OpenShift Container Platform 4.18

Backup and restore

Backing up and restoring your OpenShift Container Platform cluster

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Legal Notice

Abstract

This document provides instructions for backing up your cluster's data and for recovering from various disaster scenarios.

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CHAPTER 1. BACKUP AND RESTORE

1.1. CONTROL PLANE BACKUP AND RESTORE OPERATIONS

As a cluster administrator, you might need to stop an OpenShift Container Platform cluster for a period and restart it later. Some reasons for restarting a cluster are that you need to perform maintenance on a cluster or want to reduce resource costs. In OpenShift Container Platform, you can perform a graceful shutdown of a cluster so that you can easily restart the cluster later.

You must back up etcd data before shutting down a cluster; etcd is the key-value store for OpenShift Container Platform, which persists the state of all resource objects. An etcd backup plays a crucial role in disaster recovery. In OpenShift Container Platform, you can also replace an unhealthy etcd member.

When you want to get your cluster running again, restart the cluster gracefully.

NOTE

A cluster's certificates expire one year after the installation date. You can shut down a cluster and expect it to restart gracefully while the certificates are still valid. Although the cluster automatically retrieves the expired control plane certificates, you must still approve the certificate signing requests (CSRs) .

You might run into several situations where OpenShift Container Platform does not work as expected, such as:

- You have a cluster that is not functional after the restart because of unexpected conditions, such as node failure or network connectivity issues.
- You have deleted something critical in the cluster by mistake.
- You have lost the majority of your control plane hosts, leading to etcd quorum loss.

You can always recover from a disaster situation by restoring your cluster to its previous state using the saved etcd snapshots.

Additional resources

- Quorum protection with machine lifecycle hooks

1.2. APPLICATION BACKUP AND RESTORE OPERATIONS

As a cluster administrator, you can back up and restore applications running on OpenShift Container Platform by using the OpenShift API for Data Protection (OADP).

OADP backs up and restores Kubernetes resources and internal images, at the granularity of a namespace, by using the version of Velero that is appropriate for the version of OADP you install, according to the table in Downloading the Velero CLI tool. OADP backs up and restores persistent volumes (PVs) by using snapshots or Restic. For details, see OADP features.

1.2.1. OADP requirements

OADP has the following requirements:

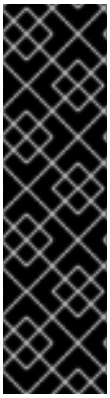
- You must be logged in as a user with a **cluster-admin** role.

- You must have object storage for storing backups, such as one of the following storage types:
  - OpenShift Data Foundation
  - Amazon Web Services
  - Microsoft Azure
  - Google Cloud Platform
  - S3-compatible object storage
  - IBM Cloud® Object Storage S3

NOTE

If you want to use CSI backup on OCP 4.11 and later, install OADP 1.1.*x*.

OADP 1.0.*x* does not support CSI backup on OCP 4.11 and later. OADP 1.0. *x* includes Velero 1.7.*x* and expects the API group **snapshot.storage.k8s.io/v1beta1**, which is not present on OCP 4.11 and later.



IMPORTANT

The **CloudStorage** API for S3 storage is a Technology Preview feature only. 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 about the support scope of Red Hat Technology Preview features, see Technology Preview Features Support Scope .

- To back up PVs with snapshots, you must have cloud storage that has a native snapshot API or supports Container Storage Interface (CSI) snapshots, such as the following providers:
  - Amazon Web Services
  - Microsoft Azure
  - Google Cloud Platform
  - CSI snapshot-enabled cloud storage, such as Ceph RBD or Ceph FS

NOTE

If you do not want to back up PVs by using snapshots, you can use Restic, which is installed by the OADP Operator by default.

1.2.2. Backing up and restoring applications

You back up applications by creating a **Backup** custom resource (CR). See Creating a Backup CR . You can configure the following backup options:

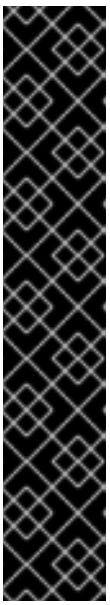
- Creating backup hooks to run commands before or after the backup operation
- Scheduling backups
- Backing up applications with File System Backup: Kopia or Restic
- You restore application backups by creating a **Restore** (CR). See Creating a Restore CR.
- You can configure restore hooks to run commands in init containers or in the application container during the restore operation.

CHAPTER 2. SHUTTING DOWN THE CLUSTER GRACEFULLY

This document describes the process to gracefully shut down your cluster. You might need to temporarily shut down your cluster for maintenance reasons, or to save on resource costs.

2.1. PREREQUISITES

- Take an etcd backup prior to shutting down the cluster.



IMPORTANT

It is important to take an etcd backup before performing this procedure so that your cluster can be restored if you encounter any issues when restarting the cluster.

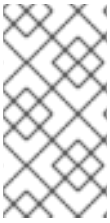
For example, the following conditions can cause the restarted cluster to malfunction:

- etcd data corruption during shutdown
- Node failure due to hardware
- Network connectivity issues

If your cluster fails to recover, follow the steps to restore to a previous cluster state.

2.2. SHUTTING DOWN THE CLUSTER

You can shut down your cluster in a graceful manner so that it can be restarted at a later date.



NOTE

You can shut down a cluster until a year from the installation date and expect it to restart gracefully. After a year from the installation date, the cluster certificates expire. However, you might need to manually approve the pending certificate signing requests (CSRs) to recover kubelet certificates when the cluster restarts.

Prerequisites

- You have access to the cluster as a user with the **cluster-admin** role.
- You have taken an etcd backup.
- If you are running a single-node OpenShift cluster, you must evacuate all workload pods off of the cluster before you shut it down.

Procedure

1. If you are shutting the cluster down for an extended period, determine the date on which certificates expire and run the following command:

```
$ oc -n openshift-kube-apiserver-operator get secret kube-apiserver-to-kubelet-signer -o
jsonpath='{.metadata.annotations.auth\.openshift\.io/certificate-not-after}'
```

Example output

```
2022-08-05T14:37:50Zuser@user:~ $ 1
```

1 To ensure that the cluster can restart gracefully, plan to restart it on or before the specified date. As the cluster restarts, the process might require you to manually approve the pending certificate signing requests (CSRs) to recover kubelet certificates.

2. Mark all the nodes in the cluster as unschedulable. You can do this from your cloud provider's web console, or by running the following loop:

```
$ for node in $(oc get nodes -o jsonpath='{.items[*].metadata.name}'); do echo ${node} ; oc adm cordon ${node} ; done
```

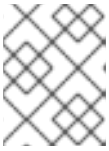
Example output

```
ci-ln-mgdnf4b-72292-n547t-master-0
node/ci-ln-mgdnf4b-72292-n547t-master-0 cordoned
ci-ln-mgdnf4b-72292-n547t-master-1
node/ci-ln-mgdnf4b-72292-n547t-master-1 cordoned
ci-ln-mgdnf4b-72292-n547t-master-2
node/ci-ln-mgdnf4b-72292-n547t-master-2 cordoned
ci-ln-mgdnf4b-72292-n547t-worker-a-s7ntl
node/ci-ln-mgdnf4b-72292-n547t-worker-a-s7ntl cordoned
ci-ln-mgdnf4b-72292-n547t-worker-b-cmc9k
node/ci-ln-mgdnf4b-72292-n547t-worker-b-cmc9k cordoned
ci-ln-mgdnf4b-72292-n547t-worker-c-vcmtn
node/ci-ln-mgdnf4b-72292-n547t-worker-c-vcmtn cordoned
```

3. Evacuate the pods using the following method:

```
$ for node in $(oc get nodes -l node-role.kubernetes.io/worker -o jsonpath='{.items[*].metadata.name}'); do echo ${node} ; oc adm drain ${node} --delete-emptydir-data --ignore-daemonsets=true --timeout=15s --force ; done
```

4. Shut down all of the nodes in the cluster. You can do this from the web console for your cloud provider web console, or by running the following loop. Shutting down the nodes by using one of these methods allows pods to terminate gracefully, which reduces the chance for data corruption.



NOTE

Ensure that the control plane node with the API VIP assigned is the last node processed in the loop. Otherwise, the shutdown command fails.

```
$ for node in $(oc get nodes -o jsonpath='{.items[*].metadata.name}'); do oc debug node/${node} -- chroot /host shutdown -h 1; done 1
```

1 **-h 1** indicates how long, in minutes, this process lasts before the control plane nodes are shut down. For large-scale clusters with 10 nodes or more, set to **-h 10** or longer to make sure all the compute nodes have time to shut down first.

Example output

```
Starting pod/ip-10-0-130-169us-east-2computeinternal-debug ...
To use host binaries, run `chroot /host`
Shutdown scheduled for Mon 2021-09-13 09:36:17 UTC, use 'shutdown -c' to cancel.
Removing debug pod ...
Starting pod/ip-10-0-150-116us-east-2computeinternal-debug ...
To use host binaries, run `chroot /host`
Shutdown scheduled for Mon 2021-09-13 09:36:29 UTC, use 'shutdown -c' to cancel.
```

NOTE

It is not necessary to drain control plane nodes of the standard pods that ship with OpenShift Container Platform prior to shutdown. Cluster administrators are responsible for ensuring a clean restart of their own workloads after the cluster is restarted. If you drained control plane nodes prior to shutdown because of custom workloads, you must mark the control plane nodes as schedulable before the cluster will be functional again after restart.

5. Shut off any cluster dependencies that are no longer needed, such as external storage or an LDAP server. Be sure to consult your vendor's documentation before doing so.

IMPORTANT

If you deployed your cluster on a cloud-provider platform, do not shut down, suspend, or delete the associated cloud resources. If you delete the cloud resources of a suspended virtual machine, OpenShift Container Platform might not restore successfully.

2.3. ADDITIONAL RESOURCES

- Restarting the cluster gracefully

CHAPTER 3. RESTARTING THE CLUSTER GRACEFULLY

This document describes the process to restart your cluster after a graceful shutdown.

Even though the cluster is expected to be functional after the restart, the cluster might not recover due to unexpected conditions, for example:

- etcd data corruption during shutdown
- Node failure due to hardware
- Network connectivity issues

If your cluster fails to recover, follow the steps to restore to a previous cluster state .

3.1. PREREQUISITES

- You have gracefully shut down your cluster .

3.2. RESTARTING THE CLUSTER

You can restart your cluster after it has been shut down gracefully.

Prerequisites

- You have access to the cluster as a user with the **cluster-admin** role.
- This procedure assumes that you gracefully shut down the cluster.

Procedure

1. Turn on the control plane nodes.
   - If you are using the **admin.kubeconfig** from the cluster installation and the API virtual IP address (VIP) is up, complete the following steps:
     a. Set the **KUBECONFIG** environment variable to the **admin.kubeconfig** path.
     b. For each control plane node in the cluster, run the following command:

     ```
     $ oc adm uncordon <node>
     ```

   - If you do not have access to your **admin.kubeconfig** credentials, complete the following steps:
     a. Use SSH to connect to a control plane node.
     b. Copy the **localhost-recovery.kubeconfig** file to the **/root** directory.
     c. Use that file to run the following command for each control plane node in the cluster:

     ```
     $ oc adm uncordon <node>
     ```

2. Power on any cluster dependencies, such as external storage or an LDAP server.

3. Start all cluster machines.
   Use the appropriate method for your cloud environment to start the machines, for example, from your cloud provider's web console.

   Wait approximately 10 minutes before continuing to check the status of control plane nodes.

4. Verify that all control plane nodes are ready.

   ```
   $ oc get nodes -l node-role.kubernetes.io/master
   ```

   The control plane nodes are ready if the status is **Ready**, as shown in the following output:

   ```
   NAME                          STATUS   ROLES                  AGE   VERSION
   ip-10-0-168-251.ec2.internal   Ready    control-plane,master   75m   v1.31.3
   ip-10-0-170-223.ec2.internal   Ready    control-plane,master   75m   v1.31.3
   ip-10-0-211-16.ec2.internal    Ready    control-plane,master   75m   v1.31.3
   ```

5. If the control plane nodes are *not* ready, then check whether there are any pending certificate signing requests (CSRs) that must be approved.

   a. Get the list of current CSRs:

      ```
      $ oc get csr
      ```

   b. Review the details of a CSR to verify that it is valid:

      ```
      $ oc describe csr <csr_name> 1
      ```

      1 **<csr_name>** is the name of a CSR from the list of current CSRs.

   c. Approve each valid CSR:

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

6. After the control plane nodes are ready, verify that all worker nodes are ready.

   ```
   $ oc get nodes -l node-role.kubernetes.io/worker
   ```

   The worker nodes are ready if the status is **Ready**, as shown in the following output:

   ```
   NAME                          STATUS   ROLES    AGE   VERSION
   ip-10-0-179-95.ec2.internal   Ready    worker   64m   v1.31.3
   ip-10-0-182-134.ec2.internal  Ready    worker   64m   v1.31.3
   ip-10-0-250-100.ec2.internal  Ready    worker   64m   v1.31.3
   ```

7. If the worker nodes are *not* ready, then check whether there are any pending certificate signing requests (CSRs) that must be approved.

   a. Get the list of current CSRs:

      ```
      $ oc get csr
      ```

b. Review the details of a CSR to verify that it is valid:

```
$ oc describe csr <csr_name> 1
```

1 **<csr_name>** is the name of a CSR from the list of current CSRs.

c. Approve each valid CSR:

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

8. After the control plane and compute nodes are ready, mark all the nodes in the cluster as schedulable by running the following command:

```
$ for node in $(oc get nodes -o jsonpath='{.items[*].metadata.name}'); do echo ${node} ; oc adm uncordon ${node} ; done
```

9. Verify that the cluster started properly.

a. Check that there are no degraded cluster Operators.

```
$ oc get clusteroperators
```

Check that there are no cluster Operators with the **DEGRADED** condition set to **True**.

```
NAME                                       VERSION   AVAILABLE   PROGRESSING   DEGRADED
SINCE
authentication                             4.18.0    True        False         False     59m
cloud-credential                           4.18.0    True        False         False     85m
cluster-autoscaler                         4.18.0    True        False         False     73m
config-operator                            4.18.0    True        False         False     73m
console                                    4.18.0    True        False         False     62m
csi-snapshot-controller                    4.18.0    True        False         False     66m
dns                                        4.18.0    True        False         False     76m
etcd                                       4.18.0    True        False         False     76m
...
```

b. Check that all nodes are in the **Ready** state:

```
$ oc get nodes
```

Check that the status for all nodes is **Ready**.

```
NAME                           STATUS   ROLES                  AGE   VERSION
ip-10-0-168-251.ec2.internal   Ready    control-plane,master   82m   v1.31.3
ip-10-0-170-223.ec2.internal   Ready    control-plane,master   82m   v1.31.3
ip-10-0-179-95.ec2.internal    Ready    worker                 70m   v1.31.3
ip-10-0-182-134.ec2.internal   Ready    worker                 70m   v1.31.3
ip-10-0-211-16.ec2.internal    Ready    control-plane,master   82m   v1.31.3
ip-10-0-250-100.ec2.internal   Ready    worker                 69m   v1.31.3
```

If the cluster did not start properly, you might need to restore your cluster using an etcd backup.

Additional resources

- See Restoring to a previous cluster state for how to use an etcd backup to restore if your cluster failed to recover after restarting.

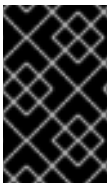
CHAPTER 4. HIBERNATING AN OPENSHIFT CONTAINER PLATFORM CLUSTER

You can hibernate your OpenShift Container Platform cluster for up to 90 days.

4.1. ABOUT CLUSTER HIBERNATION

OpenShift Container Platform clusters can be hibernated in order to save money on cloud hosting costs. You can hibernate your OpenShift Container Platform cluster for up to 90 days and expect it to resume successfully.

You must wait at least 24 hours after cluster installation before hibernating your cluster to allow for the first certification rotation.



IMPORTANT

If you must hibernate your cluster before the 24 hour certificate rotation, use the following procedure instead: Enabling OpenShift 4 Clusters to Stop and Resume Cluster VMs.

When hibernating a cluster, you must hibernate all cluster nodes. It is not supported to suspend only certain nodes.

After resuming, it can take up to 45 minutes for the cluster to become ready.

4.2. PREREQUISITES

- Take an etcd backup prior to hibernating the cluster.

IMPORTANT

It is important to take an etcd backup before hibernating so that your cluster can be restored if you encounter any issues when resuming the cluster.

For example, the following conditions can cause the resumed cluster to malfunction:

  - etcd data corruption during hibernation
  - Node failure due to hardware
  - Network connectivity issues

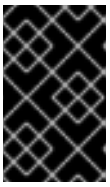
If your cluster fails to recover, follow the steps to restore to a previous cluster state.

4.3. HIBERNATING A CLUSTER

You can hibernate a cluster for up to 90 days. The cluster can recover if certificates expire while the cluster was in hibernation.

Prerequisites

- The cluster has been running for at least 24 hours to allow the first certificate rotation to complete.



IMPORTANT

If you must hibernate your cluster before the 24 hour certificate rotation, use the following procedure instead: Enabling OpenShift 4 Clusters to Stop and Resume Cluster VMs.

- You have taken an etcd backup.
- You have access to the cluster as a user with the **cluster-admin** role.

Procedure

1. Confirm that your cluster has been installed for at least 24 hours.
2. Ensure that all nodes are in a good state by running the following command:

```
$ oc get nodes
```

Example output

```
NAME                                STATUS  ROLES                AGE   VERSION
ci-ln-812tb4k-72292-8bcj7-master-0       Ready   control-plane,master  32m   v1.31.3
ci-ln-812tb4k-72292-8bcj7-master-1       Ready   control-plane,master  32m   v1.31.3
ci-ln-812tb4k-72292-8bcj7-master-2       Ready   control-plane,master  32m   v1.31.3
Ci-ln-812tb4k-72292-8bcj7-worker-a-zhdvk  Ready   worker               19m   v1.31.3
ci-ln-812tb4k-72292-8bcj7-worker-b-9hrmv  Ready   worker               19m   v1.31.3
ci-ln-812tb4k-72292-8bcj7-worker-c-q8mw2  Ready   worker               19m   v1.31.3
```

All nodes should show **Ready** in the **STATUS** column.

3. Ensure that all cluster Operators are in a good state by running the following command:

```
$ oc get clusteroperators
```

Example output

```
NAME                       VERSION   AVAILABLE  PROGRESSING  DEGRADED  SINCE
MESSAGE
authentication             4.18.0-0  True       False        False     51m
baremetal                  4.18.0-0  True       False        False     72m
cloud-controller-manager   4.18.0-0  True       False        False     75m
cloud-credential           4.18.0-0  True       False        False     77m
cluster-api                4.18.0-0  True       False        False     42m
cluster-autoscaler         4.18.0-0  True       False        False     72m
config-operator            4.18.0-0  True       False        False     72m
console                    4.18.0-0  True       False        False     55m
...
```

All cluster Operators should show **AVAILABLE**=**True**, **PROGRESSING**=**False**, and **DEGRADED**=**False**.

4. Ensure that all machine config pools are in a good state by running the following command:

```
$ oc get mcp
```

Example output

```
NAME    CONFIG                                             UPDATED  UPDATING  DEGRADED
MACHINECOUNT  READYMACHINECOUNT  UPDATEDMACHINECOUNT
DEGRADEDMACHINECOUNT  AGE
master  rendered-master-87871f187930e67233c837e1d07f49c7  True     False     False     3
3             3                  0                    96m
worker  rendered-worker-3c4c459dc5d90017983d7e72928b8aed  True     False     False     3
3             3                  0                    96m
```

All machine config pools should show **UPDATING**=**False** and **DEGRADED**=**False**.

5. Stop the cluster virtual machines:
Use the tools native to your cluster's cloud environment to shut down the cluster's virtual machines.

IMPORTANT

If you use a bastion virtual machine, do not shut down this virtual machine.

Additional resources

- Backing up etcd

4.4. RESUMING A HIBERNATED CLUSTER

When you resume a hibernated cluster within 90 days, you might have to approve certificate signing requests (CSRs) for the nodes to become ready.

It can take around 45 minutes for the cluster to resume, depending on the size of your cluster.

Prerequisites

- You hibernated your cluster less than 90 days ago.
- You have access to the cluster as a user with the **cluster-admin** role.

Procedure

1. Within 90 days of cluster hibernation, resume the cluster virtual machines:
Use the tools native to your cluster's cloud environment to resume the cluster's virtual machines.
2. Wait about 5 minutes, depending on the number of nodes in your cluster.
3. Approve CSRs for the nodes:
   a. Check that there is a CSR for each node in the **NotReady** state:

```
$ oc get csr
```

-

Example output

```
NAME        AGE  SIGNERNAME                                    REQUESTOR
REQUESTEDDURATION  CONDITION
csr-4dwsd  37m  kubernetes.io/kube-apiserver-client          system:node:ci-ln-812tb4k-
72292-8bcj7-worker-c-q8mw2                  24h            Pending
csr-4vrbr  49m  kubernetes.io/kube-apiserver-client         system:node:ci-ln-812tb4k-
72292-8bcj7-master-1                  24h            Pending
csr-4wk5x  51m  kubernetes.io/kubelet-serving               system:node:ci-ln-812tb4k-
72292-8bcj7-master-1                  <none>           Pending
csr-84vb6  51m  kubernetes.io/kube-apiserver-client-kubelet
system:serviceaccount:openshift-machine-config-operator:node-bootstrapper  <none>
Pending
```

b. Approve each valid CSR by running the following command:

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

c. Verify that all necessary CSRs were approved by running the following command:

```
$ oc get csr
```

Example output

```
NAME        AGE  SIGNERNAME                                    REQUESTOR
REQUESTEDDURATION  CONDITION
csr-4dwsd  37m  kubernetes.io/kube-apiserver-client          system:node:ci-ln-812tb4k-
72292-8bcj7-worker-c-q8mw2                  24h            Approved,Issued
csr-4vrbr  49m  kubernetes.io/kube-apiserver-client         system:node:ci-ln-812tb4k-
72292-8bcj7-master-1                  24h            Approved,Issued
csr-4wk5x  51m  kubernetes.io/kubelet-serving               system:node:ci-ln-812tb4k-
72292-8bcj7-master-1                  <none>           Approved,Issued
csr-84vb6  51m  kubernetes.io/kube-apiserver-client-kubelet
system:serviceaccount:openshift-machine-config-operator:node-bootstrapper  <none>
Approved,Issued
```

CSRs should show **Approved,Issued** in the **CONDITION** column.

4. Verify that all nodes now show as ready by running the following command:

```
$ oc get nodes
```

Example output

```
NAME                                STATUS  ROLES                AGE   VERSION
ci-ln-812tb4k-72292-8bcj7-master-0       Ready   control-plane,master  32m   v1.31.3
ci-ln-812tb4k-72292-8bcj7-master-1       Ready   control-plane,master  32m   v1.31.3
ci-ln-812tb4k-72292-8bcj7-master-2       Ready   control-plane,master  32m   v1.31.3
Ci-ln-812tb4k-72292-8bcj7-worker-a-zhdvk  Ready   worker               19m   v1.31.3
ci-ln-812tb4k-72292-8bcj7-worker-b-9hrmv  Ready   worker               19m   v1.31.3
ci-ln-812tb4k-72292-8bcj7-worker-c-q8mw2  Ready   worker               19m   v1.31.3
```

All nodes should show **Ready** in the **STATUS** column. It might take a few minutes for all nodes to become ready after approving the CSRs.

5. Wait for cluster Operators to restart to load the new certificates.
   This might take 5 or 10 minutes.

6. Verify that all cluster Operators are in a good state by running the following command:

```
$ oc get clusteroperators
```

Example output

```
NAME                                       VERSION   AVAILABLE   PROGRESSING   DEGRADED   SINCE
MESSAGE
authentication                             4.18.0-0  True        False         False      51m
baremetal                                  4.18.0-0  True        False         False      72m
cloud-controller-manager                   4.18.0-0  True        False         False      75m
cloud-credential                           4.18.0-0  True        False         False      77m
cluster-api                                4.18.0-0  True        False         False      42m
cluster-autoscaler                         4.18.0-0  True        False         False      72m
config-operator                            4.18.0-0  True        False         False      72m
console                                    4.18.0-0  True        False         False      55m
...
```

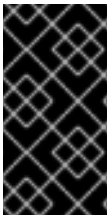
All cluster Operators should show **AVAILABLE**=**True**, **PROGRESSING**=**False**, and **DEGRADED**=**False**.

CHAPTER 5. OADP APPLICATION BACKUP AND RESTORE

5.1. INTRODUCTION TO OPENSHIFT API FOR DATA PROTECTION

The OpenShift API for Data Protection (OADP) product safeguards customer applications on OpenShift Container Platform. It offers comprehensive disaster recovery protection, covering OpenShift Container Platform applications, application-related cluster resources, persistent volumes, and internal images. OADP is also capable of backing up both containerized applications and virtual machines (VMs).

However, OADP does not serve as a disaster recovery solution for etcd or OpenShift Operators.



IMPORTANT

OADP support is provided to customer workload namespaces and cluster scope resources.

Full cluster backup and restore are not supported.

5.1.1. OpenShift API for Data Protection APIs

OADP provides APIs that enable multiple approaches to customizing backups and preventing the inclusion of unnecessary or inappropriate resources.

OADP provides the following APIs:

- Backup
- Restore
- Schedule
- BackupStorageLocation
- VolumeSnapshotLocation

5.1.1.1. Support for OpenShift API for Data Protection

Table 5.1. Supported versions of OADP

Version	OCP version	General availability	Full support ends	Maintenance ends	Extended Update Support (EUS)	Extended Update Support Term 2 (EUS Term 2)

1.4	4.14 4.15 4.16	10 Jul 2024	Release of 1.5	Release of 1.6	27 Jun 2026 EUS must be on OCP 4.16	27 Jun 2027 EUS Term 2 must be on OCP 4.16
1.3	4.12 4.13 4.14 4.15	29 Nov 2023	10 Jul 2024	Release of 1.5	31 Oct 2025 EUS must be on OCP 4.14	31 Oct 2026 EUS Term 2 must be on OCP 4.14

5.1.1.1.1. Unsupported versions of the OADP Operator

Table 5.2. Previous versions of the OADP Operator which are no longer supported

Version	General availability	Full support ended	Maintenance ended
1.2	14 Jun 2023	29 Nov 2023	10 Jul 2024
1.1	01 Sep 2022	14 Jun 2023	29 Nov 2023
1.0	09 Feb 2022	01 Sep 2022	14 Jun 2023

For more details about EUS, see Extended Update Support.

For more details about EUS Term 2, see Extended Update Support Term 2.

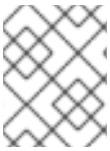
Additional resources

- Backing up etcd

5.2. OADP RELEASE NOTES

5.2.1. OADP 1.4 release notes

The release notes for OpenShift API for Data Protection (OADP) describe new features and enhancements, deprecated features, product recommendations, known issues, and resolved issues.



NOTE

For additional information about OADP, see OpenShift API for Data Protection (OADP) FAQs

5.2.1.1. OADP 1.4.4 release notes

OpenShift API for Data Protection (OADP) 1.4.4 is a Container Grade Only (CGO) release, which is released to refresh the health grades of the containers. No code was changed in the product itself compared to that of OADP 1.4.3.

5.2.1.1.1. Known issues

Issue with restoring stateful applications

When you restore a stateful application that uses the **azurefile-csi** storage class, the restore operation remains in the **Finalizing** phase. (OADP-5508)

5.2.1.2. OADP 1.4.3 release notes

The OpenShift API for Data Protection (OADP) 1.4.3 release notes lists the following new feature.

5.2.1.2.1. New features

Notable changes in the kubevirt velero plugin in version 0.7.1

With this release, the **kubevirt** velero plugin has been updated to version 0.7.1. Notable improvements include the following bug fix and new features:

- Virtual machine instances (VMIs) are no longer ignored from backup when the owner VM is excluded.
- Object graphs now include all extra objects during backup and restore operations.
- Optionally generated labels are now added to new firmware Universally Unique Identifiers (UUIDs) during restore operations.
- Switching VM run strategies during restore operations is now possible.
- Clearing a MAC address by label is now supported.
- The restore-specific checks during the backup operation are now skipped.
- The **VirtualMachineClusterInstancetype** and **VirtualMachineClusterPreference** custom resource definitions (CRDs) are now supported.

5.2.1.3. OADP 1.4.2 release notes

The OpenShift API for Data Protection (OADP) 1.4.2 release notes lists new features, resolved issues and bugs, and known issues.

5.2.1.3.1. New features

Backing up different volumes in the same namespace by using the VolumePolicy feature is now possible

With this release, Velero provides resource policies to back up different volumes in the same namespace by using the **VolumePolicy** feature. The supported **VolumePolicy** feature to back up different volumes includes **skip**, **snapshot**, and **fs-backup** actions. OADP-1071

File system backup and data mover can now use short-term credentials

File system backup and data mover can now use short-term credentials such as AWS Security Token Service (STS) and GCP WIF. With this support, backup is successfully completed without any **PartiallyFailed** status. OADP-5095

5.2.1.3.2. Resolved issues

DPA now reports errors if VSL contains an incorrect provider value

Previously, if the provider of a Volume Snapshot Location (VSL) spec was incorrect, the Data Protection Application (DPA) reconciled successfully. With this update, DPA reports errors and requests for a valid provider value. OADP-5044

Data Mover restore is successful irrespective of using different OADP namespaces for backup and restore

Previously, when backup operation was executed by using OADP installed in one namespace but was restored by using OADP installed in a different namespace, the Data Mover restore failed. With this update, Data Mover restore is now successful. OADP-5460

SSE-C backup works with the calculated MD5 of the secret key

Previously, backup failed with the following error:

> Requests specifying Server Side Encryption with Customer provided keys must provide the client calculated MD5 of the secret key.

With this update, missing Server-Side Encryption with Customer-Provided Keys (SSE-C) base64 and MD5 hash are now fixed. As a result, SSE-C backup works with the calculated MD5 of the secret key. In addition, incorrect **errorhandling** for the **customerKey** size is also fixed. OADP-5388

For a complete list of all issues resolved in this release, see the list of OADP 1.4.2 resolved issues in Jira.

5.2.1.3.3. Known issues

The nodeSelector spec is not supported for the Data Mover restore action

When a Data Protection Application (DPA) is created with the **nodeSelector** field set in the **nodeAgent** parameter, Data Mover restore partially fails instead of completing the restore operation. OADP-5260

The S3 storage does not use proxy environment when TLS skip verify is specified

In the image registry backup, the S3 storage does not use the proxy environment when the **insecureSkipTLSVerify** parameter is set to **true**. OADP-3143

Kopia does not delete artifacts after backup expiration

Even after you delete a backup, Kopia does not delete the volume artifacts from the **${bucket_name}/kopia/$openshift-adp** on the S3 location after backup expired. For more information, see "About Kopia repository maintenance". OADP-5131

Additional resources

- About Kopia repository maintenance

5.2.1.4. OADP 1.4.1 release notes

The OpenShift API for Data Protection (OADP) 1.4.1 release notes lists new features, resolved issues and bugs, and known issues.

5.2.1.4.1. New features

New DPA fields to update client qps and burst

You can now change Velero Server Kubernetes API queries per second and burst values by using the new Data Protection Application (DPA) fields. The new DPA fields are **spec.configuration.velero.client-qps** and **spec.configuration.velero.client-burst**, which both default to 100. OADP-4076

Enabling non-default algorithms with Kopia

With this update, you can now configure the hash, encryption, and splitter algorithms in Kopia to select non-default options to optimize performance for different backup workloads.

To configure these algorithms, set the **env** variable of a **velero** pod in the **podConfig** section of the DataProtectionApplication (DPA) configuration. If this variable is not set, or an unsupported algorithm is chosen, Kopia will default to its standard algorithms. OADP-4640

5.2.1.4.2. Resolved issues

Restoring a backup without pods is now successful

Previously, restoring a backup without pods and having **StorageClass VolumeBindingMode** set as **WaitForFirstConsumer**, resulted in the **PartiallyFailed** status with an error: **fail to patch dynamic PV, err: context deadline exceeded**. With this update, patching dynamic PV is skipped and restoring a backup is successful without any **PartiallyFailed** status. OADP-4231

PodVolumeBackup CR now displays correct message

Previously, the **PodVolumeBackup** custom resource (CR) generated an incorrect message, which was: **get a podvolumebackup with status "InProgress" during the server starting, mark it as "Failed"**. With this update, the message produced is now:

> found a podvolumebackup with status "InProgress" during the server starting, mark it as "Failed".

OADP-4224

Overriding imagePullPolicy is now possible with DPA

Previously, OADP set the **imagePullPolicy** parameter to **Always** for all images. With this update, OADP checks if each image contains **sha256** or **sha512** digest, then it sets **imagePullPolicy** to **IfNotPresent**; otherwise **imagePullPolicy** is set to **Always**. You can now override this policy by using the new **spec.containerImagePullPolicy** DPA field. OADP-4172

OADP Velero can now retry updating the restore status if initial update fails

Previously, OADP Velero failed to update the restored CR status. This left the status at **InProgress** indefinitely. Components which relied on the backup and restore CR status to determine the completion would fail. With this update, the restore CR status for a restore correctly proceeds to the **Completed** or **Failed** status. OADP-3227

Restoring BuildConfig Build from a different cluster is successful without any errors

Previously, when performing a restore of the **BuildConfig** Build resource from a different cluster, the application generated an error on TLS verification to the internal image registry. The resulting error was **failed to verify certificate: x509: certificate signed by unknown authority** error. With this update, the restore of the **BuildConfig** build resources to a different cluster can proceed successfully without generating the **failed to verify certificate** error. OADP-4692

Restoring an empty PVC is successful

Previously, downloading data failed while restoring an empty persistent volume claim (PVC). It failed with the following error:

```
data path restore failed: Failed to run kopia restore: Unable to load
    snapshot : snapshot not found
```

With this update, the downloading of data proceeds to correct conclusion when restoring an empty PVC and the error message is not generated. OADP-3106

There is no Velero memory leak in CSI and DataMover plugins

Previously, a Velero memory leak was caused by using the CSI and DataMover plugins. When the backup ended, the Velero plugin instance was not deleted and the memory leak consumed memory until an **Out of Memory** (OOM) condition was generated in the Velero pod. With this update, there is no resulting Velero memory leak when using the CSI and DataMover plugins. OADP-4448

Post-hook operation does not start before the related PVs are released

Previously, due to the asynchronous nature of the Data Mover operation, a post-hook might be attempted before the Data Mover persistent volume claim (PVC) releases the persistent volumes (PVs) of the related pods. This problem would cause the backup to fail with a **PartiallyFailed** status. With this update, the post-hook operation is not started until the related PVs are released by the Data Mover PVC, eliminating the **PartiallyFailed** backup status. OADP-3140

Deploying a DPA works as expected in namespaces with more than 37 characters

When you install the OADP Operator in a namespace with more than 37 characters to create a new DPA, labeling the "cloud-credentials" Secret fails and the DPA reports the following error:

```
The generated label name is too long.
```

With this update, creating a DPA does not fail in namespaces with more than 37 characters in the name. OADP-3960

Restore is successfully completed by overriding the timeout error

Previously, in a large scale environment, the restore operation would result in a **Partiallyfailed** status with the error: **fail to patch dynamic PV, err: context deadline exceeded**. With this update, the **resourceTimeout** Velero server argument is used to override this timeout error resulting in a successful restore. OADP-4344

For a complete list of all issues resolved in this release, see the list of OADP 1.4.1 resolved issues in Jira.

5.2.1.4.3. Known issues

Cassandra application pods enter into the CrashLoopBackoff status after restoring OADP

After OADP restores, the Cassandra application pods might enter **CrashLoopBackoff** status. To work around this problem, delete the **StatefulSet** pods that are returning the error **CrashLoopBackoff** state after restoring OADP. The **StatefulSet** controller then recreates these pods and it runs normally. OADP-4407

Deployment referencing ImageStream is not restored properly leading to corrupted pod and volume contents

During a File System Backup (FSB) restore operation, a **Deployment** resource referencing an **ImageStream** is not restored properly. The restored pod that runs the FSB, and the **postHook** is terminated prematurely.

During the restore operation, the OpenShift Container Platform controller updates the **spec.template.spec.containers[0].image** field in the **Deployment** resource with an updated **ImageStreamTag** hash. The update triggers the rollout of a new pod, terminating the pod on which **velero** runs the FSB along with the post-hook. For more information about image stream trigger, see Triggering updates on image stream changes .

The workaround for this behavior is a two-step restore process:

1. Perform a restore excluding the **Deployment** resources, for example:

```
$ velero restore create <RESTORE_NAME> \
  --from-backup <BACKUP_NAME> \
  --exclude-resources=deployment.apps
```

2. Once the first restore is successful, perform a second restore by including these resources, for example:

```
$ velero restore create <RESTORE_NAME> \
  --from-backup <BACKUP_NAME> \
  --include-resources=deployment.apps
```

OADP-3954

5.2.1.5. OADP 1.4.0 release notes

The OpenShift API for Data Protection (OADP) 1.4.0 release notes lists resolved issues and known issues.

5.2.1.5.1. Resolved issues

Restore works correctly in OpenShift Container Platform 4.16

Previously, while restoring the deleted application namespace, the restore operation partially failed with the **resource name may not be empty** error in OpenShift Container Platform 4.16. With this update, restore works as expected in OpenShift Container Platform 4.16. OADP-4075

Data Mover backups work properly in the OpenShift Container Platform 4.16 cluster

Previously, Velero was using the earlier version of SDK where the **Spec.SourceVolumeMode** field did not exist. As a consequence, Data Mover backups failed in the OpenShift Container Platform 4.16 cluster on the external snapshotter with version 4.2. With this update, external snapshotter is upgraded to version 7.0 and later. As a result, backups do not fail in the OpenShift Container Platform 4.16 cluster. OADP-3922

For a complete list of all issues resolved in this release, see the list of OADP 1.4.0 resolved issues in Jira.

5.2.1.5.2. Known issues

Backup fails when checksumAlgorithm is not set for MCG

While performing a backup of any application with Noobaa as the backup location, if the **checksumAlgorithm** configuration parameter is not set, backup fails. To fix this problem, if you do not provide a value for **checksumAlgorithm** in the Backup Storage Location (BSL) configuration, an empty value is added. The empty value is only added for BSLs that are created using Data Protection Application (DPA) custom resource (CR), and this value is not added if BSLs are created using any other method. OADP-4274

For a complete list of all known issues in this release, see the list of OADP 1.4.0 known issues in Jira.

5.2.1.5.3. Upgrade notes

NOTE

Always upgrade to the next minor version. **Do not** skip versions. To update to a later version, upgrade only one channel at a time. For example, to upgrade from OpenShift API for Data Protection (OADP) 1.1 to 1.3, upgrade first to 1.2, and then to 1.3.

5.2.1.5.3.1. Changes from OADP 1.3 to 1.4

The Velero server has been updated from version 1.12 to 1.14. Note that there are no changes in the Data Protection Application (DPA).

This changes the following:

- The **velero-plugin-for-csi** code is now available in the Velero code, which means an **init** container is no longer required for the plugin.
- Velero changed client Burst and QPS defaults from 30 and 20 to 100 and 100, respectively.
- The **velero-plugin-for-aws** plugin updated default value of the **spec.config.checksumAlgorithm** field in **BackupStorageLocation** objects (BSLs) from **""** (no checksum calculation) to the **CRC32** algorithm. The checksum algorithm types are known to work only with AWS. Several S3 providers require the **md5sum** to be disabled by setting the checksum algorithm to **""**. Confirm **md5sum** algorithm support and configuration with your storage provider.
  In OADP 1.4, the default value for BSLs created within DPA for this configuration is **""**. This default value means that the **md5sum** is not checked, which is consistent with OADP 1.3. For BSLs created within DPA, update it by using the

spec.backupLocations[].velero.config.checksumAlgorithm field in the DPA. If your BSLs are created outside DPA, you can update this configuration by using **spec.config.checksumAlgorithm** in the BSLs.

5.2.1.5.3.2. Backing up the DPA configuration

You must back up your current **DataProtectionApplication** (DPA) configuration.

Procedure

- Save your current DPA configuration by running the following command:

  Example command

  ```
  $ oc get dpa -n openshift-adp -o yaml > dpa.orig.backup
  ```

5.2.1.5.3.3. Upgrading the OADP Operator

Use the following procedure when upgrading the OpenShift API for Data Protection (OADP) Operator.

Procedure

1. Change your subscription channel for the OADP Operator from **stable-1.3** to **stable-1.4**.
2. Wait for the Operator and containers to update and restart.

Additional resources

- Updating installed Operators

5.2.1.5.4. Converting DPA to the new version

To upgrade from OADP 1.3 to 1.4, no Data Protection Application (DPA) changes are required.

5.2.1.5.5. Verifying the upgrade

Use the following procedure to verify the upgrade.

Procedure

1. Verify the installation by viewing the OpenShift API for Data Protection (OADP) resources by running the following command:

   ```
   $ oc get all -n openshift-adp
   ```

   Example output

   ```
   NAME                                                READY   STATUS    RESTARTS   AGE
   pod/oadp-operator-controller-manager-67d9494d47-6l8z8   2/2     Running   0          2m8s
   pod/restic-9cq4q                                    1/1     Running   0          94s
   pod/restic-m4lts                                    1/1     Running   0          94s
   pod/restic-pv4kr                                    1/1     Running   0          95s
   pod/velero-588db7f655-n842v                         1/1     Running   0          95s
   ```

```
NAME                                                  TYPE        CLUSTER-IP      EXTERNAL-IP
PORT(S)    AGE
service/oadp-operator-controller-manager-metrics-service   ClusterIP   172.30.70.140
<none>        8443/TCP   2m8s

NAME                 DESIRED   CURRENT   READY   UP-TO-DATE   AVAILABLE   NODE
SELECTOR   AGE
daemonset.apps/restic   3         3         3       3            3           <none>          96s

NAME                                     READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/oadp-operator-controller-manager    1/1     1            1           2m9s
deployment.apps/velero                              1/1     1            1           96s

NAME                                                DESIRED   CURRENT   READY   AGE
replicaset.apps/oadp-operator-controller-manager-67d9494d47    1         1         1       2m9s
replicaset.apps/velero-588db7f655                               1         1         1       96s
```

2. Verify that the **DataProtectionApplication** (DPA) is reconciled by running the following command:

```
$ oc get dpa dpa-sample -n openshift-adp -o jsonpath='{.status}'
```

Example output

```
{"conditions":[{"lastTransitionTime":"2023-10-27T01:23:57Z","message":"Reconcile
complete","reason":"Complete","status":"True","type":"Reconciled"}]}
```

3. Verify the **type** is set to **Reconciled**.

4. Verify the backup storage location and confirm that the **PHASE** is **Available** by running the following command:

```
$ oc get backupstoragelocations.velero.io -n openshift-adp
```

Example output

```
NAME           PHASE       LAST VALIDATED   AGE     DEFAULT
dpa-sample-1   Available   1s               3d16h   true
```

5.3. OADP PERFORMANCE

5.3.1. OADP recommended network settings

For a supported experience with OpenShift API for Data Protection (OADP), you should have a stable and resilient network across OpenShift nodes, S3 storage, and in supported cloud environments that meet OpenShift network requirement recommendations.

To ensure successful backup and restore operations for deployments with remote S3 buckets located off-cluster with suboptimal data paths, it is recommended that your network settings meet the following minimum requirements in such less optimal conditions:

- Bandwidth (network upload speed to object storage): Greater than 2 Mbps for small backups and 10-100 Mbps depending on the data volume for larger backups.
- Packet loss: 1%
- Packet corruption: 1%
- Latency: 100ms

Ensure that your OpenShift Container Platform network performs optimally and meets OpenShift Container Platform network requirements.

IMPORTANT

Although Red Hat provides supports for standard backup and restore failures, it does not provide support for failures caused by network settings that do not meet the recommended thresholds.

5.4. OADP FEATURES AND PLUGINS

OpenShift API for Data Protection (OADP) features provide options for backing up and restoring applications.

The default plugins enable Velero to integrate with certain cloud providers and to back up and restore OpenShift Container Platform resources.

5.4.1. OADP features

OpenShift API for Data Protection (OADP) supports the following features:

Backup

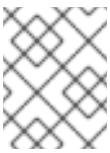
You can use OADP to back up all applications on the OpenShift Platform, or you can filter the resources by type, namespace, or label.
OADP backs up Kubernetes objects and internal images by saving them as an archive file on object storage. OADP backs up persistent volumes (PVs) by creating snapshots with the native cloud snapshot API or with the Container Storage Interface (CSI). For cloud providers that do not support snapshots, OADP backs up resources and PV data with Restic.

NOTE

You must exclude Operators from the backup of an application for backup and restore to succeed.

Restore

You can restore resources and PVs from a backup. You can restore all objects in a backup or filter the objects by namespace, PV, or label.



NOTE

You must exclude Operators from the backup of an application for backup and restore to succeed.

Schedule

You can schedule backups at specified intervals.

Hooks

You can use hooks to run commands in a container on a pod, for example, **fsfreeze** to freeze a file system. You can configure a hook to run before or after a backup or restore. Restore hooks can run in an init container or in the application container.

5.4.2. OADP plugins

The OpenShift API for Data Protection (OADP) provides default Velero plugins that are integrated with storage providers to support backup and snapshot operations. You can create custom plugins based on the Velero plugins.

OADP also provides plugins for OpenShift Container Platform resource backups, OpenShift Virtualization resource backups, and Container Storage Interface (CSI) snapshots.

Table 5.3. OADP plugins

OADP plugin	Function	Storage location
aws	Backs up and restores Kubernetes objects.	AWS S3
	Backs up and restores volumes with snapshots.	AWS EBS
azure	Backs up and restores Kubernetes objects.	Microsoft Azure Blob storage
	Backs up and restores volumes with snapshots.	Microsoft Azure Managed Disks
gcp	Backs up and restores Kubernetes objects.	Google Cloud Storage
	Backs up and restores volumes with snapshots.	Google Compute Engine Disks
openshift	Backs up and restores OpenShift Container Platform resources. [1]	Object store
kubevirt	Backs up and restores OpenShift Virtualization resources. [2]	Object store
csi	Backs up and restores volumes with CSI snapshots. [3]	Cloud storage that supports CSI snapshots

OADP plugin	Function	Storage location
vsm	VolumeSnapshotMover relocates snapshots from the cluster into an object store to be used during a restore process to recover stateful applications, in situations such as cluster deletion. [4]	Object store

1. Mandatory.
2. Virtual machine disks are backed up with CSI snapshots or Restic.
3. The **csi** plugin uses the Kubernetes CSI snapshot API.
   - OADP 1.1 or later uses **snapshot.storage.k8s.io/v1**
   - OADP 1.0 uses **snapshot.storage.k8s.io/v1beta1**
4. OADP 1.2 only.

5.4.3. About OADP Velero plugins

You can configure two types of plugins when you install Velero:

- Default cloud provider plugins
- Custom plugins

Both types of plugin are optional, but most users configure at least one cloud provider plugin.

5.4.3.1. Default Velero cloud provider plugins

You can install any of the following default Velero cloud provider plugins when you configure the **oadp_v1alpha1_dpa.yaml** file during deployment:

- **aws** (Amazon Web Services)
- **gcp** (Google Cloud Platform)
- **azure** (Microsoft Azure)
- **openshift** (OpenShift Velero plugin)
- **csi** (Container Storage Interface)
- **kubevirt** (KubeVirt)

You specify the desired default plugins in the **oadp_v1alpha1_dpa.yaml** file during deployment.

Example file

The following **.yaml** file installs the **openshift**, **aws**, **azure**, and **gcp** plugins:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: dpa-sample
spec:
  configuration:
    velero:
      defaultPlugins:
      - openshift
      - aws
      - azure
      - gcp
```

5.4.3.2. Custom Velero plugins

You can install a custom Velero plugin by specifying the plugin **image** and **name** when you configure the **oadp_v1alpha1_dpa.yaml** file during deployment.

You specify the desired custom plugins in the **oadp_v1alpha1_dpa.yaml** file during deployment.

Example file

The following **.yaml** file installs the default **openshift**, **azure**, and **gcp** plugins and a custom plugin that has the name **custom-plugin-example** and the image **quay.io/example-repo/custom-velero-plugin**:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
 name: dpa-sample
spec:
 configuration:
   velero:
     defaultPlugins:
     - openshift
     - azure
     - gcp
     customPlugins:
     - name: custom-plugin-example
       image: quay.io/example-repo/custom-velero-plugin
```

5.4.3.3. Velero plugins returning "received EOF, stopping recv loop" message

NOTE

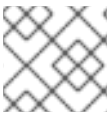
Velero plugins are started as separate processes. After the Velero operation has completed, either successfully or not, they exit. Receiving a **received EOF, stopping recv loop** message in the debug logs indicates that a plugin operation has completed. It does not mean that an error has occurred.

5.4.4. Supported architectures for OADP

OpenShift API for Data Protection (OADP) supports the following architectures:

- AMD64

- ARM64
- PPC64le
- s390x



NOTE

OADP 1.2.0 and later versions support the ARM64 architecture.

5.4.5. OADP support for IBM Power and IBM Z

OpenShift API for Data Protection (OADP) is platform neutral. The information that follows relates only to IBM Power® and to IBM Z®.

- OADP 1.3.6 was tested successfully against OpenShift Container Platform 4.12, 4.13, 4.14, and 4.15 for both IBM Power® and IBM Z®. The sections that follow give testing and support information for OADP 1.3.6 in terms of backup locations for these systems.
- OADP 1.4.4 was tested successfully against OpenShift Container Platform 4.14, 4.15, 4.16, and 4.17 for both IBM Power® and IBM Z®. The sections that follow give testing and support information for OADP 1.4.4 in terms of backup locations for these systems.

5.4.5.1. OADP support for target backup locations using IBM Power

- IBM Power® running with OpenShift Container Platform 4.12, 4.13, 4.14, and 4.15, and OADP 1.3.6 was tested successfully against an AWS S3 backup location target. Although the test involved only an AWS S3 target, Red Hat supports running IBM Power® with OpenShift Container Platform 4.13, 4.14, and 4.15, and OADP 1.3.6 against all S3 backup location targets, which are not AWS, as well.
- IBM Power® running with OpenShift Container Platform 4.14, 4.15, 4.16, and 4.17, and OADP 1.4.4 was tested successfully against an AWS S3 backup location target. Although the test involved only an AWS S3 target, Red Hat supports running IBM Power® with OpenShift Container Platform 4.14, 4.15, 4.16, and 4.17, and OADP 1.4.4 against all S3 backup location targets, which are not AWS, as well.

5.4.5.2. OADP testing and support for target backup locations using IBM Z

- IBM Z® running with OpenShift Container Platform 4.12, 4.13, 4.14, and 4.15, and 1.3.6 was tested successfully against an AWS S3 backup location target. Although the test involved only an AWS S3 target, Red Hat supports running IBM Z® with OpenShift Container Platform 4.13 4.14, and 4.15, and 1.3.6 against all S3 backup location targets, which are not AWS, as well.
- IBM Z® running with OpenShift Container Platform 4.14, 4.15, 4.16, and 4.17, and 1.4.4 was tested successfully against an AWS S3 backup location target. Although the test involved only an AWS S3 target, Red Hat supports running IBM Z® with OpenShift Container Platform 4.14, 4.15, 4.16, and 4.17, and 1.4.4 against all S3 backup location targets, which are not AWS, as well.

5.4.5.2.1. Known issue of OADP using IBM Power(R) and IBM Z(R) platforms

- Currently, there are backup method restrictions for Single-node OpenShift clusters deployed on IBM Power® and IBM Z® platforms. Only NFS storage is currently compatible with Single-node OpenShift clusters on these platforms. In addition, only the File System Backup (FSB)

methods such as Kopia and Restic are supported for backup and restore operations. There is currently no workaround for this issue.

5.4.6. OADP plugins known issues

The following section describes known issues in OpenShift API for Data Protection (OADP) plugins:

5.4.6.1. Velero plugin panics during imagestream backups due to a missing secret

When the backup and the Backup Storage Location (BSL) are managed outside the scope of the Data Protection Application (DPA), the OADP controller, meaning the DPA reconciliation does not create the relevant **oadp-<bsl_name>-<bsl_provider>-registry-secret**.

When the backup is run, the OpenShift Velero plugin panics on the imagestream backup, with the following panic error:

```
024-02-27T10:46:50.028951744Z time="2024-02-27T10:46:50Z" level=error msg="Error backing up item"
backup=openshift-adp/<backup name> error="error executing custom action (groupResource=imagestreams.image.openshift.io,
namespace=<BSL Name>, name=postgres): rpc error: code = Aborted desc = plugin panicked:
runtime error: index out of range with length 1, stack trace: goroutine 94…
```

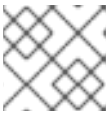
5.4.6.1.1. Workaround to avoid the panic error

To avoid the Velero plugin panic error, perform the following steps:

1. Label the custom BSL with the relevant label:

```
$ oc label backupstoragelocations.velero.io <bsl_name> app.kubernetes.io/component=bsl
```

2. After the BSL is labeled, wait until the DPA reconciles.



NOTE

You can force the reconciliation by making any minor change to the DPA itself.

3. When the DPA reconciles, confirm that the relevant **oadp-<bsl_name>-<bsl_provider>-registry-secret** has been created and that the correct registry data has been populated into it:

```
$ oc -n openshift-adp get secret/oadp-<bsl_name>-<bsl_provider>-registry-secret -o json | jq -r '.data'
```

5.4.6.2. OpenShift ADP Controller segmentation fault

If you configure a DPA with both **cloudstorage** and **restic** enabled, the **openshift-adp-controller-manager** pod crashes and restarts indefinitely until the pod fails with a crash loop segmentation fault.

You can have either **velero** or **cloudstorage** defined, because they are mutually exclusive fields.

- If you have both **velero** and **cloudstorage** defined, the **openshift-adp-controller-manager** fails.

- If you have neither **velero** nor **cloudstorage** defined, the **openshift-adp-controller-manager** fails.

For more information about this issue, see OADP-1054.

5.4.6.2.1. OpenShift ADP Controller segmentation fault workaround

You must define either **velero** or **cloudstorage** when you configure a DPA. If you define both APIs in your DPA, the **openshift-adp-controller-manager** pod fails with a crash loop segmentation fault.

5.5. OADP USE CASES

5.5.1. Backup using OpenShift API for Data Protection and Red Hat OpenShift Data Foundation (ODF)

Following is a use case for using OADP and ODF to back up an application.

5.5.1.1. Backing up an application using OADP and ODF

In this use case, you back up an application by using OADP and store the backup in an object storage provided by Red Hat OpenShift Data Foundation (ODF).

- You create a object bucket claim (OBC) to configure the backup storage location. You use ODF to configure an Amazon S3-compatible object storage bucket. ODF provides MultiCloud Object Gateway (NooBaa MCG) and Ceph Object Gateway, also known as RADOS Gateway (RGW), object storage service. In this use case, you use NooBaa MCG as the backup storage location.
- You use the NooBaa MCG service with OADP by using the **aws** provider plugin.
- You configure the Data Protection Application (DPA) with the backup storage location (BSL).
- You create a backup custom resource (CR) and specify the application namespace to back up.
- You create and verify the backup.

Prerequisites

- You installed the OADP Operator.
- You installed the ODF Operator.
- You have an application with a database running in a separate namespace.

Procedure

1. Create an OBC manifest file to request a NooBaa MCG bucket as shown in the following example:

   Example OBC

```
apiVersion: objectbucket.io/v1alpha1
kind: ObjectBucketClaim
metadata:
  name: test-obc 1
```

```
  namespace: openshift-adp
spec:
  storageClassName: openshift-storage.noobaa.io
  generateBucketName: test-backup-bucket 2
```

1 The name of the object bucket claim.

2 The name of the bucket.

2. Create the OBC by running the following command:

```
$ oc create -f <obc_file_name> 1
```

1 Specify the file name of the object bucket claim manifest.

3. When you create an OBC, ODF creates a **secret** and a **config map** with the same name as the object bucket claim. The **secret** has the bucket credentials, and the **config map** has information to access the bucket. To get the bucket name and bucket host from the generated config map, run the following command:

```
$ oc extract --to=- cm/test-obc 1
```

1 **test-obc** is the name of the OBC.

Example output

```
# BUCKET_NAME
backup-c20...41fd
# BUCKET_PORT
443
# BUCKET_REGION

# BUCKET_SUBREGION

# BUCKET_HOST
s3.openshift-storage.svc
```

4. To get the bucket credentials from the generated **secret**, run the following command:

```
$ oc extract --to=- secret/test-obc
```

Example output

```
# AWS_ACCESS_KEY_ID
ebYR....xLNMc
# AWS_SECRET_ACCESS_KEY
YXf...+NaCkdyC3QPym
```

5. Get the public URL for the S3 endpoint from the s3 route in the **openshift-storage** namespace by running the following command:

```
$ oc get route s3 -n openshift-storage
```

6. Create a **cloud-credentials** file with the object bucket credentials as shown in the following command:

```
[default]
aws_access_key_id=<AWS_ACCESS_KEY_ID>
aws_secret_access_key=<AWS_SECRET_ACCESS_KEY>
```

7. Create the **cloud-credentials** secret with the **cloud-credentials** file content as shown in the following command:

```
$ oc create secret generic \
  cloud-credentials \
  -n openshift-adp \
  --from-file cloud=cloud-credentials
```

8. Configure the Data Protection Application (DPA) as shown in the following example:

Example DPA

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: oadp-backup
  namespace: openshift-adp
spec:
  configuration:
    nodeAgent:
      enable: true
      uploaderType: kopia
    velero:
      defaultPlugins:
        - aws
        - openshift
        - csi
      defaultSnapshotMoveData: true (1)
  backupLocations:
    - velero:
        config:
          profile: "default"
          region: noobaa
          s3Url: https://s3.openshift-storage.svc (2)
          s3ForcePathStyle: "true"
          insecureSkipTLSVerify: "true"
        provider: aws
        default: true
        credential:
          key: cloud
          name:  cloud-credentials
        objectStorage:
          bucket: <bucket_name> (3)
          prefix: oadp
```

1. Set to true to use the OADP Data Mover to enable movement of Container Storage Interface (CSI) snapshots to a remote object storage.
2. This is the S3 URL of ODF storage.
3. Specify the bucket name.

9. Create the DPA by running the following command:

```
$ oc apply -f <dpa_filename>
```

10. Verify that the DPA is created successfully by running the following command. In the example output, you can see the **status** object has **type** field set to **Reconciled**. This means, the DPA is successfully created.

```
$ oc get dpa -o yaml
```

Example output

```
apiVersion: v1
items:
- apiVersion: oadp.openshift.io/v1alpha1
  kind: DataProtectionApplication
  metadata:
    namespace: openshift-adp
    #...#
  spec:
    backupLocations:
    - velero:
        config:
          #...#
  status:
    conditions:
    - lastTransitionTime: "20....9:54:02Z"
      message: Reconcile complete
      reason: Complete
      status: "True"
      type: Reconciled
kind: List
metadata:
  resourceVersion: ""
```

11. Verify that the backup storage location (BSL) is available by running the following command:

```
$ oc get backupstoragelocations.velero.io -n openshift-adp
```

Example output

```
NAME           PHASE       LAST VALIDATED   AGE   DEFAULT
dpa-sample-1   Available   3s               15s   true
```

12. Configure a backup CR as shown in the following example:

Example backup CR

Example backup CR

```
apiVersion: velero.io/v1
kind: Backup
metadata:
  name: test-backup
  namespace: openshift-adp
spec:
  includedNamespaces:
  - <application_namespace> 1
```

1 Specify the namespace for the application to back up.

13. Create the backup CR by running the following command:

```
$ oc apply -f <backup_cr_filename>
```

Verification

- Verify that the backup object is in the **Completed** phase by running the following command. For more details, see the example output.

```
$ oc describe backup test-backup -n openshift-adp
```

Example output

```
Name:         test-backup
Namespace:    openshift-adp
# ....#
Status:
  Backup Item Operations Attempted:  1
  Backup Item Operations Completed:  1
  Completion Timestamp:              2024-09-25T10:17:01Z
  Expiration:                        2024-10-25T10:16:31Z
  Format Version:                    1.1.0
  Hook Status:
  Phase:  Completed
  Progress:
    Items Backed Up:  34
    Total Items:      34
  Start Timestamp:    2024-09-25T10:16:31Z
  Version:            1
Events:               <none>
```

5.5.2. OpenShift API for Data Protection (OADP) restore use case

Following is a use case for using OADP to restore a backup to a different namespace.

5.5.2.1. Restoring an application to a different namespace using OADP

Restore a backup of an application by using OADP to a new target namespace, **test-restore-application**. To restore a backup, you create a restore custom resource (CR) as shown in the following example. In

the restore CR, the source namespace refers to the application namespace that you included in the backup. You then verify the restore by changing your project to the new restored namespace and verifying the resources.

Prerequisites

- You installed the OADP Operator.
- You have the backup of an application to be restored.

Procedure

1. Create a restore CR as shown in the following example:

   #### Example restore CR

   ```
   apiVersion: velero.io/v1
   kind: Restore
   metadata:
     name: test-restore (1)
     namespace: openshift-adp
   spec:
     backupName: <backup_name> (2)
     restorePVs: true
     namespaceMapping:
       <application_namespace>: test-restore-application (3)
   ```

   (1) The name of the restore CR.

   (2) Specify the name of the backup.

   (3) **namespaceMapping** maps the source application namespace to the target application namespace. Specify the application namespace that you backed up. **test-restore-application** is the target namespace where you want to restore the backup.

2. Apply the restore CR by running the following command:

   ```
   $ oc apply -f <restore_cr_filename>
   ```

Verification

1. Verify that the restore is in the **Completed** phase by running the following command:

   ```
   $ oc describe restores.velero.io <restore_name> -n openshift-adp
   ```

2. Change to the restored namespace **test-restore-application** by running the following command:

   ```
   $ oc project test-restore-application
   ```

3. Verify the restored resources such as persistent volume claim (pvc), service (svc), deployment, secret, and config map by running the following command:

```
$ oc get pvc,svc,deployment,secret,configmap
```

Example output

```
NAME                         STATUS   VOLUME
persistentvolumeclaim/mysql   Bound    pvc-9b3583db-...-14b86

NAME             TYPE       CLUSTER-IP     EXTERNAL-IP   PORT(S)    AGE
service/mysql    ClusterIP   172....157     <none>       3306/TCP   2m56s
service/todolist   ClusterIP   172.....15     <none>       8000/TCP   2m56s

NAME                  READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/mysql   0/1     1            0           2m55s

NAME                                  TYPE                  DATA   AGE
secret/builder-dockercfg-6bfmd             kubernetes.io/dockercfg   1      2m57s
secret/default-dockercfg-hz9kz             kubernetes.io/dockercfg   1      2m57s
secret/deployer-dockercfg-86cvd            kubernetes.io/dockercfg   1      2m57s
secret/mysql-persistent-sa-dockercfg-rgp9b   kubernetes.io/dockercfg   1      2m57s

NAME                             DATA   AGE
configmap/kube-root-ca.crt          1      2m57s
configmap/openshift-service-ca.crt   1      2m57s
```

5.5.3. Including a self-signed CA certificate during backup

You can include a self-signed Certificate Authority (CA) certificate in the Data Protection Application (DPA) and then back up an application. You store the backup in a NooBaa bucket provided by Red Hat OpenShift Data Foundation (ODF).

5.5.3.1. Backing up an application and its self-signed CA certificate

The **s3.openshift-storage.svc** service, provided by ODF, uses a Transport Layer Security protocol (TLS) certificate that is signed with the self-signed service CA.

To prevent a **certificate signed by unknown authority** error, you must include a self-signed CA certificate in the backup storage location (BSL) section of **DataProtectionApplication** custom resource (CR). For this situation, you must complete the following tasks:

- Request a NooBaa bucket by creating an object bucket claim (OBC).
- Extract the bucket details.
- Include a self-signed CA certificate in the **DataProtectionApplication** CR.
- Back up an application.

Prerequisites

- You installed the OADP Operator.
- You installed the ODF Operator.
- You have an application with a database running in a separate namespace.

Procedure

1. Create an OBC manifest to request a NooBaa bucket as shown in the following example:

   Example ObjectBucketClaim CR

```
apiVersion: objectbucket.io/v1alpha1
kind: ObjectBucketClaim
metadata:
  name: test-obc 1
  namespace: openshift-adp
spec:
  storageClassName: openshift-storage.noobaa.io
  generateBucketName: test-backup-bucket 2
```

   1 Specifies the name of the object bucket claim.

   2 Specifies the name of the bucket.

2. Create the OBC by running the following command:

```
$ oc create -f <obc_file_name>
```

3. When you create an OBC, ODF creates a **secret** and a **ConfigMap** with the same name as the object bucket claim. The **secret** object contains the bucket credentials, and the **ConfigMap** object contains information to access the bucket. To get the bucket name and bucket host from the generated config map, run the following command:

```
$ oc extract --to=- cm/test-obc 1
```

   1 The name of the OBC is **test-obc**.

   Example output

```
# BUCKET_NAME
backup-c20...41fd
# BUCKET_PORT
443
# BUCKET_REGION

# BUCKET_SUBREGION

# BUCKET_HOST
s3.openshift-storage.svc
```

4. To get the bucket credentials from the **secret** object, run the following command:

```
$ oc extract --to=- secret/test-obc
```

   Example output

```
# AWS_ACCESS_KEY_ID
```

```
ebYR....xLNMc
# AWS_SECRET_ACCESS_KEY
YXf...+NaCkdyC3QPym
```

5. Create a **cloud-credentials** file with the object bucket credentials by using the following example configuration:

```
[default]
aws_access_key_id=<AWS_ACCESS_KEY_ID>
aws_secret_access_key=<AWS_SECRET_ACCESS_KEY>
```

6. Create the **cloud-credentials** secret with the **cloud-credentials** file content by running the following command:

```
$ oc create secret generic \
  cloud-credentials \
  -n openshift-adp \
  --from-file cloud=cloud-credentials
```

7. Extract the service CA certificate from the **openshift-service-ca.crt** config map by running the following command. Ensure that you encode the certificate in **Base64** format and note the value to use in the next step.

```
$ oc get cm/openshift-service-ca.crt \
  -o jsonpath='{.data.service-ca\.crt}' | base64 -w0; echo
```

Example output

```
LS0tLS1CRUdJTiBDRVJUSUZJQ0FURS0...
....gpwOHMwaG9CRmk5a3....FLS0tLS0K
```

8. Configure the **DataProtectionApplication** CR manifest file with the bucket name and CA certificate as shown in the following example:

Example DataProtectionApplication CR

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: oadp-backup
  namespace: openshift-adp
spec:
  configuration:
    nodeAgent:
      enable: true
      uploaderType: kopia
    velero:
      defaultPlugins:
        - aws
        - openshift
        - csi
      defaultSnapshotMoveData: true
  backupLocations:
    - velero:
```

```
      config:
        profile: "default"
        region: noobaa
        s3Url: https://s3.openshift-storage.svc
        s3ForcePathStyle: "true"
        insecureSkipTLSVerify: "false" (1)
      provider: aws
      default: true
      credential:
        key: cloud
        name:  cloud-credentials
      objectStorage:
        bucket: <bucket_name> (2)
        prefix: oadp
        caCert: <ca_cert> (3)
```

(1) The **insecureSkipTLSVerify** flag can be set to either **true** or **false**. If set to "true", SSL/TLS security is disabled. If set to **false**, SSL/TLS security is enabled.

(2) Specify the name of the bucket extracted in an earlier step.

(3) Copy and paste the **Base64** encoded certificate from the previous step.

9. Create the **DataProtectionApplication** CR by running the following command:

```
$ oc apply -f <dpa_filename>
```

10. Verify that the **DataProtectionApplication** CR is created successfully by running the following command:

```
$ oc get dpa -o yaml
```

Example output

```
apiVersion: v1
items:
- apiVersion: oadp.openshift.io/v1alpha1
  kind: DataProtectionApplication
  metadata:
    namespace: openshift-adp
    #...#
  spec:
    backupLocations:
    - velero:
        config:
          #...#
  status:
    conditions:
    - lastTransitionTime: "20....9:54:02Z"
      message: Reconcile complete
      reason: Complete
      status: "True"
      type: Reconciled
```

```
kind: List
metadata:
  resourceVersion: ""
```

11. Verify that the backup storage location (BSL) is available by running the following command:

```
$ oc get backupstoragelocations.velero.io -n openshift-adp
```

Example output

```
NAME           PHASE       LAST VALIDATED   AGE   DEFAULT
dpa-sample-1   Available   3s               15s   true
```

12. Configure the **Backup** CR by using the following example:

Example Backup CR

```
apiVersion: velero.io/v1
kind: Backup
metadata:
  name: test-backup
  namespace: openshift-adp
spec:
  includedNamespaces:
  - <application_namespace> 1
```

1 Specify the namespace for the application to back up.

13. Create the **Backup** CR by running the following command:

```
$ oc apply -f <backup_cr_filename>
```

Verification

- Verify that the **Backup** object is in the **Completed** phase by running the following command:

```
$ oc describe backup test-backup -n openshift-adp
```

Example output

```
Name:         test-backup
Namespace:    openshift-adp
# ....#
Status:
  Backup Item Operations Attempted:  1
  Backup Item Operations Completed:  1
  Completion Timestamp:              2024-09-25T10:17:01Z
  Expiration:                        2024-10-25T10:16:31Z
  Format Version:                    1.1.0
  Hook Status:
  Phase:  Completed
  Progress:
```

```
  Items Backed Up:  34
  Total Items:      34
 Start Timestamp:   2024-09-25T10:16:31Z
 Version:           1
Events:             <none>
```

5.5.4. Using the legacy-aws Velero plugin

If you are using an AWS S3-compatible backup storage location, you might get a **SignatureDoesNotMatch** error while backing up your application. This error occurs because some backup storage locations still use the older versions of the S3 APIs, which are incompatible with the newer AWS SDK for Go V2. To resolve this issue, you can use the **legacy-aws** Velero plugin in the **DataProtectionApplication** custom resource (CR). The **legacy-aws** Velero plugin uses the older AWS SDK for Go V1, which is compatible with the legacy S3 APIs, ensuring successful backups.

5.5.4.1. Using the legacy-aws Velero plugin in the DataProtectionApplication CR

In the following use case, you configure the **DataProtectionApplication** CR with the **legacy-aws** Velero plugin and then back up an application.

NOTE

Depending on the backup storage location you choose, you can use either the **legacy-aws** or the **aws** plugin in your **DataProtectionApplication** CR. If you use both of the plugins in the **DataProtectionApplication** CR, the following error occurs: **aws and legacy-aws can not be both specified in DPA spec.configuration.velero.defaultPlugins**.

Prerequisites

- You have installed the OADP Operator.
- You have configured an AWS S3-compatible object storage as a backup location.
- You have an application with a database running in a separate namespace.

Procedure

1. Configure the **DataProtectionApplication** CR to use the **legacy-aws** Velero plugin as shown in the following example:

   Example DataProtectionApplication CR

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: oadp-backup
  namespace: openshift-adp
spec:
  configuration:
    nodeAgent:
      enable: true
      uploaderType: kopia
    velero:
```

```
    defaultPlugins:
      - legacy-aws (1)
      - openshift
      - csi
    defaultSnapshotMoveData: true
  backupLocations:
    - velero:
        config:
          profile: "default"
          region: noobaa
          s3Url: https://s3.openshift-storage.svc
          s3ForcePathStyle: "true"
          insecureSkipTLSVerify: "true"
        provider: aws
        default: true
        credential:
          key: cloud
          name:  cloud-credentials
        objectStorage:
          bucket: <bucket_name> (2)
          prefix: oadp
```

(1) Use the **legacy-aws** plugin.

(2) Specify the bucket name.

2. Create the **DataProtectionApplication** CR by running the following command:

```
$ oc apply -f <dpa_filename>
```

3. Verify that the **DataProtectionApplication** CR is created successfully by running the following command. In the example output, you can see the **status** object has the **type** field set to **Reconciled** and the **status** field set to **"True"**. That status indicates that the **DataProtectionApplication** CR is successfully created.

```
$ oc get dpa -o yaml
```

Example output

```
apiVersion: v1
items:
- apiVersion: oadp.openshift.io/v1alpha1
  kind: DataProtectionApplication
  metadata:
    namespace: openshift-adp
    #...#
  spec:
    backupLocations:
    - velero:
        config:
          #...#
  status:
    conditions:
    - lastTransitionTime: "20....9:54:02Z"
```

```
      message: Reconcile complete
      reason: Complete
      status: "True"
      type: Reconciled
kind: List
metadata:
  resourceVersion: ""
```

4. Verify that the backup storage location (BSL) is available by running the following command:

```
$ oc get backupstoragelocations.velero.io -n openshift-adp
```

Example output

```
NAME           PHASE       LAST VALIDATED   AGE   DEFAULT
dpa-sample-1   Available   3s               15s   true
```

5. Configure a **Backup** CR as shown in the following example:

Example backup CR

```
apiVersion: velero.io/v1
kind: Backup
metadata:
  name: test-backup
  namespace: openshift-adp
spec:
  includedNamespaces:
  - <application_namespace> 1
```

1 Specify the namespace for the application to back up.

6. Create the **Backup** CR by running the following command:

```
$ oc apply -f <backup_cr_filename>
```

Verification

- Verify that the backup object is in the **Completed** phase by running the following command. For more details, see the example output.

```
$ oc describe backups.velero.io test-backup -n openshift-adp
```

Example output

```
Name:         test-backup
Namespace:    openshift-adp
# ....#
Status:
  Backup Item Operations Attempted:  1
  Backup Item Operations Completed:  1
  Completion Timestamp:              2024-09-25T10:17:01Z
```

```
  Expiration:                 2024-10-25T10:16:31Z
  Format Version:             1.1.0
  Hook Status:
  Phase:  Completed
  Progress:
    Items Backed Up:  34
    Total Items:      34
  Start Timestamp:    2024-09-25T10:16:31Z
  Version:            1
Events:               <none>
```

5.5.5. Backing up workloads on OADP with ROSA STS

5.5.5.1. Performing a backup with OADP and ROSA STS

The following example **hello-world** application has no persistent volumes (PVs) attached. Perform a backup with OpenShift API for Data Protection (OADP) with Red Hat OpenShift Service on AWS (ROSA) STS.

Either Data Protection Application (DPA) configuration will work.

1. Create a workload to back up by running the following commands:

```
$ oc create namespace hello-world
```

```
$ oc new-app -n hello-world --image=docker.io/openshift/hello-openshift
```

2. Expose the route by running the following command:

```
$ oc expose service/hello-openshift -n hello-world
```

3. Check that the application is working by running the following command:

```
$ curl `oc get route/hello-openshift -n hello-world -o jsonpath='{.spec.host}'`
```

Example output

```
Hello OpenShift!
```

4. Back up the workload by running the following command:

```
$ cat << EOF | oc create -f -
  apiVersion: velero.io/v1
  kind: Backup
  metadata:
    name: hello-world
    namespace: openshift-adp
  spec:
    includedNamespaces:
    - hello-world
    storageLocation: ${CLUSTER_NAME}-dpa-1
    ttl: 720h0m0s
EOF
```

5. Wait until the backup is completed and then run the following command:

```
$ watch "oc -n openshift-adp get backup hello-world -o json | jq .status"
```

Example output

```
{
  "completionTimestamp": "2022-09-07T22:20:44Z",
  "expiration": "2022-10-07T22:20:22Z",
  "formatVersion": "1.1.0",
  "phase": "Completed",
  "progress": {
    "itemsBackedUp": 58,
    "totalItems": 58
  },
  "startTimestamp": "2022-09-07T22:20:22Z",
  "version": 1
}
```

6. Delete the demo workload by running the following command:

```
$ oc delete ns hello-world
```

7. Restore the workload from the backup by running the following command:

```
$ cat << EOF | oc create -f -
  apiVersion: velero.io/v1
  kind: Restore
  metadata:
    name: hello-world
    namespace: openshift-adp
  spec:
    backupName: hello-world
EOF
```

8. Wait for the Restore to finish by running the following command:

```
$ watch "oc -n openshift-adp get restore hello-world -o json | jq .status"
```

Example output

```
{
  "completionTimestamp": "2022-09-07T22:25:47Z",
  "phase": "Completed",
  "progress": {
    "itemsRestored": 38,
    "totalItems": 38
  },
  "startTimestamp": "2022-09-07T22:25:28Z",
  "warnings": 9
}
```

9. Check that the workload is restored by running the following command:

```
$ oc -n hello-world get pods
```

Example output

```
NAME                              READY   STATUS    RESTARTS   AGE
hello-openshift-9f885f7c6-kdjpj   1/1     Running   0          90s
```

10. Check the JSONPath by running the following command:

```
$ curl `oc get route/hello-openshift -n hello-world -o jsonpath='{.spec.host}'`
```

Example output

```
Hello OpenShift!
```

NOTE

For troubleshooting tips, see the OADP team's troubleshooting documentation.

5.5.5.2. Cleaning up a cluster after a backup with OADP and ROSA STS

If you need to uninstall the OpenShift API for Data Protection (OADP) Operator together with the backups and the S3 bucket from this example, follow these instructions.

Procedure

1. Delete the workload by running the following command:

```
$ oc delete ns hello-world
```

2. Delete the Data Protection Application (DPA) by running the following command:

```
$ oc -n openshift-adp delete dpa ${CLUSTER_NAME}-dpa
```

3. Delete the cloud storage by running the following command:

```
$ oc -n openshift-adp delete cloudstorage ${CLUSTER_NAME}-oadp
```

WARNING

If this command hangs, you might need to delete the finalizer by running the following command:

```
$ oc -n openshift-adp patch cloudstorage ${CLUSTER_NAME}-oadp -p
'{"metadata":{"finalizers":null}}' --type=merge
```

4. If the Operator is no longer required, remove it by running the following command:

```
$ oc -n openshift-adp delete subscription oadp-operator
```

5. Remove the namespace from the Operator:

```
$ oc delete ns openshift-adp
```

6. If the backup and restore resources are no longer required, remove them from the cluster by running the following command:

```
$ oc delete backups.velero.io hello-world
```

7. To delete backup, restore and remote objects in AWS S3 run the following command:

```
$ velero backup delete hello-world
```

8. If you no longer need the Custom Resource Definitions (CRD), remove them from the cluster by running the following command:

```
$ for CRD in `oc get crds | grep velero | awk '{print $1}'`; do oc delete crd $CRD; done
```

9. Delete the AWS S3 bucket by running the following commands:

```
$ aws s3 rm s3://${CLUSTER_NAME}-oadp --recursive
```

```
$ aws s3api delete-bucket --bucket ${CLUSTER_NAME}-oadp
```

10. Detach the policy from the role by running the following command:

```
$ aws iam detach-role-policy --role-name "${ROLE_NAME}"  --policy-arn "${POLICY_ARN}"
```

11. Delete the role by running the following command:

```
$ aws iam delete-role --role-name "${ROLE_NAME}"
```

5.6. INSTALLING OADP

5.6.1. About installing OADP

As a cluster administrator, you install the OpenShift API for Data Protection (OADP) by installing the OADP Operator. The OADP Operator installs Velero 1.14.

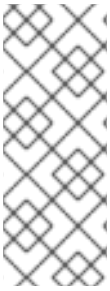
NOTE

Starting from OADP 1.0.4, all OADP 1.0.*z* versions can only be used as a dependency of the Migration Toolkit for Containers Operator and are not available as a standalone Operator.

To back up Kubernetes resources and internal images, you must have object storage as a backup location, such as one of the following storage types:

- Amazon Web Services
- Microsoft Azure
- Google Cloud Platform
- Multicloud Object Gateway
- IBM Cloud® Object Storage S3
- AWS S3 compatible object storage, such as Multicloud Object Gateway or MinIO

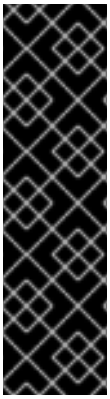
You can configure multiple backup storage locations within the same namespace for each individual OADP deployment.



NOTE

Unless specified otherwise, "NooBaa" refers to the open source project that provides lightweight object storage, while "Multicloud Object Gateway (MCG)" refers to the Red Hat distribution of NooBaa.

For more information on the MCG, see Accessing the Multicloud Object Gateway with your applications.



IMPORTANT

The **CloudStorage** API, which automates the creation of a bucket for object storage, is a Technology Preview feature only. 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 about the support scope of Red Hat Technology Preview features, see Technology Preview Features Support Scope .

NOTE

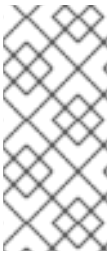
The **CloudStorage** API is a Technology Preview feature when you use a **CloudStorage** object and want OADP to use the **CloudStorage** API to automatically create an S3 bucket for use as a **BackupStorageLocation**.

The **CloudStorage** API supports manually creating a **BackupStorageLocation** object by specifying an existing S3 bucket. The **CloudStorage** API that creates an S3 bucket automatically is currently only enabled for AWS S3 storage.

You can back up persistent volumes (PVs) by using snapshots or a File System Backup (FSB).

To back up PVs with snapshots, you must have a cloud provider that supports either a native snapshot API or Container Storage Interface (CSI) snapshots, such as one of the following cloud providers:

- Amazon Web Services
- Microsoft Azure
- Google Cloud Platform
- CSI snapshot-enabled cloud provider, such as OpenShift Data Foundation



NOTE

If you want to use CSI backup on OCP 4.11 and later, install OADP 1.1.*x*.

OADP 1.0.*x* does not support CSI backup on OCP 4.11 and later. OADP 1.0. *x* includes Velero 1.7.*x* and expects the API group **snapshot.storage.k8s.io/v1beta1**, which is not present on OCP 4.11 and later.

If your cloud provider does not support snapshots or if your storage is NFS, you can back up applications with Backing up applications with File System Backup: Kopia or Restic on object storage.

You create a default **Secret** and then you install the Data Protection Application.

5.6.1.1. AWS S3 compatible backup storage providers

OADP is compatible with many object storage providers for use with different backup and snapshot operations. Several object storage providers are fully supported, several are unsupported but known to work, and some have known limitations.

5.6.1.1.1. Supported backup storage providers

The following AWS S3 compatible object storage providers are fully supported by OADP through the AWS plugin for use as backup storage locations:

- MinIO
- Multicloud Object Gateway (MCG)
- Amazon Web Services (AWS) S3
- IBM Cloud® Object Storage S3

- Ceph RADOS Gateway (Ceph Object Gateway)
- Red Hat Container Storage
- Red Hat OpenShift Data Foundation

NOTE

The following compatible object storage providers are supported and have their own Velero object store plugins:

- Google Cloud Platform (GCP)
- Microsoft Azure

5.6.1.1.2. Unsupported backup storage providers

The following AWS S3 compatible object storage providers, are known to work with Velero through the AWS plugin, for use as backup storage locations, however, they are unsupported and have not been tested by Red Hat:

- Oracle Cloud
- DigitalOcean
- NooBaa, unless installed using Multicloud Object Gateway (MCG)
- Tencent Cloud
- Ceph RADOS v12.2.7
- Quobyte
- Cloudian HyperStore

NOTE

Unless specified otherwise, "NooBaa" refers to the open source project that provides lightweight object storage, while "Multicloud Object Gateway (MCG)" refers to the Red Hat distribution of NooBaa.

For more information on the MCG, see Accessing the Multicloud Object Gateway with your applications.

5.6.1.1.3. Backup storage providers with known limitations

The following AWS S3 compatible object storage providers are known to work with Velero through the AWS plugin with a limited feature set:

- Swift - It works for use as a backup storage location for backup storage, but is not compatible with Restic for filesystem-based volume backup and restore.

5.6.1.2. Configuring Multicloud Object Gateway (MCG) for disaster recovery on OpenShift Data Foundation

If you use cluster storage for your MCG bucket **backupStorageLocation** on OpenShift Data Foundation, configure MCG as an external object store.

WARNING

Failure to configure MCG as an external object store might lead to backups not being available.

NOTE

Unless specified otherwise, "NooBaa" refers to the open source project that provides lightweight object storage, while "Multicloud Object Gateway (MCG)" refers to the Red Hat distribution of NooBaa.

For more information on the MCG, see Accessing the Multicloud Object Gateway with your applications.

Procedure

- Configure MCG as an external object store as described in Adding storage resources for hybrid or Multicloud.

Additional resources

- Overview of backup and snapshot locations in the Velero documentation

5.6.1.3. About OADP update channels

When you install an OADP Operator, you choose an *update channel*. This channel determines which upgrades to the OADP Operator and to Velero you receive. You can switch channels at any time.

The following update channels are available:

- The **stable** channel is now deprecated. The **stable** channel contains the patches (z-stream updates) of OADP **ClusterServiceVersion** for **OADP.v1.1.z** and older versions from **OADP.v1.0.z**.
- The **stable-1.0** channel is deprecated and is not supported.
- The **stable-1.1** channel is deprecated and is not supported.
- The **stable-1.2** channel is deprecated and is not supported.
- The **stable-1.3** channel contains **OADP.v1.3.z**, the most recent OADP 1.3 **ClusterServiceVersion**.
- The **stable-1.4** channel contains **OADP.v1.4.z**, the most recent OADP 1.4 **ClusterServiceVersion**.

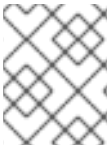
For more information, see OpenShift Operator Life Cycles.

Which update channel is right for you?

- The **stable** channel is now deprecated. If you are already using the stable channel, you will continue to get updates from **OADP.v1.1.z**.
- Choose the **stable-1.y** update channel to install OADP 1.y and to continue receiving patches for it. If you choose this channel, you will receive all z-stream patches for version 1.y.z.

When must you switch update channels?

- If you have OADP 1.y installed, and you want to receive patches only for that y-stream, you must switch from the **stable** update channel to the **stable-1.y** update channel. You will then receive all z-stream patches for version 1.y.z.
- If you have OADP 1.0 installed, want to upgrade to OADP 1.1, and then receive patches only for OADP 1.1, you must switch from the **stable-1.0** update channel to the **stable-1.1** update channel. You will then receive all z-stream patches for version 1.1.z.
- If you have OADP 1.y installed, with *y* greater than 0, and want to switch to OADP 1.0, you must uninstall your OADP Operator and then reinstall it using the **stable-1.0** update channel. You will then receive all z-stream patches for version 1.0.z.



NOTE

You cannot switch from OADP 1.y to OADP 1.0 by switching update channels. You must uninstall the Operator and then reinstall it.

5.6.1.4. Installation of OADP on multiple namespaces

You can install OpenShift API for Data Protection into multiple namespaces on the same cluster so that multiple project owners can manage their own OADP instance. This use case has been validated with File System Backup (FSB) and Container Storage Interface (CSI).

You install each instance of OADP as specified by the per-platform procedures contained in this document with the following additional requirements:

- All deployments of OADP on the same cluster must be the same version, for example, 1.4.0. Installing different versions of OADP on the same cluster is **not** supported.
- Each individual deployment of OADP must have a unique set of credentials and at least one **BackupStorageLocation** configuration. You can also use multiple **BackupStorageLocation** configurations within the same namespace.
- By default, each OADP deployment has cluster-level access across namespaces. OpenShift Container Platform administrators need to carefully review potential impacts, such as not backing up and restoring to and from the same namespace concurrently.

5.6.1.5. OADP does not support backup data immutability

Starting with OADP 1.3, backups might not function as expected when the target object storage has an immutability option configured. These immutability options are referred to by different names, for example:

- S3 object lock
- Object retention

- Bucket versioning
- Write Once Read Many (WORM) buckets

The primary reason for the absence of support is that OADP initially saves the state of a backup as *finalizing* and then scrutinizes whether any asynchronous operations are in progress.

With versions before OADP 1.3, object storage with an immutability configuration was also not supported. You might see some problems even though backups are working. For example, version objects are not deleted when a backup is deleted.

NOTE

Depending on the specific provider and configuration, backups might work in some cases.

- AWS S3 service supports backups because an S3 object lock only applies to versioned buckets. You can still update the object data for the new version. However, when backups are deleted, old versions of the objects are not deleted.
- Azure Storage Blob supports both versioned-level immutability and container-level immutability. In a versioned-level situation, data immutability can still work in OADP, but not at the container level.
- GCP Cloud storage policy only supports bucket-level immutability. Therefore, it is not feasible to implement it in the GCP environment.

Additional resources

- Cluster service version

5.6.1.6. Velero CPU and memory requirements based on collected data

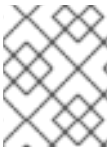
The following recommendations are based on observations of performance made in the scale and performance lab. The backup and restore resources can be impacted by the type of plugin, the amount of resources required by that backup or restore, and the respective data contained in the persistent volumes (PVs) related to those resources.

5.6.1.6.1. CPU and memory requirement for configurations

Configuration types	[1] Average usage	[2] Large usage	resourceTimeouts
CSI	Velero: CPU- Request 200m, Limits 1000m Memory - Request 256Mi, Limits 1024Mi	Velero: CPU- Request 200m, Limits 2000m Memory- Request 256Mi, Limits 2048Mi	N/A

Configuration types	[1] Average usage	[2] Large usage	resourceTimeouts
Restic	[3] Restic: CPU- Request 1000m, Limits 2000m Memory - Request 16Gi, Limits 32Gi	[4] Restic: CPU - Request 2000m, Limits 8000m Memory - Request 16Gi, Limits 40Gi	900m
[5] Data Mover	N/A	N/A	10m - average usage 60m - large usage

1. Average usage - use these settings for most usage situations.
2. Large usage - use these settings for large usage situations, such as a large PV (500GB Usage), multiple namespaces (100+), or many pods within a single namespace (2000 pods+), and for optimal performance for backup and restore involving large datasets.
3. Restic resource usage corresponds to the amount of data, and type of data. For example, many small files or large amounts of data can cause Restic to use large amounts of resources. The Velero documentation references 500m as a supplied default, for most of our testing we found a 200m request suitable with 1000m limit. As cited in the Velero documentation, exact CPU and memory usage is dependent on the scale of files and directories, in addition to environmental limitations.
4. Increasing the CPU has a significant impact on improving backup and restore times.
5. Data Mover - Data Mover default resourceTimeout is 10m. Our tests show that for restoring a large PV (500GB usage), it is required to increase the resourceTimeout to 60m.



NOTE

The resource requirements listed throughout the guide are for average usage only. For large usage, adjust the settings as described in the table above.

5.6.1.6.2. NodeAgent CPU for large usage

Testing shows that increasing **NodeAgent** CPU can significantly improve backup and restore times when using OpenShift API for Data Protection (OADP).

IMPORTANT

You can tune your OpenShift Container Platform environment based on your performance analysis and preference. Use CPU limits in the workloads when you use Kopia for file system backups.

If you do not use CPU limits on the pods, the pods can use excess CPU when it is available. If you specify CPU limits, the pods might be throttled if they exceed their limits. Therefore, the use of CPU limits on the pods is considered an anti-pattern.

Ensure that you are accurately specifying CPU requests so that pods can take advantage of excess CPU. Resource allocation is guaranteed based on CPU requests rather than CPU limits.

Testing showed that running Kopia with 20 cores and 32 Gi memory supported backup and restore operations of over 100 GB of data, multiple namespaces, or over 2000 pods in a single namespace. Testing detected no CPU limiting or memory saturation with these resource specifications.

In some environments, you might need to adjust Ceph MDS pod resources to avoid pod restarts, which occur when default settings cause resource saturation.

For more information about how to set the pod resources limit in Ceph MDS pods, see Changing the CPU and memory resources on the rook-ceph pods.

5.6.2. Installing the OADP Operator

You can install the OpenShift API for Data Protection (OADP) Operator on OpenShift Container Platform 4.18 by using Operator Lifecycle Manager (OLM).

The OADP Operator installs Velero 1.14.

Prerequisites

- You must be logged in as a user with **cluster-admin** privileges.

Procedure

1. In the OpenShift Container Platform web console, click **Operators → OperatorHub**.
2. Use the **Filter by keyword** field to find the **OADP Operator**.
3. Select the **OADP Operator** and click **Install**.
4. Click **Install** to install the Operator in the **openshift-adp** project.
5. Click **Operators → Installed Operators** to verify the installation.

5.6.2.1. OADP-Velero-OpenShift Container Platform version relationship

OADP version	Velero version	OpenShift Container Platform version
1.3.0	1.12	4.12-4.15

OADP version	Velero version	OpenShift Container Platform version
1.3.1	1.12	4.12-4.15
1.3.2	1.12	4.12-4.15
1.3.3	1.12	4.12-4.15
1.3.4	1.12	4.12-4.15
1.3.5	1.12	4.12-4.15
1.4.0	1.14	4.14-4.18
1.4.1	1.14	4.14-4.18
1.4.2	1.14	4.14-4.18
1.4.3	1.14	4.14-4.18

5.7. CONFIGURING OADP WITH AWS S3 COMPATIBLE STORAGE

5.7.1. Configuring the OpenShift API for Data Protection with AWS S3 compatible storage

You install the OpenShift API for Data Protection (OADP) with Amazon Web Services (AWS) S3 compatible storage by installing the OADP Operator. The Operator installs Velero 1.14.

NOTE

Starting from OADP 1.0.4, all OADP 1.0.*z* versions can only be used as a dependency of the Migration Toolkit for Containers Operator and are not available as a standalone Operator.

You configure AWS for Velero, create a default **Secret**, and then install the Data Protection Application. For more details, see Installing the OADP Operator.

To install the OADP Operator in a restricted network environment, you must first disable the default OperatorHub sources and mirror the Operator catalog. See Using Operator Lifecycle Manager in disconnected environments for details.

5.7.1.1. About Amazon Simple Storage Service, Identity and Access Management, and GovCloud

Amazon Simple Storage Service (Amazon S3) is a storage solution of Amazon for the internet. As an authorized user, you can use this service to store and retrieve any amount of data whenever you want, from anywhere on the web.

You securely control access to Amazon S3 and other Amazon services by using the AWS Identity and Access Management (IAM) web service.

You can use IAM to manage permissions that control which AWS resources users can access. You use IAM to both authenticate, or verify that a user is who they claim to be, and to authorize, or grant permissions to use resources.

AWS GovCloud (US) is an Amazon storage solution developed to meet the stringent and specific data security requirements of the United States Federal Government. AWS GovCloud (US) works the same as Amazon S3 except for the following:

- You cannot copy the contents of an Amazon S3 bucket in the AWS GovCloud (US) regions directly to or from another AWS region.
- If you use Amazon S3 policies, use the AWS GovCloud (US) Amazon Resource Name (ARN) identifier to unambiguously specify a resource across all of AWS, such as in IAM policies, Amazon S3 bucket names, and API calls.
    - IIn AWS GovCloud (US) regions, ARNs have an identifier that is different from the one in other standard AWS regions, **arn:aws-us-gov**. If you need to specify the US-West or US-East region, use one the following ARNs:
        - For US-West, use **us-gov-west-1**.
        - For US-East, use **us-gov-east-1**.
    - For all other standard regions, ARNs begin with: **arn:aws**.
- In AWS GovCloud (US) regions, use the endpoints listed in the **AWS GovCloud (US-East)** and **AWS GovCloud (US-West)** rows of the "Amazon S3 endpoints" table on Amazon Simple Storage Service endpoints and quotas. If you are processing export-controlled data, use one of the SSL/TLS endpoints. If you have FIPS requirements, use a FIPS 140-2 endpoint such as https://s3-fips.us-gov-west-1.amazonaws.com or https://s3-fips.us-gov-east-1.amazonaws.com.
- To find the other AWS-imposed restrictions, see How Amazon Simple Storage Service Differs for AWS GovCloud (US).

5.7.1.2. Configuring Amazon Web Services

You configure Amazon Web Services (AWS) for the OpenShift API for Data Protection (OADP).

Prerequisites

- You must have the AWS CLI installed.

Procedure

1. Set the **BUCKET** variable:

```
$ BUCKET=<your_bucket>
```

2. Set the **REGION** variable:

```
$ REGION=<your_region>
```

3. Create an AWS S3 bucket:

```
$ aws s3api create-bucket \
    --bucket $BUCKET \
    --region $REGION \
    --create-bucket-configuration LocationConstraint=$REGION 1
```

1 **us-east-1** does not support a **LocationConstraint**. If your region is **us-east-1**, omit **--create-bucket-configuration LocationConstraint=$REGION**.

4. Create an IAM user:

```
$ aws iam create-user --user-name velero 1
```

1 If you want to use Velero to back up multiple clusters with multiple S3 buckets, create a unique user name for each cluster.

5. Create a **velero-policy.json** file:

```
$ cat > velero-policy.json <<EOF
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
                "ec2:DescribeVolumes",
                "ec2:DescribeSnapshots",
                "ec2:CreateTags",
                "ec2:CreateVolume",
                "ec2:CreateSnapshot",
                "ec2:DeleteSnapshot"
            ],
            "Resource": "*"
        },
        {
            "Effect": "Allow",
            "Action": [
                "s3:GetObject",
                "s3:DeleteObject",
                "s3:PutObject",
                "s3:AbortMultipartUpload",
                "s3:ListMultipartUploadParts"
            ],
            "Resource": [
                "arn:aws:s3:::${BUCKET}/*"
            ]
        },
        {
            "Effect": "Allow",
            "Action": [
                "s3:ListBucket",
                "s3:GetBucketLocation",
```

```
                "s3:ListBucketMultipartUploads"
            ],
            "Resource": [
                "arn:aws:s3:::${BUCKET}"
            ]
        }
    ]
}
EOF
```

6. Attach the policies to give the **velero** user the minimum necessary permissions:

```
$ aws iam put-user-policy \
  --user-name velero \
  --policy-name velero \
  --policy-document file://velero-policy.json
```

7. Create an access key for the **velero** user:

```
$ aws iam create-access-key --user-name velero
```

Example output

```
{
  "AccessKey": {
        "UserName": "velero",
        "Status": "Active",
        "CreateDate": "2017-07-31T22:24:41.576Z",
        "SecretAccessKey": <AWS_SECRET_ACCESS_KEY>,
        "AccessKeyId": <AWS_ACCESS_KEY_ID>
  }
}
```

8. Create a **credentials-velero** file:

```
$ cat << EOF > ./credentials-velero
[default]
aws_access_key_id=<AWS_ACCESS_KEY_ID>
aws_secret_access_key=<AWS_SECRET_ACCESS_KEY>
EOF
```

You use the **credentials-velero** file to create a **Secret** object for AWS before you install the Data Protection Application.

5.7.1.3. About backup and snapshot locations and their secrets

You specify backup and snapshot locations and their secrets in the **DataProtectionApplication** custom resource (CR).

Backup locations
You can specify one of the following AWS S3-compatible object storage solutions as a backup location:

- Multicloud Object Gateway (MCG)

- Red Hat Container Storage
- Ceph RADOS Gateway; also known as Ceph Object Gateway
- Red Hat OpenShift Data Foundation
- MinIO

Velero backs up OpenShift Container Platform resources, Kubernetes objects, and internal images as an archive file on object storage.

Snapshot locations
If you use your cloud provider's native snapshot API to back up persistent volumes, you must specify the cloud provider as the snapshot location.

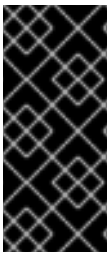
If you use Container Storage Interface (CSI) snapshots, you do not need to specify a snapshot location because you will create a **VolumeSnapshotClass** CR to register the CSI driver.

If you use File System Backup (FSB), you do not need to specify a snapshot location because FSB backs up the file system on object storage.

Secrets
If the backup and snapshot locations use the same credentials or if you do not require a snapshot location, you create a default **Secret**.

If the backup and snapshot locations use different credentials, you create two secret objects:

- Custom **Secret** for the backup location, which you specify in the **DataProtectionApplication** CR.
- Default **Secret** for the snapshot location, which is not referenced in the **DataProtectionApplication** CR.



IMPORTANT

The Data Protection Application requires a default **Secret**. Otherwise, the installation will fail.

If you do not want to specify backup or snapshot locations during the installation, you can create a default **Secret** with an empty **credentials-velero** file.

5.7.1.3.1. Creating a default Secret

You create a default **Secret** if your backup and snapshot locations use the same credentials or if you do not require a snapshot location.

The default name of the **Secret** is **cloud-credentials**.

NOTE

The **DataProtectionApplication** custom resource (CR) requires a default **Secret**. Otherwise, the installation will fail. If the name of the backup location **Secret** is not specified, the default name is used.

If you do not want to use the backup location credentials during the installation, you can create a **Secret** with the default name by using an empty **credentials-velero** file.

Prerequisites

- Your object storage and cloud storage, if any, must use the same credentials.
- You must configure object storage for Velero.

Procedure

1. Create a **credentials-velero** file for the backup storage location in the appropriate format for your cloud provider.
   See the following example:

```
[default]
aws_access_key_id=<AWS_ACCESS_KEY_ID>
aws_secret_access_key=<AWS_SECRET_ACCESS_KEY>
```

2. Create a **Secret** custom resource (CR) with the default name:

```
$ oc create secret generic cloud-credentials -n openshift-adp --from-file cloud=credentials-velero
```

The **Secret** is referenced in the **spec.backupLocations.credential** block of the **DataProtectionApplication** CR when you install the Data Protection Application.

5.7.1.3.2. Creating profiles for different credentials

If your backup and snapshot locations use different credentials, you create separate profiles in the **credentials-velero** file.

Then, you create a **Secret** object and specify the profiles in the **DataProtectionApplication** custom resource (CR).

Procedure

1. Create a **credentials-velero** file with separate profiles for the backup and snapshot locations, as in the following example:

```
[backupStorage]
aws_access_key_id=<AWS_ACCESS_KEY_ID>
aws_secret_access_key=<AWS_SECRET_ACCESS_KEY>

[volumeSnapshot]
aws_access_key_id=<AWS_ACCESS_KEY_ID>
aws_secret_access_key=<AWS_SECRET_ACCESS_KEY>
```

2. Create a **Secret** object with the **credentials-velero** file:

```
$ oc create secret generic cloud-credentials -n openshift-adp --from-file cloud=credentials-velero 1
```

3. Add the profiles to the **DataProtectionApplication** CR, as in the following example:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
```

```
metadata:
  name: <dpa_sample>
  namespace: openshift-adp
spec:
...
  backupLocations:
    - name: default
      velero:
        provider: aws
        default: true
        objectStorage:
          bucket: <bucket_name>
          prefix: <prefix>
        config:
          region: us-east-1
          profile: "backupStorage"
        credential:
          key: cloud
          name: cloud-credentials
  snapshotLocations:
    - velero:
        provider: aws
        config:
          region: us-west-2
          profile: "volumeSnapshot"
```

5.7.1.3.3. Configuring the backup storage location using AWS

You can configure the AWS backup storage location (BSL) as shown in the following example procedure.

Prerequisites

- You have created an object storage bucket using AWS.
- You have installed the OADP Operator.

Procedure

- Configure the BSL custom resource (CR) with values as applicable to your use case.

  Backup storage location

```
apiVersion: oadp.openshift.io/v1alpha1
kind: BackupStorageLocation
metadata:
  name: default
  namespace: openshift-adp
spec:
  provider: aws 1
  objectStorage:
    bucket: <bucket_name> 2
    prefix: <bucket_prefix> 3
  credential: 4
```

```
    key: cloud 5
    name: cloud-credentials 6
  config:
    region: <bucket_region> 7
    s3ForcePathStyle: "true" 8
    s3Url: <s3_url> 9
    publicUrl: <public_s3_url> 10
    serverSideEncryption: AES256 11
    kmsKeyId: "50..c-4da1-419f-a16e-ei...49f" 12
    customerKeyEncryptionFile: "/credentials/customer-key" 13
    signatureVersion: "1" 14
    profile: "default" 15
    insecureSkipTLSVerify: "true" 16
    enableSharedConfig: "true" 17
    tagging: "" 18
    checksumAlgorithm: "CRC32" 19
```

1 1 The name of the object store plugin. In this example, the plugin is **aws**. This field is required.

2 The name of the bucket in which to store backups. This field is required.

3 The prefix within the bucket in which to store backups. This field is optional.

4 The credentials for the backup storage location. You can set custom credentials. If custom credentials are not set, the default credentials' secret is used.

5 The **key** within the secret credentials' data.

6 The name of the secret containing the credentials.

7 The AWS region where the bucket is located. Optional if s3ForcePathStyle is false.

8 A boolean flag to decide whether to use path-style addressing instead of virtual hosted bucket addressing. Set to **true** if using a storage service such as MinIO or NooBaa. This is an optional field. The default value is **false**.

9 You can specify the AWS S3 URL here for explicitness. This field is primarily for storage services such as MinIO or NooBaa. This is an optional field.

10 This field is primarily used for storage services such as MinIO or NooBaa. This is an optional field.

11 The name of the server-side encryption algorithm to use for uploading objects, for example, **AES256**. This is an optional field.

12 Specify an AWS KMS key ID. You can format, as shown in the example, as an alias, such as **alias/<KMS-key-alias-name>**, or the full **ARN** to enable encryption of the backups stored in S3. Note that **kmsKeyId** cannot be used in with **customerKeyEncryptionFile**. This is an optional field.

13 Specify the file that has the **SSE-C** customer key to enable customer key encryption of the backups stored in S3. The file must contain a 32-byte string. The **customerKeyEncryptionFile** field points to a mounted secret within the **velero** container. Add the following key-value pair to the **velero cloud-credentials** secret: **customer-key:**

<your_b64_encoded_32byte_string>. Note that the **customerKeyEncryptionFile** field cannot be used with the **kmsKeyId** field. The default value is an empty string (**""**), which means **SSE-C** is disabled. This is an optional field.

14 The version of the signature algorithm used to create signed URLs. You use signed URLs to download the backups, or fetch the logs. Valid values are **1** and **4**. The default version is **4**. This is an optional field.

15 The name of the AWS profile in the credentials file. The default value is **default**. This is an optional field.

16 Set the **insecureSkipTLSVerify** field to **true** if you do not want to verify the TLS certificate when connecting to the object store, for example, for self-signed certificates with MinIO. Setting to **true** is susceptible to man-in-the-middle attacks and is not recommended for production workloads. The default value is **false**. This is an optional field.

17 Set the **enableSharedConfig** field to **true** if you want to load the credentials file as a shared config file. The default value is **false**. This is an optional field.

18 Specify the tags to annotate the AWS S3 objects. Specify the tags in key-value pairs. The default value is an empty string (**""**). This is an optional field.

19 Specify the checksum algorithm to use for uploading objects to S3. The supported values are: **CRC32**, **CRC32C**, **SHA1**, and **SHA256**. If you set the field as an empty string (**""**), the checksum check will be skipped. The default value is **CRC32**. This is an optional field.

5.7.1.3.4. Creating an OADP SSE-C encryption key for additional data security

Amazon Web Services (AWS) S3 applies server-side encryption with Amazon S3 managed keys (SSE-S3) as the base level of encryption for every bucket in Amazon S3.

OpenShift API for Data Protection (OADP) encrypts data by using SSL/TLS, HTTPS, and the **velero-repo-credentials** secret when transferring the data from a cluster to storage. To protect backup data in case of lost or stolen AWS credentials, apply an additional layer of encryption.

The velero-plugin-for-aws plugin provides several additional encryption methods. You should review its configuration options and consider implementing additional encryption.

You can store your own encryption keys by using server-side encryption with customer-provided keys (SSE-C). This feature provides additional security if your AWS credentials become exposed.

WARNING

Be sure to store cryptographic keys in a secure and safe manner. Encrypted data and backups cannot be recovered if you do not have the encryption key.

Prerequisites

- To make OADP mount a secret that contains your SSE-C key to the Velero pod at /**credentials**, use the following default secret name for AWS: **cloud-credentials**, and leave at least one of the following labels empty:

- **dpa.spec.backupLocations[].velero.credential**
- **dpa.spec.snapshotLocations[].velero.credential**
  This is a workaround for a known issue: https://issues.redhat.com/browse/OADP-3971.

NOTE

The following procedure contains an example of a **spec:backupLocations** block that does not specify credentials. This example would trigger an OADP secret mounting.

- If you need the backup location to have credentials with a different name than **cloud-credentials**, you must add a snapshot location, such as the one in the following example, that does not contain a credential name. Because the example does not contain a credential name, the snapshot location will use **cloud-credentials** as its secret for taking snapshots.

Example snapshot location in a DPA without credentials specified

```
snapshotLocations:
 - velero:
    config:
      profile: default
      region: <region>
    provider: aws
# ...
```

Procedure

1. Create an SSE-C encryption key:
   a. Generate a random number and save it as a file named **sse.key** by running the following command:

```
$ dd if=/dev/urandom bs=1 count=32 > sse.key
```

2. Create an OpenShift Container Platform secret:
   - If you are initially installing and configuring OADP, create the AWS credential and encryption key secret at the same time by running the following command:

```
$ oc create secret generic cloud-credentials --namespace openshift-adp --from-file
cloud=<path>/openshift_aws_credentials,customer-key=<path>/sse.key
```

   - If you are updating an existing installation, edit the values of the **cloud-credential secret** block of the **DataProtectionApplication** CR manifest, as in the following example:

```
apiVersion: v1
data:
  cloud:
W2Rfa2V5X2lkPSJBS0lBVkJRWUIyRkQ0TlFHRFFPQiIKYXdzX3NlY3JldF9hY2Nlc3Nfa2V
5P<snip>rUE1mNWVSbTN5K2FpeWhUTUQyQk1WZHBOIgo=
  customer-key: v+<snip>TFIiq6aaXPbj8dhos=
kind: Secret
# ...
```

3. Edit the value of the **customerKeyEncryptionFile** attribute in the **backupLocations** block of the **DataProtectionApplication** CR manifest, as in the following example:

```
spec:
  backupLocations:
    - velero:
        config:
          customerKeyEncryptionFile: /credentials/customer-key
          profile: default
# ...
```

WARNING

You must restart the Velero pod to remount the secret credentials properly on an existing installation.

The installation is complete, and you can back up and restore OpenShift Container Platform resources. The data saved in AWS S3 storage is encrypted with the new key, and you cannot download it from the AWS S3 console or API without the additional encryption key.

Verification

To verify that you cannot download the encrypted files without the inclusion of an additional key, create a test file, upload it, and then try to download it.

1. Create a test file by running the following command:

```
$ echo "encrypt me please" > test.txt
```

2. Upload the test file by running the following command:

```
$ aws s3api put-object \
  --bucket <bucket> \
  --key test.txt \
  --body test.txt \
  --sse-customer-key fileb://sse.key \
  --sse-customer-algorithm AES256
```

3. Try to download the file. In either the Amazon web console or the terminal, run the following command:

```
$ s3cmd get s3://<bucket>/test.txt test.txt
```

The download fails because the file is encrypted with an additional key.

4. Download the file with the additional encryption key by running the following command:

```
$ aws s3api get-object \
    --bucket <bucket> \
    --key test.txt \
```

```
    --sse-customer-key fileb://sse.key \
    --sse-customer-algorithm AES256 \
    downloaded.txt
```

5. Read the file contents by running the following command:

```
$ cat downloaded.txt
```

Example output

```
encrypt me please
```

Additional resources

You can also download the file with the additional encryption key backed up with Velero by running a different command. See Downloading a file with an SSE-C encryption key for files backed up by Velero .

5.7.1.3.4.1. Downloading a file with an SSE-C encryption key for files backed up by Velero

When you are verifying an SSE-C encryption key, you can also download the file with the additional encryption key for files that were backed up with Velero.

Procedure

- Download the file with the additional encryption key for files backed up by Velero by running the following command:

```
$ aws s3api get-object \
  --bucket <bucket> \
  --key velero/backups/mysql-persistent-customerkeyencryptionfile4/mysql-persistent-
customerkeyencryptionfile4.tar.gz \
  --sse-customer-key fileb://sse.key \
  --sse-customer-algorithm AES256 \
  --debug \
  velero_download.tar.gz
```

5.7.1.4. Configuring the Data Protection Application

You can configure the Data Protection Application by setting Velero resource allocations or enabling self-signed CA certificates.

5.7.1.4.1. Setting Velero CPU and memory resource allocations

You set the CPU and memory resource allocations for the **Velero** pod by editing the **DataProtectionApplication** custom resource (CR) manifest.

Prerequisites

- You must have the OpenShift API for Data Protection (OADP) Operator installed.

Procedure

- Edit the values in the **spec.configuration.velero.podConfig.ResourceAllocations** block of the **DataProtectionApplication** CR manifest, as in the following example:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: <dpa_sample>
spec:
# ...
  configuration:
    velero:
      podConfig:
        nodeSelector: <node_selector> 1
        resourceAllocations: 2
          limits:
            cpu: "1"
            memory: 1024Mi
          requests:
            cpu: 200m
            memory: 256Mi
```

1. Specify the node selector to be supplied to Velero podSpec.
2. The **resourceAllocations** listed are for average usage.

NOTE

Kopia is an option in OADP 1.3 and later releases. You can use Kopia for file system backups, and Kopia is your only option for Data Mover cases with the built-in Data Mover.

Kopia is more resource intensive than Restic, and you might need to adjust the CPU and memory requirements accordingly.

Use the **nodeSelector** field to select which nodes can run the node agent. The **nodeSelector** field is the simplest recommended form of node selection constraint. Any label specified must match the labels on each node.

For more details, see Configuring node agents and node labels.

5.7.1.4.2. Enabling self-signed CA certificates

You must enable a self-signed CA certificate for object storage by editing the **DataProtectionApplication** custom resource (CR) manifest to prevent a **certificate signed by unknown authority** error.

Prerequisites

- You must have the OpenShift API for Data Protection (OADP) Operator installed.

Procedure

- Edit the **spec.backupLocations.velero.objectStorage.caCert** parameter and **spec.backupLocations.velero.config** parameters of the **DataProtectionApplication** CR manifest:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: <dpa_sample>
spec:
# ...
  backupLocations:
    - name: default
      velero:
        provider: aws
        default: true
        objectStorage:
          bucket: <bucket>
          prefix: <prefix>
          caCert: <base64_encoded_cert_string> 1
        config:
          insecureSkipTLSVerify: "false" 2
# ...
```

1. Specify the Base64-encoded CA certificate string.
2. The **insecureSkipTLSVerify** configuration can be set to either **"true"** or **"false"**. If set to **"true"**, SSL/TLS security is disabled. If set to **"false"**, SSL/TLS security is enabled.

5.7.1.4.2.1. Using CA certificates with the velero command aliased for Velero deployment

You might want to use the Velero CLI without installing it locally on your system by creating an alias for it.

Prerequisites

- You must be logged in to the OpenShift Container Platform cluster as a user with the **cluster-admin** role.
- You must have the OpenShift CLI (**oc**) installed.

1. To use an aliased Velero command, run the following command:

```
$ alias velero='oc -n openshift-adp exec deployment/velero -c velero -it -- ./velero'
```

2. Check that the alias is working by running the following command:

Example

```
$ velero version
Client:
 Version: v1.12.1-OADP
 Git commit: -
Server:
 Version: v1.12.1-OADP
```

3. To use a CA certificate with this command, you can add a certificate to the Velero deployment by running the following commands:

```
$ CA_CERT=$(oc -n openshift-adp get dataprotectionapplications.oadp.openshift.io
<dpa-name> -o jsonpath='{.spec.backupLocations[0].velero.objectStorage.caCert}')

$ [[ -n $CA_CERT ]] && echo "$CA_CERT" | base64 -d | oc exec -n openshift-adp -i
deploy/velero -c velero -- bash -c "cat > /tmp/your-cacert.txt" || echo "DPA BSL has no
caCert"
```

```
$ velero describe backup <backup_name> --details --cacert /tmp/<your_cacert>.txt
```

4. To fetch the backup logs, run the following command:

```
$ velero backup logs  <backup_name>  --cacert /tmp/<your_cacert.txt>
```

   You can use these logs to view failures and warnings for the resources that you cannot back up.

5. If the Velero pod restarts, the **/tmp/your-cacert.txt** file disappears, and you must re-create the **/tmp/your-cacert.txt** file by re-running the commands from the previous step.

6. You can check if the **/tmp/your-cacert.txt** file still exists, in the file location where you stored it, by running the following command:

```
$ oc exec -n openshift-adp -i deploy/velero -c velero -- bash -c "ls /tmp/your-cacert.txt"
/tmp/your-cacert.txt
```

In a future release of OpenShift API for Data Protection (OADP), we plan to mount the certificate to the Velero pod so that this step is not required.

5.7.1.5. Installing the Data Protection Application

You install the Data Protection Application (DPA) by creating an instance of the **DataProtectionApplication** API.

Prerequisites

- You must install the OADP Operator.
- You must configure object storage as a backup location.
- If you use snapshots to back up PVs, your cloud provider must support either a native snapshot API or Container Storage Interface (CSI) snapshots.
- If the backup and snapshot locations use the same credentials, you must create a **Secret** with the default name, **cloud-credentials**.
- If the backup and snapshot locations use different credentials, you must create a **Secret** with the default name, **cloud-credentials**, which contains separate profiles for the backup and snapshot location credentials.

NOTE

If you do not want to specify backup or snapshot locations during the installation, you can create a default **Secret** with an empty **credentials-velero** file. If there is no default **Secret**, the installation will fail.

Procedure

1. Click **Operators → Installed Operators** and select the OADP Operator.
2. Under **Provided APIs**, click **Create instance** in the **DataProtectionApplication** box.
3. Click **YAML View** and update the parameters of the **DataProtectionApplication** manifest:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: <dpa_sample>
  namespace: openshift-adp (1)
spec:
  configuration:
    velero:
      defaultPlugins:
        - openshift (2)
        - aws
      resourceTimeout: 10m (3)
    nodeAgent: (4)
      enable: true (5)
      uploaderType: kopia (6)
      podConfig:
        nodeSelector: <node_selector> (7)
  backupLocations:
    - name: default
      velero:
        provider: aws
        default: true
        objectStorage:
          bucket: <bucket_name> (8)
          prefix: <prefix> (9)
        config:
          region: <region>
          profile: "default"
          s3ForcePathStyle: "true" (10)
          s3Url: <s3_url> (11)
        credential:
          key: cloud
          name: cloud-credentials (12)
  snapshotLocations: (13)
    - name: default
      velero:
        provider: aws
        config:
          region: <region> (14)
          profile: "default"
```

```
    credential:
      key: cloud
      name: cloud-credentials (15)
```

1. The default namespace for OADP is **openshift-adp**. The namespace is a variable and is configurable.
2. The **openshift** plugin is mandatory.
3. Specify how many minutes to wait for several Velero resources before timeout occurs, such as Velero CRD availability, volumeSnapshot deletion, and backup repository availability. The default is 10m.
4. The administrative agent that routes the administrative requests to servers.
5. Set this value to **true** if you want to enable **nodeAgent** and perform File System Backup.
6. Enter **kopia** or **restic** as your uploader. You cannot change the selection after the installation. For the Built-in DataMover you must use Kopia. The **nodeAgent** deploys a daemon set, which means that the **nodeAgent** pods run on each working node. You can configure File System Backup by adding **spec.defaultVolumesToFsBackup: true** to the **Backup** CR.
7. Specify the nodes on which Kopia or Restic are available. By default, Kopia or Restic run on all nodes.
8. Specify a bucket as the backup storage location. If the bucket is not a dedicated bucket for Velero backups, you must specify a prefix.
9. Specify a prefix for Velero backups, for example, **velero**, if the bucket is used for multiple purposes.
10. Specify whether to force path style URLs for S3 objects (Boolean). Not Required for AWS S3. Required only for S3 compatible storage.
11. Specify the URL of the object store that you are using to store backups. Not required for AWS S3. Required only for S3 compatible storage.
12. Specify the name of the **Secret** object that you created. If you do not specify this value, the default name, **cloud-credentials**, is used. If you specify a custom name, the custom name is used for the backup location.
13. Specify a snapshot location, unless you use CSI snapshots or a File System Backup (FSB) to back up PVs.
14. The snapshot location must be in the same region as the PVs.
15. Specify the name of the **Secret** object that you created. If you do not specify this value, the default name, **cloud-credentials**, is used. If you specify a custom name, the custom name is used for the snapshot location. If your backup and snapshot locations use different credentials, create separate profiles in the **credentials-velero** file.

4. Click **Create**.

Verification

1. Verify the installation by viewing the OpenShift API for Data Protection (OADP) resources by running the following command:

```
$ oc get all -n openshift-adp
```

Example output

```
NAME                                                READY   STATUS    RESTARTS   AGE
pod/oadp-operator-controller-manager-67d9494d47-6l8z8   2/2     Running   0          2m8s
pod/node-agent-9cq4q                                1/1     Running   0          94s
pod/node-agent-m4lts                                1/1     Running   0          94s
pod/node-agent-pv4kr                                1/1     Running   0          95s
pod/velero-588db7f655-n842v                         1/1     Running   0          95s

NAME                                                TYPE        CLUSTER-IP       EXTERNAL-IP
PORT(S)    AGE
service/oadp-operator-controller-manager-metrics-service   ClusterIP   172.30.70.140
<none>        8443/TCP   2m8s
service/openshift-adp-velero-metrics-svc                   ClusterIP   172.30.10.0      <none>
8085/TCP   8h

NAME                  DESIRED   CURRENT   READY   UP-TO-DATE   AVAILABLE   NODE
SELECTOR   AGE
daemonset.apps/node-agent   3         3         3       3            3           <none>          96s

NAME                                          READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/oadp-operator-controller-manager   1/1     1            1           2m9s
deployment.apps/velero                             1/1     1            1           96s

NAME                                                      DESIRED   CURRENT   READY   AGE
replicaset.apps/oadp-operator-controller-manager-67d9494d47   1         1         1       2m9s
replicaset.apps/velero-588db7f655                         1         1         1       96s
```

2. Verify that the **DataProtectionApplication** (DPA) is reconciled by running the following command:

```
$ oc get dpa dpa-sample -n openshift-adp -o jsonpath='{.status}'
```

Example output

```
{"conditions":[{"lastTransitionTime":"2023-10-27T01:23:57Z","message":"Reconcile
complete","reason":"Complete","status":"True","type":"Reconciled"}]}
```

3. Verify the **type** is set to **Reconciled**.

4. Verify the backup storage location and confirm that the **PHASE** is **Available** by running the following command:

```
$ oc get backupstoragelocations.velero.io -n openshift-adp
```

Example output

```
NAME          PHASE      LAST VALIDATED   AGE     DEFAULT
dpa-sample-1  Available  1s               3d16h   true
```

5.7.1.5.1. Configuring node agents and node labels

The DPA of OADP uses the **nodeSelector** field to select which nodes can run the node agent. The **nodeSelector** field is the simplest recommended form of node selection constraint.

Any label specified must match the labels on each node.

The correct way to run the node agent on any node you choose is for you to label the nodes with a custom label:

```
$ oc label node/<node_name> node-role.kubernetes.io/nodeAgent=""
```

Use the same custom label in the **DPA.spec.configuration.nodeAgent.podConfig.nodeSelector**, which you used for labeling nodes. For example:

```
configuration:
  nodeAgent:
    enable: true
    podConfig:
      nodeSelector:
        node-role.kubernetes.io/nodeAgent: ""
```

The following example is an anti-pattern of **nodeSelector** and does not work unless both labels, **'node-role.kubernetes.io/infra: ""** and **'node-role.kubernetes.io/worker: ""**, are on the node:

```
  configuration:
    nodeAgent:
      enable: true
      podConfig:
        nodeSelector:
          node-role.kubernetes.io/infra: ""
          node-role.kubernetes.io/worker: ""
```

5.7.1.6. Configuring the backup storage location with a MD5 checksum algorithm

You can configure the Backup Storage Location (BSL) in the Data Protection Application (DPA) to use a MD5 checksum algorithm for both Amazon Simple Storage Service (Amazon S3) and S3-compatible storage providers. The checksum algorithm calculates the checksum for uploading and downloading objects to Amazon S3. You can use one of the following options to set the **checksumAlgorithm** field in the **spec.backupLocations.velero.config.checksumAlgorithm** section of the DPA.

- **CRC32**
- **CRC32C**
- **SHA1**
- **SHA256**

NOTE

You can also set the **checksumAlgorithm** field to an empty value to skip the MD5 checksum check.

If you do not set a value for the **checksumAlgorithm** field, then the default value is set to **CRC32**.

Prerequisites

- You have installed the OADP Operator.
- You have configured Amazon S3, or S3-compatible object storage as a backup location.

Procedure

- Configure the BSL in the DPA as shown in the following example:

Example Data Protection Application

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: test-dpa
  namespace: openshift-adp
spec:
  backupLocations:
  - name: default
    velero:
      config:
        checksumAlgorithm: "" (1)
        insecureSkipTLSVerify: "true"
        profile: "default"
        region: <bucket_region>
        s3ForcePathStyle: "true"
        s3Url: <bucket_url>
      credential:
        key: cloud
        name: cloud-credentials
      default: true
      objectStorage:
        bucket: <bucket_name>
        prefix: velero
      provider: aws
  configuration:
    velero:
      defaultPlugins:
      - openshift
      - aws
      - csi
```

(1) Specify the **checksumAlgorithm**. In this example, the **checksumAlgorithm** field is set to an empty value. You can select an option from the following list: **CRC32**, **CRC32C**, **SHA1**, **SHA256**.

IMPORTANT

If you are using Noobaa as the object storage provider, and you do not set the **spec.backupLocations.velero.config.checksumAlgorithm** field in the DPA, an empty value of **checksumAlgorithm** is added to the BSL configuration.

The empty value is only added for BSLs that are created using the DPA. This value is not added if you create the BSL by using any other method.

5.7.1.7. Configuring the DPA with client burst and QPS settings

The burst setting determines how many requests can be sent to the **velero** server before the limit is applied. After the burst limit is reached, the queries per second (QPS) setting determines how many additional requests can be sent per second.

You can set the burst and QPS values of the **velero** server by configuring the Data Protection Application (DPA) with the burst and QPS values. You can use the **dpa.configuration.velero.client-burst** and **dpa.configuration.velero.client-qps** fields of the DPA to set the burst and QPS values.

Prerequisites

- You have installed the OADP Operator.

Procedure

- Configure the **client-burst** and the **client-qps** fields in the DPA as shown in the following example:

  Example Data Protection Application

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: test-dpa
  namespace: openshift-adp
spec:
  backupLocations:
    - name: default
      velero:
        config:
          insecureSkipTLSVerify: "true"
          profile: "default"
          region: <bucket_region>
          s3ForcePathStyle: "true"
          s3Url: <bucket_url>
        credential:
          key: cloud
          name: cloud-credentials
        default: true
        objectStorage:
          bucket: <bucket_name>
          prefix: velero
        provider: aws
  configuration:
    nodeAgent:
```

```
    enable: true
    uploaderType: restic
  velero:
    client-burst: 500 1
    client-qps: 300 2
    defaultPlugins:
      - openshift
      - aws
      - kubevirt
```

1 Specify the **client-burst** value. In this example, the **client-burst** field is set to 500.

2 Specify the **client-qps** value. In this example, the **client-qps** field is set to 300.

5.7.1.8. Overriding the imagePullPolicy setting in the DPA

In OADP 1.4.0 or earlier, the Operator sets the **imagePullPolicy** field of the Velero and node agent pods to **Always** for all images.

In OADP 1.4.1 or later, the Operator first checks if each image has the **sha256** or **sha512** digest and sets the **imagePullPolicy** field accordingly:

- If the image has the digest, the Operator sets **imagePullPolicy** to **IfNotPresent**.
- If the image does not have the digest, the Operator sets **imagePullPolicy** to **Always**.

You can also override the **imagePullPolicy** field by using the **spec.imagePullPolicy** field in the Data Protection Application (DPA).

Prerequisites

- You have installed the OADP Operator.

Procedure

- Configure the **spec.imagePullPolicy** field in the DPA as shown in the following example:

  Example Data Protection Application

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: test-dpa
  namespace: openshift-adp
spec:
  backupLocations:
    - name: default
      velero:
        config:
          insecureSkipTLSVerify: "true"
          profile: "default"
          region: <bucket_region>
          s3ForcePathStyle: "true"
          s3Url: <bucket_url>
```

```
      credential:
        key: cloud
        name: cloud-credentials
      default: true
      objectStorage:
        bucket: <bucket_name>
        prefix: velero
      provider: aws
  configuration:
    nodeAgent:
      enable: true
      uploaderType: kopia
    velero:
      defaultPlugins:
        - openshift
        - aws
        - kubevirt
        - csi
  imagePullPolicy: Never (1)
```

1. Specify the value for **imagePullPolicy**. In this example, the **imagePullPolicy** field is set to **Never**.

5.7.1.9. Configuring the DPA with more than one BSL

You can configure the **DataProtectionApplication** (DPA) custom resource (CR) with more than one **BackupStorageLocation** (BSL) CR and specify the credentials provided by the cloud provider.

For example, where you have configured the following two BSLs:

- Configured one BSL in the DPA and set it as the default BSL.
- Created another BSL independently by using the **BackupStorageLocation** CR.

As you have already set the BSL created through the DPA as the default, you cannot set the independently created BSL again as the default. This means, at any given time, you can set only one BSL as the default BSL.

Prerequisites

- You must install the OADP Operator.
- You must create the secrets by using the credentials provided by the cloud provider.

Procedure

1. Configure the **DataProtectionApplication** CR with more than one **BackupStorageLocation** CR. See the following example:

   Example DPA

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
#...
```

```
backupLocations:
 - name: aws (1)
   velero:
     provider: aws
     default: true (2)
     objectStorage:
       bucket: <bucket_name> (3)
       prefix: <prefix> (4)
     config:
       region: <region_name> (5)
       profile: "default"
     credential:
       key: cloud
       name: cloud-credentials (6)
 - name: odf (7)
   velero:
     provider: aws
     default: false
     objectStorage:
       bucket: <bucket_name>
       prefix: <prefix>
     config:
       profile: "default"
       region: <region_name>
       s3Url: <url> (8)
       insecureSkipTLSVerify: "true"
       s3ForcePathStyle: "true"
     credential:
       key: cloud
       name: <custom_secret_name_odf> (9)
#...
```

(1) Specify a name for the first BSL.

(2) This parameter indicates that this BSL is the default BSL. If a BSL is not set in the **Backup CR**, the default BSL is used. You can set only one BSL as the default.

(3) Specify the bucket name.

(4) Specify a prefix for Velero backups; for example, **velero**.

(5) Specify the AWS region for the bucket.

(6) Specify the name of the default **Secret** object that you created.

(7) Specify a name for the second BSL.

(8) Specify the URL of the S3 endpoint.

(9) Specify the correct name for the **Secret**; for example, **custom_secret_name_odf**. If you do not specify a **Secret** name, the default name is used.

2. Specify the BSL to be used in the backup CR. See the following example.

Example backup CR

```
apiVersion: velero.io/v1
kind: Backup
# ...
spec:
  includedNamespaces:
  - <namespace> 1
  storageLocation: <backup_storage_location> 2
  defaultVolumesToFsBackup: true
```

1. Specify the namespace to back up.
2. Specify the storage location.

5.7.1.9.1. Enabling CSI in the DataProtectionApplication CR

You enable the Container Storage Interface (CSI) in the **DataProtectionApplication** custom resource (CR) in order to back up persistent volumes with CSI snapshots.

Prerequisites

- The cloud provider must support CSI snapshots.

Procedure

- Edit the **DataProtectionApplication** CR, as in the following example:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
...
spec:
  configuration:
    velero:
      defaultPlugins:
      - openshift
      - csi 1
```

1. Add the **csi** default plugin.

5.7.1.9.2. Disabling the node agent in DataProtectionApplication

If you are not using **Restic**, **Kopia**, or **DataMover** for your backups, you can disable the **nodeAgent** field in the **DataProtectionApplication** custom resource (CR). Before you disable **nodeAgent**, ensure the OADP Operator is idle and not running any backups.

Procedure

1. To disable the **nodeAgent**, set the **enable** flag to **false**. See the following example:

Example DataProtectionApplication CR

```
# ...
configuration:
  nodeAgent:
    enable: false 1
    uploaderType: kopia
# ...
```

1 Disables the node agent.

2. To enable the **nodeAgent**, set the **enable** flag to **true**. See the following example:

Example DataProtectionApplication CR

```
# ...
configuration:
  nodeAgent:
    enable: true 1
    uploaderType: kopia
# ...
```

1 Enables the node agent.

You can set up a job to enable and disable the **nodeAgent** field in the **DataProtectionApplication** CR. For more information, see "Running tasks in pods using jobs".

Additional resources

- Installing the Data Protection Application with the **kubevirt** and **openshift** plugins
- Running tasks in pods using jobs.

5.8. CONFIGURING OADP WITH IBM CLOUD

5.8.1. Configuring the OpenShift API for Data Protection with IBM Cloud

You install the OpenShift API for Data Protection (OADP) Operator on an IBM Cloud cluster to back up and restore applications on the cluster. You configure IBM Cloud Object Storage (COS) to store the backups.

5.8.1.1. Configuring the COS instance

You create an IBM Cloud Object Storage (COS) instance to store the OADP backup data. After you create the COS instance, configure the **HMAC** service credentials.

Prerequisites

- You have an IBM Cloud Platform account.
- You installed the IBM Cloud CLI.
- You are logged in to IBM Cloud.

Procedure

1. Install the IBM Cloud Object Storage (COS) plugin by running the following command:

```
$ ibmcloud plugin install cos -f
```

2. Set a bucket name by running the following command:

```
$ BUCKET=<bucket_name>
```

3. Set a bucket region by running the following command:

```
$ REGION=<bucket_region> 1
```

1 Specify the bucket region, for example, **eu-gb**.

4. Create a resource group by running the following command:

```
$ ibmcloud resource group-create <resource_group_name>
```

5. Set the target resource group by running the following command:

```
$ ibmcloud target -g <resource_group_name>
```

6. Verify that the target resource group is correctly set by running the following command:

```
$ ibmcloud target
```

Example output

```
API endpoint:     https://cloud.ibm.com
Region:
User:             test-user
Account:          Test Account (fb6.....e95) <-> 2...122
Resource group:   Default
```

In the example output, the resource group is set to **Default**.

7. Set a resource group name by running the following command:

```
$ RESOURCE_GROUP=<resource_group> 1
```

1 Specify the resource group name, for example, **"default"**.

8. Create an IBM Cloud **service-instance** resource by running the following command:

```
$ ibmcloud resource service-instance-create \
<service_instance_name> \ 1
<service_name> \ 2
```

```
<service_plan> \ 3
<region_name> 4
```

1. Specify a name for the **service-instance** resource.
2. Specify the service name. Alternatively, you can specify a service ID.
3. Specify the service plan for your IBM Cloud account.
4. Specify the region name.

Example command

```
$ ibmcloud resource service-instance-create test-service-instance cloud-object-storage \ 1
standard \
global \
-d premium-global-deployment 2
```

1. The service name is **cloud-object-storage**.
2. The **-d** flag specifies the deployment name.

9. Extract the service instance ID by running the following command:

```
$ SERVICE_INSTANCE_ID=$(ibmcloud resource service-instance test-service-instance --
output json | jq -r '.[0].id')
```

10. Create a COS bucket by running the following command:

```
$ ibmcloud cos bucket-create \//
--bucket $BUCKET \//
--ibm-service-instance-id $SERVICE_INSTANCE_ID \//
--region $REGION
```

Variables such as **$BUCKET**, **$SERVICE_INSTANCE_ID**, and **$REGION** are replaced by the values you set previously.

11. Create **HMAC** credentials by running the following command.

```
$ ibmcloud resource service-key-create test-key Writer --instance-name test-service-instance
--parameters {\"HMAC\":true}
```

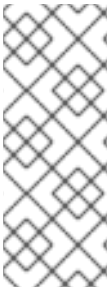
12. Extract the access key ID and the secret access key from the **HMAC** credentials and save them in the **credentials-velero** file. You can use the **credentials-velero** file to create a **secret** for the backup storage location. Run the following command:

```
$ cat > credentials-velero << __EOF__
[default]
aws_access_key_id=$(ibmcloud resource service-key test-key -o json  | jq -r '.
[0].credentials.cos_hmac_keys.access_key_id')
```

```
aws_secret_access_key=$(ibmcloud resource service-key test-key -o json  | jq -r '.
[0].credentials.cos_hmac_keys.secret_access_key')
__EOF__
```

5.8.1.2. Creating a default Secret

You create a default **Secret** if your backup and snapshot locations use the same credentials or if you do not require a snapshot location.



NOTE

The **DataProtectionApplication** custom resource (CR) requires a default **Secret**. Otherwise, the installation will fail. If the name of the backup location **Secret** is not specified, the default name is used.

If you do not want to use the backup location credentials during the installation, you can create a **Secret** with the default name by using an empty **credentials-velero** file.

Prerequisites

- Your object storage and cloud storage, if any, must use the same credentials.
- You must configure object storage for Velero.

Procedure

1. Create a **credentials-velero** file for the backup storage location in the appropriate format for your cloud provider.
2. Create a **Secret** custom resource (CR) with the default name:

```
$ oc create secret generic cloud-credentials -n openshift-adp --from-file cloud=credentials-
velero
```

The **Secret** is referenced in the **spec.backupLocations.credential** block of the **DataProtectionApplication** CR when you install the Data Protection Application.

5.8.1.3. Creating secrets for different credentials

If your backup and snapshot locations use different credentials, you must create two **Secret** objects:

- Backup location **Secret** with a custom name. The custom name is specified in the **spec.backupLocations** block of the **DataProtectionApplication** custom resource (CR).
- Snapshot location **Secret** with the default name, **cloud-credentials**. This **Secret** is not specified in the **DataProtectionApplication** CR.

Procedure

1. Create a **credentials-velero** file for the snapshot location in the appropriate format for your cloud provider.
2. Create a **Secret** for the snapshot location with the default name:

```
$ oc create secret generic cloud-credentials -n openshift-adp --from-file cloud=credentials-velero
```

3. Create a **credentials-velero** file for the backup location in the appropriate format for your object storage.

4. Create a **Secret** for the backup location with a custom name:

```
$ oc create secret generic <custom_secret> -n openshift-adp --from-file cloud=credentials-velero
```

5. Add the **Secret** with the custom name to the **DataProtectionApplication** CR, as in the following example:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: <dpa_sample>
  namespace: openshift-adp
spec:
...
  backupLocations:
    - velero:
        provider: <provider>
        default: true
        credential:
          key: cloud
          name: <custom_secret> (1)
        objectStorage:
          bucket: <bucket_name>
          prefix: <prefix>
```

(1) Backup location **Secret** with custom name.

5.8.1.4. Installing the Data Protection Application

You install the Data Protection Application (DPA) by creating an instance of the **DataProtectionApplication** API.

Prerequisites

- You must install the OADP Operator.
- You must configure object storage as a backup location.
- If you use snapshots to back up PVs, your cloud provider must support either a native snapshot API or Container Storage Interface (CSI) snapshots.
- If the backup and snapshot locations use the same credentials, you must create a **Secret** with the default name, **cloud-credentials**.

NOTE

If you do not want to specify backup or snapshot locations during the installation, you can create a default **Secret** with an empty **credentials-velero** file. If there is no default **Secret**, the installation will fail.

Procedure

1. Click **Operators → Installed Operators** and select the OADP Operator.
2. Under **Provided APIs**, click **Create instance** in the **DataProtectionApplication** box.
3. Click **YAML View** and update the parameters of the **DataProtectionApplication** manifest:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  namespace: openshift-adp
  name: <dpa_name>
spec:
  configuration:
    velero:
      defaultPlugins:
      - openshift
      - aws
      - csi
  backupLocations:
    - velero:
        provider: aws 1
        default: true
        objectStorage:
          bucket: <bucket_name> 2
          prefix: velero
        config:
          insecureSkipTLSVerify: 'true'
          profile: default
          region: <region_name> 3
          s3ForcePathStyle: 'true'
          s3Url: <s3_url> 4
        credential:
          key: cloud
          name: cloud-credentials 5
```

1. The provider is **aws** when you use IBM Cloud as a backup storage location.
2. Specify the IBM Cloud Object Storage (COS) bucket name.
3. Specify the COS region name, for example, **eu-gb**.
4. Specify the S3 URL of the COS bucket. For example, **http://s3.eu-gb.cloud-object-storage.appdomain.cloud**. Here, **eu-gb** is the region name. Replace the region name according to your bucket region.
5. Defines the name of the secret you created by using the access key and the secret access key from the **HMAC** credentials.

4. Click **Create**.

Verification

1. Verify the installation by viewing the OpenShift API for Data Protection (OADP) resources by running the following command:

```
$ oc get all -n openshift-adp
```

Example output

```
NAME                                                 READY   STATUS    RESTARTS   AGE
pod/oadp-operator-controller-manager-67d9494d47-6l8z8   2/2     Running   0          2m8s
pod/node-agent-9cq4q                                 1/1     Running   0          94s
pod/node-agent-m4lts                                 1/1     Running   0          94s
pod/node-agent-pv4kr                                 1/1     Running   0          95s
pod/velero-588db7f655-n842v                          1/1     Running   0          95s

NAME                                                     TYPE        CLUSTER-IP       EXTERNAL-IP
PORT(S)    AGE
service/oadp-operator-controller-manager-metrics-service   ClusterIP   172.30.70.140
<none>        8443/TCP   2m8s
service/openshift-adp-velero-metrics-svc                 ClusterIP   172.30.10.0      <none>
8085/TCP   8h

NAME                 DESIRED   CURRENT   READY   UP-TO-DATE   AVAILABLE   NODE
SELECTOR   AGE
daemonset.apps/node-agent   3         3         3       3            3           <none>          96s

NAME                                         READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/oadp-operator-controller-manager   1/1     1            1           2m9s
deployment.apps/velero                               1/1     1            1           96s

NAME                                                    DESIRED   CURRENT   READY   AGE
replicaset.apps/oadp-operator-controller-manager-67d9494d47   1         1         1       2m9s
replicaset.apps/velero-588db7f655                          1         1         1       96s
```

2. Verify that the **DataProtectionApplication** (DPA) is reconciled by running the following command:

```
$ oc get dpa dpa-sample -n openshift-adp -o jsonpath='{.status}'
```

Example output

```
{"conditions":[{"lastTransitionTime":"2023-10-27T01:23:57Z","message":"Reconcile
complete","reason":"Complete","status":"True","type":"Reconciled"}]}
```

3. Verify the **type** is set to **Reconciled**.

4. Verify the backup storage location and confirm that the **PHASE** is **Available** by running the following command:

```
$ oc get backupstoragelocations.velero.io -n openshift-adp
```

Example output

```
NAME          PHASE      LAST VALIDATED   AGE     DEFAULT
dpa-sample-1  Available  1s               3d16h   true
```

5.8.1.5. Setting Velero CPU and memory resource allocations

You set the CPU and memory resource allocations for the **Velero** pod by editing the **DataProtectionApplication** custom resource (CR) manifest.

Prerequisites

- You must have the OpenShift API for Data Protection (OADP) Operator installed.

Procedure

- Edit the values in the **spec.configuration.velero.podConfig.ResourceAllocations** block of the **DataProtectionApplication** CR manifest, as in the following example:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: <dpa_sample>
spec:
# ...
  configuration:
    velero:
      podConfig:
        nodeSelector: <node_selector> 1
        resourceAllocations: 2
          limits:
            cpu: "1"
            memory: 1024Mi
          requests:
            cpu: 200m
            memory: 256Mi
```

1. Specify the node selector to be supplied to Velero podSpec.
2. The **resourceAllocations** listed are for average usage.

NOTE

Kopia is an option in OADP 1.3 and later releases. You can use Kopia for file system backups, and Kopia is your only option for Data Mover cases with the built-in Data Mover.

Kopia is more resource intensive than Restic, and you might need to adjust the CPU and memory requirements accordingly.

5.8.1.6. Configuring node agents and node labels

The DPA of OADP uses the **nodeSelector** field to select which nodes can run the node agent. The **nodeSelector** field is the simplest recommended form of node selection constraint.

Any label specified must match the labels on each node.

The correct way to run the node agent on any node you choose is for you to label the nodes with a custom label:

```
$ oc label node/<node_name> node-role.kubernetes.io/nodeAgent=""
```

Use the same custom label in the **DPA.spec.configuration.nodeAgent.podConfig.nodeSelector**, which you used for labeling nodes. For example:

```
configuration:
  nodeAgent:
    enable: true
    podConfig:
      nodeSelector:
        node-role.kubernetes.io/nodeAgent: ""
```

The following example is an anti-pattern of **nodeSelector** and does not work unless both labels, **'node-role.kubernetes.io/infra: ""** and **'node-role.kubernetes.io/worker: ""**, are on the node:

```
  configuration:
    nodeAgent:
      enable: true
      podConfig:
        nodeSelector:
          node-role.kubernetes.io/infra: ""
          node-role.kubernetes.io/worker: ""
```

5.8.1.7. Configuring the DPA with client burst and QPS settings

The burst setting determines how many requests can be sent to the **velero** server before the limit is applied. After the burst limit is reached, the queries per second (QPS) setting determines how many additional requests can be sent per second.

You can set the burst and QPS values of the **velero** server by configuring the Data Protection Application (DPA) with the burst and QPS values. You can use the **dpa.configuration.velero.client-burst** and **dpa.configuration.velero.client-qps** fields of the DPA to set the burst and QPS values.

Prerequisites

- You have installed the OADP Operator.

Procedure

- Configure the **client-burst** and the **client-qps** fields in the DPA as shown in the following example:

  Example Data Protection Application

  ```
  apiVersion: oadp.openshift.io/v1alpha1
  kind: DataProtectionApplication
  metadata:
    name: test-dpa
    namespace: openshift-adp
  ```

```
spec:
  backupLocations:
    - name: default
      velero:
        config:
          insecureSkipTLSVerify: "true"
          profile: "default"
          region: <bucket_region>
          s3ForcePathStyle: "true"
          s3Url: <bucket_url>
        credential:
          key: cloud
          name: cloud-credentials
        default: true
        objectStorage:
          bucket: <bucket_name>
          prefix: velero
        provider: aws
  configuration:
    nodeAgent:
      enable: true
      uploaderType: restic
    velero:
      client-burst: 500 (1)
      client-qps: 300 (2)
      defaultPlugins:
        - openshift
        - aws
        - kubevirt
```

1. Specify the **client-burst** value. In this example, the **client-burst** field is set to 500.
2. Specify the **client-qps** value. In this example, the **client-qps** field is set to 300.

5.8.1.8. Overriding the imagePullPolicy setting in the DPA

In OADP 1.4.0 or earlier, the Operator sets the **imagePullPolicy** field of the Velero and node agent pods to **Always** for all images.

In OADP 1.4.1 or later, the Operator first checks if each image has the **sha256** or **sha512** digest and sets the **imagePullPolicy** field accordingly:

- If the image has the digest, the Operator sets **imagePullPolicy** to **IfNotPresent**.
- If the image does not have the digest, the Operator sets **imagePullPolicy** to **Always**.

You can also override the **imagePullPolicy** field by using the **spec.imagePullPolicy** field in the Data Protection Application (DPA).

Prerequisites

- You have installed the OADP Operator.

Procedure

- Configure the **spec.imagePullPolicy** field in the DPA as shown in the following example:

  Example Data Protection Application

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: test-dpa
  namespace: openshift-adp
spec:
  backupLocations:
    - name: default
      velero:
        config:
          insecureSkipTLSVerify: "true"
          profile: "default"
          region: <bucket_region>
          s3ForcePathStyle: "true"
          s3Url: <bucket_url>
        credential:
          key: cloud
          name: cloud-credentials
        default: true
        objectStorage:
          bucket: <bucket_name>
          prefix: velero
        provider: aws
  configuration:
    nodeAgent:
      enable: true
      uploaderType: kopia
    velero:
      defaultPlugins:
        - openshift
        - aws
        - kubevirt
        - csi
  imagePullPolicy: Never (1)
```

(1) Specify the value for **imagePullPolicy**. In this example, the **imagePullPolicy** field is set to **Never**.

5.8.1.9. Configuring the DPA with more than one BSL

You can configure the **DataProtectionApplication** (DPA) custom resource (CR) with more than one **BackupStorageLocation** (BSL) CR and specify the credentials provided by the cloud provider.

For example, where you have configured the following two BSLs:

- Configured one BSL in the DPA and set it as the default BSL.
- Created another BSL independently by using the **BackupStorageLocation** CR.

As you have already set the BSL created through the DPA as the default, you cannot set the independently created BSL again as the default. This means, at any given time, you can set only one BSL as the default BSL.

Prerequisites

- You must install the OADP Operator.
- You must create the secrets by using the credentials provided by the cloud provider.

Procedure

1. Configure the **DataProtectionApplication** CR with more than one **BackupStorageLocation** CR. See the following example:

Example DPA

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
#...
backupLocations:
  - name: aws (1)
    velero:
      provider: aws
      default: true (2)
      objectStorage:
        bucket: <bucket_name> (3)
        prefix: <prefix> (4)
      config:
        region: <region_name> (5)
        profile: "default"
      credential:
        key: cloud
        name: cloud-credentials (6)
  - name: odf (7)
    velero:
      provider: aws
      default: false
      objectStorage:
        bucket: <bucket_name>
        prefix: <prefix>
      config:
        profile: "default"
        region: <region_name>
        s3Url: <url> (8)
        insecureSkipTLSVerify: "true"
        s3ForcePathStyle: "true"
      credential:
        key: cloud
        name: <custom_secret_name_odf> (9)
#...
```

(1) Specify a name for the first BSL.

2 This parameter indicates that this BSL is the default BSL. If a BSL is not set in the **Backup CR**, the default BSL is used. You can set only one BSL as the default.

3 Specify the bucket name.

4 Specify a prefix for Velero backups; for example, **velero**.

5 Specify the AWS region for the bucket.

6 Specify the name of the default **Secret** object that you created.

7 Specify a name for the second BSL.

8 Specify the URL of the S3 endpoint.

9 Specify the correct name for the **Secret**; for example, **custom_secret_name_odf**. If you do not specify a **Secret** name, the default name is used.

2. Specify the BSL to be used in the backup CR. See the following example.

Example backup CR

```
apiVersion: velero.io/v1
kind: Backup
# ...
spec:
  includedNamespaces:
  - <namespace> 1
  storageLocation: <backup_storage_location> 2
  defaultVolumesToFsBackup: true
```

1 Specify the namespace to back up.

2 Specify the storage location.

5.8.1.10. Disabling the node agent in DataProtectionApplication

If you are not using **Restic**, **Kopia**, or **DataMover** for your backups, you can disable the **nodeAgent** field in the **DataProtectionApplication** custom resource (CR). Before you disable **nodeAgent**, ensure the OADP Operator is idle and not running any backups.

Procedure

1. To disable the **nodeAgent**, set the **enable** flag to **false**. See the following example:

Example DataProtectionApplication CR

```
# ...
configuration:
  nodeAgent:
    enable: false 1
    uploaderType: kopia
# ...
```

1 Disables the node agent.

2. To enable the **nodeAgent**, set the **enable** flag to **true**. See the following example:

Example DataProtectionApplication CR

```
# ...
configuration:
  nodeAgent:
    enable: true 1
    uploaderType: kopia
# ...
```

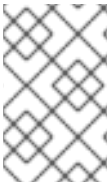
1 Enables the node agent.

You can set up a job to enable and disable the **nodeAgent** field in the **DataProtectionApplication** CR. For more information, see "Running tasks in pods using jobs".

5.9. CONFIGURING OADP WITH AZURE

5.9.1. Configuring the OpenShift API for Data Protection with Microsoft Azure

You install the OpenShift API for Data Protection (OADP) with Microsoft Azure by installing the OADP Operator. The Operator installs Velero 1.14.



NOTE

Starting from OADP 1.0.4, all OADP 1.0.*z* versions can only be used as a dependency of the Migration Toolkit for Containers Operator and are not available as a standalone Operator.

You configure Azure for Velero, create a default **Secret**, and then install the Data Protection Application. For more details, see Installing the OADP Operator.

To install the OADP Operator in a restricted network environment, you must first disable the default OperatorHub sources and mirror the Operator catalog. See Using Operator Lifecycle Manager in disconnected environments for details.

5.9.1.1. Configuring Microsoft Azure

You configure Microsoft Azure for OpenShift API for Data Protection (OADP).

Prerequisites

- You must have the Azure CLI installed.

Tools that use Azure services should always have restricted permissions to make sure that Azure resources are safe. Therefore, instead of having applications sign in as a fully privileged user, Azure offers service principals. An Azure service principal is a name that can be used with applications, hosted services, or automated tools.

This identity is used for access to resources.

- Create a service principal
- Sign in using a service principal and password
- Sign in using a service principal and certificate
- Manage service principal roles
- Create an Azure resource using a service principal
- Reset service principal credentials

For more details, see Create an Azure service principal with Azure CLI .

5.9.1.2. About backup and snapshot locations and their secrets

You specify backup and snapshot locations and their secrets in the **DataProtectionApplication** custom resource (CR).

Backup locations
You can specify one of the following AWS S3-compatible object storage solutions as a backup location:

- Multicloud Object Gateway (MCG)
- Red Hat Container Storage
- Ceph RADOS Gateway; also known as Ceph Object Gateway
- Red Hat OpenShift Data Foundation
- MinIO

Velero backs up OpenShift Container Platform resources, Kubernetes objects, and internal images as an archive file on object storage.

Snapshot locations
If you use your cloud provider's native snapshot API to back up persistent volumes, you must specify the cloud provider as the snapshot location.

If you use Container Storage Interface (CSI) snapshots, you do not need to specify a snapshot location because you will create a **VolumeSnapshotClass** CR to register the CSI driver.

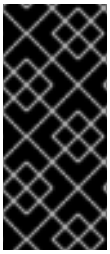
If you use File System Backup (FSB), you do not need to specify a snapshot location because FSB backs up the file system on object storage.

Secrets
If the backup and snapshot locations use the same credentials or if you do not require a snapshot location, you create a default **Secret**.

If the backup and snapshot locations use different credentials, you create two secret objects:

- Custom **Secret** for the backup location, which you specify in the **DataProtectionApplication** CR.

- Default **Secret** for the snapshot location, which is not referenced in the **DataProtectionApplication** CR.



IMPORTANT

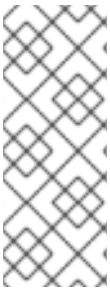
The Data Protection Application requires a default **Secret**. Otherwise, the installation will fail.

If you do not want to specify backup or snapshot locations during the installation, you can create a default **Secret** with an empty **credentials-velero** file.

5.9.1.2.1. Creating a default Secret

You create a default **Secret** if your backup and snapshot locations use the same credentials or if you do not require a snapshot location.

The default name of the **Secret** is **cloud-credentials-azure**.



NOTE

The **DataProtectionApplication** custom resource (CR) requires a default **Secret**. Otherwise, the installation will fail. If the name of the backup location **Secret** is not specified, the default name is used.

If you do not want to use the backup location credentials during the installation, you can create a **Secret** with the default name by using an empty **credentials-velero** file.

Prerequisites

- Your object storage and cloud storage, if any, must use the same credentials.
- You must configure object storage for Velero.

Procedure

1. Create a **credentials-velero** file for the backup storage location in the appropriate format for your cloud provider.
   See the following example:

```
AZURE_SUBSCRIPTION_ID= <azure_subscription_id>
AZURE_TENANT_ID=<azure_tenant_id>
AZURE_CLIENT_ID=<azure_client_id>
AZURE_CLIENT_SECRET=<azure_client_secret>
AZURE_STORAGE_ACCOUNT_ACCESS_KEY=<azure_storage_account_access_key>
AZURE_RESOURCE_GROUP=<azure_resource_group>
AZURE_CLOUD_NAME=<azure_cloud_name>
```

2. Create a **Secret** custom resource (CR) with the default name:

```
$ oc create secret generic cloud-credentials-azure -n openshift-adp --from-file
cloud=credentials-velero
```

The **Secret** is referenced in the **spec.backupLocations.credential** block of the **DataProtectionApplication** CR when you install the Data Protection Application.

5.9.1.2.2. Creating secrets for different credentials

If your backup and snapshot locations use different credentials, you must create two **Secret** objects:

- Backup location **Secret** with a custom name. The custom name is specified in the **spec.backupLocations** block of the **DataProtectionApplication** custom resource (CR).
- Snapshot location **Secret** with the default name, **cloud-credentials-azure**. This **Secret** is not specified in the **DataProtectionApplication** CR.

Procedure

1. Create a **credentials-velero** file for the snapshot location in the appropriate format for your cloud provider.
2. Create a **Secret** for the snapshot location with the default name:

```
$ oc create secret generic cloud-credentials-azure -n openshift-adp --from-file
cloud=credentials-velero
```

3. Create a **credentials-velero** file for the backup location in the appropriate format for your object storage.
4. Create a **Secret** for the backup location with a custom name:

```
$ oc create secret generic <custom_secret> -n openshift-adp --from-file cloud=credentials-
velero
```

5. Add the **Secret** with the custom name to the **DataProtectionApplication** CR, as in the following example:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: <dpa_sample>
  namespace: openshift-adp
spec:
...
  backupLocations:
    - velero:
        config:
          resourceGroup: <azure_resource_group>
          storageAccount: <azure_storage_account_id>
          subscriptionId: <azure_subscription_id>
          storageAccountKeyEnvVar: AZURE_STORAGE_ACCOUNT_ACCESS_KEY
        credential:
          key: cloud
          name: <custom_secret> 1
        provider: azure
        default: true
        objectStorage:
          bucket: <bucket_name>
          prefix: <prefix>
  snapshotLocations:
    - velero:
```

```
    config:
      resourceGroup: <azure_resource_group>
      subscriptionId: <azure_subscription_id>
      incremental: "true"
    provider: azure
```

1 Backup location **Secret** with custom name.

5.9.1.3. Configuring the Data Protection Application

You can configure the Data Protection Application by setting Velero resource allocations or enabling self-signed CA certificates.

5.9.1.3.1. Setting Velero CPU and memory resource allocations

You set the CPU and memory resource allocations for the **Velero** pod by editing the **DataProtectionApplication** custom resource (CR) manifest.

Prerequisites

- You must have the OpenShift API for Data Protection (OADP) Operator installed.

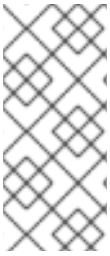
Procedure

- Edit the values in the **spec.configuration.velero.podConfig.ResourceAllocations** block of the **DataProtectionApplication** CR manifest, as in the following example:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: <dpa_sample>
spec:
# ...
  configuration:
    velero:
      podConfig:
        nodeSelector: <node_selector> 1
        resourceAllocations: 2
          limits:
            cpu: "1"
            memory: 1024Mi
          requests:
            cpu: 200m
            memory: 256Mi
```

1 Specify the node selector to be supplied to Velero podSpec.

2 The **resourceAllocations** listed are for average usage.



NOTE

Kopia is an option in OADP 1.3 and later releases. You can use Kopia for file system backups, and Kopia is your only option for Data Mover cases with the built-in Data Mover.

Kopia is more resource intensive than Restic, and you might need to adjust the CPU and memory requirements accordingly.

Use the **nodeSelector** field to select which nodes can run the node agent. The **nodeSelector** field is the simplest recommended form of node selection constraint. Any label specified must match the labels on each node.

For more details, see Configuring node agents and node labels.

5.9.1.3.2. Enabling self-signed CA certificates

You must enable a self-signed CA certificate for object storage by editing the **DataProtectionApplication** custom resource (CR) manifest to prevent a **certificate signed by unknown authority** error.

Prerequisites

- You must have the OpenShift API for Data Protection (OADP) Operator installed.

Procedure

- Edit the **spec.backupLocations.velero.objectStorage.caCert** parameter and **spec.backupLocations.velero.config** parameters of the **DataProtectionApplication** CR manifest:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: <dpa_sample>
spec:
# ...
  backupLocations:
    - name: default
      velero:
        provider: aws
        default: true
        objectStorage:
          bucket: <bucket>
          prefix: <prefix>
          caCert: <base64_encoded_cert_string> (1)
        config:
          insecureSkipTLSVerify: "false" (2)
# ...
```

1. Specify the Base64-encoded CA certificate string.
2. The **insecureSkipTLSVerify** configuration can be set to either **"true"** or **"false"**. If set to **"true"**, SSL/TLS security is disabled. If set to **"false"**, SSL/TLS security is enabled.

5.9.1.3.2.1. Using CA certificates with the velero command aliased for Velero deployment

You might want to use the Velero CLI without installing it locally on your system by creating an alias for it.

Prerequisites

- You must be logged in to the OpenShift Container Platform cluster as a user with the **cluster-admin** role.
- You must have the OpenShift CLI (**oc**) installed.

1. To use an aliased Velero command, run the following command:

```
$ alias velero='oc -n openshift-adp exec deployment/velero -c velero -it -- ./velero'
```

2. Check that the alias is working by running the following command:

   Example

```
$ velero version
Client:
 Version: v1.12.1-OADP
 Git commit: -
Server:
 Version: v1.12.1-OADP
```

3. To use a CA certificate with this command, you can add a certificate to the Velero deployment by running the following commands:

```
$ CA_CERT=$(oc -n openshift-adp get dataprotectionapplications.oadp.openshift.io <dpa-name> -o jsonpath='{.spec.backupLocations[0].velero.objectStorage.caCert}')

$ [[ -n $CA_CERT ]] && echo "$CA_CERT" | base64 -d | oc exec -n openshift-adp -i deploy/velero -c velero -- bash -c "cat > /tmp/your-cacert.txt" || echo "DPA BSL has no caCert"
```

```
$ velero describe backup <backup_name> --details --cacert /tmp/<your_cacert>.txt
```

4. To fetch the backup logs, run the following command:

```
$ velero backup logs  <backup_name>  --cacert /tmp/<your_cacert.txt>
```

   You can use these logs to view failures and warnings for the resources that you cannot back up.

5. If the Velero pod restarts, the **/tmp/your-cacert.txt** file disappears, and you must re-create the **/tmp/your-cacert.txt** file by re-running the commands from the previous step.

6. You can check if the **/tmp/your-cacert.txt** file still exists, in the file location where you stored it, by running the following command:

```
$ oc exec -n openshift-adp -i deploy/velero -c velero -- bash -c "ls /tmp/your-cacert.txt"
/tmp/your-cacert.txt
```

In a future release of OpenShift API for Data Protection (OADP), we plan to mount the certificate to the Velero pod so that this step is not required.

5.9.1.4. Installing the Data Protection Application

You install the Data Protection Application (DPA) by creating an instance of the **DataProtectionApplication** API.

Prerequisites

- You must install the OADP Operator.
- You must configure object storage as a backup location.
- If you use snapshots to back up PVs, your cloud provider must support either a native snapshot API or Container Storage Interface (CSI) snapshots.
- If the backup and snapshot locations use the same credentials, you must create a **Secret** with the default name, **cloud-credentials-azure**.
- If the backup and snapshot locations use different credentials, you must create two **Secrets**:
  - **Secret** with a custom name for the backup location. You add this **Secret** to the **DataProtectionApplication** CR.
  - **Secret** with another custom name for the snapshot location. You add this **Secret** to the **DataProtectionApplication** CR.

NOTE

If you do not want to specify backup or snapshot locations during the installation, you can create a default **Secret** with an empty **credentials-velero** file. If there is no default **Secret**, the installation will fail.

Procedure

1. Click **Operators → Installed Operators** and select the OADP Operator.
2. Under **Provided APIs**, click **Create instance** in the **DataProtectionApplication** box.
3. Click **YAML View** and update the parameters of the **DataProtectionApplication** manifest:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: <dpa_sample>
  namespace: openshift-adp (1)
spec:
  configuration:
    velero:
      defaultPlugins:
        - azure
        - openshift (2)
      resourceTimeout: 10m (3)
    nodeAgent: (4)
```

```
    enable: true (5)
    uploaderType: kopia (6)
    podConfig:
      nodeSelector: <node_selector> (7)
backupLocations:
 - velero:
    config:
      resourceGroup: <azure_resource_group> (8)
      storageAccount: <azure_storage_account_id> (9)
      subscriptionId: <azure_subscription_id> (10)
      storageAccountKeyEnvVar: AZURE_STORAGE_ACCOUNT_ACCESS_KEY
    credential:
      key: cloud
      name: cloud-credentials-azure (11)
    provider: azure
    default: true
    objectStorage:
      bucket: <bucket_name> (12)
      prefix: <prefix> (13)
snapshotLocations: (14)
 - velero:
    config:
      resourceGroup: <azure_resource_group>
      subscriptionId: <azure_subscription_id>
      incremental: "true"
    name: default
    provider: azure
    credential:
      key: cloud
      name: cloud-credentials-azure (15)
```

(1) The default namespace for OADP is **openshift-adp**. The namespace is a variable and is configurable.

(2) The **openshift** plugin is mandatory.

(3) Specify how many minutes to wait for several Velero resources before timeout occurs, such as Velero CRD availability, volumeSnapshot deletion, and backup repository availability. The default is 10m.

(4) The administrative agent that routes the administrative requests to servers.

(5) Set this value to **true** if you want to enable **nodeAgent** and perform File System Backup.

(6) Enter **kopia** or **restic** as your uploader. You cannot change the selection after the installation. For the Built-in DataMover you must use Kopia. The **nodeAgent** deploys a daemon set, which means that the **nodeAgent** pods run on each working node. You can configure File System Backup by adding **spec.defaultVolumesToFsBackup: true** to the **Backup** CR.

(7) Specify the nodes on which Kopia or Restic are available. By default, Kopia or Restic run on all nodes.

(8) Specify the Azure resource group.

9. Specify the Azure storage account ID.
10. Specify the Azure subscription ID.
11. If you do not specify this value, the default name, **cloud-credentials-azure**, is used. If you specify a custom name, the custom name is used for the backup location.
12. Specify a bucket as the backup storage location. If the bucket is not a dedicated bucket for Velero backups, you must specify a prefix.
13. Specify a prefix for Velero backups, for example, **velero**, if the bucket is used for multiple purposes.
14. You do not need to specify a snapshot location if you use CSI snapshots or Restic to back up PVs.
15. Specify the name of the **Secret** object that you created. If you do not specify this value, the default name, **cloud-credentials-azure**, is used. If you specify a custom name, the custom name is used for the backup location.

4. Click **Create**.

Verification

1. Verify the installation by viewing the OpenShift API for Data Protection (OADP) resources by running the following command:

```
$ oc get all -n openshift-adp
```

Example output

```
NAME                                                 READY   STATUS    RESTARTS   AGE
pod/oadp-operator-controller-manager-67d9494d47-6l8z8   2/2     Running   0          2m8s
pod/node-agent-9cq4q                                 1/1     Running   0          94s
pod/node-agent-m4lts                                 1/1     Running   0          94s
pod/node-agent-pv4kr                                 1/1     Running   0          95s
pod/velero-588db7f655-n842v                          1/1     Running   0          95s

NAME                                                    TYPE        CLUSTER-IP       EXTERNAL-IP
PORT(S)    AGE
service/oadp-operator-controller-manager-metrics-service   ClusterIP   172.30.70.140
<none>        8443/TCP   2m8s
service/openshift-adp-velero-metrics-svc                ClusterIP   172.30.10.0      <none>
8085/TCP   8h

NAME                  DESIRED   CURRENT   READY   UP-TO-DATE   AVAILABLE   NODE
SELECTOR   AGE
daemonset.apps/node-agent   3         3         3       3            3           <none>          96s

NAME                                            READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/oadp-operator-controller-manager   1/1     1            1           2m9s
deployment.apps/velero                             1/1     1            1           96s
```

```
NAME                                                 DESIRED   CURRENT   READY   AGE
replicaset.apps/oadp-operator-controller-manager-67d9494d47   1         1         1       2m9s
replicaset.apps/velero-588db7f655                    1         1         1       96s
```

2. Verify that the **DataProtectionApplication** (DPA) is reconciled by running the following command:

```
$ oc get dpa dpa-sample -n openshift-adp -o jsonpath='{.status}'
```

Example output

```
{"conditions":[{"lastTransitionTime":"2023-10-27T01:23:57Z","message":"Reconcile
complete","reason":"Complete","status":"True","type":"Reconciled"}]}
```

3. Verify the **type** is set to **Reconciled**.

4. Verify the backup storage location and confirm that the **PHASE** is **Available** by running the following command:

```
$ oc get backupstoragelocations.velero.io -n openshift-adp
```

Example output

```
NAME           PHASE       LAST VALIDATED   AGE     DEFAULT
dpa-sample-1   Available   1s               3d16h   true
```

5.9.1.5. Configuring the DPA with client burst and QPS settings

The burst setting determines how many requests can be sent to the **velero** server before the limit is applied. After the burst limit is reached, the queries per second (QPS) setting determines how many additional requests can be sent per second.

You can set the burst and QPS values of the **velero** server by configuring the Data Protection Application (DPA) with the burst and QPS values. You can use the **dpa.configuration.velero.client-burst** and **dpa.configuration.velero.client-qps** fields of the DPA to set the burst and QPS values.

Prerequisites

- You have installed the OADP Operator.

Procedure

- Configure the **client-burst** and the **client-qps** fields in the DPA as shown in the following example:

Example Data Protection Application

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: test-dpa
  namespace: openshift-adp
spec:
```

```
backupLocations:
  - name: default
    velero:
      config:
        insecureSkipTLSVerify: "true"
        profile: "default"
        region: <bucket_region>
        s3ForcePathStyle: "true"
        s3Url: <bucket_url>
      credential:
        key: cloud
        name: cloud-credentials
      default: true
      objectStorage:
        bucket: <bucket_name>
        prefix: velero
      provider: aws
configuration:
  nodeAgent:
    enable: true
    uploaderType: restic
  velero:
    client-burst: 500 1
    client-qps: 300 2
    defaultPlugins:
      - openshift
      - aws
      - kubevirt
```

1 Specify the **client-burst** value. In this example, the **client-burst** field is set to 500.

2 Specify the **client-qps** value. In this example, the **client-qps** field is set to 300.

5.9.1.6. Overriding the imagePullPolicy setting in the DPA

In OADP 1.4.0 or earlier, the Operator sets the **imagePullPolicy** field of the Velero and node agent pods to **Always** for all images.

In OADP 1.4.1 or later, the Operator first checks if each image has the **sha256** or **sha512** digest and sets the **imagePullPolicy** field accordingly:

- If the image has the digest, the Operator sets **imagePullPolicy** to **IfNotPresent**.
- If the image does not have the digest, the Operator sets **imagePullPolicy** to **Always**.

You can also override the **imagePullPolicy** field by using the **spec.imagePullPolicy** field in the Data Protection Application (DPA).

Prerequisites

- You have installed the OADP Operator.

Procedure

- Configure the **spec.imagePullPolicy** field in the DPA as shown in the following example:

Example Data Protection Application

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: test-dpa
  namespace: openshift-adp
spec:
  backupLocations:
    - name: default
      velero:
        config:
          insecureSkipTLSVerify: "true"
          profile: "default"
          region: <bucket_region>
          s3ForcePathStyle: "true"
          s3Url: <bucket_url>
        credential:
          key: cloud
          name: cloud-credentials
        default: true
        objectStorage:
          bucket: <bucket_name>
          prefix: velero
        provider: aws
  configuration:
    nodeAgent:
      enable: true
      uploaderType: kopia
    velero:
      defaultPlugins:
        - openshift
        - aws
        - kubevirt
        - csi
  imagePullPolicy: Never (1)
```

(1) Specify the value for **imagePullPolicy**. In this example, the **imagePullPolicy** field is set to **Never**.

5.9.1.6.1. Configuring node agents and node labels

The DPA of OADP uses the **nodeSelector** field to select which nodes can run the node agent. The **nodeSelector** field is the simplest recommended form of node selection constraint.

Any label specified must match the labels on each node.

The correct way to run the node agent on any node you choose is for you to label the nodes with a custom label:

```
$ oc label node/<node_name> node-role.kubernetes.io/nodeAgent=""
```

Use the same custom label in the **DPA.spec.configuration.nodeAgent.podConfig.nodeSelector**, which you used for labeling nodes. For example:

```
configuration:
  nodeAgent:
    enable: true
    podConfig:
      nodeSelector:
        node-role.kubernetes.io/nodeAgent: ""
```

The following example is an anti-pattern of **nodeSelector** and does not work unless both labels, **'node-role.kubernetes.io/infra: ""'** and **'node-role.kubernetes.io/worker: ""'**, are on the node:

```
  configuration:
    nodeAgent:
      enable: true
      podConfig:
        nodeSelector:
          node-role.kubernetes.io/infra: ""
          node-role.kubernetes.io/worker: ""
```

5.9.1.6.2. Enabling CSI in the DataProtectionApplication CR

You enable the Container Storage Interface (CSI) in the **DataProtectionApplication** custom resource (CR) in order to back up persistent volumes with CSI snapshots.

Prerequisites

- The cloud provider must support CSI snapshots.

Procedure

- Edit the **DataProtectionApplication** CR, as in the following example:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
...
spec:
  configuration:
    velero:
      defaultPlugins:
      - openshift
      - csi 1
```

1 Add the **csi** default plugin.

5.9.1.6.3. Disabling the node agent in DataProtectionApplication

If you are not using **Restic**, **Kopia**, or **DataMover** for your backups, you can disable the **nodeAgent** field in the **DataProtectionApplication** custom resource (CR). Before you disable **nodeAgent**, ensure the OADP Operator is idle and not running any backups.

Procedure

1. To disable the **nodeAgent**, set the **enable** flag to **false**. See the following example:

   Example DataProtectionApplication CR

   ```
   # ...
   configuration:
     nodeAgent:
       enable: false 1
       uploaderType: kopia
   # ...
   ```

   1 Disables the node agent.

2. To enable the **nodeAgent**, set the **enable** flag to **true**. See the following example:

   Example DataProtectionApplication CR

   ```
   # ...
   configuration:
     nodeAgent:
       enable: true 1
       uploaderType: kopia
   # ...
   ```

   1 Enables the node agent.

You can set up a job to enable and disable the **nodeAgent** field in the **DataProtectionApplication** CR. For more information, see "Running tasks in pods using jobs".

Additional resources

- Installing the Data Protection Application with the **kubevirt** and **openshift** plugins
- Running tasks in pods using jobs.
- Configuring the OpenShift API for Data Protection (OADP) with multiple backup storage locations

5.10. CONFIGURING OADP WITH GCP

5.10.1. Configuring the OpenShift API for Data Protection with Google Cloud Platform

You install the OpenShift API for Data Protection (OADP) with Google Cloud Platform (GCP) by installing the OADP Operator. The Operator installs Velero 1.14.

NOTE

Starting from OADP 1.0.4, all OADP 1.0.*z* versions can only be used as a dependency of the Migration Toolkit for Containers Operator and are not available as a standalone Operator.

You configure GCP for Velero, create a default **Secret**, and then install the Data Protection Application. For more details, see Installing the OADP Operator.

To install the OADP Operator in a restricted network environment, you must first disable the default OperatorHub sources and mirror the Operator catalog. See Using Operator Lifecycle Manager in disconnected environments for details.

5.10.1.1. Configuring Google Cloud Platform

You configure Google Cloud Platform (GCP) for the OpenShift API for Data Protection (OADP).

Prerequisites

- You must have the **gcloud** and **gsutil** CLI tools installed. See the Google cloud documentation for details.

Procedure

1. Log in to GCP:

```
$ gcloud auth login
```

2. Set the **BUCKET** variable:

```
$ BUCKET=<bucket> 1
```

1 Specify your bucket name.

3. Create the storage bucket:

```
$ gsutil mb gs://$BUCKET/
```

4. Set the **PROJECT_ID** variable to your active project:

```
$ PROJECT_ID=$(gcloud config get-value project)
```

5. Create a service account:

```
$ gcloud iam service-accounts create velero \
    --display-name "Velero service account"
```

6. List your service accounts:

```
$ gcloud iam service-accounts list
```

7. Set the **SERVICE_ACCOUNT_EMAIL** variable to match its **email** value:

```
$ SERVICE_ACCOUNT_EMAIL=$(gcloud iam service-accounts list \
    --filter="displayName:Velero service account" \
    --format 'value(email)')
```

8. Attach the policies to give the **velero** user the minimum necessary permissions:

```
$ ROLE_PERMISSIONS=(
    compute.disks.get
    compute.disks.create
    compute.disks.createSnapshot
    compute.snapshots.get
    compute.snapshots.create
    compute.snapshots.useReadOnly
    compute.snapshots.delete
    compute.zones.get
    storage.objects.create
    storage.objects.delete
    storage.objects.get
    storage.objects.list
    iam.serviceAccounts.signBlob
)
```

9. Create the **velero.server** custom role:

```
$ gcloud iam roles create velero.server \
    --project $PROJECT_ID \
    --title "Velero Server" \
    --permissions "$(IFS=","; echo "${ROLE_PERMISSIONS[*]}")"
```

10. Add IAM policy binding to the project:

```
$ gcloud projects add-iam-policy-binding $PROJECT_ID \
    --member serviceAccount:$SERVICE_ACCOUNT_EMAIL \
    --role projects/$PROJECT_ID/roles/velero.server
```

11. Update the IAM service account:

```
$ gsutil iam ch serviceAccount:$SERVICE_ACCOUNT_EMAIL:objectAdmin gs://${BUCKET}
```

12. Save the IAM service account keys to the **credentials-velero** file in the current directory:

```
$ gcloud iam service-accounts keys create credentials-velero \
    --iam-account $SERVICE_ACCOUNT_EMAIL
```

You use the **credentials-velero** file to create a **Secret** object for GCP before you install the Data Protection Application.

5.10.1.2. About backup and snapshot locations and their secrets

You specify backup and snapshot locations and their secrets in the **DataProtectionApplication** custom resource (CR).

Backup locations

You can specify one of the following AWS S3-compatible object storage solutions as a backup location:

- Multicloud Object Gateway (MCG)
- Red Hat Container Storage
- Ceph RADOS Gateway; also known as Ceph Object Gateway
- Red Hat OpenShift Data Foundation
- MinIO

Velero backs up OpenShift Container Platform resources, Kubernetes objects, and internal images as an archive file on object storage.

Snapshot locations
If you use your cloud provider's native snapshot API to back up persistent volumes, you must specify the cloud provider as the snapshot location.

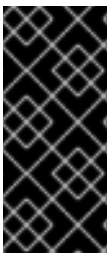
If you use Container Storage Interface (CSI) snapshots, you do not need to specify a snapshot location because you will create a **VolumeSnapshotClass** CR to register the CSI driver.

If you use File System Backup (FSB), you do not need to specify a snapshot location because FSB backs up the file system on object storage.

Secrets
If the backup and snapshot locations use the same credentials or if you do not require a snapshot location, you create a default **Secret**.

If the backup and snapshot locations use different credentials, you create two secret objects:

- Custom **Secret** for the backup location, which you specify in the **DataProtectionApplication** CR.
- Default **Secret** for the snapshot location, which is not referenced in the **DataProtectionApplication** CR.



IMPORTANT

The Data Protection Application requires a default **Secret**. Otherwise, the installation will fail.

If you do not want to specify backup or snapshot locations during the installation, you can create a default **Secret** with an empty **credentials-velero** file.

5.10.1.2.1. Creating a default Secret

You create a default **Secret** if your backup and snapshot locations use the same credentials or if you do not require a snapshot location.

The default name of the **Secret** is **cloud-credentials-gcp**.

NOTE

The **DataProtectionApplication** custom resource (CR) requires a default **Secret**. Otherwise, the installation will fail. If the name of the backup location **Secret** is not specified, the default name is used.

If you do not want to use the backup location credentials during the installation, you can create a **Secret** with the default name by using an empty **credentials-velero** file.

Prerequisites

- Your object storage and cloud storage, if any, must use the same credentials.
- You must configure object storage for Velero.

Procedure

1. Create a **credentials-velero** file for the backup storage location in the appropriate format for your cloud provider.
2. Create a **Secret** custom resource (CR) with the default name:

```
$ oc create secret generic cloud-credentials-gcp -n openshift-adp --from-file
cloud=credentials-velero
```

The **Secret** is referenced in the **spec.backupLocations.credential** block of the **DataProtectionApplication** CR when you install the Data Protection Application.

5.10.1.2.2. Creating secrets for different credentials

If your backup and snapshot locations use different credentials, you must create two **Secret** objects:

- Backup location **Secret** with a custom name. The custom name is specified in the **spec.backupLocations** block of the **DataProtectionApplication** custom resource (CR).
- Snapshot location **Secret** with the default name, **cloud-credentials-gcp**. This **Secret** is not specified in the **DataProtectionApplication** CR.

Procedure

1. Create a **credentials-velero** file for the snapshot location in the appropriate format for your cloud provider.
2. Create a **Secret** for the snapshot location with the default name:

```
$ oc create secret generic cloud-credentials-gcp -n openshift-adp --from-file
cloud=credentials-velero
```

3. Create a **credentials-velero** file for the backup location in the appropriate format for your object storage.
4. Create a **Secret** for the backup location with a custom name:

```
$ oc create secret generic <custom_secret> -n openshift-adp --from-file cloud=credentials-
velero
```

5. Add the **Secret** with the custom name to the **DataProtectionApplication** CR, as in the following example:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: <dpa_sample>
  namespace: openshift-adp
spec:
...
  backupLocations:
    - velero:
        provider: gcp
        default: true
        credential:
          key: cloud
          name: <custom_secret> 1
        objectStorage:
          bucket: <bucket_name>
          prefix: <prefix>
  snapshotLocations:
    - velero:
        provider: gcp
        default: true
        config:
          project: <project>
          snapshotLocation: us-west1
```

1 Backup location **Secret** with custom name.

5.10.1.3. Configuring the Data Protection Application

You can configure the Data Protection Application by setting Velero resource allocations or enabling self-signed CA certificates.

5.10.1.3.1. Setting Velero CPU and memory resource allocations

You set the CPU and memory resource allocations for the **Velero** pod by editing the **DataProtectionApplication** custom resource (CR) manifest.

Prerequisites

- You must have the OpenShift API for Data Protection (OADP) Operator installed.

Procedure

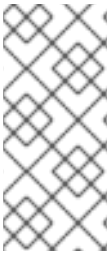
- Edit the values in the **spec.configuration.velero.podConfig.ResourceAllocations** block of the **DataProtectionApplication** CR manifest, as in the following example:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: <dpa_sample>
spec:
```

```
# ...
 configuration:
   velero:
     podConfig:
       nodeSelector: <node_selector> 1
       resourceAllocations: 2
         limits:
           cpu: "1"
           memory: 1024Mi
         requests:
           cpu: 200m
           memory: 256Mi
```

1 Specify the node selector to be supplied to Velero podSpec.

2 The **resourceAllocations** listed are for average usage.



NOTE

Kopia is an option in OADP 1.3 and later releases. You can use Kopia for file system backups, and Kopia is your only option for Data Mover cases with the built-in Data Mover.

Kopia is more resource intensive than Restic, and you might need to adjust the CPU and memory requirements accordingly.

Use the **nodeSelector** field to select which nodes can run the node agent. The **nodeSelector** field is the simplest recommended form of node selection constraint. Any label specified must match the labels on each node.

For more details, see Configuring node agents and node labels.

5.10.1.3.2. Enabling self-signed CA certificates

You must enable a self-signed CA certificate for object storage by editing the **DataProtectionApplication** custom resource (CR) manifest to prevent a **certificate signed by unknown authority** error.

Prerequisites

- You must have the OpenShift API for Data Protection (OADP) Operator installed.

Procedure

- Edit the **spec.backupLocations.velero.objectStorage.caCert** parameter and **spec.backupLocations.velero.config** parameters of the **DataProtectionApplication** CR manifest:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: <dpa_sample>
spec:
# ...
```

```
backupLocations:
  - name: default
    velero:
      provider: aws
      default: true
      objectStorage:
        bucket: <bucket>
        prefix: <prefix>
        caCert: <base64_encoded_cert_string> 1
      config:
        insecureSkipTLSVerify: "false" 2
# ...
```

1. Specify the Base64-encoded CA certificate string.
2. The **insecureSkipTLSVerify** configuration can be set to either **"true"** or **"false"**. If set to **"true"**, SSL/TLS security is disabled. If set to **"false"**, SSL/TLS security is enabled.

5.10.1.3.2.1. Using CA certificates with the velero command aliased for Velero deployment

You might want to use the Velero CLI without installing it locally on your system by creating an alias for it.

Prerequisites

- You must be logged in to the OpenShift Container Platform cluster as a user with the **cluster-admin** role.
- You must have the OpenShift CLI (**oc**) installed.

1. To use an aliased Velero command, run the following command:

```
$ alias velero='oc -n openshift-adp exec deployment/velero -c velero -it -- ./velero'
```

2. Check that the alias is working by running the following command:

Example

```
$ velero version
Client:
 Version: v1.12.1-OADP
 Git commit: -
Server:
 Version: v1.12.1-OADP
```

3. To use a CA certificate with this command, you can add a certificate to the Velero deployment by running the following commands:

```
$ CA_CERT=$(oc -n openshift-adp get dataprotectionapplications.oadp.openshift.io
<dpa-name> -o jsonpath='{.spec.backupLocations[0].velero.objectStorage.caCert}')

$ [[ -n $CA_CERT ]] && echo "$CA_CERT" | base64 -d | oc exec -n openshift-adp -i
deploy/velero -c velero -- bash -c "cat > /tmp/your-cacert.txt" || echo "DPA BSL has no
caCert"
```

```
$ velero describe backup <backup_name> --details --cacert /tmp/<your_cacert>.txt
```

4. To fetch the backup logs, run the following command:

```
$ velero backup logs  <backup_name>  --cacert /tmp/<your_cacert.txt>
```

You can use these logs to view failures and warnings for the resources that you cannot back up.

5. If the Velero pod restarts, the **/tmp/your-cacert.txt** file disappears, and you must re-create the **/tmp/your-cacert.txt** file by re-running the commands from the previous step.

6. You can check if the **/tmp/your-cacert.txt** file still exists, in the file location where you stored it, by running the following command:

```
$ oc exec -n openshift-adp -i deploy/velero -c velero -- bash -c "ls /tmp/your-cacert.txt"
/tmp/your-cacert.txt
```

In a future release of OpenShift API for Data Protection (OADP), we plan to mount the certificate to the Velero pod so that this step is not required.

5.10.1.4. Google workload identity federation cloud authentication

Applications running outside Google Cloud use service account keys, such as usernames and passwords, to gain access to Google Cloud resources. These service account keys might become a security risk if they are not properly managed.

With Google's workload identity federation, you can use Identity and Access Management (IAM) to offer IAM roles, including the ability to impersonate service accounts, to external identities. This eliminates the maintenance and security risks associated with service account keys.

Workload identity federation handles encrypting and decrypting certificates, extracting user attributes, and validation. Identity federation externalizes authentication, passing it over to Security Token Services (STS), and reduces the demands on individual developers. Authorization and controlling access to resources remain the responsibility of the application.

NOTE

Google workload identity federation is available for OADP 1.3.x and later.

When backing up volumes, OADP on GCP with Google workload identity federation authentication only supports CSI snapshots.

OADP on GCP with Google workload identity federation authentication does not support Volume Snapshot Locations (VSL) backups. For more details, see Google workload identity federation known issues.

If you do not use Google workload identity federation cloud authentication, continue to *Installing the Data Protection Application*.

Prerequisites

- You have installed a cluster in manual mode with GCP Workload Identity configured.

- You have access to the Cloud Credential Operator utility (**ccoctl**) and to the associated workload identity pool.

Procedure

1. Create an **oadp-credrequest** directory by running the following command:

```
$ mkdir -p oadp-credrequest
```

2. Create a **CredentialsRequest.yaml** file as following:

```
echo 'apiVersion: cloudcredential.openshift.io/v1
kind: CredentialsRequest
metadata:
  name: oadp-operator-credentials
  namespace: openshift-cloud-credential-operator
spec:
  providerSpec:
    apiVersion: cloudcredential.openshift.io/v1
    kind: GCPProviderSpec
    permissions:
    - compute.disks.get
    - compute.disks.create
    - compute.disks.createSnapshot
    - compute.snapshots.get
    - compute.snapshots.create
    - compute.snapshots.useReadOnly
    - compute.snapshots.delete
    - compute.zones.get
    - storage.objects.create
    - storage.objects.delete
    - storage.objects.get
    - storage.objects.list
    - iam.serviceAccounts.signBlob
    skipServiceCheck: true
  secretRef:
    name: cloud-credentials-gcp
    namespace: <OPERATOR_INSTALL_NS>
  serviceAccountNames:
  - velero
' > oadp-credrequest/credrequest.yaml
```

3. Use the **ccoctl** utility to process the **CredentialsRequest** objects in the **oadp-credrequest** directory by running the following command:

```
$ ccoctl gcp create-service-accounts \
    --name=<name> \
    --project=<gcp_project_id> \
    --credentials-requests-dir=oadp-credrequest \
    --workload-identity-pool=<pool_id> \
    --workload-identity-provider=<provider_id>
```

The **manifests/openshift-adp-cloud-credentials-gcp-credentials.yaml** file is now available to use in the following steps.

4. Create a namespace by running the following command:

```
$ oc create namespace <OPERATOR_INSTALL_NS>
```

5. Apply the credentials to the namespace by running the following command:

```
$ oc apply -f manifests/openshift-adp-cloud-credentials-gcp-credentials.yaml
```

5.10.1.4.1. Google workload identity federation known issues

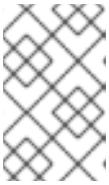
- Volume Snapshot Location (VSL) backups finish with a **PartiallyFailed** phase when GCP workload identity federation is configured. Google workload identity federation authentication does not support VSL backups.

5.10.1.5. Installing the Data Protection Application

You install the Data Protection Application (DPA) by creating an instance of the **DataProtectionApplication** API.

Prerequisites

- You must install the OADP Operator.
- You must configure object storage as a backup location.
- If you use snapshots to back up PVs, your cloud provider must support either a native snapshot API or Container Storage Interface (CSI) snapshots.
- If the backup and snapshot locations use the same credentials, you must create a **Secret** with the default name, **cloud-credentials-gcp**.
- If the backup and snapshot locations use different credentials, you must create two **Secrets**:
  - **Secret** with a custom name for the backup location. You add this **Secret** to the **DataProtectionApplication** CR.
  - **Secret** with another custom name for the snapshot location. You add this **Secret** to the **DataProtectionApplication** CR.



NOTE

If you do not want to specify backup or snapshot locations during the installation, you can create a default **Secret** with an empty **credentials-velero** file. If there is no default **Secret**, the installation will fail.

Procedure

1. Click **Operators → Installed Operators** and select the OADP Operator.
2. Under **Provided APIs**, click **Create instance** in the **DataProtectionApplication** box.
3. Click **YAML View** and update the parameters of the **DataProtectionApplication** manifest:

```
apiVersion: oadp.openshift.io/v1alpha1
```

```
kind: DataProtectionApplication
metadata:
  name: <dpa_sample>
  namespace: <OPERATOR_INSTALL_NS> (1)
spec:
  configuration:
    velero:
      defaultPlugins:
        - gcp
        - openshift (2)
      resourceTimeout: 10m (3)
    nodeAgent: (4)
      enable: true (5)
      uploaderType: kopia (6)
      podConfig:
        nodeSelector: <node_selector> (7)
  backupLocations:
    - velero:
        provider: gcp
        default: true
        credential:
          key: cloud (8)
          name: cloud-credentials-gcp (9)
        objectStorage:
          bucket: <bucket_name> (10)
          prefix: <prefix> (11)
  snapshotLocations: (12)
    - velero:
        provider: gcp
        default: true
        config:
          project: <project>
          snapshotLocation: us-west1 (13)
        credential:
          key: cloud
          name: cloud-credentials-gcp (14)
  backupImages: true (15)
```

(1) The default namespace for OADP is **openshift-adp**. The namespace is a variable and is configurable.

(2) The **openshift** plugin is mandatory.

(3) Specify how many minutes to wait for several Velero resources before timeout occurs, such as Velero CRD availability, volumeSnapshot deletion, and backup repository availability. The default is 10m.

(4) The administrative agent that routes the administrative requests to servers.

(5) Set this value to **true** if you want to enable **nodeAgent** and perform File System Backup.

(6) Enter **kopia** or **restic** as your uploader. You cannot change the selection after the installation. For the Built-in DataMover you must use Kopia. The **nodeAgent** deploys a daemon set, which means that the **nodeAgent** pods run on each working node. You can

configure File System Backup by adding **spec.defaultVolumesToFsBackup: true** to the **Backup** CR.

7. Specify the nodes on which Kopia or Restic are available. By default, Kopia or Restic run on all nodes.
8. Secret key that contains credentials. For Google workload identity federation cloud authentication use **service_account.json**.
9. Secret name that contains credentials. If you do not specify this value, the default name, **cloud-credentials-gcp**, is used.
10. Specify a bucket as the backup storage location. If the bucket is not a dedicated bucket for Velero backups, you must specify a prefix.
11. Specify a prefix for Velero backups, for example, **velero**, if the bucket is used for multiple purposes.
12. Specify a snapshot location, unless you use CSI snapshots or Restic to back up PVs.
13. The snapshot location must be in the same region as the PVs.
14. Specify the name of the **Secret** object that you created. If you do not specify this value, the default name, **cloud-credentials-gcp**, is used. If you specify a custom name, the custom name is used for the backup location.
15. Google workload identity federation supports internal image backup. Set this field to **false** if you do not want to use image backup.

4. Click **Create**.

Verification

1. Verify the installation by viewing the OpenShift API for Data Protection (OADP) resources by running the following command:

```
$ oc get all -n openshift-adp
```

Example output

```
NAME                                                 READY   STATUS    RESTARTS   AGE
pod/oadp-operator-controller-manager-67d9494d47-6l8z8   2/2     Running   0          2m8s
pod/node-agent-9cq4q                                 1/1     Running   0          94s
pod/node-agent-m4lts                                 1/1     Running   0          94s
pod/node-agent-pv4kr                                 1/1     Running   0          95s
pod/velero-588db7f655-n842v                          1/1     Running   0          95s

NAME                                                    TYPE        CLUSTER-IP       EXTERNAL-IP
PORT(S)    AGE
service/oadp-operator-controller-manager-metrics-service   ClusterIP   172.30.70.140
<none>        8443/TCP   2m8s
service/openshift-adp-velero-metrics-svc                ClusterIP   172.30.10.0      <none>
8085/TCP   8h

NAME                 DESIRED   CURRENT   READY   UP-TO-DATE   AVAILABLE   NODE
```

```
SELECTOR   AGE
daemonset.apps/node-agent   3         3         3       3            3           <none>          96s

NAME                                          READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/oadp-operator-controller-manager   1/1     1            1           2m9s
deployment.apps/velero                             1/1     1            1           96s

NAME                                                    DESIRED   CURRENT   READY   AGE
replicaset.apps/oadp-operator-controller-manager-67d9494d47   1         1         1       2m9s
replicaset.apps/velero-588db7f655                      1         1         1       96s
```

2. Verify that the **DataProtectionApplication** (DPA) is reconciled by running the following command:

```
$ oc get dpa dpa-sample -n openshift-adp -o jsonpath='{.status}'
```

Example output

```
{"conditions":[{"lastTransitionTime":"2023-10-27T01:23:57Z","message":"Reconcile
complete","reason":"Complete","status":"True","type":"Reconciled"}]}
```

3. Verify the **type** is set to **Reconciled**.

4. Verify the backup storage location and confirm that the **PHASE** is **Available** by running the following command:

```
$ oc get backupstoragelocations.velero.io -n openshift-adp
```

Example output

```
NAME           PHASE       LAST VALIDATED   AGE     DEFAULT
dpa-sample-1   Available   1s               3d16h   true
```

5.10.1.6. Configuring the DPA with client burst and QPS settings

The burst setting determines how many requests can be sent to the **velero** server before the limit is applied. After the burst limit is reached, the queries per second (QPS) setting determines how many additional requests can be sent per second.

You can set the burst and QPS values of the **velero** server by configuring the Data Protection Application (DPA) with the burst and QPS values. You can use the **dpa.configuration.velero.client-burst** and **dpa.configuration.velero.client-qps** fields of the DPA to set the burst and QPS values.

Prerequisites

- You have installed the OADP Operator.

Procedure

- Configure the **client-burst** and the **client-qps** fields in the DPA as shown in the following example:

Example Data Protection Application

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: test-dpa
  namespace: openshift-adp
spec:
  backupLocations:
    - name: default
      velero:
        config:
          insecureSkipTLSVerify: "true"
          profile: "default"
          region: <bucket_region>
          s3ForcePathStyle: "true"
          s3Url: <bucket_url>
        credential:
          key: cloud
          name: cloud-credentials
        default: true
        objectStorage:
          bucket: <bucket_name>
          prefix: velero
        provider: aws
  configuration:
    nodeAgent:
      enable: true
      uploaderType: restic
    velero:
      client-burst: 500 (1)
      client-qps: 300 (2)
      defaultPlugins:
        - openshift
        - aws
        - kubevirt
```

1. Specify the **client-burst** value. In this example, the **client-burst** field is set to 500.
2. Specify the **client-qps** value. In this example, the **client-qps** field is set to 300.

5.10.1.7. Overriding the imagePullPolicy setting in the DPA

In OADP 1.4.0 or earlier, the Operator sets the **imagePullPolicy** field of the Velero and node agent pods to **Always** for all images.

In OADP 1.4.1 or later, the Operator first checks if each image has the **sha256** or **sha512** digest and sets the **imagePullPolicy** field accordingly:

- If the image has the digest, the Operator sets **imagePullPolicy** to **IfNotPresent**.
- If the image does not have the digest, the Operator sets **imagePullPolicy** to **Always**.

You can also override the **imagePullPolicy** field by using the **spec.imagePullPolicy** field in the Data Protection Application (DPA).

Prerequisites

- You have installed the OADP Operator.

Procedure

- Configure the **spec.imagePullPolicy** field in the DPA as shown in the following example:

  Example Data Protection Application

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: test-dpa
  namespace: openshift-adp
spec:
  backupLocations:
    - name: default
      velero:
        config:
          insecureSkipTLSVerify: "true"
          profile: "default"
          region: <bucket_region>
          s3ForcePathStyle: "true"
          s3Url: <bucket_url>
        credential:
          key: cloud
          name: cloud-credentials
        default: true
        objectStorage:
          bucket: <bucket_name>
          prefix: velero
        provider: aws
  configuration:
    nodeAgent:
      enable: true
      uploaderType: kopia
    velero:
      defaultPlugins:
        - openshift
        - aws
        - kubevirt
        - csi
  imagePullPolicy: Never (1)
```

(1) Specify the value for **imagePullPolicy**. In this example, the **imagePullPolicy** field is set to **Never**.

5.10.1.7.1. Configuring node agents and node labels

The DPA of OADP uses the **nodeSelector** field to select which nodes can run the node agent. The **nodeSelector** field is the simplest recommended form of node selection constraint.

Any label specified must match the labels on each node.

The correct way to run the node agent on any node you choose is for you to label the nodes with a custom label:

```
$ oc label node/<node_name> node-role.kubernetes.io/nodeAgent=""
```

Use the same custom label in the **DPA.spec.configuration.nodeAgent.podConfig.nodeSelector**, which you used for labeling nodes. For example:

```
configuration:
  nodeAgent:
    enable: true
    podConfig:
      nodeSelector:
        node-role.kubernetes.io/nodeAgent: ""
```

The following example is an anti-pattern of **nodeSelector** and does not work unless both labels, **'node-role.kubernetes.io/infra: ""** and **'node-role.kubernetes.io/worker: ""**, are on the node:

```
  configuration:
    nodeAgent:
      enable: true
      podConfig:
        nodeSelector:
          node-role.kubernetes.io/infra: ""
          node-role.kubernetes.io/worker: ""
```

5.10.1.7.2. Enabling CSI in the DataProtectionApplication CR

You enable the Container Storage Interface (CSI) in the **DataProtectionApplication** custom resource (CR) in order to back up persistent volumes with CSI snapshots.

Prerequisites

- The cloud provider must support CSI snapshots.

Procedure

- Edit the **DataProtectionApplication** CR, as in the following example:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
...
spec:
  configuration:
    velero:
      defaultPlugins:
      - openshift
      - csi 1
```

1 Add the **csi** default plugin.

5.10.1.7.3. Disabling the node agent in DataProtectionApplication

If you are not using **Restic**, **Kopia**, or **DataMover** for your backups, you can disable the **nodeAgent** field in the **DataProtectionApplication** custom resource (CR). Before you disable **nodeAgent**, ensure the OADP Operator is idle and not running any backups.

Procedure

1. To disable the **nodeAgent**, set the **enable** flag to **false**. See the following example:

   Example DataProtectionApplication CR

```
# ...
configuration:
  nodeAgent:
    enable: false 1
    uploaderType: kopia
# ...
```

   1 Disables the node agent.

2. To enable the **nodeAgent**, set the **enable** flag to **true**. See the following example:

   Example DataProtectionApplication CR

```
# ...
configuration:
  nodeAgent:
    enable: true 1
    uploaderType: kopia
# ...
```

   1 Enables the node agent.

You can set up a job to enable and disable the **nodeAgent** field in the **DataProtectionApplication** CR. For more information, see "Running tasks in pods using jobs".

Additional resources

- Installing the Data Protection Application with the **kubevirt** and **openshift** plugins
- Running tasks in pods using jobs.
- Configuring the OpenShift API for Data Protection (OADP) with multiple backup storage locations

5.11. CONFIGURING OADP WITH MCG

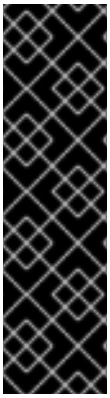
5.11.1. Configuring the OpenShift API for Data Protection with Multicloud Object Gateway

Multicloud Object Gateway (MCG) is a component of OpenShift Data Foundation, and you can configure it as a backup location in the **DataProtectionApplication** custom resource (CR). You can

install the OpenShift API for Data Protection (OADP) with MCG by installing the OADP Operator. The Operator installs Velero 1.14.

NOTE

Starting from OADP 1.0.4, all OADP 1.0.*z* versions can only be used as a dependency of the Migration Toolkit for Containers Operator and are not available as a standalone Operator.



IMPORTANT

The **CloudStorage** API, which automates the creation of a bucket for object storage, is a Technology Preview feature only. 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.

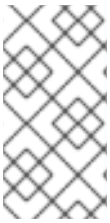
For more information about the support scope of Red Hat Technology Preview features, see Technology Preview Features Support Scope .

You can create a **Secret** CR for the backup location and install the Data Protection Application. For more details, see Installing the OADP Operator.

To install the OADP Operator in a restricted network environment, you must first disable the default OperatorHub sources and mirror the Operator catalog. For details, see Using Operator Lifecycle Manager in disconnected environments.

5.11.1.1. Retrieving Multicloud Object Gateway credentials

You must retrieve the Multicloud Object Gateway (MCG) bucket credentials to create a **Secret** custom resource (CR) for OpenShift API for Data Protection (OADP).



NOTE

Although the MCG Operator is deprecated, the MCG plugin is still available for OpenShift Data Foundation. To download the plugin, browse to Download Red Hat OpenShift Data Foundation and download the appropriate MCG plugin for your operating system.

Prerequisites

- You must deploy OpenShift Data Foundation by using the appropriate Red Hat OpenShift Data Foundation deployment guide.

Procedure

1. Create an MCG bucket. For more information, see Managing hybrid and multicloud resources.
2. Obtain the S3 endpoint, **AWS_ACCESS_KEY_ID**, **AWS_SECRET_ACCESS_KEY**, and the bucket name by running the **oc describe** command on the bucket resource.
3. Create a **credentials-velero** file:

```
$ cat << EOF > ./credentials-velero
[default]
aws_access_key_id=<AWS_ACCESS_KEY_ID>
aws_secret_access_key=<AWS_SECRET_ACCESS_KEY>
EOF
```

You can use the **credentials-velero** file to create a **Secret** object when you install the Data Protection Application.

5.11.1.2. About backup and snapshot locations and their secrets

You specify backup and snapshot locations and their secrets in the **DataProtectionApplication** custom resource (CR).

Backup locations
You can specify one of the following AWS S3-compatible object storage solutions as a backup location:

- Multicloud Object Gateway (MCG)
- Red Hat Container Storage
- Ceph RADOS Gateway; also known as Ceph Object Gateway
- Red Hat OpenShift Data Foundation
- MinIO

Velero backs up OpenShift Container Platform resources, Kubernetes objects, and internal images as an archive file on object storage.

Snapshot locations
If you use your cloud provider's native snapshot API to back up persistent volumes, you must specify the cloud provider as the snapshot location.

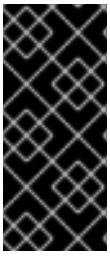
If you use Container Storage Interface (CSI) snapshots, you do not need to specify a snapshot location because you will create a **VolumeSnapshotClass** CR to register the CSI driver.

If you use File System Backup (FSB), you do not need to specify a snapshot location because FSB backs up the file system on object storage.

Secrets
If the backup and snapshot locations use the same credentials or if you do not require a snapshot location, you create a default **Secret**.

If the backup and snapshot locations use different credentials, you create two secret objects:

- Custom **Secret** for the backup location, which you specify in the **DataProtectionApplication** CR.
- Default **Secret** for the snapshot location, which is not referenced in the **DataProtectionApplication** CR.



IMPORTANT

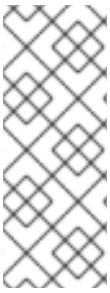
The Data Protection Application requires a default **Secret**. Otherwise, the installation will fail.

If you do not want to specify backup or snapshot locations during the installation, you can create a default **Secret** with an empty **credentials-velero** file.

5.11.1.2.1. Creating a default Secret

You create a default **Secret** if your backup and snapshot locations use the same credentials or if you do not require a snapshot location.

The default name of the **Secret** is **cloud-credentials**.



NOTE

The **DataProtectionApplication** custom resource (CR) requires a default **Secret**. Otherwise, the installation will fail. If the name of the backup location **Secret** is not specified, the default name is used.

If you do not want to use the backup location credentials during the installation, you can create a **Secret** with the default name by using an empty **credentials-velero** file.

Prerequisites

- Your object storage and cloud storage, if any, must use the same credentials.
- You must configure object storage for Velero.

Procedure

1. Create a **credentials-velero** file for the backup storage location in the appropriate format for your cloud provider.
   See the following example:

```
[default]
aws_access_key_id=<AWS_ACCESS_KEY_ID>
aws_secret_access_key=<AWS_SECRET_ACCESS_KEY>
```

2. Create a **Secret** custom resource (CR) with the default name:

```
$ oc create secret generic cloud-credentials -n openshift-adp --from-file cloud=credentials-velero
```

The **Secret** is referenced in the **spec.backupLocations.credential** block of the **DataProtectionApplication** CR when you install the Data Protection Application.

5.11.1.2.2. Creating secrets for different credentials

If your backup and snapshot locations use different credentials, you must create two **Secret** objects:

- Backup location **Secret** with a custom name. The custom name is specified in the **spec.backupLocations** block of the **DataProtectionApplication** custom resource (CR).

- Snapshot location **Secret** with the default name, **cloud-credentials**. This **Secret** is not specified in the **DataProtectionApplication** CR.

Procedure

1. Create a **credentials-velero** file for the snapshot location in the appropriate format for your cloud provider.
2. Create a **Secret** for the snapshot location with the default name:

```
$ oc create secret generic cloud-credentials -n openshift-adp --from-file cloud=credentials-velero
```

3. Create a **credentials-velero** file for the backup location in the appropriate format for your object storage.
4. Create a **Secret** for the backup location with a custom name:

```
$ oc create secret generic <custom_secret> -n openshift-adp --from-file cloud=credentials-velero
```

5. Add the **Secret** with the custom name to the **DataProtectionApplication** CR, as in the following example:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: <dpa_sample>
  namespace: openshift-adp
spec:
...
  backupLocations:
    - velero:
        config:
          profile: "default"
          region: <region_name> 1
          s3Url: <url>
          insecureSkipTLSVerify: "true"
          s3ForcePathStyle: "true"
        provider: aws
        default: true
        credential:
          key: cloud
          name:  <custom_secret> 2
        objectStorage:
          bucket: <bucket_name>
          prefix: <prefix>
```

1. Specify the region, following the naming convention of the documentation of your object storage server.
2. Backup location **Secret** with custom name.

5.11.1.3. Configuring the Data Protection Application

You can configure the Data Protection Application by setting Velero resource allocations or enabling self-signed CA certificates.

5.11.1.3.1. Setting Velero CPU and memory resource allocations

You set the CPU and memory resource allocations for the **Velero** pod by editing the **DataProtectionApplication** custom resource (CR) manifest.

Prerequisites

- You must have the OpenShift API for Data Protection (OADP) Operator installed.

Procedure

- Edit the values in the **spec.configuration.velero.podConfig.ResourceAllocations** block of the **DataProtectionApplication** CR manifest, as in the following example:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: <dpa_sample>
spec:
# ...
  configuration:
    velero:
      podConfig:
        nodeSelector: <node_selector> 1
        resourceAllocations: 2
          limits:
            cpu: "1"
            memory: 1024Mi
          requests:
            cpu: 200m
            memory: 256Mi
```

1. Specify the node selector to be supplied to Velero podSpec.
2. The **resourceAllocations** listed are for average usage.

NOTE

Kopia is an option in OADP 1.3 and later releases. You can use Kopia for file system backups, and Kopia is your only option for Data Mover cases with the built-in Data Mover.

Kopia is more resource intensive than Restic, and you might need to adjust the CPU and memory requirements accordingly.

Use the **nodeSelector** field to select which nodes can run the node agent. The **nodeSelector** field is the simplest recommended form of node selection constraint. Any label specified must match the labels on each node.

For more details, see Configuring node agents and node labels.

5.11.1.3.2. Enabling self-signed CA certificates

You must enable a self-signed CA certificate for object storage by editing the **DataProtectionApplication** custom resource (CR) manifest to prevent a **certificate signed by unknown authority** error.

Prerequisites

- You must have the OpenShift API for Data Protection (OADP) Operator installed.

Procedure

- Edit the **spec.backupLocations.velero.objectStorage.caCert** parameter and **spec.backupLocations.velero.config** parameters of the **DataProtectionApplication** CR manifest:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: <dpa_sample>
spec:
# ...
  backupLocations:
    - name: default
      velero:
        provider: aws
        default: true
        objectStorage:
          bucket: <bucket>
          prefix: <prefix>
          caCert: <base64_encoded_cert_string> 1
        config:
          insecureSkipTLSVerify: "false" 2
# ...
```

1. Specify the Base64-encoded CA certificate string.
2. The **insecureSkipTLSVerify** configuration can be set to either **"true"** or **"false"**. If set to **"true"**, SSL/TLS security is disabled. If set to **"false"**, SSL/TLS security is enabled.

5.11.1.3.2.1. Using CA certificates with the velero command aliased for Velero deployment

You might want to use the Velero CLI without installing it locally on your system by creating an alias for it.

Prerequisites

- You must be logged in to the OpenShift Container Platform cluster as a user with the **cluster-admin** role.
- You must have the OpenShift CLI (**oc**) installed.

1. To use an aliased Velero command, run the following command:

```
$ alias velero='oc -n openshift-adp exec deployment/velero -c velero -it -- ./velero'
```

2. Check that the alias is working by running the following command:

   Example

   ```
   $ velero version
   Client:
    Version: v1.12.1-OADP
    Git commit: -
   Server:
    Version: v1.12.1-OADP
   ```

3. To use a CA certificate with this command, you can add a certificate to the Velero deployment by running the following commands:

   ```
   $ CA_CERT=$(oc -n openshift-adp get dataprotectionapplications.oadp.openshift.io
   <dpa-name> -o jsonpath='{.spec.backupLocations[0].velero.objectStorage.caCert}')

   $ [[ -n $CA_CERT ]] && echo "$CA_CERT" | base64 -d | oc exec -n openshift-adp -i
   deploy/velero -c velero -- bash -c "cat > /tmp/your-cacert.txt" || echo "DPA BSL has no
   caCert"
   ```

   ```
   $ velero describe backup <backup_name> --details --cacert /tmp/<your_cacert>.txt
   ```

4. To fetch the backup logs, run the following command:

   ```
   $ velero backup logs  <backup_name>  --cacert /tmp/<your_cacert.txt>
   ```

   You can use these logs to view failures and warnings for the resources that you cannot back up.

5. If the Velero pod restarts, the **/tmp/your-cacert.txt** file disappears, and you must re-create the **/tmp/your-cacert.txt** file by re-running the commands from the previous step.

6. You can check if the **/tmp/your-cacert.txt** file still exists, in the file location where you stored it, by running the following command:

   ```
   $ oc exec -n openshift-adp -i deploy/velero -c velero -- bash -c "ls /tmp/your-cacert.txt"
   /tmp/your-cacert.txt
   ```

In a future release of OpenShift API for Data Protection (OADP), we plan to mount the certificate to the Velero pod so that this step is not required.

5.11.1.4. Installing the Data Protection Application

You install the Data Protection Application (DPA) by creating an instance of the **DataProtectionApplication** API.

Prerequisites

- You must install the OADP Operator.

- You must configure object storage as a backup location.
- If you use snapshots to back up PVs, your cloud provider must support either a native snapshot API or Container Storage Interface (CSI) snapshots.
- If the backup and snapshot locations use the same credentials, you must create a **Secret** with the default name, **cloud-credentials**.
- If the backup and snapshot locations use different credentials, you must create two **Secrets**:
  - **Secret** with a custom name for the backup location. You add this **Secret** to the **DataProtectionApplication** CR.
  - **Secret** with another custom name for the snapshot location. You add this **Secret** to the **DataProtectionApplication** CR.

NOTE

If you do not want to specify backup or snapshot locations during the installation, you can create a default **Secret** with an empty **credentials-velero** file. If there is no default **Secret**, the installation will fail.

Procedure

1. Click **Operators → Installed Operators** and select the OADP Operator.
2. Under **Provided APIs**, click **Create instance** in the **DataProtectionApplication** box.
3. Click **YAML View** and update the parameters of the **DataProtectionApplication** manifest:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: <dpa_sample>
  namespace: openshift-adp (1)
spec:
  configuration:
    velero:
      defaultPlugins:
        - aws (2)
        - openshift (3)
      resourceTimeout: 10m (4)
    nodeAgent: (5)
      enable: true (6)
      uploaderType: kopia (7)
      podConfig:
        nodeSelector: <node_selector> (8)
  backupLocations:
    - velero:
        config:
          profile: "default"
          region: <region_name> (9)
          s3Url: <url> (10)
          insecureSkipTLSVerify: "true"
          s3ForcePathStyle: "true"
```

```
    provider: aws
    default: true
    credential:
      key: cloud
      name: cloud-credentials (11)
    objectStorage:
      bucket: <bucket_name> (12)
      prefix: <prefix> (13)
```

1. The default namespace for OADP is **openshift-adp**. The namespace is a variable and is configurable.
2. An object store plugin corresponding to your storage locations is required. For all S3 providers, the required plugin is **aws**. For Azure and GCP object stores, the **azure** or **gcp** plugin is required.
3. The **openshift** plugin is mandatory.
4. Specify how many minutes to wait for several Velero resources before timeout occurs, such as Velero CRD availability, volumeSnapshot deletion, and backup repository availability. The default is 10m.
5. The administrative agent that routes the administrative requests to servers.
6. Set this value to **true** if you want to enable **nodeAgent** and perform File System Backup.
7. Enter **kopia** or **restic** as your uploader. You cannot change the selection after the installation. For the Built-in DataMover you must use Kopia. The **nodeAgent** deploys a daemon set, which means that the **nodeAgent** pods run on each working node. You can configure File System Backup by adding **spec.defaultVolumesToFsBackup: true** to the **Backup** CR.
8. Specify the nodes on which Kopia or Restic are available. By default, Kopia or Restic run on all nodes.
9. Specify the region, following the naming convention of the documentation of your object storage server.
10. Specify the URL of the S3 endpoint.
11. Specify the name of the **Secret** object that you created. If you do not specify this value, the default name, **cloud-credentials**, is used. If you specify a custom name, the custom name is used for the backup location.
12. Specify a bucket as the backup storage location. If the bucket is not a dedicated bucket for Velero backups, you must specify a prefix.
13. Specify a prefix for Velero backups, for example, **velero**, if the bucket is used for multiple purposes.

4. Click **Create**.

Verification

1. Verify the installation by viewing the OpenShift API for Data Protection (OADP) resources by running the following command:

```
$ oc get all -n openshift-adp
```

Example output

```
NAME                                                READY   STATUS    RESTARTS   AGE
pod/oadp-operator-controller-manager-67d9494d47-6l8z8   2/2     Running   0          2m8s
pod/node-agent-9cq4q                                1/1     Running   0          94s
pod/node-agent-m4lts                                1/1     Running   0          94s
pod/node-agent-pv4kr                                1/1     Running   0          95s
pod/velero-588db7f655-n842v                         1/1     Running   0          95s

NAME                                                TYPE        CLUSTER-IP       EXTERNAL-IP
PORT(S)    AGE
service/oadp-operator-controller-manager-metrics-service   ClusterIP   172.30.70.140
<none>        8443/TCP   2m8s
service/openshift-adp-velero-metrics-svc                   ClusterIP   172.30.10.0      <none>
8085/TCP   8h

NAME                 DESIRED   CURRENT   READY   UP-TO-DATE   AVAILABLE   NODE
SELECTOR   AGE
daemonset.apps/node-agent   3         3         3       3            3           <none>          96s

NAME                                          READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/oadp-operator-controller-manager   1/1     1            1           2m9s
deployment.apps/velero                             1/1     1            1           96s

NAME                                                      DESIRED   CURRENT   READY   AGE
replicaset.apps/oadp-operator-controller-manager-67d9494d47   1         1         1       2m9s
replicaset.apps/velero-588db7f655                         1         1         1       96s
```

2. Verify that the **DataProtectionApplication** (DPA) is reconciled by running the following command:

```
$ oc get dpa dpa-sample -n openshift-adp -o jsonpath='{.status}'
```

Example output

```
{"conditions":[{"lastTransitionTime":"2023-10-27T01:23:57Z","message":"Reconcile
complete","reason":"Complete","status":"True","type":"Reconciled"}]}
```

3. Verify the **type** is set to **Reconciled**.

4. Verify the backup storage location and confirm that the **PHASE** is **Available** by running the following command:

```
$ oc get backupstoragelocations.velero.io -n openshift-adp
```

Example output

```
NAME           PHASE       LAST VALIDATED   AGE     DEFAULT
dpa-sample-1   Available   1s               3d16h   true
```

5.11.1.5. Configuring the DPA with client burst and QPS settings

The burst setting determines how many requests can be sent to the **velero** server before the limit is applied. After the burst limit is reached, the queries per second (QPS) setting determines how many additional requests can be sent per second.

You can set the burst and QPS values of the **velero** server by configuring the Data Protection Application (DPA) with the burst and QPS values. You can use the **dpa.configuration.velero.client-burst** and **dpa.configuration.velero.client-qps** fields of the DPA to set the burst and QPS values.

Prerequisites

- You have installed the OADP Operator.

Procedure

- Configure the **client-burst** and the **client-qps** fields in the DPA as shown in the following example:

Example Data Protection Application

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: test-dpa
  namespace: openshift-adp
spec:
  backupLocations:
    - name: default
      velero:
        config:
          insecureSkipTLSVerify: "true"
          profile: "default"
          region: <bucket_region>
          s3ForcePathStyle: "true"
          s3Url: <bucket_url>
        credential:
          key: cloud
          name: cloud-credentials
        default: true
        objectStorage:
          bucket: <bucket_name>
          prefix: velero
        provider: aws
  configuration:
    nodeAgent:
      enable: true
      uploaderType: restic
    velero:
      client-burst: 500 (1)
      client-qps: 300 (2)
      defaultPlugins:
```

```
    - openshift
    - aws
    - kubevirt
```

1. Specify the **client-burst** value. In this example, the **client-burst** field is set to 500.
2. Specify the **client-qps** value. In this example, the **client-qps** field is set to 300.

5.11.1.6. Overriding the imagePullPolicy setting in the DPA

In OADP 1.4.0 or earlier, the Operator sets the **imagePullPolicy** field of the Velero and node agent pods to **Always** for all images.

In OADP 1.4.1 or later, the Operator first checks if each image has the **sha256** or **sha512** digest and sets the **imagePullPolicy** field accordingly:

- If the image has the digest, the Operator sets **imagePullPolicy** to **IfNotPresent**.
- If the image does not have the digest, the Operator sets **imagePullPolicy** to **Always**.

You can also override the **imagePullPolicy** field by using the **spec.imagePullPolicy** field in the Data Protection Application (DPA).

Prerequisites

- You have installed the OADP Operator.

Procedure

- Configure the **spec.imagePullPolicy** field in the DPA as shown in the following example:

  Example Data Protection Application

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: test-dpa
  namespace: openshift-adp
spec:
  backupLocations:
    - name: default
      velero:
        config:
          insecureSkipTLSVerify: "true"
          profile: "default"
          region: <bucket_region>
          s3ForcePathStyle: "true"
          s3Url: <bucket_url>
        credential:
          key: cloud
          name: cloud-credentials
        default: true
        objectStorage:
          bucket: <bucket_name>
```

```
        prefix: velero
      provider: aws
  configuration:
    nodeAgent:
      enable: true
      uploaderType: kopia
    velero:
      defaultPlugins:
        - openshift
        - aws
        - kubevirt
        - csi
  imagePullPolicy: Never (1)
```

(1) Specify the value for **imagePullPolicy**. In this example, the **imagePullPolicy** field is set to **Never**.

5.11.1.6.1. Configuring node agents and node labels

The DPA of OADP uses the **nodeSelector** field to select which nodes can run the node agent. The **nodeSelector** field is the simplest recommended form of node selection constraint.

Any label specified must match the labels on each node.

The correct way to run the node agent on any node you choose is for you to label the nodes with a custom label:

```
$ oc label node/<node_name> node-role.kubernetes.io/nodeAgent=""
```

Use the same custom label in the **DPA.spec.configuration.nodeAgent.podConfig.nodeSelector**, which you used for labeling nodes. For example:

```
configuration:
  nodeAgent:
    enable: true
    podConfig:
      nodeSelector:
        node-role.kubernetes.io/nodeAgent: ""
```

The following example is an anti-pattern of **nodeSelector** and does not work unless both labels, **'node-role.kubernetes.io/infra: ""** and **'node-role.kubernetes.io/worker: ""**, are on the node:

```
    configuration:
      nodeAgent:
        enable: true
        podConfig:
          nodeSelector:
            node-role.kubernetes.io/infra: ""
            node-role.kubernetes.io/worker: ""
```

5.11.1.6.2. Enabling CSI in the DataProtectionApplication CR

You enable the Container Storage Interface (CSI) in the **DataProtectionApplication** custom resource (CR) in order to back up persistent volumes with CSI snapshots.

Prerequisites

- The cloud provider must support CSI snapshots.

Procedure

- Edit the **DataProtectionApplication** CR, as in the following example:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
...
spec:
  configuration:
    velero:
      defaultPlugins:
      - openshift
      - csi (1)
```

(1) Add the **csi** default plugin.

5.11.1.6.3. Disabling the node agent in DataProtectionApplication

If you are not using **Restic**, **Kopia**, or **DataMover** for your backups, you can disable the **nodeAgent** field in the **DataProtectionApplication** custom resource (CR). Before you disable **nodeAgent**, ensure the OADP Operator is idle and not running any backups.

Procedure

1. To disable the **nodeAgent**, set the **enable** flag to **false**. See the following example:

   Example DataProtectionApplication CR

```
# ...
configuration:
  nodeAgent:
    enable: false (1)
    uploaderType: kopia
# ...
```

   (1) Disables the node agent.

2. To enable the **nodeAgent**, set the **enable** flag to **true**. See the following example:

   Example DataProtectionApplication CR

```
# ...
configuration:
  nodeAgent:
```

```
    enable: true (1)
    uploaderType: kopia
# ...
```

(1) Enables the node agent.

You can set up a job to enable and disable the **nodeAgent** field in the **DataProtectionApplication** CR. For more information, see "Running tasks in pods using jobs".

Additional resources

- Performance tuning guide for Multicloud Object Gateway.
- Installing the Data Protection Application with the **kubevirt** and **openshift** plugins
- Running tasks in pods using jobs.
- Configuring the OpenShift API for Data Protection (OADP) with multiple backup storage locations

5.12. CONFIGURING OADP WITH ODF

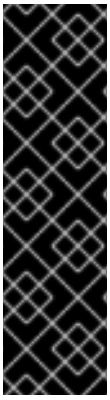
5.12.1. Configuring the OpenShift API for Data Protection with OpenShift Data Foundation

You install the OpenShift API for Data Protection (OADP) with OpenShift Data Foundation by installing the OADP Operator and configuring a backup location and a snapshot location. Then, you install the Data Protection Application.

NOTE

Starting from OADP 1.0.4, all OADP 1.0.*z* versions can only be used as a dependency of the Migration Toolkit for Containers Operator and are not available as a standalone Operator.

You can configure Multicloud Object Gateway or any AWS S3-compatible object storage as a backup location.



IMPORTANT

The **CloudStorage** API, which automates the creation of a bucket for object storage, is a Technology Preview feature only. 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 about the support scope of Red Hat Technology Preview features, see Technology Preview Features Support Scope.

You can create a **Secret** CR for the backup location and install the Data Protection Application. For more details, see Installing the OADP Operator.

To install the OADP Operator in a restricted network environment, you must first disable the default OperatorHub sources and mirror the Operator catalog. For details, see Using Operator Lifecycle Manager in disconnected environments.

5.12.1.1. About backup and snapshot locations and their secrets

You specify backup and snapshot locations and their secrets in the **DataProtectionApplication** custom resource (CR).

Backup locations
You can specify one of the following AWS S3-compatible object storage solutions as a backup location:

- Multicloud Object Gateway (MCG)
- Red Hat Container Storage
- Ceph RADOS Gateway; also known as Ceph Object Gateway
- Red Hat OpenShift Data Foundation
- MinIO

Velero backs up OpenShift Container Platform resources, Kubernetes objects, and internal images as an archive file on object storage.

Snapshot locations
If you use your cloud provider's native snapshot API to back up persistent volumes, you must specify the cloud provider as the snapshot location.

If you use Container Storage Interface (CSI) snapshots, you do not need to specify a snapshot location because you will create a **VolumeSnapshotClass** CR to register the CSI driver.

If you use File System Backup (FSB), you do not need to specify a snapshot location because FSB backs up the file system on object storage.

Secrets
If the backup and snapshot locations use the same credentials or if you do not require a snapshot location, you create a default **Secret**.

If the backup and snapshot locations use different credentials, you create two secret objects:

- Custom **Secret** for the backup location, which you specify in the **DataProtectionApplication** CR.
- Default **Secret** for the snapshot location, which is not referenced in the **DataProtectionApplication** CR.

IMPORTANT

The Data Protection Application requires a default **Secret**. Otherwise, the installation will fail.

If you do not want to specify backup or snapshot locations during the installation, you can create a default **Secret** with an empty **credentials-velero** file.

Additional resources

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

5.12.1.1.1. Creating a default Secret

You create a default **Secret** if your backup and snapshot locations use the same credentials or if you do not require a snapshot location.

The default name of the **Secret** is **cloud-credentials**, unless your backup storage provider has a default plugin, such as **aws**, **azure**, or **gcp**. In that case, the default name is specified in the provider-specific OADP installation procedure.

NOTE

The **DataProtectionApplication** custom resource (CR) requires a default **Secret**. Otherwise, the installation will fail. If the name of the backup location **Secret** is not specified, the default name is used.

If you do not want to use the backup location credentials during the installation, you can create a **Secret** with the default name by using an empty **credentials-velero** file.

Prerequisites

- Your object storage and cloud storage, if any, must use the same credentials.
- You must configure object storage for Velero.

Procedure

1. Create a **credentials-velero** file for the backup storage location in the appropriate format for your cloud provider.
   See the following example:

```
[default]
aws_access_key_id=<AWS_ACCESS_KEY_ID>
aws_secret_access_key=<AWS_SECRET_ACCESS_KEY>
```

2. Create a **Secret** custom resource (CR) with the default name:

```
$ oc create secret generic cloud-credentials -n openshift-adp --from-file cloud=credentials-velero
```

The **Secret** is referenced in the **spec.backupLocations.credential** block of the **DataProtectionApplication** CR when you install the Data Protection Application.

5.12.1.1.2. Creating secrets for different credentials

If your backup and snapshot locations use different credentials, you must create two **Secret** objects:

- Backup location **Secret** with a custom name. The custom name is specified in the **spec.backupLocations** block of the **DataProtectionApplication** custom resource (CR).
- Snapshot location **Secret** with the default name, **cloud-credentials**. This **Secret** is not specified in the **DataProtectionApplication** CR.

Procedure

1. Create a **credentials-velero** file for the snapshot location in the appropriate format for your cloud provider.
2. Create a **Secret** for the snapshot location with the default name:

```
$ oc create secret generic cloud-credentials -n openshift-adp --from-file cloud=credentials-velero
```

3. Create a **credentials-velero** file for the backup location in the appropriate format for your object storage.
4. Create a **Secret** for the backup location with a custom name:

```
$ oc create secret generic <custom_secret> -n openshift-adp --from-file cloud=credentials-velero
```

5. Add the **Secret** with the custom name to the **DataProtectionApplication** CR, as in the following example:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: <dpa_sample>
  namespace: openshift-adp
spec:
...
  backupLocations:
    - velero:
        provider: <provider>
        default: true
        credential:
          key: cloud
          name: <custom_secret> (1)
        objectStorage:
          bucket: <bucket_name>
          prefix: <prefix>
```

(1) Backup location **Secret** with custom name.

5.12.1.2. Configuring the Data Protection Application

You can configure the Data Protection Application by setting Velero resource allocations or enabling self-signed CA certificates.

5.12.1.2.1. Setting Velero CPU and memory resource allocations

You set the CPU and memory resource allocations for the **Velero** pod by editing the **DataProtectionApplication** custom resource (CR) manifest.

Prerequisites

- You must have the OpenShift API for Data Protection (OADP) Operator installed.

Procedure

- Edit the values in the **spec.configuration.velero.podConfig.ResourceAllocations** block of the **DataProtectionApplication** CR manifest, as in the following example:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: <dpa_sample>
spec:
# ...
  configuration:
    velero:
      podConfig:
        nodeSelector: <node_selector> 1
        resourceAllocations: 2
          limits:
            cpu: "1"
            memory: 1024Mi
          requests:
            cpu: 200m
            memory: 256Mi
```

1. Specify the node selector to be supplied to Velero podSpec.
2. The **resourceAllocations** listed are for average usage.

NOTE

Kopia is an option in OADP 1.3 and later releases. You can use Kopia for file system backups, and Kopia is your only option for Data Mover cases with the built-in Data Mover.

Kopia is more resource intensive than Restic, and you might need to adjust the CPU and memory requirements accordingly.

Use the **nodeSelector** field to select which nodes can run the node agent. The **nodeSelector** field is the simplest recommended form of node selection constraint. Any label specified must match the labels on each node.

For more details, see Configuring node agents and node labels.

5.12.1.2.1.1. Adjusting Ceph CPU and memory requirements based on collected data

The following recommendations are based on observations of performance made in the scale and performance lab. The changes are specifically related to Red Hat OpenShift Data Foundation (ODF). If working with ODF, consult the appropriate tuning guides for official recommendations.

5.12.1.2.1.1.1. CPU and memory requirement for configurations

Backup and restore operations require large amounts of CephFS **PersistentVolumes** (PVs). To avoid Ceph MDS pods restarting with an **out-of-memory** (OOM) error, the following configuration is suggested:

Configuration types	Request	Max limit
CPU	Request changed to 3	Max limit to 3
Memory	Request changed to 8 Gi	Max limit to 128 Gi

5.12.1.2.2. Enabling self-signed CA certificates

You must enable a self-signed CA certificate for object storage by editing the **DataProtectionApplication** custom resource (CR) manifest to prevent a **certificate signed by unknown authority** error.

Prerequisites

- You must have the OpenShift API for Data Protection (OADP) Operator installed.

Procedure

- Edit the **spec.backupLocations.velero.objectStorage.caCert** parameter and **spec.backupLocations.velero.config** parameters of the **DataProtectionApplication** CR manifest:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: <dpa_sample>
spec:
# ...
  backupLocations:
    - name: default
      velero:
        provider: aws
        default: true
        objectStorage:
          bucket: <bucket>
          prefix: <prefix>
          caCert: <base64_encoded_cert_string> 1
        config:
          insecureSkipTLSVerify: "false" 2
# ...
```

1. Specify the Base64-encoded CA certificate string.
2. The **insecureSkipTLSVerify** configuration can be set to either **"true"** or **"false"**. If set to **"true"**, SSL/TLS security is disabled. If set to **"false"**, SSL/TLS security is enabled.

5.12.1.2.2.1. Using CA certificates with the velero command aliased for Velero deployment

You might want to use the Velero CLI without installing it locally on your system by creating an alias for it.

Prerequisites

- You must be logged in to the OpenShift Container Platform cluster as a user with the **cluster-admin** role.
- You must have the OpenShift CLI (**oc**) installed.

1. To use an aliased Velero command, run the following command:

```
$ alias velero='oc -n openshift-adp exec deployment/velero -c velero -it -- ./velero'
```

2. Check that the alias is working by running the following command:

Example

```
$ velero version
Client:
 Version: v1.12.1-OADP
 Git commit: -
Server:
 Version: v1.12.1-OADP
```

3. To use a CA certificate with this command, you can add a certificate to the Velero deployment by running the following commands:

```
$ CA_CERT=$(oc -n openshift-adp get dataprotectionapplications.oadp.openshift.io
<dpa-name> -o jsonpath='{.spec.backupLocations[0].velero.objectStorage.caCert}')

$ [[ -n $CA_CERT ]] && echo "$CA_CERT" | base64 -d | oc exec -n openshift-adp -i
deploy/velero -c velero -- bash -c "cat > /tmp/your-cacert.txt" || echo "DPA BSL has no
caCert"
```

```
$ velero describe backup <backup_name> --details --cacert /tmp/<your_cacert>.txt
```

4. To fetch the backup logs, run the following command:

```
$ velero backup logs  <backup_name>  --cacert /tmp/<your_cacert.txt>
```

You can use these logs to view failures and warnings for the resources that you cannot back up.

5. If the Velero pod restarts, the **/tmp/your-cacert.txt** file disappears, and you must re-create the **/tmp/your-cacert.txt** file by re-running the commands from the previous step.

6. You can check if the **/tmp/your-cacert.txt** file still exists, in the file location where you stored it, by running the following command:

```
$ oc exec -n openshift-adp -i deploy/velero -c velero -- bash -c "ls /tmp/your-cacert.txt"
/tmp/your-cacert.txt
```

In a future release of OpenShift API for Data Protection (OADP), we plan to mount the certificate to the Velero pod so that this step is not required.

5.12.1.3. Installing the Data Protection Application

You install the Data Protection Application (DPA) by creating an instance of the **DataProtectionApplication** API.

Prerequisites

- You must install the OADP Operator.
- You must configure object storage as a backup location.
- If you use snapshots to back up PVs, your cloud provider must support either a native snapshot API or Container Storage Interface (CSI) snapshots.
- If the backup and snapshot locations use the same credentials, you must create a **Secret** with the default name, **cloud-credentials**.
- If the backup and snapshot locations use different credentials, you must create two **Secrets**:
  - **Secret** with a custom name for the backup location. You add this **Secret** to the **DataProtectionApplication** CR.
  - **Secret** with another custom name for the snapshot location. You add this **Secret** to the **DataProtectionApplication** CR.

NOTE

If you do not want to specify backup or snapshot locations during the installation, you can create a default **Secret** with an empty **credentials-velero** file. If there is no default **Secret**, the installation will fail.

Procedure

1. Click **Operators → Installed Operators** and select the OADP Operator.
2. Under **Provided APIs**, click **Create instance** in the **DataProtectionApplication** box.
3. Click **YAML View** and update the parameters of the **DataProtectionApplication** manifest:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: <dpa_sample>
  namespace: openshift-adp (1)
spec:
  configuration:
    velero:
      defaultPlugins:
        - aws (2)
        - kubevirt (3)
        - csi (4)
        - openshift (5)
      resourceTimeout: 10m (6)
    nodeAgent: (7)
      enable: true (8)
      uploaderType: kopia (9)
      podConfig:
```

```
    nodeSelector: <node_selector> 10
backupLocations:
 - velero:
    provider: gcp 11
    default: true
    credential:
      key: cloud
      name: <default_secret> 12
    objectStorage:
      bucket: <bucket_name> 13
      prefix: <prefix> 14
```

1. The default namespace for OADP is **openshift-adp**. The namespace is a variable and is configurable.
2. An object store plugin corresponding to your storage locations is required. For all S3 providers, the required plugin is **aws**. For Azure and GCP object stores, the **azure** or **gcp** plugin is required.
3. Optional: The **kubevirt** plugin is used with OpenShift Virtualization.
4. Specify the **csi** default plugin if you use CSI snapshots to back up PVs. The **csi** plugin uses the Velero CSI beta snapshot APIs. You do not need to configure a snapshot location.
5. The **openshift** plugin is mandatory.
6. Specify how many minutes to wait for several Velero resources before timeout occurs, such as Velero CRD availability, volumeSnapshot deletion, and backup repository availability. The default is 10m.
7. The administrative agent that routes the administrative requests to servers.
8. Set this value to **true** if you want to enable **nodeAgent** and perform File System Backup.
9. Enter **kopia** or **restic** as your uploader. You cannot change the selection after the installation. For the Built-in DataMover you must use Kopia. The **nodeAgent** deploys a daemon set, which means that the **nodeAgent** pods run on each working node. You can configure File System Backup by adding **spec.defaultVolumesToFsBackup: true** to the **Backup** CR.
10. Specify the nodes on which Kopia or Restic are available. By default, Kopia or Restic run on all nodes.
11. Specify the backup provider.
12. Specify the correct default name for the **Secret**, for example, **cloud-credentials-gcp**, if you use a default plugin for the backup provider. If specifying a custom name, then the custom name is used for the backup location. If you do not specify a **Secret** name, the default name is used.
13. Specify a bucket as the backup storage location. If the bucket is not a dedicated bucket for Velero backups, you must specify a prefix.
14. Specify a prefix for Velero backups, for example, **velero**, if the bucket is used for multiple purposes.

4. Click **Create**.

Verification

1. Verify the installation by viewing the OpenShift API for Data Protection (OADP) resources by running the following command:

```
$ oc get all -n openshift-adp
```

Example output

```
NAME                                                 READY   STATUS    RESTARTS   AGE
pod/oadp-operator-controller-manager-67d9494d47-6l8z8   2/2     Running   0          2m8s
pod/node-agent-9cq4q                                 1/1     Running   0          94s
pod/node-agent-m4lts                                 1/1     Running   0          94s
pod/node-agent-pv4kr                                 1/1     Running   0          95s
pod/velero-588db7f655-n842v                          1/1     Running   0          95s

NAME                                                     TYPE        CLUSTER-IP       EXTERNAL-IP
PORT(S)    AGE
service/oadp-operator-controller-manager-metrics-service   ClusterIP   172.30.70.140
<none>        8443/TCP   2m8s
service/openshift-adp-velero-metrics-svc                 ClusterIP   172.30.10.0      <none>
8085/TCP   8h

NAME                 DESIRED   CURRENT   READY   UP-TO-DATE   AVAILABLE   NODE
SELECTOR   AGE
daemonset.apps/node-agent   3         3         3       3            3           <none>          96s

NAME                                         READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/oadp-operator-controller-manager   1/1     1            1           2m9s
deployment.apps/velero                               1/1     1            1           96s

NAME                                                    DESIRED   CURRENT   READY   AGE
replicaset.apps/oadp-operator-controller-manager-67d9494d47   1         1         1       2m9s
replicaset.apps/velero-588db7f655                          1         1         1       96s
```

2. Verify that the **DataProtectionApplication** (DPA) is reconciled by running the following command:

```
$ oc get dpa dpa-sample -n openshift-adp -o jsonpath='{.status}'
```

Example output

```
{"conditions":[{"lastTransitionTime":"2023-10-27T01:23:57Z","message":"Reconcile
complete","reason":"Complete","status":"True","type":"Reconciled"}]}
```

3. Verify the **type** is set to **Reconciled**.

4. Verify the backup storage location and confirm that the **PHASE** is **Available** by running the following command:

```
$ oc get backupstoragelocations.velero.io -n openshift-adp
```

Example output

```
NAME          PHASE      LAST VALIDATED   AGE     DEFAULT
dpa-sample-1  Available  1s               3d16h   true
```

5.12.1.4. Configuring the DPA with client burst and QPS settings

The burst setting determines how many requests can be sent to the **velero** server before the limit is applied. After the burst limit is reached, the queries per second (QPS) setting determines how many additional requests can be sent per second.

You can set the burst and QPS values of the **velero** server by configuring the Data Protection Application (DPA) with the burst and QPS values. You can use the **dpa.configuration.velero.client-burst** and **dpa.configuration.velero.client-qps** fields of the DPA to set the burst and QPS values.

Prerequisites

- You have installed the OADP Operator.

Procedure

- Configure the **client-burst** and the **client-qps** fields in the DPA as shown in the following example:

Example Data Protection Application

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: test-dpa
  namespace: openshift-adp
spec:
  backupLocations:
    - name: default
      velero:
        config:
          insecureSkipTLSVerify: "true"
          profile: "default"
          region: <bucket_region>
          s3ForcePathStyle: "true"
          s3Url: <bucket_url>
        credential:
          key: cloud
          name: cloud-credentials
        default: true
        objectStorage:
          bucket: <bucket_name>
          prefix: velero
        provider: aws
  configuration:
    nodeAgent:
      enable: true
      uploaderType: restic
    velero:
```

```
    client-burst: 500 1
    client-qps: 300 2
    defaultPlugins:
      - openshift
      - aws
      - kubevirt
```

1. Specify the **client-burst** value. In this example, the **client-burst** field is set to 500.
2. Specify the **client-qps** value. In this example, the **client-qps** field is set to 300.

5.12.1.5. Overriding the imagePullPolicy setting in the DPA

In OADP 1.4.0 or earlier, the Operator sets the **imagePullPolicy** field of the Velero and node agent pods to **Always** for all images.

In OADP 1.4.1 or later, the Operator first checks if each image has the **sha256** or **sha512** digest and sets the **imagePullPolicy** field accordingly:

- If the image has the digest, the Operator sets **imagePullPolicy** to **IfNotPresent**.
- If the image does not have the digest, the Operator sets **imagePullPolicy** to **Always**.

You can also override the **imagePullPolicy** field by using the **spec.imagePullPolicy** field in the Data Protection Application (DPA).

Prerequisites

- You have installed the OADP Operator.

Procedure

- Configure the **spec.imagePullPolicy** field in the DPA as shown in the following example:

  Example Data Protection Application

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: test-dpa
  namespace: openshift-adp
spec:
  backupLocations:
    - name: default
      velero:
        config:
          insecureSkipTLSVerify: "true"
          profile: "default"
          region: <bucket_region>
          s3ForcePathStyle: "true"
          s3Url: <bucket_url>
        credential:
          key: cloud
          name: cloud-credentials
```

```
      default: true
      objectStorage:
        bucket: <bucket_name>
        prefix: velero
      provider: aws
  configuration:
    nodeAgent:
      enable: true
      uploaderType: kopia
    velero:
      defaultPlugins:
        - openshift
        - aws
        - kubevirt
        - csi
  imagePullPolicy: Never (1)
```

(1) Specify the value for **imagePullPolicy**. In this example, the **imagePullPolicy** field is set to **Never**.

5.12.1.5.1. Configuring node agents and node labels

The DPA of OADP uses the **nodeSelector** field to select which nodes can run the node agent. The **nodeSelector** field is the simplest recommended form of node selection constraint.

Any label specified must match the labels on each node.

The correct way to run the node agent on any node you choose is for you to label the nodes with a custom label:

```
$ oc label node/<node_name> node-role.kubernetes.io/nodeAgent=""
```

Use the same custom label in the **DPA.spec.configuration.nodeAgent.podConfig.nodeSelector**, which you used for labeling nodes. For example:

```
configuration:
  nodeAgent:
    enable: true
    podConfig:
      nodeSelector:
        node-role.kubernetes.io/nodeAgent: ""
```

The following example is an anti-pattern of **nodeSelector** and does not work unless both labels, **'node-role.kubernetes.io/infra: ""** and **'node-role.kubernetes.io/worker: ""**, are on the node:

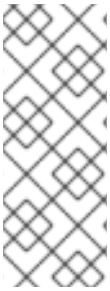
```
    configuration:
      nodeAgent:
        enable: true
        podConfig:
          nodeSelector:
            node-role.kubernetes.io/infra: ""
            node-role.kubernetes.io/worker: ""
```

5.12.1.5.2. Creating an Object Bucket Claim for disaster recovery on OpenShift Data Foundation

If you use cluster storage for your Multicloud Object Gateway (MCG) bucket **backupStorageLocation** on OpenShift Data Foundation, create an Object Bucket Claim (OBC) using the OpenShift Web Console.

WARNING

Failure to configure an Object Bucket Claim (OBC) might lead to backups not being available.



NOTE

Unless specified otherwise, "NooBaa" refers to the open source project that provides lightweight object storage, while "Multicloud Object Gateway (MCG)" refers to the Red Hat distribution of NooBaa.

For more information on the MCG, see Accessing the Multicloud Object Gateway with your applications.

Procedure

- Create an Object Bucket Claim (OBC) using the OpenShift web console as described in Creating an Object Bucket Claim using the OpenShift Web Console .

5.12.1.5.3. Enabling CSI in the DataProtectionApplication CR

You enable the Container Storage Interface (CSI) in the **DataProtectionApplication** custom resource (CR) in order to back up persistent volumes with CSI snapshots.

Prerequisites

- The cloud provider must support CSI snapshots.

Procedure

- Edit the **DataProtectionApplication** CR, as in the following example:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
...
spec:
  configuration:
    velero:
      defaultPlugins:
      - openshift
      - csi (1)
```

(1) Add the **csi** default plugin.

5.12.1.5.4. Disabling the node agent in DataProtectionApplication

If you are not using **Restic**, **Kopia**, or **DataMover** for your backups, you can disable the **nodeAgent** field in the **DataProtectionApplication** custom resource (CR). Before you disable **nodeAgent**, ensure the OADP Operator is idle and not running any backups.

Procedure

1. To disable the **nodeAgent**, set the **enable** flag to **false**. See the following example:

   Example DataProtectionApplication CR

   ```
   # ...
   configuration:
     nodeAgent:
       enable: false 1
       uploaderType: kopia
   # ...
   ```

   1 Disables the node agent.

2. To enable the **nodeAgent**, set the **enable** flag to **true**. See the following example:

   Example DataProtectionApplication CR

   ```
   # ...
   configuration:
     nodeAgent:
       enable: true 1
       uploaderType: kopia
   # ...
   ```

   1 Enables the node agent.

You can set up a job to enable and disable the **nodeAgent** field in the **DataProtectionApplication** CR. For more information, see "Running tasks in pods using jobs".

Additional resources

- Installing the Data Protection Application with the **kubevirt** and **openshift** plugins
- Running tasks in pods using jobs.
- Configuring the OpenShift API for Data Protection (OADP) with multiple backup storage locations

5.13. CONFIGURING OADP WITH OPENSHIFT VIRTUALIZATION

5.13.1. Configuring the OpenShift API for Data Protection with OpenShift Virtualization

You can install the OpenShift API for Data Protection (OADP) with OpenShift Virtualization by installing the OADP Operator and configuring a backup location. Then, you can install the Data Protection Application.

Back up and restore virtual machines by using the OpenShift API for Data Protection.

NOTE

OpenShift API for Data Protection with OpenShift Virtualization supports the following backup and restore storage options:

- Container Storage Interface (CSI) backups
- Container Storage Interface (CSI) backups with DataMover

The following storage options are excluded:

- File system backup and restore
- Volume snapshot backups and restores

For more information, see Backing up applications with File System Backup: Kopia or Restic.

To install the OADP Operator in a restricted network environment, you must first disable the default OperatorHub sources and mirror the Operator catalog. See Using Operator Lifecycle Manager in disconnected environments for details.

5.13.1.1. Installing and configuring OADP with OpenShift Virtualization

As a cluster administrator, you install OADP by installing the OADP Operator.

The latest version of the OADP Operator installs Velero 1.14.

Prerequisites

- Access to the cluster as a user with the **cluster-admin** role.

Procedure

1. Install the OADP Operator according to the instructions for your storage provider.
2. Install the Data Protection Application (DPA) with the **kubevirt** and **openshift** OADP plugins.
3. Back up virtual machines by creating a **Backup** custom resource (CR).

WARNING

Red Hat support is limited to only the following options:

- CSI backups
- CSI backups with DataMover.

You restore the **Backup** CR by creating a **Restore** CR.

Additional resources

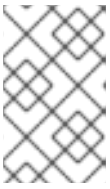
- OADP plugins
- **Backup** custom resource (CR)
- **Restore** CR
- Using Operator Lifecycle Manager in disconnected environments

5.13.1.2. Installing the Data Protection Application

You install the Data Protection Application (DPA) by creating an instance of the **DataProtectionApplication** API.

Prerequisites

- You must install the OADP Operator.
- You must configure object storage as a backup location.
- If you use snapshots to back up PVs, your cloud provider must support either a native snapshot API or Container Storage Interface (CSI) snapshots.
- If the backup and snapshot locations use the same credentials, you must create a **Secret** with the default name, **cloud-credentials**.



NOTE

If you do not want to specify backup or snapshot locations during the installation, you can create a default **Secret** with an empty **credentials-velero** file. If there is no default **Secret**, the installation will fail.

Procedure

1. Click **Operators → Installed Operators** and select the OADP Operator.
2. Under **Provided APIs**, click **Create instance** in the **DataProtectionApplication** box.
3. Click **YAML View** and update the parameters of the **DataProtectionApplication** manifest:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: <dpa_sample>
  namespace: openshift-adp (1)
spec:
  configuration:
    velero:
      defaultPlugins:
        - kubevirt (2)
        - gcp (3)
        - csi (4)
        - openshift (5)
      resourceTimeout: 10m (6)
    nodeAgent: (7)
      enable: true (8)
      uploaderType: kopia (9)
      podConfig:
        nodeSelector: <node_selector> (10)
  backupLocations:
    - velero:
        provider: gcp (11)
        default: true
        credential:
          key: cloud
          name: <default_secret> (12)
        objectStorage:
          bucket: <bucket_name> (13)
          prefix: <prefix> (14)
```

(1) The default namespace for OADP is **openshift-adp**. The namespace is a variable and is configurable.

(2) The **kubevirt** plugin is mandatory for OpenShift Virtualization.

(3) Specify the plugin for the backup provider, for example, **gcp**, if it exists.

(4) The **csi** plugin is mandatory for backing up PVs with CSI snapshots. The **csi** plugin uses the Velero CSI beta snapshot APIs. You do not need to configure a snapshot location.

(5) The **openshift** plugin is mandatory.

(6) Specify how many minutes to wait for several Velero resources before timeout occurs, such as Velero CRD availability, volumeSnapshot deletion, and backup repository availability. The default is 10m.

(7) The administrative agent that routes the administrative requests to servers.

(8) Set this value to **true** if you want to enable **nodeAgent** and perform File System Backup.

(9) Enter **kopia** as your uploader to use the Built-in DataMover. The **nodeAgent** deploys a daemon set, which means that the **nodeAgent** pods run on each working node. You can configure File System Backup by adding **spec.defaultVolumesToFsBackup: true** to the **Backup** CR.

10 Specify the nodes on which Kopia are available. By default, Kopia runs on all nodes.

11 Specify the backup provider.

12 Specify the correct default name for the **Secret**, for example, **cloud-credentials-gcp**, if you use a default plugin for the backup provider. If specifying a custom name, then the custom name is used for the backup location. If you do not specify a **Secret** name, the default name is used.

13 Specify a bucket as the backup storage location. If the bucket is not a dedicated bucket for Velero backups, you must specify a prefix.

14 Specify a prefix for Velero backups, for example, **velero**, if the bucket is used for multiple purposes.

4. Click **Create**.

Verification

1. Verify the installation by viewing the OpenShift API for Data Protection (OADP) resources by running the following command:

```
$ oc get all -n openshift-adp
```

Example output

```
NAME                                                 READY   STATUS    RESTARTS   AGE
pod/oadp-operator-controller-manager-67d9494d47-6l8z8   2/2     Running   0          2m8s
pod/node-agent-9cq4q                                 1/1     Running   0          94s
pod/node-agent-m4lts                                 1/1     Running   0          94s
pod/node-agent-pv4kr                                 1/1     Running   0          95s
pod/velero-588db7f655-n842v                          1/1     Running   0          95s

NAME                                                     TYPE        CLUSTER-IP       EXTERNAL-IP
PORT(S)    AGE
service/oadp-operator-controller-manager-metrics-service   ClusterIP   172.30.70.140
<none>        8443/TCP   2m8s
service/openshift-adp-velero-metrics-svc                 ClusterIP   172.30.10.0      <none>
8085/TCP   8h

NAME                         DESIRED   CURRENT   READY   UP-TO-DATE   AVAILABLE   NODE
SELECTOR   AGE
daemonset.apps/node-agent    3         3         3       3            3           <none>          96s

NAME                                            READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/oadp-operator-controller-manager   1/1     1            1           2m9s
deployment.apps/velero                             1/1     1            1           96s

NAME                                                       DESIRED   CURRENT   READY   AGE
replicaset.apps/oadp-operator-controller-manager-67d9494d47   1         1         1       2m9s
replicaset.apps/velero-588db7f655                          1         1         1       96s
```

2. Verify that the **DataProtectionApplication** (DPA) is reconciled by running the following command:

```
$ oc get dpa dpa-sample -n openshift-adp -o jsonpath='{.status}'
```

Example output

```
{"conditions":[{"lastTransitionTime":"2023-10-27T01:23:57Z","message":"Reconcile
complete","reason":"Complete","status":"True","type":"Reconciled"}]}
```

3. Verify the **type** is set to **Reconciled**.
4. Verify the backup storage location and confirm that the **PHASE** is **Available** by running the following command:

```
$ oc get backupstoragelocations.velero.io -n openshift-adp
```

Example output

```
NAME           PHASE       LAST VALIDATED   AGE     DEFAULT
dpa-sample-1   Available   1s               3d16h   true
```

WARNING

If you run a backup of a Microsoft Windows virtual machine (VM) immediately after the VM reboots, the backup might fail with a **PartiallyFailed** error. This is because, immediately after a VM boots, the Microsoft Windows Volume Shadow Copy Service (VSS) and Guest Agent (GA) service are not ready. The VSS and GA service being unready causes the backup to fail. In such a case, retry the backup a few minutes after the VM boots.

5.13.1.3. Backing up a single VM

If you have a namespace with multiple virtual machines (VMs), and want to back up only one of them, you can use the label selector to filter the VM that needs to be included in the backup. You can filter the VM by using the **app: vmname** label.

Prerequisites

- You have installed the OADP Operator.
- You have multiple VMs running in a namespace.
- You have added the **kubevirt** plugin in the **DataProtectionApplication** (DPA) custom resource (CR).
- You have configured the **BackupStorageLocation** CR in the **DataProtectionApplication** CR and **BackupStorageLocation** is available.

Procedure

1. Configure the **Backup** CR as shown in the following example:

Example Backup CR

```
apiVersion: velero.io/v1
kind: Backup
metadata:
  name: vmbackupsingle
  namespace: openshift-adp
spec:
  snapshotMoveData: true
  includedNamespaces:
  - <vm_namespace> 1
  labelSelector:
    matchLabels:
      app: <vm_app_name> 2
  storageLocation: <backup_storage_location_name> 3
```

1. Specify the name of the namespace where you have created the VMs.
2. Specify the VM name that needs to be backed up.
3. Specify the name of the **BackupStorageLocation** CR.

2. To create a **Backup** CR, run the following command:

```
$ oc apply -f <backup_cr_file_name> 1
```

1. Specify the name of the **Backup** CR file.

5.13.1.4. Restoring a single VM

After you have backed up a single virtual machine (VM) by using the label selector in the **Backup** custom resource (CR), you can create a **Restore** CR and point it to the backup. This restore operation restores a single VM.

Prerequisites

- You have installed the OADP Operator.
- You have backed up a single VM by using the label selector.

Procedure

1. Configure the **Restore** CR as shown in the following example:

Example Restore CR

```
apiVersion: velero.io/v1
kind: Restore
metadata:
  name: vmrestoresingle
```

```
  namespace: openshift-adp
spec:
  backupName: vmbackupsingle 1
  restorePVs: true
```

1 Specifies the name of the backup of a single VM.

2. To restore the single VM, run the following command:

```
$ oc apply -f <restore_cr_file_name> 1
```

1 Specify the name of the **Restore** CR file.

5.13.1.5. Restoring a single VM from a backup of multiple VMs

If you have a backup containing multiple virtual machines (VMs), and you want to restore only one VM, you can use the **LabelSelectors** section in the **Restore** CR to select the VM to restore. To ensure that the persistent volume claim (PVC) attached to the VM is correctly restored, and the restored VM is not stuck in a **Provisioning** status, use both the **app: <vm_name>** and the **kubevirt.io/created-by** labels. To match the **kubevirt.io/created-by** label, use the UID of **DataVolume** of the VM.

Prerequisites

- You have installed the OADP Operator.
- You have labeled the VMs that need to be backed up.
- You have a backup of multiple VMs.

Procedure

1. Before you take a backup of many VMs, ensure that the VMs are labeled by running the following command:

```
$ oc label vm <vm_name> app=<vm_name> -n openshift-adp
```

2. Configure the label selectors in the **Restore** CR as shown in the following example:

Example Restore CR

```
apiVersion: velero.io/v1
kind: Restore
metadata:
  name: singlevmrestore
  namespace: openshift-adp
spec:
  backupName: multiplevmbackup
  restorePVs: true
  LabelSelectors:
    - matchLabels:
```

```
      kubevirt.io/created-by: <datavolume_uid> 1
  - matchLabels:
      app: <vm_name> 2
```

1 Specify the UID of **DataVolume** of the VM that you want to restore. For example, **b6…53a-ddd7-4d9d-9407-a0c…e5**.

2 Specify the name of the VM that you want to restore. For example, **test-vm**.

3. To restore a VM, run the following command:

```
$ oc apply -f <restore_cr_file_name> 1
```

1 Specify the name of the **Restore** CR file.

5.13.1.6. Configuring the DPA with client burst and QPS settings

The burst setting determines how many requests can be sent to the **velero** server before the limit is applied. After the burst limit is reached, the queries per second (QPS) setting determines how many additional requests can be sent per second.

You can set the burst and QPS values of the **velero** server by configuring the Data Protection Application (DPA) with the burst and QPS values. You can use the **dpa.configuration.velero.client-burst** and **dpa.configuration.velero.client-qps** fields of the DPA to set the burst and QPS values.

Prerequisites

- You have installed the OADP Operator.

Procedure

- Configure the **client-burst** and the **client-qps** fields in the DPA as shown in the following example:

  Example Data Protection Application

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: test-dpa
  namespace: openshift-adp
spec:
  backupLocations:
    - name: default
      velero:
        config:
          insecureSkipTLSVerify: "true"
          profile: "default"
          region: <bucket_region>
          s3ForcePathStyle: "true"
          s3Url: <bucket_url>
        credential:
          key: cloud
```

```
      name: cloud-credentials
    default: true
    objectStorage:
      bucket: <bucket_name>
      prefix: velero
    provider: aws
  configuration:
    nodeAgent:
      enable: true
      uploaderType: restic
    velero:
      client-burst: 500 1
      client-qps: 300 2
      defaultPlugins:
        - openshift
        - aws
        - kubevirt
```

1 Specify the **client-burst** value. In this example, the **client-burst** field is set to 500.

2 Specify the **client-qps** value. In this example, the **client-qps** field is set to 300.

5.13.1.7. Overriding the imagePullPolicy setting in the DPA

In OADP 1.4.0 or earlier, the Operator sets the **imagePullPolicy** field of the Velero and node agent pods to **Always** for all images.

In OADP 1.4.1 or later, the Operator first checks if each image has the **sha256** or **sha512** digest and sets the **imagePullPolicy** field accordingly:

- If the image has the digest, the Operator sets **imagePullPolicy** to **IfNotPresent**.
- If the image does not have the digest, the Operator sets **imagePullPolicy** to **Always**.

You can also override the **imagePullPolicy** field by using the **spec.imagePullPolicy** field in the Data Protection Application (DPA).

Prerequisites

- You have installed the OADP Operator.

Procedure

- Configure the **spec.imagePullPolicy** field in the DPA as shown in the following example:

  Example Data Protection Application

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: test-dpa
  namespace: openshift-adp
spec:
  backupLocations:
```

```
    - name: default
      velero:
        config:
          insecureSkipTLSVerify: "true"
          profile: "default"
          region: <bucket_region>
          s3ForcePathStyle: "true"
          s3Url: <bucket_url>
        credential:
          key: cloud
          name: cloud-credentials
        default: true
        objectStorage:
          bucket: <bucket_name>
          prefix: velero
        provider: aws
  configuration:
    nodeAgent:
      enable: true
      uploaderType: kopia
    velero:
      defaultPlugins:
        - openshift
        - aws
        - kubevirt
        - csi
  imagePullPolicy: Never (1)
```

(1) Specify the value for **imagePullPolicy**. In this example, the **imagePullPolicy** field is set to **Never**.

5.13.1.7.1. Configuring node agents and node labels

The DPA of OADP uses the **nodeSelector** field to select which nodes can run the node agent. The **nodeSelector** field is the simplest recommended form of node selection constraint.

Any label specified must match the labels on each node.

The correct way to run the node agent on any node you choose is for you to label the nodes with a custom label:

```
$ oc label node/<node_name> node-role.kubernetes.io/nodeAgent=""
```

Use the same custom label in the **DPA.spec.configuration.nodeAgent.podConfig.nodeSelector**, which you used for labeling nodes. For example:

```
configuration:
  nodeAgent:
    enable: true
    podConfig:
      nodeSelector:
        node-role.kubernetes.io/nodeAgent: ""
```

The following example is an anti-pattern of **nodeSelector** and does not work unless both labels, **'node-role.kubernetes.io/infra: ""** and **'node-role.kubernetes.io/worker: ""**, are on the node:

```
configuration:
  nodeAgent:
    enable: true
    podConfig:
      nodeSelector:
        node-role.kubernetes.io/infra: ""
        node-role.kubernetes.io/worker: ""
```

5.13.1.8. About incremental back up support

OADP supports incremental backups of **block** and **Filesystem** persistent volumes for both containerized, and OpenShift Virtualization workloads. The following table summarizes the support for File System Backup (FSB), Container Storage Interface (CSI), and CSI Data Mover:

Table 5.4. OADP backup support matrix for containerized workloads

Volume mode	FSB - Restic	FSB - Kopia	CSI	CSI Data Mover
Filesystem	S [1], I [2]	S [1], I [2]	S [1]	S [1], I [2]
Block	N [3]	N [3]	S [1]	S [1], I [2]

Table 5.5. OADP backup support matrix for OpenShift Virtualization workloads

Volume mode	FSB - Restic	FSB - Kopia	CSI	CSI Data Mover
Filesystem	N [3]	N [3]	S [1]	S [1], I [2]
Block	N [3]	N [3]	S [1]	S [1], I [2]

1. Backup supported
2. Incremental backup supported
3. Not supported

NOTE

The CSI Data Mover backups use Kopia regardless of **uploaderType**.

IMPORTANT

Red Hat only supports the combination of OADP versions 1.3.0 and later, and OpenShift Virtualization versions 4.14 and later.

OADP versions before 1.3.0 are not supported for back up and restore of OpenShift Virtualization.

5.14. CONFIGURING OADP WITH MULTIPLE BACKUP STORAGE LOCATIONS

5.14.1. Configuring the OpenShift API for Data Protection (OADP) with more than one Backup Storage Location

You can configure one or more backup storage locations (BSLs) in the Data Protection Application (DPA). You can also select the location to store the backup in when you create the backup. With this configuration, you can store your backups in the following ways:

- To different regions
- To a different storage provider

OADP supports multiple credentials for configuring more than one BSL, so that you can specify the credentials to use with any BSL.

5.14.1.1. Configuring the DPA with more than one BSL

You can configure the **DataProtectionApplication** (DPA) custom resource (CR) with more than one **BackupStorageLocation** (BSL) CR and specify the credentials provided by the cloud provider.

For example, where you have configured the following two BSLs:

- Configured one BSL in the DPA and set it as the default BSL.
- Created another BSL independently by using the **BackupStorageLocation** CR.

As you have already set the BSL created through the DPA as the default, you cannot set the independently created BSL again as the default. This means, at any given time, you can set only one BSL as the default BSL.

Prerequisites

- You must install the OADP Operator.
- You must create the secrets by using the credentials provided by the cloud provider.

Procedure

1. Configure the **DataProtectionApplication** CR with more than one **BackupStorageLocation** CR. See the following example:

   Example DPA

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
#...
backupLocations:
  - name: aws (1)
    velero:
      provider: aws
      default: true (2)
      objectStorage:
```

```
      bucket: <bucket_name> 3
      prefix: <prefix> 4
    config:
      region: <region_name> 5
      profile: "default"
    credential:
      key: cloud
      name: cloud-credentials 6
  - name: odf 7
    velero:
      provider: aws
      default: false
      objectStorage:
        bucket: <bucket_name>
        prefix: <prefix>
      config:
        profile: "default"
        region: <region_name>
        s3Url: <url> 8
        insecureSkipTLSVerify: "true"
        s3ForcePathStyle: "true"
      credential:
        key: cloud
        name: <custom_secret_name_odf> 9
#...
```

1. Specify a name for the first BSL.
2. This parameter indicates that this BSL is the default BSL. If a BSL is not set in the **Backup CR**, the default BSL is used. You can set only one BSL as the default.
3. Specify the bucket name.
4. Specify a prefix for Velero backups; for example, **velero**.
5. Specify the AWS region for the bucket.
6. Specify the name of the default **Secret** object that you created.
7. Specify a name for the second BSL.
8. Specify the URL of the S3 endpoint.
9. Specify the correct name for the **Secret**; for example, **custom_secret_name_odf**. If you do not specify a **Secret** name, the default name is used.

2. Specify the BSL to be used in the backup CR. See the following example.

Example backup CR

```
apiVersion: velero.io/v1
kind: Backup
# ...
spec:
```

```
includedNamespaces:
- <namespace> 1
storageLocation: <backup_storage_location> 2
defaultVolumesToFsBackup: true
```

1. Specify the namespace to back up.
2. Specify the storage location.

5.14.1.2. OADP use case for two BSLs

In this use case, you configure the DPA with two storage locations by using two cloud credentials. You back up an application with a database by using the default BSL. OADP stores the backup resources in the default BSL. You then backup the application again by using the second BSL.

Prerequisites

- You must install the OADP Operator.
- You must configure two backup storage locations: AWS S3 and Multicloud Object Gateway (MCG).
- You must have an application with a database deployed on a Red Hat OpenShift cluster.

Procedure

1. Create the first **Secret** for the AWS S3 storage provider with the default name by running the following command:

```
$ oc create secret generic cloud-credentials -n openshift-adp --from-file cloud=
<aws_credentials_file_name> 1
```

1. Specify the name of the cloud credentials file for AWS S3.

2. Create the second **Secret** for MCG with a custom name by running the following command:

```
$ oc create secret generic mcg-secret -n openshift-adp --from-file cloud=
<MCG_credentials_file_name> 1
```

1. Specify the name of the cloud credentials file for MCG. Note the name of the **mcg-secret** custom secret.

3. Configure the DPA with the two BSLs as shown in the following example.

Example DPA

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: two-bsl-dpa
  namespace: openshift-adp
```

```
spec:
  backupLocations:
  - name: aws
    velero:
      config:
        profile: default
        region: <region_name> 1
      credential:
        key: cloud
        name: cloud-credentials
      default: true
      objectStorage:
        bucket: <bucket_name> 2
        prefix: velero
      provider: aws
  - name: mcg
    velero:
      config:
        insecureSkipTLSVerify: "true"
        profile: noobaa
        region: <region_name> 3
        s3ForcePathStyle: "true"
        s3Url: <s3_url> 4
      credential:
        key: cloud
        name: mcg-secret 5
      objectStorage:
        bucket: <bucket_name_mcg> 6
        prefix: velero
      provider: aws
  configuration:
    nodeAgent:
      enable: true
      uploaderType: kopia
    velero:
      defaultPlugins:
      - openshift
      - aws
```

1. Specify the AWS region for the bucket.
2. Specify the AWS S3 bucket name.
3. Specify the region, following the naming convention of the documentation of MCG.
4. Specify the URL of the S3 endpoint for MCG.
5. Specify the name of the custom secret for MCG storage.
6. Specify the MCG bucket name.

4. Create the DPA by running the following command:

```
$ oc create -f <dpa_file_name> 1
```

1 Specify the file name of the DPA you configured.

5. Verify that the DPA has reconciled by running the following command:

```
$ oc get dpa -o yaml
```

6. Verify that the BSLs are available by running the following command:

```
$ oc get bsl
```

Example output

```
NAME   PHASE       LAST VALIDATED   AGE     DEFAULT
aws    Available   5s               3m28s   true
mcg    Available   5s               3m28s
```

7. Create a backup CR with the default BSL.

NOTE

In the following example, the **storageLocation** field is not specified in the backup CR.

Example backup CR

```
apiVersion: velero.io/v1
kind: Backup
metadata:
  name: test-backup1
  namespace: openshift-adp
spec:
  includedNamespaces:
  - <mysql_namespace> 1
  defaultVolumesToFsBackup: true
```

1 Specify the namespace for the application installed in the cluster.

8. Create a backup by running the following command:

```
$ oc apply -f <backup_file_name> 1
```

1 Specify the name of the backup CR file.

9. Verify that the backup completed with the default BSL by running the following command:

```
$ oc get backups.velero.io <backup_name> -o yaml 1
```

1 Specify the name of the backup.

10. Create a backup CR by using MCG as the BSL. In the following example, note that the second **storageLocation** value is specified at the time of backup CR creation.

    Example backup CR

```
apiVersion: velero.io/v1
kind: Backup
metadata:
  name: test-backup1
  namespace: openshift-adp
spec:
  includedNamespaces:
  - <mysql_namespace> 1
  storageLocation: mcg 2
  defaultVolumesToFsBackup: true
```

    1 Specify the namespace for the application installed in the cluster.

    2 Specify the second storage location.

11. Create a second backup by running the following command:

```
$ oc apply -f <backup_file_name> 1
```

    1 Specify the name of the backup CR file.

12. Verify that the backup completed with the storage location as MCG by running the following command:

```
$ oc get backups.velero.io <backup_name> -o yaml 1
```

    1 Specify the name of the backup.

Additional resources

- Creating profiles for different credentials

5.15. CONFIGURING OADP WITH MULTIPLE VOLUME SNAPSHOT LOCATIONS

5.15.1. Configuring the OpenShift API for Data Protection (OADP) with more than one Volume Snapshot Location

You can configure one or more Volume Snapshot Locations (VSLs) to store the snapshots in different cloud provider regions.

5.15.1.1. Configuring the DPA with more than one VSL

You configure the DPA with more than one VSL and specify the credentials provided by the cloud provider. Make sure that you configure the snapshot location in the same region as the persistent volumes. See the following example.

Example DPA

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
#...
snapshotLocations:
  - velero:
      config:
        profile: default
        region: <region> 1
      credential:
        key: cloud
        name: cloud-credentials
      provider: aws
  - velero:
      config:
        profile: default
        region: <region>
      credential:
        key: cloud
        name: <custom_credential> 2
      provider: aws
#...
```

1 Specify the region. The snapshot location must be in the same region as the persistent volumes.

2 Specify the custom credential name.

5.16. UNINSTALLING OADP

5.16.1. Uninstalling the OpenShift API for Data Protection

You uninstall the OpenShift API for Data Protection (OADP) by deleting the OADP Operator. See Deleting Operators from a cluster for details.

5.17. OADP BACKING UP

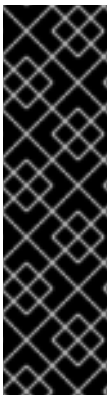
5.17.1. Backing up applications

Frequent backups might consume storage on the backup storage location. Check the frequency of backups, retention time, and the amount of data of the persistent volumes (PVs) if using non-local backups, for example, S3 buckets. Because all taken backup remains until expired, also check the time to live (TTL) setting of the schedule.

You can back up applications by creating a **Backup** custom resource (CR). For more information, see Creating a Backup CR .

- The **Backup** CR creates backup files for Kubernetes resources and internal images on S3 object storage.
- If your cloud provider has a native snapshot API or supports CSI snapshots, the **Backup** CR backs up persistent volumes (PVs) by creating snapshots. For more information about working with CSI snapshots, see Backing up persistent volumes with CSI snapshots .

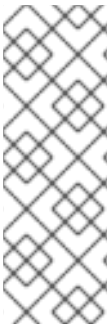
For more information about CSI volume snapshots, see CSI volume snapshots .



IMPORTANT

The **CloudStorage** API, which automates the creation of a bucket for object storage, is a Technology Preview feature only. 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 about the support scope of Red Hat Technology Preview features, see Technology Preview Features Support Scope .



NOTE

The **CloudStorage** API is a Technology Preview feature when you use a **CloudStorage** object and want OADP to use the **CloudStorage** API to automatically create an S3 bucket for use as a **BackupStorageLocation**.

The **CloudStorage** API supports manually creating a **BackupStorageLocation** object by specifying an existing S3 bucket. The **CloudStorage** API that creates an S3 bucket automatically is currently only enabled for AWS S3 storage.

- If your cloud provider does not support snapshots or if your applications are on NFS data volumes, you can create backups by using Kopia or Restic. See Backing up applications with File System Backup: Kopia or Restic.

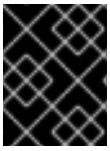
PODVOLUMERESTORE FAILS WITH A .../.SNAPSHOT: READ-ONLY FILE SYSTEM ERROR

The **.../.snapshot** directory is a snapshot copy directory, which is used by several NFS servers. This directory has read-only access by default, so Velero cannot restore to this directory.

Do not give Velero write access to the **.snapshot** directory, and disable client access to this directory.

Additional resources

- Enable or disable client access to Snapshot copy directory by editing a share
- Prerequisites for backup and restore with FlashBlade



IMPORTANT

The OpenShift API for Data Protection (OADP) does not support backing up volume snapshots that were created by other software.

5.17.1.1. Previewing resources before running backup and restore

OADP backs up application resources based on the type, namespace, or label. This means that you can view the resources after the backup is complete. Similarly, you can view the restored objects based on the namespace, persistent volume (PV), or label after a restore operation is complete. To preview the resources in advance, you can do a dry run of the backup and restore operations.

Prerequisites

- You have installed the OADP Operator.

Procedure

1. To preview the resources included in the backup before running the actual backup, run the following command:

```
$ velero backup create <backup-name> --snapshot-volumes false 1
```

1 Specify the value of **--snapshot-volumes** parameter as **false**.

2. To know more details about the backup resources, run the following command:

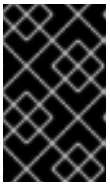
```
$ velero describe backup <backup_name> --details 1
```

1 Specify the name of the backup.

3. To preview the resources included in the restore before running the actual restore, run the following command:

```
$ velero restore create --from-backup <backup-name> 1
```

1 Specify the name of the backup created to review the backup resources.



IMPORTANT

The **velero restore create** command creates restore resources in the cluster. You must delete the resources created as part of the restore, after you review the resources.

4. To know more details about the restore resources, run the following command:

```
$ velero describe restore <restore_name> --details 1
```

1 Specify the name of the restore.

You can create backup hooks to run commands before or after the backup operation. See Creating backup hooks.

You can schedule backups by creating a **Schedule** CR instead of a **Backup** CR. See Scheduling backups using Schedule CR.

5.17.1.2. Known issues

OpenShift Container Platform 4.18 enforces a pod security admission (PSA) policy that can hinder the readiness of pods during a Restic restore process.

This issue has been resolved in the OADP 1.1.6 and OADP 1.2.2 releases, therefore it is recommended that users upgrade to these releases.

For more information, see Restic restore partially failing on OCP 4.15 due to changed PSA policy .

Additional resources

- Installing Operators on clusters for administrators
- Installing Operators in namespaces for non-administrators

5.17.2. Creating a Backup CR

You back up Kubernetes resources, internal images, and persistent volumes (PVs) by creating a **Backup** custom resource (CR).

Prerequisites

- You must install the OpenShift API for Data Protection (OADP) Operator.
- The **DataProtectionApplication** CR must be in a **Ready** state.
- Backup location prerequisites:
  - You must have S3 object storage configured for Velero.
  - You must have a backup location configured in the **DataProtectionApplication** CR.
- Snapshot location prerequisites:
  - Your cloud provider must have a native snapshot API or support Container Storage Interface (CSI) snapshots.
  - For CSI snapshots, you must create a **VolumeSnapshotClass** CR to register the CSI driver.
  - You must have a volume location configured in the **DataProtectionApplication** CR.

Procedure

1. Retrieve the **backupStorageLocations** CRs by entering the following command:

```
$ oc get backupstoragelocations.velero.io -n openshift-adp
```

Example output

```
NAMESPACE       NAME              PHASE       LAST VALIDATED   AGE   DEFAULT
openshift-adp   velero-sample-1   Available   11s              31m
```

2. Create a **Backup** CR, as in the following example:

```
apiVersion: velero.io/v1
kind: Backup
metadata:
  name: <backup>
  labels:
    velero.io/storage-location: default
  namespace: openshift-adp
spec:
  hooks: {}
  includedNamespaces:
  - <namespace> 1
  includedResources: [] 2
  excludedResources: [] 3
  storageLocation: <velero-sample-1> 4
  ttl: 720h0m0s
  labelSelector: 5
    matchLabels:
      app: <label_1>
      app: <label_2>
      app: <label_3>
  orLabelSelectors: 6
  - matchLabels:
      app: <label_1>
      app: <label_2>
      app: <label_3>
```

1. Specify an array of namespaces to back up.
2. Optional: Specify an array of resources to include in the backup. Resources might be shortcuts (for example, 'po' for 'pods') or fully-qualified. If unspecified, all resources are included.
3. Optional: Specify an array of resources to exclude from the backup. Resources might be shortcuts (for example, 'po' for 'pods') or fully-qualified.
4. Specify the name of the **backupStorageLocations** CR.
5. Map of {key,value} pairs of backup resources that have **all** the specified labels.
6. Map of {key,value} pairs of backup resources that have **one or more** of the specified labels.

3. Verify that the status of the **Backup** CR is **Completed**:

```
$ oc get backups.velero.io -n openshift-adp <backup> -o jsonpath='{.status.phase}'
```

5.17.3. Backing up persistent volumes with CSI snapshots

You back up persistent volumes with Container Storage Interface (CSI) snapshots by editing the **VolumeSnapshotClass** custom resource (CR) of the cloud storage before you create the **Backup** CR, see CSI volume snapshots.

For more information, see Creating a Backup CR.

Prerequisites

- The cloud provider must support CSI snapshots.
- You must enable CSI in the **DataProtectionApplication** CR.

Procedure

- Add the **metadata.labels.velero.io/csi-volumesnapshot-class: "true"** key-value pair to the **VolumeSnapshotClass** CR:

  Example configuration file

```
apiVersion: snapshot.storage.k8s.io/v1
kind: VolumeSnapshotClass
metadata:
  name: <volume_snapshot_class_name>
  labels:
    velero.io/csi-volumesnapshot-class: "true" (1)
  annotations:
    snapshot.storage.kubernetes.io/is-default-class: true (2)
driver: <csi_driver>
deletionPolicy: <deletion_policy_type> (3)
```

(1) Must be set to **true**.

(2) If you are restoring this volume in another cluster with the same driver, make sure that you set the **snapshot.storage.kubernetes.io/is-default-class** parameter to **false** instead of setting it to **true**. Otherwise, the restore will partially fail.

(3) OADP supports the **Retain** and **Delete** deletion policy types for CSI and Data Mover backup and restore.

Next steps

- You can now create a **Backup** CR.

5.17.4. Backing up applications with File System Backup: Kopia or Restic

You can use OADP to back up and restore Kubernetes volumes attached to pods from the file system of the volumes. This process is called File System Backup (FSB) or Pod Volume Backup (PVB). It is accomplished by using modules from the open source backup tools Restic or Kopia.

If your cloud provider does not support snapshots or if your applications are on NFS data volumes, you can create backups by using FSB.

NOTE

Restic is installed by the OADP Operator by default. If you prefer, you can install Kopia instead.

FSB integration with OADP provides a solution for backing up and restoring almost any type of Kubernetes volumes. This integration is an additional capability of OADP and is not a replacement for existing functionality.

You back up Kubernetes resources, internal images, and persistent volumes with Kopia or Restic by editing the **Backup** custom resource (CR).

You do not need to specify a snapshot location in the **DataProtectionApplication** CR.

NOTE

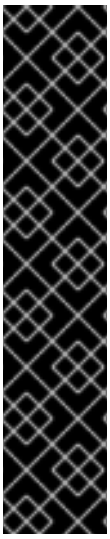
In OADP version 1.3 and later, you can use either Kopia or Restic for backing up applications.

For the Built-in DataMover, you must use Kopia.

In OADP version 1.2 and earlier, you can only use Restic for backing up applications.

IMPORTANT

FSB does not support backing up **hostPath** volumes. For more information, see FSB limitations.



PODVOLUMERESTORE FAILS WITH A .../.SNAPSHOT: READ-ONLY FILE SYSTEM ERROR

The **.../.snapshot** directory is a snapshot copy directory, which is used by several NFS servers. This directory has read-only access by default, so Velero cannot restore to this directory.

Do not give Velero write access to the **.snapshot** directory, and disable client access to this directory.

Additional resources

- Enable or disable client access to Snapshot copy directory by editing a share
- Prerequisites for backup and restore with FlashBlade

Prerequisites

- You must install the OpenShift API for Data Protection (OADP) Operator.
- You must not disable the default **nodeAgent** installation by setting **spec.configuration.nodeAgent.enable** to **false** in the **DataProtectionApplication** CR.
- You must select Kopia or Restic as the uploader by setting **spec.configuration.nodeAgent.uploaderType** to **kopia** or **restic** in the **DataProtectionApplication** CR.
- The **DataProtectionApplication** CR must be in a **Ready** state.

Procedure

- Create the **Backup** CR, as in the following example:
  -

```
apiVersion: velero.io/v1
kind: Backup
metadata:
  name: <backup>
  labels:
    velero.io/storage-location: default
  namespace: openshift-adp
spec:
  defaultVolumesToFsBackup: true (1)
...
```

(1) In OADP version 1.2 and later, add the **defaultVolumesToFsBackup: true** setting within the **spec** block. In OADP version 1.1, add **defaultVolumesToRestic: true**.

5.17.5. Creating backup hooks

When performing a backup, it is possible to specify one or more commands to execute in a container within a pod, based on the pod being backed up.

The commands can be configured to performed before any custom action processing (*Pre* hooks), or after all custom actions have been completed and any additional items specified by the custom action have been backed up (*Post* hooks).

You create backup hooks to run commands in a container in a pod by editing the **Backup** custom resource (CR).

Procedure

- Add a hook to the **spec.hooks** block of the **Backup** CR, as in the following example:

```
apiVersion: velero.io/v1
kind: Backup
metadata:
  name: <backup>
  namespace: openshift-adp
spec:
  hooks:
    resources:
      - name: <hook_name>
        includedNamespaces:
        - <namespace> (1)
        excludedNamespaces: (2)
        - <namespace>
        includedResources: []
        - pods (3)
        excludedResources: [] (4)
        labelSelector: (5)
          matchLabels:
            app: velero
            component: server
        pre: (6)
          - exec:
              container: <container> (7)
```

```
            command:
            - /bin/uname 8
            - -a
            onError: Fail 9
            timeout: 30s 10
        post: 11
...
```

1. Optional: You can specify namespaces to which the hook applies. If this value is not specified, the hook applies to all namespaces.
2. Optional: You can specify namespaces to which the hook does not apply.
3. Currently, pods are the only supported resource that hooks can apply to.
4. Optional: You can specify resources to which the hook does not apply.
5. Optional: This hook only applies to objects matching the label. If this value is not specified, the hook applies to all objects.
6. Array of hooks to run before the backup.
7. Optional: If the container is not specified, the command runs in the first container in the pod.
8. This is the entry point for the **init** container being added.
9. Allowed values for error handling are **Fail** and **Continue**. The default is **Fail**.
10. Optional: How long to wait for the commands to run. The default is **30s**.
11. This block defines an array of hooks to run after the backup, with the same parameters as the pre-backup hooks.

5.17.6. Scheduling backups using Schedule CR

The schedule operation allows you to create a backup of your data at a particular time, specified by a Cron expression.

You schedule backups by creating a **Schedule** custom resource (CR) instead of a **Backup** CR.

WARNING

Leave enough time in your backup schedule for a backup to finish before another backup is created.

For example, if a backup of a namespace typically takes 10 minutes, do not schedule backups more frequently than every 15 minutes.

Prerequisites

- You must install the OpenShift API for Data Protection (OADP) Operator.
- The **DataProtectionApplication** CR must be in a **Ready** state.

Procedure

1. Retrieve the **backupStorageLocations** CRs:

```
$ oc get backupStorageLocations -n openshift-adp
```

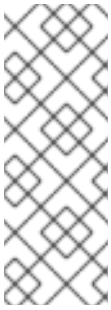
Example output

```
NAMESPACE       NAME              PHASE       LAST VALIDATED   AGE   DEFAULT
openshift-adp   velero-sample-1   Available   11s              31m
```

2. Create a **Schedule** CR, as in the following example:

```
$ cat << EOF | oc apply -f -
apiVersion: velero.io/v1
kind: Schedule
metadata:
  name: <schedule>
  namespace: openshift-adp
spec:
  schedule: 0 7 * * * 1
  template:
    hooks: {}
    includedNamespaces:
    - <namespace> 2
    storageLocation: <velero-sample-1> 3
    defaultVolumesToFsBackup: true 4
    ttl: 720h0m0s
EOF
```

1. **cron** expression to schedule the backup, for example, **0 7 * * *** to perform a backup every day at 7:00.



NOTE

To schedule a backup at specific intervals, enter the **<duration_in_minutes>** in the following format:

```
schedule: "*/10 * * * *"
```

Enter the minutes value between quotation marks (**" "**).

2. Array of namespaces to back up.
3. Name of the **backupStorageLocations** CR.
4. Optional: In OADP version 1.2 and later, add the **defaultVolumesToFsBackup: true** key-value pair to your configuration when performing backups of volumes with Restic. In OADP version 1.1, add the **defaultVolumesToRestic: true** key-value pair when you back up volumes with Restic.

1. Verify that the status of the **Schedule** CR is **Completed** after the scheduled backup runs:

```
$ oc get schedule -n openshift-adp <schedule> -o jsonpath='{.status.phase}'
```

5.17.7. Deleting backups

You can delete a backup by creating the **DeleteBackupRequest** custom resource (CR) or by running the **velero backup delete** command as explained in the following procedures.

The volume backup artifacts are deleted at different times depending on the backup method:

- Restic: The artifacts are deleted in the next full maintenance cycle, after the backup is deleted.
- Container Storage Interface (CSI): The artifacts are deleted immediately when the backup is deleted.
- Kopia: The artifacts are deleted after three full maintenance cycles of the Kopia repository, after the backup is deleted.

5.17.7.1. Deleting a backup by creating a DeleteBackupRequest CR

You can delete a backup by creating a **DeleteBackupRequest** custom resource (CR).

Prerequisites

- You have run a backup of your application.

Procedure

1. Create a **DeleteBackupRequest** CR manifest file:

```
apiVersion: velero.io/v1
kind: DeleteBackupRequest
metadata:
  name: deletebackuprequest
  namespace: openshift-adp
spec:
  backupName: <backup_name> 1
```

1 Specify the name of the backup.

2. Apply the **DeleteBackupRequest** CR to delete the backup:

```
$ oc apply -f <deletebackuprequest_cr_filename>
```

5.17.7.2. Deleting a backup by using the Velero CLI

You can delete a backup by using the Velero CLI.

Prerequisites

- You have run a backup of your application.

- You downloaded the Velero CLI and can access the Velero binary in your cluster.

Procedure

- To delete the backup, run the following Velero command:

```
$ velero backup delete <backup_name> -n openshift-adp 1
```

1 Specify the name of the backup.

5.17.7.3. About Kopia repository maintenance

There are two types of Kopia repository maintenance:

Quick maintenance

- Runs every hour to keep the number of index blobs (n) low. A high number of indexes negatively affects the performance of Kopia operations.
- Does not delete any metadata from the repository without ensuring that another copy of the same metadata exists.

Full maintenance

- Runs every 24 hours to perform garbage collection of repository contents that are no longer needed.
- **snapshot-gc**, a full maintenance task, finds all files and directory listings that are no longer accessible from snapshot manifests and marks them as deleted.
- A full maintenance is a resource-costly operation, as it requires scanning all directories in all snapshots that are active in the cluster.

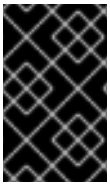
5.17.7.3.1. Kopia maintenance in OADP

The **repo-maintain-job** jobs are executed in the namespace where OADP is installed, as shown in the following example:

```
pod/repo-maintain-job-173...2527-2nbls   0/1   Completed   0   168m
pod/repo-maintain-job-173....536-fl9tm   0/1   Completed   0   108m
pod/repo-maintain-job-173...2545-55ggx   0/1   Completed   0   48m
```

You can check the logs of the **repo-maintain-job** for more details about the cleanup and the removal of artifacts in the backup object storage. You can find a note, as shown in the following example, in the **repo-maintain-job** when the next full cycle maintenance is due:

```
not due for full maintenance cycle until 2024-00-00 18:29:4
```



IMPORTANT

Three successful executions of a full maintenance cycle are required for the objects to be deleted from the backup object storage. This means you can expect up to 72 hours for all the artifacts in the backup object storage to be deleted.

5.17.7.4. Deleting a backup repository

After you delete the backup, and after the Kopia repository maintenance cycles to delete the related artifacts are complete, the backup is no longer referenced by any metadata or manifest objects. You can then delete the **backuprepository** custom resource (CR) to complete the backup deletion process.

Prerequisites

- You have deleted the backup of your application.
- You have waited up to 72 hours after the backup is deleted. This time frame allows Kopia to run the repository maintenance cycles.

Procedure

1. To get the name of the backup repository CR for a backup, run the following command:

```
$ oc get backuprepositories.velero.io -n openshift-adp
```

2. To delete the backup repository CR, run the following command:

```
$ oc delete backuprepository <backup_repository_name> -n openshift-adp 1
```

1 Specify the name of the backup repository from the earlier step.

5.17.8. About Kopia

Kopia is a fast and secure open-source backup and restore tool that allows you to create encrypted snapshots of your data and save the snapshots to remote or cloud storage of your choice.

Kopia supports network and local storage locations, and many cloud or remote storage locations, including:

- Amazon S3 and any cloud storage that is compatible with S3
- Azure Blob Storage
- Google Cloud Storage platform

Kopia uses content-addressable storage for snapshots:

- Snapshots are always incremental; data that is already included in previous snapshots is not re-uploaded to the repository. A file is only uploaded to the repository again if it is modified.
- Stored data is deduplicated; if multiple copies of the same file exist, only one of them is stored.
- If files are moved or renamed, Kopia can recognize that they have the same content and does not upload them again.

5.17.8.1. OADP integration with Kopia

OADP 1.3 supports Kopia as the backup mechanism for pod volume backup in addition to Restic. You must choose one or the other at installation by setting the **uploaderType** field in the **DataProtectionApplication** custom resource (CR). The possible values are **restic** or **kopia**. If you do not specify an **uploaderType**, OADP 1.3 defaults to using Kopia as the backup mechanism. The data is written to and read from a unified repository.

The following example shows a **DataProtectionApplication** CR configured for using Kopia:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: dpa-sample
spec:
  configuration:
    nodeAgent:
      enable: true
      uploaderType: kopia
# ...
```

5.18. OADP RESTORING

5.18.1. Restoring applications

You restore application backups by creating a **Restore** custom resource (CR). See Creating a Restore CR.

You can create restore hooks to run commands in a container in a pod by editing the **Restore** CR. See Creating restore hooks.

5.18.1.1. Previewing resources before running backup and restore

OADP backs up application resources based on the type, namespace, or label. This means that you can view the resources after the backup is complete. Similarly, you can view the restored objects based on the namespace, persistent volume (PV), or label after a restore operation is complete. To preview the resources in advance, you can do a dry run of the backup and restore operations.

Prerequisites

- You have installed the OADP Operator.

Procedure

1. To preview the resources included in the backup before running the actual backup, run the following command:

```
$ velero backup create <backup-name> --snapshot-volumes false 1
```

1 Specify the value of **--snapshot-volumes** parameter as **false**.

2. To know more details about the backup resources, run the following command:

```
$ velero describe backup <backup_name> --details 1
```

1 Specify the name of the backup.

3. To preview the resources included in the restore before running the actual restore, run the following command:

```
$ velero restore create --from-backup <backup-name> 1
```

1 Specify the name of the backup created to review the backup resources.

IMPORTANT

The **velero restore create** command creates restore resources in the cluster. You must delete the resources created as part of the restore, after you review the resources.

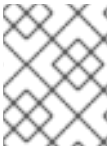
4. To know more details about the restore resources, run the following command:

```
$ velero describe restore <restore_name> --details 1
```

1 Specify the name of the restore.

5.18.1.2. Creating a Restore CR

You restore a **Backup** custom resource (CR) by creating a **Restore** CR.



NOTE

When you restore a stateful application that uses the **azurefile-csi** storage class, the restore operation remains in the **Finalizing** phase.

Prerequisites

- You must install the OpenShift API for Data Protection (OADP) Operator.
- The **DataProtectionApplication** CR must be in a **Ready** state.
- You must have a Velero **Backup** CR.
- The persistent volume (PV) capacity must match the requested size at backup time. Adjust the requested size if needed.

Procedure

1. Create a **Restore** CR, as in the following example:

```
apiVersion: velero.io/v1
kind: Restore
metadata:
  name: <restore>
```

```
  namespace: openshift-adp
spec:
  backupName: <backup> 1
  includedResources: [] 2
  excludedResources:
  - nodes
  - events
  - events.events.k8s.io
  - backups.velero.io
  - restores.velero.io
  - resticrepositories.velero.io
  restorePVs: true 3
```

1. Name of the **Backup** CR.
2. Optional: Specify an array of resources to include in the restore process. Resources might be shortcuts (for example, **po** for **pods**) or fully-qualified. If unspecified, all resources are included.
3. Optional: The **restorePVs** parameter can be set to **false** to turn off restore of **PersistentVolumes** from **VolumeSnapshot** of Container Storage Interface (CSI) snapshots or from native snapshots when **VolumeSnapshotLocation** is configured.

2. Verify that the status of the **Restore** CR is **Completed** by entering the following command:

```
$ oc get restores.velero.io -n openshift-adp <restore> -o jsonpath='{.status.phase}'
```

3. Verify that the backup resources have been restored by entering the following command:

```
$ oc get all -n <namespace> 1
```

1. Namespace that you backed up.

4. If you restore **DeploymentConfig** with volumes or if you use post-restore hooks, run the **dc-post-restore.sh** cleanup script by entering the following command:

```
$ bash dc-restic-post-restore.sh -> dc-post-restore.sh
```

NOTE

During the restore process, the OADP Velero plug-ins scale down the **DeploymentConfig** objects and restore the pods as standalone pods. This is done to prevent the cluster from deleting the restored **DeploymentConfig** pods immediately on restore and to allow the restore and post-restore hooks to complete their actions on the restored pods. The cleanup script shown below removes these disconnected pods and scales any **DeploymentConfig** objects back up to the appropriate number of replicas.

Example 5.1. dc-restic-post-restore.sh → dc-post-restore.sh cleanup script

```
#!/bin/bash
```

```
set -e

# if sha256sum exists, use it to check the integrity of the file
if command -v sha256sum >/dev/null 2>&1; then
  CHECKSUM_CMD="sha256sum"
else
  CHECKSUM_CMD="shasum -a 256"
fi

label_name () {
    if [ "${#1}" -le "63" ]; then
 echo $1
 return
    fi
    sha=$(echo -n $1|$CHECKSUM_CMD)
    echo "${1:0:57}${sha:0:6}"
}

if [[ $# -ne 1 ]]; then
    echo "usage: ${BASH_SOURCE} restore-name"
    exit 1
fi

echo "restore: $1"

label=$(label_name $1)
echo "label:   $label"

echo Deleting disconnected restore pods
oc delete pods --all-namespaces -l oadp.openshift.io/disconnected-from-dc=$label

for dc in $(oc get dc --all-namespaces -l oadp.openshift.io/replicas-modified=$label -o
jsonpath='{range .items[*]}{.metadata.namespace}{","}{.metadata.name}{","}
{.metadata.annotations.oadp\.openshift\.io/original-replicas}{","}
{.metadata.annotations.oadp\.openshift\.io/original-paused}{"\n"}')
do
    IFS=',' read -ra dc_arr <<< "$dc"
    if [ ${#dc_arr[0]} -gt 0 ]; then
 echo Found deployment ${dc_arr[0]}/${dc_arr[1]}, setting replicas: ${dc_arr[2]}, paused:
${dc_arr[3]}
 cat <<EOF | oc patch dc  -n ${dc_arr[0]} ${dc_arr[1]} --patch-file /dev/stdin
spec:
  replicas: ${dc_arr[2]}
  paused: ${dc_arr[3]}
EOF
    fi
done
```

5.18.1.3. Creating restore hooks

You create restore hooks to run commands in a container in a pod by editing the **Restore** custom resource (CR).

You can create two types of restore hooks:

- An **init** hook adds an init container to a pod to perform setup tasks before the application container starts.
  If you restore a Restic backup, the **restic-wait** init container is added before the restore hook init container.

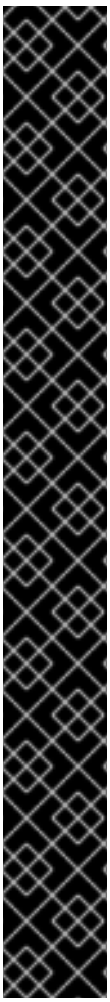
- An **exec** hook runs commands or scripts in a container of a restored pod.

Procedure

- Add a hook to the **spec.hooks** block of the **Restore** CR, as in the following example:

```
apiVersion: velero.io/v1
kind: Restore
metadata:
  name: <restore>
  namespace: openshift-adp
spec:
  hooks:
    resources:
      - name: <hook_name>
        includedNamespaces:
        - <namespace> 1
        excludedNamespaces:
        - <namespace>
        includedResources:
        - pods 2
        excludedResources: []
        labelSelector: 3
          matchLabels:
            app: velero
            component: server
        postHooks:
        - init:
            initContainers:
            - name: restore-hook-init
              image: alpine:latest
              volumeMounts:
              - mountPath: /restores/pvc1-vm
                name: pvc1-vm
              command:
              - /bin/ash
              - -c
            timeout: 4
        - exec:
            container: <container> 5
            command:
            - /bin/bash 6
            - -c
            - "psql < /backup/backup.sql"
            waitTimeout: 5m 7
            execTimeout: 1m 8
            onError: Continue 9
```

1. Optional: Array of namespaces to which the hook applies. If this value is not specified, the hook applies to all namespaces.
2. Currently, pods are the only supported resource that hooks can apply to.
3. Optional: This hook only applies to objects matching the label selector.
4. Optional: Timeout specifies the maximum length of time Velero waits for **initContainers** to complete.
5. Optional: If the container is not specified, the command runs in the first container in the pod.
6. This is the entrypoint for the init container being added.
7. Optional: How long to wait for a container to become ready. This should be long enough for the container to start and for any preceding hooks in the same container to complete. If not set, the restore process waits indefinitely.
8. Optional: How long to wait for the commands to run. The default is **30s**.
9. Allowed values for error handling are **Fail** and **Continue**:
   - **Continue**: Only command failures are logged.
   - **Fail**: No more restore hooks run in any container in any pod. The status of the **Restore** CR will be **PartiallyFailed**.



IMPORTANT

During a File System Backup (FSB) restore operation, a **Deployment** resource referencing an **ImageStream** is not restored properly. The restored pod that runs the FSB, and the **postHook** is terminated prematurely.

This happens because, during the restore operation, OpenShift controller updates the **spec.template.spec.containers[0].image** field in the **Deployment** resource with an updated **ImageStreamTag** hash. The update triggers the rollout of a new pod, terminating the pod on which **velero** runs the FSB and the post restore hook. For more information about image stream trigger, see "Triggering updates on image stream changes".

The workaround for this behavior is a two-step restore process:

1. First, perform a restore excluding the **Deployment** resources, for example:

```
$ velero restore create <RESTORE_NAME> \
  --from-backup <BACKUP_NAME> \
  --exclude-resources=deployment.apps
```

2. After the first restore is successful, perform a second restore by including these resources, for example:

```
$ velero restore create <RESTORE_NAME> \
  --from-backup <BACKUP_NAME> \
  --include-resources=deployment.apps
```

Additional resources

- Triggering updates on image stream changes

5.19. OADP AND ROSA

5.19.1. Backing up applications on ROSA clusters using OADP

You can use OpenShift API for Data Protection (OADP) with Red Hat OpenShift Service on AWS (ROSA) clusters to back up and restore application data.

ROSA is a fully-managed, turnkey application platform that allows you to deliver value to your customers by building and deploying applications.

ROSA provides seamless integration with a wide range of Amazon Web Services (AWS) compute, database, analytics, machine learning, networking, mobile, and other services to speed up the building and delivery of differentiating experiences to your customers.

You can subscribe to the service directly from your AWS account.

After you create your clusters, you can operate your clusters with the OpenShift Container Platform web console or through Red Hat OpenShift Cluster Manager . You can also use ROSA with OpenShift APIs and command-line interface (CLI) tools.

For additional information about ROSA installation, see Installing Red Hat OpenShift Service on AWS (ROSA) interactive walkthrough.

Before installing OpenShift API for Data Protection (OADP), you must set up role and policy credentials for OADP so that it can use the Amazon Web Services API.

This process is performed in the following two stages:

1. Prepare AWS credentials
2. Install the OADP Operator and give it an IAM role

5.19.1.1. Preparing AWS credentials for OADP

An Amazon Web Services account must be prepared and configured to accept an OpenShift API for Data Protection (OADP) installation.

Procedure

1. Create the following environment variables by running the following commands:

IMPORTANT

Change the cluster name to match your ROSA cluster, and ensure you are logged into the cluster as an administrator. Ensure that all fields are outputted correctly before continuing.

```
$ export CLUSTER_NAME=my-cluster (1)
  export ROSA_CLUSTER_ID=$(rosa describe cluster -c ${CLUSTER_NAME} --output json |
jq -r .id)
```

```
  export REGION=$(rosa describe cluster -c ${CLUSTER_NAME} --output json | jq -r
.region.id)
  export OIDC_ENDPOINT=$(oc get authentication.config.openshift.io cluster -o
jsonpath='{.spec.serviceAccountIssuer}' | sed 's|^https://||')
  export AWS_ACCOUNT_ID=$(aws sts get-caller-identity --query Account --output text)
  export CLUSTER_VERSION=$(rosa describe cluster -c ${CLUSTER_NAME} -o json | jq -r
.version.raw_id | cut -f -2 -d '.')
  export ROLE_NAME="${CLUSTER_NAME}-openshift-oadp-aws-cloud-credentials"
  export SCRATCH="/tmp/${CLUSTER_NAME}/oadp"
  mkdir -p ${SCRATCH}
  echo "Cluster ID: ${ROSA_CLUSTER_ID}, Region: ${REGION}, OIDC Endpoint:
  ${OIDC_ENDPOINT}, AWS Account ID: ${AWS_ACCOUNT_ID}"
```

1 Replace **my-cluster** with your ROSA cluster name.

2. On the AWS account, create an IAM policy to allow access to AWS S3:

   a. Check to see if the policy exists by running the following command:

```
$ POLICY_ARN=$(aws iam list-policies --query "Policies[?
PolicyName=='RosaOadpVer1'].{ARN:Arn}" --output text) 1
```

1 Replace **RosaOadp** with your policy name.

   b. Enter the following command to create the policy JSON file and then create the policy in ROSA:

NOTE

If the policy ARN is not found, the command creates the policy. If the policy ARN already exists, the **if** statement intentionally skips the policy creation.

```
$ if [[ -z "${POLICY_ARN}" ]]; then
  cat << EOF > ${SCRATCH}/policy.json 1
  {
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "s3:CreateBucket",
        "s3:DeleteBucket",
        "s3:PutBucketTagging",
        "s3:GetBucketTagging",
        "s3:PutEncryptionConfiguration",
        "s3:GetEncryptionConfiguration",
        "s3:PutLifecycleConfiguration",
        "s3:GetLifecycleConfiguration",
        "s3:GetBucketLocation",
        "s3:ListBucket",
        "s3:GetObject",
        "s3:PutObject",
        "s3:DeleteObject",
```

```
        "s3:ListBucketMultipartUploads",
        "s3:AbortMultipartUpload",
        "s3:ListMultipartUploadParts",
        "ec2:DescribeSnapshots",
        "ec2:DescribeVolumes",
        "ec2:DescribeVolumeAttribute",
        "ec2:DescribeVolumesModifications",
        "ec2:DescribeVolumeStatus",
        "ec2:CreateTags",
        "ec2:CreateVolume",
        "ec2:CreateSnapshot",
        "ec2:DeleteSnapshot"
      ],
      "Resource": "*"
    }
  ]}
EOF

  POLICY_ARN=$(aws iam create-policy --policy-name "RosaOadpVer1" \
  --policy-document file:///${SCRATCH}/policy.json --query Policy.Arn \
  --tags Key=rosa_openshift_version,Value=${CLUSTER_VERSION}
Key=rosa_role_prefix,Value=ManagedOpenShift
Key=operator_namespace,Value=openshift-oadp Key=operator_name,Value=openshift-
oadp \
  --output text)
  fi
```

1 **SCRATCH** is a name for a temporary directory created for the environment variables.

c. View the policy ARN by running the following command:

```
$ echo ${POLICY_ARN}
```

3. Create an IAM role trust policy for the cluster:

a. Create the trust policy file by running the following command:

```
$ cat <<EOF > ${SCRATCH}/trust-policy.json
  {
      "Version": "2012-10-17",
      "Statement": [{
        "Effect": "Allow",
        "Principal": {
          "Federated": "arn:aws:iam::${AWS_ACCOUNT_ID}:oidc-
provider/${OIDC_ENDPOINT}"
        },
        "Action": "sts:AssumeRoleWithWebIdentity",
        "Condition": {
          "StringEquals": {
            "${OIDC_ENDPOINT}:sub": [
              "system:serviceaccount:openshift-adp:openshift-adp-controller-manager",
              "system:serviceaccount:openshift-adp:velero"]
          }
        }
```

```
      }]
  }
EOF
```

b. Create the role by running the following command:

```
$ ROLE_ARN=$(aws iam create-role --role-name \
  "${ROLE_NAME}" \
  --assume-role-policy-document file://${SCRATCH}/trust-policy.json \
  --tags Key=rosa_cluster_id,Value=${ROSA_CLUSTER_ID} \
        Key=rosa_openshift_version,Value=${CLUSTER_VERSION} \
        Key=rosa_role_prefix,Value=ManagedOpenShift \
        Key=operator_namespace,Value=openshift-adp \
        Key=operator_name,Value=openshift-oadp \
  --query Role.Arn --output text)
```

c. View the role ARN by running the following command:

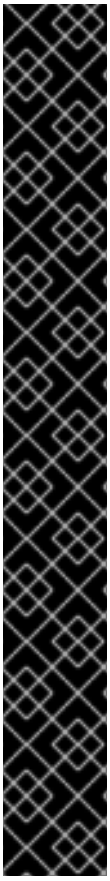
```
$ echo ${ROLE_ARN}
```

4. Attach the IAM policy to the IAM role by running the following command:

```
$ aws iam attach-role-policy --role-name "${ROLE_NAME}" \
  --policy-arn ${POLICY_ARN}
```

5.19.1.2. Installing the OADP Operator and providing the IAM role

AWS Security Token Service (AWS STS) is a global web service that provides short-term credentials for IAM or federated users. OpenShift Container Platform (ROSA) with STS is the recommended credential mode for ROSA clusters. This document describes how to install OpenShift API for Data Protection (OADP) on ROSA with AWS STS.



IMPORTANT

Restic is unsupported.

Kopia file system backup (FSB) is supported when backing up file systems that do not have Container Storage Interface (CSI) snapshotting support.

Example file systems include the following:

- Amazon Elastic File System (EFS)
- Network File System (NFS)
- **emptyDir** volumes
- Local volumes

For backing up volumes, OADP on ROSA with AWS STS supports only native snapshots and Container Storage Interface (CSI) snapshots.

In an Amazon ROSA cluster that uses STS authentication, restoring backed-up data in a different AWS region is not supported.

The Data Mover feature is not currently supported in ROSA clusters. You can use native AWS S3 tools for moving data.

Prerequisites

- An OpenShift Container Platform ROSA cluster with the required access and tokens. For instructions, see the previous procedure *Preparing AWS credentials for OADP*. If you plan to use two different clusters for backing up and restoring, you must prepare AWS credentials, including **ROLE_ARN**, for each cluster.

Procedure

1. Create an OpenShift Container Platform secret from your AWS token file by entering the following commands:

   a. Create the credentials file:

```
$ cat <<EOF > ${SCRATCH}/credentials
  [default]
  role_arn = ${ROLE_ARN}
  web_identity_token_file = /var/run/secrets/openshift/serviceaccount/token
  region = <aws_region> (1)
EOF
```

   (1) Replace **<aws_region>** with the AWS region to use for the STS endpoint.

   b. Create a namespace for OADP:

```
$ oc create namespace openshift-adp
```

   c. Create the OpenShift Container Platform secret:

```
$ oc -n openshift-adp create secret generic cloud-credentials \
  --from-file=${SCRATCH}/credentials
```

NOTE

In OpenShift Container Platform versions 4.15 and later, the OADP Operator supports a new standardized STS workflow through the Operator Lifecycle Manager (OLM) and Cloud Credentials Operator (CCO). In this workflow, you do not need to create the above secret, you only need to supply the role ARN during the installation of OLM-managed operators using the OpenShift Container Platform web console, for more information see *Installing from OperatorHub using the web console*.

The preceding secret is created automatically by CCO.

2. Install the OADP Operator:

   a. In the OpenShift Container Platform web console, browse to **Operators → OperatorHub**.

   b. Search for the **OADP Operator**.

   c. In the **role_ARN** field, paste the role_arn that you created previously and click **Install**.

3. Create AWS cloud storage using your AWS credentials by entering the following command:

```
$ cat << EOF | oc create -f -
  apiVersion: oadp.openshift.io/v1alpha1
  kind: CloudStorage
  metadata:
    name: ${CLUSTER_NAME}-oadp
    namespace: openshift-adp
  spec:
    creationSecret:
      key: credentials
      name: cloud-credentials
    enableSharedConfig: true
    name: ${CLUSTER_NAME}-oadp
    provider: aws
    region: $REGION
EOF
```

4. Check your application's storage default storage class by entering the following command:

```
$ oc get pvc -n <namespace>
```

Example output

```
NAME     STATUS   VOLUME                                     CAPACITY   ACCESS MODES
STORAGECLASS   AGE
applog   Bound    pvc-351791ae-b6ab-4e8b-88a4-30f73caf5ef8   1Gi        RWO            gp3-
csi        4d19h
mysql    Bound    pvc-16b8e009-a20a-4379-accc-bc81fedd0621   1Gi        RWO            gp3-
csi        4d19h
```

5. Get the storage class by running the following command:

```
$ oc get storageclass
```

Example output

```
NAME              PROVISIONER             RECLAIMPOLICY   VOLUMEBINDINGMODE
ALLOWVOLUMEEXPANSION   AGE
gp2               kubernetes.io/aws-ebs   Delete          WaitForFirstConsumer   true
4d21h
gp2-csi           ebs.csi.aws.com         Delete          WaitForFirstConsumer   true
4d21h
gp3               ebs.csi.aws.com         Delete          WaitForFirstConsumer   true
4d21h
gp3-csi (default)   ebs.csi.aws.com       Delete          WaitForFirstConsumer   true
4d21h
```

NOTE

The following storage classes will work:

- gp3-csi
- gp2-csi
- gp3
- gp2

If the application or applications that are being backed up are all using persistent volumes (PVs) with Container Storage Interface (CSI), it is advisable to include the CSI plugin in the OADP DPA configuration.

6. Create the **DataProtectionApplication** resource to configure the connection to the storage where the backups and volume snapshots are stored:

   a. If you are using only CSI volumes, deploy a Data Protection Application by entering the following command:

```
$ cat << EOF | oc create -f -
  apiVersion: oadp.openshift.io/v1alpha1
  kind: DataProtectionApplication
  metadata:
    name: ${CLUSTER_NAME}-dpa
    namespace: openshift-adp
  spec:
    backupImages: true (1)
    features:
      dataMover:
        enable: false
    backupLocations:
    - bucket:
        cloudStorageRef:
          name: ${CLUSTER_NAME}-oadp
```

```
        credential:
          key: credentials
          name: cloud-credentials
        prefix: velero
        default: true
        config:
          region: ${REGION}
    configuration:
      velero:
        defaultPlugins:
        - openshift
        - aws
        - csi
      nodeAgent: 2
        enable: false
        uploaderType: kopia 3
EOF
```

1. ROSA supports internal image backup. Set this field to **false** if you do not want to use image backup.
2. See the important note regarding the **nodeAgent** attribute.
3. The type of uploader. The possible values are **restic** or **kopia**. The built-in Data Mover uses Kopia as the default uploader mechanism regardless of the value of the **uploaderType** field.

a. If you are using CSI or non-CSI volumes, deploy a Data Protection Application by entering the following command:

```
$ cat << EOF | oc create -f -
  apiVersion: oadp.openshift.io/v1alpha1
  kind: DataProtectionApplication
  metadata:
    name: ${CLUSTER_NAME}-dpa
    namespace: openshift-adp
  spec:
    backupImages: true 1
    backupLocations:
    - bucket:
        cloudStorageRef:
          name: ${CLUSTER_NAME}-oadp
        credential:
          key: credentials
          name: cloud-credentials
        prefix: velero
        default: true
        config:
          region: ${REGION}
    configuration:
      velero:
        defaultPlugins:
        - openshift
        - aws
      nodeAgent: 2
```

```
      enable: false
      uploaderType: restic
    snapshotLocations:
      - velero:
          config:
            credentialsFile: /tmp/credentials/openshift-adp/cloud-credentials-credentials 3
            enableSharedConfig: "true" 4
            profile: default 5
            region: ${REGION} 6
          provider: aws
EOF
```

1. ROSA supports internal image backup. Set this field to false if you do not want to use image backup.
2. See the important note regarding the **nodeAgent** attribute.
3. The **credentialsFile** field is the mounted location of the bucket credential on the pod.
4. The **enableSharedConfig** field allows the **snapshotLocations** to share or reuse the credential defined for the bucket.
5. Use the profile name set in the AWS credentials file.
6. Specify **region** as your AWS region. This must be the same as the cluster region.

You are now ready to back up and restore OpenShift Container Platform applications, as described in *Backing up applications*.

IMPORTANT

The **enable** parameter of **restic** is set to **false** in this configuration, because OADP does not support Restic in ROSA environments.

If you use OADP 1.2, replace this configuration:

```
nodeAgent:
  enable: false
  uploaderType: restic
```

with the following configuration:

```
restic:
  enable: false
```

If you want to use two different clusters for backing up and restoring, the two clusters must have the same AWS S3 storage names in both the cloud storage CR and the OADP **DataProtectionApplication** configuration.

5.19.1.3. Updating the IAM role ARN in the OADP Operator subscription

While installing the OADP Operator on a ROSA Security Token Service (STS) cluster, if you provide an incorrect IAM role Amazon Resource Name (ARN), the **openshift-adp-controller** pod gives an error.

The credential requests that are generated contain the wrong IAM role ARN. To update the credential requests object with the correct IAM role ARN, you can edit the OADP Operator subscription and patch the IAM role ARN with the correct value. By editing the OADP Operator subscription, you do not have to uninstall and reinstall OADP to update the IAM role ARN.

Prerequisites

- You have a Red Hat OpenShift Service on AWS STS cluster with the required access and tokens.
- You have installed OADP on the ROSA STS cluster.

Procedure

1. To verify that the OADP subscription has the wrong IAM role ARN environment variable set, run the following command:

```
$ oc get sub -o yaml redhat-oadp-operator
```

Example subscription

```
apiVersion: operators.coreos.com/v1alpha1
kind: Subscription
metadata:
  annotations:
  creationTimestamp: "2025-01-15T07:18:31Z"
  generation: 1
  labels:
    operators.coreos.com/redhat-oadp-operator.openshift-adp: ""
  name: redhat-oadp-operator
  namespace: openshift-adp
  resourceVersion: "77363"
  uid: 5ba00906-5ad2-4476-ae7b-ffa90986283d
spec:
  channel: stable-1.4
  config:
    env:
    - name: ROLEARN
      value: arn:aws:iam::11111111:role/wrong-role-arn (1)
  installPlanApproval: Manual
  name: redhat-oadp-operator
  source: prestage-operators
  sourceNamespace: openshift-marketplace
  startingCSV: oadp-operator.v1.4.2
```

(1) Verify the value of **ROLEARN** you want to update.

2. Update the **ROLEARN** field of the subscription with the correct role ARN by running the following command:

```
$ oc patch subscription redhat-oadp-operator -p '{"spec": {"config": {"env": [{"name":
"ROLEARN", "value": "<role_arn>"}]}}}' --type='merge'
```

where:

<role_arn>

Specifies the IAM role ARN to be updated. For example, **arn:aws:iam::160…..6956:role/oadprosa…..8wlf**.

3. Verify that the **secret** object is updated with correct role ARN value by running the following command:

```
$ oc get secret cloud-credentials -o jsonpath='{.data.credentials}' | base64 -d
```

Example output

```
[default]
sts_regional_endpoints = regional
role_arn = arn:aws:iam::160.....6956:role/oadprosa.....8wlf
web_identity_token_file = /var/run/secrets/openshift/serviceaccount/token
```

4. Configure the **DataProtectionApplication** custom resource (CR) manifest file as shown in the following example:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: test-rosa-dpa
  namespace: openshift-adp
spec:
  backupLocations:
  - bucket:
      config:
        region: us-east-1
      cloudStorageRef:
        name: <cloud_storage> 1
      credential:
        name: cloud-credentials
        key: credentials
      prefix: velero
      default: true
  configuration:
    velero:
      defaultPlugins:
      - aws
      - openshift
```

1 Specify the **CloudStorage** CR.

5. Create the **DataProtectionApplication** CR by running the following command:

```
$ oc create -f <dpa_manifest_file>
```

6. Verify that the **DataProtectionApplication** CR is reconciled and the **status** is set to **"True"** by running the following command:

```
$  oc get dpa -n openshift-adp -o yaml
```

Example DataProtectionApplication

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
...
status:
   conditions:
   - lastTransitionTime: "2023-07-31T04:48:12Z"
     message: Reconcile complete
     reason: Complete
     status: "True"
     type: Reconciled
```

7. Verify that the **BackupStorageLocation** CR is in an available state by running the following command:

```
$ oc get backupstoragelocations.velero.io -n openshift-adp
```

Example BackupStorageLocation

```
NAME       PHASE       LAST VALIDATED   AGE   DEFAULT
ts-dpa-1   Available   3s               6s    true
```

Additional resources

- Installing from OperatorHub using the web console .
- Backing up applications

5.19.1.4. Example: Backing up workload on OADP ROSA STS, with an optional cleanup

5.19.1.4.1. Performing a backup with OADP and ROSA STS

The following example **hello-world** application has no persistent volumes (PVs) attached. Perform a backup with OpenShift API for Data Protection (OADP) with Red Hat OpenShift Service on AWS (ROSA) STS.

Either Data Protection Application (DPA) configuration will work.

1. Create a workload to back up by running the following commands:

```
$ oc create namespace hello-world
```

```
$ oc new-app -n hello-world --image=docker.io/openshift/hello-openshift
```

2. Expose the route by running the following command:

```
$ oc expose service/hello-openshift -n hello-world
```

3. Check that the application is working by running the following command:

```
$ curl `oc get route/hello-openshift -n hello-world -o jsonpath='{.spec.host}'`
```

Example output

```
Hello OpenShift!
```

4. Back up the workload by running the following command:

```
$ cat << EOF | oc create -f -
  apiVersion: velero.io/v1
  kind: Backup
  metadata:
    name: hello-world
    namespace: openshift-adp
  spec:
    includedNamespaces:
    - hello-world
    storageLocation: ${CLUSTER_NAME}-dpa-1
    ttl: 720h0m0s
EOF
```

5. Wait until the backup is completed and then run the following command:

```
$ watch "oc -n openshift-adp get backup hello-world -o json | jq .status"
```

Example output

```
{
  "completionTimestamp": "2022-09-07T22:20:44Z",
  "expiration": "2022-10-07T22:20:22Z",
  "formatVersion": "1.1.0",
  "phase": "Completed",
  "progress": {
    "itemsBackedUp": 58,
    "totalItems": 58
  },
  "startTimestamp": "2022-09-07T22:20:22Z",
  "version": 1
}
```

6. Delete the demo workload by running the following command:

```
$ oc delete ns hello-world
```

7. Restore the workload from the backup by running the following command:

```
$ cat << EOF | oc create -f -
  apiVersion: velero.io/v1
  kind: Restore
  metadata:
    name: hello-world
    namespace: openshift-adp
```

```
  spec:
    backupName: hello-world
EOF
```

8. Wait for the Restore to finish by running the following command:

```
$ watch "oc -n openshift-adp get restore hello-world -o json | jq .status"
```

Example output

```
{
  "completionTimestamp": "2022-09-07T22:25:47Z",
  "phase": "Completed",
  "progress": {
    "itemsRestored": 38,
    "totalItems": 38
  },
  "startTimestamp": "2022-09-07T22:25:28Z",
  "warnings": 9
}
```

9. Check that the workload is restored by running the following command:

```
$ oc -n hello-world get pods
```

Example output

```
NAME                         READY   STATUS    RESTARTS   AGE
hello-openshift-9f885f7c6-kdjpj   1/1     Running   0          90s
```

10. Check the JSONPath by running the following command:

```
$ curl `oc get route/hello-openshift -n hello-world -o jsonpath='{.spec.host}'`
```

Example output

```
Hello OpenShift!
```

NOTE

For troubleshooting tips, see the OADP team's troubleshooting documentation.

5.19.1.4.2. Cleaning up a cluster after a backup with OADP and ROSA STS

If you need to uninstall the OpenShift API for Data Protection (OADP) Operator together with the backups and the S3 bucket from this example, follow these instructions.

Procedure

1. Delete the workload by running the following command:

```
$ oc delete ns hello-world
```

2. Delete the Data Protection Application (DPA) by running the following command:

```
$ oc -n openshift-adp delete dpa ${CLUSTER_NAME}-dpa
```

3. Delete the cloud storage by running the following command:

```
$ oc -n openshift-adp delete cloudstorage ${CLUSTER_NAME}-oadp
```

WARNING

If this command hangs, you might need to delete the finalizer by running the following command:

```
$ oc -n openshift-adp patch cloudstorage ${CLUSTER_NAME}-oadp -p
'{"metadata":{"finalizers":null}}' --type=merge
```

4. If the Operator is no longer required, remove it by running the following command:

```
$ oc -n openshift-adp delete subscription oadp-operator
```

5. Remove the namespace from the Operator:

```
$ oc delete ns openshift-adp
```

6. If the backup and restore resources are no longer required, remove them from the cluster by running the following command:

```
$ oc delete backups.velero.io hello-world
```

7. To delete backup, restore and remote objects in AWS S3 run the following command:

```
$ velero backup delete hello-world
```

8. If you no longer need the Custom Resource Definitions (CRD), remove them from the cluster by running the following command:

```
$ for CRD in `oc get crds | grep velero | awk '{print $1}'`; do oc delete crd $CRD; done
```

9. Delete the AWS S3 bucket by running the following commands:

```
$ aws s3 rm s3://${CLUSTER_NAME}-oadp --recursive
```

```
$ aws s3api delete-bucket --bucket ${CLUSTER_NAME}-oadp
```

10. Detach the policy from the role by running the following command:

```
$ aws iam detach-role-policy --role-name "${ROLE_NAME}"  --policy-arn "${POLICY_ARN}"
```

11. Delete the role by running the following command:

```
$ aws iam delete-role --role-name "${ROLE_NAME}"
```

5.20. OADP AND AWS STS

5.20.1. Backing up applications on AWS STS using OADP

You install the OpenShift API for Data Protection (OADP) with Amazon Web Services (AWS) by installing the OADP Operator. The Operator installs Velero 1.14.

NOTE

Starting from OADP 1.0.4, all OADP 1.0.*z* versions can only be used as a dependency of the Migration Toolkit for Containers Operator and are not available as a standalone Operator.

You configure AWS for Velero, create a default **Secret**, and then install the Data Protection Application. For more details, see Installing the OADP Operator.

To install the OADP Operator in a restricted network environment, you must first disable the default OperatorHub sources and mirror the Operator catalog. See Using Operator Lifecycle Manager in disconnected environments for details.

You can install OADP on an AWS Security Token Service (STS) (AWS STS) cluster manually. Amazon AWS provides AWS STS as a web service that enables you to request temporary, limited-privilege credentials for users. You use STS to provide trusted users with temporary access to resources via API calls, your AWS console, or the AWS command-line interface (CLI).

Before installing OpenShift API for Data Protection (OADP), you must set up role and policy credentials for OADP so that it can use the Amazon Web Services API.

This process is performed in the following two stages:

1. Prepare AWS credentials.
2. Install the OADP Operator and give it an IAM role.

5.20.1.1. Preparing AWS STS credentials for OADP

An Amazon Web Services account must be prepared and configured to accept an OpenShift API for Data Protection (OADP) installation. Prepare the AWS credentials by using the following procedure.

Procedure

1. Define the **cluster_name** environment variable by running the following command:

```
$ export CLUSTER_NAME= <AWS_cluster_name> 1
```

1 The variable can be set to any value.

2. Retrieve all of the details of the **cluster** such as the **AWS_ACCOUNT_ID, OIDC_ENDPOINT** by running the following command:

```
$ export CLUSTER_VERSION=$(oc get clusterversion version -o
jsonpath='{.status.desired.version}{"\n"}')

export AWS_CLUSTER_ID=$(oc get clusterversion version -o jsonpath='{.spec.clusterID}
{"\n"}')

export OIDC_ENDPOINT=$(oc get authentication.config.openshift.io cluster -o
jsonpath='{.spec.serviceAccountIssuer}' | sed 's|^https://||')

export REGION=$(oc get infrastructures cluster -o
jsonpath='{.status.platformStatus.aws.region}' --allow-missing-template-keys=false || echo
us-east-2)

export AWS_ACCOUNT_ID=$(aws sts get-caller-identity --query Account --output text)

export ROLE_NAME="${CLUSTER_NAME}-openshift-oadp-aws-cloud-credentials"
```

3. Create a temporary directory to store all of the files by running the following command:

```
$ export SCRATCH="/tmp/${CLUSTER_NAME}/oadp"
mkdir -p ${SCRATCH}
```

4. Display all of the gathered details by running the following command:

```
$ echo "Cluster ID: ${AWS_CLUSTER_ID}, Region: ${REGION}, OIDC Endpoint:
${OIDC_ENDPOINT}, AWS Account ID: ${AWS_ACCOUNT_ID}"
```

5. On the AWS account, create an IAM policy to allow access to AWS S3:

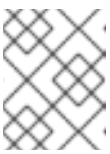
   a. Check to see if the policy exists by running the following commands:

```
$ export POLICY_NAME="OadpVer1" 1
```

   1 The variable can be set to any value.

```
$ POLICY_ARN=$(aws iam list-policies --query "Policies[?
PolicyName=='$POLICY_NAME'].{ARN:Arn}" --output text)
```

   b. Enter the following command to create the policy JSON file and then create the policy:



NOTE

If the policy ARN is not found, the command creates the policy. If the policy ARN already exists, the **if** statement intentionally skips the policy creation.

```
$ if [[ -z "${POLICY_ARN}" ]]; then
cat << EOF > ${SCRATCH}/policy.json
{
"Version": "2012-10-17",
```

```
"Statement": [
 {
  "Effect": "Allow",
  "Action": [
   "s3:CreateBucket",
   "s3:DeleteBucket",
   "s3:PutBucketTagging",
   "s3:GetBucketTagging",
   "s3:PutEncryptionConfiguration",
   "s3:GetEncryptionConfiguration",
   "s3:PutLifecycleConfiguration",
   "s3:GetLifecycleConfiguration",
   "s3:GetBucketLocation",
   "s3:ListBucket",
   "s3:GetObject",
   "s3:PutObject",
   "s3:DeleteObject",
   "s3:ListBucketMultipartUploads",
   "s3:AbortMultipartUpload",
   "s3:ListMultipartUploadParts",
   "ec2:DescribeSnapshots",
   "ec2:DescribeVolumes",
   "ec2:DescribeVolumeAttribute",
   "ec2:DescribeVolumesModifications",
   "ec2:DescribeVolumeStatus",
   "ec2:CreateTags",
   "ec2:CreateVolume",
   "ec2:CreateSnapshot",
   "ec2:DeleteSnapshot"
  ],
  "Resource": "*"
 }
]}
EOF

POLICY_ARN=$(aws iam create-policy --policy-name $POLICY_NAME \
--policy-document file:///${SCRATCH}/policy.json --query Policy.Arn \
--tags Key=openshift_version,Value=${CLUSTER_VERSION}
Key=operator_namespace,Value=openshift-adp Key=operator_name,Value=oadp \
--output text) 1
fi
```

1 **SCRATCH** is a name for a temporary directory created for storing the files.

c. View the policy ARN by running the following command:

```
$ echo ${POLICY_ARN}
```

6. Create an IAM role trust policy for the cluster:

a. Create the trust policy file by running the following command:

```
$ cat <<EOF > ${SCRATCH}/trust-policy.json
{
    "Version": "2012-10-17",
```

```
    "Statement": [{
      "Effect": "Allow",
      "Principal": {
        "Federated": "arn:aws:iam::${AWS_ACCOUNT_ID}:oidc-
provider/${OIDC_ENDPOINT}"
      },
      "Action": "sts:AssumeRoleWithWebIdentity",
      "Condition": {
        "StringEquals": {
          "${OIDC_ENDPOINT}:sub": [
            "system:serviceaccount:openshift-adp:openshift-adp-controller-manager",
            "system:serviceaccount:openshift-adp:velero"]
        }
      }
    }]
}
EOF
```

b. Create an IAM role trust policy for the cluster by running the following command:

```
$ ROLE_ARN=$(aws iam create-role --role-name \
  "${ROLE_NAME}" \
  --assume-role-policy-document file://${SCRATCH}/trust-policy.json \
  --tags Key=cluster_id,Value=${AWS_CLUSTER_ID}
Key=openshift_version,Value=${CLUSTER_VERSION}
Key=operator_namespace,Value=openshift-adp Key=operator_name,Value=oadp --
query Role.Arn --output text)
```

c. View the role ARN by running the following command:

```
$ echo ${ROLE_ARN}
```

7. Attach the IAM policy to the IAM role by running the following command:

```
$ aws iam attach-role-policy --role-name "${ROLE_NAME}" --policy-arn ${POLICY_ARN}
```

5.20.1.1.1. Setting Velero CPU and memory resource allocations

You set the CPU and memory resource allocations for the **Velero** pod by editing the **DataProtectionApplication** custom resource (CR) manifest.

Prerequisites

- You must have the OpenShift API for Data Protection (OADP) Operator installed.

Procedure

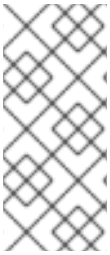
- Edit the values in the **spec.configuration.velero.podConfig.ResourceAllocations** block of the **DataProtectionApplication** CR manifest, as in the following example:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: <dpa_sample>
```

```
spec:
# ...
  configuration:
    velero:
      podConfig:
        nodeSelector: <node_selector> 1
        resourceAllocations: 2
          limits:
            cpu: "1"
            memory: 1024Mi
          requests:
            cpu: 200m
            memory: 256Mi
```

1 Specify the node selector to be supplied to Velero podSpec.

2 The **resourceAllocations** listed are for average usage.



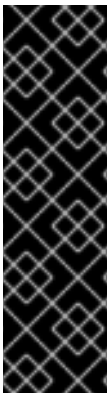
NOTE

Kopia is an option in OADP 1.3 and later releases. You can use Kopia for file system backups, and Kopia is your only option for Data Mover cases with the built-in Data Mover.

Kopia is more resource intensive than Restic, and you might need to adjust the CPU and memory requirements accordingly.

5.20.1.2. Installing the OADP Operator and providing the IAM role

AWS Security Token Service (AWS STS) is a global web service that provides short-term credentials for IAM or federated users. This document describes how to install OpenShift API for Data Protection (OADP) on an AWS STS cluster manually.



IMPORTANT

Restic and Kopia are not supported in the OADP AWS STS environment. Verify that the Restic and Kopia node agent is disabled. For backing up volumes, OADP on AWS STS supports only native snapshots and Container Storage Interface (CSI) snapshots.

In an AWS cluster that uses STS authentication, restoring backed-up data in a different AWS region is not supported.

The Data Mover feature is not currently supported in AWS STS clusters. You can use native AWS S3 tools for moving data.

Prerequisites

- An OpenShift Container Platform AWS STS cluster with the required access and tokens. For instructions, see the previous procedure *Preparing AWS credentials for OADP*. If you plan to use two different clusters for backing up and restoring, you must prepare AWS credentials, including **ROLE_ARN**, for each cluster.

Procedure

1. Create an OpenShift Container Platform secret from your AWS token file by entering the following commands:

   a. Create the credentials file:

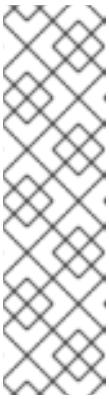
   ```
   $ cat <<EOF > ${SCRATCH}/credentials
     [default]
     role_arn = ${ROLE_ARN}
     web_identity_token_file = /var/run/secrets/openshift/serviceaccount/token
   EOF
   ```

   b. Create a namespace for OADP:

   ```
   $ oc create namespace openshift-adp
   ```

   c. Create the OpenShift Container Platform secret:

   ```
   $ oc -n openshift-adp create secret generic cloud-credentials \
     --from-file=${SCRATCH}/credentials
   ```

   NOTE

   In OpenShift Container Platform versions 4.14 and later, the OADP Operator supports a new standardized STS workflow through the Operator Lifecycle Manager (OLM) and Cloud Credentials Operator (CCO). In this workflow, you do not need to create the above secret, you only need to supply the role ARN during the installation of OLM-managed operators using the OpenShift Container Platform web console, for more information see *Installing from OperatorHub using the web console*.

   The preceding secret is created automatically by CCO.

2. Install the OADP Operator:

   a. In the OpenShift Container Platform web console, browse to **Operators → OperatorHub**.

   b. Search for the **OADP Operator**.

   c. In the **role_ARN** field, paste the role_arn that you created previously and click **Install**.

3. Create AWS cloud storage using your AWS credentials by entering the following command:

   ```
   $ cat << EOF | oc create -f -
     apiVersion: oadp.openshift.io/v1alpha1
     kind: CloudStorage
     metadata:
       name: ${CLUSTER_NAME}-oadp
       namespace: openshift-adp
     spec:
       creationSecret:
         key: credentials
         name: cloud-credentials
       enableSharedConfig: true
       name: ${CLUSTER_NAME}-oadp
   ```

```
    provider: aws
    region: $REGION
EOF
```

4. Check your application's storage default storage class by entering the following command:

```
$ oc get pvc -n <namespace>
```

Example output

```
NAME     STATUS   VOLUME                                     CAPACITY   ACCESS MODES
STORAGECLASS   AGE
applog   Bound    pvc-351791ae-b6ab-4e8b-88a4-30f73caf5ef8   1Gi        RWO            gp3-
csi        4d19h
mysql    Bound    pvc-16b8e009-a20a-4379-accc-bc81fedd0621   1Gi        RWO            gp3-
csi        4d19h
```

5. Get the storage class by running the following command:

```
$ oc get storageclass
```

Example output

```
NAME              PROVISIONER             RECLAIMPOLICY   VOLUMEBINDINGMODE
ALLOWVOLUMEEXPANSION   AGE
gp2               kubernetes.io/aws-ebs   Delete          WaitForFirstConsumer   true
4d21h
gp2-csi           ebs.csi.aws.com         Delete          WaitForFirstConsumer   true
4d21h
gp3               ebs.csi.aws.com         Delete          WaitForFirstConsumer   true
4d21h
gp3-csi (default)   ebs.csi.aws.com         Delete          WaitForFirstConsumer   true
4d21h
```

NOTE

The following storage classes will work:

- gp3-csi
- gp2-csi
- gp3
- gp2

If the application or applications that are being backed up are all using persistent volumes (PVs) with Container Storage Interface (CSI), it is advisable to include the CSI plugin in the OADP DPA configuration.

6. Create the **DataProtectionApplication** resource to configure the connection to the storage where the backups and volume snapshots are stored:

a. If you are using only CSI volumes, deploy a Data Protection Application by entering the following command:

```
$ cat << EOF | oc create -f -
  apiVersion: oadp.openshift.io/v1alpha1
  kind: DataProtectionApplication
  metadata:
    name: ${CLUSTER_NAME}-dpa
    namespace: openshift-adp
  spec:
    backupImages: true (1)
    features:
      dataMover:
        enable: false
    backupLocations:
    - bucket:
        cloudStorageRef:
          name: ${CLUSTER_NAME}-oadp
        credential:
          key: credentials
          name: cloud-credentials
        prefix: velero
        default: true
        config:
          region: ${REGION}
    configuration:
      velero:
        defaultPlugins:
        - openshift
        - aws
        - csi
      restic:
        enable: false
EOF
```

(1) Set this field to **false** if you do not want to use image backup.

a. If you are using CSI or non-CSI volumes, deploy a Data Protection Application by entering the following command:

```
$ cat << EOF | oc create -f -
  apiVersion: oadp.openshift.io/v1alpha1
  kind: DataProtectionApplication
  metadata:
    name: ${CLUSTER_NAME}-dpa
    namespace: openshift-adp
  spec:
    backupImages: true (1)
    features:
      dataMover:
        enable: false
    backupLocations:
    - bucket:
        cloudStorageRef:
          name: ${CLUSTER_NAME}-oadp
```

```
      credential:
        key: credentials
        name: cloud-credentials
      prefix: velero
      default: true
      config:
        region: ${REGION}
  configuration:
    velero:
      defaultPlugins:
      - openshift
      - aws
    nodeAgent: 2
      enable: false
      uploaderType: restic
  snapshotLocations:
    - velero:
        config:
          credentialsFile: /tmp/credentials/openshift-adp/cloud-credentials-credentials 3
          enableSharedConfig: "true" 4
          profile: default 5
          region: ${REGION} 6
        provider: aws
EOF
```

1. Set this field to **false** if you do not want to use image backup.
2. See the important note regarding the **nodeAgent** attribute.
3. The **credentialsFile** field is the mounted location of the bucket credential on the pod.
4. The **enableSharedConfig** field allows the **snapshotLocations** to share or reuse the credential defined for the bucket.
5. Use the profile name set in the AWS credentials file.
6. Specify **region** as your AWS region. This must be the same as the cluster region.

You are now ready to back up and restore OpenShift Container Platform applications, as described in *Backing up applications*.

IMPORTANT

If you use OADP 1.2, replace this configuration:

```
nodeAgent:
  enable: false
  uploaderType: restic
```

with the following configuration:

```
restic:
  enable: false
```

If you want to use two different clusters for backing up and restoring, the two clusters must have the same AWS S3 storage names in both the cloud storage CR and the OADP **DataProtectionApplication** configuration.

Additional resources

- Installing from OperatorHub using the web console
- Backing up applications

5.20.1.3. Backing up workload on OADP AWS STS, with an optional cleanup

5.20.1.3.1. Performing a backup with OADP and AWS STS

The following example **hello-world** application has no persistent volumes (PVs) attached. Perform a backup with OpenShift API for Data Protection (OADP) with Amazon Web Services (AWS) (AWS STS).

Either Data Protection Application (DPA) configuration will work.

1. Create a workload to back up by running the following commands:

```
$ oc create namespace hello-world
```

```
$ oc new-app -n hello-world --image=docker.io/openshift/hello-openshift
```

2. Expose the route by running the following command:

```
$ oc expose service/hello-openshift -n hello-world
```

3. Check that the application is working by running the following command:

```
$ curl `oc get route/hello-openshift -n hello-world -o jsonpath='{.spec.host}'`
```

Example output

```
Hello OpenShift!
```

4. Back up the workload by running the following command:

```
$ cat << EOF | oc create -f -
  apiVersion: velero.io/v1
  kind: Backup
  metadata:
    name: hello-world
    namespace: openshift-adp
  spec:
    includedNamespaces:
    - hello-world
    storageLocation: ${CLUSTER_NAME}-dpa-1
    ttl: 720h0m0s
EOF
```

5. Wait until the backup has completed and then run the following command:

```
$ watch "oc -n openshift-adp get backup hello-world -o json | jq .status"
```

Example output

```
{
  "completionTimestamp": "2022-09-07T22:20:44Z",
  "expiration": "2022-10-07T22:20:22Z",
  "formatVersion": "1.1.0",
  "phase": "Completed",
  "progress": {
    "itemsBackedUp": 58,
    "totalItems": 58
  },
  "startTimestamp": "2022-09-07T22:20:22Z",
  "version": 1
}
```

6. Delete the demo workload by running the following command:

```
$ oc delete ns hello-world
```

7. Restore the workload from the backup by running the following command:

```
$ cat << EOF | oc create -f -
  apiVersion: velero.io/v1
  kind: Restore
  metadata:
    name: hello-world
    namespace: openshift-adp
  spec:
    backupName: hello-world
EOF
```

8. Wait for the Restore to finish by running the following command:

```
$ watch "oc -n openshift-adp get restore hello-world -o json | jq .status"
```

Example output

```
{
  "completionTimestamp": "2022-09-07T22:25:47Z",
  "phase": "Completed",
  "progress": {
    "itemsRestored": 38,
    "totalItems": 38
  },
  "startTimestamp": "2022-09-07T22:25:28Z",
  "warnings": 9
}
```

9. Check that the workload is restored by running the following command:

```
$ oc -n hello-world get pods
```

Example output

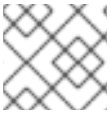
```
NAME                     READY   STATUS    RESTARTS   AGE
hello-openshift-9f885f7c6-kdjpj   1/1     Running   0          90s
```

10. Check the JSONPath by running the following command:

```
$ curl `oc get route/hello-openshift -n hello-world -o jsonpath='{.spec.host}'`
```

Example output

```
Hello OpenShift!
```



NOTE

For troubleshooting tips, see the OADP team's troubleshooting documentation.

5.20.1.3.2. Cleaning up a cluster after a backup with OADP and AWS STS

If you need to uninstall the OpenShift API for Data Protection (OADP) Operator together with the backups and the S3 bucket from this example, follow these instructions.

Procedure

1. Delete the workload by running the following command:

```
$ oc delete ns hello-world
```

2. Delete the Data Protection Application (DPA) by running the following command:

```
$ oc -n openshift-adp delete dpa ${CLUSTER_NAME}-dpa
```

3. Delete the cloud storage by running the following command:

```
$ oc -n openshift-adp delete cloudstorage ${CLUSTER_NAME}-oadp
```

IMPORTANT

If this command hangs, you might need to delete the finalizer by running the following command:

```
$ oc -n openshift-adp patch cloudstorage ${CLUSTER_NAME}-oadp -p
'{"metadata":{"finalizers":null}}' --type=merge
```

4. If the Operator is no longer required, remove it by running the following command:

```
$ oc -n openshift-adp delete subscription oadp-operator
```

5. Remove the namespace from the Operator by running the following command:

```
$ oc delete ns openshift-adp
```

6. If the backup and restore resources are no longer required, remove them from the cluster by running the following command:

```
$ oc delete backups.velero.io hello-world
```

7. To delete backup, restore and remote objects in AWS S3, run the following command:

```
$ velero backup delete hello-world
```

8. If you no longer need the Custom Resource Definitions (CRD), remove them from the cluster by running the following command:

```
$ for CRD in `oc get crds | grep velero | awk '{print $1}'`; do oc delete crd $CRD; done
```

9. Delete the AWS S3 bucket by running the following commands:

```
$ aws s3 rm s3://${CLUSTER_NAME}-oadp --recursive
```

```
$ aws s3api delete-bucket --bucket ${CLUSTER_NAME}-oadp
```

10. Detach the policy from the role by running the following command:

```
$ aws iam detach-role-policy --role-name "${ROLE_NAME}"  --policy-arn "${POLICY_ARN}"
```

11. Delete the role by running the following command:

```
$ aws iam delete-role --role-name "${ROLE_NAME}"
```

5.21. OADP AND 3SCALE

5.21.1. Backing up and restoring 3scale API Management by using OADP

With Red Hat 3scale API Management, you can manage your APIs for internal or external users. You can deploy 3scale components on-premise, in the cloud, as a managed service, or in any combination based on your requirements.

With OpenShift API for Data Protection (OADP), you can safeguard 3scale API Management deployments by backing up application resources, persistent volumes, and configurations.

NOTE

You can use the OpenShift API for Data Protection (OADP) Operator to back up and restore your 3scale API Management on-cluster storage databases without affecting your running services

You can configure OADP to perform the following operations with 3scale API Management:

- Create a backup of 3scale components by following the steps in Backing up 3scale API Management.

- Restore the components to scale up the 3scale operator and deployment by following the steps in Restoring 3scale API Management.

5.21.2. Backing up 3scale API Management by using OADP

You can back up Red Hat 3scale API Management components by backing up the 3scale operator, and databases such as MySQL and Redis.

Prerequisites

- You installed and configured Red Hat 3scale API Management. For more information, see Installing 3scale API Management on OpenShift and Red Hat 3scale API Management.

5.21.2.1. Creating the Data Protection Application

You can create a Data Protection Application (DPA) custom resource (CR) for Red Hat 3scale API Management.

Procedure

1. Create a YAML file with the following configuration:

Example dpa.yaml file

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: dpa-sample
  namespace: openshift-adp
spec:
  configuration:
    velero:
      defaultPlugins:
        - openshift
        - aws
        - csi
      resourceTimeout: 10m
    nodeAgent:
      enable: true
      uploaderType: kopia
  backupLocations:
    - name: default
      velero:
        provider: aws
        default: true
        objectStorage:
          bucket: <bucket_name> 1
          prefix: <prefix> 2
        config:
          region: <region> 3
          profile: "default"
          s3ForcePathStyle: "true"
          s3Url: <s3_url> 4
```

```
    credential:
      key: cloud
      name: cloud-credentials
```

1. Specify a bucket as the backup storage location. If the bucket is not a dedicated bucket for Velero backups, you must specify a prefix.
2. Specify a prefix for Velero backups, for example, velero, if the bucket is used for multiple purposes.
3. Specify a region for backup storage location.
4. Specify the URL of the object store that you are using to store backups.

2. Create the DPA CR by running the following command:

```
$ oc create -f dpa.yaml
```

Additional resources

- Installing the Data Protection Application

5.21.2.2. Backing up the 3scale API Management operator, secret, and APIManager

You can back up the Red Hat 3scale API Management operator resources, and both the **Secret** and APIManager custom resource (CR).

Prerequisites

- You created the Data Protection Application (DPA).

Procedure

1. Back up your 3scale operator CRs, such as **operatorgroup**, **namespaces**, and **subscriptions**, by creating a YAML file with the following configuration:

Example backup.yaml file

```
apiVersion: velero.io/v1
kind: Backup
metadata:
  name: operator-install-backup 1
  namespace: openshift-adp
spec:
  csiSnapshotTimeout: 10m0s
  defaultVolumesToFsBackup: false
  includedNamespaces:
  - threescale 2
  includedResources:
  - operatorgroups
  - subscriptions
  - namespaces
```

```
  itemOperationTimeout: 1h0m0s
  snapshotMoveData: false
  ttl: 720h0m0s
```

1. The value of the **metadata.name** parameter in the backup is the same value used in the **metadata.backupName** parameter used when restoring the 3scale operator.
2. Namespace where the 3scale operator is installed.

NOTE

You can also back up and restore **ReplicationControllers**, **Deployment**, and **Pod** objects to ensure that all manually set environments are backed up and restored. This does not affect the flow of restoration.

2. Create a backup CR by running the following command:

```
$ oc create -f backup.yaml
```

Example output

```
backup.velero.io/operator-install-backup created
```

3. Back up the **Secret** CR by creating a YAML file with the following configuration:

Example backup-secret.yaml file

```
apiVersion: velero.io/v1
kind: Backup
metadata:
  name: operator-resources-secrets 1
  namespace: openshift-adp
spec:
  csiSnapshotTimeout: 10m0s
  defaultVolumesToFsBackup: false
  includedNamespaces:
  - threescale
  includedResources:
  - secrets
  itemOperationTimeout: 1h0m0s
  labelSelector:
    matchLabels:
      app: 3scale-api-management
  snapshotMoveData: false
  snapshotVolumes: false
  ttl: 720h0m0s
```

1. The value of the **metadata.name** parameter in the backup is the same value used in the **metadata.backupName** parameter used when restoring the **Secret**.

4. Create the **Secret** backup CR by running the following command:

```
$ oc create -f backup-secret.yaml
```

Example output

```
backup.velero.io/operator-resources-secrets created
```

5. Back up the APIManager CR by creating a YAML file with the following configuration:

Example backup-apimanager.yaml file

```
apiVersion: velero.io/v1
kind: Backup
metadata:
  name: operator-resources-apim (1)
  namespace: openshift-adp
spec:
  csiSnapshotTimeout: 10m0s
  defaultVolumesToFsBackup: false
  includedNamespaces:
  - threescale
  includedResources:
  - apimanagers
  itemOperationTimeout: 1h0m0s
  snapshotMoveData: false
  snapshotVolumes: false
  storageLocation: ts-dpa-1
  ttl: 720h0m0s
  volumeSnapshotLocations:
  - ts-dpa-1
```

(1) The value of the **metadata.name** parameter in the backup is the same value used in the **metadata.backupName** parameter used when restoring the APIManager.

6. Create the APIManager CR by running the following command:

```
$ oc create -f backup-apimanager.yaml
```

Example output

```
backup.velero.io/operator-resources-apim created
```

Additional resources

- Creating a Backup CR

5.21.2.3. Backing up a MySQL database

You can back up a MySQL database by creating and attaching a persistent volume claim (PVC) to include the dumped data in the specified path.

Prerequisites

- You have backed up the Red Hat 3scale API Management operator.

Procedure

1. Create a YAML file with the following configuration for adding an additional PVC:

   Example ts_pvc.yaml file

```
kind: PersistentVolumeClaim
apiVersion: v1
metadata:
  name: example-claim
  namespace: threescale
spec:
  accessModes:
    - ReadWriteOnce
  resources:
    requests:
      storage: 1Gi
  storageClassName: gp3-csi
  volumeMode: Filesystem
```

2. Create the additional PVC by running the following command:

```
$ oc create -f ts_pvc.yml
```

3. Attach the PVC to the system database pod by editing the **system-mysql** deployment to use the MySQL dump:

```
$ oc edit deployment system-mysql -n threescale
```

```
volumeMounts:
  - name: example-claim
    mountPath: /var/lib/mysqldump/data
  - name: mysql-storage
    mountPath: /var/lib/mysql/data
  - name: mysql-extra-conf
    mountPath: /etc/my-extra.d
  - name: mysql-main-conf
    mountPath: /etc/my-extra
  ...
    serviceAccount: amp
volumes:
      - name: example-claim
        persistentVolumeClaim:
          claimName: example-claim 1
  ...
```

1 The PVC that contains the dumped data.

4. Create a YAML file with following configuration to back up the MySQL database:

   Example mysql.yaml file

```
apiVersion: velero.io/v1
kind: Backup
metadata:
  name: mysql-backup (1)
  namespace: openshift-adp
spec:
  csiSnapshotTimeout: 10m0s
  defaultVolumesToFsBackup: true
  hooks:
    resources:
    - name: dumpdb
      pre:
      - exec:
          command:
          - /bin/sh
          - -c
          - mysqldump -u $MYSQL_USER --password=$MYSQL_PASSWORD system --no-
tablespaces
            > /var/lib/mysqldump/data/dump.sql (2)
          container: system-mysql
          onError: Fail
          timeout: 5m
  includedNamespaces:
  - threescale
  includedResources: (3)
  - deployment
  - pods
  - replicationControllers
  - persistentvolumeclaims
  - persistentvolumes
  itemOperationTimeout: 1h0m0s
  labelSelector:
    matchLabels:
      app: 3scale-api-management
      threescale_component_element: mysql
  snapshotMoveData: false
  ttl: 720h0m0s
```

(1) The value of the **metadata.name** parameter in the backup is the same value used in the **metadata.backupName** parameter used when restoring the MySQL database.

(2) A directory where the data is backed up.

(3) Resources to back up.

5. Back up the MySQL database by running the following command:

```
$ oc create -f mysql.yaml
```

Example output

```
backup.velero.io/mysql-backup created
```

Verification

- Verify that the MySQL backup is completed by running the following command:

```
$ oc get backups.velero.io mysql-backup -o yaml
```

Example output

```
status:
completionTimestamp: "2025-04-17T13:25:19Z"
errors: 1
expiration: "2025-05-17T13:25:16Z"
formatVersion: 1.1.0
hookStatus: {}
phase: Completed
progress: {}
startTimestamp: "2025-04-17T13:25:16Z"
version: 1
```

5.21.2.4. Backing up the back-end Redis database

You can back up the Redis database by adding the required annotations and by listing which resources to back up using the **includedResources** parameter.

Prerequisites

- You backed up the Red Hat 3scale API Management operator.
- You backed up your MySQL database.
- The Redis queues have been drained before performing the backup.

Procedure

1. Edit the annotations on the **backend-redis** deployment by running the following command:

```
$ oc edit deployment backend-redis -n threescale
```

```
annotations:
post.hook.backup.velero.io/command: >-
        ["/bin/bash", "-c", "redis-cli CONFIG SET auto-aof-rewrite-percentage
        100"]
      pre.hook.backup.velero.io/command: >-
        ["/bin/bash", "-c", "redis-cli CONFIG SET auto-aof-rewrite-percentage
        0"]
```

2. Create a YAML file with the following configuration to back up the Redis database:

Example redis-backup.yaml file

```
apiVersion: velero.io/v1
kind: Backup
metadata:
```

```
  name: redis-backup (1)
  namespace: openshift-adp
spec:
  csiSnapshotTimeout: 10m0s
  defaultVolumesToFsBackup: true
  includedNamespaces:
  - threescale
  includedResources:
  - deployment
  - pods
  - replicationcontrollers
  - persistentvolumes
  - persistentvolumeclaims
  itemOperationTimeout: 1h0m0s
  labelSelector:
    matchLabels:
      app: 3scale-api-management
      threescale_component: backend
      threescale_component_element: redis
  snapshotMoveData: false
  snapshotVolumes: false
  ttl: 720h0m0s
```

(1) The value of the **metadata.name** parameter in the backup is the same value used in the **metadata.backupName** parameter used when restoring the restoring the Redis database.

3. Back up the Redis database by running the following command:

```
$ oc create -f redis-backup.yaml
```

Example output:

```
backup.velero.io/redis-backup created
```

Verification

- Verify that the Redis backup is completed by running the following command:

```
$ oc get backups.velero.io redis-backup -o yaml
```

Example output:

```
status:
completionTimestamp: "2025-04-17T13:25:19Z"
errors: 1
expiration: "2025-05-17T13:25:16Z"
formatVersion: 1.1.0
hookStatus: {}
phase: Completed
progress: {}
startTimestamp: "2025-04-17T13:25:16Z"
version: 1
```

5.21.3. Restoring 3scale API Management by using OADP

You can restore Red Hat 3scale API Management components by restoring the backed up 3scale operator resources. You can also restore databases such as MySQL and Redis.

After the data has been restored, you can scale up the 3scale operator and deployment.

Prerequisites

- You installed and configured Red Hat 3scale API Management. For more information, see Installing 3scale API Management on OpenShift and Red Hat 3scale API Management.
- You backed up the 3scale operator, and databases such as MySQL and Redis.
- Ensure that you are restoring 3scale on the same cluster where it was backed up from.
- If you want to restore 3scale on a different cluster, ensure that the original backed-up cluster and the cluster you want to restore the operator on are using the same custom domain.

5.21.3.1. Restoring the 3scale API Management operator, secrets, and APIManager

You can restore the Red Hat 3scale API Management operator resources, and both the **Secret** and APIManager custom resources (CRs) by using the following procedure.

Prerequisites

- You backed up the 3scale operator.
- You backed up the MySQL and Redis databases.
- You are restoring the database on the same cluster, where it was backed up.
  If you are restoring the operator to a different cluster that you backed up from, install and configure OADP with **nodeAgent** enabled on the destination cluster. Ensure that the OADP configuration is same as it was on the source cluster.

Procedure

1. Delete the 3scale operator custom resource definitions (CRDs) along with the **threescale** namespace by running the following command:

   ```
   $ oc delete project threescale
   ```

   Example output

   ```
   "threescale" project deleted successfully
   ```

2. Create a YAML file with the following configuration to restore the 3scale operator:

   Example restore.yaml file

   ```
   apiVersion: velero.io/v1
   kind: Restore
   metadata:
     name: operator-installation-restore
   ```

```
  namespace: openshift-adp
spec:
  backupName: operator-install-backup 1
  excludedResources:
  - nodes
  - events
  - events.events.k8s.io
  - backups.velero.io
  - restores.velero.io
  - resticrepositories.velero.io
  - csinodes.storage.k8s.io
  - volumeattachments.storage.k8s.io
  - backuprepositories.velero.io
  itemOperationTimeout: 4h0m0s
```

1 Restoring the 3scale operator's backup

3. Restore the 3scale operator by running the following command:

```
$ oc create -f restore.yaml
```

Example output

```
restore.velerio.io/operator-installation-restore created
```

4. Manually create the **s3-credentials Secret** object by running the following command:

```
$ oc apply -f - <<EOF
---
apiVersion: v1
kind: Secret
metadata:
    name: s3-credentials
    namespace: threescale
stringData:
  AWS_ACCESS_KEY_ID: <ID_123456> 1
  AWS_SECRET_ACCESS_KEY: <ID_98765544> 2
  AWS_BUCKET: <mybucket.example.com> 3
  AWS_REGION: <us-east-1> 4
type: Opaque
EOF
```

1 Replace <ID_123456> with your AWS credentials ID.

2 Replace <ID_98765544> with your AWS credentials KEY.

3 Replace <mybucket.example.com> with your target bucket name.

4 Replace <us-east-1> with the AWS region of your bucket.

5. Scale down the 3scale operator by running the following command:

```
$ oc scale deployment threescale-operator-controller-manager-v2 --replicas=0 -n threescale
```

Example output

```
deployment.apps/threescale-operator-controller-manager-v2 scaled
```

6. Create a YAML file with the following configuration to restore the **Secret**:

Example restore-secret.yaml file

```
apiVersion: velero.io/v1
kind: Restore
metadata:
  name: operator-resources-secrets
  namespace: openshift-adp
spec:
  backupName: operator-resources-secrets 1
  excludedResources:
  - nodes
  - events
  - events.events.k8s.io
  - backups.velero.io
  - restores.velero.io
  - resticrepositories.velero.io
  - csinodes.storage.k8s.io
  - volumeattachments.storage.k8s.io
  - backuprepositories.velero.io
  itemOperationTimeout: 4h0m0s
```

1 Restoring the **Secret** backup.

7. Restore the **Secret** by running the following command:

```
$ oc create -f restore-secrets.yaml
```

Example output

```
restore.velerio.io/operator-resources-secrets created
```

8. Create a YAML file with the following configuration to restore APIManager:

Example restore-apimanager.yaml file

```
apiVersion: velero.io/v1
kind: Restore
metadata:
  name: operator-resources-apim
  namespace: openshift-adp
spec:
  backupName: operator-resources-apim 1
  excludedResources: 2
  - nodes
```

```
    - events
    - events.events.k8s.io
    - backups.velero.io
    - restores.velero.io
    - resticrepositories.velero.io
    - csinodes.storage.k8s.io
    - volumeattachments.storage.k8s.io
    - backuprepositories.velero.io
  itemOperationTimeout: 4h0m0s
```

1. Restoring the APIManager backup.
2. The resources that you do not want to restore.

9. Restore the APIManager by running the following command:

```
$ oc create -f restore-apimanager.yaml
```

Example output

```
restore.velerio.io/operator-resources-apim created
```

10. Scale up the 3scale operator by running the following command:

```
$ oc scale deployment threescale-operator-controller-manager-v2 --replicas=1 -n threescale
```

Example output

```
deployment.apps/threescale-operator-controller-manager-v2 scaled
```

5.21.3.2. Restoring a MySQL database

Restoring a MySQL database re-creates the following resources:

- The **Pod**, **ReplicationController**, and **Deployment** objects.
- The additional persistent volumes (PVs) and associated persistent volume claims (PVCs).
- The MySQL dump, which the **example-claim** PVC contains.

WARNING

Do not delete the default PV and PVC associated with the database. If you do, your backups are deleted.

Prerequisites

- You restored the **Secret** and APIManager custom resources (CRs).

Procedure

1. Scale down the Red Hat 3scale API Management operator by running the following command:

```
$ oc scale deployment threescale-operator-controller-manager-v2 --replicas=0 -n threescale
```

Example output:

```
deployment.apps/threescale-operator-controller-manager-v2 scaled
```

2. Create the following script to scale down the 3scale operator:

```
$ vi ./scaledowndeployment.sh
```

Example script:

```
for deployment in apicast-production apicast-staging backend-cron backend-listener backend-redis backend-worker system-app system-memcache system-mysql system-redis system-searchd system-sidekiq zync zync-database zync-que; do
    oc scale deployment/$deployment --replicas=0 -n threescale
done
```

3. Scale down all the deployment 3scale components by running the following script:

```
$ ./scaledowndeployment.sh
```

Example output:

```
deployment.apps.openshift.io/apicast-production scaled
deployment.apps.openshift.io/apicast-staging scaled
deployment.apps.openshift.io/backend-cron scaled
deployment.apps.openshift.io/backend-listener scaled
deployment.apps.openshift.io/backend-redis scaled
deployment.apps.openshift.io/backend-worker scaled
deployment.apps.openshift.io/system-app scaled
deployment.apps.openshift.io/system-memcache scaled
deployment.apps.openshift.io/system-mysql scaled
deployment.apps.openshift.io/system-redis scaled
deployment.apps.openshift.io/system-searchd scaled
deployment.apps.openshift.io/system-sidekiq scaled
deployment.apps.openshift.io/zync scaled
deployment.apps.openshift.io/zync-database scaled
deployment.apps.openshift.io/zync-que scaled
```

4. Delete the **system-mysql Deployment** object by running the following command:

```
$ oc delete deployment system-mysql -n threescale
```

Example output:

```
Warning: apps.openshift.io/v1 deployment is deprecated in v4.14+, unavailable in v4.10000+
deployment.apps.openshift.io "system-mysql" deleted
```

5. Create the following YAML file to restore the MySQL database:

Example restore-mysql.yaml file

```
apiVersion: velero.io/v1
kind: Restore
metadata:
  name: restore-mysql
  namespace: openshift-adp
spec:
  backupName: mysql-backup (1)
  excludedResources:
    - nodes
    - events
    - events.events.k8s.io
    - backups.velero.io
    - restores.velero.io
    - csinodes.storage.k8s.io
    - volumeattachments.storage.k8s.io
    - backuprepositories.velero.io
    - resticrepositories.velero.io
  hooks:
    resources:
      - name: restoreDB
        postHooks:
          - exec:
              command:
                - /bin/sh
                - '-c'
                - >
                  sleep 30

                  mysql -h 127.0.0.1 -D system -u root
                  --password=$MYSQL_ROOT_PASSWORD <
                  /var/lib/mysqldump/data/dump.sql (2)
              container: system-mysql
              execTimeout: 80s
              onError: Fail
              waitTimeout: 5m
  itemOperationTimeout: 1h0m0s
  restorePVs: true
```

(1) Restoring the MySQL backup.

(2) A path where the data is restored from.

6. Restore the MySQL database by running the following command:

```
$ oc create -f restore-mysql.yaml
```

Example output

```
restore.velerio.io/restore-mysql created
```

Verification

1. Verify that the **PodVolumeRestore** restore is completed by running the following command:

```
$ oc get podvolumerestores.velero.io -n openshift-adp
```

Example output:

```
NAME                    NAMESPACE    POD                    UPLOADER TYPE    VOLUME
STATUS      TOTALBYTES   BYTESDONE   AGE
restore-mysql-rbzvm     threescale   system-mysql-2-kjkhl   kopia            mysql-storage
Completed   771879108    771879108   40m
restore-mysql-z7x7l     threescale   system-mysql-2-kjkhl   kopia            example-claim
Completed   380415       380415      40m
```

2. Verify that the additional PVC has been restored by running the following command:

```
$ oc get pvc -n threescale
```

Example output:

```
NAME                   STATUS   VOLUME                                     CAPACITY   ACCESS MODES
STORAGECLASS   VOLUMEATTRIBUTESCLASS   AGE
backend-redis-storage   Bound    pvc-3dca410d-3b9f-49d4-aebf-75f47152e09d   1Gi
RWO            gp3-csi        <unset>                 68m
example-claim           Bound    pvc-cbaa49b0-06cd-4b1a-9e90-0ef755c67a54   1Gi        RWO
gp3-csi        <unset>                 57m
mysql-storage           Bound    pvc-4549649f-b9ad-44f7-8f67-dd6b9dbb3896   1Gi        RWO
gp3-csi        <unset>                 68m
system-redis-storage    Bound    pvc-04dadafd-8a3e-4d00-8381-6041800a24fc   1Gi
RWO            gp3-csi        <unset>                 68m
system-searchd          Bound    pvc-afbf606c-d4a8-4041-8ec6-54c5baf1a3b9   1Gi        RWO
gp3-csi        <unset>                 68m
```

5.21.3.3. Restoring the back-end Redis database

You can restore the back-end Redis database by deleting the deployment and specifying which resources you do not want to restore.

Prerequisites

- You restored the Red Hat 3scale API Management operator resources, **Secret**, and APIManager custom resources.
- You restored the MySQL database.

Procedure

1. Delete the **backend-redis** deployment by running the following command:

```
$ oc delete deployment backend-redis -n threescale
```

Example output:

```
Warning: apps.openshift.io/v1 deployment is deprecated in v4.14+, unavailable in v4.10000+

deployment.apps.openshift.io "backend-redis" deleted
```

2. Create a YAML file with the following configuration to restore the Redis database:

Example restore-backend.yaml file

```
apiVersion: velero.io/v1
kind: Restore
metadata:
  name: restore-backend
  namespace: openshift-adp
spec:
  backupName: redis-backup 1
  excludedResources:
    - nodes
    - events
    - events.events.k8s.io
    - backups.velero.io
    - restores.velero.io
    - resticrepositories.velero.io
    - csinodes.storage.k8s.io
    - volumeattachments.storage.k8s.io
    - backuprepositories.velero.io
  itemOperationTimeout: 1h0m0s
  restorePVs: true
```

1 Restoring the Redis backup.

3. Restore the Redis database by running the following command:

```
$ oc create -f restore-backend.yaml
```

Example output

```
restore.velerio.io/restore-backend created
```

Verification

- Verify that the **PodVolumeRestore** restore is completed by running the following command:

```
$ oc get podvolumerestores.velero.io -n openshift-adp
```

Example output:

```
NAME                  NAMESPACE    POD                 UPLOADER TYPE   VOLUME
STATUS      TOTALBYTES   BYTESDONE   AGE
restore-backend-jmrwx   threescale   backend-redis-1-bsfmv   kopia          backend-redis-
storage   Completed   76123        76123       21m
```

5.21.3.4. Scaling up the 3scale API Management operator and deployment

You can scale up the Red Hat 3scale API Management operator and any deployment that was manually scaled down. After a few minutes, 3scale installation should be fully functional, and its state should match the backed-up state.

Prerequisites

- You restored the 3scale operator resources, and both the **Secret** and APIManager custom resources (CRs).
- You restored the MySQL and back-end Redis databases.
- Ensure that there are no scaled up deployments or no extra pods running. There might be some **system-mysql** or **backend-redis** pods running detached from deployments after restoration, which can be removed after the restoration is successful.

Procedure

1. Scale up the 3scale operator by running the following command:

```
$ oc scale deployment threescale-operator-controller-manager-v2 --replicas=1 -n threescale
```

Example output

```
deployment.apps/threescale-operator-controller-manager-v2 scaled
```

2. Ensure that the 3scale pod is running to verify if the 3scale operator was deployed by running the following command:

```
$ oc get pods -n threescale
```

Example output

```
NAME                                                READY   STATUS    RESTARTS   AGE
threescale-operator-controller-manager-v2-79546bd8c-b4qbh 1/1     Running   0
2m5s
```

3. Create the following script to scale up the deployments:

```
$ vi ./scaledeployment.sh
```

Example script file:

```
for deployment in apicast-production apicast-staging backend-cron backend-listener backend-
redis backend-worker system-app system-memcache system-mysql system-redis system-
searchd system-sidekiq zync zync-database zync-que; do
   oc scale deployment/$deployment --replicas=1 -n threescale
done
```

4. Scale up the deployments by running the following script:

```
$ ./scaledeployment.sh
```

Example output:

```
deployment.apps.openshift.io/apicast-production scaled
deployment.apps.openshift.io/apicast-staging scaled
deployment.apps.openshift.io/backend-cron scaled
deployment.apps.openshift.io/backend-listener scaled
deployment.apps.openshift.io/backend-redis scaled
deployment.apps.openshift.io/backend-worker scaled
deployment.apps.openshift.io/system-app scaled
deployment.apps.openshift.io/system-memcache scaled
deployment.apps.openshift.io/system-mysql scaled
deployment.apps.openshift.io/system-redis scaled
deployment.apps.openshift.io/system-searchd scaled
deployment.apps.openshift.io/system-sidekiq scaled
deployment.apps.openshift.io/zync scaled
deployment.apps.openshift.io/zync-database scaled
deployment.apps.openshift.io/zync-que scaled
```

5. Get the **3scale-admin** route to log in to the 3scale UI by running the following command:

```
$ oc get routes -n threescale
```

Example output

```
NAME                     HOST/PORT                                                                    PATH
SERVICES          PORT      TERMINATION     WILDCARD
backend                  backend-3scale.apps.custom-cluster-name.openshift.com
backend-listener     http      edge/Allow      None
zync-3scale-api-b4l4d        api-3scale-apicast-production.apps.custom-cluster-
name.openshift.com          apicast-production   gateway   edge/Redirect   None
zync-3scale-api-b6sns        api-3scale-apicast-staging.apps.custom-cluster-
name.openshift.com           apicast-staging      gateway   edge/Redirect   None
zync-3scale-master-7sc4j     master.apps.custom-cluster-name.openshift.com
system-master        http      edge/Redirect   None
zync-3scale-provider-7r2nm   3scale-admin.apps.custom-cluster-name.openshift.com
system-provider      http      edge/Redirect   None
zync-3scale-provider-mjxlb   3scale.apps.custom-cluster-name.openshift.com
system-developer     http      edge/Redirect   None
```

In this example, **3scale-admin.apps.custom-cluster-name.openshift.com** is the 3scale-admin URL.

6. Use the URL from this output to log in to the 3scale operator as an administrator. You can verify that the data, when you took backup, is available.

5.22. OADP DATA MOVER

5.22.1. About the OADP Data Mover

OpenShift API for Data Protection (OADP) includes a built-in Data Mover that you can use to move Container Storage Interface (CSI) volume snapshots to a remote object store. The built-in Data Mover allows you to restore stateful applications from the remote object store if a failure, accidental deletion,

or corruption of the cluster occurs. It uses Kopia as the uploader mechanism to read the snapshot data and write to the unified repository.

OADP supports CSI snapshots on the following:

- Red Hat OpenShift Data Foundation
- Any other cloud storage provider with the Container Storage Interface (CSI) driver that supports the Kubernetes Volume Snapshot API

5.22.1.1. Data Mover support

The OADP built-in Data Mover, which was introduced in OADP 1.3 as a Technology Preview, is now fully supported for both containerized and virtual machine workloads.

Supported

The Data Mover backups taken with OADP 1.3 can be restored using OADP 1.3, 1.4, and later. This is supported.

Not supported

Backups taken with OADP 1.1 or OADP 1.2 using the Data Mover feature cannot be restored using OADP 1.3 and later. Therefore, it is not supported.

OADP 1.1 and OADP 1.2 are no longer supported. The DataMover feature in OADP 1.1 or OADP 1.2 was a Technology Preview and was never supported. DataMover backups taken with OADP 1.1 or OADP 1.2 cannot be restored on later versions of OADP.

5.22.1.2. Enabling the built-in Data Mover

To enable the built-in Data Mover, you must include the CSI plugin and enable the node agent in the **DataProtectionApplication** custom resource (CR). The node agent is a Kubernetes daemonset that hosts data movement modules. These include the Data Mover controller, uploader, and the repository.

Example DataProtectionApplication manifest

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: dpa-sample
spec:
  configuration:
    nodeAgent:
      enable: true (1)
      uploaderType: kopia (2)
    velero:
      defaultPlugins:
      - openshift
      - aws
      - csi (3)
      defaultSnapshotMoveData: true
      defaultVolumesToFSBackup: (4)
      featureFlags:
      - EnableCSI
# ...
```

-

1. The flag to enable the node agent.
2. The type of uploader. The possible values are **restic** or **kopia**. The built-in Data Mover uses Kopia as the default uploader mechanism regardless of the value of the **uploaderType** field.
3. The CSI plugin included in the list of default plugins.
4. In OADP 1.3.1 and later, set to **true** if you use Data Mover only for volumes that opt out of **fs-backup**. Set to **false** if you use Data Mover by default for volumes.

5.22.1.3. Built-in Data Mover controller and custom resource definitions (CRDs)

The built-in Data Mover feature introduces three new API objects defined as CRDs for managing backup and restore:

- **DataDownload**: Represents a data download of a volume snapshot. The CSI plugin creates one **DataDownload** object per volume to be restored. The **DataDownload** CR includes information about the target volume, the specified Data Mover, the progress of the current data download, the specified backup repository, and the result of the current data download after the process is complete.
- **DataUpload**: Represents a data upload of a volume snapshot. The CSI plugin creates one **DataUpload** object per CSI snapshot. The **DataUpload** CR includes information about the specified snapshot, the specified Data Mover, the specified backup repository, the progress of the current data upload, and the result of the current data upload after the process is complete.
- **BackupRepository**: Represents and manages the lifecycle of the backup repositories. OADP creates a backup repository per namespace when the first CSI snapshot backup or restore for a namespace is requested.

5.22.1.4. About incremental back up support

OADP supports incremental backups of **block** and **Filesystem** persistent volumes for both containerized, and OpenShift Virtualization workloads. The following table summarizes the support for File System Backup (FSB), Container Storage Interface (CSI), and CSI Data Mover:

Table 5.6. OADP backup support matrix for containerized workloads

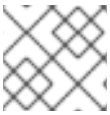
Volume mode	FSB - Restic	FSB - Kopia	CSI	CSI Data Mover
Filesystem	S [1], I [2]	S [1], I [2]	S [1]	S [1], I [2]
Block	N [3]	N [3]	S [1]	S [1], I [2]

Table 5.7. OADP backup support matrix for OpenShift Virtualization workloads

Volume mode	FSB - Restic	FSB - Kopia	CSI	CSI Data Mover
Filesystem	N [3]	N [3]	S [1]	S [1], I [2]

Volume mode	FSB - Restic	FSB - Kopia	CSI	CSI Data Mover
Block	N [3]	N [3]	S [1]	S [1], I [2]

1. Backup supported
2. Incremental backup supported
3. Not supported



NOTE

The CSI Data Mover backups use Kopia regardless of **uploaderType**.

5.22.2. Backing up and restoring CSI snapshots data movement

You can back up and restore persistent volumes by using the OADP 1.3 Data Mover.

5.22.2.1. Backing up persistent volumes with CSI snapshots

You can use the OADP Data Mover to back up Container Storage Interface (CSI) volume snapshots to a remote object store.

Prerequisites

- You have access to the cluster with the **cluster-admin** role.
- You have installed the OADP Operator.
- You have included the CSI plugin and enabled the node agent in the **DataProtectionApplication** custom resource (CR).
- You have an application with persistent volumes running in a separate namespace.
- You have added the **metadata.labels.velero.io/csi-volumesnapshot-class: "true"** key-value pair to the **VolumeSnapshotClass** CR.

Procedure

1. Create a YAML file for the **Backup** object, as in the following example:

Example Backup CR

```
kind: Backup
apiVersion: velero.io/v1
metadata:
  name: backup
  namespace: openshift-adp
spec:
  csiSnapshotTimeout: 10m0s
  defaultVolumesToFsBackup: 1
  includedNamespaces:
```

```
    - mysql-persistent
    itemOperationTimeout: 4h0m0s
    snapshotMoveData: true 2
    storageLocation: default
    ttl: 720h0m0s
    volumeSnapshotLocations:
    - dpa-sample-1
  # ...
```

1 Set to **true** if you use Data Mover only for volumes that opt out of **fs-backup**. Set to **false** if you use Data Mover by default for volumes.

2 Set to **true** to enable movement of CSI snapshots to remote object storage.

NOTE

If you format the volume by using XFS filesystem and the volume is at 100% capacity, the backup fails with a **no space left on device** error. For example:

```
Error: relabel failed /var/lib/kubelet/pods/3ac..34/volumes/ \
kubernetes.io~csi/pvc-684..12c/mount: lsetxattr /var/lib/kubelet/ \
pods/3ac..34/volumes/kubernetes.io~csi/pvc-68..2c/mount/data-xfs-103: \
no space left on device
```

In this scenario, consider resizing the volume or using a different filesystem type, for example, **ext4**, so that the backup completes successfully.

2. Apply the manifest:

```
$ oc create -f backup.yaml
```

A **DataUpload** CR is created after the snapshot creation is complete.

Verification

- Verify that the snapshot data is successfully transferred to the remote object store by monitoring the **status.phase** field of the **DataUpload** CR. Possible values are **In Progress**, **Completed**, **Failed**, or **Canceled**. The object store is configured in the **backupLocations** stanza of the **DataProtectionApplication** CR.
  - Run the following command to get a list of all **DataUpload** objects:

```
$ oc get datauploads -A
```

Example output

```
NAMESPACE       NAME              STATUS      STARTED   BYTES DONE   TOTAL
BYTES   STORAGE LOCATION   AGE     NODE
openshift-adp   backup-test-1-sw76b   Completed   9m47s     108104082    108104082
dpa-sample-1       9m47s   ip-10-0-150-57.us-west-2.compute.internal
openshift-adp   mongo-block-7dtpf     Completed   14m       1073741824   1073741824
dpa-sample-1       14m     ip-10-0-150-57.us-west-2.compute.internal
```

- Check the value of the **status.phase** field of the specific **DataUpload** object by running the following command:

```
$ oc get datauploads <dataupload_name> -o yaml
```

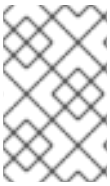
Example output

```
apiVersion: velero.io/v2alpha1
kind: DataUpload
metadata:
  name: backup-test-1-sw76b
  namespace: openshift-adp
spec:
  backupStorageLocation: dpa-sample-1
  csiSnapshot:
    snapshotClass: ""
    storageClass: gp3-csi
    volumeSnapshot: velero-mysql-fq8sl
  operationTimeout: 10m0s
  snapshotType: CSI
  sourceNamespace: mysql-persistent
  sourcePVC: mysql
status:
  completionTimestamp: "2023-11-02T16:57:02Z"
  node: ip-10-0-150-57.us-west-2.compute.internal
  path: /host_pods/15116bac-cc01-4d9b-8ee7-
609c3bef6bde/volumes/kubernetes.io~csi/pvc-eead8167-556b-461a-b3ec-
441749e291c4/mount
  phase: Completed (1)
  progress:
    bytesDone: 108104082
    totalBytes: 108104082
  snapshotID: 8da1c5febf25225f4577ada2aeb9f899
  startTimestamp: "2023-11-02T16:56:22Z"
```

(1) Indicates that snapshot data is successfully transferred to the remote object store.

5.22.2.2. Restoring CSI volume snapshots

You can restore a volume snapshot by creating a **Restore** CR.



NOTE

You cannot restore Volsync backups from OADP 1.2 with the OAPD 1.3 built-in Data Mover. It is recommended to do a file system backup of all of your workloads with Restic prior to upgrading to OADP 1.3.

Prerequisites

- You have access to the cluster with the **cluster-admin** role.
- You have an OADP **Backup** CR from which to restore the data.

Procedure

Procedure

1. Create a YAML file for the **Restore** CR, as in the following example:

Example Restore CR

```
apiVersion: velero.io/v1
kind: Restore
metadata:
  name: restore
  namespace: openshift-adp
spec:
  backupName: <backup>
# ...
```

2. Apply the manifest:

```
$ oc create -f restore.yaml
```

A **DataDownload** CR is created when the restore starts.

Verification

- You can monitor the status of the restore process by checking the **status.phase** field of the **DataDownload** CR. Possible values are **In Progress**, **Completed**, **Failed**, or **Canceled**.
  - To get a list of all **DataDownload** objects, run the following command:

```
$ oc get datadownloads -A
```

Example output

```
NAMESPACE       NAME                 STATUS      STARTED   BYTES DONE   TOTAL
BYTES   STORAGE LOCATION   AGE     NODE
openshift-adp   restore-test-1-sk7lg   Completed   7m11s     108104082    108104082
dpa-sample-1       7m11s   ip-10-0-150-57.us-west-2.compute.internal
```

  - Enter the following command to check the value of the **status.phase** field of the specific **DataDownload** object:

```
$ oc get datadownloads <datadownload_name> -o yaml
```

Example output

```
apiVersion: velero.io/v2alpha1
kind: DataDownload
metadata:
  name: restore-test-1-sk7lg
  namespace: openshift-adp
spec:
  backupStorageLocation: dpa-sample-1
  operationTimeout: 10m0s
  snapshotID: 8da1c5febf25225f4577ada2aeb9f899
  sourceNamespace: mysql-persistent
```

```
  targetVolume:
    namespace: mysql-persistent
    pv: ""
    pvc: mysql
status:
  completionTimestamp: "2023-11-02T17:01:24Z"
  node: ip-10-0-150-57.us-west-2.compute.internal
  phase: Completed (1)
  progress:
    bytesDone: 108104082
    totalBytes: 108104082
  startTimestamp: "2023-11-02T17:00:52Z"
```

1 Indicates that the CSI snapshot data is successfully restored.

5.22.2.3. Deletion policy for OADP 1.3

The deletion policy determines rules for removing data from a system, specifying when and how deletion occurs based on factors such as retention periods, data sensitivity, and compliance requirements. It manages data removal effectively while meeting regulations and preserving valuable information.

5.22.2.3.1. Deletion policy guidelines for OADP 1.3

Review the following deletion policy guidelines for the OADP 1.3:

- In OADP 1.3.x, when using any type of backup and restore methods, you can set the **deletionPolicy** field to **Retain** or **Delete** in the **VolumeSnapshotClass** custom resource (CR).

5.22.3. Overriding Kopia hashing, encryption, and splitter algorithms

You can override the default values of Kopia hashing, encryption, and splitter algorithms by using specific environment variables in the Data Protection Application (DPA).

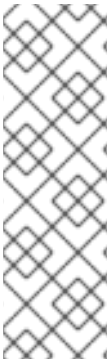
5.22.3.1. Configuring the DPA to override Kopia hashing, encryption, and splitter algorithms

You can use an OpenShift API for Data Protection (OADP) option to override the default Kopia algorithms for hashing, encryption, and splitter to improve Kopia performance or to compare performance metrics. You can set the following environment variables in the **spec.configuration.velero.podConfig.env** section of the DPA:

- **KOPIA_HASHING_ALGORITHM**
- **KOPIA_ENCRYPTION_ALGORITHM**
- **KOPIA_SPLITTER_ALGORITHM**

Prerequisites

- You have installed the OADP Operator.
- You have created the secret by using the credentials provided by the cloud provider.



NOTE

The configuration of the Kopia algorithms for splitting, hashing, and encryption in the Data Protection Application (DPA) apply only during the initial Kopia repository creation, and cannot be changed later.

To use different Kopia algorithms, ensure that the object storage does not contain any previous Kopia repositories of backups. Configure a new object storage in the Backup Storage Location (BSL) or specify a unique prefix for the object storage in the BSL configuration.

Procedure

- Configure the DPA with the environment variables for hashing, encryption, and splitter as shown in the following example.

Example DPA

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
#...
configuration:
  nodeAgent:
    enable: true (1)
    uploaderType: kopia (2)
  velero:
    defaultPlugins:
    - openshift
    - aws
    - csi (3)
    defaultSnapshotMoveData: true
    podConfig:
      env:
        - name: KOPIA_HASHING_ALGORITHM
          value: <hashing_algorithm_name> (4)
        - name: KOPIA_ENCRYPTION_ALGORITHM
          value: <encryption_algorithm_name> (5)
        - name: KOPIA_SPLITTER_ALGORITHM
          value: <splitter_algorithm_name> (6)
```

1. Enable the **nodeAgent**.
2. Specify the **uploaderType** as **kopia**.
3. Include the **csi** plugin.
4. Specify a hashing algorithm. For example, **BLAKE3-256**.
5. Specify an encryption algorithm. For example, **CHACHA20-POLY1305-HMAC-SHA256**.
6. Specify a splitter algorithm. For example, **DYNAMIC-8M-RABINKARP**.

5.22.3.2. Use case for overriding Kopia hashing, encryption, and splitter algorithms

The use case example demonstrates taking a backup of an application by using Kopia environment variables for hashing, encryption, and splitter. You store the backup in an AWS S3 bucket. You then verify the environment variables by connecting to the Kopia repository.

Prerequisites

- You have installed the OADP Operator.
- You have an AWS S3 bucket configured as the backup storage location.
- You have created the secret by using the credentials provided by the cloud provider.
- You have installed the Kopia client.
- You have an application with persistent volumes running in a separate namespace.

Procedure

1. Configure the Data Protection Application (DPA) as shown in the following example:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
name: <dpa_name> 1
namespace: openshift-adp
spec:
backupLocations:
- name: aws
  velero:
    config:
      profile: default
      region: <region_name> 2
    credential:
      key: cloud
      name: cloud-credentials 3
    default: true
    objectStorage:
      bucket: <bucket_name> 4
      prefix: velero
    provider: aws
configuration:
  nodeAgent:
    enable: true
    uploaderType: kopia
  velero:
    defaultPlugins:
    - openshift
    - aws
    - csi 5
    defaultSnapshotMoveData: true
    podConfig:
      env:
        - name: KOPIA_HASHING_ALGORITHM
          value: BLAKE3-256 6
        - name: KOPIA_ENCRYPTION_ALGORITHM
```

```
      value: CHACHA20-POLY1305-HMAC-SHA256 7
    - name: KOPIA_SPLITTER_ALGORITHM
      value: DYNAMIC-8M-RABINKARP 8
```

1. Specify a name for the DPA.
2. Specify the region for the backup storage location.
3. Specify the name of the default **Secret** object.
4. Specify the AWS S3 bucket name.
5. Include the **csi** plugin.
6. Specify the hashing algorithm as **BLAKE3-256**.
7. Specify the encryption algorithm as **CHACHA20-POLY1305-HMAC-SHA256**.
8. Specify the splitter algorithm as **DYNAMIC-8M-RABINKARP**.

2. Create the DPA by running the following command:

```
$ oc create -f <dpa_file_name> 1
```

1. Specify the file name of the DPA you configured.

3. Verify that the DPA has reconciled by running the following command:

```
$ oc get dpa -o yaml
```

4. Create a backup CR as shown in the following example:

Example backup CR

```
apiVersion: velero.io/v1
kind: Backup
metadata:
  name: test-backup
  namespace: openshift-adp
spec:
  includedNamespaces:
  - <application_namespace> 1
  defaultVolumesToFsBackup: true
```

1. Specify the namespace for the application installed in the cluster.

5. Create a backup by running the following command:

```
$ oc apply -f <backup_file_name> 1
```

1. Specify the name of the backup CR file.

6. Verify that the backup completed by running the following command:

```
$ oc get backups.velero.io <backup_name> -o yaml 1
```

1 Specify the name of the backup.

Verification

1. Connect to the Kopia repository by running the following command:

```
$ kopia repository connect s3 \
  --bucket=<bucket_name> \ 1
  --prefix=velero/kopia/<application_namespace> \ 2
  --password=static-passw0rd \ 3
  --access-key="<aws_s3_access_key>" \ 4
  --secret-access-key="<aws_s3_secret_access_key>" \ 5
```

1 Specify the AWS S3 bucket name.

2 Specify the namespace for the application.

3 This is the Kopia password to connect to the repository.

4 Specify the AWS S3 access key.

5 Specify the AWS S3 storage provider secret access key.

NOTE

If you are using a storage provider other than AWS S3, you will need to add **--endpoint**, the bucket endpoint URL parameter, to the command.

2. Verify that Kopia uses the environment variables that are configured in the DPA for the backup by running the following command:

```
$ kopia repository status
```

Example output

```
Config file:         /../.config/kopia/repository.config

Description:         Repository in S3: s3.amazonaws.com <bucket_name>
# ...

Storage type:        s3
Storage capacity:    unbounded
Storage config:      {
                       "bucket": <bucket_name>,
                       "prefix": "velero/kopia/<application_namespace>/",
                       "endpoint": "s3.amazonaws.com",
                       "accessKeyID": <access_key>,
```

```
                  "secretAccessKey": "****************************************",
                  "sessionToken": ""
                }

Unique ID:          58....aeb0
Hash:               BLAKE3-256
Encryption:         CHACHA20-POLY1305-HMAC-SHA256
Splitter:           DYNAMIC-8M-RABINKARP
Format version:     3
# ...
```

5.22.3.3. Benchmarking Kopia hashing, encryption, and splitter algorithms

You can run Kopia commands to benchmark the hashing, encryption, and splitter algorithms. Based on the benchmarking results, you can select the most suitable algorithm for your workload. In this procedure, you run the Kopia benchmarking commands from a pod on the cluster. The benchmarking results can vary depending on CPU speed, available RAM, disk speed, current I/O load, and so on.

Prerequisites

- You have installed the OADP Operator.
- You have an application with persistent volumes running in a separate namespace.
- You have run a backup of the application with Container Storage Interface (CSI) snapshots.

NOTE

The configuration of the Kopia algorithms for splitting, hashing, and encryption in the Data Protection Application (DPA) apply only during the initial Kopia repository creation, and cannot be changed later.

To use different Kopia algorithms, ensure that the object storage does not contain any previous Kopia repositories of backups. Configure a new object storage in the Backup Storage Location (BSL) or specify a unique prefix for the object storage in the BSL configuration.

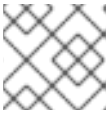
Procedure

1. Configure the **must-gather** pod as shown in the following example. Make sure you are using the **oadp-mustgather** image for OADP version 1.3 and later.

   Example pod configuration

```
apiVersion: v1
kind: Pod
metadata:
  name: oadp-mustgather-pod
  labels:
    purpose: user-interaction
spec:
  containers:
  - name: oadp-mustgather-container
```

```
image: registry.redhat.io/oadp/oadp-mustgather-rhel9:v1.3
command: ["sleep"]
args: ["infinity"]
```



NOTE

The Kopia client is available in the **oadp-mustgather** image.

2. Create the pod by running the following command:

```
$ oc apply -f <pod_config_file_name> 1
```

1 Specify the name of the YAML file for the pod configuration.

3. Verify that the Security Context Constraints (SCC) on the pod is **anyuid**, so that Kopia can connect to the repository.

```
$ oc describe pod/oadp-mustgather-pod | grep scc
```

Example output

```
openshift.io/scc: anyuid
```

4. Connect to the pod via SSH by running the following command:

```
$ oc -n openshift-adp rsh pod/oadp-mustgather-pod
```

5. Connect to the Kopia repository by running the following command:

```
sh-5.1# kopia repository connect s3 \
  --bucket=<bucket_name> \ 1
  --prefix=velero/kopia/<application_namespace> \ 2
  --password=static-passw0rd \ 3
  --access-key="<access_key>" \ 4
  --secret-access-key="<secret_access_key>" \ 5
  --endpoint=<bucket_endpoint> \ 6
```

1 Specify the object storage provider bucket name.

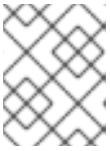
2 Specify the namespace for the application.

3 This is the Kopia password to connect to the repository.

4 Specify the object storage provider access key.

5 Specify the object storage provider secret access key.

6 Specify the bucket endpoint. You do not need to specify the bucket endpoint, if you are using AWS S3 as the storage provider.



NOTE

This is an example command. The command can vary based on the object storage provider.

6. To benchmark the hashing algorithm, run the following command:

```
sh-5.1# kopia benchmark hashing
```

Example output

```
Benchmarking hash 'BLAKE2B-256' (100 x 1048576 bytes, parallelism 1)
Benchmarking hash 'BLAKE2B-256-128' (100 x 1048576 bytes, parallelism 1)
Benchmarking hash 'BLAKE2S-128' (100 x 1048576 bytes, parallelism 1)
Benchmarking hash 'BLAKE2S-256' (100 x 1048576 bytes, parallelism 1)
Benchmarking hash 'BLAKE3-256' (100 x 1048576 bytes, parallelism 1)
Benchmarking hash 'BLAKE3-256-128' (100 x 1048576 bytes, parallelism 1)
Benchmarking hash 'HMAC-SHA224' (100 x 1048576 bytes, parallelism 1)
Benchmarking hash 'HMAC-SHA256' (100 x 1048576 bytes, parallelism 1)
Benchmarking hash 'HMAC-SHA256-128' (100 x 1048576 bytes, parallelism 1)
Benchmarking hash 'HMAC-SHA3-224' (100 x 1048576 bytes, parallelism 1)
Benchmarking hash 'HMAC-SHA3-256' (100 x 1048576 bytes, parallelism 1)
    Hash                 Throughput
-----------------------------------------------------------------
  0. BLAKE3-256           15.3 GB / second
  1. BLAKE3-256-128       15.2 GB / second
  2. HMAC-SHA256-128      6.4 GB / second
  3. HMAC-SHA256          6.4 GB / second
  4. HMAC-SHA224          6.4 GB / second
  5. BLAKE2B-256-128      4.2 GB / second
  6. BLAKE2B-256          4.1 GB / second
  7. BLAKE2S-256          2.9 GB / second
  8. BLAKE2S-128          2.9 GB / second
  9. HMAC-SHA3-224        1.6 GB / second
 10. HMAC-SHA3-256        1.5 GB / second
-----------------------------------------------------------------
Fastest option for this machine is: --block-hash=BLAKE3-256
```

7. To benchmark the encryption algorithm, run the following command:

```
sh-5.1# kopia benchmark encryption
```

Example output

```
Benchmarking encryption 'AES256-GCM-HMAC-SHA256'... (1000 x 1048576 bytes,
parallelism 1)
Benchmarking encryption 'CHACHA20-POLY1305-HMAC-SHA256'... (1000 x 1048576
bytes, parallelism 1)
    Encryption                     Throughput
-----------------------------------------------------------------
  0. AES256-GCM-HMAC-SHA256         2.2 GB / second
  1. CHACHA20-POLY1305-HMAC-SHA256  1.8 GB / second
-----------------------------------------------------------------
Fastest option for this machine is: --encryption=AES256-GCM-HMAC-SHA256
```

8. To benchmark the splitter algorithm, run the following command:

```
sh-5.1# kopia benchmark splitter
```

Example output

```
splitting 16 blocks of 32MiB each, parallelism 1
DYNAMIC                  747.6 MB/s count:107 min:9467 10th:2277562 25th:2971794
50th:4747177 75th:7603998 90th:8388608 max:8388608
DYNAMIC-128K-BUZHASH        718.5 MB/s count:3183 min:3076 10th:80896 25th:104312
50th:157621 75th:249115 90th:262144 max:262144
DYNAMIC-128K-RABINKARP      164.4 MB/s count:3160 min:9667 10th:80098 25th:106626
50th:162269 75th:250655 90th:262144 max:262144
# ...
FIXED-512K               102.9 TB/s count:1024 min:524288 10th:524288 25th:524288
50th:524288 75th:524288 90th:524288 max:524288
FIXED-8M                 566.3 TB/s count:64 min:8388608 10th:8388608 25th:8388608
50th:8388608 75th:8388608 90th:8388608 max:8388608
-----------------------------------------------------------------
  0. FIXED-8M                566.3 TB/s   count:64 min:8388608 10th:8388608 25th:8388608
50th:8388608 75th:8388608 90th:8388608 max:8388608
  1. FIXED-4M                425.8 TB/s   count:128 min:4194304 10th:4194304 25th:4194304
50th:4194304 75th:4194304 90th:4194304 max:4194304
  # ...
 22. DYNAMIC-128K-RABINKARP    164.4 MB/s   count:3160 min:9667 10th:80098
25th:106626 50th:162269 75th:250655 90th:262144 max:262144
```

5.23. APIS USED WITH OADP

The document provides information about the following APIs that you can use with OADP:

- Velero API
- OADP API

5.23.1. Velero API

Velero API documentation is maintained by Velero, not by Red Hat. It can be found at Velero API types.

5.23.2. OADP API

The following tables provide the structure of the OADP API:

Table 5.8. DataProtectionApplicationSpec

Property	Type	Description
backupLocations	[] **BackupLocation**	Defines the list of configurations to use for **BackupStorageLocations**.

Property	Type	Description
snapshotLocations	[] **SnapshotLocation**	Defines the list of configurations to use for **VolumeSnapshotLocations**.
unsupportedOverrides	map [UnsupportedImageKey] string	Can be used to override the deployed dependent images for development. Options are **veleroImageFqin**, **awsPluginImageFqin**, **openshiftPluginImageFqin**, **azurePluginImageFqin**, **gcpPluginImageFqin**, **csiPluginImageFqin**, **dataMoverImageFqin**, **resticRestoreImageFqin**, **kubevirtPluginImageFqin**, and **operator-type**.
podAnnotations	map [string] string	Used to add annotations to pods deployed by Operators.
podDnsPolicy	**DNSPolicy**	Defines the configuration of the DNS of a pod.
podDnsConfig	**PodDNSConfig**	Defines the DNS parameters of a pod in addition to those generated from **DNSPolicy**.
backupImages	*bool	Used to specify whether or not you want to deploy a registry for enabling backup and restore of images.
configuration	***ApplicationConfig**	Used to define the data protection application's server configuration.
features	***Features**	Defines the configuration for the DPA to enable the Technology Preview features.

Complete schema definitions for the OADP API .

Table 5.9. BackupLocation

Property	Type	Description

Property	Type	Description
velero	*velero.BackupStorageLocationSpec	Location to store volume snapshots, as described in Backup Storage Location.
bucket	*CloudStorageLocation	[Technology Preview] Automates creation of a bucket at some cloud storage providers for use as a backup storage location.

IMPORTANT

The **bucket** parameter is a Technology Preview feature only. 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 about the support scope of Red Hat Technology Preview features, see Technology Preview Features Support Scope .

Complete schema definitions for the type **BackupLocation**.

Table 5.10. SnapshotLocation

Property	Type	Description
velero	*VolumeSnapshotLocationSpec	Location to store volume snapshots, as described in Volume Snapshot Location.

Complete schema definitions for the type **SnapshotLocation**.

Table 5.11. ApplicationConfig

Property	Type	Description
velero	*VeleroConfig	Defines the configuration for the Velero server.
restic	*ResticConfig	Defines the configuration for the Restic server.

Complete schema definitions for the type **ApplicationConfig**.

Table 5.12. VeleroConfig

Property	Type	Description
featureFlags	[] string	Defines the list of features to enable for the Velero instance.
defaultPlugins	[] string	The following types of default Velero plugins can be installed: **aws**,**azure**, **csi**, **gcp**, **kubevirt**, and **openshift**.
customPlugins	[]CustomPlugin	Used for installation of custom Velero plugins. Default and custom plugins are described in OADP plugins
restoreResourcesVersionPriority	string	Represents a config map that is created if defined for use in conjunction with the **EnableAPIGroupVersions** feature flag. Defining this field automatically adds **EnableAPIGroupVersions** to the Velero server feature flag.
noDefaultBackupLocation	bool	To install Velero without a default backup storage location, you must set the **noDefaultBackupLocation** flag in order to confirm installation.
podConfig	***PodConfig**	Defines the configuration of the **Velero** pod.
logLevel	string	Velero server's log level (use **debug** for the most granular logging, leave unset for Velero default). Valid options are **trace**, **debug**, **info**, **warning**, **error**, **fatal**, and **panic**.

Complete schema definitions for the type **VeleroConfig**.

Table 5.13. CustomPlugin

Property	Type	Description
name	string	Name of custom plugin.
image	string	Image of custom plugin.

Complete schema definitions for the type **CustomPlugin**.

Table 5.14. ResticConfig

Property	Type	Description
enable	*bool	If set to **true**, enables backup and restore using Restic. If set to **false**, snapshots are needed.
supplementalGroups	[]int64	Defines the Linux groups to be applied to the **Restic** pod.
timeout	string	A user-supplied duration string that defines the Restic timeout. Default value is **1hr** (1 hour). A duration string is a possibly signed sequence of decimal numbers, each with optional fraction and a unit suffix, such as **300ms**, -1.5h` or **2h45m**. Valid time units are **ns**, **us** (or **µs**), **ms**, **s**, **m**, and **h**.
podConfig	***PodConfig**	Defines the configuration of the **Restic** pod.

Complete schema definitions for the type **ResticConfig**.

Table 5.15. PodConfig

Property	Type	Description
nodeSelector	map [string] string	Defines the **nodeSelector** to be supplied to a **Velero podSpec** or a **Restic podSpec**. For more details, see Configuring node agents and node labels.
tolerations	[]Toleration	Defines the list of tolerations to be applied to a Velero deployment or a Restic **daemonset**.
resourceAllocations	ResourceRequirements	Set specific resource **limits** and **requests** for a **Velero** pod or a **Restic** pod as described in Setting Velero CPU and memory resource allocations.
labels	map [string] string	Labels to add to pods.

5.23.2.1. Configuring node agents and node labels

The DPA of OADP uses the **nodeSelector** field to select which nodes can run the node agent. The **nodeSelector** field is the simplest recommended form of node selection constraint.

Any label specified must match the labels on each node.

The correct way to run the node agent on any node you choose is for you to label the nodes with a custom label:

```
$ oc label node/<node_name> node-role.kubernetes.io/nodeAgent=""
```

Use the same custom label in the **DPA.spec.configuration.nodeAgent.podConfig.nodeSelector**, which you used for labeling nodes. For example:

```
configuration:
  nodeAgent:
    enable: true
    podConfig:
      nodeSelector:
        node-role.kubernetes.io/nodeAgent: ""
```

The following example is an anti-pattern of **nodeSelector** and does not work unless both labels, **'node-role.kubernetes.io/infra: ""** and **'node-role.kubernetes.io/worker: ""**, are on the node:

```
    configuration:
      nodeAgent:
        enable: true
        podConfig:
          nodeSelector:
            node-role.kubernetes.io/infra: ""
            node-role.kubernetes.io/worker: ""
```

Complete schema definitions for the type **PodConfig**.

Table 5.16. Features

Property	Type	Description
dataMover	*[DataMover](#)	Defines the configuration of the Data Mover.

Complete schema definitions for the type **Features**.

Table 5.17. DataMover

Property	Type	Description
enable	bool	If set to **true**, deploys the volume snapshot mover controller and a modified CSI Data Mover plugin. If set to **false**, these are not deployed.

Property	Type	Description
credentialName	string	User-supplied Restic **Secret** name for Data Mover.
timeout	string	A user-supplied duration string for **VolumeSnapshotBackup** and **VolumeSnapshotRestore** to complete. Default is **10m** (10 minutes). A duration string is a possibly signed sequence of decimal numbers, each with optional fraction and a unit suffix, such as **300ms**, -1.5h` or **2h45m**. Valid time units are **ns**, **us** (or **µs**), **ms**, **s**, **m**, and **h**.

The OADP API is more fully detailed in OADP Operator.

5.24. ADVANCED OADP FEATURES AND FUNCTIONALITIES

This document provides information about advanced features and functionalities of OpenShift API for Data Protection (OADP).

5.24.1. Working with different Kubernetes API versions on the same cluster

5.24.1.1. Listing the Kubernetes API group versions on a cluster

A source cluster might offer multiple versions of an API, where one of these versions is the preferred API version. For example, a source cluster with an API named **Example** might be available in the **example.com/v1** and **example.com/v1beta2** API groups.

If you use Velero to back up and restore such a source cluster, Velero backs up only the version of that resource that uses the preferred version of its Kubernetes API.

To return to the above example, if **example.com/v1** is the preferred API, then Velero only backs up the version of a resource that uses **example.com/v1**. Moreover, the target cluster needs to have **example.com/v1** registered in its set of available API resources in order for Velero to restore the resource on the target cluster.

Therefore, you need to generate a list of the Kubernetes API group versions on your target cluster to be sure the preferred API version is registered in its set of available API resources.

Procedure

- Enter the following command:

```
$ oc api-resources
```

5.24.1.2. About Enable API Group Versions

By default, Velero only backs up resources that use the preferred version of the Kubernetes API. However, Velero also includes a feature, Enable API Group Versions, that overcomes this limitation. When enabled on the source cluster, this feature causes Velero to back up *all* Kubernetes API group versions that are supported on the cluster, not only the preferred one. After the versions are stored in the backup .tar file, they are available to be restored on the destination cluster.

For example, a source cluster with an API named **Example** might be available in the **example.com/v1** and **example.com/v1beta2** API groups, with **example.com/v1** being the preferred API.

Without the Enable API Group Versions feature enabled, Velero backs up only the preferred API group version for **Example**, which is **example.com/v1**. With the feature enabled, Velero also backs up **example.com/v1beta2**.

When the Enable API Group Versions feature is enabled on the destination cluster, Velero selects the version to restore on the basis of the order of priority of API group versions.

NOTE

Enable API Group Versions is still in beta.

Velero uses the following algorithm to assign priorities to API versions, with **1** as the top priority:

1. Preferred version of the *destination* cluster
2. Preferred version of the source_ cluster
3. Common non-preferred supported version with the highest Kubernetes version priority

Additional resources

- Enable API Group Versions Feature

5.24.1.3. Using Enable API Group Versions

You can use Velero's Enable API Group Versions feature to back up *all* Kubernetes API group versions that are supported on a cluster, not only the preferred one.

NOTE

Enable API Group Versions is still in beta.

Procedure

- Configure the **EnableAPIGroupVersions** feature flag:

```
apiVersion: oadp.openshift.io/vialpha1
kind: DataProtectionApplication
...
spec:
  configuration:
    velero:
      featureFlags:
      - EnableAPIGroupVersions
```

Additional resources

- Enable API Group Versions Feature

5.24.2. Backing up data from one cluster and restoring it to another cluster

5.24.2.1. About backing up data from one cluster and restoring it on another cluster

OpenShift API for Data Protection (OADP) is designed to back up and restore application data in the same OpenShift Container Platform cluster. Migration Toolkit for Containers (MTC) is designed to migrate containers, including application data, from one OpenShift Container Platform cluster to another cluster.

You can use OADP to back up application data from one OpenShift Container Platform cluster and restore it on another cluster. However, doing so is more complicated than using MTC or using OADP to back up and restore on the same cluster.

To successfully use OADP to back up data from one cluster and restore it to another cluster, you must take into account the following factors, in addition to the prerequisites and procedures that apply to using OADP to back up and restore data on the same cluster:

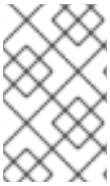
- Operators
- Use of Velero
- UID and GID ranges

5.24.2.1.1. Operators

You must exclude Operators from the backup of an application for backup and restore to succeed.

5.24.2.1.2. Use of Velero

Velero, which OADP is built upon, does not natively support migrating persistent volume snapshots across cloud providers. To migrate volume snapshot data between cloud platforms, you must *either* enable the Velero Restic file system backup option, which backs up volume contents at the file system level, *or* use the OADP Data Mover for CSI snapshots.



NOTE

In OADP 1.1 and earlier, the Velero Restic file system backup option is called **restic**. In OADP 1.2 and later, the Velero Restic file system backup option is called **file-system-backup**.

- You must also use Velero's File System Backup to migrate data between AWS regions or between Microsoft Azure regions.
- Velero does not support restoring data to a cluster with an *earlier* Kubernetes version than the source cluster.
- It is theoretically possible to migrate workloads to a destination with a *later* Kubernetes version than the source, but you must consider the compatibility of API groups between clusters for each custom resource. If a Kubernetes version upgrade breaks the compatibility of core or native API groups, you must first update the impacted custom resources.

5.24.2.2. About determining which pod volumes to back up

Before you start a backup operation by using File System Backup (FSB), you must specify which pods contain a volume that you want to back up. Velero refers to this process as "discovering" the appropriate pod volumes.

Velero supports two approaches for determining pod volumes. Use the opt-in or the opt-out approach to allow Velero to decide between an FSB, a volume snapshot, or a Data Mover backup.

- **Opt-in approach**: With the opt-in approach, volumes are backed up using snapshot or Data Mover by default. FSB is used on specific volumes that are opted-in by annotations.
- **Opt-out approach**: With the opt-out approach, volumes are backed up using FSB by default. Snapshots or Data Mover is used on specific volumes that are opted-out by annotations.

5.24.2.2.1. Limitations

- FSB does not support backing up and restoring **hostpath** volumes. However, FSB does support backing up and restoring local volumes.
- Velero uses a static, common encryption key for all backup repositories it creates. **This static key means that anyone who can access your backup storage can also decrypt your backup data**. It is essential that you limit access to backup storage.
- For PVCs, every incremental backup chain is maintained across pod reschedules.
  For pod volumes that are *not* PVCs, such as **emptyDir** volumes, if a pod is deleted or recreated, for example, by a **ReplicaSet** or a deployment, the next backup of those volumes will be a full backup and not an incremental backup. It is assumed that the lifecycle of a pod volume is defined by its pod.
- Even though backup data can be kept incrementally, backing up large files, such as a database, can take a long time. This is because FSB uses deduplication to find the difference that needs to be backed up.
- FSB reads and writes data from volumes by accessing the file system of the node on which the pod is running. For this reason, FSB can only back up volumes that are mounted from a pod and not directly from a PVC. Some Velero users have overcome this limitation by running a staging pod, such as a BusyBox or Alpine container with an infinite sleep, to mount these PVC and PV pairs before performing a Velero backup..
- FSB expects volumes to be mounted under **<hostPath>/<pod UID>**, with **<hostPath>** being configurable. Some Kubernetes systems, for example, vCluster, do not mount volumes under the **<pod UID>** subdirectory, and VFSB does not work with them as expected.

5.24.2.2.2. Backing up pod volumes by using the opt-in method

You can use the opt-in method to specify which volumes need to be backed up by File System Backup (FSB). You can do this by using the **backup.velero.io/backup-volumes** command.

Procedure

- On each pod that contains one or more volumes that you want to back up, enter the following command:

```
$ oc -n <your_pod_namespace> annotate pod/<your_pod_name> \
  backup.velero.io/backup-volumes=<your_volume_name_1>, \ <your_volume_name_2>>,...,
<your_volume_name_n>
```

where:

<your_volume_name_x>

specifies the name of the xth volume in the pod specification.

5.24.2.2.3. Backing up pod volumes by using the opt-out method

When using the opt-out approach, all pod volumes are backed up by using File System Backup (FSB), although there are some exceptions:

- Volumes that mount the default service account token, secrets, and configuration maps.
- **hostPath** volumes

You can use the opt-out method to specify which volumes **not** to back up. You can do this by using the **backup.velero.io/backup-volumes-excludes** command.

Procedure

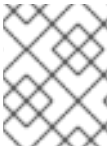
- On each pod that contains one or more volumes that you do not want to back up, run the following command:

```
$ oc -n <your_pod_namespace> annotate pod/<your_pod_name> \
  backup.velero.io/backup-volumes-excludes=<your_volume_name_1>, \
<your_volume_name_2>>,...,<your_volume_name_n>
```

where:

<your_volume_name_x>

specifies the name of the xth volume in the pod specification.



NOTE

You can enable this behavior for all Velero backups by running the **velero install** command with the **--default-volumes-to-fs-backup** flag.

5.24.2.3. UID and GID ranges

If you back up data from one cluster and restore it to another cluster, problems might occur with UID (User ID) and GID (Group ID) ranges. The following section explains these potential issues and mitigations:

Summary of the issues

The namespace UID and GID ranges might change depending on the destination cluster. OADP does not back up and restore OpenShift UID range metadata. If the backed up application requires a specific UID, ensure the range is availableupon restore. For more information about OpenShift's UID and GID ranges, see A Guide to OpenShift and UIDs .

Detailed description of the issues

When you create a namespace in OpenShift Container Platform by using the shell command **oc**

create namespace, OpenShift Container Platform assigns the namespace a unique User ID (UID) range from its available pool of UIDs, a Supplemental Group (GID) range, and unique SELinux MCS labels. This information is stored in the **metadata.annotations** field of the cluster. This information is part of the Security Context Constraints (SCC) annotations, which comprise of the following components:

- **openshift.io/sa.scc.mcs**
- **openshift.io/sa.scc.supplemental-groups**
- **openshift.io/sa.scc.uid-range**

When you use OADP to restore the namespace, it automatically uses the information in **metadata.annotations** without resetting it for the destination cluster. As a result, the workload might not have access to the backed up data if any of the following is true:

- There is an existing namespace with other SCC annotations, for example, on another cluster. In this case, OADP uses the existing namespace during the backup instead of the namespace you want to restore.
- A label selector was used during the backup, but the namespace in which the workloads are executed does not have the label. In this case, OADP does not back up the namespace, but creates a new namespace during the restore that does not contain the annotations of the backed up namespace. This results in a new UID range being assigned to the namespace. This can be an issue for customer workloads if OpenShift Container Platform assigns a pod a **securityContext** UID to a pod based on namespace annotations that have changed since the persistent volume data was backed up.
- The UID of the container no longer matches the UID of the file owner.
- An error occurs because OpenShift Container Platform has not changed the UID range of the destination cluster to match the backup cluster data. As a result, the backup cluster has a different UID than the destination cluster, which means that the application cannot read or write data on the destination cluster.

  Mitigations

  You can use one or more of the following mitigations to resolve the UID and GID range issues:

- Simple mitigations:
  - If you use a label selector in the **Backup** CR to filter the objects to include in the backup, be sure to add this label selector to the namespace that contains the workspace.
  - Remove any pre-existing version of a namespace on the destination cluster before attempting to restore a namespace with the same name.
- Advanced mitigations:
  - Fix UID ranges after migration by Resolving overlapping UID ranges in OpenShift namespaces after migration. Step 1 is optional.

For an in-depth discussion of UID and GID ranges in OpenShift Container Platform with an emphasis on overcoming issues in backing up data on one cluster and restoring it on another, see A Guide to OpenShift and UIDs.

5.24.2.4. Backing up data from one cluster and restoring it to another cluster

In general, you back up data from one OpenShift Container Platform cluster and restore it on another OpenShift Container Platform cluster in the same way that you back up and restore data to the same cluster. However, there are some additional prerequisites and differences in the procedure when backing up data from one OpenShift Container Platform cluster and restoring it on another.

Prerequisites

- All relevant prerequisites for backing up and restoring on your platform (for example, AWS, Microsoft Azure, GCP, and so on), especially the prerequisites for the Data Protection Application (DPA), are described in the relevant sections of this guide.

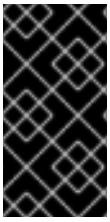
Procedure

1. Make the following additions to the procedures given for your platform:
   - Ensure that the backup store location (BSL) and volume snapshot location have the same names and paths to restore resources to another cluster.
   - Share the same object storage location credentials across the clusters.
   - For best results, use OADP to create the namespace on the destination cluster.
   - If you use the Velero **file-system-backup** option, enable the **--default-volumes-to-fs-backup** flag for use during backup by running the following command:

     ```
     $ velero backup create <backup_name> --default-volumes-to-fs-backup
     <any_other_options>
     ```

NOTE

In OADP 1.2 and later, the Velero Restic option is called **file-system-backup**.



IMPORTANT

Before restoring a CSI back up, edit the **VolumeSnapshotClass** custom resource (CR), and set the **snapshot.storage.kubernetes.io/is-default-class parameter** to false. Otherwise, the restore will partially fail due to the same value in the **VolumeSnapshotClass** in the target cluster for the same drive.

5.24.3. OADP storage class mapping

5.24.3.1. Storage class mapping

Storage class mapping allows you to define rules or policies specifying which storage class should be applied to different types of data. This feature automates the process of determining storage classes based on access frequency, data importance, and cost considerations. It optimizes storage efficiency and cost-effectiveness by ensuring that data is stored in the most suitable storage class for its characteristics and usage patterns.

You can use the **change-storage-class-config** field to change the storage class of your data objects, which lets you optimize costs and performance by moving data between different storage tiers, such as from standard to archival storage, based on your needs and access patterns.

5.24.3.1.1. Storage class mapping with Migration Toolkit for Containers

You can use the Migration Toolkit for Containers (MTC) to migrate containers, including application data, from one OpenShift Container Platform cluster to another cluster and for storage class mapping and conversion. You can convert the storage class of a persistent volume (PV) by migrating it within the same cluster. To do so, you must create and run a migration plan in the MTC web console.

5.24.3.1.2. Mapping storage classes with OADP

You can use OpenShift API for Data Protection (OADP) with the Velero plugin v1.1.0 and later to change the storage class of a persistent volume (PV) during restores, by configuring a storage class mapping in the config map in the Velero namespace.

To deploy ConfigMap with OADP, use the **change-storage-class-config** field. You must change the storage class mapping based on your cloud provider.

Procedure

1. Change the storage class mapping by running the following command:

```
$ cat change-storageclass.yaml
```

2. Create a config map in the Velero namespace as shown in the following example:

   Example

```
apiVersion: v1
kind: ConfigMap
metadata:
  name: change-storage-class-config
  namespace: openshift-adp
  labels:
    velero.io/plugin-config: ""
    velero.io/change-storage-class: RestoreItemAction
data:
  standard-csi: ssd-csi
```

3. Save your storage class mapping preferences by running the following command:

```
$ oc create -f change-storage-class-config
```

5.24.4. Additional resources

- Working with different Kubernetes API versions on the same cluster .
- Using Data Mover for CSI snapshots .
- Backing up applications with File System Backup: Kopia or Restic .
- Migration converting storage classes .

5.25. OADP TROUBLESHOOTING

5.25.1. Troubleshooting

You can troubleshoot OADP issues by using the following methods:

- Debug Velero custom resources (CRs) by using the OpenShift CLI tool or the Velero CLI tool. The Velero CLI tool provides more detailed logs and information.
- Debug Velero or Restic pod crashes, which are caused due to a lack of memory or CPU by using Pods crash or restart due to lack of memory or CPU .
- Debug issues with Velero and admission webhooks by using Issues with Velero and admission webhooks.
- Check OADP installation issues, OADP Operator issues, backup and restore CR issues , and Restic issues.
- Use the available OADP timeouts to reduce errors, retries, or failures.
- Collect logs and CR information by using the **must-gather** tool.
- Monitor and analyze the workload performance with the help of OADP monitoring.

5.25.2. Velero CLI tool

You can obtain the **velero** CLI tool by using the following options:

- Downloading the **velero** CLI tool
- Accessing the **velero** binary in the Velero deployment in the cluster

5.25.2.1. Downloading the Velero CLI tool

You can download and install the Velero CLI tool by following the instructions on the Velero documentation page.

The page includes instructions for:

- macOS by using Homebrew
- GitHub
- Windows by using Chocolatey

Prerequisites

- You have access to a Kubernetes cluster, v1.16 or later, with DNS and container networking enabled.
- You have installed **kubectl** locally.

Procedure

1. Open a browser and navigate to "Install the CLI" on the Velero website .
2. Follow the appropriate procedure for macOS, GitHub, or Windows.

3. Download the Velero version appropriate for your version of OADP and OpenShift Container Platform.

5.25.2.1.1. OADP-Velero-OpenShift Container Platform version relationship

OADP version	Velero version	OpenShift Container Platform version
1.3.0	1.12	4.12-4.15
1.3.1	1.12	4.12-4.15
1.3.2	1.12	4.12-4.15
1.3.3	1.12	4.12-4.15
1.3.4	1.12	4.12-4.15
1.3.5	1.12	4.12-4.15
1.4.0	1.14	4.14-4.18
1.4.1	1.14	4.14-4.18
1.4.2	1.14	4.14-4.18
1.4.3	1.14	4.14-4.18

5.25.2.2. Accessing the Velero binary in the Velero deployment in the cluster

You can use a shell command to access the Velero binary in the Velero deployment in the cluster.

Prerequisites

- Your **DataProtectionApplication** custom resource has a status of **Reconcile complete**.

Procedure

- Enter the following command to set the needed alias:

```
$ alias velero='oc -n openshift-adp exec deployment/velero -c velero -it -- ./velero'
```

5.25.2.3. Debugging Velero resources with the OpenShift CLI tool

You can debug a failed backup or restore by checking Velero custom resources (CRs) and the **Velero** pod log with the OpenShift CLI tool.

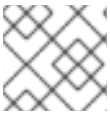
Velero CRs
Use the **oc describe** command to retrieve a summary of warnings and errors associated with a **Backup** or **Restore** CR:

```
$ oc describe <velero_cr> <cr_name>
```

Velero pod logs
Use the **oc logs** command to retrieve the **Velero** pod logs:

```
$ oc logs pod/<velero>
```

Velero pod debug logs
You can specify the Velero log level in the **DataProtectionApplication** resource as shown in the following example.



NOTE

This option is available starting from OADP 1.0.3.

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: velero-sample
spec:
  configuration:
    velero:
      logLevel: warning
```

The following **logLevel** values are available:

- **trace**
- **debug**
- **info**
- **warning**
- **error**
- **fatal**
- **panic**

It is recommended to use the **info logLevel** value for most logs.

5.25.2.4. Debugging Velero resources with the Velero CLI tool

You can debug **Backup** and **Restore** custom resources (CRs) and retrieve logs with the Velero CLI tool.

The Velero CLI tool provides more detailed information than the OpenShift CLI tool.

Syntax
Use the **oc exec** command to run a Velero CLI command:

```
$ oc -n openshift-adp exec deployment/velero -c velero -- ./velero \
  <backup_restore_cr> <command> <cr_name>
```

Example

```
$ oc -n openshift-adp exec deployment/velero -c velero -- ./velero \
  backup describe 0e44ae00-5dc3-11eb-9ca8-df7e5254778b-2d8ql
```

Help option
Use the **velero --help** option to list all Velero CLI commands:

```
$ oc -n openshift-adp exec deployment/velero -c velero -- ./velero \
  --help
```

Describe command
Use the **velero describe** command to retrieve a summary of warnings and errors associated with a **Backup** or **Restore** CR:

```
$ oc -n openshift-adp exec deployment/velero -c velero -- ./velero \
  <backup_restore_cr> describe <cr_name>
```

Example

```
$ oc -n openshift-adp exec deployment/velero -c velero -- ./velero \
  backup describe 0e44ae00-5dc3-11eb-9ca8-df7e5254778b-2d8ql
```

The following types of restore errors and warnings are shown in the output of a **velero describe** request:

- **Velero**: A list of messages related to the operation of Velero itself, for example, messages related to connecting to the cloud, reading a backup file, and so on
- **Cluster**: A list of messages related to backing up or restoring cluster-scoped resources
- **Namespaces**: A list of list of messages related to backing up or restoring resources stored in namespaces

One or more errors in one of these categories results in a **Restore** operation receiving the status of **PartiallyFailed** and not **Completed**. Warnings do not lead to a change in the completion status.

IMPORTANT

- For resource-specific errors, that is, **Cluster** and **Namespaces** errors, the **restore describe --details** output includes a resource list that lists all resources that Velero succeeded in restoring. For any resource that has such an error, check to see if the resource is actually in the cluster.
- If there are **Velero** errors, but no resource-specific errors, in the output of a **describe** command, it is possible that the restore completed without any actual problems in restoring workloads, but carefully validate post-restore applications. For example, if the output contains **PodVolumeRestore** or node agent-related errors, check the status of **PodVolumeRestores** and **DataDownloads**. If none of these are failed or still running, then volume data might have been fully restored.

Logs command
Use the **velero logs** command to retrieve the logs of a **Backup** or **Restore** CR:

```
$ oc -n openshift-adp exec deployment/velero -c velero -- ./velero \
  <backup_restore_cr> logs <cr_name>
```

Example

```
$ oc -n openshift-adp exec deployment/velero -c velero -- ./velero \
  restore logs ccc7c2d0-6017-11eb-afab-85d0007f5a19-x4lbf
```

5.25.3. Pods crash or restart due to lack of memory or CPU

If a Velero or Restic pod crashes due to a lack of memory or CPU, you can set specific resource requests for either of those resources.

The values for the resource request fields must follow the same format as Kubernetes resource requirements. If you do not specify **configuration.velero.podConfig.resourceAllocations** or **configuration.restic.podConfig.resourceAllocations**, see the following default **resources** specification configuration for a Velero or Restic pod:

```
requests:
  cpu: 500m
  memory: 128Mi
```

Additional resources

- Velero CPU and memory requirements based on collected data

5.25.3.1. Setting resource requests for a Velero pod

You can use the **configuration.velero.podConfig.resourceAllocations** specification field in the **oadp_v1alpha1_dpa.yaml** file to set specific resource requests for a **Velero** pod.

Procedure

- Set the **cpu** and **memory** resource requests in the YAML file:

  Example Velero file

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
...
configuration:
  velero:
    podConfig:
      resourceAllocations: 1
        requests:
          cpu: 200m
          memory: 256Mi
```

1 The **resourceAllocations** listed are for average usage.

5.25.3.2. Setting resource requests for a Restic pod

You can use the **configuration.restic.podConfig.resourceAllocations** specification field to set specific resource requests for a **Restic** pod.

Procedure

- Set the **cpu** and **memory** resource requests in the YAML file:

  Example Restic file

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
...
configuration:
  restic:
    podConfig:
      resourceAllocations: 1
        requests:
          cpu: 1000m
          memory: 16Gi
```

1 The **resourceAllocations** listed are for average usage.

5.25.4. Issues with Velero and admission webhooks

Velero has limited abilities to resolve admission webhook issues during a restore. If you have workloads with admission webhooks, you might need to use an additional Velero plugin or make changes to how you restore the workload.

Typically, workloads with admission webhooks require you to create a resource of a specific kind first. This is especially true if your workload has child resources because admission webhooks typically block child resources.

For example, creating or restoring a top-level object such as **service.serving.knative.dev** typically creates child resources automatically. If you do this first, you will not need to use Velero to create and restore these resources. This avoids the problem of child resources being blocked by an admission webhook that Velero might use.

5.25.4.1. Restoring workarounds for Velero backups that use admission webhooks

You need additional steps to restore resources for several types of Velero backups that use admission webhooks.

5.25.4.1.1. Restoring Knative resources

You might encounter problems using Velero to back up Knative resources that use admission webhooks.

You can avoid such problems by restoring the top level **Service** resource first whenever you back up and restore Knative resources that use admission webhooks.

Procedure

- Restore the top level **service.serving.knavtive.dev Service** resource:

```
$ velero restore <restore_name> \
  --from-backup=<backup_name> --include-resources \
  service.serving.knavtive.dev
```

5.25.4.1.2. Restoring IBM AppConnect resources

If you experience issues when you use Velero to a restore an IBM® AppConnect resource that has an admission webhook, you can run the checks in this procedure.

Procedure

1. Check if you have any mutating admission plugins of **kind: MutatingWebhookConfiguration** in the cluster:

```
$ oc get mutatingwebhookconfigurations
```

2. Examine the YAML file of each **kind: MutatingWebhookConfiguration** to ensure that none of its rules block creation of the objects that are experiencing issues. For more information, see the official Kubernetes documentation.

3. Check that any **spec.version** in **type: Configuration.appconnect.ibm.com/v1beta1** used at backup time is supported by the installed Operator.

5.25.4.2. OADP plugins known issues

The following section describes known issues in OpenShift API for Data Protection (OADP) plugins:

5.25.4.2.1. Velero plugin panics during imagestream backups due to a missing secret

When the backup and the Backup Storage Location (BSL) are managed outside the scope of the Data Protection Application (DPA), the OADP controller, meaning the DPA reconciliation does not create the relevant **oadp-<bsl_name>-<bsl_provider>-registry-secret**.

When the backup is run, the OpenShift Velero plugin panics on the imagestream backup, with the following panic error:

```
024-02-27T10:46:50.028951744Z time="2024-02-27T10:46:50Z" level=error msg="Error backing up
item"
backup=openshift-adp/<backup name> error="error executing custom action
(groupResource=imagestreams.image.openshift.io,
namespace=<BSL Name>, name=postgres): rpc error: code = Aborted desc = plugin panicked:
runtime error: index out of range with length 1, stack trace: goroutine 94…
```

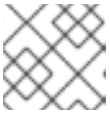
5.25.4.2.1.1. Workaround to avoid the panic error

To avoid the Velero plugin panic error, perform the following steps:

1. Label the custom BSL with the relevant label:

```
$ oc label backupstoragelocations.velero.io <bsl_name> app.kubernetes.io/component=bsl
```

2. After the BSL is labeled, wait until the DPA reconciles.



NOTE

You can force the reconciliation by making any minor change to the DPA itself.

3. When the DPA reconciles, confirm that the relevant **oadp-<bsl_name>-<bsl_provider>-registry-secret** has been created and that the correct registry data has been populated into it:

```
$ oc -n openshift-adp get secret/oadp-<bsl_name>-<bsl_provider>-registry-secret -o json | jq -r '.data'
```

5.25.4.2.2. OpenShift ADP Controller segmentation fault

If you configure a DPA with both **cloudstorage** and **restic** enabled, the **openshift-adp-controller-manager** pod crashes and restarts indefinitely until the pod fails with a crash loop segmentation fault.

You can have either **velero** or **cloudstorage** defined, because they are mutually exclusive fields.

- If you have both **velero** and **cloudstorage** defined, the **openshift-adp-controller-manager** fails.
- If you have neither **velero** nor **cloudstorage** defined, the **openshift-adp-controller-manager** fails.

For more information about this issue, see OADP-1054.

5.25.4.2.2.1. OpenShift ADP Controller segmentation fault workaround

You must define either **velero** or **cloudstorage** when you configure a DPA. If you define both APIs in your DPA, the **openshift-adp-controller-manager** pod fails with a crash loop segmentation fault.

5.25.4.3. Velero plugins returning "received EOF, stopping recv loop" message

NOTE

Velero plugins are started as separate processes. After the Velero operation has completed, either successfully or not, they exit. Receiving a **received EOF, stopping recv loop** message in the debug logs indicates that a plugin operation has completed. It does not mean that an error has occurred.

Additional resources

- Admission plugins
- Webhook admission plugins
- Types of webhook admission plugins

5.25.5. OADP installation issues

You might encounter issues caused by using invalid directories or incorrect credentials when you install the Data Protection Application.

5.25.5.1. Backup storage contains invalid directories

The **Velero** pod log displays the following error message: **Backup storage contains invalid top-level directories**.

Cause

The object storage contains top-level directories that are not Velero directories.

Solution

If the object storage is not dedicated to Velero, you must specify a prefix for the bucket by setting the **spec.backupLocations.velero.objectStorage.prefix** parameter in the **DataProtectionApplication** manifest.

5.25.5.2. Incorrect AWS credentials

The **oadp-aws-registry** pod log displays the following error message: **InvalidAccessKeyId: The AWS Access Key Id you provided does not exist in our records.**

The **Velero** pod log displays the following error message: **NoCredentialProviders: no valid providers in chain**.

Cause

The **credentials-velero** file used to create the **Secret** object is incorrectly formatted.

Solution

Ensure that the **credentials-velero** file is correctly formatted, as in the following example:

Example credentials-velero file

```
[default] 1
aws_access_key_id=AKIAIOSFODNN7EXAMPLE 2
aws_secret_access_key=wJalrXUtnFEMI/K7MDENG/bPxRfiCYEXAMPLEKEY
```

1 AWS default profile.

2 Do not enclose the values with quotation marks (**"**, **'**).

5.25.6. OADP Operator issues

The OpenShift API for Data Protection (OADP) Operator might encounter issues caused by problems it is not able to resolve.

5.25.6.1. OADP Operator fails silently

The S3 buckets of an OADP Operator might be empty, but when you run the command **oc get po -n <oadp_operator_namespace>**, you see that the Operator has a status of **Running**. In such a case, the Operator is said to have *failed silently* because it incorrectly reports that it is running.

Cause

The problem is caused when cloud credentials provide insufficient permissions.

Solution

Retrieve a list of backup storage locations (BSLs) and check the manifest of each BSL for credential issues.

Procedure

1. Retrieve a list of BSLs by using either the OpenShift or Velero command-line interface (CLI):
   a. Retrieve a list of BSLs by using the OpenShift CLI (**oc**):

```
$ oc get backupstoragelocations.velero.io -A
```

   b. Retrieve a list of BSLs by using the **velero** CLI:

```
$ velero backup-location get -n <oadp_operator_namespace>
```

2. Use the list of BSLs from the previous step and run the following command to examine the manifest of each BSL for an error:

```
$ oc get backupstoragelocations.velero.io -n <namespace> -o yaml
```

Example result

```
apiVersion: v1
items:
- apiVersion: velero.io/v1
  kind: BackupStorageLocation
  metadata:
    creationTimestamp: "2023-11-03T19:49:04Z"
    generation: 9703
    name: example-dpa-1
    namespace: openshift-adp-operator
    ownerReferences:
    - apiVersion: oadp.openshift.io/v1alpha1
      blockOwnerDeletion: true
      controller: true
      kind: DataProtectionApplication
      name: example-dpa
      uid: 0beeeaff-0287-4f32-bcb1-2e3c921b6e82
    resourceVersion: "24273698"
    uid: ba37cd15-cf17-4f7d-bf03-8af8655cea83
  spec:
    config:
      enableSharedConfig: "true"
      region: us-west-2
    credential:
      key: credentials
      name: cloud-credentials
    default: true
    objectStorage:
      bucket: example-oadp-operator
      prefix: example
    provider: aws
  status:
    lastValidationTime: "2023-11-10T22:06:46Z"
    message: "BackupStorageLocation \"example-dpa-1\" is unavailable: rpc
```

```
      error: code = Unknown desc = WebIdentityErr: failed to retrieve credentials\ncaused
      by: AccessDenied: Not authorized to perform sts:AssumeRoleWithWebIdentity\n\tstatus
      code: 403, request id: d3f2e099-70a0-467b-997e-ff62345e3b54"
    phase: Unavailable
kind: List
metadata:
  resourceVersion: ""
```

5.25.7. OADP timeouts

Extending a timeout allows complex or resource-intensive processes to complete successfully without premature termination. This configuration can reduce errors, retries, or failures.

Ensure that you balance timeout extensions in a logical manner so that you do not configure excessively long timeouts that might hide underlying issues in the process. Consider and monitor an appropriate timeout value that meets the needs of the process and the overall system performance.

The following OADP timeouts show instructions of how and when to implement these parameters:

- Restic timeout
- Velero resource timeout
- Data Mover timeout
- CSI snapshot timeout
- Item operation timeout - backup
- Item operation timeout - restore

5.25.7.1. Restic timeout

The **spec.configuration.nodeAgent.timeout** parameter defines the Restic timeout. The default value is **1h**.

Use the Restic **timeout** parameter in the **nodeAgent** section for the following scenarios:

- For Restic backups with total PV data usage that is greater than 500GB.
- If backups are timing out with the following error:

```
level=error msg="Error backing up item" backup=velero/monitoring error="timed out waiting for all PodVolumeBackups to complete"
```

Procedure

- Edit the values in the **spec.configuration.nodeAgent.timeout** block of the **DataProtectionApplication** custom resource (CR) manifest, as shown in the following example:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
 name: <dpa_name>
spec:
```

```
  configuration:
    nodeAgent:
      enable: true
      uploaderType: restic
      timeout: 1h
# ...
```

5.25.7.2. Velero resource timeout

resourceTimeout defines how long to wait for several Velero resources before timeout occurs, such as Velero custom resource definition (CRD) availability, **volumeSnapshot** deletion, and repository availability. The default is **10m**.

Use the **resourceTimeout** for the following scenarios:

- For backups with total PV data usage that is greater than 1TB. This parameter is used as a timeout value when Velero tries to clean up or delete the Container Storage Interface (CSI) snapshots, before marking the backup as complete.
    - A sub-task of this cleanup tries to patch VSC and this timeout can be used for that task.
- To create or ensure a backup repository is ready for filesystem based backups for Restic or Kopia.
- To check if the Velero CRD is available in the cluster before restoring the custom resource (CR) or resource from the backup.

Procedure

- Edit the values in the **spec.configuration.velero.resourceTimeout** block of the **DataProtectionApplication** CR manifest, as in the following example:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
 name: <dpa_name>
spec:
  configuration:
    velero:
      resourceTimeout: 10m
# ...
```

5.25.7.2.1. Velero default item operation timeout

defaultItemOperationTimeout defines how long to wait on asynchronous **BackupItemActions** and **RestoreItemActions** to complete before timing out. The default value is **1h**.

Use the **defaultItemOperationTimeout** for the following scenarios:

- Only with Data Mover 1.2.x.
- To specify the amount of time a particular backup or restore should wait for the Asynchronous actions to complete. In the context of OADP features, this value is used for the Asynchronous actions involved in the Container Storage Interface (CSI) Data Mover feature.

- When **defaultItemOperationTimeout** is defined in the Data Protection Application (DPA) using the **defaultItemOperationTimeout**, it applies to both backup and restore operations. You can use **itemOperationTimeout** to define only the backup or only the restore of those CRs, as described in the following "Item operation timeout - restore", and "Item operation timeout - backup" sections.

Procedure

- Edit the values in the **spec.configuration.velero.defaultItemOperationTimeout** block of the **DataProtectionApplication** CR manifest, as in the following example:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
 name: <dpa_name>
spec:
  configuration:
    velero:
      defaultItemOperationTimeout: 1h
# ...
```

5.25.7.3. Data Mover timeout

timeout is a user-supplied timeout to complete **VolumeSnapshotBackup** and **VolumeSnapshotRestore**. The default value is **10m**.

Use the Data Mover **timeout** for the following scenarios:

- If creation of **VolumeSnapshotBackups** (VSBs) and **VolumeSnapshotRestores** (VSRs), times out after 10 minutes.
- For large scale environments with total PV data usage that is greater than 500GB. Set the timeout for **1h**.
- With the **VolumeSnapshotMover** (VSM) plugin.
- Only with OADP 1.1.x.

Procedure

- Edit the values in the **spec.features.dataMover.timeout** block of the **DataProtectionApplication** CR manifest, as in the following example:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
 name: <dpa_name>
spec:
  features:
    dataMover:
      timeout: 10m
# ...
```

5.25.7.4. CSI snapshot timeout

CSISnapshotTimeout specifies the time during creation to wait until the **CSI VolumeSnapshot** status becomes **ReadyToUse**, before returning error as timeout. The default value is **10m**.

Use the **CSISnapshotTimeout** for the following scenarios:

- With the CSI plugin.
- For very large storage volumes that may take longer than 10 minutes to snapshot. Adjust this timeout if timeouts are found in the logs.

NOTE

Typically, the default value for **CSISnapshotTimeout** does not require adjustment, because the default setting can accommodate large storage volumes.

Procedure

- Edit the values in the **spec.csiSnapshotTimeout** block of the **Backup** CR manifest, as in the following example:

```
apiVersion: velero.io/v1
kind: Backup
metadata:
 name: <backup_name>
spec:
 csiSnapshotTimeout: 10m
# ...
```

5.25.7.5. Item operation timeout - restore

ItemOperationTimeout specifies the time that is used to wait for **RestoreItemAction** operations. The default value is **1h**.

Use the restore **ItemOperationTimeout** for the following scenarios:

- Only with Data Mover 1.2.x.
- For Data Mover uploads and downloads to or from the **BackupStorageLocation**. If the restore action is not completed when the timeout is reached, it will be marked as failed. If Data Mover operations are failing due to timeout issues, because of large storage volume sizes, then this timeout setting may need to be increased.

Procedure

- Edit the values in the **Restore.spec.itemOperationTimeout** block of the **Restore** CR manifest, as in the following example:

```
apiVersion: velero.io/v1
kind: Restore
metadata:
 name: <restore_name>
spec:
 itemOperationTimeout: 1h
# ...
```

5.25.7.6. Item operation timeout - backup

ItemOperationTimeout specifies the time used to wait for asynchronous **BackupItemAction** operations. The default value is **1h**.

Use the backup **ItemOperationTimeout** for the following scenarios:

- Only with Data Mover 1.2.x.
- For Data Mover uploads and downloads to or from the **BackupStorageLocation**. If the backup action is not completed when the timeout is reached, it will be marked as failed. If Data Mover operations are failing due to timeout issues, because of large storage volume sizes, then this timeout setting may need to be increased.

Procedure

- Edit the values in the **Backup.spec.itemOperationTimeout** block of the **Backup** CR manifest, as in the following example:

```
apiVersion: velero.io/v1
kind: Backup
metadata:
 name: <backup_name>
spec:
 itemOperationTimeout: 1h
# ...
```

5.25.8. Backup and Restore CR issues

You might encounter these common issues with **Backup** and **Restore** custom resources (CRs).

5.25.8.1. Backup CR cannot retrieve volume

The **Backup** CR displays the following error message: **InvalidVolume.NotFound: The volume 'vol-xxxx' does not exist**.

Cause

The persistent volume (PV) and the snapshot locations are in different regions.

Solution

1. Edit the value of the **spec.snapshotLocations.velero.config.region** key in the **DataProtectionApplication** manifest so that the snapshot location is in the same region as the PV.
2. Create a new **Backup** CR.

5.25.8.2. Backup CR status remains in progress

The status of a **Backup** CR remains in the **InProgress** phase and does not complete.

Cause

If a backup is interrupted, it cannot be resumed.

Solution

1. Retrieve the details of the **Backup** CR by running the following command:

```
$ oc -n {namespace} exec deployment/velero -c velero -- ./velero \
  backup describe <backup>
```

2. Delete the **Backup** CR by running the following command:

```
$ oc delete backups.velero.io <backup> -n openshift-adp
```

   You do not need to clean up the backup location because an in progress **Backup** CR has not uploaded files to object storage.

3. Create a new **Backup** CR.

4. View the Velero backup details by running the following command:

```
$ velero backup describe <backup-name> --details
```

5.25.8.3. Backup CR status remains in PartiallyFailed

The status of a **Backup** CR without Restic in use remains in the **PartiallyFailed** phase and is not completed. A snapshot of the affiliated PVC is not created.

Cause

If the backup created based on the CSI snapshot class is missing a label, the CSI snapshot plugin fails to create a snapshot. As a result, the **Velero** pod logs an error similar to the following message:

```
time="2023-02-17T16:33:13Z" level=error msg="Error backing up item" backup=openshift-adp/user1-backup-check5 error="error executing custom action (groupResource=persistentvolumeclaims, namespace=busy1, name=pvc1-user1): rpc error: code = Unknown desc = failed to get volumesnapshotclass for storageclass ocs-storagecluster-ceph-rbd: failed to get volumesnapshotclass for provisioner openshift-storage.rbd.csi.ceph.com, ensure that the desired volumesnapshot class has the velero.io/csi-volumesnapshot-class label" logSource="/remote-source/velero/app/pkg/backup/backup.go:417" name=busybox-79799557b5-vprq
```

Solution

1. Delete the **Backup** CR by running the following command::

```
$ oc delete backups.velero.io <backup> -n openshift-adp
```

2. If required, clean up the stored data on the **BackupStorageLocation** to free up space.

3. Apply the label **velero.io/csi-volumesnapshot-class=true** to the **VolumeSnapshotClass** object by running the following command:

```
$ oc label volumesnapshotclass/<snapclass_name> velero.io/csi-volumesnapshot-class=true
```

4. Create a new **Backup** CR.

5.25.9. Restic issues

You might encounter these issues when you back up applications with Restic.

5.25.9.1. Restic permission error for NFS data volumes with root_squash enabled

The **Restic** pod log displays the following error message: **controller=pod-volume-backup error="fork/exec/usr/bin/restic: permission denied"**.

Cause

If your NFS data volumes have **root_squash** enabled, **Restic** maps to **nfsnobody** and does not have permission to create backups.

Solution

You can resolve this issue by creating a supplemental group for **Restic** and adding the group ID to the **DataProtectionApplication** manifest:

1. Create a supplemental group for **Restic** on the NFS data volume.
2. Set the **setgid** bit on the NFS directories so that group ownership is inherited.
3. Add the **spec.configuration.nodeAgent.supplementalGroups** parameter and the group ID to the **DataProtectionApplication** manifest, as shown in the following example:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
# ...
spec:
  configuration:
    nodeAgent:
      enable: true
      uploaderType: restic
      supplementalGroups:
      - <group_id> 1
# ...
```

1 Specify the supplemental group ID.

4. Wait for the **Restic** pods to restart so that the changes are applied.

5.25.9.2. Restic Backup CR cannot be recreated after bucket is emptied

If you create a Restic **Backup** CR for a namespace, empty the object storage bucket, and then recreate the **Backup** CR for the same namespace, the recreated **Backup** CR fails.

The **velero** pod log displays the following error message: **stderr=Fatal: unable to open config file: Stat: The specified key does not exist.\nIs there a repository at the following location?**.

Cause

Velero does not recreate or update the Restic repository from the **ResticRepository** manifest if the Restic directories are deleted from object storage. See Velero issue 4421 for more information.

Solution

- Remove the related Restic repository from the namespace by running the following command:

```
$ oc delete resticrepository openshift-adp <name_of_the_restic_repository>
```

In the following error log, **mysql-persistent** is the problematic Restic repository. The name of the repository appears in italics for clarity.

```
time="2021-12-29T18:29:14Z" level=info msg="1 errors
encountered backup up item" backup=velero/backup65
logSource="pkg/backup/backup.go:431" name=mysql-7d99fc949-qbkds
time="2021-12-29T18:29:14Z" level=error msg="Error backing up item"
backup=velero/backup65 error="pod volume backup failed: error running
restic backup, stderr=Fatal: unable to open config file: Stat: The
specified key does not exist.\nIs there a repository at the following
location?\ns3:http://minio-minio.apps.mayap-oadp-
veleo-1234.qe.devcluster.openshift.com/mayapvelerooadp2/velero1/
restic/mysql-persistent\n: exit status 1" error.file="/remote-source/
src/github.com/vmware-tanzu/velero/pkg/restic/backupper.go:184"
error.function="github.com/vmware-tanzu/velero/
pkg/restic.(*backupper).BackupPodVolumes"
logSource="pkg/backup/backup.go:435" name=mysql-7d99fc949-qbkds
```

5.25.9.3. Restic restore partially failing on OCP 4.14 due to changed PSA policy

OpenShift Container Platform 4.14 enforces a Pod Security Admission (PSA) policy that can hinder the readiness of pods during a Restic restore process.

If a **SecurityContextConstraints** (SCC) resource is not found when a pod is created, and the PSA policy on the pod is not set up to meet the required standards, pod admission is denied.

This issue arises due to the resource restore order of Velero.

Sample error

```
\"level=error\" in line#2273: time=\"2023-06-12T06:50:04Z\"
level=error msg=\"error restoring mysql-869f9f44f6-tp5lv: pods\\\
"mysql-869f9f44f6-tp5lv\\\" is forbidden: violates PodSecurity\\\
"restricted:v1.24\\\": privil eged (container \\\"mysql\\\
" must not set securityContext.privileged=true),
allowPrivilegeEscalation != false (containers \\\
"restic-wait\\\", \\\"mysql\\\" must set securityContext.allowPrivilegeEscalation=false), unrestricted
capabilities (containers \\\
"restic-wait\\\", \\\"mysql\\\" must set securityContext.capabilities.drop=[\\\"ALL\\\"]), seccompProfile
(pod or containers \\\
"restic-wait\\\", \\\"mysql\\\" must set securityContext.seccompProfile.type to \\\
"RuntimeDefault\\\" or \\\"Localhost\\\")\" logSource=\"/remote-
source/velero/app/pkg/restore/restore.go:1388\" restore=openshift-adp/todolist-backup-0780518c-
08ed-11ee-805c-0a580a80e92c\n
velero container contains \"level=error\" in line#2447: time=\"2023-06-12T06:50:05Z\"
level=error msg=\"Namespace todolist-mariadb,
resource restore error: error restoring pods/todolist-mariadb/mysql-869f9f44f6-tp5lv: pods \\\
"mysql-869f9f44f6-tp5lv\\\" is forbidden: violates PodSecurity \\\"restricted:v1.24\\\": privileged
(container \\\
```

```
"mysql\\\" must not set securityContext.privileged=true),
allowPrivilegeEscalation != false (containers \\\
"restic-wait\\\",\\\"mysql\\\" must set securityContext.allowPrivilegeEscalation=false), unrestricted
capabilities (containers \\\
"restic-wait\\\", \\\"mysql\\\" must set securityContext.capabilities.drop=[\\\"ALL\\\"]), seccompProfile
(pod or containers \\\
"restic-wait\\\", \\\"mysql\\\" must set securityContext.seccompProfile.type to \\\
"RuntimeDefault\\\" or \\\"Localhost\\\")\"
logSource=\"/remote-source/velero/app/pkg/controller/restore_controller.go:510\"
restore=openshift-adp/todolist-backup-0780518c-08ed-11ee-805c-0a580a80e92c\n]",
```

Solution

1. In your DPA custom resource (CR), check or set the **restore-resource-priorities** field on the Velero server to ensure that **securitycontextconstraints** is listed in order before **pods** in the list of resources:

```
$ oc get dpa -o yaml
```

Example DPA CR

```
# ...
configuration:
  restic:
    enable: true
  velero:
    args:
      restore-resource-priorities:
'securitycontextconstraints,customresourcedefinitions,namespaces,storageclasses,volumesnaps
hotclass.snapshot.storage.k8s.io,volumesnapshotcontents.snapshot.storage.k8s.io,volumesnap
hots.snapshot.storage.k8s.io,datauploads.velero.io,persistentvolumes,persistentvolumeclaims,s
rviceaccounts,secrets,configmaps,limitranges,pods,replicasets.apps,clusterclasses.cluster.x-
k8s.io,endpoints,services,-,clusterbootstraps.run.tanzu.vmware.com,clusters.cluster.x-
k8s.io,clusterresourcesets.addons.cluster.x-k8s.io' (1)
    defaultPlugins:
    - gcp
    - openshift
```

(1) If you have an existing restore resource priority list, ensure you combine that existing list with the complete list.

2. Ensure that the security standards for the application pods are aligned, as provided in Fixing PodSecurity Admission warnings for deployments, to prevent deployment warnings. If the application is not aligned with security standards, an error can occur regardless of the SCC.

NOTE

This solution is temporary, and ongoing discussions are in progress to address it.

Additional resources

- Fixing PodSecurity Admission warnings for deployments

5.25.10. Using the must-gather tool

You can collect logs, metrics, and information about OADP custom resources by using the **must-gather** tool. The **must-gather** data must be attached to all customer cases.

You can run the **must-gather** tool with the following data collection options:

- Full **must-gather** data collection collects Prometheus metrics, pod logs, and Velero CR information for all namespaces where the OADP Operator is installed.
- Essential **must-gather** data collection collects pod logs and Velero CR information for a specific duration of time, for example, one hour or 24 hours. Prometheus metrics and duplicate logs are not included.
- **must-gather** data collection with timeout. Data collection can take a long time if there are many failed **Backup** CRs. You can improve performance by setting a timeout value.
- Prometheus metrics data dump downloads an archive file containing the metrics data collected by Prometheus.

Prerequisites

- You have logged in to the OpenShift Container Platform cluster as a user with the **cluster-admin** role.
- You have installed the OpenShift CLI (**oc**).
- You must use Red Hat Enterprise Linux (RHEL) 9 with OADP 1.4.

Procedure

1. Navigate to the directory where you want to store the **must-gather** data.
2. Run the **oc adm must-gather** command for one of the following data collection options:
   - For full **must-gather** data collection, including Prometheus metrics, run the following command:

     ```
     $ oc adm must-gather --image=registry.redhat.io/oadp/oadp-mustgather-rhel9:v1.4
     ```

     The data is saved as **must-gather/must-gather.tar.gz**. You can upload this file to a support case on the Red Hat Customer Portal.

     For essential **must-gather** data collection, without Prometheus metrics, for a specific time duration, run the following command:

     ```
     $ oc adm must-gather --image=registry.redhat.io/oadp/oadp-mustgather-rhel9:v1.4 \
       -- /usr/bin/gather_<time>_essential 1
     ```

     1 Specify the time in hours. Allowed values are **1h**, **6h**, **24h**, **72h**, or **all**, for example, **gather_1h_essential** or **gather_all_essential**.

   - For **must-gather** data collection with timeout, run the following command:

```
$ oc adm must-gather --image=registry.redhat.io/oadp/oadp-mustgather-rhel9:v1.4 \
  -- /usr/bin/gather_with_timeout <timeout> 1
```

1 Specify a timeout value in seconds.

- For a Prometheus metrics data dump, run the following command:

```
$ oc adm must-gather --image=registry.redhat.io/oadp/oadp-mustgather-rhel9:v1.4 --
/usr/bin/gather_metrics_dump
```

This operation can take a long time. The data is saved as **must-gather/metrics/prom_data.tar.gz**.

Additional resources

- Gathering cluster data

5.25.10.1. Using must-gather with insecure TLS connections

If a custom CA certificate is used, the **must-gather** pod fails to grab the output for **velero logs/describe**. To use the **must-gather** tool with insecure TLS connections, you can pass the **gather_without_tls** flag to the **must-gather** command.

Procedure

- Pass the **gather_without_tls** flag, with value set to **true**, to the **must-gather** tool by using the following command:

```
$ oc adm must-gather --image=registry.redhat.io/oadp/oadp-mustgather-rhel9:v1.4 --
/usr/bin/gather_without_tls <true/false>
```

By default, the flag value is set to **false**. Set the value to **true** to allow insecure TLS connections.

5.25.10.2. Combining options when using the must-gather tool

Currently, it is not possible to combine must-gather scripts, for example specifying a timeout threshold while permitting insecure TLS connections. In some situations, you can get around this limitation by setting up internal variables on the must-gather command line, such as the following example:

```
$ oc adm must-gather --image=registry.redhat.io/oadp/oadp-mustgather-rhel9:v1.4 -- skip_tls=true
/usr/bin/gather_with_timeout <timeout_value_in_seconds>
```

In this example, set the **skip_tls** variable before running the **gather_with_timeout** script. The result is a combination of **gather_with_timeout** and **gather_without_tls**.

The only other variables that you can specify this way are the following:

- **logs_since**, with a default value of **72h**
- **request_timeout**, with a default value of **0s**

If **DataProtectionApplication** custom resource (CR) is configured with **s3Url** and **insecureSkipTLS: true**, the CR does not collect the necessary logs because of a missing CA certificate. To collect those logs, run the **must-gather** command with the following option:

```
$ oc adm must-gather --image=registry.redhat.io/oadp/oadp-mustgather-rhel9:v1.4 --
/usr/bin/gather_without_tls true
```

5.25.11. OADP monitoring

By using the OpenShift Container Platform monitoring stack, users and administrators can effectively perform the following tasks:

- Monitor and manage clusters
- Analyze the workload performance of user applications
- Monitor services running on the clusters
- Receive alerts if an event occurs

Additional resources

- About OpenShift Container Platform monitoring

5.25.11.1. OADP monitoring setup

The OADP Operator leverages an OpenShift User Workload Monitoring provided by the OpenShift Monitoring Stack for retrieving metrics from the Velero service endpoint. The monitoring stack allows creating user-defined Alerting Rules or querying metrics by using the OpenShift Metrics query front end.

With enabled User Workload Monitoring, it is possible to configure and use any Prometheus-compatible third-party UI, such as Grafana, to visualize Velero metrics.

Monitoring metrics requires enabling monitoring for the user-defined projects and creating a **ServiceMonitor** resource to scrape those metrics from the already enabled OADP service endpoint that resides in the **openshift-adp** namespace.

Prerequisites

- You have access to an OpenShift Container Platform cluster using an account with **cluster-admin** permissions.
- You have created a cluster monitoring config map.

Procedure

1. Edit the **cluster-monitoring-config ConfigMap** object in the **openshift-monitoring** namespace:

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

2. Add or enable the **enableUserWorkload** option in the **data** section's **config.yaml** field:

```
apiVersion: v1
```

```
data:
  config.yaml: |
    enableUserWorkload: true 1
kind: ConfigMap
metadata:
# ...
```

1 Add this option or set to **true**

3. Wait a short period of time to verify the User Workload Monitoring Setup by checking if the following components are up and running in the **openshift-user-workload-monitoring** namespace:

```
$ oc get pods -n openshift-user-workload-monitoring
```

Example output

```
NAME                                   READY   STATUS    RESTARTS   AGE
prometheus-operator-6844b4b99c-b57j9   2/2     Running   0          43s
prometheus-user-workload-0             5/5     Running   0          32s
prometheus-user-workload-1             5/5     Running   0          32s
thanos-ruler-user-workload-0           3/3     Running   0          32s
thanos-ruler-user-workload-1           3/3     Running   0          32s
```

4. Verify the existence of the **user-workload-monitoring-config** ConfigMap in the **openshift-user-workload-monitoring**. If it exists, skip the remaining steps in this procedure.

```
$ oc get configmap user-workload-monitoring-config -n openshift-user-workload-monitoring
```

Example output

```
Error from server (NotFound): configmaps "user-workload-monitoring-config" not found
```

5. Create a **user-workload-monitoring-config ConfigMap** object for the User Workload Monitoring, and save it under the **2_configure_user_workload_monitoring.yaml** file name:

Example output

```
apiVersion: v1
kind: ConfigMap
metadata:
  name: user-workload-monitoring-config
  namespace: openshift-user-workload-monitoring
data:
  config.yaml: |
```

6. Apply the **2_configure_user_workload_monitoring.yaml** file:

```
$ oc apply -f 2_configure_user_workload_monitoring.yaml
configmap/user-workload-monitoring-config created
```

5.25.11.2. Creating OADP service monitor

OADP provides an **openshift-adp-velero-metrics-svc** service which is created when the DPA is configured. The service monitor used by the user workload monitoring must point to the defined service.

Get details about the service by running the following commands:

Procedure

1. Ensure the **openshift-adp-velero-metrics-svc** service exists. It should contain **app.kubernetes.io/name=velero** label, which will be used as selector for the **ServiceMonitor** object.

```
$ oc get svc -n openshift-adp -l app.kubernetes.io/name=velero
```

Example output

```
NAME                          TYPE        CLUSTER-IP      EXTERNAL-IP   PORT(S)    AGE
openshift-adp-velero-metrics-svc   ClusterIP   172.30.38.244   <none>        8085/TCP   1h
```

2. Create a **ServiceMonitor** YAML file that matches the existing service label, and save the file as **3_create_oadp_service_monitor.yaml**. The service monitor is created in the **openshift-adp** namespace where the **openshift-adp-velero-metrics-svc** service resides.

Example ServiceMonitor object

```
apiVersion: monitoring.coreos.com/v1
kind: ServiceMonitor
metadata:
  labels:
    app: oadp-service-monitor
  name: oadp-service-monitor
  namespace: openshift-adp
spec:
  endpoints:
  - interval: 30s
    path: /metrics
    targetPort: 8085
    scheme: http
  selector:
    matchLabels:
      app.kubernetes.io/name: "velero"
```

3. Apply the **3_create_oadp_service_monitor.yaml** file:

```
$ oc apply -f 3_create_oadp_service_monitor.yaml
```

Example output

```
servicemonitor.monitoring.coreos.com/oadp-service-monitor created
```

Verification

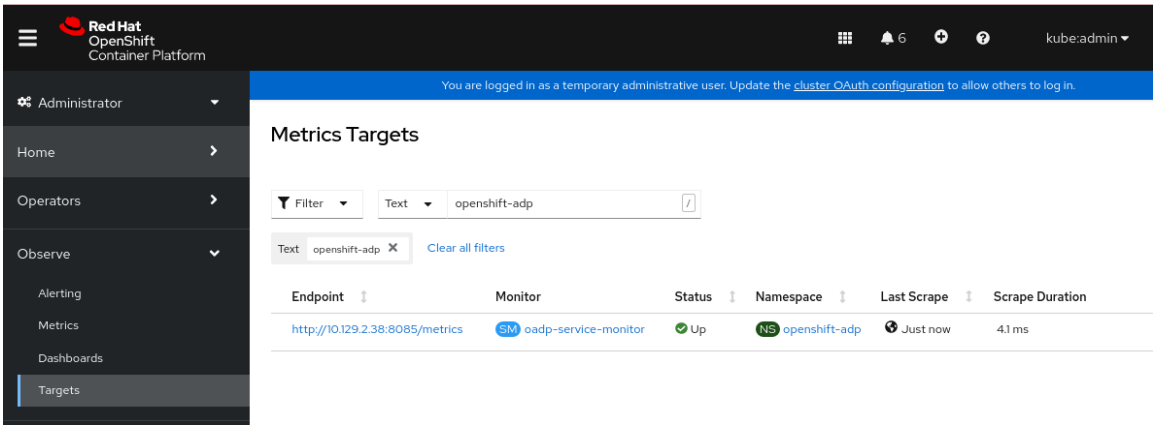
- Confirm that the new service monitor is in an **Up** state by using the **Administrator** perspective of the OpenShift Container Platform web console:

  a. Navigate to the **Observe → Targets** page.

  b. Ensure the **Filter** is unselected or that the **User** source is selected and type **openshift-adp** in the **Text** search field.

  c. Verify that the status for the **Status** for the service monitor is **Up**.

  Figure 5.1. OADP metrics targets



5.25.11.3. Creating an alerting rule

The OpenShift Container Platform monitoring stack allows to receive Alerts configured using Alerting Rules. To create an Alerting rule for the OADP project, use one of the Metrics which are scraped with the user workload monitoring.

Procedure

1. Create a **PrometheusRule** YAML file with the sample **OADPBackupFailing** alert and save it as **4_create_oadp_alert_rule.yaml**.

   Sample OADPBackupFailing alert

```
apiVersion: monitoring.coreos.com/v1
kind: PrometheusRule
metadata:
  name: sample-oadp-alert
  namespace: openshift-adp
spec:
  groups:
  - name: sample-oadp-backup-alert
    rules:
    - alert: OADPBackupFailing
      annotations:
        description: 'OADP had {{$value | humanize}} backup failures over the last 2 hours.'
        summary: OADP has issues creating backups
      expr: |
        increase(velero_backup_failure_total{job="openshift-adp-velero-metrics-svc"}[2h]) > 0
      for: 5m
      labels:
        severity: warning
```

In this sample, the Alert displays under the following conditions:

- There is an increase of new failing backups during the 2 last hours that is greater than 0 and the state persists for at least 5 minutes.
- If the time of the first increase is less than 5 minutes, the Alert will be in a **Pending** state, after which it will turn into a **Firing** state.

2. Apply the **4_create_oadp_alert_rule.yaml** file, which creates the **PrometheusRule** object in the **openshift-adp** namespace:

```
$ oc apply -f 4_create_oadp_alert_rule.yaml
```

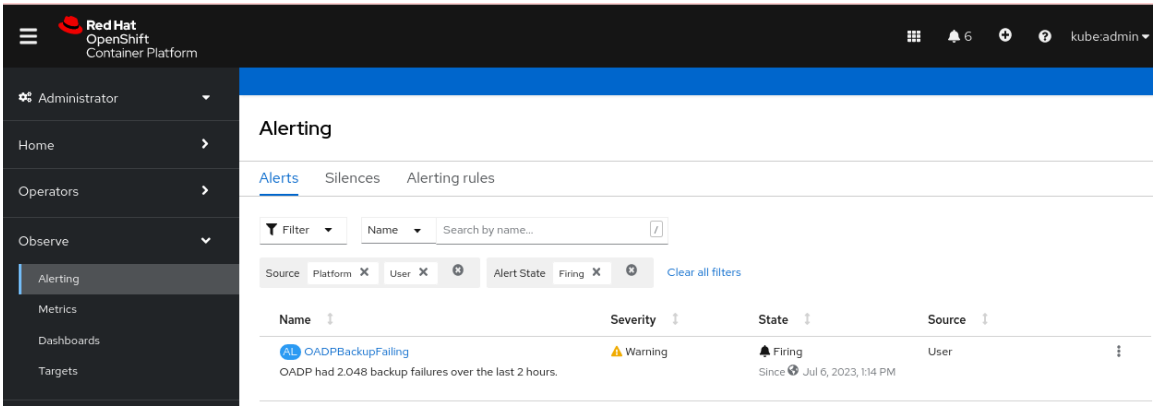
Example output

```
prometheusrule.monitoring.coreos.com/sample-oadp-alert created
```

Verification

- After the Alert is triggered, you can view it in the following ways:
  - In the **Developer** perspective, select the **Observe** menu.
  - In the **Administrator** perspective under the **Observe → Alerting** menu, select **User** in the **Filter** box. Otherwise, by default only the **Platform** Alerts are displayed.

Figure 5.2. OADP backup failing alert



Additional resources

- Managing alerts as an Administrator

5.25.11.4. List of available metrics

These are the list of metrics provided by the OADP together with their Types.

Metric name	Description	Type
kopia_content_cache_hit_bytes	Number of bytes retrieved from the cache	Counter

Metric name	Description	Type
kopia_content_cache_hit_count	Number of times content was retrieved from the cache	Counter
kopia_content_cache_malformed	Number of times malformed content was read from the cache	Counter
kopia_content_cache_miss_count	Number of times content was not found in the cache and fetched	Counter
kopia_content_cache_missed_bytes	Number of bytes retrieved from the underlying storage	Counter
kopia_content_cache_miss_error_count	Number of times content could not be found in the underlying storage	Counter
kopia_content_cache_store_error_count	Number of times content could not be saved in the cache	Counter
kopia_content_get_bytes	Number of bytes retrieved using **GetContent()**	Counter
kopia_content_get_count	Number of times **GetContent()** was called	Counter
kopia_content_get_error_count	Number of times **GetContent()** was called and the result was an error	Counter
kopia_content_get_not_found_count	Number of times **GetContent()** was called and the result was not found	Counter
kopia_content_write_bytes	Number of bytes passed to **WriteContent()**	Counter
kopia_content_write_count	Number of times **WriteContent()** was called	Counter
velero_backup_attempt_total	Total number of attempted backups	Counter
velero_backup_deletion_attempt_total	Total number of attempted backup deletions	Counter
velero_backup_deletion_failure_total	Total number of failed backup deletions	Counter

Metric name	Description	Type
velero_backup_deletion_success_total	Total number of successful backup deletions	Counter
velero_backup_duration_seconds	Time taken to complete backup, in seconds	Histogram
velero_backup_failure_total	Total number of failed backups	Counter
velero_backup_items_errors	Total number of errors encountered during backup	Gauge
velero_backup_items_total	Total number of items backed up	Gauge
velero_backup_last_status	Last status of the backup. A value of 1 is success, 0.	Gauge
velero_backup_last_successful_timestamp	Last time a backup ran successfully, Unix timestamp in seconds	Gauge
velero_backup_partial_failure_total	Total number of partially failed backups	Counter
velero_backup_success_total	Total number of successful backups	Counter
velero_backup_tarball_size_bytes	Size, in bytes, of a backup	Gauge
velero_backup_total	Current number of existent backups	Gauge
velero_backup_validation_failure_total	Total number of validation failed backups	Counter
velero_backup_warning_total	Total number of warned backups	Counter
velero_csi_snapshot_attempt_total	Total number of CSI attempted volume snapshots	Counter
velero_csi_snapshot_failure_total	Total number of CSI failed volume snapshots	Counter
velero_csi_snapshot_success_total	Total number of CSI successful volume snapshots	Counter

Metric name	Description	Type
velero_restore_attempt_total	Total number of attempted restores	Counter
velero_restore_failed_total	Total number of failed restores	Counter
velero_restore_partial_failure_total	Total number of partially failed restores	Counter
velero_restore_success_total	Total number of successful restores	Counter
velero_restore_total	Current number of existent restores	Gauge
velero_restore_validation_failed_total	Total number of failed restores failing validations	Counter
velero_volume_snapshot_attempt_total	Total number of attempted volume snapshots	Counter
velero_volume_snapshot_failure_total	Total number of failed volume snapshots	Counter
velero_volume_snapshot_success_total	Total number of successful volume snapshots	Counter

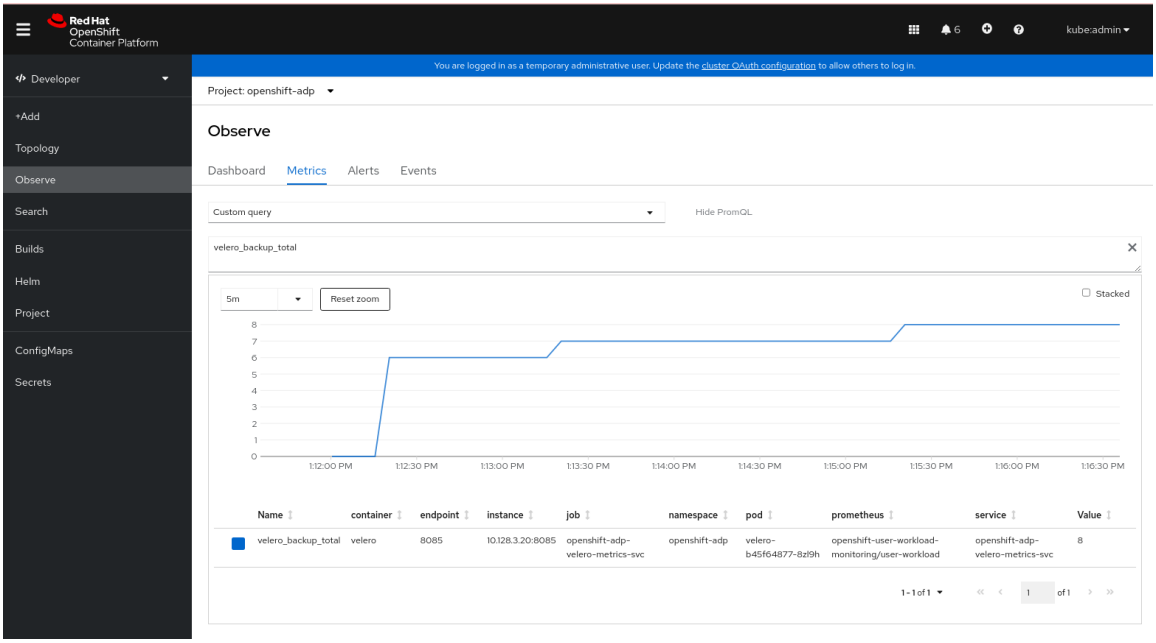
5.25.11.5. Viewing metrics using the Observe UI

You can view metrics in the OpenShift Container Platform web console from the **Administrator** or **Developer** perspective, which must have access to the **openshift-adp** project.

Procedure

- Navigate to the **Observe → Metrics** page:
  - If you are using the **Developer** perspective, follow these steps:
    a. Select **Custom query**, or click on the **Show PromQL** link.
    b. Type the query and click **Enter**.
  - If you are using the **Administrator** perspective, type the expression in the text field and select **Run Queries**.

Figure 5.3. OADP metrics query



CHAPTER 6. CONTROL PLANE BACKUP AND RESTORE

6.1. BACKING UP ETCD

etcd is the key-value store for OpenShift Container Platform, which persists the state of all resource objects.

Back up your cluster's etcd data regularly and store in a secure location ideally outside the OpenShift Container Platform environment. Do not take an etcd backup before the first certificate rotation completes, which occurs 24 hours after installation, otherwise the backup will contain expired certificates. It is also recommended to take etcd backups during non-peak usage hours because the etcd snapshot has a high I/O cost.

Be sure to take an etcd backup before you update your cluster. Taking a backup before you update is important because when you restore your cluster, you must use an etcd backup that was taken from the same z-stream release. For example, an OpenShift Container Platform 4.17.5 cluster must use an etcd backup that was taken from 4.17.5.

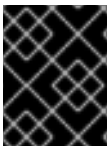
IMPORTANT

Back up your cluster's etcd data by performing a single invocation of the backup script on a control plane host. Do not take a backup for each control plane host.

After you have an etcd backup, you can restore to a previous cluster state .

6.1.1. Backing up etcd data

Follow these steps to back up etcd data by creating an etcd snapshot and backing up the resources for the static pods. This backup can be saved and used at a later time if you need to restore etcd.



IMPORTANT

Only save a backup from a single control plane host. Do not take a backup from each control plane host in the cluster.

Prerequisites

- You have access to the cluster as a user with the **cluster-admin** role.
- You have checked whether the cluster-wide proxy is enabled.

  TIP

  You can check whether the proxy is enabled by reviewing the output of **oc get proxy cluster -o yaml**. The proxy is enabled if the **httpProxy**, **httpsProxy**, and **noProxy** fields have values set.

Procedure

1. Start a debug session as root for a control plane node:

   ```
   $ oc debug --as-root node/<node_name>
   ```

2. Change your root directory to **/host** in the debug shell:

```
sh-4.4# chroot /host
```

3. If the cluster-wide proxy is enabled, export the **NO_PROXY**, **HTTP_PROXY**, and **HTTPS_PROXY** environment variables by running the following commands:

```
$ export HTTP_PROXY=http://<your_proxy.example.com>:8080
```

```
$ export HTTPS_PROXY=https://<your_proxy.example.com>:8080
```

```
$ export NO_PROXY=<example.com>
```

4. Run the **cluster-backup.sh** script in the debug shell and pass in the location to save the backup to.

TIP

The **cluster-backup.sh** script is maintained as a component of the etcd Cluster Operator and is a wrapper around the **etcdctl snapshot save** command.

```
sh-4.4# /usr/local/bin/cluster-backup.sh /home/core/assets/backup
```

Example script output

```
found latest kube-apiserver: /etc/kubernetes/static-pod-resources/kube-apiserver-pod-6
found latest kube-controller-manager: /etc/kubernetes/static-pod-resources/kube-controller-manager-pod-7
found latest kube-scheduler: /etc/kubernetes/static-pod-resources/kube-scheduler-pod-6
found latest etcd: /etc/kubernetes/static-pod-resources/etcd-pod-3
ede95fe6b88b87ba86a03c15e669fb4aa5bf0991c180d3c6895ce72eaade54a1
etcdctl version: 3.4.14
API version: 3.4
{"level":"info","ts":1624647639.0188997,"caller":"snapshot/v3_snapshot.go:119","msg":"created temporary db file","path":"/home/core/assets/backup/snapshot_2021-06-25_190035.db.part"}
{"level":"info","ts":"2021-06-25T19:00:39.030Z","caller":"clientv3/maintenance.go:200","msg":"opened snapshot stream; downloading"}
{"level":"info","ts":1624647639.0301006,"caller":"snapshot/v3_snapshot.go:127","msg":"fetching snapshot","endpoint":"https://10.0.0.5:2379"}
{"level":"info","ts":"2021-06-25T19:00:40.215Z","caller":"clientv3/maintenance.go:208","msg":"completed snapshot read; closing"}
{"level":"info","ts":1624647640.6032252,"caller":"snapshot/v3_snapshot.go:142","msg":"fetched snapshot","endpoint":"https://10.0.0.5:2379","size":"114 MB","took":1.584090459}
{"level":"info","ts":1624647640.6047094,"caller":"snapshot/v3_snapshot.go:152","msg":"saved","path":"/home/core/assets/backup/snapshot_2021-06-25_190035.db"}
Snapshot saved at /home/core/assets/backup/snapshot_2021-06-25_190035.db
{"hash":3866667823,"revision":31407,"totalKey":12828,"totalSize":114446336}
snapshot db and kube resources are successfully saved to /home/core/assets/backup
```

In this example, two files are created in the **/home/core/assets/backup/** directory on the control plane host:

- **snapshot_<datetimestamp>.db**: This file is the etcd snapshot. The **cluster-backup.sh** script confirms its validity.
- **static_kuberesources_<datetimestamp>.tar.gz**: This file contains the resources for the static pods. If etcd encryption is enabled, it also contains the encryption keys for the etcd snapshot.

NOTE

If etcd encryption is enabled, it is recommended to store this second file separately from the etcd snapshot for security reasons. However, this file is required to restore from the etcd snapshot.

Keep in mind that etcd encryption only encrypts values, not keys. This means that resource types, namespaces, and object names are unencrypted.

6.1.2. Additional resources

- Recovering an unhealthy etcd cluster

6.1.3. Creating automated etcd backups

The automated backup feature for etcd supports both recurring and single backups. Recurring backups create a cron job that starts a single backup each time the job triggers.

IMPORTANT

Automating etcd backups is a Technology Preview feature only. 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 about the support scope of Red Hat Technology Preview features, see Technology Preview Features Support Scope .

Follow these steps to enable automated backups for etcd.

WARNING

Enabling the **TechPreviewNoUpgrade** feature set on your cluster prevents minor version updates. The **TechPreviewNoUpgrade** feature set cannot be disabled. Do not enable this feature set on production clusters.

Prerequisites

- You have access to the cluster as a user with the **cluster-admin** role.

- You have access to the OpenShift CLI (**oc**).

Procedure

1. Create a **FeatureGate** custom resource (CR) file named **enable-tech-preview-no-upgrade.yaml** with the following contents:

```
apiVersion: config.openshift.io/v1
kind: FeatureGate
metadata:
  name: cluster
spec:
  featureSet: TechPreviewNoUpgrade
```

2. Apply the CR and enable automated backups:

```
$ oc apply -f enable-tech-preview-no-upgrade.yaml
```

3. It takes time to enable the related APIs. Verify the creation of the custom resource definition (CRD) by running the following command:

```
$ oc get crd | grep backup
```

Example output

```
backups.config.openshift.io 2023-10-25T13:32:43Z
etcdbackups.operator.openshift.io 2023-10-25T13:32:04Z
```

6.1.3.1. Creating a single etcd backup

Follow these steps to create a single etcd backup by creating and applying a custom resource (CR).

Prerequisites

- You have access to the cluster as a user with the **cluster-admin** role.
- You have access to the OpenShift CLI (**oc**).

Procedure

- If dynamically-provisioned storage is available, complete the following steps to create a single automated etcd backup:

  a. Create a persistent volume claim (PVC) named **etcd-backup-pvc.yaml** with contents such as the following example:

```
kind: PersistentVolumeClaim
apiVersion: v1
metadata:
  name: etcd-backup-pvc
  namespace: openshift-etcd
spec:
  accessModes:
```

```
    - ReadWriteOnce
  resources:
    requests:
      storage: 200Gi (1)
  volumeMode: Filesystem
```

(1) The amount of storage available to the PVC. Adjust this value for your requirements.

b. Apply the PVC by running the following command:

```
$ oc apply -f etcd-backup-pvc.yaml
```

c. Verify the creation of the PVC by running the following command:

```
$ oc get pvc
```

Example output

```
NAME              STATUS    VOLUME   CAPACITY   ACCESS MODES
STORAGECLASS   AGE
etcd-backup-pvc   Bound                                      51s
```

NOTE

Dynamic PVCs stay in the **Pending** state until they are mounted.

d. Create a CR file named **etcd-single-backup.yaml** with contents such as the following example:

```
apiVersion: operator.openshift.io/v1alpha1
kind: EtcdBackup
metadata:
  name: etcd-single-backup
  namespace: openshift-etcd
spec:
  pvcName: etcd-backup-pvc (1)
```

(1) The name of the PVC to save the backup to. Adjust this value according to your environment.

e. Apply the CR to start a single backup:

```
$ oc apply -f etcd-single-backup.yaml
```

- If dynamically-provisioned storage is not available, complete the following steps to create a single automated etcd backup:

a. Create a **StorageClass** CR file named **etcd-backup-local-storage.yaml** with the following contents:

```
apiVersion: storage.k8s.io/v1
```

```
kind: StorageClass
metadata:
  name: etcd-backup-local-storage
provisioner: kubernetes.io/no-provisioner
volumeBindingMode: Immediate
```

b. Apply the **StorageClass** CR by running the following command:

```
$ oc apply -f etcd-backup-local-storage.yaml
```

c. Create a PV named **etcd-backup-pv-fs.yaml** with contents such as the following example:

```
apiVersion: v1
kind: PersistentVolume
metadata:
  name: etcd-backup-pv-fs
spec:
  capacity:
    storage: 100Gi (1)
  volumeMode: Filesystem
  accessModes:
  - ReadWriteOnce
  persistentVolumeReclaimPolicy: Retain
  storageClassName: etcd-backup-local-storage
  local:
    path: /mnt
  nodeAffinity:
    required:
      nodeSelectorTerms:
      - matchExpressions:
      - key: kubernetes.io/hostname
        operator: In
        values:
        - <example_master_node> (2)
```

(1) The amount of storage available to the PV. Adjust this value for your requirements.

(2) Replace this value with the node to attach this PV to.

d. Verify the creation of the PV by running the following command:

```
$ oc get pv
```

Example output

```
NAME                CAPACITY   ACCESS MODES   RECLAIM POLICY   STATUS
CLAIM   STORAGECLASS              REASON   AGE
etcd-backup-pv-fs   100Gi      RWO            Retain           Available           etcd-backup-
local-storage           10s
```

e. Create a PVC named **etcd-backup-pvc.yaml** with contents such as the following example:

```
kind: PersistentVolumeClaim
```

```
apiVersion: v1
metadata:
  name: etcd-backup-pvc
  namespace: openshift-etcd
spec:
  accessModes:
  - ReadWriteOnce
  volumeMode: Filesystem
  resources:
    requests:
      storage: 10Gi 1
```

1 The amount of storage available to the PVC. Adjust this value for your requirements.

f. Apply the PVC by running the following command:

```
$ oc apply -f etcd-backup-pvc.yaml
```

g. Create a CR file named **etcd-single-backup.yaml** with contents such as the following example:

```
apiVersion: operator.openshift.io/v1alpha1
kind: EtcdBackup
metadata:
  name: etcd-single-backup
  namespace: openshift-etcd
spec:
  pvcName: etcd-backup-pvc 1
```

1 The name of the persistent volume claim (PVC) to save the backup to. Adjust this value according to your environment.

h. Apply the CR to start a single backup:

```
$ oc apply -f etcd-single-backup.yaml
```

6.1.3.2. Creating recurring etcd backups

Follow these steps to create automated recurring backups of etcd.

Use dynamically-provisioned storage to keep the created etcd backup data in a safe, external location if possible. If dynamically-provisioned storage is not available, consider storing the backup data on an NFS share to make backup recovery more accessible.

Prerequisites

- You have access to the cluster as a user with the **cluster-admin** role.
- You have access to the OpenShift CLI (**oc**).

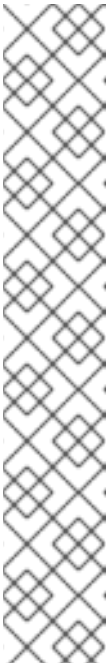
Procedure

1. If dynamically-provisioned storage is available, complete the following steps to create automated recurring backups:

   a. Create a persistent volume claim (PVC) named **etcd-backup-pvc.yaml** with contents such as the following example:

```
kind: PersistentVolumeClaim
apiVersion: v1
metadata:
  name: etcd-backup-pvc
  namespace: openshift-etcd
spec:
  accessModes:
    - ReadWriteOnce
  resources:
    requests:
      storage: 200Gi 1
  volumeMode: Filesystem
  storageClassName: etcd-backup-local-storage
```

   1 The amount of storage available to the PVC. Adjust this value for your requirements.



NOTE

Each of the following providers require changes to the **accessModes** and **storageClassName** keys:

Provider	**accessModes** value	**storageClassName** value
AWS with the **versioned-installer-efc_operator-ci** profile	**- ReadWriteMany**	**efs-sc**
Google Cloud Platform	**- ReadWriteMany**	**filestore-csi**
Microsoft Azure	**- ReadWriteMany**	**azurefile-csi**

   b. Apply the PVC by running the following command:

```
$ oc apply -f etcd-backup-pvc.yaml
```

   c. Verify the creation of the PVC by running the following command:

```
$ oc get pvc
```

Example output

```
NAME              STATUS    VOLUME   CAPACITY   ACCESS MODES
STORAGECLASS   AGE
etcd-backup-pvc   Bound                                      51s
```

NOTE

Dynamic PVCs stay in the **Pending** state until they are mounted.

2. If dynamically-provisioned storage is unavailable, create a local storage PVC by completing the following steps:

WARNING

If you delete or otherwise lose access to the node that contains the stored backup data, you can lose data.

a. Create a **StorageClass** CR file named **etcd-backup-local-storage.yaml** with the following contents:

```
apiVersion: storage.k8s.io/v1
kind: StorageClass
metadata:
  name: etcd-backup-local-storage
provisioner: kubernetes.io/no-provisioner
volumeBindingMode: Immediate
```

b. Apply the **StorageClass** CR by running the following command:

```
$ oc apply -f etcd-backup-local-storage.yaml
```

c. Create a PV named **etcd-backup-pv-fs.yaml** from the applied **StorageClass** with contents such as the following example:

```
apiVersion: v1
kind: PersistentVolume
metadata:
  name: etcd-backup-pv-fs
spec:
  capacity:
    storage: 100Gi (1)
  volumeMode: Filesystem
  accessModes:
  - ReadWriteMany
  persistentVolumeReclaimPolicy: Delete
  storageClassName: etcd-backup-local-storage
  local:
    path: /mnt/
  nodeAffinity:
```

```
      required:
        nodeSelectorTerms:
        - matchExpressions:
          - key: kubernetes.io/hostname
            operator: In
            values:
            - <example_master_node> 2
```

1 The amount of storage available to the PV. Adjust this value for your requirements.

2 Replace this value with the master node to attach this PV to.

TIP

Run the following command to list the available nodes:

```
$ oc get nodes
```

d. Verify the creation of the PV by running the following command:

```
$ oc get pv
```

Example output

```
NAME                CAPACITY   ACCESS MODES   RECLAIM POLICY   STATUS
CLAIM   STORAGECLASS            REASON   AGE
etcd-backup-pv-fs   100Gi      RWX            Delete           Available           etcd-backup-
local-storage           10s
```

e. Create a PVC named **etcd-backup-pvc.yaml** with contents such as the following example:

```
kind: PersistentVolumeClaim
apiVersion: v1
metadata:
  name: etcd-backup-pvc
spec:
  accessModes:
  - ReadWriteMany
  volumeMode: Filesystem
  resources:
    requests:
      storage: 10Gi 1
  storageClassName: etcd-backup-local-storage
```

1 The amount of storage available to the PVC. Adjust this value for your requirements.

f. Apply the PVC by running the following command:

```
$ oc apply -f etcd-backup-pvc.yaml
```

3. Create a custom resource definition (CRD) file named **etcd-recurring-backups.yaml**. The contents of the created CRD define the schedule and retention type of automated backups. For the default retention type of **RetentionNumber** with 15 retained backups, use contents such as the following example:

```
apiVersion: config.openshift.io/v1alpha1
kind: Backup
metadata:
  name: etcd-recurring-backup
spec:
  etcd:
    schedule: "20 4 * * *" 1
    timeZone: "UTC"
    pvcName: etcd-backup-pvc
```

1 The **CronTab** schedule for recurring backups. Adjust this value for your needs.

To use retention based on the maximum number of backups, add the following key-value pairs to the **etcd** key:

```
spec:
  etcd:
    retentionPolicy:
      retentionType: RetentionNumber 1
      retentionNumber:
        maxNumberOfBackups: 5 2
```

1 The retention type. Defaults to **RetentionNumber** if unspecified.

2 The maximum number of backups to retain. Adjust this value for your needs. Defaults to 15 backups if unspecified.

WARNING

A known issue causes the number of retained backups to be one greater than the configured value.

For retention based on the file size of backups, use the following:

```
spec:
  etcd:
    retentionPolicy:
      retentionType: RetentionSize
      retentionSize:
        maxSizeOfBackupsGb: 20 1
```

1 The maximum file size of the retained backups in gigabytes. Adjust this value for your needs. Defaults to 10 GB if unspecified.

WARNING

A known issue causes the maximum size of retained backups to be up to 10 GB greater than the configured value.

4. Create the cron job defined by the CRD by running the following command:

```
$ oc create -f etcd-recurring-backup.yaml
```

5. To find the created cron job, run the following command:

```
$ oc get cronjob -n openshift-etcd
```

6.2. REPLACING AN UNHEALTHY ETCD MEMBER

This document describes the process to replace a single unhealthy etcd member.

This process depends on whether the etcd member is unhealthy because the machine is not running or the node is not ready, or whether it is unhealthy because the etcd pod is crashlooping.

NOTE

If you have lost the majority of your control plane hosts, follow the disaster recovery procedure to restore to a previous cluster state instead of this procedure.

If the control plane certificates are not valid on the member being replaced, then you must follow the procedure to recover from expired control plane certificates instead of this procedure.

If a control plane node is lost and a new one is created, the etcd cluster Operator handles generating the new TLS certificates and adding the node as an etcd member.

6.2.1. Prerequisites

- Take an etcd backup prior to replacing an unhealthy etcd member.

6.2.2. Identifying an unhealthy etcd member

You can identify if your cluster has an unhealthy etcd member.

Prerequisites

- Access to the cluster as a user with the **cluster-admin** role.

Procedure

1. Check the status of the **EtcdMembersAvailable** status condition using the following command:

```
$ oc get etcd -o=jsonpath='{range .items[0].status.conditions[?
(@.type=="EtcdMembersAvailable")]}{.message}{"\n"}'
```

2. Review the output:

```
2 of 3 members are available, ip-10-0-131-183.ec2.internal is unhealthy
```

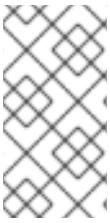
This example output shows that the **ip-10-0-131-183.ec2.internal** etcd member is unhealthy.

6.2.3. Determining the state of the unhealthy etcd member

The steps to replace an unhealthy etcd member depend on which of the following states your etcd member is in:

- The machine is not running or the node is not ready
- The etcd pod is crashlooping

This procedure determines which state your etcd member is in. This enables you to know which procedure to follow to replace the unhealthy etcd member.



NOTE

If you are aware that the machine is not running or the node is not ready, but you expect it to return to a healthy state soon, then you do not need to perform a procedure to replace the etcd member. The etcd cluster Operator will automatically sync when the machine or node returns to a healthy state.

Prerequisites

- You have access to the cluster as a user with the **cluster-admin** role.
- You have identified an unhealthy etcd member.

Procedure

1. Determine if the **machine is not running**:

```
$ oc get machines -A -ojsonpath='{range .items[*]}{@.status.nodeRef.name}{"\t"}
{@.status.providerStatus.instanceState}{"\n"}' | grep -v running
```

Example output

```
ip-10-0-131-183.ec2.internal  stopped 1
```

1 This output lists the node and the status of the node's machine. If the status is anything other than **running**, then the **machine is not running**.

If the **machine is not running**, then follow the *Replacing an unhealthy etcd member whose machine is not running or whose node is not ready* procedure.

2. Determine if the **node is not ready**.

If either of the following scenarios are true, then the **node is not ready**.

- If the machine is running, then check whether the node is unreachable:

```
$ oc get nodes -o jsonpath='{range .items[*]}{"\n"}{.metadata.name}{"\t"}{range
.spec.taints[*]}{.key}{" "}' | grep unreachable
```

Example output

```
ip-10-0-131-183.ec2.internal node-role.kubernetes.io/master
node.kubernetes.io/unreachable node.kubernetes.io/unreachable 1
```

1 If the node is listed with an **unreachable** taint, then the **node is not ready**.

- If the node is still reachable, then check whether the node is listed as **NotReady**:

```
$ oc get nodes -l node-role.kubernetes.io/master | grep "NotReady"
```

Example output

```
ip-10-0-131-183.ec2.internal   NotReady   master   122m   v1.31.3 1
```

1 If the node is listed as **NotReady**, then the **node is not ready**.

If the **node is not ready**, then follow the *Replacing an unhealthy etcd member whose machine is not running or whose node is not ready* procedure.

3. Determine if the **etcd pod is crashlooping**
   If the machine is running and the node is ready, then check whether the etcd pod is crashlooping.

   a. Verify that all control plane nodes are listed as **Ready**:

```
$ oc get nodes -l node-role.kubernetes.io/master
```

Example output

```
NAME                          STATUS   ROLES    AGE     VERSION
ip-10-0-131-183.ec2.internal   Ready    master   6h13m   v1.31.3
ip-10-0-164-97.ec2.internal    Ready    master   6h13m   v1.31.3
ip-10-0-154-204.ec2.internal   Ready    master   6h13m   v1.31.3
```

   b. Check whether the status of an etcd pod is either **Error** or **CrashloopBackoff**:

```
$ oc -n openshift-etcd get pods -l k8s-app=etcd
```

Example output

```
etcd-ip-10-0-131-183.ec2.internal   2/3   Error     7   6h9m 1
etcd-ip-10-0-164-97.ec2.internal    3/3   Running   0   6h6m
etcd-ip-10-0-154-204.ec2.internal   3/3   Running   0   6h6m
```

1 Since this status of this pod is **Error**, then the **etcd pod is crashlooping**

If the **etcd pod is crashlooping** then follow the *Replacing an unhealthy etcd member whose etcd pod is crashlooping* procedure.

6.2.4. Replacing the unhealthy etcd member

Depending on the state of your unhealthy etcd member, use one of the following procedures:

- Replacing an unhealthy etcd member whose machine is not running or whose node is not ready
- Installing a primary control plane node on an unhealthy cluster
- Replacing an unhealthy etcd member whose etcd pod is crashlooping
- Replacing an unhealthy stopped baremetal etcd member

6.2.4.1. Replacing an unhealthy etcd member whose machine is not running or whose node is not ready

This procedure details the steps to replace an etcd member that is unhealthy either because the machine is not running or because the node is not ready.

NOTE

If your cluster uses a control plane machine set, see "Recovering a degraded etcd Operator" in "Troubleshooting the control plane machine set" for a more simple etcd recovery procedure.

Prerequisites

- You have identified the unhealthy etcd member.
- You have verified that either the machine is not running or the node is not ready.

IMPORTANT

You must wait if you power off other control plane nodes. The control plane nodes must remain powered off until the replacement of an unhealthy etcd member is complete.

- You have access to the cluster as a user with the **cluster-admin** role.
- You have taken an etcd backup.

IMPORTANT

Before you perform this procedure, take an etcd backup so that you can restore your cluster if you experience any issues.

Procedure

1. Remove the unhealthy member.

   a. Choose a pod that is not on the affected node:
   In a terminal that has access to the cluster as a **cluster-admin** user, run the following command:

   ```
   $ oc -n openshift-etcd get pods -l k8s-app=etcd
   ```

   Example output

   ```
   etcd-ip-10-0-131-183.ec2.internal             3/3     Running     0          123m
   etcd-ip-10-0-164-97.ec2.internal              3/3     Running     0          123m
   etcd-ip-10-0-154-204.ec2.internal             3/3     Running     0          124m
   ```

   b. Connect to the running etcd container, passing in the name of a pod that is not on the affected node:
   In a terminal that has access to the cluster as a **cluster-admin** user, run the following command:

   ```
   $ oc rsh -n openshift-etcd etcd-ip-10-0-154-204.ec2.internal
   ```

   c. View the member list:

   ```
   sh-4.2# etcdctl member list -w table
   ```

   Example output

   ```
   +------------------+---------+------------------------------+---------------------------+--------------------
   -----------+
   |        ID        | STATUS  |             NAME             |        PEER ADDRS         |       CLIENT
   ADDRS        |
   +------------------+---------+------------------------------+---------------------------+--------------------
   -----------+
   | 6fc1e7c9db35841d | started | ip-10-0-131-183.ec2.internal | https://10.0.131.183:2380 |
   https://10.0.131.183:2379 |
   | 757b6793e2408b6c | started |  ip-10-0-164-97.ec2.internal |  https://10.0.164.97:2380 |
   https://10.0.164.97:2379 |
   | ca8c2990a0aa29d1 | started | ip-10-0-154-204.ec2.internal | https://10.0.154.204:2380 |
   https://10.0.154.204:2379 |
   +------------------+---------+------------------------------+---------------------------+--------------------
   -----------+
   ```

   Take note of the ID and the name of the unhealthy etcd member because these values are needed later in the procedure. The **$ etcdctl endpoint health** command will list the removed member until the procedure of replacement is finished and a new member is added.

   d. Remove the unhealthy etcd member by providing the ID to the **etcdctl member remove** command:

   ```
   sh-4.2# etcdctl member remove 6fc1e7c9db35841d
   ```

Example output

```
Member 6fc1e7c9db35841d removed from cluster ead669ce1fbfb346
```

e. View the member list again and verify that the member was removed:

```
sh-4.2# etcdctl member list -w table
```

Example output

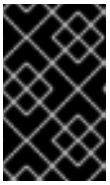
```
+------------------+---------+-----------------------------+--------------------------+----------------
-----------+
|        ID        | STATUS  |            NAME             |        PEER ADDRS        |      CLIENT
ADDRS       |
+------------------+---------+-----------------------------+--------------------------+----------------
-----------+
| 757b6793e2408b6c | started |  ip-10-0-164-97.ec2.internal |  https://10.0.164.97:2380 |
https://10.0.164.97:2379 |
| ca8c2990a0aa29d1 | started | ip-10-0-154-204.ec2.internal | https://10.0.154.204:2380 |
https://10.0.154.204:2379 |
+------------------+---------+-----------------------------+--------------------------+----------------
-----------+
```

You can now exit the node shell.

2. Turn off the quorum guard by entering the following command:

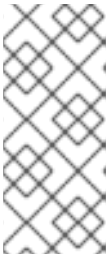
```
$ oc patch etcd/cluster --type=merge -p '{"spec": {"unsupportedConfigOverrides":
{"useUnsupportedUnsafeNonHANonProductionUnstableEtcd": true}}}'
```

This command ensures that you can successfully re-create secrets and roll out the static pods.



IMPORTANT

After you turn off the quorum guard, the cluster might be unreachable for a short time while the remaining etcd instances reboot to reflect the configuration change.



NOTE

etcd cannot tolerate any additional member failure when running with two members. Restarting either remaining member breaks the quorum and causes downtime in your cluster. The quorum guard protects etcd from restarts due to configuration changes that could cause downtime, so it must be disabled to complete this procedure.

3. Delete the affected node by running the following command:

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

Example command

```
$ oc delete node ip-10-0-131-183.ec2.internal
```

4. Remove the old secrets for the unhealthy etcd member that was removed.

   a. List the secrets for the unhealthy etcd member that was removed.

   ```
   $ oc get secrets -n openshift-etcd | grep ip-10-0-131-183.ec2.internal 1
   ```

   1 Pass in the name of the unhealthy etcd member that you took note of earlier in this procedure.

   There is a peer, serving, and metrics secret as shown in the following output:

   Example output

   ```
   etcd-peer-ip-10-0-131-183.ec2.internal             kubernetes.io/tls                     2      47m
   etcd-serving-ip-10-0-131-183.ec2.internal          kubernetes.io/tls                     2      47m
   etcd-serving-metrics-ip-10-0-131-183.ec2.internal  kubernetes.io/tls                     2
   47m
   ```

   b. Delete the secrets for the unhealthy etcd member that was removed.

      i. Delete the peer secret:

      ```
      $ oc delete secret -n openshift-etcd etcd-peer-ip-10-0-131-183.ec2.internal
      ```

      ii. Delete the serving secret:

      ```
      $ oc delete secret -n openshift-etcd etcd-serving-ip-10-0-131-183.ec2.internal
      ```

      iii. Delete the metrics secret:

      ```
      $ oc delete secret -n openshift-etcd etcd-serving-metrics-ip-10-0-131-
      183.ec2.internal
      ```

5. Check whether a control plane machine set exists by entering the following command:

   ```
   $ oc -n openshift-machine-api get controlplanemachineset
   ```

   - If the control plane machine set exists, delete and re-create the control plane machine. After this machine is re-created, a new revision is forced and etcd scales up automatically. For more information, see "Replacing an unhealthy etcd member whose machine is not running or whose node is not ready".
     If you are running installer-provisioned infrastructure, or you used the Machine API to create your machines, follow these steps. Otherwise, you must create the new control plane by using the same method that was used to originally create it.

     a. Obtain the machine for the unhealthy member.
     In a terminal that has access to the cluster as a **cluster-admin** user, run the following command:

     ```
     $ oc get machines -n openshift-machine-api -o wide
     ```

Example output

```
NAME                                 PHASE     TYPE        REGION      ZONE         AGE
NODE                           PROVIDERID                          STATE
clustername-8qw5l-master-0           Running   m4.xlarge   us-east-1   us-east-1a   3h37m   ip-10-0-131-183.ec2.internal   aws:///us-east-1a/i-0ec2782f8287dfb7e   stopped (1)
clustername-8qw5l-master-1           Running   m4.xlarge   us-east-1   us-east-1b   3h37m   ip-10-0-154-204.ec2.internal   aws:///us-east-1b/i-096c349b700a19631   running
clustername-8qw5l-master-2           Running   m4.xlarge   us-east-1   us-east-1c   3h37m   ip-10-0-164-97.ec2.internal    aws:///us-east-1c/i-02626f1dba9ed5bba   running
clustername-8qw5l-worker-us-east-1a-wbtgd   Running   m4.large   us-east-1   us-east-1a   3h28m   ip-10-0-129-226.ec2.internal   aws:///us-east-1a/i-010ef6279b4662ced   running
clustername-8qw5l-worker-us-east-1b-lrdxb   Running   m4.large   us-east-1   us-east-1b   3h28m   ip-10-0-144-248.ec2.internal   aws:///us-east-1b/i-0cb45ac45a166173b   running
clustername-8qw5l-worker-us-east-1c-pkg26   Running   m4.large   us-east-1   us-east-1c   3h28m   ip-10-0-170-181.ec2.internal   aws:///us-east-1c/i-06861c00007751b0a   running
```

(1) This is the control plane machine for the unhealthy node, **ip-10-0-131-183.ec2.internal**.

b. Delete the machine of the unhealthy member:

```
$ oc delete machine -n openshift-machine-api clustername-8qw5l-master-0 (1)
```

(1) Specify the name of the control plane machine for the unhealthy node.

A new machine is automatically provisioned after deleting the machine of the unhealthy member.

c. Verify that a new machine was created:

```
$ oc get machines -n openshift-machine-api -o wide
```

Example output

```
NAME                                 PHASE     TYPE        REGION      ZONE
AGE   NODE                           PROVIDERID                          STATE
clustername-8qw5l-master-1           Running   m4.xlarge   us-east-1   us-east-1b   3h37m   ip-10-0-154-204.ec2.internal   aws:///us-east-1b/i-096c349b700a19631   running
clustername-8qw5l-master-2           Running   m4.xlarge   us-east-1   us-east-1c   3h37m   ip-10-0-164-97.ec2.internal    aws:///us-east-1c/i-02626f1dba9ed5bba   running
clustername-8qw5l-master-3           Provisioning   m4.xlarge   us-east-1   us-east-1a   85s   ip-10-0-133-53.ec2.internal   aws:///us-east-1a/i-015b0888fe17bc2c8   running (1)
```

```
clustername-8qw5l-worker-us-east-1a-wbtgd  Running      m4.large  us-east-1
us-east-1a  3h28m  ip-10-0-129-226.ec2.internal  aws:///us-east-1a/i-
010ef6279b4662ced  running
clustername-8qw5l-worker-us-east-1b-lrdxb  Running      m4.large  us-east-1  us-
east-1b  3h28m  ip-10-0-144-248.ec2.internal  aws:///us-east-1b/i-
0cb45ac45a166173b  running
clustername-8qw5l-worker-us-east-1c-pkg26  Running      m4.large  us-east-1
us-east-1c  3h28m  ip-10-0-170-181.ec2.internal  aws:///us-east-1c/i-
06861c00007751b0a  running
```

1 The new machine, **clustername-8qw5l-master-3** is being created and is ready once the phase changes from **Provisioning** to **Running**.

It might take a few minutes for the new machine to be created. The etcd cluster Operator automatically syncs when the machine or node returns to a healthy state.

NOTE

Verify the subnet IDs that you are using for your machine sets to ensure that they end up in the correct availability zone.

- If the control plane machine set does not exist, delete and re-create the control plane machine. After this machine is re-created, a new revision is forced and etcd scales up automatically.
  If you are running installer-provisioned infrastructure, or you used the Machine API to create your machines, follow these steps. Otherwise, you must create the new control plane by using the same method that was used to originally create it.

  a. Obtain the machine for the unhealthy member.
  In a terminal that has access to the cluster as a **cluster-admin** user, run the following command:

```
$ oc get machines -n openshift-machine-api -o wide
```

Example output

```
NAME                                PHASE     TYPE        REGION      ZONE         AGE
NODE                           PROVIDERID                          STATE
clustername-8qw5l-master-0          Running   m4.xlarge   us-east-1   us-east-1a
3h37m   ip-10-0-131-183.ec2.internal   aws:///us-east-1a/i-0ec2782f8287dfb7e
stopped 1
clustername-8qw5l-master-1          Running   m4.xlarge   us-east-1   us-east-1b
3h37m   ip-10-0-154-204.ec2.internal   aws:///us-east-1b/i-096c349b700a19631
running
clustername-8qw5l-master-2          Running   m4.xlarge   us-east-1   us-east-1c
3h37m   ip-10-0-164-97.ec2.internal    aws:///us-east-1c/i-02626f1dba9ed5bba
running
clustername-8qw5l-worker-us-east-1a-wbtgd  Running   m4.large  us-east-1  us-
east-1a  3h28m  ip-10-0-129-226.ec2.internal  aws:///us-east-1a/i-
010ef6279b4662ced  running
clustername-8qw5l-worker-us-east-1b-lrdxb  Running   m4.large  us-east-1  us-
east-1b  3h28m  ip-10-0-144-248.ec2.internal  aws:///us-east-1b/i-
0cb45ac45a166173b  running
```

```
clustername-8qw5l-worker-us-east-1c-pkg26  Running  m4.large  us-east-1  us-east-1c  3h28m  ip-10-0-170-181.ec2.internal  aws:///us-east-1c/i-06861c00007751b0a  running
```

1 This is the control plane machine for the unhealthy node, **ip-10-0-131-183.ec2.internal**.

b. Save the machine configuration to a file on your file system:

```
$ oc get machine clustername-8qw5l-master-0 \ 1
    -n openshift-machine-api \
    -o yaml \
    > new-master-machine.yaml
```

1 Specify the name of the control plane machine for the unhealthy node.

c. Edit the **new-master-machine.yaml** file that was created in the previous step to assign a new name and remove unnecessary fields.

i. Remove the entire **status** section:

```
status:
  addresses:
  - address: 10.0.131.183
    type: InternalIP
  - address: ip-10-0-131-183.ec2.internal
    type: InternalDNS
  - address: ip-10-0-131-183.ec2.internal
    type: Hostname
  lastUpdated: "2020-04-20T17:44:29Z"
  nodeRef:
    kind: Node
    name: ip-10-0-131-183.ec2.internal
    uid: acca4411-af0d-4387-b73e-52b2484295ad
  phase: Running
  providerStatus:
    apiVersion: awsproviderconfig.openshift.io/v1beta1
    conditions:
    - lastProbeTime: "2020-04-20T16:53:50Z"
      lastTransitionTime: "2020-04-20T16:53:50Z"
      message: machine successfully created
      reason: MachineCreationSucceeded
      status: "True"
      type: MachineCreation
    instanceId: i-0fdb85790d76d0c3f
    instanceState: stopped
    kind: AWSMachineProviderStatus
```

ii. Change the **metadata.name** field to a new name.
Keep the same base name as the old machine and change the ending number to the next available number. In this example, **clustername-8qw5l-master-0** is changed to **clustername-8qw5l-master-3**.

For example:

```
apiVersion: machine.openshift.io/v1beta1
kind: Machine
metadata:
  ...
  name: clustername-8qw5l-master-3
  ...
```

iii. Remove the **spec.providerID** field:

```
providerID: aws:///us-east-1a/i-0fdb85790d76d0c3f
```

d. Delete the machine of the unhealthy member:

```
$ oc delete machine -n openshift-machine-api clustername-8qw5l-master-0 1
```

1 Specify the name of the control plane machine for the unhealthy node.

e. Verify that the machine was deleted:

```
$ oc get machines -n openshift-machine-api -o wide
```

Example output

```
NAME                                PHASE     TYPE        REGION      ZONE         AGE
NODE                           PROVIDERID                          STATE
clustername-8qw5l-master-1          Running   m4.xlarge   us-east-1   us-east-1b   3h37m   ip-10-0-154-204.ec2.internal   aws:///us-east-1b/i-096c349b700a19631   running
clustername-8qw5l-master-2          Running   m4.xlarge   us-east-1   us-east-1c   3h37m   ip-10-0-164-97.ec2.internal    aws:///us-east-1c/i-02626f1dba9ed5bba   running
clustername-8qw5l-worker-us-east-1a-wbtgd   Running   m4.large   us-east-1   us-east-1a   3h28m   ip-10-0-129-226.ec2.internal   aws:///us-east-1a/i-010ef6279b4662ced   running
clustername-8qw5l-worker-us-east-1b-lrdxb   Running   m4.large   us-east-1   us-east-1b   3h28m   ip-10-0-144-248.ec2.internal   aws:///us-east-1b/i-0cb45ac45a166173b   running
clustername-8qw5l-worker-us-east-1c-pkg26   Running   m4.large   us-east-1   us-east-1c   3h28m   ip-10-0-170-181.ec2.internal   aws:///us-east-1c/i-06861c00007751b0a   running
```

f. Create the new machine by using the **new-master-machine.yaml** file:

```
$ oc apply -f new-master-machine.yaml
```

g. Verify that the new machine was created:

```
$ oc get machines -n openshift-machine-api -o wide
```

Example output

```
NAME                                PHASE     TYPE        REGION      ZONE
```

```
AGE     NODE                          PROVIDERID                          STATE
clustername-8qw5l-master-1            Running     m4.xlarge   us-east-1   us-east-
1b   3h37m   ip-10-0-154-204.ec2.internal   aws:///us-east-1b/i-096c349b700a19631
running
clustername-8qw5l-master-2            Running     m4.xlarge   us-east-1   us-east-
1c   3h37m   ip-10-0-164-97.ec2.internal    aws:///us-east-1c/i-02626f1dba9ed5bba
running
clustername-8qw5l-master-3            Provisioning m4.xlarge  us-east-1   us-east-
1a   85s     ip-10-0-133-53.ec2.internal    aws:///us-east-1a/i-015b0888fe17bc2c8
running (1)
clustername-8qw5l-worker-us-east-1a-wbtgd  Running     m4.large    us-east-1
us-east-1a   3h28m   ip-10-0-129-226.ec2.internal   aws:///us-east-1a/i-
010ef6279b4662ced   running
clustername-8qw5l-worker-us-east-1b-lrdxb  Running     m4.large    us-east-1   us-
east-1b   3h28m   ip-10-0-144-248.ec2.internal   aws:///us-east-1b/i-
0cb45ac45a166173b   running
clustername-8qw5l-worker-us-east-1c-pkg26  Running     m4.large    us-east-1
us-east-1c   3h28m   ip-10-0-170-181.ec2.internal   aws:///us-east-1c/i-
06861c00007751b0a   running
```

(1) The new machine, **clustername-8qw5l-master-3** is being created and is ready once the phase changes from **Provisioning** to **Running**.

It might take a few minutes for the new machine to be created. The etcd cluster Operator automatically syncs when the machine or node returns to a healthy state.

6. Turn the quorum guard back on by entering the following command:

```
$ oc patch etcd/cluster --type=merge -p '{"spec": {"unsupportedConfigOverrides": null}}'
```

7. You can verify that the **unsupportedConfigOverrides** section is removed from the object by entering this command:

```
$ oc get etcd/cluster -oyaml
```

8. If you are using single-node OpenShift, restart the node. Otherwise, you might experience the following error in the etcd cluster Operator:

Example output

```
EtcdCertSignerControllerDegraded: [Operation cannot be fulfilled on secrets "etcd-peer-sno-
0": the object has been modified; please apply your changes to the latest version and try
again, Operation cannot be fulfilled on secrets "etcd-serving-sno-0": the object has been
modified; please apply your changes to the latest version and try again, Operation cannot be
fulfilled on secrets "etcd-serving-metrics-sno-0": the object has been modified; please apply
your changes to the latest version and try again]
```

Verification

1. Verify that all etcd pods are running properly.
In a terminal that has access to the cluster as a **cluster-admin** user, run the following command:

```
$ oc -n openshift-etcd get pods -l k8s-app=etcd
```

Example output

```
etcd-ip-10-0-133-53.ec2.internal             3/3     Running     0          7m49s
etcd-ip-10-0-164-97.ec2.internal             3/3     Running     0          123m
etcd-ip-10-0-154-204.ec2.internal            3/3     Running     0          124m
```

If the output from the previous command only lists two pods, you can manually force an etcd redeployment. In a terminal that has access to the cluster as a **cluster-admin** user, run the following command:

```
$ oc patch etcd cluster -p='{"spec": {"forceRedeploymentReason": "recovery-'"$( date --rfc-3339=ns )"'"}}' --type=merge 1
```

1 The **forceRedeploymentReason** value must be unique, which is why a timestamp is appended.

2. Verify that there are exactly three etcd members.

   a. Connect to the running etcd container, passing in the name of a pod that was not on the affected node:
   In a terminal that has access to the cluster as a **cluster-admin** user, run the following command:

   ```
   $ oc rsh -n openshift-etcd etcd-ip-10-0-154-204.ec2.internal
   ```

   b. View the member list:

   ```
   sh-4.2# etcdctl member list -w table
   ```

   Example output

   ```
   +------------------+---------+-----------------------------+---------------------------+---------------
   -----------+
   |        ID        | STATUS  |            NAME             |        PEER ADDRS         |      CLIENT
   ADDRS       |
   +------------------+---------+-----------------------------+---------------------------+---------------
   -----------+
   | 5eb0d6b8ca24730c | started |  ip-10-0-133-53.ec2.internal |  https://10.0.133.53:2380 |
   https://10.0.133.53:2379 |
   | 757b6793e2408b6c | started |  ip-10-0-164-97.ec2.internal |  https://10.0.164.97:2380 |
   https://10.0.164.97:2379 |
   | ca8c2990a0aa29d1 | started | ip-10-0-154-204.ec2.internal | https://10.0.154.204:2380 |
   https://10.0.154.204:2379 |
   +------------------+---------+-----------------------------+---------------------------+---------------
   -----------+
   ```

   If the output from the previous command lists more than three etcd members, you must carefully remove the unwanted member.

WARNING

Be sure to remove the correct etcd member; removing a good etcd member might lead to quorum loss.

Additional resources

- Recovering a degraded etcd Operator
- Installing a primary control plane node on an unhealthy cluster

6.2.4.2. Replacing an unhealthy etcd member whose etcd pod is crashlooping

This procedure details the steps to replace an etcd member that is unhealthy because the etcd pod is crashlooping.

Prerequisites

- You have identified the unhealthy etcd member.
- You have verified that the etcd pod is crashlooping.
- You have access to the cluster as a user with the **cluster-admin** role.
- You have taken an etcd backup.

IMPORTANT

It is important to take an etcd backup before performing this procedure so that your cluster can be restored if you encounter any issues.

Procedure

1. Stop the crashlooping etcd pod.

   a. Debug the node that is crashlooping.
   In a terminal that has access to the cluster as a **cluster-admin** user, run the following command:

   ```
   $ oc debug node/ip-10-0-131-183.ec2.internal 1
   ```

   1 Replace this with the name of the unhealthy node.

   b. Change your root directory to /**host**:

   ```
   sh-4.2# chroot /host
   ```

   c. Move the existing etcd pod file out of the kubelet manifest directory:

```
sh-4.2# mkdir /var/lib/etcd-backup
```

```
sh-4.2# mv /etc/kubernetes/manifests/etcd-pod.yaml /var/lib/etcd-backup/
```

d. Move the etcd data directory to a different location:

```
sh-4.2# mv /var/lib/etcd/ /tmp
```

You can now exit the node shell.

2. Remove the unhealthy member.

a. Choose a pod that is *not* on the affected node.
In a terminal that has access to the cluster as a **cluster-admin** user, run the following command:

```
$ oc -n openshift-etcd get pods -l k8s-app=etcd
```

Example output

```
etcd-ip-10-0-131-183.ec2.internal             2/3     Error       7          6h9m
etcd-ip-10-0-164-97.ec2.internal              3/3     Running     0          6h6m
etcd-ip-10-0-154-204.ec2.internal             3/3     Running     0          6h6m
```

b. Connect to the running etcd container, passing in the name of a pod that is not on the affected node.
In a terminal that has access to the cluster as a **cluster-admin** user, run the following command:

```
$ oc rsh -n openshift-etcd etcd-ip-10-0-154-204.ec2.internal
```

c. View the member list:

```
sh-4.2# etcdctl member list -w table
```

Example output

```
+------------------+---------+-----------------------------+---------------------------+---------------
-----------+
|        ID        | STATUS  |            NAME             |        PEER ADDRS         |       CLIENT
ADDRS        |
+------------------+---------+-----------------------------+---------------------------+---------------
-----------+
| 62bcf33650a7170a | started | ip-10-0-131-183.ec2.internal | https://10.0.131.183:2380 |
https://10.0.131.183:2379 |
| b78e2856655bc2eb | started |  ip-10-0-164-97.ec2.internal |  https://10.0.164.97:2380 |
https://10.0.164.97:2379 |
| d022e10b498760d5 | started | ip-10-0-154-204.ec2.internal | https://10.0.154.204:2380
| https://10.0.154.204:2379 |
+------------------+---------+-----------------------------+---------------------------+---------------
-----------+
```

Take note of the ID and the name of the unhealthy etcd member, because these values are needed later in the procedure.

d. Remove the unhealthy etcd member by providing the ID to the **etcdctl member remove** command:

```
sh-4.2# etcdctl member remove 62bcf33650a7170a
```

Example output

```
Member 62bcf33650a7170a removed from cluster ead669ce1fbfb346
```

e. View the member list again and verify that the member was removed:

```
sh-4.2# etcdctl member list -w table
```

Example output

```
+------------------+---------+-----------------------------+--------------------------+----------------
-----------+
|        ID        | STATUS  |            NAME             |        PEER ADDRS        |      CLIENT
ADDRS       |
+------------------+---------+-----------------------------+--------------------------+----------------
-----------+
| b78e2856655bc2eb | started |  ip-10-0-164-97.ec2.internal |  https://10.0.164.97:2380 |
https://10.0.164.97:2379 |
| d022e10b498760d5 | started | ip-10-0-154-204.ec2.internal | https://10.0.154.204:2380
| https://10.0.154.204:2379 |
+------------------+---------+-----------------------------+--------------------------+----------------
-----------+
```

You can now exit the node shell.

3. Turn off the quorum guard by entering the following command:

```
$ oc patch etcd/cluster --type=merge -p '{"spec": {"unsupportedConfigOverrides":
{"useUnsupportedUnsafeNonHANonProductionUnstableEtcd": true}}}'
```

This command ensures that you can successfully re-create secrets and roll out the static pods.

4. Remove the old secrets for the unhealthy etcd member that was removed.

a. List the secrets for the unhealthy etcd member that was removed.

```
$ oc get secrets -n openshift-etcd | grep ip-10-0-131-183.ec2.internal 1
```

1 Pass in the name of the unhealthy etcd member that you took note of earlier in this procedure.

There is a peer, serving, and metrics secret as shown in the following output:

Example output

```
etcd-peer-ip-10-0-131-183.ec2.internal             kubernetes.io/tls                 2      47m
etcd-serving-ip-10-0-131-183.ec2.internal          kubernetes.io/tls                 2      47m
etcd-serving-metrics-ip-10-0-131-183.ec2.internal  kubernetes.io/tls                 2
47m
```

b. Delete the secrets for the unhealthy etcd member that was removed.

i. Delete the peer secret:

```
$ oc delete secret -n openshift-etcd etcd-peer-ip-10-0-131-183.ec2.internal
```

ii. Delete the serving secret:

```
$ oc delete secret -n openshift-etcd etcd-serving-ip-10-0-131-183.ec2.internal
```

iii. Delete the metrics secret:

```
$ oc delete secret -n openshift-etcd etcd-serving-metrics-ip-10-0-131-
183.ec2.internal
```

5. Force etcd redeployment.
In a terminal that has access to the cluster as a **cluster-admin** user, run the following command:

```
$ oc patch etcd cluster -p='{"spec": {"forceRedeploymentReason": "single-master-recovery-
'"$( date --rfc-3339=ns )"'"}}' --type=merge 1
```

1 The **forceRedeploymentReason** value must be unique, which is why a timestamp is appended.

When the etcd cluster Operator performs a redeployment, it ensures that all control plane nodes have a functioning etcd pod.

6. Turn the quorum guard back on by entering the following command:

```
$ oc patch etcd/cluster --type=merge -p '{"spec": {"unsupportedConfigOverrides": null}}'
```

7. You can verify that the **unsupportedConfigOverrides** section is removed from the object by entering this command:

```
$ oc get etcd/cluster -oyaml
```

8. If you are using single-node OpenShift, restart the node. Otherwise, you might encounter the following error in the etcd cluster Operator:

Example output

```
EtcdCertSignerControllerDegraded: [Operation cannot be fulfilled on secrets "etcd-peer-sno-
0": the object has been modified; please apply your changes to the latest version and try
again, Operation cannot be fulfilled on secrets "etcd-serving-sno-0": the object has been
modified; please apply your changes to the latest version and try again, Operation cannot be
fulfilled on secrets "etcd-serving-metrics-sno-0": the object has been modified; please apply
your changes to the latest version and try again]
```

Verification

- Verify that the new member is available and healthy.

  a. Connect to the running etcd container again.
  In a terminal that has access to the cluster as a cluster-admin user, run the following command:

  ```
  $ oc rsh -n openshift-etcd etcd-ip-10-0-154-204.ec2.internal
  ```

  b. Verify that all members are healthy:

  ```
  sh-4.2# etcdctl endpoint health
  ```

  Example output

  ```
  https://10.0.131.183:2379 is healthy: successfully committed proposal: took =
  16.671434ms
  https://10.0.154.204:2379 is healthy: successfully committed proposal: took =
  16.698331ms
  https://10.0.164.97:2379 is healthy: successfully committed proposal: took =
  16.621645ms
  ```

6.2.4.3. Replacing an unhealthy bare metal etcd member whose machine is not running or whose node is not ready

This procedure details the steps to replace a bare metal etcd member that is unhealthy either because the machine is not running or because the node is not ready.

If you are running installer-provisioned infrastructure or you used the Machine API to create your machines, follow these steps. Otherwise you must create the new control plane node using the same method that was used to originally create it.

Prerequisites

- You have identified the unhealthy bare metal etcd member.
- You have verified that either the machine is not running or the node is not ready.
- You have access to the cluster as a user with the **cluster-admin** role.
- You have taken an etcd backup.

IMPORTANT

You must take an etcd backup before performing this procedure so that your cluster can be restored if you encounter any issues.

Procedure

1. Verify and remove the unhealthy member.

   a. Choose a pod that is *not* on the affected node:

In a terminal that has access to the cluster as a **cluster-admin** user, run the following command:

```
$ oc -n openshift-etcd get pods -l k8s-app=etcd -o wide
```

Example output

```
etcd-openshift-control-plane-0  5/5  Running  11  3h56m  192.168.10.9  openshift-control-plane-0  <none>  <none>
etcd-openshift-control-plane-1  5/5  Running  0   3h54m  192.168.10.10  openshift-control-plane-1  <none>  <none>
etcd-openshift-control-plane-2  5/5  Running  0   3h58m  192.168.10.11  openshift-control-plane-2  <none>  <none>
```

b. Connect to the running etcd container, passing in the name of a pod that is not on the affected node:
In a terminal that has access to the cluster as a **cluster-admin** user, run the following command:

```
$ oc rsh -n openshift-etcd etcd-openshift-control-plane-0
```

c. View the member list:

```
sh-4.2# etcdctl member list -w table
```

Example output

```
+------------------+---------+--------------------+---------------------------+---------------------------+
| ID               | STATUS  | NAME               | PEER ADDRS                | CLIENT ADDRS              | IS LEARNER |
+------------------+---------+--------------------+---------------------------+---------------------------+
| 7a8197040a5126c8 | started | openshift-control-plane-2 | https://192.168.10.11:2380/ | https://192.168.10.11:2379/ | false |
| 8d5abe9669a39192 | started | openshift-control-plane-1 | https://192.168.10.10:2380/ | https://192.168.10.10:2379/ | false |
| cc3830a72fc357f9 | started | openshift-control-plane-0 | https://192.168.10.9:2380/ | https://192.168.10.9:2379/   | false |
+------------------+---------+--------------------+---------------------------+---------------------------+
```

Take note of the ID and the name of the unhealthy etcd member, because these values are required later in the procedure. The **etcdctl endpoint health** command will list the removed member until the replacement procedure is completed and the new member is added.

d. Remove the unhealthy etcd member by providing the ID to the **etcdctl member remove** command:

WARNING

Be sure to remove the correct etcd member; removing a good etcd member might lead to quorum loss.

```
sh-4.2# etcdctl member remove 7a8197040a5126c8
```

Example output

```
Member 7a8197040a5126c8 removed from cluster b23536c33f2cdd1b
```

e. View the member list again and verify that the member was removed:

```
sh-4.2# etcdctl member list -w table
```

Example output

```
+------------------+---------+--------------------+--------------------------+--------------------------
-+------------------------+
| ID               | STATUS  | NAME               | PEER ADDRS               | CLIENT
ADDRS                | IS LEARNER |
+------------------+---------+--------------------+--------------------------+--------------------------
-+------------------------+
| cc3830a72fc357f9 | started | openshift-control-plane-2 | https://192.168.10.11:2380/ |
https://192.168.10.11:2379/ | false |
| 8d5abe9669a39192 | started | openshift-control-plane-1 | https://192.168.10.10:2380/ |
https://192.168.10.10:2379/ | false |
+------------------+---------+--------------------+--------------------------+--------------------------
-+------------------------+
```

You can now exit the node shell.

IMPORTANT

After you remove the member, the cluster might be unreachable for a short time while the remaining etcd instances reboot.

2. Turn off the quorum guard by entering the following command:

```
$ oc patch etcd/cluster --type=merge -p '{"spec": {"unsupportedConfigOverrides":
{"useUnsupportedUnsafeNonHANonProductionUnstableEtcd": true}}}'
```

This command ensures that you can successfully re-create secrets and roll out the static pods.

3. Remove the old secrets for the unhealthy etcd member that was removed by running the following commands.

a. List the secrets for the unhealthy etcd member that was removed.

```
$ oc get secrets -n openshift-etcd | grep openshift-control-plane-2
```

Pass in the name of the unhealthy etcd member that you took note of earlier in this procedure.

There is a peer, serving, and metrics secret as shown in the following output:

```
etcd-peer-openshift-control-plane-2              kubernetes.io/tls   2   134m
etcd-serving-metrics-openshift-control-plane-2   kubernetes.io/tls   2   134m
etcd-serving-openshift-control-plane-2           kubernetes.io/tls   2   134m
```

b. Delete the secrets for the unhealthy etcd member that was removed.

i. Delete the peer secret:

```
$ oc delete secret etcd-peer-openshift-control-plane-2 -n openshift-etcd

secret "etcd-peer-openshift-control-plane-2" deleted
```

ii. Delete the serving secret:

```
$ oc delete secret etcd-serving-metrics-openshift-control-plane-2 -n openshift-etcd

secret "etcd-serving-metrics-openshift-control-plane-2" deleted
```

iii. Delete the metrics secret:

```
$ oc delete secret etcd-serving-openshift-control-plane-2 -n openshift-etcd

secret "etcd-serving-openshift-control-plane-2" deleted
```

4. Obtain the machine for the unhealthy member.
In a terminal that has access to the cluster as a **cluster-admin** user, run the following command:

```
$ oc get machines -n openshift-machine-api -o wide
```

Example output

```
NAME                              PHASE     TYPE   REGION   ZONE   AGE     NODE
PROVIDERID                                                              STATE
examplecluster-control-plane-0    Running                          3h11m   openshift-control-plane-0
baremetalhost:///openshift-machine-api/openshift-control-plane-0/da1ebe11-3ff2-41c5-b099-
0aa41222964e   externally provisioned  (1)
examplecluster-control-plane-1    Running                          3h11m   openshift-control-plane-1
baremetalhost:///openshift-machine-api/openshift-control-plane-1/d9f9acbc-329c-475e-8d81-
03b20280a3e1   externally provisioned
examplecluster-control-plane-2    Running                          3h11m   openshift-control-plane-2
baremetalhost:///openshift-machine-api/openshift-control-plane-2/3354bdac-61d8-410f-be5b-
6a395b056135   externally provisioned
examplecluster-compute-0          Running                          165m    openshift-compute-0
baremetalhost:///openshift-machine-api/openshift-compute-0/3d685b81-7410-4bb3-80ec-
13a31858241f          provisioned
```

```
examplecluster-compute-1        Running                 165m    openshift-compute-1
baremetalhost:///openshift-machine-api/openshift-compute-1/0fdae6eb-2066-4241-91dc-
e7ea72ab13b9        provisioned
```

1 This is the control plane machine for the unhealthy node, **examplecluster-control-plane-2**.

5. Ensure that the Bare Metal Operator is available by running the following command:

```
$ oc get clusteroperator baremetal
```

Example output

```
NAME        VERSION   AVAILABLE   PROGRESSING   DEGRADED   SINCE   MESSAGE
baremetal   4.18.0    True        False         False      3d15h
```

6. Remove the old **BareMetalHost** object by running the following command:

```
$ oc delete bmh openshift-control-plane-2 -n openshift-machine-api
```

Example output

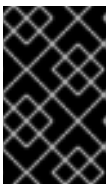
```
baremetalhost.metal3.io "openshift-control-plane-2" deleted
```

7. Delete the machine of the unhealthy member by running the following command:

```
$ oc delete machine -n openshift-machine-api examplecluster-control-plane-2
```

After you remove the **BareMetalHost** and **Machine** objects, then the **Machine** controller automatically deletes the **Node** object.

If deletion of the machine is delayed for any reason or the command is obstructed and delayed, you can force deletion by removing the machine object finalizer field.



IMPORTANT

Do not interrupt machine deletion by pressing **Ctrl+c**. You must allow the command to proceed to completion. Open a new terminal window to edit and delete the finalizer fields.

A new machine is automatically provisioned after deleting the machine of the unhealthy member.

a. Edit the machine configuration by running the following command:

```
$ oc edit machine -n openshift-machine-api examplecluster-control-plane-2
```

b. Delete the following fields in the **Machine** custom resource, and then save the updated file:

```
finalizers:
- machine.machine.openshift.io
```

Example output

```
machine.machine.openshift.io/examplecluster-control-plane-2 edited
```

8. Verify that the machine was deleted by running the following command:

```
$ oc get machines -n openshift-machine-api -o wide
```

Example output

```
NAME                              PHASE     TYPE   REGION   ZONE   AGE     NODE
PROVIDERID                                                             STATE
examplecluster-control-plane-0    Running                          3h11m   openshift-control-plane-0
baremetalhost:///openshift-machine-api/openshift-control-plane-0/da1ebe11-3ff2-41c5-b099-
0aa41222964e   externally provisioned
examplecluster-control-plane-1    Running                          3h11m   openshift-control-plane-1
baremetalhost:///openshift-machine-api/openshift-control-plane-1/d9f9acbc-329c-475e-8d81-
03b20280a3e1   externally provisioned
examplecluster-compute-0          Running                          165m    openshift-compute-0
baremetalhost:///openshift-machine-api/openshift-compute-0/3d685b81-7410-4bb3-80ec-
13a31858241f         provisioned
examplecluster-compute-1          Running                          165m    openshift-compute-1
baremetalhost:///openshift-machine-api/openshift-compute-1/0fdae6eb-2066-4241-91dc-
e7ea72ab13b9         provisioned
```

9. Verify that the node has been deleted by running the following command:

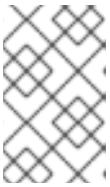
```
$ oc get nodes

NAME                       STATUS ROLES    AGE   VERSION
openshift-control-plane-0 Ready master 3h24m v1.31.3
openshift-control-plane-1 Ready master 3h24m v1.31.3
openshift-compute-0       Ready worker 176m v1.31.3
openshift-compute-1       Ready worker 176m v1.31.3
```

10. Create the new **BareMetalHost** object and the secret to store the BMC credentials:

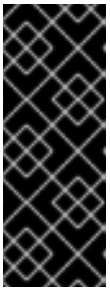
```
$ cat <<EOF | oc apply -f -
apiVersion: v1
kind: Secret
metadata:
  name: openshift-control-plane-2-bmc-secret
  namespace: openshift-machine-api
data:
  password: <password>
  username: <username>
type: Opaque
---
apiVersion: metal3.io/v1alpha1
kind: BareMetalHost
metadata:
  name: openshift-control-plane-2
  namespace: openshift-machine-api
spec:
```

```
  automatedCleaningMode: disabled
  bmc:
    address: redfish://10.46.61.18:443/redfish/v1/Systems/1
    credentialsName: openshift-control-plane-2-bmc-secret
    disableCertificateVerification: true
  bootMACAddress: 48:df:37:b0:8a:a0
  bootMode: UEFI
  externallyProvisioned: false
  online: true
  rootDeviceHints:
    deviceName: /dev/disk/by-id/scsi-<serial_number>
  userData:
    name: master-user-data-managed
    namespace: openshift-machine-api
EOF
```



NOTE

The username and password can be found from the other bare metal host's secrets. The protocol to use in **bmc:address** can be taken from other bmh objects.



IMPORTANT

If you reuse the **BareMetalHost** object definition from an existing control plane host, do not leave the **externallyProvisioned** field set to **true**.

Existing control plane **BareMetalHost** objects may have the **externallyProvisioned** flag set to **true** if they were provisioned by the OpenShift Container Platform installation program.

After the inspection is complete, the **BareMetalHost** object is created and available to be provisioned.

11. Verify the creation process using available **BareMetalHost** objects:

```
$ oc get bmh -n openshift-machine-api

NAME                 STATE                  CONSUMER                      ONLINE ERROR   AGE
openshift-control-plane-0 externally provisioned examplecluster-control-plane-0 true
4h48m
openshift-control-plane-1 externally provisioned examplecluster-control-plane-1 true
4h48m
openshift-control-plane-2 available          examplecluster-control-plane-3 true      47m
openshift-compute-0       provisioned        examplecluster-compute-0       true      4h48m
openshift-compute-1       provisioned        examplecluster-compute-1       true      4h48m
```

a. Verify that a new machine has been created:

```
$ oc get machines -n openshift-machine-api -o wide
```

Example output

```
NAME                        PHASE    TYPE   REGION   ZONE   AGE     NODE
```

```
PROVIDERID                                                        STATE
examplecluster-control-plane-0        Running                   3h11m   openshift-control-
plane-0   baremetalhost:///openshift-machine-api/openshift-control-plane-0/da1ebe11-
3ff2-41c5-b099-0aa41222964e   externally provisioned (1)
examplecluster-control-plane-1        Running                   3h11m   openshift-control-
plane-1   baremetalhost:///openshift-machine-api/openshift-control-plane-1/d9f9acbc-
329c-475e-8d81-03b20280a3e1   externally provisioned
examplecluster-control-plane-2        Running                   3h11m   openshift-control-
plane-2   baremetalhost:///openshift-machine-api/openshift-control-plane-2/3354bdac-
61d8-410f-be5b-6a395b056135   externally provisioned
examplecluster-compute-0              Running                   165m    openshift-compute-
0         baremetalhost:///openshift-machine-api/openshift-compute-0/3d685b81-7410-
4bb3-80ec-13a31858241f        provisioned
examplecluster-compute-1              Running                   165m    openshift-compute-
1         baremetalhost:///openshift-machine-api/openshift-compute-1/0fdae6eb-2066-
4241-91dc-e7ea72ab13b9        provisioned
```

(1) The new machine, **clustername-8qw5l-master-3** is being created and is ready after the phase changes from **Provisioning** to **Running**.

It should take a few minutes for the new machine to be created. The etcd cluster Operator will automatically sync when the machine or node returns to a healthy state.

b. Verify that the bare metal host becomes provisioned and no error reported by running the following command:

```
$ oc get bmh -n openshift-machine-api
```

Example output

```
$ oc get bmh -n openshift-machine-api
NAME                 STATE                  CONSUMER                  ONLINE ERROR AGE
openshift-control-plane-0 externally provisioned examplecluster-control-plane-0 true
4h48m
openshift-control-plane-1 externally provisioned examplecluster-control-plane-1 true
4h48m
openshift-control-plane-2 provisioned          examplecluster-control-plane-3 true
47m
openshift-compute-0       provisioned          examplecluster-compute-0       true
4h48m
openshift-compute-1       provisioned          examplecluster-compute-1       true
4h48m
```

c. Verify that the new node is added and in a ready state by running this command:

```
$ oc get nodes
```

Example output

```
$ oc get nodes
NAME                 STATUS ROLES   AGE   VERSION
openshift-control-plane-0 Ready master 4h26m v1.31.3
openshift-control-plane-1 Ready master 4h26m v1.31.3
```

```
openshift-control-plane-2 Ready master 12m   v1.31.3
openshift-compute-0       Ready worker 3h58m v1.31.3
openshift-compute-1       Ready worker 3h58m v1.31.3
```

12. Turn the quorum guard back on by entering the following command:

```
$ oc patch etcd/cluster --type=merge -p '{"spec": {"unsupportedConfigOverrides": null}}'
```

13. You can verify that the **unsupportedConfigOverrides** section is removed from the object by entering this command:

```
$ oc get etcd/cluster -oyaml
```

14. If you are using single-node OpenShift, restart the node. Otherwise, you might encounter the following error in the etcd cluster Operator:

Example output

```
EtcdCertSignerControllerDegraded: [Operation cannot be fulfilled on secrets "etcd-peer-sno-0": the object has been modified; please apply your changes to the latest version and try again, Operation cannot be fulfilled on secrets "etcd-serving-sno-0": the object has been modified; please apply your changes to the latest version and try again, Operation cannot be fulfilled on secrets "etcd-serving-metrics-sno-0": the object has been modified; please apply your changes to the latest version and try again]
```

Verification

1. Verify that all etcd pods are running properly.
In a terminal that has access to the cluster as a **cluster-admin** user, run the following command:

```
$ oc -n openshift-etcd get pods -l k8s-app=etcd
```

Example output

```
etcd-openshift-control-plane-0     5/5   Running   0   105m
etcd-openshift-control-plane-1     5/5   Running   0   107m
etcd-openshift-control-plane-2     5/5   Running   0   103m
```

If the output from the previous command only lists two pods, you can manually force an etcd redeployment. In a terminal that has access to the cluster as a **cluster-admin** user, run the following command:

```
$ oc patch etcd cluster -p='{"spec": {"forceRedeploymentReason": "recovery-'"$( date --rfc-3339=ns )"'"}}' --type=merge 1
```

1 The **forceRedeploymentReason** value must be unique, which is why a timestamp is appended.

To verify there are exactly three etcd members, connect to the running etcd container, passing in the name of a pod that was not on the affected node. In a terminal that has access to the cluster as a **cluster-admin** user, run the following command:

```
$ oc rsh -n openshift-etcd etcd-openshift-control-plane-0
```

2. View the member list:

```
sh-4.2# etcdctl member list -w table
```

Example output

```
+------------------+---------+-------------------+--------------------------+--------------------------+---
--------------+
|        ID        | STATUS  |       NAME        |        PEER ADDRS        |       CLIENT ADDRS
|    IS LEARNER    |
+------------------+---------+-------------------+--------------------------+--------------------------+---
--------------+
| 7a8197040a5126c8 | started | openshift-control-plane-2 | https://192.168.10.11:2380 |
https://192.168.10.11:2379 |    false |
| 8d5abe9669a39192 | started | openshift-control-plane-1 | https://192.168.10.10:2380 |
https://192.168.10.10:2379 |    false |
| cc3830a72fc357f9 | started | openshift-control-plane-0 | https://192.168.10.9:2380 |
https://192.168.10.9:2379 |     false |
+------------------+---------+-------------------+--------------------------+--------------------------+---
--------------+
```

NOTE

If the output from the previous command lists more than three etcd members, you must carefully remove the unwanted member.

3. Verify that all etcd members are healthy by running the following command:

```
# etcdctl endpoint health --cluster
```

Example output

```
https://192.168.10.10:2379 is healthy: successfully committed proposal: took = 8.973065ms
https://192.168.10.9:2379 is healthy: successfully committed proposal: took = 11.559829ms
https://192.168.10.11:2379 is healthy: successfully committed proposal: took = 11.665203ms
```

4. Validate that all nodes are at the latest revision by running the following command:

```
$ oc get etcd -o=jsonpath='{range.items[0].status.conditions[?
(@.type=="NodeInstallerProgressing")]}{.reason}{"\n"}{.message}{"\n"}'
```

```
AllNodesAtLatestRevision
```

6.2.5. Additional resources

- Quorum protection with machine lifecycle hooks

6.3. DISASTER RECOVERY

6.3.1. About disaster recovery

The disaster recovery documentation provides information for administrators on how to recover from several disaster situations that might occur with their OpenShift Container Platform cluster. As an administrator, you might need to follow one or more of the following procedures to return your cluster to a working state.

IMPORTANT

Disaster recovery requires you to have at least one healthy control plane host.

Quorum restoration

This solution handles situations where you have lost the majority of your control plane hosts, leading to etcd quorum loss and the cluster going offline. This solution does not require an etcd backup.

NOTE

If you have a majority of your control plane nodes still available and have an etcd quorum, then replace a single unhealthy etcd member.

Restoring to a previous cluster state

This solution handles situations where you want to restore your cluster to a previous state, for example, if an administrator deletes something critical. If you have taken an etcd backup, you can restore your cluster to a previous state.
If applicable, you might also need to recover from expired control plane certificates .

WARNING

Restoring to a previous cluster state is a destructive and destablizing action to take on a running cluster. This procedure should only be used as a last resort.

Prior to performing a restore, see About restoring cluster state for more information on the impact to the cluster.

Recovering from expired control plane certificates

This solution handles situations where your control plane certificates have expired. For example, if you shut down your cluster before the first certificate rotation, which occurs 24 hours after installation, your certificates will not be rotated and will expire. You can follow this procedure to recover from expired control plane certificates.

6.3.1.1. Testing restore procedures

Testing the restore procedure is important to ensure that your automation and workload handle the new cluster state gracefully. Due to the complex nature of etcd quorum and the etcd Operator attempting to mend automatically, it is often difficult to correctly bring your cluster into a broken enough state that it can be restored.

WARNING

You **must** have SSH access to the cluster. Your cluster might be entirely lost without SSH access.

Prerequisites

- You have SSH access to control plane hosts.
- You have installed the OpenShift CLI (**oc**).

Procedure

1. Use SSH to connect to each of your nonrecovery nodes and run the following commands to disable etcd and the **kubelet** service:
   a. Disable etcd by running the following command:

      ```
      $ sudo /usr/local/bin/disable-etcd.sh
      ```

   b. Delete variable data for etcd by running the following command:

      ```
      $ sudo rm -rf /var/lib/etcd
      ```

   c. Disable the **kubelet** service by running the following command:

      ```
      $ sudo systemctl disable kubelet.service
      ```

2. Exit every SSH session.
3. Run the following command to ensure that your nonrecovery nodes are in a **NOT READY** state:

   ```
   $ oc get nodes
   ```

4. Follow the steps in "Restoring to a previous cluster state" to restore your cluster.
5. After you restore the cluster and the API responds, use SSH to connect to each nonrecovery node and enable the **kubelet** service:

   ```
   $ sudo systemctl enable kubelet.service
   ```

6. Exit every SSH session.
7. Run the following command to observe your nodes coming back into the **READY** state:

   ```
   $ oc get nodes
   ```

8. Run the following command to verify that etcd is available:

```
$ oc get pods -n openshift-etcd
```

Additional resources

- Restoring to a previous cluster state

6.3.2. Quorum restoration

You can use the **quorum-restore.sh** script to restore etcd quorum on clusters that are offline due to quorum loss. When quorum is lost, the OpenShift Container Platform API becomes read-only. After quorum is restored, the OpenShift Container Platform API returns to read/write mode.

6.3.2.1. Restoring etcd quorum for high availability clusters

You can use the **quorum-restore.sh** script to instantly bring back a new single-member etcd cluster based on its local data directory and mark all other members as invalid by retiring the previous cluster identifier. No prior backup is required to restore the control plane from.

For high availability (HA) clusters, a three-node HA cluster requires you to shut down etcd on two hosts to avoid a cluster split. On four-node and five-node HA clusters, you must shut down three hosts. Quorum requires a simple majority of nodes. The minimum number of nodes required for quorum on a three-node HA cluster is two. On four-node and five-node HA clusters, the minimum number of nodes required for quorum is three. If you start a new cluster from backup on your recovery host, the other etcd members might still be able to form quorum and continue service.

WARNING

You might experience data loss if the host that runs the restoration does not have all data replicated to it.

IMPORTANT

Quorum restoration should not be used to decrease the number of nodes outside of the restoration process. Decreasing the number of nodes results in an unsupported cluster configuration.

Prerequisites

- You have SSH access to the node used to restore quorum.

Procedure

1. Select a control plane host to use as the recovery host. You run the restore operation on this host.
   a. List the running etcd pods by running the following command:

```
$ oc get pods -n openshift-etcd -l app=etcd --field-selector="status.phase==Running"
```

b. Choose a pod and run the following command to obtain its IP address:

```
$ oc exec -n openshift-etcd <etcd-pod> -c etcdctl -- etcdctl endpoint status -w table
```

Note the IP address of a member that is not a learner and has the highest Raft index.

c. Run the following command and note the node name that corresponds to the IP address of the chosen etcd member:

```
$ oc get nodes -o jsonpath='{range .items[*]}[{.metadata.name},{.status.addresses[?
(@.type=="InternalIP")].address}]{end}'
```

2. Using SSH, connect to the chosen recovery node and run the following command to restore etcd quorum:

```
$ sudo -E /usr/local/bin/quorum-restore.sh
```

After a few minutes, the nodes that went down are automatically synchronized with the node that the recovery script was run on. Any remaining online nodes automatically rejoin the new etcd cluster created by the **quorum-restore.sh** script. This process takes a few minutes.

3. Exit the SSH session.

4. Return to a three-node configuration if any nodes are offline. Repeat the following steps for each node that is offline to delete and re-create them. After the machines are re-created, a new revision is forced and etcd automatically scales up.

- If you use a user-provisioned bare-metal installation, you can re-create a control plane machine by using the same method that you used to originally create it. For more information, see "Installing a user-provisioned cluster on bare metal".

WARNING

Do not delete and re-create the machine for the recovery host.

- If you are running installer-provisioned infrastructure, or you used the Machine API to create your machines, follow these steps:

WARNING

Do not delete and re-create the machine for the recovery host.

For bare-metal installations on installer-provisioned infrastructure, control plane machines are not re-created. For more information, see "Replacing a bare-metal control plane node".

a. Obtain the machine for one of the offline nodes.
In a terminal that has access to the cluster as a **cluster-admin** user, run the following command:

```
$ oc get machines -n openshift-machine-api -o wide
```

Example output:

```
NAME                                PHASE     TYPE        REGION      ZONE       AGE
NODE                           PROVIDERID                          STATE
clustername-8qw5l-master-0          Running   m4.xlarge   us-east-1   us-east-1a
3h37m   ip-10-0-131-183.ec2.internal   aws:///us-east-1a/i-0ec2782f8287dfb7e
stopped (1)
clustername-8qw5l-master-1          Running   m4.xlarge   us-east-1   us-east-1b
3h37m   ip-10-0-143-125.ec2.internal   aws:///us-east-1b/i-096c349b700a19631
running
clustername-8qw5l-master-2          Running   m4.xlarge   us-east-1   us-east-1c
3h37m   ip-10-0-154-194.ec2.internal   aws:///us-east-1c/i-02626f1dba9ed5bba
running
clustername-8qw5l-worker-us-east-1a-wbtgd   Running   m4.large   us-east-1   us-
east-1a   3h28m   ip-10-0-129-226.ec2.internal   aws:///us-east-1a/i-
010ef6279b4662ced   running
clustername-8qw5l-worker-us-east-1b-lrdxb   Running   m4.large   us-east-1   us-
east-1b   3h28m   ip-10-0-144-248.ec2.internal   aws:///us-east-1b/i-
0cb45ac45a166173b   running
clustername-8qw5l-worker-us-east-1c-pkg26   Running   m4.large   us-east-1   us-
east-1c   3h28m   ip-10-0-170-181.ec2.internal   aws:///us-east-1c/i-
06861c00007751b0a   running
```

(1) This is the control plane machine for the offline node, **ip-10-0-131-183.ec2.internal**.

b. Delete the machine of the offline node by running:

```
$ oc delete machine -n openshift-machine-api clustername-8qw5l-master-0 (1)
```

(1) Specify the name of the control plane machine for the offline node.

A new machine is automatically provisioned after deleting the machine of the offline node.

5. Verify that a new machine has been created by running:

```
$ oc get machines -n openshift-machine-api -o wide
```

Example output:

```
NAME                                PHASE     TYPE        REGION      ZONE       AGE
NODE                           PROVIDERID                          STATE
clustername-8qw5l-master-1          Running   m4.xlarge   us-east-1   us-east-1b
3h37m   ip-10-0-143-125.ec2.internal   aws:///us-east-1b/i-096c349b700a19631   running
clustername-8qw5l-master-2          Running   m4.xlarge   us-east-1   us-east-1c
```

```
3h37m  ip-10-0-154-194.ec2.internal  aws:///us-east-1c/i-02626f1dba9ed5bba  running
clustername-8qw5l-master-3  Provisioning  m4.xlarge  us-east-1  us-east-1a  85s
ip-10-0-173-171.ec2.internal  aws:///us-east-1a/i-015b0888fe17bc2c8  running (1)
clustername-8qw5l-worker-us-east-1a-wbtgd  Running  m4.large  us-east-1  us-east-1a
3h28m  ip-10-0-129-226.ec2.internal  aws:///us-east-1a/i-010ef6279b4662ced  running
clustername-8qw5l-worker-us-east-1b-lrdxb  Running  m4.large  us-east-1  us-east-1b
3h28m  ip-10-0-144-248.ec2.internal  aws:///us-east-1b/i-0cb45ac45a166173b  running
clustername-8qw5l-worker-us-east-1c-pkg26  Running  m4.large  us-east-1  us-east-1c
3h28m  ip-10-0-170-181.ec2.internal  aws:///us-east-1c/i-06861c00007751b0a  running
```

(1) The new machine, **clustername-8qw5l-master-3** is being created and is ready after the phase changes from **Provisioning** to **Running**.

It might take a few minutes for the new machine to be created. The etcd cluster Operator will automatically synchronize when the machine or node returns to a healthy state.

a. Repeat these steps for each node that is offline.

6. Wait until the control plane recovers by running the following command:

```
$ oc adm wait-for-stable-cluster
```

NOTE

It can take up to 15 minutes for the control plane to recover.

Troubleshooting

- If you see no progress rolling out the etcd static pods, you can force redeployment from the etcd cluster Operator by running the following command:

```
$ oc patch etcd cluster -p='{"spec": {"forceRedeploymentReason": "recovery-'"$(date --rfc-3339=ns )"'"}}' --type=merge
```

6.3.2.2. Additional resources

- Installing a user-provisioned cluster on bare metal
- Replacing a bare-metal control plane node

6.3.3. Restoring to a previous cluster state

To restore the cluster to a previous state, you must have previously backed up the **etcd** data by creating a snapshot. You will use this snapshot to restore the cluster state. For more information, see "Backing up etcd data".

6.3.3.1. About restoring cluster state

You can use an etcd backup to restore your cluster to a previous state. This can be used to recover from the following situations:

- The cluster has lost the majority of control plane hosts (quorum loss).

- An administrator has deleted something critical and must restore to recover the cluster.

WARNING

Restoring to a previous cluster state is a destructive and destablizing action to take on a running cluster. This should only be used as a last resort.

If you are able to retrieve data using the Kubernetes API server, then etcd is available and you should not restore using an etcd backup.

Restoring etcd effectively takes a cluster back in time and all clients will experience a conflicting, parallel history. This can impact the behavior of watching components like kubelets, Kubernetes controller managers, persistent volume controllers, and OpenShift Container Platform Operators, including the network Operator.

It can cause Operator churn when the content in etcd does not match the actual content on disk, causing Operators for the Kubernetes API server, Kubernetes controller manager, Kubernetes scheduler, and etcd to get stuck when files on disk conflict with content in etcd. This can require manual actions to resolve the issues.

In extreme cases, the cluster can lose track of persistent volumes, delete critical workloads that no longer exist, reimage machines, and rewrite CA bundles with expired certificates.

6.3.3.2. Restoring to a previous cluster state for a single node

You can use a saved etcd backup to restore a previous cluster state on a single node.

IMPORTANT

When you restore your cluster, you must use an etcd backup that was taken from the same z-stream release. For example, an OpenShift Container Platform 4.18.2 cluster must use an etcd backup that was taken from 4.18.2.

Prerequisites

- Access to the cluster as a user with the **cluster-admin** role through a certificate-based **kubeconfig** file, like the one that was used during installation.
- You have SSH access to control plane hosts.
- A backup directory containing both the etcd snapshot and the resources for the static pods, which were from the same backup. The file names in the directory must be in the following formats: **snapshot_<datetimestamp>.db** and **static_kuberesources_<datetimestamp>.tar.gz**.

Procedure

1. Use SSH to connect to the single node and copy the etcd backup to the **/home/core** directory by running the following command:

```
$ cp <etcd_backup_directory> /home/core
```

2. Run the following command in the single node to restore the cluster from a previous backup:

```
$ sudo -E /usr/local/bin/cluster-restore.sh /home/core/<etcd_backup_directory>
```

3. Exit the SSH session.

4. Monitor the recovery progress of the control plane by running the following command:

```
$ oc adm wait-for-stable-cluster
```

NOTE

It can take up to 15 minutes for the control plane to recover.

6.3.3.3. Restoring to a previous cluster state

You can use a saved etcd backup to restore a previous cluster state or restore a cluster that has lost the majority of control plane hosts.

For high availability (HA) clusters, a three-node HA cluster requires you to shut down etcd on two hosts to avoid a cluster split. On four-node and five-node HA clusters, you must shut down three hosts. Quorum requires a simple majority of nodes. The minimum number of nodes required for quorum on a three-node HA cluster is two. On four-node and five-node HA clusters, the minimum number of nodes required for quorum is three. If you start a new cluster from backup on your recovery host, the other etcd members might still be able to form quorum and continue service.

NOTE

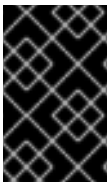
If your cluster uses a control plane machine set, see "Troubleshooting the control plane machine set" for a more simple etcd recovery procedure. For OpenShift Container Platform on a single node, see "Restoring to a previous cluster state for a single node".

IMPORTANT

When you restore your cluster, you must use an etcd backup that was taken from the same z-stream release. For example, an OpenShift Container Platform 4.18.2 cluster must use an etcd backup that was taken from 4.18.2.

Prerequisites

- Access to the cluster as a user with the **cluster-admin** role through a certificate-based **kubeconfig** file, like the one that was used during installation.
- A healthy control plane host to use as the recovery host.
- You have SSH access to control plane hosts.
- A backup directory containing both the **etcd** snapshot and the resources for the static pods, which were from the same backup. The file names in the directory must be in the following formats: **snapshot_<datetimestamp>.db** and **static_kuberesources_<datetimestamp>.tar.gz**.

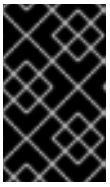


IMPORTANT

For non-recovery control plane nodes, it is not required to establish SSH connectivity or to stop the static pods. You can delete and recreate other non-recovery, control plane machines, one by one.

Procedure

1. Select a control plane host to use as the recovery host. This is the host that you run the restore operation on.
2. Establish SSH connectivity to each of the control plane nodes, including the recovery host. **kube-apiserver** becomes inaccessible after the restore process starts, so you cannot access the control plane nodes. For this reason, it is recommended to establish SSH connectivity to each control plane host in a separate terminal.



IMPORTANT

If you do not complete this step, you will not be able to access the control plane hosts to complete the restore procedure, and you will be unable to recover your cluster from this state.

3. Using SSH, connect to each control plane node and run the following command to disable etcd:

```
$ sudo -E /usr/local/bin/disable-etcd.sh
```

4. Copy the etcd backup directory to the recovery control plane host.
This procedure assumes that you copied the **backup** directory containing the etcd snapshot and the resources for the static pods to the **/home/core/** directory of your recovery control plane host.
5. Use SSH to connect to the recovery host and restore the cluster from a previous backup by running the following command:

```
$ sudo -E /usr/local/bin/cluster-restore.sh /home/core/<etcd-backup-directory>
```

6. Exit the SSH session.
7. Once the API responds, turn off the etcd Operator quorum guard by runnning the following command:

```
$ oc patch etcd/cluster --type=merge -p '{"spec": {"unsupportedConfigOverrides":
{"useUnsupportedUnsafeNonHANonProductionUnstableEtcd": true}}}'
```

8. Monitor the recovery progress of the control plane by running the following command:

```
$ oc adm wait-for-stable-cluster
```

NOTE

It can take up to 15 minutes for the control plane to recover.

9. Once recovered, enable the quorum guard by running the following command:

```
$ oc patch etcd/cluster --type=merge -p '{"spec": {"unsupportedConfigOverrides": null}}'
```

Troubleshooting

If you see no progress rolling out the etcd static pods, you can force redeployment from the **cluster-etcd-operator** by running the following command:

```
$ oc patch etcd cluster -p='{"spec": {"forceRedeploymentReason": "recovery-'"$(date --rfc-3339=ns
)"'"}}' --type=merge
```

6.3.3.4. Restoring a cluster manually from an etcd backup

The restore procedure described in the section "Restoring to a previous cluster state":

- Requires the complete recreation of 2 control plane nodes, which might be a complex procedure for clusters installed with the UPI installation method, since an UPI installation does not create any **Machine** or **ControlPlaneMachineset** for the control plane nodes.
- Uses the script /usr/local/bin/cluster-restore.sh, which starts a new single-member etcd cluster and then scales it to three members.

In contrast, this procedure:

- Does not require recreating any control plane nodes.
- Directly starts a three-member etcd cluster.

If the cluster uses a **MachineSet** for the control plane, it is suggested to use the "Restoring to a previous cluster state" for a simpler etcd recovery procedure.

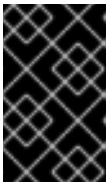
When you restore your cluster, you must use an etcd backup that was taken from the same z-stream release. For example, an OpenShift Container Platform 4.7.2 cluster must use an etcd backup that was taken from 4.7.2.

Prerequisites

- Access to the cluster as a user with the **cluster-admin** role; for example, the **kubeadmin** user.
- SSH access to *all* control plane hosts, with a host user allowed to become **root**; for example, the default **core** host user.
- A backup directory containing both a previous etcd snapshot and the resources for the static pods from the same backup. The file names in the directory must be in the following formats: **snapshot_<datetimestamp>.db** and **static_kuberesources_<datetimestamp>.tar.gz**.

Procedure

1. Use SSH to connect to each of the control plane nodes.
   The Kubernetes API server becomes inaccessible after the restore process starts, so you cannot access the control plane nodes. For this reason, it is recommended to use a SSH connection for each control plane host you are accessing in a separate terminal.



IMPORTANT

If you do not complete this step, you will not be able to access the control plane hosts to complete the restore procedure, and you will be unable to recover your cluster from this state.

2. Copy the etcd backup directory to each control plane host.
This procedure assumes that you copied the **backup** directory containing the etcd snapshot and the resources for the static pods to the **/home/core/assets** directory of each control plane host. You might need to create such **assets** folder if it does not exist yet.

3. Stop the static pods on all the control plane nodes; one host at a time.

   a. Move the existing Kubernetes API Server static pod manifest out of the kubelet manifest directory.

   ```
   $ mkdir -p /root/manifests-backup
   $ mv /etc/kubernetes/manifests/kube-apiserver-pod.yaml /root/manifests-backup/
   ```

   b. Verify that the Kubernetes API Server containers have stopped with the command:

   ```
   $ crictl ps | grep kube-apiserver | grep -E -v "operator|guard"
   ```

   The output of this command should be empty. If it is not empty, wait a few minutes and check again.

   c. If the Kubernetes API Server containers are still running, terminate them manually with the following command:

   ```
   $ crictl stop <container_id>
   ```

   d. Repeat the same steps for **kube-controller-manager-pod.yaml**, **kube-scheduler-pod.yaml** and **finally etcd-pod.yaml**.

      i. Stop the **kube-controller-manager** pod with the following command:

      ```
      $ mv /etc/kubernetes/manifests/kube-controller-manager-pod.yaml /root/manifests-backup/
      ```

      ii. Check if the containers are stopped using the following command:

      ```
      $ crictl ps | grep kube-controller-manager | grep -E -v "operator|guard"
      ```

      iii. Stop the **kube-scheduler** pod using the following command:

      ```
      $ mv /etc/kubernetes/manifests/kube-scheduler-pod.yaml /root/manifests-backup/
      ```

      iv. Check if the containers are stopped using the following command:

      ```
      $ crictl ps | grep kube-scheduler | grep -E -v "operator|guard"
      ```

      v. Stop the **etcd** pod using the following command:

```
$ mv /etc/kubernetes/manifests/etcd-pod.yaml /root/manifests-backup/
```

vi. Check if the containers are stopped using the following command:

```
$ crictl ps | grep etcd | grep -E -v "operator|guard"
```

4. On each control plane host, save the current **etcd** data, by moving it into the **backup** folder:

```
$ mkdir /home/core/assets/old-member-data
$ mv /var/lib/etcd/member /home/core/assets/old-member-data
```

This data will be useful in case the **etcd** backup restore does not work and the **etcd** cluster must be restored to the current state.

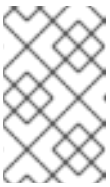
5. Find the correct etcd parameters for each control plane host.

a. The value for **<ETCD_NAME>** is unique for the each control plane host, and it is equal to the value of the **ETCD_NAME** variable in the manifest **/etc/kubernetes/static-pod-resources/etcd-certs/configmaps/restore-etcd-pod/pod.yaml** file in the specific control plane host. It can be found with the command:

```
RESTORE_ETCD_POD_YAML="/etc/kubernetes/static-pod-resources/etcd-certs/configmaps/restore-etcd-pod/pod.yaml"
cat $RESTORE_ETCD_POD_YAML | \
  grep -A 1 $(cat $RESTORE_ETCD_POD_YAML | grep 'export ETCD_NAME' | grep -Eo 'NODE_.+_ETCD_NAME') | \
  grep -Po '(?<=value: ").+(?=")'
```

b. The value for **<UUID>** can be generated in a control plane host with the command:

```
$ uuidgen
```



NOTE

The value for **<UUID>** must be generated only once. After generating **UUID** on one control plane host, do not generate it again on the others. The same **UUID** will be used in the next steps on all control plane hosts.

c. The value for **ETCD_NODE_PEER_URL** should be set like the following example:

```
https://<IP_CURRENT_HOST>:2380
```

The correct IP can be found from the **<ETCD_NAME>** of the specific control plane host, with the command:

```
$ echo <ETCD_NAME> | \
  sed -E 's/[.-]/_/g' | \
  xargs -I {} grep {} /etc/kubernetes/static-pod-resources/etcd-certs/configmaps/etcd-scripts/etcd.env | \
  grep "IP" | grep -Po '(?<=").+(?=")'
```

d. The value for **<ETCD_INITIAL_CLUSTER>** should be set like the following, where **<ETCD_NAME_n>** is the **<ETCD_NAME>** of each control plane host.

NOTE

The port used must be 2380 and not 2379. The port 2379 is used for etcd database management and is configured directly in etcd start command in container.

Example output

```
<ETCD_NAME_0>=<ETCD_NODE_PEER_URL_0>,<ETCD_NAME_1>=
<ETCD_NODE_PEER_URL_1>,<ETCD_NAME_2>=<ETCD_NODE_PEER_URL_2>
1
```

1 Specifies the **ETCD_NODE_PEER_URL** values from each control plane host.

The **<ETCD_INITIAL_CLUSTER>** value remains same across all control plane hosts. The same value is required in the next steps on every control plane host.

6. Regenerate the etcd database from the backup.
   Such operation must be executed on each control plane host.

   a. Copy the **etcd** backup to **/var/lib/etcd** directory with the command:

   ```
   $ cp /home/core/assets/backup/<snapshot_yyyy-mm-dd_hhmmss>.db /var/lib/etcd
   ```

   b. Identify the correct **etcdctl** image before proceeding. Use the following command to retrieve the image from the backup of the pod manifest:

   ```
   $ jq -r '.spec.containers[]|select(.name=="etcdctl")|.image' /root/manifests-backup/etcd-pod.yaml
   ```

   ```
   $ podman run --rm -it --entrypoint="/bin/bash" -v /var/lib/etcd:/var/lib/etcd:z <image-hash>
   ```

   c. Check that the version of the **etcdctl** tool is the version of the **etcd** server where the backup was created:

   ```
   $ etcdctl version
   ```

   d. Run the following command to regenerate the **etcd** database, using the correct values for the current host:

   ```
   $ ETCDCTL_API=3 /usr/bin/etcdctl snapshot restore /var/lib/etcd/<snapshot_yyyy-mm-dd_hhmmss>.db \
     --name "<ETCD_NAME>" \
     --initial-cluster="<ETCD_INITIAL_CLUSTER>" \
     --initial-cluster-token "openshift-etcd-<UUID>" \
     --initial-advertise-peer-urls "<ETCD_NODE_PEER_URL>" \
     --data-dir="/var/lib/etcd/restore-<UUID>" \
     --skip-hash-check=true
   ```

NOTE

The quotes are mandatory when regenerating the **etcd** database.

7. Record the values printed in the **added member** logs; for example:

Example output

```
2022-06-28T19:52:43Z info membership/cluster.go:421 added member {"cluster-id": "c5996b7c11c30d6b", "local-member-id": "0", "added-peer-id": "56cd73b614699e7", "added-peer-peer-urls": ["https://10.0.91.5:2380"], "added-peer-is-learner": false}
2022-06-28T19:52:43Z info membership/cluster.go:421 added member {"cluster-id": "c5996b7c11c30d6b", "local-member-id": "0", "added-peer-id": "1f63d01b31bb9a9e", "added-peer-peer-urls": ["https://10.0.90.221:2380"], "added-peer-is-learner": false}
2022-06-28T19:52:43Z info membership/cluster.go:421 added member {"cluster-id": "c5996b7c11c30d6b", "local-member-id": "0", "added-peer-id": "fdc2725b3b70127c", "added-peer-peer-urls": ["https://10.0.94.214:2380"], "added-peer-is-learner": false}
```

   a. Exit from the container.

   b. Repeat these steps on the other control plane hosts, checking that the values printed in the **added member** logs are the same for all control plane hosts.

8. Move the regenerated **etcd** database to the default location.
   Such operation must be executed on each control plane host.

   a. Move the regenerated database (the **member** folder created by the previous **etcdctl snapshot restore** command) to the default etcd location **/var/lib/etcd**:

   ```
   $ mv /var/lib/etcd/restore-<UUID>/member /var/lib/etcd
   ```

   b. Restore the SELinux context for **/var/lib/etcd/member** folder on **/var/lib/etcd** directory:

   ```
   $ restorecon -vR /var/lib/etcd/
   ```

   c. Remove the leftover files and directories:

   ```
   $ rm -rf /var/lib/etcd/restore-<UUID>
   ```

   ```
   $ rm /var/lib/etcd/<snapshot_yyyy-mm-dd_hhmmss>.db
   ```

   IMPORTANT

   When you are finished the **/var/lib/etcd** directory must contain only the folder **member**.

   d. Repeat these steps on the other control plane hosts.

9. Restart the etcd cluster.

   a. The following steps must be executed on all control plane hosts, but **one host at a time**.

b. Move the **etcd** static pod manifest back to the kubelet manifest directory, in order to make kubelet start the related containers :

```
$ mv /tmp/etcd-pod.yaml /etc/kubernetes/manifests
```

c. Verify that all the **etcd** containers have started:

```
$ crictl ps | grep etcd | grep -v operator
```

Example output

```
38c814767ad983
f79db5a8799fd2c08960ad9ee22f784b9fbe23babe008e8a3bf68323f004c840
28 seconds ago       Running             etcd-health-monitor                   2
fe4b9c3d6483c
e1646b15207c6
9d28c15860870e85c91d0e36b45f7a6edd3da757b113ec4abb4507df88b17f06
About a minute ago   Running             etcd-metrics                          0
fe4b9c3d6483c
08ba29b1f58a7
9d28c15860870e85c91d0e36b45f7a6edd3da757b113ec4abb4507df88b17f06
About a minute ago   Running             etcd                                  0
fe4b9c3d6483c
2ddc9eda16f53
9d28c15860870e85c91d0e36b45f7a6edd3da757b113ec4abb4507df88b17f06
About a minute ago   Running             etcdctl
```

If the output of this command is empty, wait a few minutes and check again.

10. Check the status of the **etcd** cluster.

a. On any of the control plane hosts, check the status of the **etcd** cluster with the following command:

```
$ crictl exec -it $(crictl ps | grep etcdctl | awk '{print $1}') etcdctl endpoint status -w table
```

Example output

```
+--------------------------+------------------+---------+---------+-----------+------------+-----------
+------------+--------------------+--------+
|         ENDPOINT         |        ID        | VERSION | DB SIZE | IS LEADER | IS LEARNER |
RAFT TERM | RAFT INDEX | RAFT APPLIED INDEX | ERRORS |
+--------------------------+------------------+---------+---------+-----------+------------+-----------
+------------+--------------------+--------+
| https://10.0.89.133:2379 | 682e4a83a0cec6c0 |   3.5.0 |   67 MB |      true |      false |
2 |       218 |                218 |        |
|  https://10.0.92.74:2379 | 450bcf6999538512 |   3.5.0 |   67 MB |     false |      false |
2 |       218 |                218 |        |
| https://10.0.93.129:2379 | 358efa9c1d91c3d6 |   3.5.0 |   67 MB |     false |      false |
2 |       218 |                218 |        |
+--------------------------+------------------+---------+---------+-----------+------------+-----------
+------------+--------------------+--------+
```

11. Restart the other static pods.

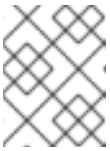
The following steps must be executed on all control plane hosts, but one host at a time.

a. Move the Kubernetes API Server static pod manifest back to the kubelet manifest directory to make kubelet start the related containers with the command:

```
$ mv /root/manifests-backup/kube-apiserver-pod.yaml /etc/kubernetes/manifests
```

b. Verify that all the Kubernetes API Server containers have started:

```
$ crictl ps | grep kube-apiserver | grep -v operator
```



NOTE

if the output of the following command is empty, wait a few minutes and check again.

c. Repeat the same steps for **kube-controller-manager-pod.yaml** and **kube-scheduler-pod.yaml** files.

i. Restart the kubelets in all nodes using the following command:

```
$ systemctl restart kubelet
```

ii. Start the remaining control plane pods using the following command:

```
$ mv /root/manifests-backup/kube-* /etc/kubernetes/manifests/
```

iii. Check if the **kube-apiserver**, **kube-scheduler** and **kube-controller-manager** pods start correctly:

```
$ crictl ps | grep -E 'kube-(apiserver|scheduler|controller-manager)' | grep -v -E
'operator|guard'
```

iv. Wipe the OVN databases using the following commands:

```
for NODE in  $(oc get node -o name | sed 's:node/::g')
do
  oc debug node/${NODE} -- chroot /host /bin/bash -c  'rm -f /var/lib/ovn-
ic/etc/ovn*.db && systemctl restart ovs-vswitchd ovsdb-server'
  oc -n openshift-ovn-kubernetes delete pod -l app=ovnkube-node --field-
selector=spec.nodeName=${NODE} --wait
  oc -n openshift-ovn-kubernetes wait pod -l app=ovnkube-node --field-
selector=spec.nodeName=${NODE} --for condition=ContainersReady --
timeout=600s
done
```

6.3.3.5. Additional resources

- Backing up etcd data
- Installing a user-provisioned cluster on bare metal

- Creating a bastion host to access OpenShift Container Platform instances and the control plane nodes with SSH
- Replacing a bare-metal control plane node

6.3.3.6. Issues and workarounds for restoring a persistent storage state

If your OpenShift Container Platform cluster uses persistent storage of any form, a state of the cluster is typically stored outside etcd. It might be an Elasticsearch cluster running in a pod or a database running in a **StatefulSet** object. When you restore from an etcd backup, the status of the workloads in OpenShift Container Platform is also restored. However, if the etcd snapshot is old, the status might be invalid or outdated.

IMPORTANT

The contents of persistent volumes (PVs) are never part of the etcd snapshot. When you restore an OpenShift Container Platform cluster from an etcd snapshot, non-critical workloads might gain access to critical data, or vice-versa.

The following are some example scenarios that produce an out-of-date status:

- MySQL database is running in a pod backed up by a PV object. Restoring OpenShift Container Platform from an etcd snapshot does not bring back the volume on the storage provider, and does not produce a running MySQL pod, despite the pod repeatedly attempting to start. You must manually restore this pod by restoring the volume on the storage provider, and then editing the PV to point to the new volume.
- Pod P1 is using volume A, which is attached to node X. If the etcd snapshot is taken while another pod uses the same volume on node Y, then when the etcd restore is performed, pod P1 might not be able to start correctly due to the volume still being attached to node Y. OpenShift Container Platform is not aware of the attachment, and does not automatically detach it. When this occurs, the volume must be manually detached from node Y so that the volume can attach on node X, and then pod P1 can start.
- Cloud provider or storage provider credentials were updated after the etcd snapshot was taken. This causes any CSI drivers or Operators that depend on the those credentials to not work. You might have to manually update the credentials required by those drivers or Operators.
- A device is removed or renamed from OpenShift Container Platform nodes after the etcd snapshot is taken. The Local Storage Operator creates symlinks for each PV that it manages from **/dev/disk/by-id** or **/dev** directories. This situation might cause the local PVs to refer to devices that no longer exist.
  To fix this problem, an administrator must:

  1. Manually remove the PVs with invalid devices.
  2. Remove symlinks from respective nodes.
  3. Delete **LocalVolume** or **LocalVolumeSet** objects (see *Storage → Configuring persistent storage → Persistent storage using local volumes → Deleting the Local Storage Operator Resources*).

6.3.4. Recovering from expired control plane certificates

6.3.4.1. Recovering from expired control plane certificates

The cluster can automatically recover from expired control plane certificates.

However, you must manually approve the pending **node-bootstrapper** certificate signing requests (CSRs) to recover kubelet certificates. For user-provisioned installations, you might also need to approve pending kubelet serving CSRs.

Use the following steps to approve the pending CSRs:

Procedure

1. Get the list of current CSRs:

```
$ oc get csr
```

Example output

```
NAME        AGE    SIGNERNAME                                    REQUESTOR
CONDITION
csr-2s94x   8m3s   kubernetes.io/kubelet-serving                 system:node:<node_name>
Pending (1)
csr-4bd6t   8m3s   kubernetes.io/kubelet-serving                 system:node:<node_name>
Pending
csr-4hl85   13m    kubernetes.io/kube-apiserver-client-kubelet
system:serviceaccount:openshift-machine-config-operator:node-bootstrapper   Pending (2)
csr-zhhhp   3m8s   kubernetes.io/kube-apiserver-client-kubelet
system:serviceaccount:openshift-machine-config-operator:node-bootstrapper   Pending
...
```

(1) A pending kubelet service CSR (for user-provisioned installations).

(2) A pending **node-bootstrapper** CSR.

2. Review the details of a CSR to verify that it is valid:

```
$ oc describe csr <csr_name> (1)
```

(1) **<csr_name>** is the name of a CSR from the list of current CSRs.

3. Approve each valid **node-bootstrapper** CSR:

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

4. For user-provisioned installations, approve each valid kubelet serving CSR:

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