Red Hat OpenShift Container Storage 4.8

Scaling storage

Horizontal and vertical scaling options

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Red Hat OpenShift Container Storage 4.8 Scaling storage

Horizontal and vertical scaling options

Legal Notice

Abstract

This document explains scaling options for Red Hat OpenShift Container Storage.

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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.

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.
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- For submitting more complex 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

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

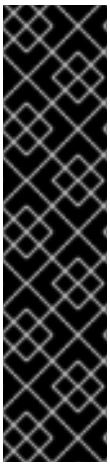
- **Scale up storage nodes** - Add storage capacity to the existing Red Hat OpenShift Container Storage worker nodes
- **Scale out storage nodes** - Add new worker nodes containing storage capacity

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

CHAPTER 1. REQUIREMENTS FOR SCALING STORAGE NODES

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

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



IMPORTANT

Always ensure that you have plenty of storage capacity.

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

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

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

1.1. SUPPORTED DEPLOYMENTS FOR RED HAT OPENSHIFT CONTAINER STORAGE

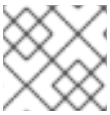
- User-provisioned infrastructure:
  - Amazon Web Services (AWS)
  - VMware
  - Bare metal
  - IBM Power Systems
  - IBM Z or LinuxONE
- Installer-provisioned infrastructure:
  - Amazon Web Services (AWS)
  - Microsoft Azure
  - Red Hat Virtualization
  - VMware

CHAPTER 2. SCALING UP STORAGE CAPACITY

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

- For AWS, VMware, Red Hat Virtualization or Azure infrastructures using dynamic or automated provisioning of storage devices, see Section 2.2, "Scaling up storage by adding capacity to your OpenShift Container Storage nodes"
- For bare metal, VMware or Red Hat Virtualization infrastructures using local storage devices, see Section 2.3, "Scaling up storage by adding capacity to your OpenShift Container Storage nodes using local storage devices"
- For IBM Z or LinuxONE infrastructures using local storage devices, see Section 2.4, "Scaling up storage by adding capacity to your OpenShift Container Storage nodes on IBM Z or LinuxONE infrastructure"
- For IBM Power Systems using local storage devices, see Section 2.5, "Scaling up storage by adding capacity to your OpenShift Container Storage nodes on IBM Power Systems infrastructure using local storage devices"

If you want to scale using a storage class other than the one provisioned during deployment, you must also define an additional storage class before you scale. See Creating a storage class for details.



NOTE

OpenShift Container Storage does not support heterogeneous OSD sizes.

2.1. CREATING A STORAGE CLASS

You can define a new storage class to dynamically provision storage from an existing provider.

Prerequisites

- Administrator access to OpenShift web console.

Procedure

1. Log in to OpenShift Web Console.
2. Click **Storage → Storage Classes**.
3. Click **Create Storage Class**
4. Enter the storage class **Name** and **Description**.
5. Select the required **Reclaim Policy** and **Provisioner**.
6. Click **Create** to create the Storage Class.

Verification steps

- Click **Storage → Storage Classes** and verify that you can see the new storage class.

2.2. SCALING UP STORAGE BY ADDING CAPACITY TO YOUR OPENSHIFT CONTAINER STORAGE NODES

Use this procedure to add storage capacity and performance to your configured Red Hat OpenShift Container Storage worker nodes on the following infrastructures:

- AWS
- VMware vSphere
- Red Hat Virtualization
- Microsoft Azure

Prerequisites

- A running OpenShift Container Storage 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 on **Operators → Installed Operators**.
3. Click **OpenShift Container Storage** Operator.
4. Click **Storage Cluster** tab.
5. The visible list should have only one item. Click (⋮) on the far right to extend the options menu.
6. Select **Add Capacity** from the options menu.
7. Select the **Storage Class**.
   Set the storage class to **gp2** on AWS, **thin** on VMware, **ovirt-csi-sc** on Red Hat Virtualization or **managed_premium** on Microsoft Azure if you are using the default storage class generated during deployment. If you have created other storage classes, select whichever is appropriate.

IMPORTANT

Using storage classes other than the default for your provider 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.

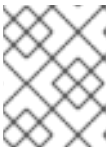
For more information, see Technology Preview Features Support Scope .

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 Container Storage uses a replica count of 3.

8. Click **Add** and wait for the cluster state to change to **Ready**.

Verification steps

- Navigate to **Overview → Block and File** tab, then check the **Raw Capacity breakdown** card. Note that the capacity increases based on your selections.



NOTE

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

- Verify that the new OSDs and their corresponding new PVCs are created.
  - 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.
  - 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.
- (Optional) If cluster-wide encryption is enabled on the cluster, verify that the new OSD devices are encrypted.
  a. Identify the node(s) where the new OSD pod(s) are running.

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

  For example:

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

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

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

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

```
$ lsblk
```

IMPORTANT

Cluster reduction is supported only with the Red Hat Support Team's assistance.

2.3. SCALING UP STORAGE BY ADDING CAPACITY TO YOUR OPENSHIFT CONTAINER STORAGE NODES USING LOCAL STORAGE DEVICES

Use this procedure to add storage capacity (additional storage devices) to your configured local storage based OpenShift Container Storage worker nodes on the following infrastructures:

- Bare metal
- VMware
- Red Hat Virtualization

Prerequisites

- You must be logged into the OpenShift Container Platform cluster.
- You must have installed local storage operator. Use any of the following procedures applicable to your infrastructure:
  - Installing Local Storage Operator on bare metal
  - Installing Local Storage Operator on vSphere cluster
  - Installing Local Storage Operator on Red Hat Virtualization cluster
- If you upgraded to OpenShift Container Storage version 4.8 from a previous version, and have not already created the **LocalVolumeDiscovery** and **LocalVolumeSet** objects, do so now by following the procedure described in Post-update configuration changes for clusters backed by local storage.
- You must have three OpenShift Container Platform worker nodes with the same storage type and size attached to each node (for example, 2TB NVMe drive) as the original OpenShift Container Storage StorageCluster was created with.

Procedure

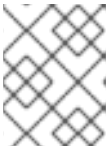
To add capacity, you can either use a storage class that you provisioned during the deployment or any other storage class that matches the filter.

1. On the OpenShift web console, click on **Operators → Installed Operators**.
2. Click **OpenShift Container Storage** Operator.
3. Click **Storage Cluster** tab.
4. The visible list should have only one item. Click (⋮) on the far right to extend the options menu.
5. Select **Add Capacity** from the options menu.
6. Select the **Storage Class** for which you added disks or the new storage class depending on your requirement. Available Capacity displayed is based on the local disks available in storage class.

7. Click **Add**.
   You might need to wait a couple of minutes for the storage cluster to reach **Ready** state.

Verification steps

- Navigate to **Overview → Block and File** tab, then check the **Raw Capacity breakdown** card.
  Note that the capacity increases based on your selections.



NOTE

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

- Verify that the new OSDs and their corresponding new PVCs are created.
  - 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.
  - 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.
- (Optional) If cluster-wide encryption is enabled on the cluster, verify that the new OSD devices are encrypted.
  a. Identify the node(s) where the new OSD pod(s) are running.

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

  For example:

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

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

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

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

```
$ lsblk
```

IMPORTANT

Cluster reduction is supported only with the Red Hat Support Team’s assistance.

2.4. SCALING UP STORAGE BY ADDING CAPACITY TO YOUR OPENSHIFT CONTAINER STORAGE NODES ON IBM Z OR LINUXONE INFRASTRUCTURE

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

Prerequisites

- A running OpenShift Container Storage Platform.
- Administrative privileges on the OpenShift Web Console.
- 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. Add additional hardware resources with zFCP disks

   a. List all the disks with the following command.

   ```
   $ lszdev
   ```

   Example output:

   ```
   TYPE        ID                                      ON   PERS  NAMES
   zfcp-host   0.0.8204                                  yes  yes
   zfcp-lun    0.0.8204:0x102107630b1b5060:0x4001402900000000  yes  no    sda sg0
   zfcp-lun    0.0.8204:0x500407630c0b50a4:0x3002b03000000000  yes  yes   sdb sg1
   qeth        0.0.bdd0:0.0.bdd1:0.0.bdd2                 yes  no    encbdd0
   generic-ccw 0.0.0009                                   yes  no
   ```

   A SCSI disk is represented as a **zfcp-lun** with the structure **<device-id>:<wwpn>:<lun-id>** in the ID section. The first disk is used for the operating system. The device id for the new disk can be the same.

   b. Append a new SCSI disk with the following command.

   ```
   $ chzdev -e 0.0.8204:0x400506630b1b50a4:0x3001301a00000000
   ```

   NOTE

   The device ID for the new disk must be the same as the disk to be replaced. The new disk is identified with its WWPN and LUN ID.

   c. List all the FCP devices to verify the new disk is configured.

   ```
   $ lszdev zfcp-lun
   TYPE        ID                                      ON   PERS  NAMES
   zfcp-lun    0.0.8204:0x102107630b1b5060:0x4001402900000000 yes  no    sda sg0
   zfcp-lun    0.0.8204:0x500507630b1b50a4:0x4001302a00000000  yes  yes   sdb sg1
   zfcp-lun    0.0.8204:0x400506630b1b50a4:0x3001301a00000000  yes  yes   sdc sg2
   ```

2. Navigate to the OpenShift Web Console.
3. Click **Operators** on the left navigation bar.
4. Select **Installed Operators**.
5. In the window, click **OpenShift Container Storage** Operator:
6. In the top navigation bar, scroll right and click **Storage Cluster** tab.
7. Click (⋮) next to the visible list to extend the options menu.
8. Select **Add Capacity** from the options menu.
   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 Container Storage uses a replica count of 3.
9. Click **Add** and wait for the cluster state to change to **Ready**.

Verification steps

1. Navigate to **Overview → Block and File** tab, then check the **Capacity breakdown** card.
   Note that the capacity increases based on your selections.

NOTE

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

IMPORTANT

Cluster reduction is supported only with the Red Hat Support Team's assistance.

2.5. SCALING UP STORAGE BY ADDING CAPACITY TO YOUR OPENSHIFT CONTAINER STORAGE NODES ON IBM POWER SYSTEMS INFRASTRUCTURE USING LOCAL STORAGE DEVICES

Use this procedure to add storage capacity (additional storage devices) to your configured local storage based OpenShift Container Storage worker nodes on IBM Power Systems infrastructures.

Prerequisites

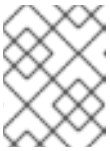
- You must be logged into OpenShift Container Platform (RHOCP) cluster.
- You must have installed local storage operator. Use the following procedures, see
  - Installing Local Storage Operator on IBM Power Systems
- If you upgraded to OpenShift Container Storage 4.8 from a previous version and have not already created the **LocalVolumeDiscovery** object, do so now by following the procedure described in Post-update configuration changes for clusters backed by local storage .

- You must have three OpenShift Container Platform worker nodes with the same storage type and size attached to each node (for example, 0.5TB SSD) as the original OpenShift Container Storage StorageCluster was created with.

Procedure

1. To add storage capacity to OpenShift Container Platform nodes with OpenShift Container Storage installed, you need to

   a. Find the available devices that you want to add, that is, a minimum of one device per worker node. You can follow the procedure for finding available storage devices in the respective deployment guide.

   NOTE

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

   b. Add the additional disks to the **LocalVolume** custom resource (CR).

   ```
   $ oc edit -n openshift-local-storage localvolume localblock
   ```

   Example output:

   ```
   spec:
     logLevel: Normal
     managementState: Managed
     nodeSelector:
       nodeSelectorTerms:
         - matchExpressions:
             - key: kubernetes.io/hostname
               operator: In
               values:
                 - worker-0
                 - worker-1
                 - worker-2
     storageClassDevices:
       - devicePaths:
           - /dev/sda
           - /dev/sdx    # newly added device
         storageClassName: localblock
         volumeMode: Block
   ```

   Make sure to save the changes after editing the CR.

   Example output:

   ```
   localvolume.local.storage.openshift.io/localblock edited
   ```

   You can see in this CR that new devices have been added.

   - **sdx**

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

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

Example output:

```
local-pv-a04ffd8    500Gi    RWO    Delete    Available    localblock    24s
local-pv-a0ca996b   500Gi    RWO    Delete    Available    localblock    23s
local-pv-c171754a   500Gi    RWO    Delete    Available    localblock    23s
```

3. Navigate to the OpenShift Web Console.
4. Click on **Operators** on the left navigation bar.
5. Select **Installed Operators**.
6. In the window, click **OpenShift Container Storage** Operator:
7. In the top navigation bar, scroll right and click **Storage Cluster** tab.
8. The visible list should have only one item. Click (⋮) on the far right to extend the options menu.
9. Select **Add Capacity** from the options menu.
   From this dialog box, set the **Storage Class** name to the name used in the **localVolume** CR.
   Available Capacity displayed is based on the local disks available in storage class.
10. Once you are done with your setting, click **Add**.
    You might need to wait a couple of minutes for the storage cluster to reach **Ready** state.

Verification steps

- Navigate to **Overview → Block and File** tab, then check the **Raw Capacity breakdown** card.
  Note that the capacity increases based on your selections.

NOTE

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

- Verify that the new OSDs and their corresponding new PVCs are created.
  - 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.
  - 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.
- (Optional) If cluster-wide encryption is enabled on the cluster, verify that the new OSD devices are encrypted.
  a. Identify the node(s) where the new OSD pod(s) are running.

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

For example:

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

b. For each of the nodes identified in previous step, do the following:

i. Create a debug pod and open a chroot environment for the selected host(s).

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

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

```
$ lsblk
```

IMPORTANT

Cluster reduction is supported only with the Red Hat Support Team’s assistance.

CHAPTER 3. SCALING OUT STORAGE CAPACITY

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

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

NOTE

OpenShift Container Storage does not support heterogeneous OSD sizes.

3.1. ADDING A NODE

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

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

- For AWS or Azure or Red Hat Virtualization installer-provisioned infrastructures, see Adding a node on an installer-provisioned infrastructure
- For AWS or VMware user-provisioned infrastructure, see Adding a node on an user-provisioned infrastructure
- For bare metal, IBM Z or LinuxONE, VMware, or Red Hat Virtualization infrastructures, see Adding a node using a local storage device
- For IBM Power Systems, see Adding a node using a local storage device on IBM Power Systems

3.1.1. Adding a node on an installer-provisioned infrastructure

Use this procedure to add a node on the following installer provisioned infrastructures:

- AWS
- Azure
- Red Hat Virtualization
- VMware

Prerequisites

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

Procedure

1. Navigate to **Compute → Machine Sets**.
2. On the machine set where you want to add nodes, select **Edit Machine Count**

3. Add the amount of nodes, and click **Save**.
4. Click **Compute → Nodes** and confirm if the new node is in **Ready** state.
5. Apply the OpenShift Container Storage label to the new node.
    a. For the new node, **Action menu (⋮) → Edit Labels**.
    b. Add **cluster.ocs.openshift.io/openshift-storage** and click **Save**.

NOTE

It is recommended to add 3 nodes, one 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 .

3.1.2. Adding a node on an user-provisioned infrastructure

Use this procedure to add a node on an AWS or VMware user-provisioned infrastructure.

Prerequisites

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

Procedure

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

```
$ oc get csr
```

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

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

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

   From User interface

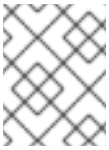
   a. For the new node, click **Action Menu (⋮) → Edit Labels**

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

   From Command line interface

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

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

     NOTE

     It is recommended to add 3 nodes, one 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 .

3.1.3. Adding a node using a local storage device

Use this procedure to add a node on the following:

- Bare metal
- IBM Z or LinuxONE
- VMware
- Red Hat Virtualization

Prerequisites

- You must be logged into the OpenShift Container Platform (RHOCP) cluster.
- You must have three OpenShift Container Platform worker nodes with the same storage type and size attached to each node (for example, 2TB SSD or 2TB NVMe drive) as the original OpenShift Container Storage StorageCluster was created with.
- If you upgraded to OpenShift Container Storage version 4.8 from a previous version, and have not already created the **LocalVolumeDiscovery** and **LocalVolumeSet** objects, do so now by following the procedure described in Post-update configuration changes for clusters backed by local storage.

Procedure

1. Depending on whether you are adding a node on bare metal, IBM Power Systems, IBM Z or LinuxONE, VMware infrastructure, or Red Hat Virtualization platform, perform the following steps:

   - For VMware:

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

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

   - For Red Hat Virtualization:

     a. Create a new VM on Red Hat Virtualization with the required infrastructure. See Platform requirements.

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

   - For bare metal:

     a. Get a new bare metal machine with the required infrastructure. See Platform requirements.

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

- For IBM Z or LinuxONE:

  a. Get a new IBM Z or LinuxONE machine with the required infrastructure. See Platform requirements.

  b. Create a new OpenShift Container Platform node using the new IBM Z or LinuxONE machine.

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

        ```
        $ oc get csr
        ```

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

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

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

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

        From User interface

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

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

     From Command line interface

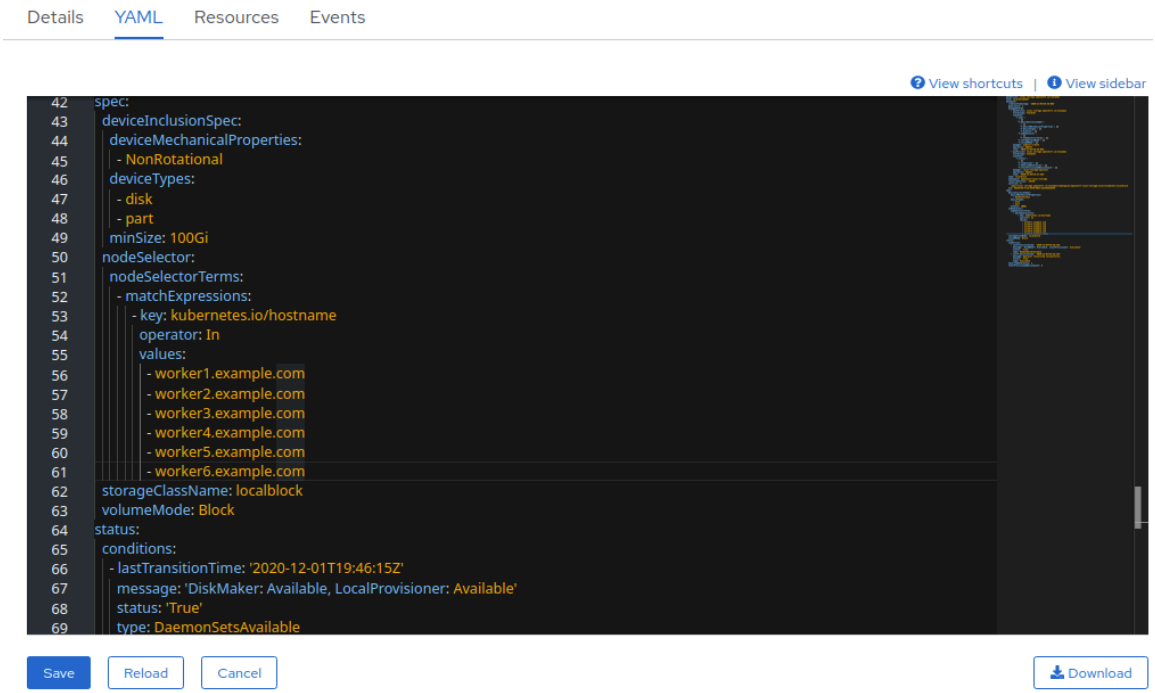
- Execute the following command to apply the OpenShift Container Storage label to the new node:

  -

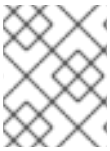
```
$ oc label node <new_node_name> cluster.ocs.openshift.io/openshift-storage=""
```

1. Click **Operators → Installed Operators** from the OpenShift Web Console.
   From the **Project** drop-down list, make sure to select the project where the Local Storage Operator is installed.
2. Click on **Local Storage**.
3. Click the **Local Volume Discovery** tab.
4. Beside the **LocalVolumeDiscovery**, click Action menu (⋮) → **Edit Local Volume Discovery**.
5. In the YAML, add the hostname of the new node in the **values** field under the node selector.
6. Click **Save**.
7. Click the **Local Volume Sets** tab.
8. Beside the **LocalVolumeSet**, click Action menu (⋮) → **Edit Local Volume Set**
9. In the YAML, add the hostname of the new node in the **values** field under the **node selector**.

Figure 3.1. YAML showing the addition of new hostnames



10. Click **Save**.



NOTE

It is recommended to add 3 nodes, one 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 .

3.1.4. Adding a node using a local storage device on IBM Power Systems

Prerequisites

- You must be logged into the OpenShift Container Platform (RHOCP) cluster.
- You must have three OpenShift Container Platform worker nodes with the same storage type and size attached to each node (for example, 2TB SSD drive) as the original OpenShift Container Storage StorageCluster was created with.
- If you have upgraded from a previous version of OpenShift Container Storage and have not already created a **LocalVolumeDiscovery** object, do so now by following the procedure described in Post-update configuration changes for clusters backed by local storage .

Procedure

- For IBM Power Systems:
  a. Get a new IBM Power machine with the required infrastructure. See Platform requirements.
  b. Create a new OpenShift Container Platform node using the new IBM Power Systems machine.
     1. Check for certificate signing requests (CSRs) related to OpenShift Container Storage that are in **Pending** state:

        ```
        $ oc get csr
        ```

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

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

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

        From User interface

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

     From Command line interface

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

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

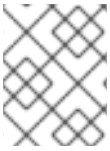
  1. Click **Operators → Installed Operators** from the OpenShift Web Console.
     From the **Project** drop-down list, make sure to select the project where the Local Storage Operator is installed.

2. Click on **Local Storage**.
3. Click the **Local Volume Discovery** tab.
4. Click the Action menu (⋮) next to **LocalVolumeDiscovery → Edit Local Volume Discovery**.
5. In the YAML, add the hostname of the new node in the **values** field under the node selector.
6. Click **Save**.
7. Click the **Local Volume** tab.
8. Beside the **LocalVolume**, click Action menu (⋮) → **Edit Local Volume**.
9. In the YAML, add the hostname of the new node in the **values** field under the **node selector**.

Figure 3.2. YAML showing the addition of new hostnames

```yaml
apiVersion: local.storage.openshift.io/v1
kind: LocalVolume
metadata:
  creationTimestamp: '2021-07-09T08:12:56Z'
  finalizers:…
  generation: 2
  managedFields:…
  name: localblock
  namespace: openshift-local-storage
  resourceVersion: '1988620'
  uid: 89d78619-a76b-4b97-af9d-6760c57ab531
spec:
  logLevel: Normal
  managementState: Managed
  nodeSelector:
    nodeSelectorTerms:
      - matchExpressions:
          - key: kubernetes.io/hostname
            operator: In
            values:
              - worker-0
              - worker-1
              - worker-2
              - worker-3
  storageClassDevices:
```

10. Click **Save**.



NOTE

It is recommended to add 3 nodes, one 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 .

3.1.5. 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-***

3.2. ADDING CAPACITY TO A NEWLY ADDED NODE

To add capacity to a newly added node, either use the **Add Capacity** option to expand the storage cluster with 3 OSDs or use the new flexible scaling feature that allows you to expand the storage cluster by any number of OSDs if it is enabled.

3.2.1. Add capacity with 3 OSDs using the Add Capacity option

To add capacity by 3 OSDs for dynamic and local storage using the **Add Capacity** option in the user interface, see Scaling up storage by adding capacity . The **Add Capacity** option is available for storage clusters with or without the flexible scaling feature enabled.

3.2.2. Add capacity using YAML

With flexible scaling enabled, you can add capacity by 1 or more OSDs at a time using the YAML instead of the default set of 3 OSDs. However, you need to make sure that you add disks in a way that the cluster remains balanced.

Flexible scaling is supported only for the internal-attached mode of storage cluster creation. Flexible scaling of storage clusters is available only for the new deployments of Red Hat OpenShift Container Storage 4.7 and not for the upgraded clusters.

To enable flexible scaling, create a cluster with 3 nodes, and fewer than 3 availability zones. The OpenShift Web Console detects the 3 nodes spread across fewer than 3 availability zones and enables flexible scaling.

IMPORTANT

You can not enable or disable the flexible scaling feature after creating the storage cluster.

3.2.2.1. Verifying if flexible scaling is enabled

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

1. Click **OpenShift Container Storage** Operator.
2. Click the **Storage Cluster** tab.
3. Click on the action menu **(⋮)** next to the storage cluster.
4. Click **Edit Storage Cluster**. You are redirected to the YAML.

5. In the YAML, 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
```

3.2.2.2. Adding capacity using the YAML in multiples of 1 OSD

To add OSDs to your storage cluster flexibly through the YAML, perform the following steps:

Prerequisites

- Administrator access to the OpenShift Container Platform web console.
- A storage cluster with flexible scaling enabled.
- Additional disks available for adding capacity.

Procedure

1. Click **Operators → Installed Operators** to view all the installed operators. Ensure that the Project selected is openshift-storage.
2. Click the **OpenShift Container Storage** operator.
3. Click the **Storage Cluster tab**.
4. Click on the action menu **(⋮)** next to the storage cluster you want to scale up.
5. Click **Edit Storage Cluster**. You are redirected to the YAML.
6. In YAML, search for the key **count** . This count parameter scales up the capacity.
7. Increase the count by the number of OSDs you want to add to your cluster.

IMPORTANT

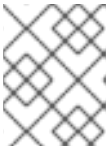
Ensure the **count** parameter in YAML is incremented depending on the number of available disks and also make sure that you add disks in a way that the cluster remains balanced.

8. Click **Save**.

You might need to wait a couple of minutes for the storage cluster to reach the Ready state.

Verification steps

- Navigate to **Overview → Block and File** tab, then check the **Raw Capacity breakdown** card. Note that the capacity increases based on your selections.



NOTE

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

- Verify that the new OSDs and their corresponding new PVCs are created.
  - 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.
  - 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.
- (Optional) If cluster-wide encryption is enabled on the cluster, verify that the new OSD devices are encrypted.
  a. Identify the node(s) where the new OSD pod(s) are running.

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

  For example:

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

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

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

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

```
$ lsblk
```

IMPORTANT

Cluster reduction is supported only with the Red Hat Support Team’s assistance.