Red Hat OpenShift Data Foundation 4.9

Deploying and managing OpenShift Data Foundation using Google Cloud

Instructions on deploying and managing OpenShift Data Foundation on existing Red Hat OpenShift Container Platform Google Cloud clusters

Last Updated: 2022-02-14
Red Hat OpenShift Data Foundation 4.9 Deploying and managing
OpenShift Data Foundation using Google Cloud

Instructions on deploying and managing OpenShift Data Foundation on existing Red Hat OpenShift
Container Platform Google Cloud clusters
Abstract

Read this document for instructions on installing and managing Red Hat OpenShift Data Foundation on Google Cloud. Deploying and managing OpenShift Data Foundation on Google Cloud 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.
9.3.2. Verifying the addition of a new node
9.3.3. Scaling up storage capacity

CHAPTER 10. MULTICLOUD OBJECT GATEWAY ................................................................. 49
10.1. ABOUT THE MULTICLOUD OBJECT GATEWAY 49
10.2. ACCESSING THE MULTICLOUD OBJECT GATEWAY WITH YOUR APPLICATIONS 49
10.2.1. Accessing the Multicloud Object Gateway from the terminal 50
10.2.2. Accessing the Multicloud Object Gateway from the MCG command-line interface 52
10.3. ALLOWING USER ACCESS TO THE MULTICLOUD OBJECT GATEWAY CONSOLE 55
10.4. ADDING STORAGE RESOURCES FOR HYBRID OR MULTICLOUD 56
10.4.1. Creating a new backing store 56
10.4.2. Adding storage resources for hybrid or Multicloud using the MCG command line interface 57
10.4.2.1. Creating an AWS-backed backingstore 57
10.4.2.2. Creating an IBM COS-backed backingstore 59
10.4.2.3. Creating an Azure-backed backingstore 61
10.4.2.4. Creating a GCP-backed backingstore 63
10.4.2.5. Creating a local Persistent Volume-backed backingstore 64
10.4.3. Creating an s3 compatible Multicloud Object Gateway backingstore 66
10.4.4. Adding storage resources for hybrid and Multicloud using the user interface 67
10.4.5. Creating a new bucket class 69
10.4.6. Editing a bucket class 70
10.4.7. Editing backing stores for bucket class 70
10.5. MANAGING NAMESPACE BUCKETS 72
10.5.1. Amazon S3 API endpoints for objects in namespace buckets 72
10.5.2. Adding a namespace bucket using the Multicloud Object Gateway CLI and YAM 73
10.5.2.1. Adding an AWS S3 namespace bucket using YAM 73
10.5.2.2. Adding an IBM COS namespace bucket using YAM 75
10.5.2.3. Adding an AWS S3 namespace bucket using the Multicloud Object Gateway CLI 78
10.5.2.4. Adding an IBM COS namespace bucket using the Multicloud Object Gateway CLI 80
10.5.3. Adding a namespace bucket using the OpenShift Container Platform user interface 81
10.6. MIRRORING DATA FOR HYBRID AND MULTICLOUD BUCKETS 83
10.6.1. Creating bucket classes to mirror data using the MCG command-line interface 83
10.6.2. Creating bucket classes to mirror data using a YAML 84
10.6.3. Configuring buckets to mirror data using the user interface 84
10.7. BUCKET POLICIES IN THE MULTICLOUD OBJECT GATEWAY 86
10.7.1. About bucket policies 86
10.7.2. Using bucket policies 86
10.7.3. Creating an AWS S3 user in the Multicloud Object Gateway 88
10.8. OBJECT BUCKET CLAIM 90
10.8.1. Dynamic Object Bucket Claim 90
10.8.2. Creating an Object Bucket Claim using the command line interface 92
10.8.3. Creating an Object Bucket Claim using the OpenShift Web Console 95
10.8.4. Attaching an Object Bucket Claim to a deployment 98
10.8.5. Viewing object buckets using the OpenShift Web Console 99
10.8.6. Deleting Object Bucket Claims 100
10.9. CACHING POLICY FOR OBJECT BUCKETS 100
10.9.1. Creating an AWS cache bucket 101
10.9.2. Creating an IBM COS cache bucket 103
10.10. SCALING MULTICLOUD OBJECT GATEWAY PERFORMANCE BY ADDING ENDPOINTS 105
10.10.1. Scaling the Multicloud Object Gateway with storage nodes 105
10.11. AUTOMATIC SCALING OF MULTICLOUD OBJECT GATEWAY ENDPOINTS 106

CHAPTER 11. MANAGING PERSISTENT VOLUME CLAIMS ................................................. 107
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.1</td>
<td>Configuring Application Pods to Use OpenShift Data Foundation</td>
<td>107</td>
</tr>
<tr>
<td>11.2</td>
<td>Viewing Persistent Volume Claim Request Status</td>
<td>109</td>
</tr>
<tr>
<td>11.3</td>
<td>Reviewing Persistent Volume Claim Request Events</td>
<td>109</td>
</tr>
<tr>
<td>11.4</td>
<td>Dynamic Provisioning</td>
<td>109</td>
</tr>
<tr>
<td>11.4.1</td>
<td>About dynamic provisioning</td>
<td>109</td>
</tr>
<tr>
<td>11.4.2</td>
<td>Dynamic provisioning in OpenShift Data Foundation</td>
<td>110</td>
</tr>
<tr>
<td>11.4.3</td>
<td>Available dynamic provisioning plug-ins</td>
<td>110</td>
</tr>
<tr>
<td>11.5</td>
<td>Creating Volume Snapshots</td>
<td>112</td>
</tr>
<tr>
<td>12.2</td>
<td>Restoring Volume Snapshots</td>
<td>113</td>
</tr>
<tr>
<td>12.3</td>
<td>Deleting Volume Snapshots</td>
<td>115</td>
</tr>
<tr>
<td>12.1</td>
<td>Creating Volume Snapshots</td>
<td>117</td>
</tr>
<tr>
<td>12.1.1</td>
<td>Creating a Clone</td>
<td>117</td>
</tr>
<tr>
<td>13.1</td>
<td>Creating a Clone</td>
<td>117</td>
</tr>
<tr>
<td>13.2</td>
<td>Restoring Volume Snapshots</td>
<td>118</td>
</tr>
<tr>
<td>13.3</td>
<td>Deleting Volume Snapshots</td>
<td>119</td>
</tr>
<tr>
<td>14.1</td>
<td>Replacing Operational Nodes on Google Cloud Installer-Provisioned Infrastructure</td>
<td>118</td>
</tr>
<tr>
<td>14.2</td>
<td>Replacing Failed Nodes on Google Cloud Installer-Provisioned Infrastructure</td>
<td>119</td>
</tr>
<tr>
<td>15.1</td>
<td>Replacing Operational or Failed Storage Devices on Google Cloud Installer-Provisioned Infrastructure</td>
<td>122</td>
</tr>
<tr>
<td>15.2</td>
<td>Replacing Failed Storage Devices on Google Cloud Installer-Provisioned Infrastructure</td>
<td>122</td>
</tr>
<tr>
<td>16.1</td>
<td>Overview of the OpenShift Data Foundation Update Process</td>
<td>123</td>
</tr>
<tr>
<td>16.2</td>
<td>Updating Red Hat OpenShift Container Storage 4.8 to Red Hat OpenShift Data Foundation 4.9</td>
<td>124</td>
</tr>
<tr>
<td>16.3</td>
<td>Updating Red Hat OpenShift Data Foundation 4.9.X to 4.9.Y</td>
<td>126</td>
</tr>
<tr>
<td>16.4</td>
<td>Changing the Update Approval Strategy</td>
<td>128</td>
</tr>
</tbody>
</table>
Red Hat is committed to replacing problematic language in our code, documentation, and web properties. We are beginning with these four terms: master, slave, blacklist, and whitelist. Because of the enormity of this endeavor, these changes will be implemented gradually over several upcoming releases. For more details, see our CTO Chris Wright’s message.
PROVIDING FEEDBACK ON RED HAT DOCUMENTATION

We appreciate your input on our documentation. Do let us know how we can make it better. To give feedback:

- For simple comments on specific passages:
  1. Make sure you are viewing the documentation in the *Multi-page HTML* format. In addition, ensure you see the *Feedback* button in the upper right corner of the document.
  2. Use your mouse cursor to highlight the part of text that you want to comment on.
  3. Click the *Add Feedback* pop-up that appears below the highlighted text.
  4. Follow the displayed instructions.

- For submitting more complex feedback, create a Bugzilla ticket:
  1. Go to the *Bugzilla* website.
  2. As the Component, use *Documentation*.
  3. Fill in the *Description* field with your suggestion for improvement. Include a link to the relevant part(s) of documentation.
  4. Click *Submit Bug*. 
PREFACE

Red Hat OpenShift Data Foundation 4.9 supports deployment on existing Red Hat OpenShift Container Platform (RHOCPP) Google Cloud clusters.

NOTE

Only internal OpenShift Data Foundation clusters are supported on Google Cloud. See Planning your deployment for more information about deployment requirements.

To deploy OpenShift Data Foundation in internal mode, start with the requirements in Preparing to deploy OpenShift Data Foundation chapter and follow the appropriate deployment process based on your requirement:

- Deploy OpenShift Data Foundation on Google Cloud
- Deploy standalone Multicloud Object Gateway component
CHAPTER 1. PREPARING TO DEPLOY OPENShift DATA FOUNDATION

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

Before you begin the deployment of Red Hat OpenShift Data Foundation, follow these steps:

1. On the external key management system (KMS),
   - Ensure that a policy with a token exists and the key value backend path in Vault is enabled. See enabled the key value backend path and policy in Vault.
   - Ensure that you are using signed certificates on your Vault servers.

2. Minimum starting node requirements [Technology Preview]
   An OpenShift Data Foundation cluster will be deployed with minimum configuration when the standard deployment resource requirement is not met. See Resource requirements section in Planning guide.

3. Regional-DR requirements [Developer Preview]
   Disaster Recovery features supported by Red Hat OpenShift Data Foundation require all of the following prerequisites in order to successfully implement a Disaster Recovery solution:
   - A valid Red Hat OpenShift Data Foundation Advanced subscription
   - A valid Red Hat Advanced Cluster Management for Kubernetes subscription
   For detailed requirements, see Regional-DR requirements and RHACM requirements.

1.1. ENABLING KEY VALUE BACKEND PATH AND POLICY IN VAULT

Prerequisites

- Administrator access to Vault.

- Carefully, choose a unique path name as the backend path that follows the naming convention since it cannot be changed later.

Procedure

1. Enable the Key/Value (KV) backend path in Vault.
   For Vault KV secret engine API, version 1:

   $ vault secrets enable -path=ocs kv

   For Vault KV secret engine API, version 2:

   $ vault secrets enable -path=ocs kv-v2

2. Create a policy to restrict users to perform a write or delete operation on the secret using the following commands.
3. Create a token matching the above policy.

```bash
$ vault token create -policy=ocs -format json
```
CHAPTER 2. DEPLOYING OPENSHIFT DATA FOUNDATION ON GOOGLE CLOUD

You can deploy OpenShift Data Foundation on OpenShift Container Platform using dynamic storage devices provided by Google Cloud installer-provisioned infrastructure. This enables you to create internal cluster resources and it results in internal provisioning of the base services, which helps to make additional storage classes available to applications.

Also, it is possible to deploy only the Multicloud Object Gateway (MCG) component with OpenShift Data Foundation. For more information, see Deploy standalone Multicloud Object Gateway.

NOTE

Only internal OpenShift Data Foundation clusters are supported on Google Cloud. See Planning your deployment for more information about deployment requirements.

Ensure that you have addressed the requirements in Preparing to deploy OpenShift Data Foundation chapter before proceeding with the below steps for deploying using dynamic storage devices:

1. Install the Red Hat OpenShift Data Foundation Operator.
2. Create the OpenShift Data Foundation Cluster.

2.1. INSTALLING RED HAT OPENSHIFT DATA FOUNDATION OPERATOR

You can install Red Hat OpenShift Data Foundation Operator using the Red Hat OpenShift Container Platform Operator Hub.

Prerequisites

- Access to an OpenShift Container Platform cluster using an account with cluster-admin and Operator installation permissions.
- You must have at least three worker nodes in the Red Hat OpenShift Container Platform cluster.
- For additional resource requirements, see the Planning your deployment guide.

IMPORTANT

- When you need to override the cluster-wide default node selector for OpenShift Data Foundation, you can use the following command in the command line interface to specify a blank node selector for the openshift-storage namespace (create openshift-storage namespace in this case):

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

- Taint a node as infra to ensure only Red Hat OpenShift Data Foundation resources are scheduled on that node. This helps you save on subscription costs. For more information, see How to use dedicated worker nodes for Red Hat OpenShift Data Foundation chapter in the Managing and Allocating Storage Resources guide.
Procedure

1. Log in to the OpenShift Web Console.

2. Click Operators → OperatorHub.

3. Scroll or type OpenShift Data Foundation into the Filter by keyword box to find the OpenShift Data Foundation Operator.

4. Click Install.

5. Set the following options on the Install Operator page:
   a. Update Channel as stable-4.9.
   b. Installation Mode as A specific namespace on the cluster
   c. Installed Namespace as Operator recommended namespace openshift-storage. If Namespace openshift-storage does not exist, it is created during the operator installation.
   d. Select Approval Strategy as Automatic or Manual.
      If you select Automatic updates, then the Operator Lifecycle Manager (OLM) automatically upgrades the running instance of your Operator without any intervention.
      If you select Manual updates, then the OLM creates an update request. As a cluster administrator, you must then manually approve that update request to update the Operator to a newer version.
   e. Ensure that the Enable option is selected for the Console plugin.
   f. Click Install.

   NOTE
   We recommend using all default settings. Changing it may result in unexpected behavior. Alter only if you are aware of its result.

Verification steps

- Verify that the OpenShift Data Foundation Operator shows a green tick indicating successful installation.
- After the operator is successfully installed, a pop-up with a message, Web console update is available appears on the user interface. Click Refresh web console from this pop-up for the console changes to reflect.
- In the Web Console, navigate to Storage and verify if OpenShift Data Foundation is available.

IMPORTANT

In case the console plugin option was not automatically enabled after you installed the OpenShift Data Foundation Operator, you need to enable it.

For more information on how to enable the console plugin, see Enabling the Red Hat OpenShift Data Foundation console plugin.
2.2. CREATING AN OPENSİFT DATA FOUNDATION CLUSTER

Create an OpenShift Data Foundation cluster after you install the OpenShift Data Foundation operator.

Prerequisites

- The OpenShift Data Foundation operator must be installed from the Operator Hub. For more information, see Installing OpenShift Data Foundation Operator.

- Be aware that the default storage class of the Google Cloud platform uses hard disk drive (HDD). To use solid state drive (SSD) based disks for better performance, you need to create a storage class, using pd-ssd as shown in the following ssd-storageclass.yaml example:

```yaml
apiVersion: storage.k8s.io/v1
kind: StorageClass
metadata:
  name: faster
  provisioner: kubernetes.io/gce-pd
parameters:
  type: pd-ssd
volumeBindingMode: WaitForFirstConsumer
reclaimPolicy: Delete
```

Procedure

1. In the OpenShift Web Console, click Operators → Installed Operators to view all the installed operators.
   Ensure that the Project selected is openshift-storage.

2. Click on the OpenShift Data Foundation operator, and then click Create StorageSystem.

3. In the Backing storage page, select the following:
   a. Select the Use an existing StorageClass option.
   b. Select the Storage Class.
      By default, it is set to standard. However, if you created a storage class to use SSD based disks for better performance, you need to select that storage class.
   c. Expand Advanced and select Full Deployment for the Deployment type option.
   d. Click Next.

4. In the Capacity and nodes page, provide the necessary information:
   a. Select a value for Requested Capacity from the dropdown list. It is set to 2 TiB by default.

      **NOTE**

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

   b. In the Select Nodes section, select at least three available nodes.
      For cloud platforms with multiple availability zones, ensure that the Nodes are spread across different Locations/availability zones.
If the nodes selected do not match the OpenShift Data Foundation cluster requirement of an aggregated 30 CPUs and 72 GiB of RAM, a minimal cluster is deployed. For minimum starting node requirements, see the Resource requirements section in the Planning guide.

c. Click Next.

5. Optional: In the Security and network page, configure the following based on your requirements:
   
a. To enable encryption, select Enable data encryption for block and file storage
   
b. Choose either one or both the encryption levels:
      
      - **Cluster-wide encryption**
        Encrypts the entire cluster (block and file).
      
      - **StorageClass encryption**
        Creates encrypted persistent volume (block only) using encryption enabled storage class.
   
c. Select the Connect to an external key management service checkbox. This is optional for cluster-wide encryption.
      
i. Key Management Service Provider is set to Vault by default.
      
ii. Enter Vault Service Name, host Address of Vault server ('https://<hostname or ip>'), Port number and Token.
      
iii. Expand Advanced Settings to enter additional settings and certificate details based on your Vault configuration:
          
          A. Enter the Key Value secret path in Backend Path that is dedicated and unique to OpenShift Data Foundation.
          
          B. Optional: Enter TLS Server Name and Vault Enterprise Namespace
          
          C. Upload the respective PEM encoded certificate file to provide the CA Certificate, Client Certificate and Client Private Key.
          
          D. Click Save.
   
d. Click Next.

6. In the Review and create page, review the configuration details.
   To modify any configuration settings, click Back.

7. Click Create StorageSystem.

Verification steps

- To verify the final Status of the installed storage cluster:
  
a. In the OpenShift Web Console, navigate to Installed Operators → OpenShift Data Foundation → Storage System → ocs-storagecluster-storagesystem → Resources.
  
b. Verify that Status of StorageCluster is Ready and has a green tick mark next to it.
1. To verify that all components for OpenShift Data Foundation are successfully installed, see Verifying your OpenShift Data Foundation deployment.

Additional resources
To enable Overprovision Control alerts, refer to Alerts in Monitoring guide.

### 2.3. VERIFYING OPENSHIFT DATA FOUNDATION DEPLOYMENT

Use this section to verify that OpenShift Data Foundation is deployed correctly.

#### 2.3.1. Verifying the state of the pods

**Procedure**

1. Click **Workloads → Pods** from the OpenShift Web Console.
2. Select **openshift-storage** from the **Project** drop-down list.

   **NOTE**
   If the **Show default projects** option is disabled, use the toggle button to list all the default projects.

   For more information about the expected number of pods for each component and how it varies depending on the number of nodes, see Table 2.1, “Pods corresponding to OpenShift Data Foundation cluster”.

3. Click the **Running** and **Completed** tabs to verify that the following pods are in **Running** and **Completed** state:

   **Table 2.1. Pods corresponding to OpenShift Data Foundation cluster**

<table>
<thead>
<tr>
<th>Component</th>
<th>Corresponding pods</th>
</tr>
</thead>
<tbody>
<tr>
<td>OpenShift Data Foundation Operator</td>
<td>- ocs-operator-* (1 pod on any worker node)</td>
</tr>
<tr>
<td></td>
<td>- ocs-metrics-exporter-* (1 pod on any worker node)</td>
</tr>
<tr>
<td></td>
<td>- odf-operator-controller-manager-* (1 pod on any worker node)</td>
</tr>
<tr>
<td></td>
<td>- odf-console-* (1 pod on any worker node)</td>
</tr>
<tr>
<td>Rook–ceph Operator</td>
<td>rook-ceph-operator-* (1 pod on any worker node)</td>
</tr>
<tr>
<td>Component</td>
<td>Corresponding pods</td>
</tr>
<tr>
<td>-------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Multicloud Object Gateway</td>
<td>- noobaa-operator-* (1 pod on any worker node)</td>
</tr>
<tr>
<td></td>
<td>- noobaa-core-* (1 pod on any storage node)</td>
</tr>
<tr>
<td></td>
<td>- noobaa-db-pg-* (1 pod on any storage node)</td>
</tr>
<tr>
<td></td>
<td>- noobaa-endpoint-* (1 pod on any storage node)</td>
</tr>
<tr>
<td>MON</td>
<td>rook-ceph-mon-*</td>
</tr>
<tr>
<td></td>
<td>(3 pods distributed across storage nodes)</td>
</tr>
<tr>
<td>MGR</td>
<td>rook-ceph-mgr-*</td>
</tr>
<tr>
<td></td>
<td>(1 pod on any storage node)</td>
</tr>
<tr>
<td>MDS</td>
<td>rook-ceph-mds-ocs-storagecluster-cephfilesystem-*</td>
</tr>
<tr>
<td></td>
<td>(2 pods distributed across storage nodes)</td>
</tr>
<tr>
<td>CSI</td>
<td>* cephfs</td>
</tr>
<tr>
<td></td>
<td>- csi-cephfsplugin-* (1 pod on each worker node)</td>
</tr>
<tr>
<td></td>
<td>- csi-cephfsplugin-provisioner-* (2 pods distributed across worker nodes)</td>
</tr>
<tr>
<td></td>
<td>* rbd</td>
</tr>
<tr>
<td></td>
<td>- csi-rbdplugin-* (1 pod on each worker node)</td>
</tr>
<tr>
<td></td>
<td>- csi-rbdplugin-provisioner-* (2 pods distributed across worker nodes)</td>
</tr>
<tr>
<td>rook-ceph-crashcollector</td>
<td>rook-ceph-crashcollector-*</td>
</tr>
<tr>
<td></td>
<td>(1 pod on each storage node)</td>
</tr>
<tr>
<td>OSD</td>
<td>* rook-ceph-osd-* (1 pod for each device)</td>
</tr>
<tr>
<td></td>
<td>* rook-ceph-osd-prepare-ocs-deviceset-* (1 pod for each device)</td>
</tr>
</tbody>
</table>
2.3.2. Verifying the OpenShift Data Foundation cluster is healthy

Procedure

1. In the OpenShift Web Console, click **Storage → OpenShift Data Foundation**.

2. In the **Status** card of the **Overview** tab, click **Storage System** and then click the storage system link from the pop up that appears.

3. In the **Status** card of the **Block and File** tab, verify that **Storage Cluster** has a green tick.

4. In the **Details** card, verify that the cluster information is displayed.

For more information on the health of the OpenShift Data Foundation cluster using the **Block and File** dashboard, see [Monitoring OpenShift Data Foundation](#).

2.3.3. Verifying the Multicloud Object Gateway is healthy

Procedure

1. In the OpenShift Web Console, click **Storage → OpenShift Data Foundation**.

2. In the **Status** card of the **Overview** tab, click **Storage System** and then click the storage system link from the pop up that appears.

   a. In the **Status card** of the **Object** tab, verify that both **Object Service** and **Data Resiliency** have a green tick.

   b. In the **Details** card, verify that the MCG information is displayed.

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

2.3.4. Verifying that the OpenShift Data Foundation specific storage classes exist

Procedure

1. Click **Storage → Storage Classes** from the left pane of the OpenShift Web Console.

2. Verify that the following storage classes are created with the OpenShift Data Foundation cluster creation:

   - **ocs-storagecluster-ceph-rbd**
   - **ocs-storagecluster-cephfs**
   - **openshift-storage.noobaa.io**
CHAPTER 3. DEPLOY STANDALONE MULTICLOUD OBJECT GATEWAY

Deploying only the Multicloud Object Gateway component with the OpenShift Data Foundation provides the flexibility in deployment and helps to reduce the resource consumption. Use this section to deploy only the standalone Multicloud Object Gateway component, which involves the following steps:

- Installing Red Hat OpenShift Data Foundation Operator
- Creating standalone Multicloud Object Gateway

3.1. INSTALLING RED HAT OPENSFIGHT DATA FOUNDATION OPERATOR

You can install Red Hat OpenShift Data Foundation Operator using the Red Hat OpenShift Container Platform Operator Hub.

Prerequisites

- Access to an OpenShift Container Platform cluster using an account with `cluster-admin` and Operator installation permissions.
- You must have at least three worker nodes in the Red Hat OpenShift Container Platform cluster.
- For additional resource requirements, see the Planning your deployment guide.

IMPORTANT

- When you need to override the cluster-wide default node selector for OpenShift Data Foundation, you can use the following command in the command line interface to specify a blank node selector for the `openshift-storage` namespace (create openshift-storage namespace in this case):

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

- Taint a node as `infra` to ensure only Red Hat OpenShift Data Foundation resources are scheduled on that node. This helps you save on subscription costs. For more information, see How to use dedicated worker nodes for Red Hat OpenShift Data Foundation chapter in the Managing and Allocating Storage Resources guide.

Procedure

1. Log in to the OpenShift Web Console.
2. Click Operators → OperatorHub.
3. Scroll or type OpenShift Data Foundation into the Filter by keyword box to find the OpenShift Data Foundation Operator.
4. Click Install.
5. Set the following options on the Install Operator page:
a. Update Channel as **stable-4.9**.

b. Installation Mode as **A specific namespace on the cluster**

c. Installed Namespace as **Operator recommended namespace openshift-storage**. If Namespace `openshift-storage` does not exist, it is created during the operator installation.

d. Select Approval Strategy as **Automatic** or **Manual**. If you select **Automatic** updates, then the Operator Lifecycle Manager (OLM) automatically upgrades the running instance of your Operator without any intervention. If you select **Manual** updates, then the OLM creates an update request. As a cluster administrator, you must then manually approve that update request to update the Operator to a newer version.

e. Ensure that the **Enable** option is selected for the **Console plugin**.

f. Click **Install**.

**NOTE**

We recommend using all default settings. Changing it may result in unexpected behavior. Alter only if you are aware of its result.

**Verification steps**

- Verify that the **OpenShift Data Foundation** Operator shows a green tick indicating successful installation.

- After the operator is successfully installed, a pop-up with a message, **Web console update is available** appears on the user interface. Click **Refresh web console** from this pop-up for the console changes to reflect.

  - In the Web Console, navigate to **Storage** and verify if **OpenShift Data Foundation** is available.

**IMPORTANT**

In case the console plugin option was not automatically enabled after you installed the OpenShift Data Foundation Operator, you need to enable it.

For more information on how to enable the console plugin, see **Enabling the Red Hat OpenShift Data Foundation console plugin**.

### 3.2. CREATING STANDALONE MULTICLOUD OBJECT GATEWAY

Use this section to create only the Multicloud Object Gateway component with OpenShift Data Foundation.

**Prerequisites**

- Ensure that OpenShift Data Foundation Operator is installed.

- (For deploying using local storage devices only) Ensure that Local Storage Operator is installed.
- Ensure that you have a storage class and is set as the default.

**Procedure**

1. In the OpenShift Web Console, click **Operators → Installed Operators** to view all the installed operators. Ensure that the Project selected is **openshift-storage**.

2. Click **OpenShift Data Foundation** operator and then click **Create StorageSystem**.

3. In the **Backing storage** page, expand **Advanced**.

4. Select **Multicloud Object Gateway** for **Deployment type**.

5. Click **Next**.

6. Optional: In the **Security** page, select **Connect to an external key management service**
   a. **Key Management Service Provider** is set to **Vault** by default.
   b. Enter **Vault Service Name**, host Address of Vault server ('https://<hostname or ip>'), **Port number**, and **Token**.
   c. Expand **Advanced Settings** to enter additional settings and certificate details based on your **Vault** configuration:
      i. Enter the Key Value secret path in the **Backend Path** that is dedicated and unique to OpenShift Data Foundation.
      ii. Optional: Enter **TLS Server Name** and **Vault Enterprise Namespace**.
      iii. Upload the respective PEM encoded certificate file to provide the **CA Certificate**, **Client Certificate**, and **Client Private Key**.
      iv. Click **Save**.
   d. Click **Next**.

7. In the **Review and create** page, review the configuration details:
   To modify any configuration settings, click **Back**.

8. Click **Create StorageSystem**.

**Verification steps**

**Verifying that the OpenShift Data Foundation cluster is healthy**

1. In the OpenShift Web Console, click **Storage → OpenShift Data Foundation**.

2. In the **Status** card of the **Overview** tab, click **Storage System** and then click the storage system link from the pop up that appears.
   a. In the **Status card** of the **Object** tab, verify that both **Object Service** and **Data Resiliency** have a green tick.
   b. In the **Details** card, verify that the MCG information is displayed.
Verify the state of the pods

1. Click **Workloads → Pods** from the OpenShift Web Console.

2. Select **openshift-storage** from the **Project** drop-down list and verify that the following pods are in **Running** state.

   **NOTE**

   If the **Show default projects** option is disabled, use the toggle button to list all the default projects.

<table>
<thead>
<tr>
<th>Component</th>
<th>Corresponding pods</th>
</tr>
</thead>
<tbody>
<tr>
<td>OpenShift Data Foundation Operator</td>
<td>• <strong>ocs-operator</strong>-* (1 pod on any worker node)</td>
</tr>
<tr>
<td></td>
<td>• <strong>ocs-metrics-exporter</strong>-* (1 pod on any worker node)</td>
</tr>
<tr>
<td></td>
<td>• <strong>odf-operator-controller-manager</strong>-* (1 pod on any worker node)</td>
</tr>
<tr>
<td></td>
<td>• <strong>odf-console</strong>-* (1 pod on any worker node)</td>
</tr>
<tr>
<td>Rook-ceph Operator</td>
<td><strong>rook-ceph-operator</strong>-*</td>
</tr>
<tr>
<td></td>
<td>(1 pod on any worker node)</td>
</tr>
<tr>
<td>Multicloud Object Gateway</td>
<td>• <strong>noobaa-operator</strong>-* (1 pod on any worker node)</td>
</tr>
<tr>
<td></td>
<td>• <strong>noobaa-core</strong>-* (1 pod on any worker node)</td>
</tr>
<tr>
<td></td>
<td>• <strong>noobaa-db-pg</strong>-* (1 pod on any worker node)</td>
</tr>
<tr>
<td></td>
<td>• <strong>noobaa-endpoint</strong>-* (1 pod on any worker node)</td>
</tr>
</tbody>
</table>
CHAPTER 4. UNINSTALLING OPENSHIFT DATA FOUNDATION

4.1. UNINSTALLING OPENSHIFT DATA FOUNDATION IN INTERNAL MODE

To uninstall OpenShift Data Foundation in Internal mode, refer to the knowledge base article on Uninstalling OpenShift Data Foundation.
CHAPTER 5. STORAGE CLASSES AND STORAGE POOLS

The OpenShift Data Foundation operator installs a default storage class depending on the platform in use. This default storage class is owned and controlled by the operator and it cannot be deleted or modified. However, you can create a custom storage class if you want the storage class to have a different behaviour.

You can create multiple storage pools which map to storage classes that provide the following features:

- Enable applications with their own high availability to use persistent volumes with two replicas, potentially improving application performance.
- Save space for persistent volume claims using storage classes with compression enabled.

**NOTE**

Multiple storage classes and multiple pools are not supported for *external mode* OpenShift Data Foundation clusters.

**NOTE**

With a minimal cluster of a single device set, only two new storage classes can be created. Every storage cluster expansion allows two new additional storage classes.

5.1. CREATING STORAGE CLASSES AND POOLS

You can create a storage class using an existing pool or you can create a new pool for the storage class while creating it.

**Prerequisites**

- Ensure that you are logged into the OpenShift Container Platform web console and OpenShift Data Foundation cluster is in **Ready** state.

**Procedure**

1. Click **Storage → StorageClasses**.

2. Click **Create Storage Class**

3. Enter the storage class **Name** and **Description**.

4. Select either **Delete** or **Retain** for the Reclaim Policy. By default, **Delete** is selected.

5. Select RBD Provisioner which is the plugin used for provisioning the persistent volumes.

6. Select an existing **Storage Pool** from the list or create a new pool.

**Create new pool**

a. Click **Create New Pool**

b. Enter **Pool name**

c. Choose **2-way-Replication** or **3-way-Replication** as the Data Protection Policy.
d. Select **Enable compression** if you need to compress the data. Enabling compression can impact application performance and might prove ineffective when data to be written is already compressed or encrypted. Data written before enabling compression will not be compressed.

e. Click **Create** to create the new storage pool.

f. Click **Finish** after the pool is created.

7. Optional: Select **Enable Encryption** checkbox.

8. Click **Create** to create the storage class.

### 5.2. Creating a Storage Class for Persistent Volume Encryption

Persistent volume (PV) encryption guarantees isolation and confidentiality between tenants (applications). Before you can use PV encryption, you must create a storage class for PV encryption.

OpenShift Data Foundation supports storing encryption passphrases in HashiCorp Vault. Use the following procedure to create an encryption enabled storage class using an external key management system (KMS) for persistent volume encryption. Persistent volume encryption is only available for RBD PVs. You can configure access to the KMS in two different ways:

- Using **vaulttokens**: allows users to authenticate using a token
- Using **vaulttenantsa** (technology preview): allows users to use serviceaccounts to authenticate with Vault

**IMPORTANT**

Accessing the KMS using **vaulttenantsa** 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](#).

See the relevant prerequisites section for your use case before following the procedure for creating the storage class:

- **Section 5.2.1, “Prerequisites for using vaulttokens”**
- **Section 5.2.2, “Prerequisites for using vaulttenantsa”**

### 5.2.1. Prerequisites for using vaulttokens

- The OpenShift Data Foundation cluster is in **Ready** state.
- On the external key management system (KMS),
○ Ensure that a policy with a token exists and the key value backend path in Vault is enabled. For more information, see Enabling key value and policy in Vault.

○ Ensure that you are using signed certificates on your Vault servers.

● Create a secret in the tenant’s namespace as follows:
  ○ On the OpenShift Container Platform web console, navigate to Workloads → Secrets.
  ○ Click Create → Key/value secret.
  ○ Enter Secret Name as ceph-csi-kms-token.
  ○ Enter Key as token.
  ○ Enter Value. It is the token from Vault. You can either click Browse to select and upload the file containing the token or enter the token directly in the text box.
  ○ Click Create.

  **NOTE**
  The token can be deleted only after all the encrypted PVCs using the ceph-csi-kms-token have been deleted.

Next, follow the steps in Section 5.2.3, “Procedure for creating a storage class for PV encryption”.

**5.2.2. Prerequisites for using vaulttenantsa**

● The OpenShift Data Foundation cluster is in Ready state.

● On the external key management system (KMS),
  ○ Ensure that a policy exists and the key value backend path in Vault is enabled. For more information, see Enabling key value and policy in Vault.
  ○ Ensure that you are using signed certificates on your Vault servers.

● Create the following serviceaccount in the tenant namespace as shown below:

```
$ cat <<EOF | oc create -f -
apiVersion: v1
kind: ServiceAccount
metadata:
  name: ceph-csi-vault-sa
EOF
```

● The Kubernetes authentication method must be configured before OpenShift Data Foundation can authenticate with and start using Vault. The instructions below create and configure serviceAccount, ClusterRole, and ClusterRoleBinding required to allow OpenShift Data Foundation to authenticate with Vault.

1. Apply the following YAML to your Openshift cluster:

```
apiVersion: v1
kind: ServiceAccount
```
CHAPTER 5. STORAGE CLASSES AND STORAGE POOLS

metadata:
  name: rbd-csi-vault-token-review
---
kind: ClusterRole
apiVersion: rbac.authorization.k8s.io/v1
metadata:
  name: rbd-csi-vault-token-review
rules:
- apiGroups: ["authentication.k8s.io"]
  resources: ["tokenreviews"]
  verbs: ["create", "get", "list"]
---
kind: ClusterRoleBinding
apiVersion: rbac.authorization.k8s.io/v1
metadata:
  name: rbd-csi-vault-token-review
subjects:
- kind: ServiceAccount
  name: rbd-csi-vault-token-review
  namespace: openshift-storage
roleRef:
  kind: ClusterRole
  name: rbd-csi-vault-token-review
  apiGroup: rbac.authorization.k8s.io

2. Identify the secret name associated with the serviceaccount (SA) created above:

   $ oc -n openshift-storage get sa rbd-csi-vault-token-review -o jsonpath="{.secrets[\*]['name']}"

3. Get the token and the CA certificate from the secret:

   $ oc get secret <secret associated with SA> -o jsonpath="{.data[\'token\']}
   | base64 --decode; echo
   $ oc get secret <secret associated with SA> -o jsonpath="{.data[\'ca.crt\']}
   | base64 --decode; echo

4. Retrieve the OCP cluster endpoint:

   $ oc config view --minify --flatten -o jsonpath="{.clusters[0].cluster.server}"

5. Use the information collected in the steps above to setup the kubernetes authentication method in Vault as shown below:

   $ vault auth enable kubernetes
   $ vault write auth/kubernetes/config token_reviewer_jwt=<SA token> kubernetes_host=<OCP cluster endpoint> kubernetes_ca_cert=<SA CA certificate>

6. Create a role in Vault for the tenant namespace:

   $ vault write "auth/kubernetes/role/csi-kubernetes"
   bound_service_account_names="ceph-csi-vault-sa"
   bound_service_account_namespaces=<tenant_namespace> policies=
**csi-kubernetes** is the default role name that OpenShift Data Foundation looks for in Vault. The default service account name in the tenant namespace in the OpenShift Data Foundation cluster is **ceph-csi-vault-sa**. These default values can be overridden by creating a ConfigMap in the tenant namespace.

For more information about overriding the default names, see [Overriding Vault connection details using tenant ConfigMap](#).

In order to create a storageclass that uses the **vaulttenantsa** method for PV encryption, you must either edit the existing ConfigMap or create a ConfigMap named **csi-kms-connection-details** that will hold all the information needed to establish the connection with Vault. The sample yaml given below can be used to update or create the **csi-kms-connection-detail** ConfigMap:

```yaml
apiVersion: v1
data:
vault-tenant-sa: |
{
  "encryptionKMSType": "vaulttenantsa",
  "vaultAddress": "https://hostname_or_ip_of_vault_server:port",
  "vaultTLSServerName": "<vault TLS server name>",
  "vaultAuthPath": "/v1/auth/kubernetes/login",
  "vaultAuthNamespace": "<vault auth namespace name>",
  "vaultNamespace": "<vault namespace name>",
  "vaultBackendPath": "<vault backend path name>",
  "vaultCAFromSecret": "<secret containing CA cert>",
  "vaultClientCertFromSecret": "<secret containing client cert>",
  "vaultClientCertKeyFromSecret": "<secret containing client private key>",
  "tenantSAName": "<service account name in the tenant namespace>",
}
metadata:
  name: csi-kms-connection-details
```

- **encryptionKMSType**: should be set to **vaulttenantsa** to use service accounts for authentication with vault.
- **vaultAddress**: The hostname or IP address of the vault server with the port number.
- **vaultTLSServerName**: (Optional) The vault TLS server name
- **vaultAuthPath**: (Optional) The path where kubernetes auth method is enabled in Vault. The default path is **kubernetes**. If the auth method is enabled in a different path other than **kubernetes**, this variable needs to be set as `"/v1/auth/<path>/login"`.
- **vaultAuthNamespace**: (Optional) The Vault namespace where kubernetes auth method is enabled.
- **vaultNamespace**: (Optional) The Vault namespace where the backend path being used to store the keys exists
- **vaultBackendPath**: The backend path in Vault where the encryption keys will be stored
- **vaultCAFromSecret**: The secret in the OpenShift Data Foundation cluster containing the CA certificate from Vault
The secret in the OpenShift Data Foundation cluster containing the client certificate from Vault

The secret in the OpenShift Data Foundation cluster containing the client private key from Vault

(Optional) The service account name in the tenant namespace. The default value is ceph-csi-vault-sa. If a different name is to be used, this variable has to be set accordingly.

Next, follow the steps in Section 5.2.3, “Procedure for creating a storage class for PV encryption”.

5.2.3. Procedure for creating a storage class for PV encryption

After performing the required prerequisites for either vaulttokens or vaulttenantsa, perform the steps below to create a storage class with encryption enabled.

1. Navigate to Storage → Storage Classes.
2. Click Create Storage Class.
3. Enter the storage class Name and Description.
4. Select either Delete or Retain for the Reclaim Policy. By default, Delete is selected.
5. Select either Immediate or WaitForFirstConsumer as the Volume binding mode. WaitForConsumer is set as the default option.
6. Select RBD Provisioner openshift-storage.rbd.csi.ceph.com which is the plugin used for provisioning the persistent volumes.
7. Select Storage Pool where the volume data is stored from the list or create a new pool.
8. Select the Enable encryption checkbox. There are two options available to set the KMS connection details:
   - Choose existing KMS connection: Select an existing KMS connection from the drop-down list. The list is populated from the connection details available in the csi-kms-connection-details ConfigMap.
   - Create new KMS connection: This is applicable for vaulttokens only.
     a. Key Management Service Provider is set to Vault by default.
     b. Enter a unique Vault Service Name, host Address of the Vault server (https://<hostname or ip>), and Port number.
     c. Expand Advanced Settings to enter additional settings and certificate details based on your Vault configuration.
        i. Enter the key value secret path in Backend Path that is dedicated and unique to OpenShift Data Foundation.
        ii. Optional: Enter TLS Server Name and Vault Enterprise Namespace.
        iii. Provide CA Certificate, Client Certificate and Client Private Key by uploading the respective PEM encoded certificate file.
iv. Click **Save**.

d. Click **Save**.

9. Click **Create**.

10. Edit the ConfigMap to add the **VAULT_BACKEND** or **vaultBackend** parameter if the HashiCorp Vault setup does not allow automatic detection of the Key/Value (KV) secret engine API version used by the backend path.

    ![NOTE](image)

**NOTE**

**VAULT_BACKEND** or **vaultBackend** are optional parameters that has added to the configmap to specify the version of the KV secret engine API associated with the backend path. Ensure that the value matches the KV secret engine API version that is set for the backend path, otherwise it might result in a failure during persistent volume claim (PVC) creation.

a. Identify the encryptionKMSID being used by the newly created storage class.

    i. On the OpenShift Web Console, navigate to **Storage → Storage Classes**.

    ii. Click the **Storage class** name → **YAML** tab.

    iii. Capture the **encryptionKMSID** being used by the storage class.

        Example:

        ```yaml
        encryptionKMSID: 1-vault
        ```

b. On the OpenShift Web Console, navigate to **Workloads → ConfigMaps**.

c. To view the KMS connection details, click **csi-kms-connection-details**.

d. Edit the ConfigMap.

    i. Click **Action menu (⋯) → Edit ConfigMap**.

    ii. Add the **VAULT_BACKEND** or **vaultBackend** parameter depending on the backend that is configured for the previously identified encryptionKMSID. You can assign **kv** for KV secret engine API, version 1 and **kv-v2** for KV secret engine API, version 2.

        Example:

        ```yaml
        kind: ConfigMap
        apiVersion: v1
        metadata:
          name: csi-kms-connection-details
          [...]
        data:
          1-vault: |
            |
            "KMS_PROVIDER": "vaulttokens",
            "KMS_SERVICE_NAME": "1-vault",
          [...]
        ```
"VAULT_BACKEND": "kv-v2"
}
2-vault: |
{
  "encryptionKMSType": "vaulttenantsa",
  ...
  "vaultBackend": "kv-v2"
}

iii. Click Save

Next steps

- The storage class can be used to create encrypted persistent volumes. For more information, see managing persistent volume claims.

**IMPORTANT**

Red Hat works with the technology partners to provide this documentation as a service to the customers. However, Red Hat does not provide support for the HashiCorp product. For technical assistance with this product, contact HashiCorp.

### 5.2.3.1. Overriding Vault connection details using tenant ConfigMap

The Vault connections details can be reconfigured per tenant by creating a ConfigMap in the Openshift namespace with configuration options that differ from the values set in the `csi-kms-connection-details` ConfigMap in the `openshift-storage` namespace. The ConfigMap needs to be located in the tenant namespace. The values in the ConfigMap in the tenant namespace will override the values set in the `csi-kms-connection-details` ConfigMap for the encrypted Persistent Volumes created in that namespace.

**Procedure**

1. Ensure that you are in the tenant namespace.

2. Click on Workloads → ConfigMaps.

3. Click on Create ConfigMap.

4. The following is a sample yaml. The values to be overridden for the given tenant namespace can be specified under the `data` section as shown below:

```yaml
---
apiVersion: v1
kind: ConfigMap
metadata:
  name: ceph-csi-kms-config
data:
  vaultAddress: "<vault_address:port>"
  vaultBackendPath: "<backend_path>"
  vaultTLSServerName: "<vault_tls_server_name>"
  vaultNamespace: "<vault_namespace>"
```

5. Once the yaml is edited, click on Create.
CHAPTER 6. CONFIGURE STORAGE FOR OPENSHIFT CONTAINER PLATFORM SERVICES

You can use OpenShift Data Foundation 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 Data Foundation 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.

6.1. CONFIGURING IMAGE REGISTRY TO USE OPENSHIFT DATA FOUNDATION

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 Data Foundation as storage for the Container Image Registry. On Google Cloud, it is not required to change the storage for the registry.

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 Data Foundation 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 → StorageClasses** to view available storage classes.

**Procedure**

1. **Create a Persistent Volume Claim for the Image Registry to use.**
   a. In the 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.

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

For example:

```yaml
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**.

6.2. CONFIGURING MONITORING TO USE OPENSHEET DATA FOUNDATION

OpenShift Data Foundation provides a monitoring stack that comprises of Prometheus and Alert Manager.

Follow the instructions in this section to configure OpenShift Data Foundation 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 interval for this service. See the [Modifying retention time for Prometheus metrics data](#) of Monitoring guide in the OpenShift Container Platform documentation for details.

**Prerequisites**

- You have administrative access to OpenShift Web Console.
- OpenShift Data Foundation Operator is installed and running in the openshift-storage namespace. In the OpenShift Web Console, click **Operators → Installed Operators** to view installed operators.
- Monitoring Operator is installed and running in the openshift-monitoring namespace. In the 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 the OpenShift Web Console, click **Storage → StorageClasses** to view available storage classes.

**Procedure**

1. In the 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**

```yaml
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.
2. Verify that the new alertmanager-main-* pods appear with a state of **Running**.
   a. Go to Workloads → Pods.
   b. Click the new alertmanager-main-* pods to view the pod details.
   c. 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.

![Figure 6.2. Persistent Volume Claims attached to alertmanager-main-* pod](image)

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.

![Figure 6.3. Persistent Volume Claims attached to prometheus-k8s-* pod](image)

## 6.3. CLUSTER LOGGING FOR OPENSHIFT DATA FOUNDATION
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 Data Foundation 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 Data Foundation to have OpenShift Data Foundation 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.

### 6.3.1. 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:

```yaml
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:

```yaml
spec:
  logStore:
    type: "elasticsearch"
    elasticsearch:
      nodeCount: 3
      storage: {}
```
For more information, see Configuring cluster logging.

### 6.3.2. Configuring cluster logging to use OpenShift data Foundation

Follow the instructions in this section to configure OpenShift Data Foundation as storage for the OpenShift cluster logging.

**NOTE**

You can obtain all the logs when you configure logging for the first time in OpenShift Data Foundation. 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 Data Foundation 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`:

   ```yaml
   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 # Change as per your requirement
         redundancyPolicy: "SingleRedundancy"
     visualization:
   ```
type: "kibana"
kibana:
  replicas: 1
curation:
  type: "curator"
curator:
    schedule: "30 3 * * *"
collection:
  logs:
    type: "fluentd"
    fluentd: {}

If you have tainted the OpenShift Data Foundation nodes, you must add toleration to enable scheduling of the daemonset pods for logging.

```yaml
spec:
  collection:
    logs:
      fluentd:
        tolerations:
          - effect: NoSchedule
            key: node.ocp.openshift.io/storage
            value: 'true'
type: 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 6.4. Cluster logging created and bound](image)

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 PersistentVolumeClaim 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.

```yaml
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 Data Foundation in the uninstall chapter of the respective deployment guide.
You cannot directly install OpenShift Data Foundation during the OpenShift Container Platform installation. However, you can install OpenShift Data Foundation on an existing OpenShift Container Platform by using the Operator Hub and then configure the OpenShift Container Platform applications to be backed by OpenShift Data Foundation.

Prerequisites

- OpenShift Container Platform is installed and you have administrative access to OpenShift Web Console.
- OpenShift Data Foundation 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 can expand the block PVs but cannot reduce 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 which you added storage to display 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 Persistent Volume Claim Overview page.
CHAPTER 8. HOW TO USE DEDICATED WORKER NODES FOR RED HAT OPENSHIFT DATA FOUNDATION

Any Red Hat OpenShift Container Platform subscription requires an OpenShift Data Foundation subscription. However, you can save on the OpenShift Container Platform subscription costs if you are using infrastructure nodes to schedule OpenShift Data Foundation resources.

It is important to maintain consistency across environments with or without Machine API support. Because of this, it is highly recommended in all cases to have a special category of nodes labeled as either worker or infra or have both roles. See the Section 8.3, “Manual creation of infrastructure nodes” section for more information.

8.1. ANATOMY OF AN INFRASTRUCTURE NODE

Infrastructure nodes for use with OpenShift Data Foundation have a few attributes. The infra node-role label is required to ensure the node does not consume RHOCP entitlements. The infra node-role label is responsible for ensuring only OpenShift Data Foundation entitlements are necessary for the nodes running OpenShift Data Foundation.

- Labeled with node-role.kubernetes.io/infra

Adding an OpenShift Data Foundation taint with a NoSchedule effect is also required so that the infra node will only schedule OpenShift Data Foundation resources.

- Tainted with node.ocs.openshift.io/storage="true"

The label identifies the RHOCP node as an infra node so that RHOCP subscription cost is not applied. The taint prevents non OpenShift Data Foundation resources to be scheduled on the tainted nodes.

Example of the taint and labels required on infrastructure node that will be used to run OpenShift Data Foundation services:

```yaml
spec:
  taints:
  - effect: NoSchedule
    key: node.ocs.openshift.io/storage
    value: "true"
  metadata:
    creationTimestamp: null
  labels:
    node-role.kubernetes.io/worker: ""
    node-role.kubernetes.io/infra: ""
    cluster.ocs.openshift.io/openshift-storage: ""
```

8.2. MACHINE SETS FOR CREATING INFRASTRUCTURE NODES

If the Machine API is supported in the environment, then labels should be added to the templates for the Machine Sets that will be provisioning the infrastructure nodes. Avoid the anti-pattern of adding labels manually to nodes created by the machine API. Doing so is analogous to adding labels to pods created by a deployment. In both cases, when the pod/node fails, the replacement pod/node will not have the appropriate labels.
NOTE

In EC2 environments, you will need three machine sets, each configured to provision infrastructure nodes in a distinct availability zone (such as us-east-2a, us-east-2b, us-east-2c). Currently, OpenShift Data Foundation does not support deploying in more than three availability zones.

The following Machine Set template example creates nodes with the appropriate taint and labels required for infrastructure nodes. This will be used to run OpenShift Data Foundation services.

```yaml
template:
  metadata:
    creationTimestamp: null
    labels:
      machine.openshift.io/cluster-api-cluster: kb-s25vf
      machine.openshift.io/cluster-api-machine-role: worker
      machine.openshift.io/cluster-api-machine-type: worker
      machine.openshift.io/cluster-api-machineset: kb-s25vf-infra-us-west-2a
  spec:
    taints:
    - effect: NoSchedule
      key: node.ocs.openshift.io/storage
      value: "true"
    metadata:
      creationTimestamp: null
      labels:
        node-role.kubernetes.io/infra: ""
        cluster.ocs.openshift.io/openshift-storage: ""
```

8.3. MANUAL CREATION OF INFRASTRUCTURE NODES

Only when the Machine API is not supported in the environment should labels be directly applied to nodes. Manual creation requires that at least 3 RHOCP worker nodes are available to schedule OpenShift Data Foundation services, and that these nodes have sufficient CPU and memory resources. To avoid the RHOCP subscription cost, the following is required:

```bash
oc label node <node> node-role.kubernetes.io/infra=""
oc label node <node> cluster.ocs.openshift.io/openshift-storage=""
```

Adding a **NoSchedule** OpenShift Data Foundation taint is also required so that the **infra** node will only schedule OpenShift Data Foundation resources and repel any other non-OpenShift Data Foundation workloads.

```bash
oc adm taint node <node> node.ocs.openshift.io/storage="true":NoSchedule
```
WARNING

Do not remove the node-role.kubernetes.io/worker=""

The removal of the node-role.kubernetes.io/worker="" can cause issues unless changes are made both to the OpenShift scheduler and to MachineConfig resources.

If already removed, it should be added again to each infra node. Adding node-role node-role.kubernetes.io/infra="" and OpenShift Data Foundation taint is sufficient to conform to entitlement exemption requirements.
CHAPTER 9. SCALING STORAGE NODES

To scale the storage capacity of OpenShift Data Foundation, you can do either of the following:

- **Scale up storage nodes** - Add storage capacity to the existing OpenShift Data Foundation worker nodes
- **Scale out storage nodes** - Add new worker nodes containing storage capacity

9.1. 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 Data Foundation instance:

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

**WARNING**

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.

9.2. SCALING UP STORAGE BY ADDING CAPACITY TO YOUR OPENSHIFT DATA FOUNDATION NODES ON GOOGLE CLOUD INFRASTRUCTURE

You can add storage capacity and performance to your configured Red Hat OpenShift Data Foundation worker nodes.

**Prerequisites**

- A running OpenShift Data Foundation Platform.
- Administrative privileges on the OpenShift Web Console.
To scale using a storage class other than the one provisioned during deployment, first define an additional storage class. See Creating a storage class for details.

**Procedure**

1. Log in to the OpenShift Web Console.
2. Click Operators → Installed Operators
3. Click OpenShift Data Foundation Operator.
4. Click the Storage Systems tab.
   a. Click the Action Menu (⋮) on the far right of the storage system name to extend the options menu.
   b. Select Add Capacity from the options menu.
   c. Select the Storage Class.

Set the storage class to **standard** if you are using the default storage class that uses HDD. However, if you created a storage class to use SSD based disks for better performance, you need to select that storage class.

+ The **Raw Capacity** field shows the size set during storage class creation. The total amount of storage consumed is three times this amount, because OpenShift Data Foundation uses a replica count of 3.

   a. Click Add.

   1. To check the status, navigate to Storage → OpenShift Data Foundation and verify that Storage System in the Status card has a green tick.

**Verification steps**

- Verify the **Raw Capacity** card.
  a. In the OpenShift Web Console, click Storage → OpenShift Data Foundation.
  b. In the Status card of the Overview tab, click Storage System and then click the storage system link from the pop up that appears.
  c. In the Block and File tab, check the Raw Capacity card.

  **NOTE**

  The raw capacity does not take replication into account and shows the full capacity.

- Verify that the new OSDs and their corresponding new Persistent Volume Claims (PVCs) are created.

  a. To view the state of the newly created OSDs:
     a. Click Workloads → Pods from the OpenShift Web Console.
     b. Select openshift-storage from the Project drop-down list.
NOTE
If the **Show default projects** option is disabled, use the toggle button to list all the default projects.

- To view the state of the PVCs:
  a. Click **Storage → Persistent Volume Claims** from the OpenShift Web Console.
  b. Select **openshift-storage** from the **Project** drop-down list.

NOTE
If the **Show default projects** option is disabled, use the toggle button to list all the default projects.

- Optional: If cluster-wide encryption is enabled on the cluster, verify that the new OSD devices are encrypted.
  a. Identify the nodes where the new OSD pods are running.

```bash
$ oc get -o=custom-columns=NODE:.spec.nodeName pod/<OSD-pod-name>
```

*<OSD-pod-name>*

Is the name of the OSD pod.
For example:

```bash
oc get -o=custom-columns=NODE:.spec.nodeName pod/rook-ceph-osd-0-544db49d7f-qrgqm
```

b. For each of the nodes identified in the previous step, do the following:
  i. Create a debug pod and open a chroot environment for the selected hosts.

```bash
$ oc debug node/<node-name>
```

*<node-name>*

Is the name of the node.

```bash
$ chroot /host
```

  ii. Check for the **crypt** keyword beside the **ocs-deviceset** names.

```bash
$ lsblk
```

**IMPORTANT**
Cluster reduction is not currently supported, regardless of whether reduction would be done by removing nodes or OSDs.
9.3. SCALING OUT STORAGE CAPACITY BY ADDING NEW NODES

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

- Add a new node to increase the storage capacity when existing worker nodes are already running at their maximum supported OSDs, which is the increment of 3 OSDs of the capacity selected during initial configuration.
- Verify that the new node is added successfully
- Scale up the storage capacity after the node is added

9.3.1. Adding a node on Google Cloud installer-provisioned infrastructure

Prerequisites

- You must be logged into OpenShift Container Platform cluster.

Procedure

1. Navigate to Compute → Machine Sets.
2. On the machine set where you want to add nodes, select Edit Machine Count
   a. Add the amount of nodes, and click Save.
   b. Click Compute → Nodes and confirm if the new node is in Ready state.
3. Apply the OpenShift Data Foundation label to the new node.
   a. For the new node, click 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 Verifying the addition of a new node.

9.3.2. 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-
9.3.3. Scaling up storage capacity

After you add a new node to OpenShift Data Foundation, you must scale up the storage capacity as described in Scaling up storage by adding capacity.
10.1. 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.

10.2. 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 Multicloud Object Gateway (MCG) endpoint, an access key, and a secret access key. You can use your terminal or the MCG CLI to retrieve this information.

Prerequisites

- A running OpenShift Data Foundation Platform.
- Download the MCG command-line interface for easier management.

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

**NOTE**

Specify the appropriate architecture for enabling the repositories using the subscription manager.

- For IBM Power Systems, use the following command:

  ```bash
  # subscription-manager repos --enable=rh-odf-4-for-rhel-8-ppc64le-rpms
  ```

- For IBM Z infrastructure, use the following command:

  ```bash
  # subscription-manager repos --enable=rh-odf-4-for-rhel-8-s390x-rpms
  ```

- Alternatively, you can install the MCG package from the OpenShift Data Foundation RPMs found at Download RedHat OpenShift Data Foundation page.

**NOTE**

Choose the correct Product Variant according to your architecture.

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

- **Section 10.2.1, “Accessing the Multicloud Object Gateway from the terminal”**

- **Section 10.2.2, “Accessing the Multicloud Object Gateway from the MCG command-line interface”**
Example 10.1. Example

Accessing the MCG bucket(s) using the virtual-hosted style

If the client application tries to access https://<bucket-name>.s3-openshiftstorage.apps.mycluster-cluster.qe.rh-ocs.com

 `<bucket-name>`

is the name of the MCG bucket
For example, https://mcg-test-bucket.s3-openshift-storage.apps.mycluster-cluster.qe.rh-ocs.com

A DNS entry is needed for mcg-test-bucket.s3-openshift-storage.apps.mycluster-cluster.qe.rh-ocs.com to point to the S3 Service.

**IMPORTANT**

Ensure that you have a DNS entry in order to point the client application to the MCG bucket(s) using the virtual-hosted style.

10.2.1. Accessing the Multicloud Object Gateway from the terminal

Procedure

Run the `describe` command to view information about the Multicloud Object Gateway (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:
  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
```
Welcome to NooBaa!

---

Welcome to NooBaa!

---

NooBaa Core Version:
NooBaa Operator Version:

Let's 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
access key (**AWS_ACCESS_KEY_ID** value)

secret access key (**AWS_SECRET_ACCESS_KEY** value)

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.

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

**Prerequisites**

- Download the MCG command-line interface.

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

**NOTE**

Specify the appropriate architecture for enabling the repositories using the subscription manager.

- For IBM Power Systems, use the following command:

```shell
# subscription-manager repos --enable=rh-odf-4-for-rhel-8-ppc64le-rpms
```

- For IBM Z infrastructure, use the following command:

```shell
# subscription-manager repos --enable=rh-odf-4-for-rhel-8-s390x-rpms
```

**Procedure**

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

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

The output will look similar to the following:
INFO[0000] Namespace: openshift-storage
INFO[0000] CRD Status:
INFO[0000]  Exists: CustomResourceDefinition "nooba.noobaa.io"
INFO[0000]  Exists: CustomResourceDefinition "backingstores.noobaa.io"
INFO[0000]  Exists: CustomResourceDefinition "bucketclasses.noobaa.io"
INFO[0000]  Exists: CustomResourceDefinition "objectbucketclaims.objectbucket.io"
INFO[0000]  Exists: CustomResourceDefinition "objectbuckets.objectbucket.io"
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] System Status:
INFO[0006]  Exists: NooBaa "noobaa"
INFO[0006]  Exists: StatefulSet "noobaa-core"
INFO[0006]  Exists: Service "noobaa-mgmt"
INFO[0006]  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/soulkSiA==
You now have the relevant endpoint, access key, and secret access key in order to connect to your applications.

Example 10.2. Example
If AWS S3 CLI is the application, the following command will list the buckets in OpenShift Data Foundation:

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

### 10.3. ALLOWING USER ACCESS TO THE MULTICLOUD OBJECT GATEWAY CONSOLE

To allow access to the Multicloud Object Gateway (MCG) 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 Data Foundation Platform.

**Procedure**

1. Enable access to the MCG console.
   Perform the following steps once on the cluster:
   a. Create a `cluster-admins` group.
      ```bash
      # oc adm groups new cluster-admins
      ```
   b. Bind the group to the `cluster-admin` role.
      ```bash
      # 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 MCG console.
   - To add a set of users to the `cluster-admins` group:
     ```bash
     # 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 Data Foundation dashboard.

   - To remove a set of users from the `cluster-admins` group:
     ```bash
     # oc adm groups del-users cluster-admins <user-name> <user-name> <user-name>...
     ```
# 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 Storage → OpenShift Data Foundation.
3. In the Storage Systems tab, select the storage system and then click Overview → Object tab.
4. Select the Multicloud Object Gateway link.
5. Click Allow selected permissions.

10.4. ADDING STORAGE RESOURCES FOR HYBRID OR MULTICLOUD

10.4.1. Creating a new backing store

Use this procedure to create a new backing store in OpenShift Data Foundation.

Prerequisites

- Administrator access to OpenShift Data Foundation.

Procedure

1. In the OpenShift Web Console, click Storage → OpenShift Data Foundation.
2. Click the Backing Store tab.
3. Click Create Backing Store.
4. 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 the 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 backing store requires a different secret. For more information on creating the secret for a particular backing store, see the Section 10.4.2, “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.
f. Enter the **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 the MCG that it can use this bucket for the system.

5. Click **Create Backing Store**.

**Verification steps**

1. In the OpenShift Web Console, click **Storage → OpenShift Data Foundation**.
2. Click the **Backing Store** tab to view all the backing stores.

### 10.4.2. 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 10.4.2.1, “Creating an AWS-backed backingstore”**
- For creating an IBM COS-backed backingstore, see **Section 10.4.2.2, “Creating an IBM COS-backed backingstore”**
- For creating an Azure-backed backingstore, see **Section 10.4.2.3, “Creating an Azure-backed backingstore”**
- For creating a GCP-backed backingstore, see **Section 10.4.2.4, “Creating a GCP-backed backingstore”**
- For creating a local Persistent Volume-backed backingstore, see **Section 10.4.2.5, “Creating a local Persistent Volume-backed backingstore”**

For VMware deployments, skip to **Section 10.4.3, “Creating an s3 compatible Multicloud Object Gateway backingstore”** for further instructions.

#### 10.4.2.1. Creating an AWS-backed backingstore

**Prerequisites**

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

```bash
# subscription-manager repos --enable=rh-odf-4-for-rhel-8-x86_64-rpms
# yum install mcg
```
NOTE
Specify the appropriate architecture for enabling the repositories using the subscription manager. For instance, in case of IBM Z infrastructure use the following command:

```
# subscription-manager repos --enable=rh-odf-4-for-rhel-8-s390x-rpms
```

- Alternatively, you can install the MCG package from the OpenShift Data Foundation RPMs found here [here](https://access.redhat.com/downloads/content/547/ver=4/rhel--8/4/x86_64/packages)

NOTE
Choose the correct Product Variant according to your architecture.

Procedure

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

```
noobaa backingstore create aws-s3 <backingstore_name> --access-key=<AWS ACCESS KEY> --secret-key=<AWS SECRET ACCESS KEY> --target-bucket <bucket-name> -n openshift-storage
```

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 the MCG 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:

```yaml
apiVersion: v1
kind: Secret
metadata:
  name: <backingstore-secret-name>
  namespace: openshift-storage
  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>
```

You can create and use this secret as needed.
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>`.

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

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

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

a. Replace `<bucket-name>` with an existing AWS bucket name. This argument tells the MCG 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.

### 10.4.2.2. Creating an IBM COS-backed backingstore

**Prerequisites**

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

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

**NOTE**

Specify the appropriate architecture for enabling the repositories using the subscription manager. For instance,

- For IBM Power Systems, use the following command:

```bash
# subscription-manager repos --enable=rh-odf-4-for-rhel-8-ppc64le-rpms
```

- For IBM Z infrastructure, use the following command:

```bash
# subscription-manager repos --enable=rh-odf-4-for-rhel-8-s390x-rpms
```
Alternatively, you can install the MCG package from the OpenShift Data Foundation RPMs found here https://access.redhat.com/downloads/content/547/ver=4/rhel---8/4/x86_64/packages

**NOTE**

Choose the correct Product Variant according to your architecture.

**Procedure**

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

   ```bash
   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> -n openshift-storage
   ```

   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 the MCG 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:

      ```yaml
      apiVersion: v1
      kind: Secret
      metadata:
        name: <backingstore-secret-name>
        namespace: openshift-storage
      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 the MCG 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.

10.4.2.3. Creating an Azure-backed backingstore

Prerequisites

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

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

NOTE

Specify the appropriate architecture for enabling the repositories using the subscription manager. For instance, in case of IBM Z infrastructure use the following command:

  ```bash
  # subscription-manager repos --enable=rh-odf-4-for-rhel-8-s390x-rpms
  ```

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

NOTE

Choose the correct Product Variant according to your architecture.
Procedure

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

   ```shell
   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 the MCG 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:

   ```yaml
   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:

   ```yaml
   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 the MCG 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.

10.4.2.4. Creating a GCP-backed backingstore

Prerequisites

- Download the Multicloud Object Gateway (MCG) command-line interface.
  
  # subscription-manager repos --enable=rh-odf-4-for-rhel-8-x86_64-rpms
  # yum install mcg

  **NOTE**

  Specify the appropriate architecture for enabling the repositories using the subscription manager. For instance, in case of IBM Z infrastructure use the following command:

  # subscription-manager repos --enable=rh-odf-4-for-rhel-8-s390x-rpms

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

  **NOTE**

  Choose the correct Product Variant according to your architecture.

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 the MCG 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:
You can also add storage resources using a YAML:

1. Create a secret with the credentials:

   ```yaml
   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:

   ```yaml
   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 the MCG 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.

10.4.2.5. Creating a local Persistent Volume-backed backingstore

**Prerequisites**

- Download the Multicloud Object Gateway (MCG) command-line interface.
# subscription-manager repos --enable=rh-odf-4-for-rhel-8-x86_64-rpms
# yum install mcg

**NOTE**

Specify the appropriate architecture for enabling the repositories using the subscription manager. For instance, in case of IBM Z infrastructure use the following command:

```bash
# subscription-manager repos --enable=rh-odf-4-for-rhel-8-s390x-rpms
```

- Alternatively, you can install the MCG package from the OpenShift Data Foundation RPMs found here [https://access.redhat.com/downloads/content/547/ver=4/rhel--8/4/x86_64/packages](https://access.redhat.com/downloads/content/547/ver=4/rhel--8/4/x86_64/packages)

**NOTE**

Choose the correct Product Variant according to your architecture.

**Procedure**

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

```bash
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. Note that increasing the number of volumes scales up the storage.
   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:

   ```bash
   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:

```yaml
apiVersion: noobaa.io/v1alpha1
type: 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. Note that increasing the number of volumes scales up the storage.
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`.

10.4.3. Creating an s3 compatible Multicloud Object Gateway backingstore

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

Procedure

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

   ```
   noobaa backingstore create s3-compatible rgw-resource --access-key=<RGW ACCESS KEY> --secret-key=<RGW SECRET KEY> --target-bucket=<bucket-name> --endpoint=<RGW endpoint>
   ```

   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 -n openshift-storage
   ```

   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 the MCG which bucket to use as a target bucket for its backing store, and subsequently, data storage and administration.

e. To get the `<RGW endpoint>` , see Accessing the RADOS Object Gateway S3 endpoint . The output will be similar to the following:
You can also create the backingstore using a YAML:

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

   ```yaml
   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:

   ```yaml
   apiVersion: noobaa.io/v1alpha1
   kind: BackingStore
   metadata:
     finalizers:
     - noobaa.io/finalizer
   labels:
     app: noobaa
     name: <backingstore-name>
     namespace: openshift-storage
   spec:
     s3Compatible:
       endpoint: <RGW endpoint>
       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 the MCG which bucket to use as a target bucket for its backing store, and subsequently, data storage and administration.

   c. To get the `<RGW endpoint>`, see Accessing the RADOS Object Gateway S3 endpoint.

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

Procedure
1. In the OpenShift Web Console, click **Storage → OpenShift Data Foundation**.

2. In the **Storage Systems** tab, select the storage system and then click **Overview → Object** tab.

3. Select the **Multicloud Object Gateway** link.

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

2. Select **Add new connection**

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

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

### 10.4.5. 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 Data Foundation.

**Procedure**

1. In the OpenShift Web Console, click *Storage → OpenShift Data Foundation*.
2. Click the *Bucket Class* tab.
3. Click *Create Bucket Class*.
4. On the Create new Bucket Class page, perform the following:
   a. Select the bucket class type and enter a bucket class name.
      i. Select the *BucketClass type*. Choose one of the following options:
         - **Standard**: data will be consumed by a Multicloud Object Gateway (MCG), deduped, compressed and encrypted.
         - **Namespace**: data is stored on the NamespaceStores without performing deduplication, compression or encryption.
         By default, **Standard** is selected.
      ii. Enter a *Bucket Class Name*.
      iii. Click *Next*. 
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.

c. Select at least one **Back ing 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.

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

d. Review and confirm Bucket Class settings.

e. Click **Create Bucket Class**

Verification steps

1. In the OpenShift Web Console, click **Storage → OpenShift Data Foundation**.

2. Click the **Bucket Class** tab and search the new Bucket Class.

10.4.6. Editing a bucket class

Use the following procedure to edit the bucket class components through the YAML file by clicking the **edit** button on the Openshift web console.

**Prerequisites**

- Administrator access to OpenShift Web Console.

**Procedure**

1. In the OpenShift Web Console, click **Storage → OpenShift Data Foundation**.

2. Click the **Bucket Class** tab.

3. Click the Action Menu (⋯) next to the Bucket class you want to edit.

4. Click **Edit Bucket Class**.

5. You are redirected to the YAML file, make the required changes in this file and click **Save**.

10.4.7. Editing backing stores for bucket class

Use the following procedure to edit an existing Multicloud Object Gateway (MCG) bucket class to change the underlying backing stores used in a bucket class.
Prerequisites

- Administrator access to OpenShift Web Console.
- A bucket class.
- Backing stores.

Procedure

1. In the OpenShift Web Console, click **Storage → OpenShift Data Foundation**.

2. Click the **Bucket Class** tab.

3. Click the Action Menu (⋮) next to the Bucket class you want to edit.

4. Click **Edit Bucket Class Resources**.

5. On the **Edit Bucket Class Resources** page, edit the bucket class resources either by adding a backing store to the bucket class or by removing a backing store from the bucket class. You can also edit bucket class resources created with one or two tiers and different placement policies.

   - To add a backing store to the bucket class, select the name of the backing store.

   - To remove a backing store from the bucket class, clear the name of the backing store.

6. Click **Save**.
10.5. MANAGING NAMESPACE BUCKETS

Namespace buckets let you connect data repositories on different providers together, so you can interact with all of your data through a single unified view. Add the object bucket associated with each provider to the namespace bucket, and access your data through the namespace bucket to see all of your object buckets at once. This lets you write to your preferred storage provider while reading from multiple other storage providers, greatly reducing the cost of migrating to a new storage provider.

You can interact with objects in a namespace bucket using the S3 API. See S3 API endpoints for objects in namespace buckets for more information.

NOTE

A namespace bucket can only be used if its write target is available and functional.

10.5.1. Amazon S3 API endpoints for objects in namespace buckets

You can interact with objects in the namespace buckets using the Amazon Simple Storage Service (S3) API.

Red Hat OpenShift Data Foundation 4.6 onwards supports the following namespace bucket operations:

- ListObjectVersions
- ListObjects
- PutObject
- CopyObject
- ListParts
- CreateMultipartUpload
- CompleteMultipartUpload
- UploadPart
- UploadPartCopy
- AbortMultipartUpload
- GetObjectAcl
- GetObject
- HeadObject
- DeleteObject
- DeleteObjects

See the Amazon S3 API reference documentation for the most up-to-date information about these operations and how to use them.

Additional resources
10.5.2. Adding a namespace bucket using the Multicloud Object Gateway CLI and YAML

For more information about namespace buckets, see Managing namespace buckets.

Depending on the type of your deployment and whether you want to use YAML or the Multicloud Object Gateway CLI, choose one of the following procedures to add a namespace bucket:

- Adding an AWS S3 namespace bucket using YAML
- Adding an IBM COS namespace bucket using YAML
- Adding an AWS S3 namespace bucket using the Multicloud Object Gateway CLI
- Adding an IBM COS namespace bucket using the Multicloud Object Gateway CLI

10.5.2.1. Adding an AWS S3 namespace bucket using YAML

**Prerequisites**

- A running OpenShift Data Foundation Platform
- Access to the Multicloud Object Gateway (MCG), see Chapter 2, Accessing the Multicloud Object Gateway with your applications.

**Procedure**

1. Create a secret with the credentials:

   ```yaml
   apiVersion: v1
   kind: Secret
   metadata:
     name: <namespacestore-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 `<namespacestore-secret-name>` with a unique name.

2. Create a NamespaceStore resource using OpenShift Custom Resource Definitions (CRDs). A NamespaceStore represents underlying storage to be used as a read or write target for the data in the MCG namespace buckets. To create a NamespaceStore resource, apply the following YAML:

   ```yaml
   apiVersion: noobaa.io/v1alpha1
   kind: NamespaceStore
   ```
metadata:
  finalizers:
  - noobaa.io/finalizer
labels:
  app: noobaa
  name: <resource-name>
  namespace: openshift-storage
spec:
  awsS3:
    secret:
      name: <namespacestore-secret-name>
      namespace: <namespace-secret>
      targetBucket: <target-bucket>
type: aws-s3

a. Replace `<resource-name>` with the name you want to give to the resource.
b. Replace `<namespacestore-secret-name>` with the secret created in step 1.
c. Replace `<namespace-secret>` with the namespace where the secret can be found.
d. Replace `<target-bucket>` with the target bucket you created for the NamespaceStore.

3. Create a namespace bucket class that defines a namespace policy for the namespace buckets. The namespace policy requires a type of either `single` or `multi`.
   - A namespace policy of type `single` requires the following configuration:

   ```yaml
   apiVersion: noobaa.io/v1alpha1
   kind: BucketClass
   metadata:
     labels:
       app: noobaa
       name: <my-bucket-class>
       namespace: openshift-storage
   spec:
     namespacePolicy:
       type:
       single:
         resource: <resource>
   ```
   - Replace `<my-bucket-class>` with a unique namespace bucket class name.
   - Replace `<resource>` with the name of a single namespace-store that defines the read and write target of the namespace bucket.

   - A namespace policy of type `multi` requires the following configuration:

   ```yaml
   apiVersion: noobaa.io/v1alpha1
   kind: BucketClass
   metadata:
     labels:
       app: noobaa
       name: <my-bucket-class>
       namespace: openshift-storage
   ```
spec:
  namespacePolicy:
    type: Multi
  multi:
    writeResource: <write-resource>
    readResources:
      - <read-resources>
      - <read-resources>

- Replace `<my-bucket-class>` with a unique bucket class name.
- Replace `<write-resource>` with the name of a single namespace-store that defines the write target of the namespace bucket.
- Replace `<read-resources>` with a list of the names of the namespace-stores that defines the read targets of the namespace bucket.

4. Apply the following YAML to create a bucket using an Object Bucket Class (OBC) resource that uses the bucket class defined in step 2.

```yaml
apiVersion: objectbucket.io/v1alpha1
kind: ObjectBucketClaim
metadata:
  name: <resource-name>
  namespace: openshift-storage
spec:
  generateBucketName: <my-bucket>
  storageClassName: noobaa.noobaa.io
  additionalConfig:
    bucketclass: <my-bucket-class>
```

**NOTE**

For IBM Power Systems and IBM Z infrastructure use `storageClassName` as `openshift-storage.noobaa.io`

a. Replace `<resource-name>` with the name you want to give to the resource.
b. Replace `<my-bucket>` with the name you want to give to the bucket.
c. Replace `<my-bucket-class>` with the bucket class created in the previous step.

Once the OBC is provisioned by the operator, a bucket is created in the MCG, and the operator creates a Secret and ConfigMap with the same name and on the same namespace of the OBC.

### 10.5.2.2. Adding an IBM COS namespace bucket using YAML

**Prerequisites**

- A running OpenShift Data Foundation Platform.
- Access to the Multicloud Object Gateway (MCG), see Chapter 2, *Accessing the Multicloud Object Gateway with your applications.*
Procedure

1. Create a secret with the credentials:

```yaml
apiVersion: v1
kind: Secret
metadata:
  name: <namespacestore-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 `<namespacestore-secret-name>` with a unique name.

2. Create a NamespaceStore resource using OpenShift Custom Resource Definitions (CRDs). A NamespaceStore represents underlying storage to be used as a read or write target for the data in the MCG namespace buckets. To create a NamespaceStore resource, apply the following YAML:

```yaml
apiVersion: noobaa.io/v1alpha1
kind: NamespaceStore
metadata:
  finalizers:
  - noobaa.io/finalizer
  labels:
    app: noobaa
  name: bs
  namespace: openshift-storage
spec:
  s3Compatible:
    endpoint: <IBM COS ENDPOINT>
  secret:
    name: <namespacestore-secret-name>
    namespace: <namespace-secret>
    signatureVersion: v2
  targetBucket: <target-bucket>
  type: ibm-cos
```

   a. Replace `<IBM COS ENDPOINT>` with the appropriate IBM COS endpoint.

   b. Replace `<namespacestore-secret-name>` with the secret created in step 1.

   c. Replace `<namespace-secret>` with the namespace where the secret can be found.

   d. Replace `<target-bucket>` with the target bucket you created for the NamespaceStore.

3. Create a namespace bucket class that defines a namespace policy for the namespace buckets. The namespace policy requires a type of either **single** or **multi**.

   - A namespace policy of type **single** requires the following configuration:
apiVersion: noobaa.io/v1alpha1
kind: BucketClass
metadata:
  labels:
    app: noobaa
    name: <my-bucket-class>
  namespace: openshift-storage
spec:
  namespacePolicy:
    type:
      single:
        resource: <resource>

- Replace `<my-bucket-class>` with a unique namespace bucket class name.
- Replace `<resource>` with the name of a single namespace-store that defines the read and write target of the namespace bucket.

- A namespace policy of type `multi` requires the following configuration:

apiVersion: noobaa.io/v1alpha1
kind: BucketClass
metadata:
  labels:
    app: noobaa
    name: <my-bucket-class>
  namespace: openshift-storage
spec:
  namespacePolicy:
    type: Multi
    multi:
      writeResource: <write-resource>
      readResources:
        - <read-resources>
        - <read-resources>

- Replace `<my-bucket-class>` with a unique bucket class name.
- Replace `<write-resource>` with the name of a single namespace-store that defines the write target of the namespace bucket.
- Replace `<read-resources>` with a list of the names of namespace-stores that defines the read targets of the namespace bucket.

4. Apply the following YAML to create a bucket using an Object Bucket Class (OBC) resource that uses the bucket class defined in step 2.

apiVersion: objectbucket.io/v1alpha1
kind: ObjectBucketClaim
metadata:
  name: <resource-name>
  namespace: openshift-storage
spec:
  generateBucketName: <my-bucket>
storageClassName: noobaa.noobaa.io
additionalConfig:
  bucketclass: <my-bucket-class>

NOTE
For IBM Power Systems and IBM Z infrastructure use storageClassName as openshift-storage.noobaa.io

a. Replace `<resource-name>` with the name you want to give to the resource.
b. Replace `<my-bucket>` with the name you want to give to the bucket.
c. Replace `<my-bucket-class>` with the bucket class created in the previous step.

Once the OBC is provisioned by the operator, a bucket is created in the MCG, and the operator creates a Secret and ConfigMap with the same name and on the same namespace of the OBC.

10.5.2.3. Adding an AWS S3 namespace bucket using the Multicloud Object Gateway CLI

Prerequisites

- A running OpenShift Data Foundation Platform.
- Access to the Multicloud Object Gateway (MCG), see Chapter 2, Accessing the Multicloud Object Gateway with your applications.

Download the MCG command-line interface:

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

NOTE
Specify the appropriate architecture for enabling the repositories using subscription manager. For instance, in case of IBM Z infrastructure use the following command:

```bash
# subscription-manager repos --enable=rh-odf-4-for-rhel-8-s390x-rpms
```

Alternatively, you can install the MCG package from the OpenShift Data Foundation RPMs found here

NOTE
Choose the correct Product Variant according to your architecture.

Procedure

1. Create a NamespaceStore resource. A NamespaceStore represents an underlying storage to be used as a read or write target for the data in MCG namespace buckets. From the MCG command-line interface, run the following command:
noobaa namespacestore create aws-s3 <namespacestore> --access-key <AWS ACCESS KEY> --secret-key <AWS SECRET ACCESS KEY> --target-bucket <bucket-name> -n openshift-storage

a. Replace <namespacestore> with the name of the NamespaceStore.

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 the MCG which bucket to use as a target bucket for its backing store, and subsequently, data storage and administration.

2. Create a namespace bucket class that defines a namespace policy for the namespace buckets. The namespace policy requires a type of either single or multi.

   - Run the following command to create a namespace bucket class with a namespace policy of type single:

     ```
     noobaa bucketclass create namespace-bucketclass single <my-bucket-class> --resource <resource> -n openshift-storage
     ```

     - Replace <resource-name> with the name you want to give the resource.

     - Replace <my-bucket-class> with a unique bucket class name.

     - Replace <resource> with a single namespace-store that defines the read and write target of the namespace bucket.

   - Run the following command to create a namespace bucket class with a namespace policy of type multi:

     ```
     noobaa bucketclass create namespace-bucketclass multi <my-bucket-class> --write-resource <write-resource> --read-resources <read-resources> -n openshift-storage
     ```

     - Replace <resource-name> with the name you want to give the resource.

     - Replace <my-bucket-class> with a unique bucket class name.

     - Replace <write-resource> with a single namespace-store that defines the write target of the namespace bucket.

     - Replace <read-resources> with a list of namespace-stores separated by commas that defines the read targets of the namespace bucket.

3. Run the following command to create a bucket using an Object Bucket Class (OBC) resource that uses the bucket class defined in step 2.

   ```
   noobaa obc create my-bucket-claim -n openshift-storage --app-namespace my-app --bucketclass <custom-bucket-class>
   ```

   a. Replace <bucket-name> with a bucket name of your choice.

   b. Replace <custom-bucket-class> with the name of the bucket class created in step 2.
Once the OBC is provisioned by the operator, a bucket is created in the MCG, and the operator creates a Secret and ConfigMap with the same name and on the same namespace of the OBC.

### 10.5.2.4. Adding an IBM COS namespace bucket using the Multicloud Object Gateway CLI

#### Prerequisites
- A running OpenShift Data Foundation Platform.
- Access to the Multicloud Object Gateway (MCG), see Chapter 2, *Accessing the Multicloud Object Gateway with your applications*.
- Download the MCG command-line interface:

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

  **NOTE**
  Specify the appropriate architecture for enabling the repositories using subscription manager.

  - For IBM Power Systems, use the following command:
    ```sh
    # subscription-manager repos --enable=rh-odf-4-for-rhel-8-ppc64le-rpms
    ```
  - For IBM Z infrastructure, use the following command:
    ```sh
    # subscription-manager repos --enable=rh-odf-4-for-rhel-8-s390x-rpms
    ```

  Alternatively, you can install the MCG package from the OpenShift Data Foundation RPMs found here https://access.redhat.com/downloads/content/547/ver=4/rhel-8/4/x86_64/package.

  **NOTE**
  Choose the correct Product Variant according to your architecture.

#### Procedure
1. Create a NamespaceStore resource. A NamespaceStore represents an underlying storage to be used as a read or write target for the data in MCG namespace buckets. From the MCG command-line interface, run the following command:

   ```sh
   noobaa namespacestore create ibm-cos <namespacestore> --endpoint <IBM COS ENDPOINT> --access-key <IBM ACCESS KEY> --secret-key <IBM SECRET ACCESS KEY> --target-bucket <bucket-name> -n openshift-storage
   ```

   a. Replace `<namespacestore>` with the name of the NamespaceStore.

   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.
Replace `<bucket-name>` with an existing IBM bucket name. This argument tells the MCG which bucket to use as a target bucket for its backing store, and subsequently, data storage and administration.

2. Create a namespace bucket class that defines a namespace policy for the namespace buckets. The namespace policy requires a type of either `single` or `multi`.

   - Run the following command to create a namespace bucket class with a namespace policy of type `single`:
     ```
     noobaa bucketclass create namespace-bucketclass single <my-bucket-class> --resource <resource> -n openshift-storage
     ```
     - Replace `<resource-name>` with the name you want to give the resource.
     - Replace `<my-bucket-class>` with a unique bucket class name.
     - Replace `<resource>` with a single namespace-store that defines the read and write target of the namespace bucket.

   - Run the following command to create a namespace bucket class with a namespace policy of type `multi`:
     ```
     noobaa bucketclass create namespace-bucketclass multi <my-bucket-class> --write-resource <write-resource> --read-resources <read-resources> -n openshift-storage
     ```
     - Replace `<resource-name>` with the name you want to give the resource.
     - Replace `<my-bucket-class>` with a unique bucket class name.
     - Replace `<write-resource>` with a single namespace-store that defines the write target of the namespace bucket.
     - Replace `<read-resources>` with a list of namespace-stores separated by commas that defines the read targets of the namespace bucket.

3. Run the following command to create a bucket using an Object Bucket Class (OBC) resource that uses the bucket class defined in step 2.

   ```
   noobaa obc create my-bucket-claim -n openshift-storage --app-namespace my-app --bucketclass <custom-bucket-class>
   ```

   a. Replace `<bucket-name>` with a bucket name of your choice.

   b. Replace `<custom-bucket-class>` with the name of the bucket class created in step 2.

Once the OBC is provisioned by the operator, a bucket is created in the MCG, and the operator creates a Secret and ConfigMap with the same name and on the same namespace of the OBC.

10.5.3. Adding a namespace bucket using the OpenShift Container Platform user interface

With the release of OpenShift Data Foundation 4.8, namespace buckets can be added using the OpenShift Container Platform user interface. For more information about namespace buckets, see Managing namespace buckets.
Prerequisites

- OpenShift Container Platform with OpenShift Data Foundation operator installed.
- Access to the Multicloud Object Gateway (MCG).

Procedure

1. Log into the OpenShift Web Console.
2. Click Storage → OpenShift Data Foundation.
3. Click the **Namespace Store** tab to create a **namespacestore** resources to be used in the namespace bucket.
   a. Click **Create namespace store**
   b. Enter a namespacestore name.
   c. Choose a provider.
   d. Choose a region.
   e. Either select an existing secret, or click **Switch to credentials** to create a secret by entering a secret key and secret access key.
   f. Choose a target bucket.
   g. Click **Create**.
   h. Verify the namespacestore is in the **Ready** state.
   i. Repeat these steps until you have the desired amount of resources.
4. Click the **Bucket Class** tab → **Create a new Bucket Class**
   a. Select the **Namespace** radio button.
   b. Enter a Bucket Class name.
   c. Add a description (optional).
   d. Click **Next**.
5. Choose a namespace policy type for your namespace bucket, and then click **Next**.
6. Select the target resource(s).
   - If your namespace policy type is **Single**, you need to choose a read resource.
   - If your namespace policy type is **Multi**, you need to choose read resources and a write resource.
   - If your namespace policy type is **Cache**, you need to choose a Hub namespace store that defines the read and write target of the namespace bucket.
7. Click **Next**.
8. Review your new bucket class, and then click **Create Bucketclass**.

9. On the **BucketClass** page, verify that your newly created resource is in the **Created** phase.

10. In the OpenShift Web Console, click **Storage → OpenShift Data Foundation**.

11. In the **Status** card, click **Storage System** and click the storage system link from the pop up that appears.

12. In the **Object** tab, click **Multicloud Object Gateway → Buckets → Namespace Buckets** tab.

13. Click **Create Namespace Bucket**
   
   a. On the **Choose Name** tab, specify a **Name** for the namespace bucket and click **Next**.
   
   b. On the **Set Placement** tab:
      
      i. Under **Read Policy**, select the checkbox for each namespace resource created in step 5 that the namespace bucket should read data from.
      
      ii. If the namespace policy type you are using is **Multi**, then Under **Write Policy**, specify which namespace resource the namespace bucket should write data to.
      
      iii. Click **Next**.
   
   c. Click **Create**.

**Verification**

- Verify that the namespace bucket is listed with a green check mark in the **State** column, the expected number of read resources, and the expected write resource name.

10.6. 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 10.4, “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 in three ways:

- **Section 10.6.1, “Creating bucket classes to mirror data using the MCG command-line-interface”**
- **Section 10.6.2, “Creating bucket classes to mirror data using a YAML”**
- **Section 10.6.3, “Configuring buckets to mirror data using the user interface”**

10.6.1. Creating bucket classes to mirror data using the MCG command-line-interface
1. From the Multicloud Object Gateway (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

10.6.2. 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:

   ```yaml
   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):

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

   For more information about OBCs, see Section 10.8, “Object Bucket Claim”.

10.6.3. Configuring buckets to mirror data using the user interface

1. In the OpenShift Web Console, click Storage → OpenShift Data Foundation.

2. In the Status card, click Storage System and click the storage system link from the pop up that appears.

3. In the Object tab, click the Multicloud Object Gateway link.

4. On the NooBaa page, click the buckets icon on the left side. You can see a list of your buckets:
5. Click the bucket you want to update.

6. Click Edit Tier 1 Resources

7. 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:
NOTE

Resources created in NooBaa UI cannot be used by OpenShift UI or Multicloud Object Gateway (MCG) CLI.

10.7. BUCKET POLICIES IN THE MULTICLOUD OBJECT GATEWAY

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

10.7.1. 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.

10.7.2. Using bucket policies

Prerequisites

- A running OpenShift Data Foundation Platform.
- Access to the Multicloud Object Gateway (MCG), see Section 10.2, “Accessing the Multicloud Object Gateway with your applications”

Procedure

To use bucket policies in the MCG:

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

```json
{
    "Version": "NewVersion",
    "Statement": [
    
    
```
There are many available elements for bucket policies with regard to access permissions.

For details on these elements and examples of how they can be used to control the access permissions, 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 10.7.3, “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

   a. Replace ENDPOINT with the S3 endpoint.

   b. Replace MyBucket with the bucket to set the policy on.

   c. Replace BucketPolicy with the bucket policy JSON file.

   d. 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.

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

Prerequisites

- A running OpenShift Data Foundation Platform.
- Access to the Multicloud Object Gateway (MCG), see Section 10.2, “Accessing the Multicloud Object Gateway with your applications”

Procedure

1. In the OpenShift Web Console, click Storage → OpenShift Data Foundation.
2. In the Status card, click Storage System and click the storage system link from the pop up that appears.
3. In the Object tab, click the Multicloud Object Gateway link.
4. Under the Accounts tab, click Create Account

![Create Account screenshot]

5. Select S3 Access Only, provide the Account Name, for example, john.doe@example.com. Click Next.
6. Select S3 default placement, for example, noobaa-default-backing-store. Select Buckets Permissions. A specific bucket or all buckets can be selected. Click Create.
10.8. 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 in three ways:

- **Section 10.8.1, "Dynamic Object Bucket Claim"
- **Section 10.8.2, "Creating an Object Bucket Claim using the command line interface"
- **Section 10.8.3, "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.

10.8.1. Dynamic Object Bucket Claim

Similar to Persistent Volumes, you can add the details of the Object Bucket claim (OBC) 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:

```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 OBC itself.

a. Replace `<obc-name>` with the a unique OBC name.

b. Replace `<obc-bucket-name>` with a unique bucket name for your OBC.

2. You can add more lines to the YAML file to automate the use of the OBC. 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 claims the Object Bucket from NooBaa, which creates a bucket and an account.

```yaml
apiVersion: batch/v1
kind: Job
metadata:
  name: testjob
spec:
template:
spec:
  restartPolicy: OnFailure
containers:
- image: <your application image>
nname: 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
```
valueFrom:
secretKeyRef:
  name: <obc-name>
  key: AWS_SECRET_ACCESS_KEY

a. Replace all instances of `<obc-name>` with your OBC name.

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

3. Apply the updated YAML file:

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

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

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

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

Replace `<obc-name>` with the name of your OBC.

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.

### 10.8.2. Creating an Object Bucket Claim using the command line interface

When creating an Object Bucket Claim (OBC) 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 Multicloud Object Gateway (MCG) command-line interface.

```bash
# subscription-manager repos --enable=rh-odf-4-for-rhel-8-x86_64-rpms
# yum install mcg
```
**NOTE**

Specify the appropriate architecture for enabling the repositories using the subscription manager.

- For IBM Power Systems, use the following command:

```bash
# subscription-manager repos --enable=rh-odf-4-for-rhel-8-ppc64le-rpms
```

- For IBM Z infrastructure, use the following command:

```bash
# subscription-manager repos --enable=rh-odf-4-for-rhel-8-s390x-rpms
```

**Procedure**

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

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

Replace `<obc-name>` with a unique OBC name, for example, `myappobc`.

Additionally, you can use the `--app-namespace` option to specify the namespace where the OBC 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 OBC:

```bash
# 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 OBC:

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

Example output:

```yaml
apiVersion: objectbucket.io/v1alpha1
domain:
kind: ObjectBucketClaim
metadata:
  creationTimestamp: "2019-10-24T13:30:07Z"
finalizers:
  - objectbucket.io/finalizer
```

```yaml
Spec:
  bucketName: test21obc
  bucketDomain: myappobc
  namespace: openshift-storage
```
4. Inside of your **openshift-storage** namespace, you can find the configuration map and the secret to use this OBC. The CM and the secret have the same name as the OBC. Run the following command to view the secret:

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

Example output:

```
apiVersion: v1
data:
  AWS_ACCESS_KEY_ID: c0M0R2xVanF3ODR3bHBkVW94cmY=
  AWS_SECRET_ACCESS_KEY: Wi9kcFluSWxHRzlWaFizNk1hc0xma2JXcjM1MVhqa051SlBleXpmOQ==
kind: Secret
metadata:
  creationTimestamp: "2019-10-24T13:30:07Z"
finalizers:
- objectbucket.io/finalizer
labels:
  app: noobaa
  bucket-provisioner: openshift-storage.noobaa.io-obic
  noobaa-domain: openshift-storage.noobaa.io
name: test21obic
namespace: openshift-storage
ownerReferences:
- apiVersion: objectbucket.io/v1alpha1
  blockOwnerDeletion: true
  controller: true
  kind: ObjectBucketClaim
  name: test21obic
  uid: 64f04cba-f662-11e9-bc3c-0295250841af
resourceVersion: "40751"
selfLink: /api/v1/namespaces/openshift-storage/secrets/test21obic
uid: 65117c1c-f662-11e9-9094-0a5305de57bb
type: Opaque
```
The secret gives you the S3 access credentials.

5. Run the following command 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.

10.8.3. 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 10.8.1, "Dynamic Object Bucket Claim".

**Procedure**

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

   a. 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**

   ![Create Object Bucket Claim]

   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 (MCG)

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

- **ocs-external-storagecluster-ceph-rgw** uses the RGW
- **openshift-storage.noobaa.io** uses the MCG

**NOTE**

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

b. Click **Create**.

Once you create the OBC, you are redirected to its detail page:
10.8.4. 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.

   a. From the drop-down menu, select **Attach to Deployment**

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

Additional Resources

- Section 10.8, “Object Bucket Claim”
### 10.8.5. 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**

1. Log into the OpenShift Web Console.

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

   ![Object Buckets](image)

   Alternatively, 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 Details** page.

**Additional Resources**

- Section 10.8, “Object Bucket Claim”
10.8.6. 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 the Action menu (⋮) next to the Object Bucket Claim (OBC) you want to delete.
   a. Select Delete Object Bucket Claim
   b. Click Delete.

Additional Resources

- Section 10.8, “Object Bucket Claim”

10.9. CACHING POLICY FOR OBJECT BUCKETS

A cache bucket is a namespace bucket with a hub target and a cache target. The hub target is an S3 compatible large object storage bucket. The cache bucket is the local Multicloud Object Gateway bucket. You can create a cache bucket that caches an AWS bucket or an IBM COS bucket.

IMPORTANT

Cache buckets are 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.

- AWS S3
- IBM COS
10.9.1. Creating an AWS cache bucket

Prerequisites

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

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

**NOTE**

Specify the appropriate architecture for enabling the repositories using the subscription manager. In case of IBM Z infrastructure use the following command:

```
# subscription-manager repos --enable=rh-odf-4-for-rhel-8-s390x-rpms
```

Alternatively, you can install the MCG package from the OpenShift Data Foundation RPMs found here [https://access.redhat.com/downloads/content/547/ver=4/rhel---8/4/x86_64/package](https://access.redhat.com/downloads/content/547/ver=4/rhel---8/4/x86_64/package).

**NOTE**

Choose the correct Product Variant according to your architecture.

Procedure

1. Create a NamespaceStore resource. A NamespaceStore represents an underlying storage to be used as a read or write target for the data in the MCG namespace buckets. From the MCG command-line interface, run the following command:

```
noobaa namespacestore create aws-s3 <namespacestore> --access-key <AWS ACCESS KEY> --secret-key <AWS SECRET ACCESS KEY> --target-bucket <bucket-name>
```

   a. Replace `<namespacestore>` with the name of the namespacestore.

   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 the MCG which bucket to use as a target bucket for its backing store, and subsequently, data storage and administration.

You can also add storage resources by applying a YAML. First create a secret with credentials:

```yaml
apiVersion: v1
kind: Secret
metadata:
  name: <namespacestore-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>

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>.

Replace <namespacestore-secret-name> with a unique name.

Then apply the following YAML:

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

d. Replace <namespacestore> with a unique name.

e. Replace <namespacestore-secret-name> with the secret created in the previous step.

f. Replace <namespace-secret> with the namespace used to create the secret in the previous step.

g. Replace <target-bucket> with the AWS S3 bucket you created for the namespacestore.

2. Run the following command to create a bucket class:

```
noobaa bucketclass create namespace-bucketclass cache <my-cache-bucket-class> --backingstores <backing-store> --hub-resource <namespacestore>
```

a. Replace <my-cache-bucket-class> with a unique bucket class name.

b. Replace <backing-store> with the relevant backing store. You can list one or more backingstores separated by commas in this field.

c. Replace <namespacestore> with the namespacestore created in the previous step.

3. Run the following command to create a bucket using an Object Bucket Claim (OBC) resource that uses the bucket class defined in step 2.

```
noobaa obc create <my-bucket-claim> my-app --bucketclass <custom-bucket-class>
```

a. Replace <my-bucket-claim> with a unique name.
b. Replace `<custom-bucket-class>` with the name of the bucket class created in step 2.

### 10.9.2. Creating an IBM COS cache bucket

#### Prerequisites

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

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

**NOTE**

Specify the appropriate architecture for enabling the repositories using the subscription manager.

- For IBM Power Systems, use the following command:

```
# subscription-manager repos --enable=rh-odf-4-for-rhel-8-ppc64le-rpms
```

- For IBM Z infrastructure, use the following command:

```
# subscription-manager repos --enable=rh-odf-4-for-rhel-8-s390x-rpms
```

Alternatively, you can install the MCG package from the OpenShift Data Foundation RPMs found here [https://access.redhat.com/downloads/content/547/ver=4/rhel---8/4/x86_64/package](https://access.redhat.com/downloads/content/547/ver=4/rhel---8/4/x86_64/package).

**NOTE**

Choose the correct Product Variant according to your architecture.

#### Procedure

1. Create a NamespaceStore resource. A NamespaceStore represents an underlying storage to be used as a read or write target for the data in the MCG namespace buckets. From the MCG command-line interface, run the following command:

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

a. Replace `<namespacestore>` with the name of the NamespaceStore.

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.

c. Replace `<bucket-name>` with an existing IBM bucket name. This argument tells the MCG which bucket to use as a target bucket for its backing store, and subsequently, data storage and administration.
You can also add storage resources by applying a YAML. First, create a secret with the credentials:

```yaml
apiVersion: v1
kind: Secret
metadata:
  name: <namespacestore-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>
```

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>`.

Replace `<namespacestore-secret-name>` with a unique name.

Then apply the following YAML:

```yaml
apiVersion: noobaa.io/v1alpha1
kind: NamespaceStore
metadata:
  finalizers:
  - noobaa.io/finalizer
  labels:
    app: noobaa
    name: <namespacestore>
    namespace: openshift-storage
spec:
  s3Compatible:
    endpoint: <IBM COS ENDPOINT>
  secret:
    name: <backingstore-secret-name>
    namespace: <namespace-secret>
    signatureVersion: v2
  targetBucket: <target-bucket>
  type: ibm-cos
```

d. Replace `<namespacestore>` with a unique name.

e. Replace `<IBM COS ENDPOINT>` with the appropriate IBM COS endpoint.

f. Replace `<backingstore-secret-name>` with the secret created in the previous step.

g. Replace `<namespace-secret>` with the namespace used to create the secret in the previous step.

h. Replace `<target-bucket>` with the AWS S3 bucket you created for the namespacestore.

2. Run the following command to create a bucket class:

   ```bash
   noobaa bucketclass create namespace-bucketclass cache <my-bucket-class> --backingstores <backing-store> --hubResource <namespacestore>
   ```
a. Replace `<my-bucket-class>` with a unique bucket class name.

b. Replace `<backing-store>` with the relevant backing store. You can list one or more backing stores separated by commas in this field.

c. Replace `<namespacestore>` with the namespace store created in the previous step.

3. Run the following command to create a bucket using an Object Bucket Claim resource that uses the bucket class defined in step 2.

```bash
noobaa obc create <my-bucket-claim> my-app --bucketclass <custom-bucket-class>
```

a. Replace `<my-bucket-claim>` with a unique name.

b. Replace `<custom-bucket-class>` with the name of the bucket class created in step 2.

### 10.10. 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.

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

#### 10.10.1. Scaling the Multicloud Object Gateway with storage nodes

**Prerequisites**

- A running OpenShift Data Foundation cluster on OpenShift Container Platform with access to the Multicloud Object Gateway (MCG).

A storage node in the MCG is a NooBaa daemon container attached to one or more Persistent Volumes (PVs) 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. Log in to OpenShift Web Console.
2. From the MCG user interface, click Overview → Add Storage Resources.
3. In the window, click Deploy Kubernetes Pool.
4. In the Create Pool step create the target pool for the future installed nodes.
5. In the Configure step, configure the number of requested pods and the size of each PV. For each new pod, one PV is to be created.
6. 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.

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

10.11. AUTOMATIC SCALING OF MULTICLOUD OBJECT GATEWAY ENDPOINTS

The number of MultiCloud Object Gateway (MCG) endpoints scale automatically when the load on the MCG S3 service increases or decreases. OpenShift Data Foundation clusters are deployed with one active MCG endpoint. Each MCG endpoint pod is configured by default with 1 CPU and 2Gi memory request, with limits matching the request. When the CPU load on the endpoint crosses over an 80% usage threshold for a consistent period of time, a second endpoint is deployed lowering the load on the first endpoint. When the average CPU load on both endpoints falls below the 80% threshold for a consistent period of time, one of the endpoints is deleted. This feature improves performance and serviceability of the MCG.
CHAPTER 11. MANAGING PERSISTENT VOLUME CLAIMS

IMPORTANT

Expanding PVCs is not supported for PVCs backed by OpenShift Data Foundation.

11.1. CONFIGURING APPLICATION PODS TO USE OPENSHIFT DATA FOUNDATION

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

Prerequisites

- You have administrative access to OpenShift Web Console.
- OpenShift Data Foundation 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 Data Foundation are available. In OpenShift Web Console, click **Storage** → **StorageClasses** 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 Data Foundation.
      ii. Specify the PVC **Name**, for example, myclaim.
      iii. Select the required **Access Mode**.

      NOTE

      The **Access Mode**, **Shared access (RWX)** is not supported in IBM FlashSystem.

   iv. For Rados Block Device (RBD), if the **Access mode** is ReadWriteOnce (RWO), select the required **Volume mode**. The default volume mode is **Filesystem**.

   v. For Rados Block Device (RBD), if the **Access mode** is ReadWriteOnce (RWO), select the required **Volume mode**. The default volume mode is **Filesystem**.

   vi. Specify a **Size** as per application requirement.

   vii. 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.

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

     For example:

     ```yaml
     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**.

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

     For example:

     ```yaml
     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.

11.2. VIEWING PERSISTENT VOLUME CLAIM REQUEST STATUS

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

Prerequisites

- Administrator access to OpenShift Data Foundation.

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.

11.3. 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. In the OpenShift Web Console, click Storage → OpenShift Data Foundation
2. In the Storage systems tab, select the storage system and then click Overview → Block and File.
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.

11.4. DYNAMIC PROVISIONING

11.4.1. 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.

### 11.4.2. Dynamic provisioning in OpenShift Data Foundation

Red Hat OpenShift Data Foundation 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 Data Foundation 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 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 Data Foundation 4, 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 judgment of which driver (RBD or CephFS) to use is based on the entry in the `storageclass.yaml` file.

### 11.4.3. 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:
<table>
<thead>
<tr>
<th>Storage type</th>
<th>Provisioner plug-in name</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>OpenStack Cinder</td>
<td>kubernetes.io/cinder</td>
<td>For dynamic provisioning when using multiple clusters in different zones, tag each node with Key=kubernetes.io/cluster/&lt;cluster_name&gt;,Value=&lt;cluster_id&gt; where &lt;cluster_name&gt; and &lt;cluster_id&gt; are unique per cluster.</td>
</tr>
<tr>
<td>AWS Elastic Block Store (EBS)</td>
<td>kubernetes.io/aws-ebs</td>
<td>Dynamic provisioning is accomplished through the EFS provisioner pod and not through a provisioner plug-in.</td>
</tr>
<tr>
<td>AWS Elastic File System (EFS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Azure Disk</td>
<td>kubernetes.io/azure-disk</td>
<td></td>
</tr>
<tr>
<td>Azure File</td>
<td>kubernetes.io/azure-file</td>
<td>The persistent-volume-binder ServiceAccount requires permissions to create and get Secrets to store the Azure storage account and keys.</td>
</tr>
<tr>
<td>GCE Persistent Disk (gcePD)</td>
<td>kubernetes.io/gce-pd</td>
<td>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.</td>
</tr>
<tr>
<td>VMware vSphere</td>
<td>kubernetes.io/vsphere-volume</td>
<td></td>
</tr>
<tr>
<td>Red Hat Virtualization</td>
<td>csi.ovirt.org</td>
<td></td>
</tr>
</tbody>
</table>

**IMPORTANT**

Any chosen provisioner plug-in also requires configuration for the relevant cloud, host, or third-party provider as per the relevant documentation.
CHAPTER 12. VOLUME SNAPSHOTS

A volume snapshot is the state of the storage volume in a cluster at a particular point in time. These snapshots help to use storage more efficiently by not having to make a full copy each time and can be used as building blocks for developing an application.

You can create multiple snapshots of the same persistent volume claim (PVC). For CephFS, you can create up to 100 snapshots per PVC. For RADOS Block Device (RBD), you can create up to 512 snapshots per PVC.

**NOTE**
You cannot schedule periodic creation of snapshots.

12.1. CREATING VOLUME SNAPSHOTS

You can create a volume snapshot either from the Persistent Volume Claim (PVC) page or the Volume Snapshots page.

**Prerequisites**

- For a consistent snapshot, the PVC should be in **Bound** state and not be in use. Ensure to stop all IO before taking the snapshot.

**NOTE**
OpenShift Data Foundation only provides crash consistency for a volume snapshot of a PVC if a pod is using it. For application consistency, be sure to first tear down a running pod to ensure consistent snapshots or use any quiesce mechanism provided by the application to ensure it.

**Procedure**

**From the Persistent Volume Claims page**

1. Click **Storage → Persistent Volume Claims** from the OpenShift Web Console.

2. To create a volume snapshot, do one of the following:
   - Beside the desired PVC, click Action menu (⋮) → **Create Snapshot**
   - Click on the PVC for which you want to create the snapshot and click **Actions → Create Snapshot**.

3. Enter a **Name** for the volume snapshot.

4. Choose the **Snapshot Class** from the drop-down list.

5. Click **Create**. You will be redirected to the Details page of the volume snapshot that is created.

**From the Volume Snapshots page**

1. Click **Storage → Volume Snapshots** from the OpenShift Web Console.
2. In the Volume Snapshots page, click Create Volume Snapshot.

3. Choose the required Project from the drop-down list.

4. Choose the Persistent Volume Claim from the drop-down list.

5. Enter a Name for the snapshot.

6. Choose the Snapshot Class from the drop-down list.

7. Click Create. You will be redirected to the Details page of the volume snapshot that is created.

Verification steps

- Go to the Details page of the PVC and click the Volume Snapshots tab to see the list of
  volume snapshots. Verify that the new volume snapshot is listed.

- Click Storage ➔ Volume Snapshots from the OpenShift Web Console. Verify that the new
  volume snapshot is listed.

- Wait for the volume snapshot to be in Ready state.

12.2. RESTORING VOLUME SNAPSHOTS

When you restore a volume snapshot, a new Persistent Volume Claim (PVC) gets created. The restored
PVC is independent of the volume snapshot and the parent PVC.

You can restore a volume snapshot from either the Persistent Volume Claim page or the Volume
Snapshots page.

Procedure

From the Persistent Volume Claims page

You can restore volume snapshot from the Persistent Volume Claims page only if the parent PVC is
present.

1. Click Storage ➔ Persistent Volume Claims from the OpenShift Web Console.

2. Click on the PVC name with the volume snapshot to restore a volume snapshot as a new
   PVC.

3. In the Volume Snapshots tab, click the Action menu (⋯) next to the volume snapshot you
   want to restore.

4. Click Restore as new PVC.

5. Enter a name for the new PVC.

6. Select the Storage Class name.
NOTE

For Rados Block Device (RBD), you must select a storage class with the same pool as that of the parent PVC. Restoring the snapshot of an encrypted PVC using a storage class where encryption is not enabled and vice versa is not supported.

7. Select the **Access Mode** of your choice.

IMPORTANT

The ReadOnlyMany (ROX) access mode is a Developer Preview feature and is subject to Developer Preview support limitations. Developer Preview releases are not intended to be run in production environments and are not supported through the Red Hat Customer Portal case management system. If you need assistance with ReadOnlyMany feature, reach out to the [ocs-devpreview@redhat.com](mailto:ocs-devpreview@redhat.com) mailing list and a member of the Red Hat Development Team will assist you as quickly as possible based on availability and work schedules. See Creating a clone or restoring a snapshot with the new readonly access mode to use the ROX access mode.

8. Optional: For RBD, select **Volume mode**.

9. Click **Restore**. You are redirected to the new PVC details page.

From the Volume Snapshots page

1. Click **Storage → Volume Snapshots** from the OpenShift Web Console.

2. In the **Volume Snapshots** tab, click the Action menu ( ⋮ ) next to the volume snapshot you want to restore.

3. Click **Restore as new PVC**

4. Enter a name for the new PVC.

5. Select the **Storage Class** name.

NOTE

For Rados Block Device (RBD), you must select a storage class with the same pool as that of the parent PVC. Restoring the snapshot of an encrypted PVC using a storage class where encryption is not enabled and vice versa is not supported.

6. Select the **Access Mode** of your choice.
The ReadOnlyMany (ROX) access mode is a Developer Preview feature and is subject to Developer Preview support limitations. Developer Preview releases are not intended to be run in production environments and are not supported through the Red Hat Customer Portal case management system. If you need assistance with ReadOnlyMany feature, reach out to the ocs-devpreview@redhat.com mailing list and a member of the Red Hat Development Team will assist you as quickly as possible based on availability and work schedules. See Creating a clone or restoring a snapshot with the new readonly access mode to use the ROX access mode.

7. Optional: For RBD, select **Volume mode**.

8. Click **Restore**. You are redirected to the new PVC details page.

**Verification steps**

- Click **Storage → Persistent Volume Claims** from the OpenShift Web Console and confirm that the new PVC is listed in the **Persistent Volume Claims** page.

- Wait for the new PVC to reach **Bound** state.

### 12.3. DELETING VOLUME SNAPSHOTS

**Prerequisites**

- For deleting a volume snapshot, the volume snapshot class which is used in that particular volume snapshot should be present.

**Procedure**

**From Persistent Volume Claims page**

1. Click **Storage → Persistent Volume Claims** from the OpenShift Web Console.

2. Click on the PVC name which has the volume snapshot that needs to be deleted.

3. In the **Volume Snapshots** tab, beside the desired volume snapshot, click Action menu (⋯)→ **Delete Volume Snapshot**

**From Volume Snapshots page**

1. Click **Storage → Volume Snapshots** from the OpenShift Web Console.

2. In the **Volume Snapshots** page, beside the desired volume snapshot click Action menu (⋯)→ **Delete Volume Snapshot**

**Verification steps**

- Ensure that the deleted volume snapshot is not present in the **Volume Snapshots** tab of the PVC details page.
- Click **Storage → Volume Snapshots** and ensure that the deleted volume snapshot is not listed.
CHAPTER 13. VOLUME CLONING

A clone is a duplicate of an existing storage volume that is used as any standard volume. You create a clone of a volume to make a point in time copy of the data. A persistent volume claim (PVC) cannot be cloned with a different size. You can create up to 512 clones per PVC for both CephFS and RADOS Block Device (RBD).

13.1. CREATING A CLONE

Prerequisites

- Source PVC must be in **Bound** state and must not be in use.

**NOTE**

Do not create a clone of a PVC if a Pod is using it. Doing so might cause data corruption because the PVC is not quiesced (paused).

Procedure

1. Click **Storage → Persistent Volume Claims** from the OpenShift Web Console.
2. To create a clone, do one of the following:
   - Beside the desired PVC, click Action menu (⋮) → **Clone PVC**.
   - Click on the PVC that you want to clone and click **Actions → Clone PVC**.
3. Enter a **Name** for the clone.
4. Select the access mode of your choice.

**IMPORTANT**

The ReadOnlyMany (ROX) access mode is a Developer Preview feature and is subject to Developer Preview support limitations. Developer Preview releases are not intended to be run in production environments and are not supported through the Red Hat Customer Portal case management system. If you need assistance with ReadOnlyMany feature, reach out to the ocs-devpreview@redhat.com mailing list and a member of the Red Hat Development Team will assist you as quickly as possible based on availability and work schedules. See Creating a clone or restoring a snapshot with the new readonly access mode to use the ROX access mode.

5. Click **Clone**. You are redirected to the new PVC details page.
6. Wait for the cloned PVC status to become **Bound**.
   - The cloned PVC is now available to be consumed by the pods. This cloned PVC is independent of its dataSource PVC.
CHAPTER 14. REPLACING STORAGE NODES

You can choose one of the following procedures to replace storage nodes:

- Section 14.1, “Replacing operational nodes on Google Cloud installer-provisioned infrastructure”
- Section 14.2, “Replacing failed nodes on Google Cloud installer-provisioned infrastructure”

14.1. REPLACING OPERATIONAL NODES ON GOOGLE CLOUD INSTALLER-PROVISIONED INFRASTRUCTURE

Use this procedure to replace an operational node on Google Cloud 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 Data Foundation 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 Data Foundation 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 Data Foundation pods are in Running state.

4. Verify that new OSD pods are running on the replacement node.

  ```
  $ oc get pods -o wide -n openshift-storage| egrep -i new-node-name | egrep osd
  ```

5. Optional: If cluster-wide encryption is enabled on the cluster, verify that the new OSD devices are encrypted.
   
   For each of the new nodes identified in previous step, do the following:
   
   a. Create a debug pod and open a chroot environment for the selected host(s).

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

   b. Run “lsblk” and check for the “crypt” keyword beside the `ocs-deviceset` name(s)

   ```
   $ lsblk
   ```

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

### 14.2. REPLACING FAILED NODES ON GOOGLE CLOUD INSTALLER-PROVISIONED INFRASTRUCTURE

Perform this procedure to replace a failed node which is not operational on Google Cloud installer-provisioned infrastructure (IPI) for OpenShift Data Foundation.

**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 Data Foundation label to the new node using any one of the following:

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

   **From the command line interface**
   
   - Execute the following command to apply the OpenShift Data Foundation label to the new node:
     ```bash
     $ oc label node <new_node_name> cluster.ocs.openshift.io/openshift-storage=""
     ```

9. [Optional]: If the failed Google Cloud instance is not removed automatically, terminate the instance from Google Cloud console.

**Verification steps**

1. Execute the following command and verify that the new node is present in the output:
   ```bash
   $ 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 Data Foundation pods are in **Running** state.

4. Verify that new OSD pods are running on the replacement node.
   ```bash
   $ oc get pods -o wide -n openshift-storage|grep -i new-node-name | grep osd
   ```
5. Optional: If cluster-wide encryption is enabled on the cluster, verify that the new OSD devices are encrypted.
   For each of the new nodes identified in previous step, do the following:
   
a. Create a debug pod and open a chroot environment for the selected host(s).
   
   $ oc debug node/<node name>
   $ chroot /host

   b. Run "lsblk" and check for the "crypt" keyword beside the **ocs-deviceset** name(s)

   $ lsblk

6. If verification steps fail, contact Red Hat Support.
CHAPTER 15. REPLACING STORAGE DEVICES

15.1. REPLACING OPERATIONAL OR FAILED STORAGE DEVICES ON GOOGLE CLOUD INSTALLER-PROVISIONED INFRASTRUCTURE

When you need to replace a device in a dynamically created storage cluster on an Google Cloud installer-provisioned infrastructure, you must replace the storage node. For information about how to replace nodes, see:

- Replacing operational nodes on Google Cloud installer-provisioned infrastructure
- Replacing failed nodes on Google Cloud installer-provisioned infrastructures.
CHAPTER 16. UPGRADING TO OPENSIFT DATA FOUNDATION

16.1. OVERVIEW OF THE OPENSIFT DATA FOUNDATION UPDATE PROCESS

OpenShift Container Storage, based on the open source Ceph technology, has expanded its scope and foundational role in a containerized, hybrid cloud environment since its introduction. It complements existing storage in addition to other data-related hardware and software, making them rapidly attachable, accessible, and scalable in a hybrid cloud environment. To better reflect these foundational and infrastructure distinctives, OpenShift Container Storage is now OpenShift Data Foundation.

IMPORTANT

You can perform the upgrade process for OpenShift Data Foundation version 4.9 from OpenShift Container Storage version 4.8 only by installing the OpenShift Data Foundation operator from OpenShift Container Platform OperatorHub.

In the future release, you can upgrade Red Hat OpenShift Data Foundation, either between minor releases like 4.9 and 4.x, or between batch updates like 4.9.0 and 4.9.1 by enabling automatic updates (if not done so during operator installation) or performing manual updates.

You also need to upgrade the different parts of Red Hat OpenShift Data Foundation in the following order for both internal and external mode deployments:

1. Update OpenShift Container Platform according to the Updating clusters documentation for OpenShift Container Platform.

2. Update Red Hat OpenShift Data Foundation.
   a. To prepare a disconnected environment for updates see Operators guide to using Operator Lifecycle Manager on restricted networks to be able to update Red Hat OpenShift Data Foundation as well as Local Storage Operator when in use.
   c. Update Red Hat OpenShift Data Foundation from 4.9.x to 4.9.y See Updating Red Hat OpenShift Data Foundation 4.9.x to 4.9.y.
   d. For updating external mode deployments you must also perform the steps from section Updating the OpenShift Data Foundation external secret.
   e. If you use local storage:
      i. Update the Local Storage operator See Checking for Local Storage Operator deployments if you are unsure.
      ii. Perform post-update configuration changes for clusters backed by local storage. See Post-update configuration for clusters backed by local storage for details.

Update considerations
Review the following important considerations before you begin.

- Red Hat recommends using the same version of Red Hat OpenShift Container Platform with Red Hat OpenShift Data Foundation. See the **Interoperability Matrix** for more information about supported combinations of OpenShift Container Platform and Red Hat OpenShift Data Foundation.

- The Local Storage Operator is fully supported only when the Local Storage Operator version matches the Red Hat OpenShift Container Platform version.

- The flexible scaling feature is available only in new deployments of Red Hat OpenShift Data Foundation versions 4.7 and later. Storage clusters upgraded from a previous version to version 4.7 or later do not support flexible scaling. For more information, see *Flexible scaling of OpenShift Container Storage cluster* in the **New features section of 4.7 Release Notes**.

## 16.2. UPDATING RED HAT OPENSIFT CONTAINER STORAGE 4.8 TO RED HAT OPENSIFT DATA FOUNDATION 4.9

This chapter helps you to upgrade between the z-stream release for all Red Hat OpenShift Data Foundation deployments (Internal, Internal-Attached and External). The upgrade process remains the same for all deployments. The Only difference is what gets upgraded and what’s not.

- For Internal and Internal-attached deployments, upgrading OpenShift Container Storage upgrades all OpenShift Container Storage services including the backend Ceph Storage cluster.

- For External mode deployments, upgrading OpenShift Container Storage only upgrades the OpenShift Container Storage service while the backend Ceph storage cluster remains untouched and needs to be upgraded separately. We recommend upgrading RHCS along with OpenShift Container Storage in order to get new feature support, security fixes, and other bug fixes. Since we do not have a strong dependency on RHCS upgrade, you can upgrade the OpenShift Data Foundation operator first followed by RHCS upgrade or vice-versa. See [solution](#) to know more about Red Hat Ceph Storage releases.

### IMPORTANT

Upgrading to 4.9 directly from any version older than 4.8 is unsupported.

### Prerequisites

- Ensure that the **OpenShift Container Platform** cluster has been updated to the latest stable release of version 4.9.X, see *Updating Clusters*.

- Ensure that the **OpenShift Container Storage** cluster is healthy and data is resilient.
  - Navigate to *Storage ➔ Overview* and check both *Block and File* and *Object* tabs for the green tick on the status card. Green tick indicates that the *storage cluster*, *object service* and *data resiliency* are all healthy.

- 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, on the OpenShift Web Console, click *Workloads ➔ Pods* Select *openshift-storage* from the *Project* drop-down list.
NOTE

If the Show default projects option is disabled, use the toggle button to list all the default projects.

- Ensure that you have sufficient time to complete the OpenShift Data Foundation update process, as the update time varies depending on the number of OSDs that run in the cluster.

Procedure

2. Search for OpenShift Data Foundation using the Filter by keyword box and click on the OpenShift Data Foundation tile.
3. Click Install.

NOTE

We recommend using all default settings. Changing it may result in unexpected behavior. Alter only if you are aware of its result.

Verification steps

1. Verify that the page displays Succeeded message along with the option to Create StorageSystem.

NOTE

For the upgraded clusters, since the storage system is automatically created, do not create it again.

2. On the notification popup, click Refresh web console link to reflect the OpenShift Data Foundation changes in the OpenShift console.
3. Verify the state of the pods on the OpenShift Web Console.
   - Click Workloads → Pods
   - Select openshift-storage from the Project drop-down list.

NOTE

If the Show default projects option is disabled, use the toggle button to list all the default projects.

Wait for all the pods in the openshift-storage namespace to restart and reach Running state.

4. Verify that the OpenShift Data Foundation cluster is healthy and data is resilient.
   - Navigate to Storage → OpenShift Data foundation → Storage Systems tab and then click on the storage system name.
Check both Block and File and Object tabs for the green tick on the status card. Green tick indicates that the storage cluster, object service and data resiliency are all healthy.

**IMPORTANT**

- In case the console plugin option was not automatically enabled after you installed the OpenShift Data Foundation Operator, you need to enable it. For more information on how to enable the console plugin, see Enabling the Red Hat OpenShift Data Foundation console plugin.

- After updating external mode deployments, you must also update the external secret. For instructions, see Updating the OpenShift Data Foundation external secret.

**Additional Resources**

If you face any issues while updating OpenShift Data Foundation, see the Commonly required logs for troubleshooting section in the Troubleshooting guide.

### 16.3. UPDATING RED HAT OPENSFITH DATA FOUNDATION 4.9.X TO 4.9.Y

This chapter helps you to upgrade between the z-stream release for all Red Hat OpenShift Data Foundation deployments (Internal, Internal-Attached and External). The upgrade process remains the same for all deployments. The Only difference is what gets upgraded and what’s not.

- For Internal and Internal-attached deployments, upgrading OpenShift Container Storage upgrades all OpenShift Container Storage services including the backend Ceph Storage cluster.

- For External mode deployments, upgrading OpenShift Container Storage only upgrades the OpenShift Container Storage service while the backend Ceph storage cluster remains untouched and needs to be upgraded separately. Hence, we recommend upgrading RHCS along with OpenShift Container Storage in order to get new feature support, security fixes, and other bug fixes. Since we do not have a strong dependency on RHCS upgrade, you can upgrade the OpenShift Data Foundation operator first followed by RHCS upgrade or vice-versa. See solution to know more about Red Hat Ceph Storage releases.

When a new z-stream release becomes available, the upgrade process triggers automatically if the update strategy was set to Automatic. If the update strategy is set to Manual then use the following procedure.

**Prerequisites**

- Ensure that the OpenShift Container Platform cluster has been updated to the latest stable release of version 4.9.X, see Updating Clusters.

- Ensure that the OpenShift Data Foundation cluster is healthy and data is resilient.
  - Navigate to Storage → OpenShift Data Foundation → Storage Systems tab and then click on the storage system name.
  - Check for the green tick on the status card of Overview - Block and File and Object tabs. Green tick indicates that the storage cluster, object service and data resiliency is healthy.
● Ensure that all OpenShift Data Foundation Pods, including the operator pods, are in Running state in the openshift-storage namespace. To view the state of the pods, on the OpenShift Web Console, click Workloads → Pods. Select openshift-storage from the Project drop-down list.

NOTE
If the Show default projects option is disabled, use the toggle button to list all the default projects.

● Ensure that you have sufficient time to complete the OpenShift Data Foundation update process, as the update time varies depending on the number of OSDs that run in the cluster.

Procedure


2. Select openshift-storage project.

   NOTE
   If the Show default projects option is disabled, use the toggle button to list all the default projects.

3. Click the OpenShift Data Foundation operator name.

4. Click the Subscription tab.

5. If the Upgrade Status shows require approval, click on requires approval link.

6. On the InstallPlan Details page, click Preview Install Plan.

7. Review the install plan and click Approve.

8. Wait for the Status to change from Unknown to Created.

Verification steps

● Verify that the Version below the OpenShift Data Foundation name and the operator status is the latest version.
   ○ Navigate to Operators → Installed Operators and select the openshift-storage project.
   ○ When the upgrade completes, the version updates to a new version number for OpenShift Data Foundation and status changes to Succeeded with a green tick.

● Verify that the OpenShift Data Foundation cluster is healthy and data is resilient.
   ○ Navigate to Storage → OpenShift Data Foundation → Storage Systems tab and then click on the storage system name.
   ○ Check for the green tick on the status card of Overview - Block and File and Object tabs. Green tick indicates that the storage cluster, object service and data resiliency is healthy.
IMPORTANT

In case the console plugin option was not automatically enabled after you installed the OpenShift Data Foundation Operator, you need to enable it.

For more information on how to enable the console plugin, see Enabling the Red Hat OpenShift Data Foundation console plugin.

- If verification steps fail, contact Red Hat Support.

16.4. CHANGING THE UPDATE APPROVAL STRATEGY

To ensure that the storage system gets updated automatically when a new update is available in the same channel, we recommend keeping the update approval strategy to Automatic. Changing the update approval strategy to Manual will need manual approval for each upgrade.

Procedure

1. Navigate to Operators → Installed Operators
2. Select openshift-storage from the Project drop-down list.

   **NOTE**

   If the Show default projects option is disabled, use the toggle button to list all the default projects.

3. Click on OpenShift Data Foundation operator name
4. Go to the Subscription tab.
5. Click on the pencil icon for changing the Update approval.
6. Select the update approval strategy and click Save.

Verification steps

- Verify that the Update approval shows the newly selected approval strategy below it.