocs-osd-removal` job.

```
# oc delete job ocs-osd-removal-${osd_id_to_remove}
```

Example output:

```
job.batch "ocs-osd-removal-0" deleted
```

Verification steps

1. Execute the following command and verify that the new node is present in the output:

```
$ oc get nodes --show-labels | grep cluster.ocs.openshift.io/openshift-storage= |cut -d' ' -f1
```

2. Click **Workloads → Pods**, confirm that at least the following pods on the new node are in **Running** state:

- **csi-cephfsplugin-***
- **csi-rbdplugin-***

3. Verify that all other required OpenShift Container Storage pods are in Running state.
   Ensure that the new incremental **mon** is created and is in the Running state.

```
$ oc get pod -n openshift-storage | grep mon
```

Example output:

```
rook-ceph-mon-c-64556f7659-c2ngc         1/1     Running     0          6h14m
rook-ceph-mon-d-7c8b74dc4d-tt6hd         1/1     Running     0          4h24m
rook-ceph-mon-e-57fb8c657-wg5f2          1/1     Running     0          162m
```

OSD and Mon might take several minutes to get to the **Running** state.

4. If verification steps fail, contact Red Hat Support.

CHAPTER 10. REPLACING A STORAGE DEVICE

Depending on the type of your deployment, you can choose one of the following procedures to replace a storage device:

- For dynamically created storage clusters deployed on AWS, see:
  - Section 10.1.1, “Replacing operational or failed storage devices on AWS user-provisioned infrastructure”
  - Section 10.1.2, “Replacing operational or failed storage devices on AWS installer-provisioned infrastructure”
- For dynamically created storage clusters deployed on VMware, see Section 10.2.1, “Replacing operational or failed storage devices on VMware user-provisioned infrastructure”
- For storage clusters deployed using local storage devices, see:
  - Section 10.3.1, “Replacing failed storage devices on Amazon EC2 infrastructure”
  - Section 10.3.2, “Replacing operational or failed storage devices on VMware and bare metal infrastructures”

10.1. DYNAMICALLY PROVISIONED OPENSHIFT CONTAINER STORAGE DEPLOYED ON AWS

10.1.1. Replacing operational or failed storage devices on AWS user-provisioned infrastructure

When you need to replace a device in a dynamically created storage cluster on an AWS user-provisioned infrastructure, you must replace the storage node. For information about how to replace nodes, see:

- Replacing an operational AWS node on user-provisioned infrastructure
- Replacing a failed AWS node on user-provisioned infrastructure

10.1.2. Replacing operational or failed storage devices on AWS installer-provisioned infrastructure

When you need to replace a device in a dynamically created storage cluster on an AWS installer-provisioned infrastructure, you must replace the storage node. For information about how to replace nodes, see:

- Replacing an operational AWS node on installer-provisioned infrastructure
- Replacing a failed AWS node on installer-provisioned infrastructure

10.2. DYNAMICALLY PROVISIONED OPENSHIFT CONTAINER STORAGE DEPLOYED ON VMWARE

10.2.1. Replacing operational or failed storage devices on VMware user-provisioned infrastructure

Use this procedure when a virtual machine disk (VMDK) needs to be replaced in OpenShift Container Storage which is deployed dynamically on VMware infrastructure. This procedure helps to create a new Persistent Volume Claim (PVC) on a new volume and remove the old object storage device (OSD).

Procedure

1. Identify the OSD that needs to be replaced.

```
# oc get -n openshift-storage pods -l app=rook-ceph-osd -o wide
```

Example output:

```
rook-ceph-osd-0-6d77d6c7c6-m8xj6   0/1   CrashLoopBackOff   0   24h   10.129.0.16
compute-2   <none>           <none>
rook-ceph-osd-1-85d99fb95f-2svc7   1/1   Running   0   24h   10.128.2.24   compute-0
<none>           <none>
rook-ceph-osd-2-6c66cdb977-jp542   1/1   Running   0   24h   10.131.2.32   compute-1
<none>           <none>
```

In this example, **rook-ceph-osd-0-6d77d6c7c6-m8xj6** needs to be replaced.

NOTE

If the OSD to be replaced is healthy, the status of the pod will be Running.

2. Scale down the OSD deployment for the OSD to be replaced

```
# osd_id_to_remove=0
# oc scale -n openshift-storage deployment rook-ceph-osd-${osd_id_to_remove} --replicas=0
```

where, **osd_id_to_remove** is the integer in the pod name immediately after the **rook-ceph-osd** prefix. In this example, the deployment name is **rook-ceph-osd-0**.

Example output:

```
deployment.extensions/rook-ceph-osd-0 scaled
```

3. Verify that the **rook-ceph-osd** pod is terminated.

```
# oc get -n openshift-storage pods -l ceph-osd-id=${osd_id_to_remove}
```

Example output:

```
No resources found.
```

NOTE

If the **rook-ceph-osd** pod is in **terminating** state, use the **force** option to delete the pod.

```
# oc delete pod rook-ceph-osd-0-6d77d6c7c6-m8xj6 --force --grace-period=0
```

Example output:

```
warning: Immediate deletion does not wait for confirmation that the running resource has been terminated. The resource may continue to run on the cluster indefinitely.
  pod "rook-ceph-osd-0-6d77d6c7c6-m8xj6" force deleted
```

4. Remove the old OSD from the cluster so that a new OSD can be added.

```
# oc process -n openshift-storage ocs-osd-removal -p FAILED_OSD_ID=${osd_id_to_remove} | oc create -f -
```

WARNING

This step results in OSD being completely removed from the cluster. Make sure that the correct value of **osd_id_to_remove** is provided.

5. Verify that the OSD is removed successfully by checking the status of the **ocs-osd-removal** pod. A status of **Completed** confirms that the OSD removal job succeeded.

```
# oc get pod -l job-name=ocs-osd-removal-${osd_id_to_remove} -n openshift-storage
```

NOTE

If **ocs-osd-removal** fails and the pod is not in the expected **Completed** state, check the pod logs for further debugging. For example:

```
# oc logs -l job-name=ocs-osd-removal-${osd_id_to_remove} -n openshift-storage --tail=-1
```

6. Delete the PVC resources associated with the OSD to be replaced.

   a. Identify the **DeviceSet** associated with the OSD to be replaced.

   ```
   # oc get -n openshift-storage -o yaml deployment rook-ceph-osd-${osd_id_to_remove} | grep ceph.rook.io/pvc
   ```

   Example output:

```
ceph.rook.io/pvc: ocs-deviceset-0-0-nvs68
   ceph.rook.io/pvc: ocs-deviceset-0-0-nvs68
```

In this example, the PVC name is **ocs-deviceset-0-0-nvs68**.

b. Identify the PV associated with the PVC.

```
# oc get -n openshift-storage pvc ocs-deviceset-<x>-<y>-<pvc-suffix>
```

where, **x**, **y**, and **pvc-suffix** are the values in the **DeviceSet** identified in the previous step.

Example output:

```
NAME                    STATUS   VOLUME                                     CAPACITY   ACCESS
MODES   STORAGECLASS   AGE
ocs-deviceset-0-0-nvs68   Bound    pvc-0e621d45-7d18-4d35-a282-9700c3cc8524
512Gi      RWO            thin           24h
```

In this example, the PVC is **ocs-deviceset-0-0-nvs68** that is identified in the previous step and associated PV is **pvc-0e621d45-7d18-4d35-a282-9700c3cc8524**.

c. Identify the **prepare-pod** associated with the OSD to be replaced. Use the PVC name obtained in an earlier step.

```
# oc describe -n openshift-storage pvc ocs-deviceset-<x>-<y>-<pvc-suffix> | grep
Mounted
```

where, **x**, **y**, and **pvc-suffix** are the values in the **DeviceSet** identified in an earlier step.

Example output:

```
Mounted By:    rook-ceph-osd-prepare-ocs-deviceset-0-0-nvs68-zblp7
```

d. Delete the **osd-prepare** pod before removing the associated PVC.

```
# oc delete -n openshift-storage pod rook-ceph-osd-prepare-ocs-deviceset-<x>-<y>-
<pvc-suffix>-<pod-suffix>
```

where, **x**, **y**, **pvc-suffix**, and **pod-suffix** are the values in the **osd-prepare** pod name identified in the previous step.

Example output:

```
pod "rook-ceph-osd-prepare-ocs-deviceset-0-0-nvs68-zblp7" deleted
```

e. Delete the PVC associated with the device.

```
# oc delete -n openshift-storage pvc ocs-deviceset-<x>-<y>-<pvc-suffix>
```

where, **x**, **y**, and **pvc-suffix** are the values in the **DeviceSet** identified in an earlier step.

Example output:

```
persistentvolumeclaim "ocs-deviceset-0-0-nvs68" deleted
```

7. Create new OSD for new device.

   a. Delete the deployment for the OSD to be replaced.

   ```
   # oc delete -n openshift-storage deployment rook-ceph-osd-${osd_id_to_remove}
   ```

   Example output:

   ```
   deployment.extensions/rook-ceph-osd-0 deleted
   ```

   b. Verify that the PV for the device identified in an earlier step is deleted.

   ```
   # oc get -n openshift-storage pv pvc-0e621d45-7d18-4d35-a282-9700c3cc8524
   ```

   Example output:

   ```
   Error from server (NotFound): persistentvolumes "pvc-0e621d45-7d18-4d35-a282-
   9700c3cc8524" not found
   ```

   In this example, the PV name is **pvc-0e621d45-7d18-4d35-a282-9700c3cc8524**.

   - If the PV still exists, delete the PV associated with the device.

     ```
     # oc delete pv pvc-0e621d45-7d18-4d35-a282-9700c3cc8524
     ```

     Example output:

     ```
     persistentvolume "pvc-0e621d45-7d18-4d35-a282-9700c3cc8524" deleted
     ```

     In this example, the PV name is **pvc-0e621d45-7d18-4d35-a282-9700c3cc8524**.

   c. Deploy the new OSD by restarting the **rook-ceph-operator** to force operator reconciliation.

      i. Identify the name of the **rook-ceph-operator**.

      ```
      # oc get -n openshift-storage pod -l app=rook-ceph-operator
      ```

      Example output:

      ```
      NAME                                  READY   STATUS    RESTARTS   AGE
      rook-ceph-operator-6f74fb5bff-2d982   1/1     Running   0          1d20h
      ```

      ii. Delete the **rook-ceph-operator**.

      ```
      # oc delete -n openshift-storage pod rook-ceph-operator-6f74fb5bff-2d982
      ```

      Example output:

      ```
      pod "rook-ceph-operator-6f74fb5bff-2d982" deleted
      ```

In this example, the rook-ceph-operator pod name is **rook-ceph-operator-6f74fb5bff-2d982**.

iii. Verify that the **rook-ceph-operator** pod is restarted.

```
# oc get -n openshift-storage pod -l app=rook-ceph-operator
```

Example output:

```
NAME                                  READY   STATUS    RESTARTS   AGE
rook-ceph-operator-6f74fb5bff-7mvrq   1/1     Running   0          66s
```

Creation of the new OSD may take several minutes after the operator restarts.

8. Delete the **ocs-osd-removal** job.

```
# oc delete job ocs-osd-removal-${osd_id_to_remove}
```

Example output:

```
job.batch "ocs-osd-removal-0" deleted
```

Verfication steps

- Verify that there is a new OSD running and a new PVC created.

```
# oc get -n openshift-storage pods -l app=rook-ceph-osd
```

Example output:

```
rook-ceph-osd-0-5f7f4747d4-snshw                    1/1     Running     0          4m47s
rook-ceph-osd-1-85d99fb95f-2svc7                    1/1     Running     0          1d20h
rook-ceph-osd-2-6c66cdb977-jp542                    1/1     Running     0          1d20h
```

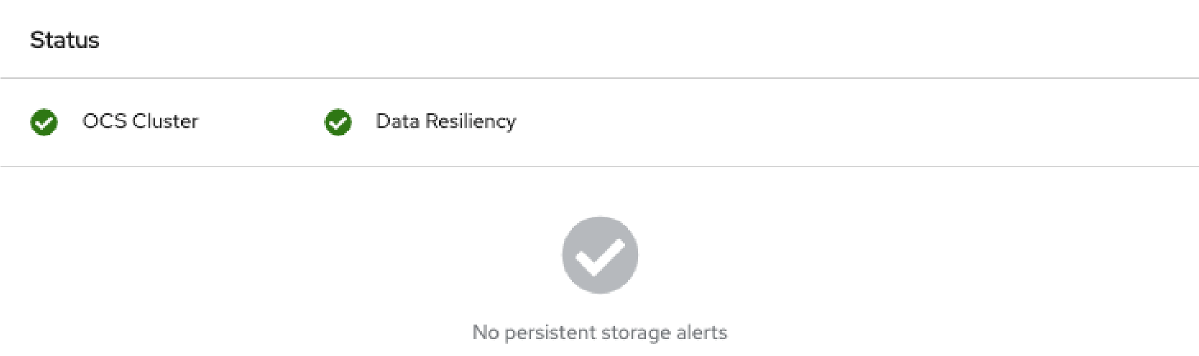
```
# oc get -n openshift-storage pvc
```

Example output:

```
NAME                      STATUS   VOLUME                                     CAPACITY   ACCESS
MODES   STORAGECLASS   AGE
ocs-deviceset-0-0-2s6w4   Bound    pvc-7c9bcaf7-de68-40e1-95f9-0b0d7c0ae2fc   512Gi
RWO            thin           5m
ocs-deviceset-1-0-q8fwh   Bound    pvc-9e7e00cb-6b33-402e-9dc5-b8df4fd9010f   512Gi
RWO            thin           1d20h
ocs-deviceset-2-0-9v8lq   Bound    pvc-38cdfcee-ea7e-42a5-a6e1-aaa6d4924291   512Gi
RWO            thin           1d20h
```

- Log in to OpenShift Web Console and view the storage dashboard.

Figure 10.1. OSD status in OpenShift Container Platform storage dashboard after device replacement



10.3. OPENSHIFT CONTAINER STORAGE DEPLOYED USING LOCAL STORAGE DEVICES

10.3.1. Replacing failed storage devices on Amazon EC2 infrastructure

When you need to replace a storage device on an Amazon EC2 (storage-optimized I3) infrastructure, you must replace the storage node. For information about how to replace nodes, see Replacing failed storage nodes on Amazon EC2 infrastructure.

10.3.2. Replacing operational or failed storage devices on VMware and bare metal infrastructures

You can replace an object storage device (OSD) in OpenShift Container Storage deployed using local storage devices on bare metal and VMware infrastructures. Use this procedure when an underlying storage device needs to be replaced.

Procedure

1. Identify the OSD that needs to be replaced and the OpenShift Container Platform node that has the OSD scheduled on it.

```
# oc get -n openshift-storage pods -l app=rook-ceph-osd -o wide
```

Example output:

```
rook-ceph-osd-0-6d77d6c7c6-m8xj6   0/1   CrashLoopBackOff   0   24h   10.129.0.16
compute-2   <none>           <none>
rook-ceph-osd-1-85d99fb95f-2svc7   1/1   Running   0   24h   10.128.2.24   compute-0
<none>           <none>
rook-ceph-osd-2-6c66cdb977-jp542   1/1   Running   0   24h   10.130.0.18   compute-1
<none>           <none>
```

In this example, **rook-ceph-osd-0-6d77d6c7c6-m8xj6** needs to be replaced and **compute-2** is the OCP node on which the OSD is scheduled.

> **NOTE**
>
> If the OSD to be replaced is healthy, the status of the pod will be **Running**.

2. Scale down the OSD deployment for the OSD to be replaced.

```
# osd_id_to_remove=0
# oc scale -n openshift-storage deployment rook-ceph-osd-${osd_id_to_remove} --replicas=0
```

where **osd_id_to_remove** is the integer in the pod name immediately after the **rook-ceph-osd** prefix. In this example, the deployment name is **rook-ceph-osd-0**.

Example output:

```
deployment.extensions/rook-ceph-osd-0 scaled
```

3. Verify that the **rook-ceph-osd** pod is terminated.

```
# oc get -n openshift-storage pods -l ceph-osd-id=${osd_id_to_remove}
```

Example output:

```
No resources found in openshift-storage namespace.
```

> **NOTE**
>
> If the **rook-ceph-osd** pod is in **terminating** state, use the **force** option to delete the pod.
>
> ```
> # oc delete pod rook-ceph-osd-0-6d77d6c7c6-m8xj6 --grace-period=0 --force
> ```
>
> Example output:
>
> ```
> warning: Immediate deletion does not wait for confirmation that the running resource has been terminated. The resource may continue to run on the cluster indefinitely.
>   pod "rook-ceph-osd-0-6d77d6c7c6-m8xj6" force deleted
> ```

4. Remove the old OSD from the cluster so that a new OSD can be added.

   a. Delete any old **ocs-osd-removal** jobs.

   ```
   # oc delete job ocs-osd-removal-${osd_id_to_remove}
   ```

   Example output:

   ```
   job.batch "ocs-osd-removal-0" deleted
   ```

   b. Remove the old OSD from the cluster

   ```
   # oc process -n openshift-storage ocs-osd-removal -p
   FAILED_OSD_ID=${osd_id_to_remove} | oc create -f -
   ```

> **WARNING**
>
> This step results in OSD being completely removed from the cluster. Make sure that the correct value of **osd_id_to_remove** is provided.

5. Verify that the OSD is removed successfully by checking the status of the **ocs-osd-removal** pod. A status of **Completed** confirms that the OSD removal job succeeded.

```
# oc get pod -l job-name=ocs-osd-removal-${osd_id_to_remove} -n openshift-storage
```

> **NOTE**
>
> If **ocs-osd-removal** fails and the pod is not in the expected **Completed** state, check the pod logs for further debugging. For example:
>
> ```
> # oc logs -l job-name=ocs-osd-removal-${osd_id_to_remove} -n openshift-storage --tail=-1
> ```

6. Delete the Persistent Volume Claim (PVC) resources associated with the OSD to be replaced.

   a. Identify the **DeviceSet** associated with the OSD to be replaced.

   ```
   # oc get -n openshift-storage -o yaml deployment rook-ceph-osd-${osd_id_to_remove} | grep ceph.rook.io/pvc
   ```

   Example output:

   ```
   ceph.rook.io/pvc: ocs-deviceset-0-0-nvs68
      ceph.rook.io/pvc: ocs-deviceset-0-0-nvs68
   ```

   In this example, the PVC name is **ocs-deviceset-0-0-nvs68**.

   b. Identify the PV associated with the PVC.

   ```
   # oc get -n openshift-storage pvc ocs-deviceset-<x>-<y>-<pvc-suffix>
   ```

   where, **x**, **y**, and **pvc-suffix** are the values in the **DeviceSet** identified in an earlier step.

   Example output:

   ```
   NAME                    STATUS   VOLUME              CAPACITY   ACCESS MODES   STORAGECLASS   AGE
   ocs-deviceset-0-0-nvs68 Bound    local-pv-d9c5cbd6   1490Gi     RWO            localblock     24h
   ```

   In this example, the associated PV is **local-pv-d9c5cbd6**.

   c. Identify the name of the device to be replaced.

```
# oc get pv local-pv-<pv-suffix> -o yaml | grep path
```

where, **pv-suffix** is the value in the PV name identified in an earlier step.

Example output:

```
path: /mnt/local-storage/localblock/nvme0n1
```

In this example, the device name is **nvme0n1**.

d. Identify the **prepare-pod** associated with the OSD to be replaced.

```
# oc describe -n openshift-storage pvc ocs-deviceset-<x>-<y>-<pvc-suffix> | grep
Mounted
```

where, **x**, **y**, and **pvc-suffix** are the values in the **DeviceSet** identified in an earlier step.

Example output:

```
Mounted By:    rook-ceph-osd-prepare-ocs-deviceset-0-0-nvs68-zblp7
```

In this example the **prepare-pod** name is **rook-ceph-osd-prepare-ocs-deviceset-0-0-nvs68-zblp7**.

e. Delete the **osd-prepare** pod before removing the associated PVC.

```
# oc delete -n openshift-storage pod rook-ceph-osd-prepare-ocs-deviceset-<x>-<y>-
<pvc-suffix>-<pod-suffix>
```

where, **x**, **y**, **pvc-suffix**, and **pod-suffix** are the values in the **osd-prepare** pod name identified in an earlier step.

Example output:

```
pod "rook-ceph-osd-prepare-ocs-deviceset-0-0-nvs68-zblp7" deleted
```

f. Delete the PVC associated with the OSD to be replaced.

```
# oc delete -n openshift-storage pvc ocs-deviceset-<x>-<y>-<pvc-suffix>
```

where, **x**, **y**, and **pvc-suffix** are the values in the **DeviceSet** identified in an earlier step.

Example output:

```
persistentvolumeclaim "ocs-deviceset-0-0-nvs68" deleted
```

7. Replace the old device and use the new device to create a new OpenShift Container Platform PV.

a. Log in to OpenShift Container Platform node with the device to be replaced. In this example, the OpenShift Container Platform node is **compute-2**.

```
# oc debug node/compute-2
```

Example output:

```
Starting pod/compute-2-debug ...
To use host binaries, run `chroot /host`
Pod IP: 10.70.56.66
If you don't see a command prompt, try pressing enter.
# chroot /host
```

b. Record the **/dev/disk/by-id/{id}** that is to be replaced using the device name, **nvme0n1**, identified earlier.

```
# ls -alh /mnt/local-storage/localblock
```

Example output:

```
total 0
drwxr-xr-x. 2 root root 51 Aug 18 19:05 .
drwxr-xr-x. 3 root root 24 Aug 18 19:05 ..
lrwxrwxrwx. 1 root root 57 Aug 18 19:05 nvme0n1 -> /dev/disk/by-id/nvme-
eui.01000000010000005cd2e4de2f0f5251
```

c. Find the name of the **LocalVolume** CR, and remove or comment out the device **/dev/disk/by-id/{id}** that is to be replaced.

```
# oc get -n local-storage localvolume
NAME          AGE
local-block   25h
```

```
# oc edit -n local-storage localvolume local-block
```

Example output:

```
[...]
    storageClassDevices:
    - devicePaths:
      - /dev/disk/by-id/nvme-eui.01000000010000005cd2e4895e0e5251
      - /dev/disk/by-id/nvme-eui.01000000010000005cd2e4ea2f0f5251
  #   - /dev/disk/by-id/nvme-eui.01000000010000005cd2e4de2f0f5251
      storageClassName: localblock
      volumeMode: Block
[...]
```

Make sure to save the changes after editing the CR.

8. Log in to OpenShift Container Platform node with the device to be replaced and remove the old **symlink**.

```
# oc debug node/compute-2
```

Example output:

```
Starting pod/compute-2-debug ...
To use host binaries, run `chroot /host`
```

```
Pod IP: 10.70.56.66
If you don't see a command prompt, try pressing enter.
# chroot /host
```

a. Identify the old **symlink** for the device name to be replaced. In this example, the device name is **nvme0n1**.

```
# ls -alh /mnt/local-storage/localblock
```

Example output:

```
total 0
drwxr-xr-x. 2 root root 51 Aug 18 19:05 .
drwxr-xr-x. 3 root root 24 Aug 18 19:05 ..
lrwxrwxrwx. 1 root root 57 Aug 18 19:05 nvme0n1 -> /dev/disk/by-id/nvme-
eui.01000000010000005cd2e4de2f0f5251
```

b. Remove the **symlink**.

```
# rm /mnt/local-storage/localblock/nvme0n1
```

c. Verify that the **symlink** is removed.

```
# ls -alh /mnt/local-storage/localblock
```

Example output:

```
total 0
drwxr-xr-x. 2 root root 17 Apr 10 00:56 .
drwxr-xr-x. 3 root root 24 Apr  8 23:03 ..
```

IMPORTANT

For new deployments of OpenShift Container Storage 4.5 or later, LVM is not in use, **ceph-volume** raw mode is in play instead. Therefore, additional validation is not needed and you can proceed to the next step.

For OpenShift Container Storage 4.4, or if OpenShift Container Storage has been upgraded to version 4.5 from a prior version, then both **/dev/mapper** and **/dev/** should be checked to see if there are orphans related to **ceph** before moving on. Use the results of **vgdisplay** to find these orphans. If there is anything in **/dev/mapper** or **/dev/ceph-*** with **ceph** in the name that is not from the list of VG Names, use **dmsetup** to remove it.

9. Delete the PV associated with the device to be replaced, which was identified in earlier steps. In this example, the PV name is **local-pv-d9c5cbd6**.

```
# oc delete pv local-pv-d9c5cbd6
```

Example output:

```
persistentvolume "local-pv-d9c5cbd6" deleted
```

10. Replace the device with the new device.

11. Log back into the correct OpenShift Container Platform node and identify the device name for the new drive. The device name can be the same as the old device, but the **by-id** must change unless you are reseating the same device.

```
# lsblk
```

Example output:

```
NAME                          MAJ:MIN RM   SIZE RO TYPE MOUNTPOINT
sda                             8:0    0   120G  0 disk
|-sda1                          8:1    0   384M  0 part /boot
|-sda2                          8:2    0   127M  0 part /boot/efi
|-sda3                          8:3    0     1M  0 part
`-sda4                          8:4    0 119.5G  0 part
  `-coreos-luks-root-nocrypt 253:0    0 119.5G  0 dm   /sysroot
nvme0n1                       259:0    0   1.5T  0 disk
```

In this example, the new device name is **nvme0n1**.

a. Identify the **/dev/disk/by-id/{id}** for the new device and record it.

```
# ls -alh /dev/disk/by-id | grep nvme0n1
```

Example output:

```
lrwxrwxrwx. 1 root root 57 Aug 18 19:05 nvme0n1 -> /dev/disk/by-id/nvme-
eui.01000000010000005cd2e4ce090e5251
```

12. After the new **/dev/disk/by-id/{id}** is available a new disk entry can be added to the **LocalVolume** CR.

a. Find the name of the **LocalVolume** CR.

```
# oc get -n local-storage localvolume
NAME          AGE
local-block   25h
```

b. Edit **LocalVolume** CR and add the new **/dev/disk/by-id/{id}**. In this example the new device is **/dev/disk/by-id/nvme-eui.01000000010000005cd2e4ce090e5251**.

```
# oc edit -n local-storage localvolume local-block
```

Example output:

```
[...]
    storageClassDevices:
    - devicePaths:
      - /dev/disk/by-id/nvme-eui.01000000010000005cd2e4895e0e5251
      - /dev/disk/by-id/nvme-eui.01000000010000005cd2e4ea2f0f5251
  #   - /dev/disk/by-id/nvme-eui.01000000010000005cd2e4de2f0f5251
      - /dev/disk/by-id/nvme-eui.01000000010000005cd2e4ce090e5251
```

```
    storageClassName: localblock
    volumeMode: Block
[...]
```

Make sure to save the changes after editing the CR.

13. Verify that there is a new PV in **Available** state and of the correct size.

```
# oc get pv | grep 1490Gi
```

Example output:

```
local-pv-3e8964d3                  1490Gi     RWO          Delete          Bound       openshift-
storage/ocs-deviceset-2-0-79j94   localblock                        25h
local-pv-414755e0                  1490Gi     RWO          Delete          Bound       openshift-
storage/ocs-deviceset-1-0-959rp   localblock                        25h
local-pv-b481410                  1490Gi     RWO          Delete          Available
```

14. Create new OSD for new device.

a. Delete the deployment for the OSD to be replaced.

```
# osd_id_to_remove=0
# oc delete -n openshift-storage deployment rook-ceph-osd-${osd_id_to_remove}
```

Example output:

```
deployment.extensions/rook-ceph-osd-0 deleted
```

b. Deploy the new OSD by restarting the **rook-ceph-operator** to force operator reconciliation.

i. Identify the name of the **rook-ceph-operator**.

```
# oc get -n openshift-storage pod -l app=rook-ceph-operator
```

Example output:

```
NAME                                  READY   STATUS    RESTARTS   AGE
rook-ceph-operator-6f74fb5bff-2d982   1/1     Running   0          1d20h
```

ii. Delete the **rook-ceph-operator**.

```
# oc delete -n openshift-storage pod rook-ceph-operator-6f74fb5bff-2d982
```

Example output:

```
pod "rook-ceph-operator-6f74fb5bff-2d982" deleted
```

In this example, the rook-ceph-operator pod name is **rook-ceph-operator-6f74fb5bff-2d982**.

iii. Verify that the **rook-ceph-operator** pod is restarted.

```
# oc get -n openshift-storage pod -l app=rook-ceph-operator
```

Example output:

```
NAME                                  READY   STATUS    RESTARTS   AGE
rook-ceph-operator-6f74fb5bff-7mvrq   1/1     Running   0          66s
```

Creation of the new OSD may take several minutes after the operator restarts.

Verfication steps

- Verify that there is a new OSD running and a new PVC created.

```
# oc get -n openshift-storage pods -l app=rook-ceph-osd
```

Example output:

```
rook-ceph-osd-0-5f7f4747d4-snshw                 1/1     Running     0          4m47s
rook-ceph-osd-1-85d99fb95f-2svc7                 1/1     Running     0          1d20h
rook-ceph-osd-2-6c66cdb977-jp542                 1/1     Running     0          1d20h
```

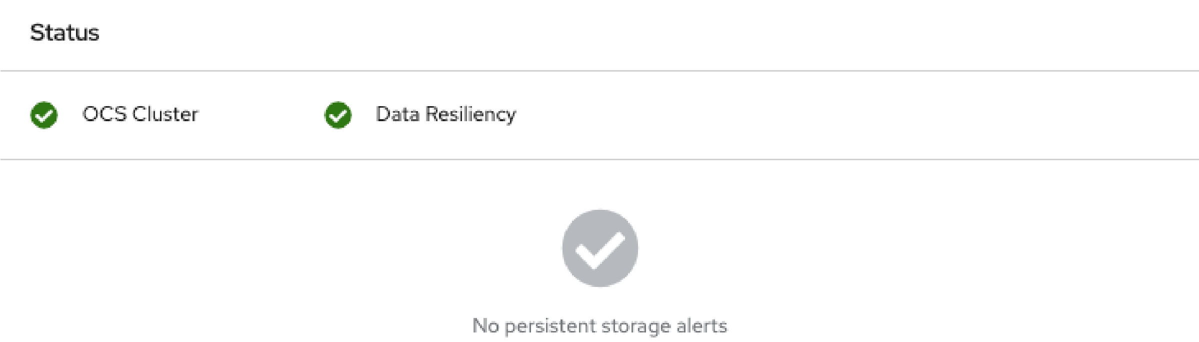
```
# oc get -n openshift-storage pvc | grep localblock
```

Example output:

```
ocs-deviceset-0-0-c2mqb   Bound    local-pv-b481410                      1490Gi     RWO
localblock                5m
ocs-deviceset-1-0-959rp   Bound    local-pv-414755e0                     1490Gi     RWO
localblock                1d20h
ocs-deviceset-2-0-79j94   Bound    local-pv-3e8964d3                     1490Gi     RWO
localblock                1d20h
```

- Log in to OpenShift Web Console and view the storage dashboard.

Figure 10.2. OSD status in OpenShift Container Platform storage dashboard after device replacement



CHAPTER 11. UPDATING OPENSHIFT CONTAINER STORAGE

To update your cluster, you must first update Red Hat OpenShift Container Platform, and then, update Red Hat OpenShift Container Storage. It is recommended to use the same version of Red Hat OpenShift Container Platform with Red Hat OpenShift Container Storage. Refer to this Red Hat Knowledgebase article for a complete OpenShift Container Platform and OpenShift Container Storage supportability and compatibility matrix.

For updating Local Storage Operator:

- The 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 updated when Red Hat OpenShift Container Platform is updated. To check if your OpenShift Container Storage cluster uses the Local Storage Operator, see the Checking for Local Storage Operator deployments section of the Troubleshooting Guide.

You can update OpenShift Container Storage in:

- Internal mode
- External mode
- Disconnected environment

> **NOTE**
>
> The update procedure is the same for proxy environment.

11.1. UPDATING OPENSHIFT CONTAINER STORAGE IN INTERNAL MODE

Use the following procedures to update your OpenShift Container Storage cluster deployed in internal mode.

11.1.1. Enabling automatic updates for OpenShift Container Storage operator in internal mode

Use this procedure to enable automatic update approval for updating OpenShift Container Storage operator in OpenShift Container Platform.

Prerequisites

- Under **Persistent Storage** in **Status** card, confirm that the **OCS cluster** is healthy and data is resilient.
- Update the OpenShift Container Platform cluster to the latest stable release of version 4.4.X or 4.5.Y, see Updating Clusters.
- Switch the Red Hat OpenShift Container Storage channel from **stable-4.4** to **stable-4.5**. For details about channels, see OpenShift Container Platform upgrade channels and releases.

> **NOTE**
>
> You are required to switch channels only when you are updating minor versions (for example, updating from 4.4 to 4.5) and not when updating between batch updates of 4.5 (for example, updating from 4.5.0 to 4.5.1).

- Ensure that all OpenShift Container Storage Pods, including the operator pods, are in **Running** state in the **openshift-storage namespace**.
  To view the state of the pods, click **Workloads → Pods** from the left pane of the OpenShift Web Console. Select **openshift-storage** from the **Project** drop down list.
- Ensure that you have sufficient time to complete the Openshift Container Storage (OCS) update process, as the update time varies depending on the number of OSDs that run in the cluster.

Procedure

1. Log in to OpenShift Web Console.
2. Click **Operators → Installed Operators**
3. Select the **openshift-storage** project.
4. Click on the OpenShift Container Storage operator name.
5. Click **Subscription** tab and click the link under **Approval**.
6. Select **Automatic (default)** and click **Save**.
7. Perform one of the following depending on the **Upgrade Status**:
   - **Upgrade Status** *shows* **requires approval**.

     > **NOTE**
     >
     > **Upgrade status** shows **requires approval** if the new OpenShift Container Storage version is already detected in the channel, and approval strategy was changed from **Manual** to **Automatic** at the time of update.

     a. Click on the **Install Plan** link.
     b. On the **InstallPlan Details** page, click **Preview Install Plan**.
     c. Review the install plan and click **Approve**.
     d. Wait for the **Status** to change from **Unknown** to **Created**.
     e. Click **Operators → Installed Operators**
     f. Select the **openshift-storage** project.
     g. Wait for the **Status** to change to **Up to date**
   - **Upgrade Status** *does not show* **requires approval**:

     a. Wait for the update to initiate. This may take up to 20 minutes.

b. Click **Operators → Installed Operators**

c. Select the **openshift-storage** project.

d. Wait for the **Status** to change to **Up to date**

Verification steps

1. Click **Overview → Persistent Storage** tab and in **Status** card confirm that the **OCS cluster** has a green tick mark indicating it is healthy.

2. Click **Operators → Installed Operators → OpenShift Container Storage Operator**. Under **Storage Cluster**, verify that the cluster service status is **Ready**.

> **NOTE**
>
> Once updated from OpenShift Container Storage version 4.4 to 4.5, the **Version** field here will still display 4.4. This is because the **ocs-operator** does not update the string represented in this field.

3. Ensure that all OpenShift Container Storage Pods, including the operator pods, are in **Running** state in the **openshift-storage namespace**.
   To view the state of the pods, click **Workloads → Pods** from the left pane of the OpenShift Web Console. Select **openshift-storage** from the **Project** drop down list.

4. If verification steps fail, kindly contact Red Hat Support .

Additional Resources

If you face any issues while updating OpenShift Container Storage, see the *Commonly required logs for troubleshooting* section in the Troubleshooting guide.

11.1.2. Manually updating OpenShift Container Storage operator in internal mode

Use this procedure to update OpenShift Container Storage operator by providing manual approval to the install plan.

Prerequisites

- Under **Persistent Storage** in **Status** card, confirm that the **OCS cluster** is healthy and data is resilient.

- Update the OpenShift Container Platform cluster to the latest stable release of version 4.4.X or 4.5.Y, see Updating Clusters.

- Switch the Red Hat OpenShift Container Storage channel channel from **stable-4.4** to **stable-4.5**. For details about channels, see OpenShift Container Platform upgrade channels and releases.

> **NOTE**
>
> You are required to switch channels only when you are updating minor versions (for example, updating from 4.4 to 4.5) and not when updating between batch updates of 4.5 (for example, updating from 4.5.0 to 4.5.1).

- Ensure that all OpenShift Container Storage Pods, including the operator pods, are in **Running** state in the **openshift-storage namespace**.
  To view the state of the pods, click **Workloads → Pods** from the left pane of the OpenShift Web Console. Select **openshift-storage** from the **Project** drop down list.

- Ensure that you have sufficient time to complete the Openshift Container Storage (OCS) update process, as the update time varies depending on the number of OSDs that run in the cluster.

Procedure

1. Log in to OpenShift Web Console.
2. Click **Operators → Installed Operators**
3. Select the **openshift-storage** project.
4. Click on the OpenShift Container Storage operator name.
5. Click **Subscription** tab and click the link under **Approval**.
6. Select **Manual** and click **Save**.
7. Wait for the **Upgrade Status** to change to **Upgrading**.
8. If the **Upgrade Status** shows **requires approval**, click on **requires approval**.
9. On the **InstallPlan Details** page, click **Preview Install Plan**.
10. Review the install plan and click **Approve**.
11. Wait for the **Status** to change from **Unknown** to **Created**.
12. Click **Operators → Installed Operators**
13. Select the **openshift-storage** project.
14. Wait for the **Status** to change to **Up to date**

Verification steps

1. Click **Overview → Persistent Storage** tab and in **Status** card confirm that the **OCS cluster** has a green tick mark indicating it is healthy.
2. Click **Operators → Installed Operators → OpenShift Container Storage Operator**. Under **Storage Cluster**, verify that the cluster service status is **Ready**.

   > **NOTE**
   >
   > Once updated from OpenShift Container Storage version 4.4 to 4.5, the **Version** field here will still display 4.4. This is because the **ocs-operator** does not update the string represented in this field.

3. Ensure that all OpenShift Container Storage Pods, including the operator pods, are in **Running** state in the **openshift-storage namespace**.

To view the state of the pods, click **Workloads → Pods** from the left pane of the OpenShift Web Console. Select **openshift-storage** from the **Project** drop down list.

4. If verification steps fail, kindly contact Red Hat Support.

Additional Resources

If you face any issues while updating OpenShift Container Storage, see the *Commonly required logs for troubleshooting* section in the Troubleshooting guide.

11.2. UPDATING OPENSHIFT CONTAINER STORAGE IN EXTERNAL MODE

Use the following procedures to update your OpenShift Container Storage cluster deployed in external mode.

> **NOTE**
>
> Updating Red Hat OpenShift Container Storage Operator will not update the external Red Hat Ceph Storage cluster. It will only update the Red Hat OpenShift Container Storage Services running on the OpenShift Container Platform. To update the external Red Hat Ceph Storage cluster contact your Red Hat Ceph Storage administrator.

11.2.1. Enabling automatic updates for OpenShift Container Storage operator in external mode

Use this procedure to enable automatic update approval for updating OpenShift Container Storage operator in OpenShift Container Platform. Automatic Updates for Openshift Container Storage in external mode is supported from version 4.5 onwards.

> **NOTE**
>
> Updating OpenShift Container Storage will not update the external Red Hat Ceph Storage cluster.

Prerequisites

- Update the OpenShift Container Platform cluster to the latest stable release of version 4.5.x, see Updating Clusters.
- Ensure the Red Hat OpenShift Container Storage channel is set to **stable-4.5**, see OpenShift Container Platform upgrade channels and releases.

> **NOTE**
>
> You are not required to switch channels when updating between batch updates of 4.5 (for example, updating from 4.5.0 to 4.5.1).

- Ensure that all OpenShift Container Storage Pods, including the operator pods, are in **Running** state in the **openshift-storage namespace**.
  To view the state of the pods, click **Workloads → Pods** from the left pane of the OpenShift Web Console. Select **openshift-storage** from the **Project** drop down list.
- Under **Persistent Storage** in **Status** card, confirm that the **OCS cluster** is healthy.

- Ensure that you have sufficient time to complete the Openshift Container Storage (OCS) update process.

Procedure

1. Log in to OpenShift Web Console.
2. Click **Operators → Installed Operators**.
3. Select the **openshift-storage** project.
4. Click on the OpenShift Container Storage operator name.
5. Click **Subscription** tab and click the link under **Approval**.
6. Select **Automatic (default)** and click **Save**.
7. Perform one of the following depending on the **Upgrade Status**:
   - **Upgrade Status** *shows* **requires approval**.

     NOTE

     Upgrade status shows requires approval if the new OpenShift Container Storage version is already detected in the channel, and approval strategy was changed from **Manual** to **Automatic** at the time of update.

     a. Click the **Install Plan** link.
     b. On the **InstallPlan Details** page, click **Preview Install Plan**.
     c. Review the install plan and click **Approve**.
     d. Wait for the **Status** to change from **Unknown** to **Created**.
     e. Click **Operators → Installed Operators**.
     f. Select the **openshift-storage** project.
     g. Wait for the **Status** to change to **Up to date**.
   - **Upgrade Status** *does not show* **requires approval**.
     a. Wait for the update to initiate. This may take up to 20 minutes.
     b. Click **Operators → Installed Operators**.
     c. Select the **openshift-storage** project.
     d. Wait for the **Status** to change to **Up to date**.

Verification steps

1. Click **Overview → Persistent Storage** tab and in **Status** card confirm that the **OCS cluster** has a green tick mark indicating it is healthy.

2. Click **Operators → Installed Operators → OpenShift Container Storage Operator**. Under **Storage Cluster**, verify that the cluster service status in **Ready**.

3. Ensure that all OpenShift Container Storage Pods, including the operator pods, are in **Running** state in the **openshift-storage namespace**.
   To view the state of the pods, click **Workloads → Pods** from the left pane of the OpenShift Web Console. Select **openshift-storage** from the Project drop down list.

4. If verification steps fail, kindly contact Red Hat Support .

Additional Resources

If you face any issues while updating OpenShift Container Storage, see the *Commonly required logs for troubleshooting* section in the Troubleshooting guide.

11.2.2. Manually updating OpenShift Container Storage operator in external mode

Use this procedure to update OpenShift Container Storage operator by providing manual approval to the install plan. Manual Updates for Openshift Container Storage in external mode is supported from version 4.5 onwards.

> **NOTE**
>
> Updating OpenShift Container Storage will not update the external Red Hat Ceph Storage cluster.

Prerequisites

- Update the OpenShift Container Platform cluster to the latest stable release of version of 4.5.x, see Updating Clusters.
- Ensure the Red Hat OpenShift Container Storage channel is set to **stable-4.5**, see OpenShift Container Platform upgrade channels and releases.

> **NOTE**
>
> You are not required to switch channels when updating between batch updates of 4.5 (for example, updating from 4.5.0 to 4.5.1).

- Ensure that all OpenShift Container Storage Pods, including the operator pods, are in **Running** state in the **openshift-storage namespace**.
  To view the state of the pods, click **Workloads → Pods** from the left pane of the OpenShift Web Console. Select **openshift-storage** from the Project drop down list.
- Under **Persistent Storage** in **Status** card, confirm that the **OCS cluster** is healthy.
- Ensure that you have sufficient time to complete the Openshift Container Storage (OCS) update process.

Procedure

1. Log in to OpenShift Web Console.
2. Click **Operators → Installed Operators**.

3. Select the **openshift-storage** project.
4. Click on the OpenShift Container Storage operator name.
5. Click **Subscription** tab and click the link under **Approval**.
6. Select **Manual** and click **Save**.
7. Wait for the **Upgrade Status** to change to **Upgrading**.
8. If the **Upgrade Status** shows **requires approval**, click on **requires approval**.
9. On the **InstallPlan Details** page, click **Preview Install Plan**.
10. Review the install plan and click **Approve**.
11. Wait for the **Status** to change from **Unknown** to **Created**.
12. Click **Operators → Installed Operators**.
13. Select the **openshift-storage** project.
14. Wait for the **Status** to change to **Up to date**.

Verification steps

1. Click **Overview → Persistent Storage** tab and in **Status** card confirm that the **OCS cluster** has a green tick mark indicating it is healthy.
2. Click **Operators → Installed Operators → OpenShift Container Storage Operator**. Under **Storage Cluster**, verify that the cluster service status in **Ready**.
3. Ensure that all OpenShift Container Storage Pods, including the operator pods, are in **Running** state in the **openshift-storage namespace**.
   To view the state of the pods, click **Workloads → Pods** from the left pane of the OpenShift Web Console. Select **openshift-storage** from the Project drop down list.
4. If verification steps fail, kindly contact Red Hat Support.

Additional Resources

If you face any issues while updating OpenShift Container Storage, see the *Commonly required logs for troubleshooting* section in the Troubleshooting guide.

11.3. PREPARING TO UPDATE IN A DISCONNECTED ENVIRONMENT

When your Red Hat OpenShift Container Storage environment is not directly connected to the internet, some additional configuration is required to provide the Operator Lifecycle Manager (OLM) with alternatives to the default Operator Hub and image registries.

See the OpenShift Container Platform documentation for more general information: Updating an Operator catalog image.

To configure your cluster for disconnected update:

1. Configure authentication for an alternative registry.

2. Build and mirror the Red Hat operator catalog .
3. Creating Operator imageContentSourcePolicy
4. Updating redhat-operator catalogsource

When these steps are complete, Continue with update as usual.

11.3.1. Adding mirror registry authentication details

Prerequisites

- Verify that your existing disconnected cluster uses OpenShift Container Platform 4.3 or higher.
- Verify that you have an **oc client** version of 4.4 or higher.
- Prepare a mirror host with a mirror registry. See Preparing your mirror host for details.

Procedure

1. Log in to the OpenShift Container Platform cluster using the **cluster-admin** role.
2. Locate your **auth.json** file.
   This file is generated when you use podman or docker to log in to a registry. It is located in one of the following locations:
   - **~/.docker/auth.json**
   - **/run/user/<UID>/containers/auth.json**
   - **/var/run/containers/<UID>/auth.json**
3. Obtain your unique Red Hat registry pull secret and paste it into your **auth.json** file. It will look something like this.

```
{
    "auths": {
        "cloud.openshift.com": {
            "auth": "*****************",
            "email": "user@example.com"
        },
        "quay.io": {
            "auth": "*****************",
            "email": "user@example.com"
        },
        "registry.connect.redhat.com": {
            "auth": "*****************",
            "email": "user@example.com"
        },
        "registry.redhat.io": {
            "auth": "*****************",
            "email": "user@example.com"
        }
    }
}
```

4. Export environment variables with the appropriate details for your setup.

```
$ export AUTH_FILE="<location_of_auth.json>"
$ export MIRROR_REGISTRY_DNS="<your_registry_url>:<port>"
```

5. Use **podman** to log in to the mirror registry and store the credentials in the **${AUTH_FILE}**.

```
$ podman login ${MIRROR_REGISTRY_DNS} --tls-verify=false --authfile ${AUTH_FILE}
```

This adds the mirror registry to the **auth.json** file.

```
{
  "auths": {
    "cloud.openshift.com": {
      "auth": "*****************",
      "email": "user@example.com"
    },
    "quay.io": {
      "auth": "*****************",
      "email": "user@example.com"
    },
    "registry.connect.redhat.com": {
      "auth": "*****************",
      "email": "user@example.com"
    },
    "registry.redhat.io": {
      "auth": "*****************",
      "email": "user@example.com"
    },
    "<mirror_registry>": {
      "auth": "*****************",
    }
  }
}
```

11.3.2. Building and mirroring the Red Hat operator catalog

Follow this process on a host that has access to Red Hat registries to create a mirror of those registries.

Prerequisites

- Run these commands as a cluster administrator.
- Be aware that mirroring the **redhat-operator** catalog can take hours to complete, and requires substantial available disk space on the mirror host.

Procedure

1. Build the catalog for **redhat-operators**.
   Set **--from** to the **ose-operator-registry** base image using the tag that matches the target OpenShift Container Platform cluster major and minor version.

```
$ oc adm catalog build --appregistry-org redhat-operators \
  --from=registry.redhat.io/openshift4/ose-operator-registry:v4.5 \
```

```
--to=${MIRROR_REGISTRY_DNS}/olm/redhat-operators:v2 \
--registry-config=${AUTH_FILE} \
--filter-by-os="linux/amd64" --insecure
```

2. Mirror the catalog for **redhat-operators**.
   This is a long operation and can take 1-5 hours. Make sure there is 100 GB available disk space on the mirror host.

```
$ oc adm catalog mirror ${MIRROR_REGISTRY_DNS}/olm/redhat-operators:v2 \
${MIRROR_REGISTRY_DNS} --registry-config=${AUTH_FILE} --insecure
```

11.3.3. Creating Operator **imageContentSourcePolicy**

After the **oc adm catalog mirror** command is completed, the **imageContentSourcePolicy.yaml** file gets created. The output directory for this file is usually, **./[catalog image name]-manifests)**. Use this procedure to add any missing entries to the **.yaml** file and apply them to cluster.

Procedure

1. Check the content of this file for the mirrors mapping shown as follows:

```
spec:
  repositoryDigestMirrors:
    - mirrors:
      - <your_registry>/ocs4
      source: registry.redhat.io/ocs4
    - mirrors:
      - <your_registry>/rhceph
      source: registry.redhat.io/rhceph
    - mirrors:
      - <your_registry>/openshift4
      source: registry.redhat.io/openshift4
    - mirrors:
      - <your_registry>/rhscl
      source: registry.redhat.io/rhscl
```

2. Add any missing entries to the end of the **imageContentSourcePolicy.yaml** file.

3. Apply the imageContentSourcePolicy.yaml file to the cluster.

```
$ oc apply -f ./[output dir]/imageContentSourcePolicy.yaml
```

   Once the Image Content Source Policy is updated, all the nodes (master, infra, and workers) in the cluster need to be updated and rebooted. This process is automatically handled through the Machine Config Pool operator and take up to 30 minutes although the exact elapsed time might vary based on the number of nodes in your OpenShift cluster. You can monitor the update process by using the **oc get mcp** command or the **oc get node** command.

11.3.4. Updating redhat-operator **CatalogSource**

Procedure

1. Recreate a **CatalogSource** object that references the catalog image for Red Hat operators.

> **NOTE**
>
> Make sure you have mirrored the correct catalog source with the correct version (that is, **v2**).

+ Save the following in a **redhat-operator-catalogsource.yaml** file, remembering to replace *<your_registry>* with your mirror registry URL:

+

```
apiVersion: operators.coreos.com/v1alpha1
kind: CatalogSource
metadata:
  name: redhat-operators
  namespace: openshift-marketplace
spec:
  sourceType: grpc
  icon:
    base64data:
PHN2ZyBpZD0iTGF5ZXJfMSIgZGF0YS1uYW1lPSJMYXllciAxIiB4bWxucz0iaHR0cDovL3d3dy53My5vc
mcvMjAwMC9zdmciIHZpZXdCb3g9IjAgMCAxOTIgMTQ1Ij48ZGVmcz48c3R5bGU+LmNscy0xe2ZpbG
w6I2UwMDt9PC9zdHlsZT48L2RlZnM+PHRpdGxlPlJlZEhhdC1Mb2dvLUhhdC1Db2xvcjwvdGl0bGU+P
HBhdGggZD0iTTE1Ny43Nyw2Mi42MWExNCwxNCwwLDAsMSwuMzEsMy40MmMwLDE0Ljg4LTE4Lj
EsMTcuNDYtMzAuNjEsMTcuNDZDNzguODMsODMuNDksNDIuNTMsNTMuMjYsNDIuNTMsNDRhNi4
0Myw2LjQzLDAsMCwxLC4yMi0xLjk0bC0zLjY2LDkuMDZhMTguNDUsMTguNDUsMCwwLDAtMS41M
Sw3LjMzYzAsMTguMTEsNDEsNDUuNDgsODcuNzQsNDUuNDgsMjAuNjksMCwzNi40My03Ljc2LDM2
LjQzLTIxLjc3LDAtMS4wOCwwLTEuOTQtMS43My0xMC4xM1oiLz48cGF0aCBjbGFzcz0iY2xzLTEiIGQ
9Ik0xMjcuNDcsODMuNDljMTIuNTEsMCwzMC42MS0yLjU4LDMwLjYxLTE3LjQ2YTE0LDE0LDAsMCw
wLS4zMS0zLjQybC03LjQ1LTMyLjM2Yy0xLjcyLTcuMTItMy4yMy0xMC4zNS0xNS43My0xNi42QzEyNC
4OSw4LjY5LDEwMy43Ni41LDk3LjUxLjUsOTEuNjkuNSw5MCw4LDgzLjA2LDhjLTYuNjgsMC0xMS42N
C01LjYtMTcuODktNS42LTYsMC05LjkxLDQuMDktMTIuOTMsMTIuNSwwLDAtOC40MSwyMy43Mi05Lj
Q5LDI3LjE2QTYuNDMsNi40MywwLDAsMCw0Mi41Myw0NGMwLDkuMjIsMzYuMywzOS40NSw4NC4
5NCwzOS40NU0xNjAsNzIuMDdjMS43Myw4LjE5LDEuNzMsOS4wNSwxLjczLDEwLjEzLDAsMTQtMTU
uNzQsMjEuNzctMzYuNDMsMjEuNzdDNzguNTQsMTA0LDM3LjU4LDc2LjYsMzcuNTgsNTguNDlhMTg
uNDUsMTguNDUsMCwwLDEsMS41MS03LjMzQzIyLjI3LDUyLC41LDU1LC41LDc0LjIyYzAsMzEuNDg
sNzQuNTksNzAuMjgsMTMzLjY1LDcwLjI4LDQ1LjI4LDAsNTYuNy0yMC40OCw1Ni43LTM2LjY1LDAtM
TIuNzItMTEtMjcuMTYtMzAuODMtMzUuNzgiLz48L3N2Zz4=
    mediatype: image/svg+xml
  image: <your_registry>/olm/redhat-operators:v2
  displayName: Redhat Operators Catalog
  publisher: Red Hat
```

1. Create a catalogsource using the redhat-operator-catalogsource.yaml file:

   ```
   $ oc apply -f redhat-operator-catalogsource.yaml
   ```

2. Verify that the new **redhat-operator** pod is running.

   ```
   $ oc get pod -n openshift-marketplace | grep redhat-operators
   ```

11.3.5. Continue to update

After your alternative catalog source is configured, you can continue to the appropriate update process:

- Updating OpenShift Container Storage in internal mode