Red Hat OpenShift Data Foundation 4.11

Deploying OpenShift Data Foundation using IBM Z infrastructure

Instructions on deploying Red Hat OpenShift Data Foundation to use local storage on IBM Z infrastructure

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Legal Notice

Abstract

Read this document for instructions about how to install Red Hat OpenShift Data Foundation to use local storage on IBM Z infrastructure. While this document refers only to IBM Z, all information in it also applies to LinuxONE.

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MAKING OPEN SOURCE MORE INCLUSIVE

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.

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

To give feedback, create a Bugzilla ticket:

1. Go to the Bugzilla website.
2. In the **Component** section, choose **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 supports deployment on existing Red Hat OpenShift Container Platform (RHOCP) IBM System Z clusters in connected or disconnected environments along with out-of-the-box support for proxy environments.

NOTE

See Planning your deployment and Preparing to deploy OpenShift Data Foundation for more information about deployment requirements.

To deploy OpenShift Data Foundation, follow the appropriate deployment process for your environment:

- Internal Attached Devices mode
  - Deploy using local storage devices
- External mode

CHAPTER 1. PREPARING TO DEPLOY OPENSHIFT DATA FOUNDATION

When you deploy OpenShift Data Foundation on OpenShift Container Platform using local storage devices, you can create internal cluster resources. This approach internally provisions base services and all applications can access additional storage classes.

Before you begin the deployment of Red Hat OpenShift Data Foundation using local storage, ensure that your resource requirements are met. See requirements for installing OpenShift Data Foundation using local storage devices.

On the external key management system (KMS),

- When the Token authentication method is selected for encryption then refer to Enabling cluster-wide encryption with the Token authentication using KMS.
- Ensure that you are using signed certificates on your Vault servers.

After you have addressed the above, follow these steps in the order given:

1. Install the Red Hat OpenShift Data Foundation Operator .
2. Install Local Storage Operator .
3. Find the available storage devices .
4. Create the OpenShift Data Foundation cluster service on IBM Z .

1.1. REQUIREMENTS FOR INSTALLING OPENSHIFT DATA FOUNDATION USING LOCAL STORAGE DEVICES

Node requirements

The cluster must consist of at least three OpenShift Container Platform worker nodes with locally attached-storage devices on each of them.

- Each of the three selected nodes must have at least one raw block device available. OpenShift Data Foundation uses the one or more available raw block devices.
- The devices you use must be empty, the disks must not include Physical Volumes (PVs), Volume Groups (VGs), or Logical Volumes (LVs) remaining on the disk.

For more information, see the *Resource requirements* section in the Planning guide.

1.2. ENABLING CLUSTER-WIDE ENCRYPTION WITH KMS USING THE TOKEN AUTHENTICATION METHOD

You can enable the key value backend path and policy in the vault for token authentication.

Prerequisites

- Administrator access to the vault.

- A valid Red Hat OpenShift Data Foundation Advanced subscription. For more information, see the knowledgebase article on OpenShift Data Foundation subscriptions.
- Carefully, select a unique path name as the backend **path** that follows the naming convention since you cannot change it later.

Procedure

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

   ```
   $ vault secrets enable -path=odf kv
   ```

   For vault KV secret engine API, version 2:

   ```
   $ vault secrets enable -path=odf kv-v2
   ```

2. Create a policy to restrict the users to perform a write or delete operation on the secret:

   ```
   echo '
   path "odf/*" {
     capabilities = ["create", "read", "update", "delete", "list"]
   }
   path "sys/mounts" {
   capabilities = ["read"]
   }'| vault policy write odf -
   ```

3. Create a token that matches the above policy:

   ```
   $ vault token create -policy=odf -format json
   ```

CHAPTER 2. DEPLOY OPENSHIFT DATA FOUNDATION USING LOCAL STORAGE DEVICES

Deploying OpenShift Data Foundation on OpenShift Container Platform using local storage devices provides you with the option to create internal cluster resources. Follow this deployment method to use local storage to back persistent volumes for your OpenShift Container Platform applications.

Use this section to deploy OpenShift Data Foundation on IBM Z infrastructure where OpenShift Container Platform is already installed.

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. Each node should include one disk and requires 3 disks (PVs). However, one PV remains eventually unused by default. This is an expected behavior.
- 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 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 the *How to use dedicated worker nodes for Red Hat OpenShift Data Foundation* section 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-4.11**.

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**.

Verification steps

- 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 Installed Operators and verify that the **OpenShift Data Foundation** Operator shows a green tick indicating successful installation.
  - Navigate to **Storage** and verify if **Data Foundation** dashboard is available.

2.2. INSTALLING LOCAL STORAGE OPERATOR

Install the Local Storage Operator from the Operator Hub before creating Red Hat OpenShift Data Foundation clusters on local storage devices.

Procedure

1. Log in to the OpenShift Web Console.
2. Click **Operators → OperatorHub**.
3. Type **local storage** in the **Filter by keyword** box to find the **Local Storage Operator** from the list of operators, and click on it.
4. Set the following options on the **Install Operator** page:
   a. Update channel as either **4.11** or **stable**.
   b. Installation mode as **A specific namespace on the cluster**.
   c. Installed Namespace as **Operator recommended namespace openshift-local-storage**.
   d. Update approval as **Automatic**.
5. Click **Install**.

Verification steps

- Verify that the Local Storage Operator shows a green tick indicating successful installation.

2.3. FINDING AVAILABLE STORAGE DEVICES (OPTIONAL)

This step is additional information and can be skipped as the disks are automatically discovered during storage cluster creation. Use this procedure to identify the device names for each of the three or more worker nodes that you have labeled with the OpenShift Data Foundation label **cluster.ocs.openshift.io/openshift-storage="** before creating Persistent Volumes (PV) for IBM Z.

Procedure

1. List and verify the name of the worker nodes with the OpenShift Data Foundation label.

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

   Example output:

```
NAME         STATUS   ROLES    AGE    VERSION
bmworker01   Ready    worker   6h45m  v1.16.2
bmworker02   Ready    worker   6h45m  v1.16.2
bmworker03   Ready    worker   6h45m  v1.16.2
```

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

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

   Example output:

```
$ oc debug node/bmworker01
Starting pod/bmworker01-debug ...
To use host binaries, run `chroot /host`
Pod IP: 10.0.135.71
If you don't see a command prompt, try pressing enter.
sh-4.2# chroot /host
sh-4.4# lsblk
NAME                         MAJ:MIN RM   SIZE RO TYPE MOUNTPOINT
loop0                         7:0    0   500G  0 loop
sda                           8:0    0   120G  0 disk
|-sda1                        8:1    0   384M  0 part /boot
`-sda4                        8:4    0 119.6G  0 part
`-coreos-luks-root-nocrypt   253:0    0 119.6G  0 dm   /sysroot
sdb                           8:16   0   500G  0 disk
```

   In this example, for **bmworker01**, the available local device is **sdb**.

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

```
sh-4.4#ls -l /dev/disk/by-id/  | grep sdb
lrwxrwxrwx. 1 root root  9 Feb  3 16:49 scsi-360050763808104bc2800000000000259 ->
../../sdb
```

```
lrwxrwxrwx. 1 root root  9 Feb  3 16:49 scsi-SIBM_2145_00e020412f0aXX00 -> ../../sdb
lrwxrwxrwx. 1 root root  9 Feb  3 16:49 scsi-0x60050763808104bc2800000000000259 ->
../../sdb
```

In the above example, the ID for the local device **sdb**

```
scsi-0x60050763808104bc2800000000000259
```

4. Repeat the above step to identify the device ID for all the other nodes that have the storage devices to be used by OpenShift Data Foundation. See this Knowledge Base article for more details.

2.4. CREATING OPENSHIFT DATA FOUNDATION CLUSTER ON IBM Z

Use this procedure to create an OpenShift Data Foundation cluster on IBM Z.

Prerequisites

- Ensure that all the requirements in the Requirements for installing OpenShift Data Foundation using local storage devices section are met.
- You must have at least three worker nodes with the same storage type and size attached to each node (for example, 200 GB) to use local storage devices on IBM Z or LinuxONE.

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, perform the following:
   a. Select the **Create a new StorageClass using the local storage devices for Backing storage type** option.
   b. Select **Full Deployment** for the **Deployment type** option.
   c. Click Next.

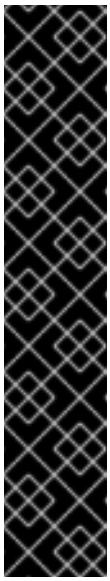
IMPORTANT

You are prompted to install the Local Storage Operator if it is not already installed. Click **Install**, and follow the procedure as described in Installing Local Storage Operator.

4. In the **Create local volume set** page, provide the following information:
   a. Enter a name for the **LocalVolumeSet** and the **StorageClass**.
   By default, the local volume set name appears for the storage class name. You can change the name.
   b. Choose one of the following:

- **Disks on all nodes**
  Uses the available disks that match the selected filters on all the nodes.

- **Disks on selected nodes**
  Uses the available disks that match the selected filters only on the selected nodes.



IMPORTANT

- The flexible scaling feature is enabled only when the storage cluster that you created with three or more nodes are spread across fewer than the minimum requirement of three availability zones.
  For information about flexible scaling, see the Add capacity using YAML section in Scaling Storage guide.
- Flexible scaling features get enabled at the time of deployment and can not be enabled or disabled later on.
- 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. From the available list of **Disk Type**, select **SSD/NVME**.

d. Expand the **Advanced** section and set the following options:

Volume Mode	Block is selected by default.
Device Type	Select one or more device type from the dropdown list.
Disk Size	Set a minimum size of 100GB for the device and maximum available size of the device that needs to be included.
Maximum Disks Limit	This indicates the maximum number of PVs that can be created on a node. If this field is left empty, then PVs are created for all the available disks on the matching nodes.

e. Click **Next**.
A pop-up to confirm the creation of LocalVolumeSet is displayed.

f. Click **Yes** to continue.

5. In the **Capacity and nodes** page, configure the following:

a. **Available raw capacity** is populated with the capacity value based on all the attached disks associated with the storage class. This takes some time to show up. The **Selected nodes** list shows the nodes based on the storage class.

b. You can check the box to select **Taint** nodes.

c. Click **Next**.

6. Optional: In the **Security and network** page, configure the following based on your requirement:

    a. To enable encryption, select **Enable data encryption for block and file storage**

    b. Choose one or both of the following **Encryption level**:

    - **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 **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 **CA Certificate**, **Client Certificate** and **Client Private Key**.

            D. Click **Save**.

    d. Select **Default (SDN)** as Multus is not yet supported on OpenShift Data Foundation on IBM Z infrastructure.

    e. Click **Next**.

7. In the Review and create page::

    a. Review the configuration details. To modify any configuration settings, click **Back** to go back to the previous configuration page.

    b. 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.

- To verify if flexible scaling is enabled on your storage cluster, perform the following steps:

1. In the OpenShift Web Console, navigate to **Installed Operators → OpenShift Data Foundation → Storage System → ocs-storagecluster-storagesystem → Resources → ocs-storagecluster**.

2. In the YAML tab, search for the keys **flexibleScaling** in **spec** section and **failureDomain** in **status** section. If **flexible scaling** is true and **failureDomain** is set to host, flexible scaling feature is enabled.

```
spec:
flexibleScaling: true
[…]
status:
failureDomain: host
```

- To verify that all components for OpenShift Data Foundation are successfully installed, see Verifying your OpenShift Data Foundation deployment .

Additional resources

- To expand the capacity of the initial cluster, see the Scaling Storage guide.

CHAPTER 3. VERIFYING OPENSHIFT DATA FOUNDATION DEPLOYMENT FOR INTERNAL-ATTACHED DEVICES MODE

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

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 on the expected number of pods for each component and how it varies depending on the number of nodes, see Table 3.1, "Pods corresponding to OpenShift Data Foundation cluster".

3. Set filter for Running and Completed pods to verify that the following pods are in **Running** and **Completed** state:

Table 3.1. Pods corresponding to OpenShift Data Foundation cluster

Component	Corresponding pods
OpenShift Data Foundation Operator	• **ocs-operator-*** (1 pod on any storage node) • **ocs-metrics-exporter-*** (1 pod on any storage node) • **odf-operator-controller-manager-*** (1 pod on any storage node • **csi-addons-controller-manager-*** (1 pod on any storage node) • **odf-console-*** (1 pod on any storage node)
Rook-ceph Operator	**rook-ceph-operator-*** (1 pod on any storage node)

Component	Corresponding pods
Multicloud Object Gateway	• **noobaa-operator-*** (1 pod on any storage node) • **noobaa-core-*** (1 pod on any storage node) • **noobaa-db-pg-*** (1 pod on any storage node) • **noobaa-endpoint-*** (1 pod on any storage node)
MON	**rook-ceph-mon-*** (3 pods distributed across storage nodes)
MGR	**rook-ceph-mgr-*** (1 pod on any storage node)
MDS	**rook-ceph-mds-ocs-storagecluster-cephfilesystem-*** (2 pods distributed across storage nodes)
RGW	**rook-ceph-rgw-ocs-storagecluster-cephobjectstore-*** (1 pod on any storage node)

CSI	• **cephfs**
	  ◦ **csi-cephfsplugin-*** (1 pod on each storage node)
	  ◦ **csi-cephfsplugin-provisioner-*** (2 pods distributed across storage nodes)
	• **rbd**
	  ◦ **csi-rbdplugin-*** (1 pod on each storage node)
	  ◦ **csi-rbdplugin-provisioner-*** (2 pods distributed across storage nodes)

rook-ceph-crashcollector	**rook-ceph-crashcollector-*** (1 pod on each storage node)

Component	Corresponding pods
OSD	• **rook-ceph-osd-*** (1 pod for each device) • **rook-ceph-osd-prepare-ocs-deviceset-*** (1 pod for each device)

3.2. VERIFYING THE OPENSHIFT DATA FOUNDATION CLUSTER IS HEALTHY

Procedure

1. In the OpenShift Web Console, click **Storage → Data Foundation**.
2. Click the **Storage Systems** tab and then click on **ocs-storagecluster-storagesystem**.
3. In the **Status card** of Block and File dashboard under Overview tab, verify that both *Storage Cluster* and *Data Resiliency* has a green tick mark.
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.

3.3. VERIFYING THE MULTICLOUD OBJECT GATEWAY IS HEALTHY

Procedure

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

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**
- **ocs-storagecluster-ceph-rgw**

CHAPTER 4. UNINSTALLING OPENSHIFT DATA FOUNDATION

4.1. UNINSTALLING OPENSHIFT DATA FOUNDATION IN INTERNAL-ATTACHED DEVICES MODE

Use the steps in this section to uninstall OpenShift Data Foundation.

Uninstall Annotations

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

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

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

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

Annotation	Value	Default	Behavior
cleanup-policy	delete	Yes	Rook cleans up the physical drives and the **DataDirHostPath**
cleanup-policy	retain	No	Rook does **not** clean up the physical drives and the **DataDirHostPath**
mode	graceful	Yes	Rook and NooBaa **pauses** the uninstall process until the administrator/user removes the Persistent Volume Claims (PVCs) and Object Bucket Claims (OBCs)
mode	forced	No	Rook and NooBaa proceeds with uninstall even if the PVCs/OBCs provisioned using Rook and NooBaa exist respectively

Edit the value of the annotation to change the cleanup policy or the uninstall mode.

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

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

Expected output for both commands:

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

Prerequisites

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

Procedure

1. Delete the volume snapshots that are using OpenShift Data Foundation.
   a. List the volume snapshots from all the namespaces.

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

   b. From the output of the previous command, identify and delete the volume snapshots that are using OpenShift Data Foundation.

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

      <VOLUME-SNAPSHOT-NAME>

      Is the name of the volume snapshot

      <NAMESPACE>

      Is the project namespace

2. Delete PVCs and OBCs that are using OpenShift Data Foundation.
   In the default uninstall mode (graceful), the uninstaller waits till all the PVCs and OBCs that use OpenShift Data Foundation are deleted.

   If you want to delete the Storage Cluster without deleting the PVCs, you can set the uninstall mode annotation to **forced** and skip this step. Doing so results in orphan PVCs and OBCs in the system.

   a. Delete OpenShift Container Platform monitoring stack PVCs using OpenShift Data Foundation.
      See Removing monitoring stack from OpenShift Data Foundation

   b. Delete OpenShift Container Platform Registry PVCs using OpenShift Data Foundation.
      Removing OpenShift Container Platform registry from OpenShift Data Foundation

   c. Delete OpenShift Container Platform logging PVCs using OpenShift Data Foundation.

Removing the cluster logging operator from OpenShift Data Foundation

d. Delete the other PVCs and OBCs provisioned using OpenShift Data Foundation.

- Given below is a sample script to identify the PVCs and OBCs provisioned using OpenShift Data Foundation. The script ignores the PVCs that are used internally by OpenShift Data Foundation.

```
#!/bin/bash

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

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

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

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

NOTE

Omit **RGW_PROVISIONER** for cloud platforms.

- Delete the OBCs.

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

<obc-name>

Is the name of the OBC

<project-name>

Is the name of the project

- Delete the PVCs.

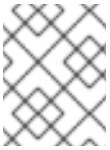
```
$ oc delete pvc <pvc-name> -n <project-name>
```

<pvc-name>

Is the name of the PVC

<project-name>

Is the name of the project



NOTE

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

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

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

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

```
$ oc get pods -n openshift-storage | grep -i cleanup
```

Example output:

```
NAME                          READY   STATUS      RESTARTS   AGE
cluster-cleanup-job-<xx>       0/1     Completed   0          8m35s
cluster-cleanup-job-<yy>       0/1     Completed   0          8m35s
cluster-cleanup-job-<zz>       0/1     Completed   0          8m35s
```

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

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

6. If encryption was enabled at the time of install, remove **dm-crypt** managed **device-mapper** mapping from the OSD devices on all the OpenShift Data Foundation nodes.

   a. Create a **debug** pod and **chroot** to the host on the storage node.

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

   ```
   $ chroot /host
   ```

   <node-name>

   Is the name of the node

   b. Get Device names and make note of the OpenShift Data Foundation devices.

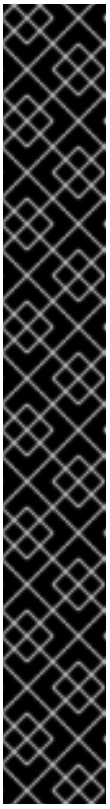
   ```
   $ dmsetup ls
   ```

Example output:

```
ocs-deviceset-0-data-0-57snx-block-dmcrypt (253:1)
```

c. Remove the mapped device.

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



IMPORTANT

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

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

```
$ ps -ef | grep crypt
```

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

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

<PID>

Is the process ID

- Verify that the device name is removed.

```
$ dmsetup ls
```

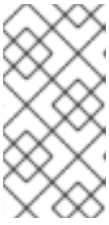
7. Delete the namespace and wait till the deletion is complete. You need to switch to another project if **openshift-storage** is the active project.
For example:

```
$ oc project default
```

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

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

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



NOTE

While uninstalling OpenShift Data Foundation, if **namespace** is not deleted completely and remains in **Terminating** state, perform the steps in Troubleshooting and deleting remaining resources during Uninstall to identify objects that are blocking the namespace from being terminated.

8. Delete local storage operator configurations if you have deployed OpenShift Data Foundation using local storage devices. See Removing local storage operator configurations .

9. Unlabel the storage nodes.

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

```
$ oc label nodes  --all topology.rook.io/rack-
```

10. Remove the OpenShift Data Foundation taint if the nodes were tainted.

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

11. Confirm all the Persistent volumes (PVs) provisioned using OpenShift Data Foundation are deleted. If there is any PV left in the **Released** state, delete it.

```
$ oc get pv
```

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

<pv-name>

Is the name of the PV

12. Remove the **CustomResourceDefinitions**.

```
$ oc delete crd backingstores.noobaa.io bucketclasses.noobaa.io
cephblockpools.ceph.rook.io cephclusters.ceph.rook.io cephfilesystems.ceph.rook.io
cephnfses.ceph.rook.io cephobjectstores.ceph.rook.io cephobjectstoreusers.ceph.rook.io
noobaas.noobaa.io ocsinitializations.ocs.openshift.io storageclusters.ocs.openshift.io
cephclients.ceph.rook.io cephobjectrealms.ceph.rook.io cephobjectzonegroups.ceph.rook.io
cephobjectzones.ceph.rook.io cephrbdmirrors.ceph.rook.io storagesystems.odf.openshift.io --
wait=true --timeout=5m
```

13. To ensure that OpenShift Data Foundation is uninstalled completely, on the OpenShift Container Platform Web Console,

    a. Click **Storage**.

    b. Verify that **OpenShift Data Foundation** no longer appears under Storage.

4.1.1. Removing local storage operator configurations

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

NOTE

For OpenShift Data Foundation deployments only using **localvolume** resources, go directly to step 8.

Procedure

1. Identify the **LocalVolumeSet** and the corresponding **StorageClassName** being used by OpenShift Data Foundation.

```
$ oc get localvolumesets.local.storage.openshift.io -n openshift-local-storage
```

2. Set the variable SC to the **StorageClass** providing the **LocalVolumeSet**.

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

3. List and note the devices to be cleaned up later. Inorder to list the device ids of the disks, please follow the procedure mentioned here, See Find the available storage devices .
Example output:

```
/dev/disk/by-id/scsi-360050763808104bc28000000000000eb
/dev/disk/by-id/scsi-360050763808104bc28000000000000ef
/dev/disk/by-id/scsi-360050763808104bc28000000000000f3
```

4. Delete the **LocalVolumeSet**.

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

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

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

6. Delete the **StorageClassName**.

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

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

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

8. Delete **LocalVolumeDiscovery**.

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

9. Remove the **LocalVolume** resources (if any).
Use the following steps to remove the **LocalVolume** resources that were used to provision PVs in the current or previous OpenShift Data Foundation version. Also, ensure that these resources are not being used by other tenants on the cluster.

   For each of the local volumes, do the following:

   a. Identify the **LocalVolume** and the corresponding **StorageClassName** being used by OpenShift Data Foundation.

```
$ oc get localvolume.local.storage.openshift.io -n openshift-local-storage
```

b. Set the variable LV to the name of the LocalVolume and variable SC to the name of the StorageClass
For example:

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

c. List and note the devices to be cleaned up later.

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

Example output:

```
/dev/sdb
/dev/sdc
/dev/sdd
/dev/sde
```

d. Delete the local volume resource.

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

e. Delete the remaining PVs and StorageClasses if they exist.

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

f. Clean up the artifacts from the storage nodes for that resource.

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

Example output:

```
Starting pod/node-xxx-debug ...
To use host binaries, run `chroot /host`
removed '/mnt/local-storage/localblock/nvme2n1'
removed directory '/mnt/local-storage/localblock'

Removing debug pod ...
Starting pod/node-yyy-debug ...
To use host binaries, run `chroot /host`
removed '/mnt/local-storage/localblock/nvme2n1'
removed directory '/mnt/local-storage/localblock'

Removing debug pod ...
Starting pod/node-zzz-debug ...
To use host binaries, run `chroot /host`
removed '/mnt/local-storage/localblock/nvme2n1'
```

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

Removing debug pod ...
```

10. Wipe the disks for each of the local volumesets or local volumes listed in step 1 and 8 respectively so that they can be reused.

    a. List the storage nodes.

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

    Example output:

    ```
    NAME      STATUS   ROLES    AGE     VERSION
    node-xxx  Ready    worker   4h45m   v1.18.3+6c42de8
    node-yyy  Ready    worker   4h46m   v1.18.3+6c42de8
    node-zzz  Ready    worker   4h45m   v1.18.3+6c42de8
    ```

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

    ```
    $ oc debug node/node-xxx
    Starting pod/node-xxx-debug …
    To use host binaries, run `chroot /host`
    Pod IP: w.x.y.z
    If you don't see a command prompt, try pressing enter.
    sh-4.2# chroot /host
    ```

    c. Store the disk paths in the **DISKS** variable within quotes. For the list of disk paths, see step 3 and step 8.c for local volumeset and local volume respectively.
    Example output:

    ```
    sh-4.4# DISKS="/dev/disk/by-id/scsi-360050763808104bc28000000000000eb
    /dev/disk/by-id/scsi-360050763808104bc28000000000000ef /dev/disk/by-id/scsi-
    360050763808104bc28000000000000f3 "
    or
    sh-4.2# DISKS="/dev/sdb /dev/sdc /dev/sdd /dev/sde ".
    ```

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

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

    Example output:

    ```
    Creating new GPT entries.
    GPT data structures destroyed! You may now partition the disk using fdisk or
    other utilities.
    Creating new GPT entries.
    GPT data structures destroyed! You may now partition the disk using fdisk or
    other utilities.
    Creating new GPT entries.
    GPT data structures destroyed! You may now partition the disk using fdisk or
    other utilities.
    ```

```
Creating new GPT entries.
GPT data structures destroyed! You may now partition the disk using fdisk or
other utilities.
```

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

```
sh-4.4# exit
exit
sh-4.2# exit
exit
Removing debug pod ...
```

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

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

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

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

4.2. REMOVING MONITORING STACK FROM OPENSHIFT DATA FOUNDATION

Use this section to clean up the monitoring stack from OpenShift Data Foundation.

The Persistent Volume Claims (PVCs) that are created as a part of configuring the monitoring stack are in the **openshift-monitoring** namespace.

Prerequisites

- PVCs are configured to use OpenShift Container Platform monitoring stack.
For more information, see configuring monitoring stack.

Procedure

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

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

Example output:

```
NAME                        READY   STATUS    RESTARTS   AGE
pod/alertmanager-main-0     3/3     Running   0          8d
pod/alertmanager-main-1     3/3     Running   0          8d
pod/alertmanager-main-2     3/3     Running   0          8d
pod/cluster-monitoring-
operator-84457656d-pkrxm    1/1     Running   0          8d
pod/grafana-79ccf6689f-2ll28  2/2   Running   0          8d
```

```
pod/kube-state-metrics-
7d86fb966-rvd9w              3/3     Running   0          8d
pod/node-exporter-25894      2/2     Running   0          8d
pod/node-exporter-4dsd7      2/2     Running   0          8d
pod/node-exporter-6p4zc      2/2     Running   0          8d
pod/node-exporter-jbjvg      2/2     Running   0          8d
pod/node-exporter-jj4t5      2/2     Running   0          6d18h
pod/node-exporter-k856s      2/2     Running   0          6d18h
pod/node-exporter-rf8gn      2/2     Running   0          8d
pod/node-exporter-rmb5m      2/2     Running   0          6d18h
pod/node-exporter-zj7kx      2/2     Running   0          8d
pod/openshift-state-metrics-
59dbd4f654-4clng             3/3     Running   0          8d
pod/prometheus-adapter-
5df5865596-k8dzn             1/1     Running   0          7d23h
pod/prometheus-adapter-
5df5865596-n2gj9             1/1     Running   0          7d23h
pod/prometheus-k8s-0         6/6     Running   1          8d
pod/prometheus-k8s-1         6/6     Running   1          8d
pod/prometheus-operator-
55cfb858c9-c4zd9             1/1     Running   0          6d21h
pod/telemeter-client-
78fc8fc97d-2rgfp             3/3     Running   0          8d

NAME                                         STATUS   VOLUME
CAPACITY   ACCESS MODES   STORAGECLASS               AGE
persistentvolumeclaim/my-alertmanager-claim-alertmanager-main-0   Bound    pvc-0d519c4f-
15a5-11ea-baa0-026d231574aa   40Gi       RWO           ocs-storagecluster-ceph-rbd   8d
persistentvolumeclaim/my-alertmanager-claim-alertmanager-main-1   Bound    pvc-
0d5a9825-15a5-11ea-baa0-026d231574aa   40Gi       RWO           ocs-storagecluster-ceph-
rbd   8d
persistentvolumeclaim/my-alertmanager-claim-alertmanager-main-2   Bound    pvc-
0d6413dc-15a5-11ea-baa0-026d231574aa   40Gi       RWO           ocs-storagecluster-ceph-
rbd   8d
persistentvolumeclaim/my-prometheus-claim-prometheus-k8s-0        Bound    pvc-0b7c19b0-
15a5-11ea-baa0-026d231574aa   40Gi       RWO           ocs-storagecluster-ceph-rbd   8d
persistentvolumeclaim/my-prometheus-claim-prometheus-k8s-1        Bound    pvc-0b8aed3f-
15a5-11ea-baa0-026d231574aa   40Gi       RWO           ocs-storagecluster-ceph-rbd   8d
```

2. Edit the monitoring **configmap**.

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

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

Before editing

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

After editing

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

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

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

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

<pvc-name>

Is the name of the PVC

4.3. REMOVING OPENSHIFT CONTAINER PLATFORM REGISTRY FROM OPENSHIFT DATA FOUNDATION

Use this section to clean up the OpenShift Container Platform registry from OpenShift Data Foundation. If you want to configure an alternative storage, see Image registry.

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

Prerequisites

- The image registry must have been configured to use an OpenShift Data Foundation PVC.

Procedure

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

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

Before editing

```
.
.
.

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

After editing

```
.
.
.
storage:
  emptyDir: {}
.
.
.
```

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

2. Delete the PVC.

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

<pvc-name>

Is the name of the PVC

4.4. REMOVING THE CLUSTER LOGGING OPERATOR FROM OPENSHIFT DATA FOUNDATION

Use this section to clean up the cluster logging operator from OpenShift Data Foundation.

The Persistent Volume Claims (PVCs) that are created as a part of configuring the cluster logging operator are in the **openshift-logging** namespace.

Prerequisites

- The cluster logging instance should have been configured to use the OpenShift Data Foundation PVCs.

Procedure

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

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

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

2. Delete the PVCs.

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

<pvc-name>

Is the name of the PVC