



# OpenShift Container Platform 4.14

## Backup and restore

Backing up and restoring your OpenShift Container Platform cluster



## OpenShift Container Platform 4.14 Backup and restore

---

Backing up and restoring your OpenShift Container Platform cluster

## Legal Notice

Copyright © 2023 Red Hat, Inc.

The text of and illustrations in this document are licensed by Red Hat under a Creative Commons Attribution–Share Alike 3.0 Unported license ("CC-BY-SA"). An explanation of CC-BY-SA is available at

<http://creativecommons.org/licenses/by-sa/3.0/>

. In accordance with CC-BY-SA, if you distribute this document or an adaptation of it, you must provide the URL for the original version.

Red Hat, as the licensor of this document, waives the right to enforce, and agrees not to assert, Section 4d of CC-BY-SA to the fullest extent permitted by applicable law.

Red Hat, Red Hat Enterprise Linux, the Shadowman logo, the Red Hat logo, JBoss, OpenShift, Fedora, the Infinity logo, and RHCE are trademarks of Red Hat, Inc., registered in the United States and other countries.

Linux<sup>®</sup> is the registered trademark of Linus Torvalds in the United States and other countries.

Java<sup>®</sup> is a registered trademark of Oracle and/or its affiliates.

XFS<sup>®</sup> is a trademark of Silicon Graphics International Corp. or its subsidiaries in the United States and/or other countries.

MySQL<sup>®</sup> is a registered trademark of MySQL AB in the United States, the European Union and other countries.

Node.js<sup>®</sup> is an official trademark of Joyent. Red Hat is not formally related to or endorsed by the official Joyent Node.js open source or commercial project.

The OpenStack<sup>®</sup> Word Mark and OpenStack logo are either registered trademarks/service marks or trademarks/service marks of the OpenStack Foundation, in the United States and other countries and are used with the OpenStack Foundation's permission. We are not affiliated with, endorsed or sponsored by the OpenStack Foundation, or the OpenStack community.

All other trademarks are the property of their respective owners.

## Abstract

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

## Table of Contents

<b>CHAPTER 1. BACKUP AND RESTORE .....</b>	<b>8</b>
1.1. CONTROL PLANE BACKUP AND RESTORE OPERATIONS	8
1.2. APPLICATION BACKUP AND RESTORE OPERATIONS	8
1.2.1. OADP requirements	8
1.2.2. Backing up and restoring applications	9
<b>CHAPTER 2. SHUTTING DOWN THE CLUSTER GRACEFULLY .....</b>	<b>11</b>
2.1. PREREQUISITES	11
2.2. SHUTTING DOWN THE CLUSTER	11
2.3. ADDITIONAL RESOURCES	13
<b>CHAPTER 3. RESTARTING THE CLUSTER GRACEFULLY .....</b>	<b>14</b>
3.1. PREREQUISITES	14
3.2. RESTARTING THE CLUSTER	14
<b>CHAPTER 4. OADP APPLICATION BACKUP AND RESTORE .....</b>	<b>17</b>
4.1. INTRODUCTION TO OPENSIFT API FOR DATA PROTECTION	17
4.1.1. OpenShift API for Data Protection APIs	17
4.2. OADP RELEASE NOTES	17
4.2.1. OADP 1.2.3 release notes	17
4.2.1.1. New features	17
4.2.1.2. Resolved issues	17
4.2.1.3. Known issues	18
4.2.2. OADP 1.2.2 release notes	18
4.2.2.1. New features	18
4.2.2.2. Resolved issues	18
4.2.2.3. Known issues	19
4.2.3. OADP 1.2.1 release notes	19
4.2.3.1. New features	19
4.2.3.2. Resolved issues	19
4.2.3.3. Known issues	19
4.2.4. OADP 1.2.0 release notes	20
4.2.4.1. New features	20
4.2.4.1.1. Technical preview features	20
4.2.4.2. Resolved issues	21
4.2.4.3. Known issues	21
4.2.5. OADP 1.1.7 release notes	21
4.2.5.1. Resolved issues	21
4.2.5.2. Known issues	21
4.2.6. OADP 1.1.6 release notes	22
4.2.6.1. Resolved issues	22
4.2.6.2. Known issues	22
4.2.7. OADP 1.1.5 release notes	22
4.2.7.1. New features	22
4.2.7.2. Resolved issues	22
4.2.7.3. Known issues	22
4.2.8. OADP 1.1.4 release notes	22
4.2.8.1. New features	22
4.2.8.2. Resolved issues	22
4.2.8.3. Known issues	23
4.2.9. OADP 1.1.3 release notes	23
4.2.9.1. New features	23

4.2.9.2. Resolved issues	23
4.2.9.3. Known issues	23
4.2.10. OADP 1.1.2 release notes	24
4.2.10.1. Product recommendations	24
4.2.10.2. Resolved issues	24
4.2.10.3. Known issues	24
4.2.11. OADP 1.1.1 release notes	24
4.2.11.1. Product recommendations	25
4.2.11.2. Known issues	25
4.3. OADP FEATURES AND PLUGINS	25
4.3.1. OADP features	25
4.3.2. OADP plugins	26
4.3.3. About OADP Velero plugins	27
4.3.3.1. Default Velero cloud provider plugins	27
4.3.3.2. Custom Velero plugins	28
4.3.4. Supported architectures for OADP	28
4.3.5. OADP support for IBM Power and IBM Z	29
4.3.5.1. OADP support for target backup locations using IBM Power	29
4.3.5.2. OADP testing and support for target backup locations using IBM Z	29
4.4. INSTALLING AND CONFIGURING OADP	29
4.4.1. About installing OADP	29
4.4.1.1. AWS S3 compatible backup storage providers	30
4.4.1.1.1. Supported backup storage providers	31
4.4.1.1.2. Unsupported backup storage providers	31
4.4.1.1.3. Backup storage providers with known limitations	31
4.4.1.2. Configuring Multicloud Object Gateway (MCG) for disaster recovery on OpenShift Data Foundation	32
4.4.1.3. About OADP update channels	32
4.4.1.4. Installation of OADP on multiple namespaces	33
4.4.1.5. Velero CPU and memory requirements based on collected data	33
4.4.1.5.1. CPU and memory requirement for configurations	34
4.4.2. Installing the OADP Operator	34
4.4.2.1. OADP-Velero-OpenShift Container Platform version relationship	35
4.4.3. Configuring the OpenShift API for Data Protection with Amazon Web Services	36
4.4.3.1. Configuring Amazon Web Services	36
4.4.3.2. About backup and snapshot locations and their secrets	38
Backup locations	38
Snapshot locations	38
Secrets	38
4.4.3.2.1. Creating a default Secret	39
4.4.3.2.2. Creating profiles for different credentials	39
4.4.3.3. Configuring the Data Protection Application	40
4.4.3.3.1. Setting Velero CPU and memory resource allocations	40
4.4.3.3.2. Enabling self-signed CA certificates	41
4.4.3.4. Installing the Data Protection Application	42
4.4.3.4.1. Enabling CSI in the DataProtectionApplication CR	45
4.4.4. Configuring the OpenShift API for Data Protection with Microsoft Azure	45
4.4.4.1. Configuring Microsoft Azure	46
4.4.4.2. About backup and snapshot locations and their secrets	47
Backup locations	47
Snapshot locations	48
Secrets	48
4.4.4.2.1. Creating a default Secret	48

4.4.4.2.2. Creating secrets for different credentials	49
4.4.4.3. Configuring the Data Protection Application	50
4.4.4.3.1. Setting Velero CPU and memory resource allocations	50
4.4.4.3.2. Enabling self-signed CA certificates	51
4.4.4.4. Installing the Data Protection Application	51
4.4.4.4.1. Enabling CSI in the DataProtectionApplication CR	54
4.4.5. Configuring the OpenShift API for Data Protection with Google Cloud Platform	55
4.4.5.1. Configuring Google Cloud Platform	55
4.4.5.2. About backup and snapshot locations and their secrets	57
Backup locations	57
Snapshot locations	57
Secrets	57
4.4.5.2.1. Creating a default Secret	57
4.4.5.2.2. Creating secrets for different credentials	58
4.4.5.3. Configuring the Data Protection Application	59
4.4.5.3.1. Setting Velero CPU and memory resource allocations	59
4.4.5.3.2. Enabling self-signed CA certificates	60
4.4.5.4. Installing the Data Protection Application	61
4.4.5.4.1. Enabling CSI in the DataProtectionApplication CR	64
4.4.6. Configuring the OpenShift API for Data Protection with Multicloud Object Gateway	64
4.4.6.1. Retrieving Multicloud Object Gateway credentials	65
4.4.6.2. About backup and snapshot locations and their secrets	65
Backup locations	65
Snapshot locations	66
Secrets	66
4.4.6.2.1. Creating a default Secret	66
4.4.6.2.2. Creating secrets for different credentials	67
4.4.6.3. Configuring the Data Protection Application	68
4.4.6.3.1. Setting Velero CPU and memory resource allocations	68
4.4.6.3.2. Enabling self-signed CA certificates	69
4.4.6.4. Installing the Data Protection Application	69
4.4.6.4.1. Enabling CSI in the DataProtectionApplication CR	72
4.4.7. Configuring the OpenShift API for Data Protection with OpenShift Data Foundation	72
4.4.7.1. About backup and snapshot locations and their secrets	73
Backup locations	73
Snapshot locations	73
Secrets	73
4.4.7.1.1. Creating a default Secret	74
4.4.7.2. Configuring the Data Protection Application	74
4.4.7.2.1. Setting Velero CPU and memory resource allocations	75
4.4.7.2.2. Enabling self-signed CA certificates	75
4.4.7.3. Installing the Data Protection Application	76
4.4.7.3.1. Creating an Object Bucket Claim for disaster recovery on OpenShift Data Foundation	78
4.4.7.3.2. Enabling CSI in the DataProtectionApplication CR	78
4.5. UNINSTALLING OADP	79
4.5.1. Uninstalling the OpenShift API for Data Protection	79
4.6. OADP BACKING UP	79
4.6.1. Backing up applications	79
4.6.1.1. Known issues	79
4.6.2. Creating a Backup CR	80
4.6.3. Backing up persistent volumes with CSI snapshots	81
4.6.4. Backing up applications with Restic	82
4.6.5. Creating backup hooks	83

4.6.6. Scheduling backups using Schedule CR	84
4.6.7. Deleting backups	85
4.7. OADP RESTORING	86
4.7.1. Restoring applications	86
4.7.1.1. Creating a Restore CR	86
4.7.1.2. Creating restore hooks	89
4.8. OADP DATA MOVER	90
4.8.1. OADP Data Mover Introduction	90
4.8.1.1. OADP Data Mover prerequisites	91
4.8.2. Using Data Mover for CSI snapshots	91
4.8.3. Using OADP 1.2 Data Mover with Ceph storage	97
4.8.3.1. Prerequisites for using OADP 1.2 Data Mover with Ceph storage	97
4.8.3.2. Defining custom resources for use with OADP 1.2 Data Mover	97
4.8.3.2.1. Defining CephFS custom resources for use with OADP 1.2 Data Mover	97
4.8.3.2.2. Defining CephRBD custom resources for use with OADP 1.2 Data Mover	98
4.8.3.2.3. Defining additional custom resources for use with OADP 1.2 Data Mover	100
4.8.3.3. Backing up and restoring data using OADP 1.2 Data Mover and CephFS storage	101
4.8.3.3.1. Creating a DPA for use with CephFS storage	101
4.8.3.3.2. Backing up data using OADP 1.2 Data Mover and CephFS storage	102
4.8.3.3.3. Restoring data using OADP 1.2 Data Mover and CephFS storage	103
4.8.3.4. Backing up and restoring data using OADP 1.2 Data Mover and split volumes (CephFS and Ceph RBD)	104
4.8.3.4.1. Creating a DPA for use with split volumes	104
4.8.3.4.2. Backing up data using OADP 1.2 Data Mover and split volumes	105
4.8.3.4.3. Restoring data using OADP 1.2 Data Mover and split volumes	106
4.8.4. Cleaning up after a backup using OADP 1.1 Data Mover	107
4.8.4.1. Deleting snapshots in a bucket	107
4.8.4.2. Deleting cluster resources	108
4.8.4.2.1. Deleting cluster resources following a successful backup and restore that used Data Mover	108
4.8.4.2.2. Deleting cluster resources following a partially successful or a failed backup and restore that used Data Mover	108
4.9. TROUBLESHOOTING	109
4.9.1. Downloading the Velero CLI tool	109
4.9.1.1. OADP-Velero-OpenShift Container Platform version relationship	110
4.9.2. Accessing the Velero binary in the Velero deployment in the cluster	111
4.9.3. Debugging Velero resources with the OpenShift CLI tool	111
Velero CRs	111
Velero pod logs	111
Velero pod debug logs	111
4.9.4. Debugging Velero resources with the Velero CLI tool	112
Syntax	112
Help option	112
Describe command	112
Logs command	112
4.9.5. Pods crash or restart due to lack of memory or CPU	113
4.9.5.1. Setting resource requests for a Velero pod	113
4.9.5.2. Setting resource requests for a Restic pod	113
4.9.6. Issues with Velero and admission webhooks	114
4.9.6.1. Restoring workarounds for Velero backups that use admission webhooks	114
4.9.6.1.1. Restoring Knative resources	114
4.9.6.1.2. Restoring IBM AppConnect resources	115
4.9.7. Installation issues	115
4.9.7.1. Backup storage contains invalid directories	115



4.9.7.2. Incorrect AWS credentials	115
4.9.8. OADP timeouts	116
4.9.8.1. Restic timeout	116
4.9.8.2. Velero resource timeout	117
4.9.8.3. Data Mover timeout	117
4.9.8.4. CSI snapshot timeout	118
4.9.8.5. Velero default item operation timeout	118
4.9.8.6. Item operation timeout - restore	119
4.9.8.7. Item operation timeout - backup	120
4.9.9. Backup and Restore CR issues	120
4.9.9.1. Backup CR cannot retrieve volume	120
4.9.9.2. Backup CR status remains in progress	120
4.9.9.3. Backup CR status remains in PartiallyFailed	121
4.9.10. Restic issues	121
4.9.10.1. Restic permission error for NFS data volumes with root_squash enabled	121
4.9.10.2. Restic Backup CR cannot be recreated after bucket is emptied	122
4.9.10.3. Restic restore partially failing on OCP 4.14 due to changed PSA policy	123
4.9.11. Using the must-gather tool	124
4.9.12. OADP Monitoring	125
4.9.12.1. OADP monitoring setup	125
4.9.12.2. Creating OADP service monitor	127
4.9.12.3. Creating an alerting rule	128
4.9.12.4. List of available metrics	129
4.9.12.5. Viewing metrics using the Observe UI	132
4.10. APIS USED WITH OADP	133
4.10.1. Velero API	133
4.10.2. OADP API	133
4.11. ADVANCED OADP FEATURES AND FUNCTIONALITIES	138
4.11.1. Working with different Kubernetes API versions on the same cluster	138
4.11.1.1. Listing the Kubernetes API group versions on a cluster	138
4.11.1.2. About Enable API Group Versions	139
4.11.1.3. Using Enable API Group Versions	139
4.11.2. Backing up data from one cluster and restoring it to another cluster	140
4.11.2.1. About backing up data from one cluster and restoring it on another cluster	140
4.11.2.1.1. Operators	140
4.11.2.1.2. Use of Velero	140
4.11.2.1.3. UID and GID ranges	141
4.11.2.2. Backing up data from one cluster and restoring it to another cluster	142
4.11.3. Additional resources	143
<b>CHAPTER 5. CONTROL PLANE BACKUP AND RESTORE .....</b>	<b>144</b>
5.1. BACKING UP ETCD	144
5.1.1. Backing up etcd data	144
5.1.2. Additional resources	146
5.1.3. Creating automated etcd backups	146
5.1.3.1. Enabling automated etcd backups	146
5.1.3.2. Creating a single etcd backup	147
5.1.3.3. Creating recurring etcd backups	148
5.2. REPLACING AN UNHEALTHY ETCD MEMBER	152
5.2.1. Prerequisites	153
5.2.2. Identifying an unhealthy etcd member	153
5.2.3. Determining the state of the unhealthy etcd member	153
5.2.4. Replacing the unhealthy etcd member	155

5.2.4.1. Replacing an unhealthy etcd member whose machine is not running or whose node is not ready	155
5.2.4.2. Replacing an unhealthy etcd member whose etcd pod is crashlooping	163
5.2.4.3. Replacing an unhealthy bare metal etcd member whose machine is not running or whose node is not ready	167
5.2.5. Additional resources	178
5.3. DISASTER RECOVERY	178
5.3.1. About disaster recovery	179
5.3.2. Restoring to a previous cluster state	179
5.3.2.1. About restoring cluster state	179
5.3.2.2. Restoring to a previous cluster state	180
5.3.2.3. Additional resources	193
5.3.2.4. Issues and workarounds for restoring a persistent storage state	193
5.3.3. Recovering from expired control plane certificates	194
5.3.3.1. Recovering from expired control plane certificates	194



# 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.

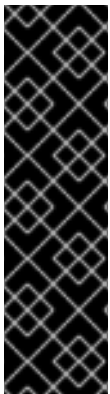
- You must have object storage for storing backups, such as one of the following storage types:
  - OpenShift Data Foundation
  - Amazon Web Services
  - Microsoft Azure
  - Google Cloud Platform
  - S3-compatible object storage



### 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](#)
- [Restic backups](#)
- 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.

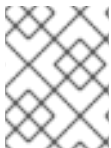
For example, the following conditions can cause the restarted cluster to malfunction:

- 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.

#### Prerequisites

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

#### 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 ; done
```

4. Shut down all of the nodes in the cluster. You can do this from your cloud provider's web console, or by running the following loop:

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

### 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.
```

Shutting down the nodes using one of these methods allows pods to terminate gracefully, which reduces the chance for data corruption.



**NOTE**

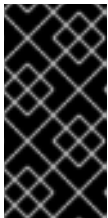
Adjust the shut down time to be longer for large-scale clusters:

```
$ for node in $(oc get nodes -o jsonpath='{.items[*].metadata.name}'); do oc  
debug node/${node} -- chroot /host shutdown -h 10; done
```

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

3. 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	master	75m	v1.27.3
ip-10-0-170-223.ec2.internal	Ready	master	75m	v1.27.3
ip-10-0-211-16.ec2.internal	Ready	master	75m	v1.27.3

4. 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>
```

5. 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	v1.27.3
ip-10-0-182-134.ec2.internal	Ready	worker	64m	v1.27.3
ip-10-0-250-100.ec2.internal	Ready	worker	64m	v1.27.3

6. 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>
```

7. 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
authentication	4.14.0	True	False	False

cloud-credential	4.14.0	True	False	False	85m
cluster-autoscaler	4.14.0	True	False	False	73m
config-operator	4.14.0	True	False	False	73m
console	4.14.0	True	False	False	62m
csi-snapshot-controller	4.14.0	True	False	False	66m
dns	4.14.0	True	False	False	76m
etcd	4.14.0	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	master	82m	v1.27.3
ip-10-0-170-223.ec2.internal	Ready	master	82m	v1.27.3
ip-10-0-179-95.ec2.internal	Ready	worker	70m	v1.27.3
ip-10-0-182-134.ec2.internal	Ready	worker	70m	v1.27.3
ip-10-0-211-16.ec2.internal	Ready	master	82m	v1.27.3
ip-10-0-250-100.ec2.internal	Ready	worker	69m	v1.27.3

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. OADP APPLICATION BACKUP AND RESTORE

### 4.1. INTRODUCTION TO OPENSIFT 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.

#### 4.1.1. OpenShift API for Data Protection APIs

OpenShift API for Data Protection (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

#### Additional resources

- [Backing up etcd](#)

### 4.2. OADP 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.

#### 4.2.1. OADP 1.2.3 release notes

##### 4.2.1.1. New features

There are no new features in the release of OpenShift API for Data Protection (OADP) 1.2.3.

##### 4.2.1.2. Resolved issues

The following highlighted issues are resolved in OADP 1.2.3:

#### Multiple HTTP/2 enabled web servers are vulnerable to a DDoS attack (Rapid Reset Attack)

In previous releases of OADP 1.2, the HTTP/2 protocol was susceptible to a denial of service attack because request cancellation could reset multiple streams quickly. The server had to set up and tear down the streams while not hitting any server-side limit for the maximum number of active streams per

connection. This resulted in a denial of service due to server resource consumption. For a list of all OADP issues associated with this CVE, see the following [Jira list](#).

For more information, see [CVE-2023-39325 \(Rapid Reset Attack\)](#).

For a complete list of all issues resolved in the release of OADP 1.2.3, see the list of [OADP 1.2.3 resolved issues](#) in Jira.

#### 4.2.1.3. Known issues

There are no known issues in the release of OADP 1.2.3.

### 4.2.2. OADP 1.2.2 release notes

#### 4.2.2.1. New features

There are no new features in the release of OpenShift API for Data Protection (OADP) 1.2.2.

#### 4.2.2.2. Resolved issues

The following highlighted issues are resolved in OADP 1.2.2:

##### **Restic restore partially failed due to a Pod Security standard**

In previous releases of OADP 1.2, OpenShift Container Platform 4.14 enforced a pod security admission (PSA) policy that hindered the readiness of pods during a Restic restore process.

This issue has been resolved in the release of OADP 1.2.2, and also OADP 1.1.6. Therefore, it is recommended that users upgrade to these releases.

For more information, see [Restic restore partially failing on OCP 4.14 due to changed PSA policy \(OADP-2094\)](#).

##### **Backup of an app with internal images partially failed with plugin panicked error**

In previous releases of OADP 1.2, the backup of an application with internal images partially failed with plugin panicked error returned. The backup partially fails with this error in the Velero logs:

```
time="2022-11-23T15:40:46Z" level=info msg="1 errors encountered backup up item"
backup=openshift-adp/django-persistent-67a5b83d-6b44-11ed-9cba-902e163f806c
logSource="/remote-source/velero/app/pkg/backup/backup.go:413" name=django-psql-persistent
time="2022-11-23T15:40:46Z" level=error msg="Error backing up item" backup=openshift-
adp/django-persistent-67a5b83d-6b44-11ed-9cba-902e163f8
```

This issue has been resolved in OADP 1.2.2. ([OADP-1057](#)).

##### **ACM cluster restore was not functioning as expected due to restore order**

In previous releases of OADP 1.2, ACM cluster restore was not functioning as expected due to restore order. ACM applications were removed and re-created on managed clusters after restore activation. ([OADP-2505](#))

##### **VM's using filesystemOverhead failed when backing up and restoring due to volume size mismatch**

In previous releases of OADP 1.2, due to storage provider implementation choices, whenever there was a

difference between the application persistent volume claims (PVCs) storage request and the snapshot size of the same PVC, VM's using filesystemOverhead failed when backing up and restoring. This issue has been resolved in the Data Mover of OADP 1.2.2. ([OADP-2144](#))

### **OADP did not contain an option to set VolSync replication source prune interval**

In previous releases of OADP 1.2, there was no option to set the VolSync replication source **pruneInterval**. ([OADP-2052](#))

### **Possible pod volume backup failure if Velero was installed in multiple namespaces**

In previous releases of OADP 1.2, there was a possibility of pod volume backup failure if Velero was installed in multiple namespaces. ([OADP-2409](#))

### **Backup Storage Locations moved to unavailable phase when VSL uses custom secret**

In previous releases of OADP 1.2, Backup Storage Locations moved to unavailable phase when Volume Snapshot Location used custom secret. ([OADP-1737](#))

For a complete list of all issues resolved in the release of OADP 1.2.2, see the list of [OADP 1.2.2 resolved issues](#) in Jira.

#### **4.2.2.3. Known issues**

The following issues have been highlighted as known issues in the release of OADP 1.2.2:

##### **Must-gather command fails to remove ClusterRoleBinding resources**

The **oc adm must-gather** command fails to remove **ClusterRoleBinding** resources, which are left on cluster due to admission webhook. Therefore, requests for the removal of the **ClusterRoleBinding** resources are denied. ([OADP-27730](#))

admission webhook "clusterrolebindings-validation.managed.openshift.io" denied the request:  
Deleting ClusterRoleBinding must-gather-p7vwj is not allowed

For a complete list of all known issues in this release, see the list of [OADP 1.2.2 known issues](#) in Jira.

#### **4.2.3. OADP 1.2.1 release notes**

##### **4.2.3.1. New features**

There are no new features in the release of OpenShift API for Data Protection (OADP) 1.2.1.

##### **4.2.3.2. Resolved issues**

For a complete list of all issues resolved in the release of OADP 1.2.1, see the list of [OADP 1.2.1 resolved issues](#) in Jira.

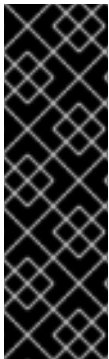
##### **4.2.3.3. Known issues**

The following issues have been highlighted as known issues in the release of OADP 1.2.1:

##### **DataMover Restic retain and prune policies do not work as expected**

The retention and prune features provided by VolSync and Restic are not working as expected. Because there is no working option to set the prune interval on VolSync replication, you have to manage and prune remotely stored backups on S3 storage outside of OADP. For more details, see:

- [OADP-2052](#)
- [OADP-2048](#)
- [OADP-2175](#)
- [OADP-1690](#)



### IMPORTANT

OADP Data Mover 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](#).

For a complete list of all known issues in this release, see the list of [OADP 1.2.1 known issues](#) in Jira.

## 4.2.4. OADP 1.2.0 release notes

The OADP 1.2.0 release notes include information about new features, bug fixes, and known issues.

### 4.2.4.1. New features

#### Resource timeouts

The new **resourceTimeout** option specifies the timeout duration in minutes for waiting on various Velero resources. This option applies to resources such as Velero CRD availability, **volumeSnapshot** deletion, and backup repository availability. The default duration is 10 minutes.

#### AWS S3 compatible backup storage providers

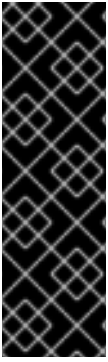
You can back up objects and snapshots on AWS S3 compatible providers.

### 4.2.4.1.1. Technical preview features

#### Data Mover

The OADP Data Mover enables you to back up Container Storage Interface (CSI) volume snapshots to a remote object store. When you enable Data Mover, you can restore stateful applications using CSI volume snapshots pulled from the object store in case of accidental cluster deletion, cluster failure, or data corruption.





## IMPORTANT

OADP Data Mover 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](#).

### 4.2.4.2. Resolved issues

For a complete list of all issues resolved in this release, see the list of [OADP 1.2.0 resolved issues](#) in Jira.

### 4.2.4.3. Known issues

The following issues have been highlighted as known issues in the release of OADP 1.2.0:

#### Multiple HTTP/2 enabled web servers are vulnerable to a DDoS attack (Rapid Reset Attack)

The HTTP/2 protocol is susceptible to a denial of service attack because request cancellation can reset multiple streams quickly. The server has to set up and tear down the streams while not hitting any server-side limit for the maximum number of active streams per connection. This results in a denial of service due to server resource consumption. For a list of all OADP issues associated with this CVE, see the following [Jira list](#).

It is advised to upgrade to OADP 1.2.3, which resolves this issue.

For more information, see [CVE-2023-39325 \(Rapid Reset Attack\)](#).

## 4.2.5. OADP 1.1.7 release notes

The OADP 1.1.7 release notes lists any resolved issues and known issues.

### 4.2.5.1. Resolved issues

The following highlighted issues are resolved in OADP 1.1.7:

#### Multiple HTTP/2 enabled web servers are vulnerable to a DDoS attack (Rapid Reset Attack)

In previous releases of OADP 1.1, the HTTP/2 protocol was susceptible to a denial of service attack because request cancellation could reset multiple streams quickly. The server had to set up and tear down the streams while not hitting any server-side limit for the maximum number of active streams per connection. This resulted in a denial of service due to server resource consumption. For a list of all OADP issues associated with this CVE, see the following [Jira list](#).

For more information, see [CVE-2023-39325 \(Rapid Reset Attack\)](#).

For a complete list of all issues resolved in the release of OADP 1.1.7, see the list of [OADP 1.1.7 resolved issues](#) in Jira.

### 4.2.5.2. Known issues

There are no known issues in the release of OADP 1.1.7.

#### 4.2.6. OADP 1.1.6 release notes

The OADP 1.1.6 release notes lists any new features, resolved issues and bugs, and known issues.

##### 4.2.6.1. Resolved issues

###### Restic restore partially failing due to Pod Security standard

OCP 4.14 introduced pod security standards that meant the **privileged** profile is **enforced**. In previous releases of OADP, this profile caused the pod to receive **permission denied** errors. This issue was caused because of the restore order. The pod was created before the security context constraints (SCC) resource. As this pod violated the pod security standard, the pod was denied and subsequently failed. [OADP-2420](#)

###### Restore partially failing for job resource

In previous releases of OADP, the restore of job resource was partially failing in OCP 4.14. This issue was not seen in older OCP versions. The issue was caused by an additional label being to the job resource, which was not present in older OCP versions. [OADP-2530](#)

For a complete list of all issues resolved in this release, see the list of [OADP 1.1.6 resolved issues](#) in Jira.

##### 4.2.6.2. Known issues

For a complete list of all known issues in this release, see the list of [OADP 1.1.6 known issues](#) in Jira.

#### 4.2.7. OADP 1.1.5 release notes

The OADP 1.1.5 release notes lists any new features, resolved issues and bugs, and known issues.

##### 4.2.7.1. New features

This version of OADP is a service release. No new features are added to this version.

##### 4.2.7.2. Resolved issues

For a complete list of all issues resolved in this release, see the list of [OADP 1.1.5 resolved issues](#) in Jira.

##### 4.2.7.3. Known issues

For a complete list of all known issues in this release, see the list of [OADP 1.1.5 known issues](#) in Jira.

#### 4.2.8. OADP 1.1.4 release notes

The OADP 1.1.4 release notes lists any new features, resolved issues and bugs, and known issues.

##### 4.2.8.1. New features

This version of OADP is a service release. No new features are added to this version.

##### 4.2.8.2. Resolved issues

## Add support for all the velero deployment server arguments

In previous releases of OADP, OADP did not facilitate the support of all the upstream Velero server arguments. This issue has been resolved in OADP 1.1.4 and all the upstream Velero server arguments are supported. [OADP-1557](#)

## Data Mover can restore from an incorrect snapshot when there was more than one VSR for the restore name and pvc name

In previous releases of OADP, OADP Data Mover could restore from an incorrect snapshot if there was more than one Volume Snapshot Restore (VSR) resource in the cluster for the same Velero **restore** name and PersistentVolumeClaim (pvc) name. [OADP-1822](#)

## Cloud Storage API BSLs need OwnerReference

In previous releases of OADP, ACM BackupSchedules failed validation because of a missing **OwnerReference** on Backup Storage Locations (BSLs) created with **dpa.spec.backupLocations.bucket**. [OADP-1511](#)

For a complete list of all issues resolved in this release, see the list of [OADP 1.1.4 resolved issues](#) in Jira.

### 4.2.8.3. Known issues

This release has the following known issues:

#### OADP backups might fail because a UID/GID range might have changed on the cluster

OADP backups might fail because a UID/GID range might have changed on the cluster where the application has been restored, with the result that OADP does not back up and restore OpenShift Container Platform UID/GID range metadata. To avoid the issue, if the backed application requires a specific UUID, ensure the range is available when restored. An additional workaround is to allow OADP to create the namespace in the restore operation.

#### A restoration might fail if ArgoCD is used during the process due to a label used by ArgoCD

A restoration might fail if ArgoCD is used during the process due to a label used by ArgoCD, **app.kubernetes.io/instance**. This label identifies which resources ArgoCD needs to manage, which can create a conflict with OADP's procedure for managing resources on restoration. To work around this issue, set **.spec.resourceTrackingMethod** on the ArgoCD YAML to **annotation+label** or **annotation**. If the issue continues to persist, then disable ArgoCD before beginning to restore, and enable it again when restoration is finished.

For a complete list of all known issues in this release, see the list of [OADP 1.1.4 known issues](#) in Jira.

### 4.2.9. OADP 1.1.3 release notes

The OADP 1.1.3 release notes lists any new features, resolved issues and bugs, and known issues.

#### 4.2.9.1. New features

This version of OADP is a service release. No new features are added to this version.

#### 4.2.9.2. Resolved issues

For a complete list of all issues resolved in this release, see the list of [OADP 1.1.3 resolved issues](#) in Jira.

#### 4.2.9.3. Known issues

For a complete list of all known issues in this release, see the list of [OADP 1.1.3 known issues](#) in Jira.

## 4.2.10. OADP 1.1.2 release notes

The OADP 1.1.2 release notes include product recommendations, a list of fixed bugs and descriptions of known issues.

### 4.2.10.1. Product recommendations

#### VolSync

To prepare for the upgrade from VolSync 0.5.1 to the latest version available from the VolSync **stable** channel, you must add this annotation in the **openshift-adp** namespace by running the following command:

```
$ oc annotate --overwrite namespace/openshift-adp volsync.backube/privileged-movers='true'
```

#### Velero

In this release, Velero has been upgraded from version 1.9.2 to version [1.9.5](#).

#### Restic

In this release, Restic has been upgraded from version 0.13.1 to version [0.14.0](#).

### 4.2.10.2. Resolved issues

The following issues have been resolved in this release:

- [OADP-1150](#)
- [OADP-290](#)
- [OADP-1056](#)

### 4.2.10.3. Known issues

This release has the following known issues:

- OADP currently does not support backup and restore of AWS EFS volumes using restic in Velero ([OADP-778](#)).
- CSI backups might fail due to a Ceph limitation of **VolumeSnapshotContent** snapshots per PVC.  
You can create many snapshots of the same persistent volume claim (PVC) but cannot schedule periodic creation of snapshots:
  - For CephFS, you can create up to 100 snapshots per PVC. ([OADP-804](#))
  - For RADOS Block Device (RBD), you can create up to 512 snapshots for each PVC. ([OADP-975](#))

For more information, see [Volume Snapshots](#).

## 4.2.11. OADP 1.1.1 release notes

The OADP 1.1.1 release notes include product recommendations and descriptions of known issues.

#### 4.2.11.1. Product recommendations

Before you install OADP 1.1.1, it is recommended to either install VolSync 0.5.1 or to upgrade to it.

#### 4.2.11.2. Known issues

This release has the following known issues:

- Multiple HTTP/2 enabled web servers are vulnerable to a DDoS attack (Rapid Reset Attack)  
The HTTP/2 protocol is susceptible to a denial of service attack because request cancellation can reset multiple streams quickly. The server has to set up and tear down the streams while not hitting any server-side limit for the maximum number of active streams per connection. This results in a denial of service due to server resource consumption. For a list of all OADP issues associated with this CVE, see the following [Jira list](#).

It is advised to upgrade to OADP 1.1.7 or 1.2.3, which resolve this issue.

For more information, see [CVE-2023-39325 \(Rapid Reset Attack\)](#).

- OADP currently does not support backup and restore of AWS EFS volumes using restic in Velero ([OADP-778](#)).
- CSI backups might fail due to a Ceph limitation of **VolumeSnapshotContent** snapshots per PVC.  
You can create many snapshots of the same persistent volume claim (PVC) but cannot schedule periodic creation of snapshots:
  - For CephFS, you can create up to 100 snapshots per PVC.
  - For RADOS Block Device (RBD), you can create up to 512 snapshots for each PVC. ([OADP-804](#)) and ([OADP-975](#))  
For more information, see [Volume Snapshots](#).

### 4.3. 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.

#### 4.3.1. 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.

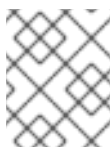
OADP backs up Kubernetes objects and internal images by saving them as an archive file on object storage. OADP backs up persistent volumes (PVs) by creating snapshots with the native cloud snapshot API or with the Container Storage Interface (CSI). For cloud providers that do not support snapshots, OADP 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.

**4.3.2. 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 4.1. OADP plugins**

OADP plugin	Function	Storage location
<b>aws</b>	Backs up and restores Kubernetes objects.	AWS S3
	Backs up and restores volumes with snapshots.	AWS EBS
<b>azure</b>	Backs up and restores Kubernetes objects.	Microsoft Azure Blob storage
	Backs up and restores volumes with snapshots.	Microsoft Azure Managed Disks
<b>gcp</b>	Backs up and restores Kubernetes objects.	Google Cloud Storage

OADP plugin	Function	Storage location
	Backs up and restores volumes with snapshots.	Google Compute Engine Disks
<b>openshift</b>	Backs up and restores OpenShift Container Platform resources. <sup>[1]</sup>	Object store
<b>kubevirt</b>	Backs up and restores OpenShift Virtualization resources. <sup>[2]</sup>	Object store
<b>csi</b>	Backs up and restores volumes with CSI snapshots. <sup>[3]</sup>	Cloud storage that supports CSI snapshots
<b>vsm</b>	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. <sup>[4]</sup>	Object store

1. Mandatory.
2. Virtual machine disks are backed up with CSI snapshots or Restic.
3. The **csi** plugin uses the [Velero CSI beta snapshot API](#).
4. OADP 1.2 only.

### 4.3.3. 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.

#### 4.3.3.1. 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
```

#### 4.3.3.2. 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
```

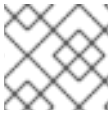
#### 4.3.4. Supported architectures for OADP

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.

### 4.3.5. 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 1.1.0 was tested successfully against OpenShift Container Platform 4.11 for both IBM Power® and IBM Z®. The sections that follow give testing and support information for OADP 1.1.0 in terms of backup locations for these systems.

#### 4.3.5.1. OADP support for target backup locations using IBM Power

IBM Power® running with OpenShift Container Platform 4.11 and 4.12, and OpenShift API for Data Protection (OADP) 1.1.2 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 4.11 and 4.12, and OADP 1.1.2 against all non-AWS S3 backup location targets as well.

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

IBM Z® running with OpenShift Container Platform 4.11 and 4.12, and OpenShift API for Data Protection (OADP) 1.1.2 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 4.11 and 4.12, and OADP 1.1.2 against all non-AWS S3 backup location targets as well.

## 4.4. INSTALLING AND CONFIGURING OADP

### 4.4.1. 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 1.11](#).

**NOTE**

Starting from OADP 1.0.4, all OADP 1.0.z versions can only be used as a dependency of the MTC 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:

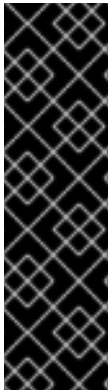
- [Amazon Web Services](#)
- [Microsoft Azure](#)
- [Google Cloud Platform](#)

- [Multicloud Object Gateway](#)
- AWS S3 compatible object storage, such as Multicloud Object Gateway or MinIO

**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](#).

You can back up persistent volumes (PVs) by using snapshots or Restic.

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 [Restic backups](#) on object storage.

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

#### 4.4.1.1. 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.

#### 4.4.1.1.1. 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



#### NOTE

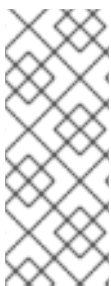
The following compatible object storage providers are supported and have their own Velero object store plugins:

- Google Cloud Platform (GCP)
- Microsoft Azure

#### 4.4.1.1.2. 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:

- IBM Cloud®
- 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](#).

#### 4.4.1.1.3. 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.

#### 4.4.1.2. 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](#)

#### 4.4.1.3. 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 contains **oadp.v1.0.z**, the most recent OADP 1.0 **ClusterServiceVersion**.
- The **stable-1.1** channel contains **oadp.v1.1.z**, the most recent OADP 1.1 **ClusterServiceVersion**.

- The **stable-1.2** channel contains **oadp.v1.2.z**, the most recent OADP 1.2 **ClusterServiceVersion**.

#### 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.

#### 4.4.1.4. Installation of OADP on multiple namespaces

You can install OADP 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 Restic and 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, 1.1.4. 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 a unique **BackupStorageLocation** configuration.
- By default, each OADP deployment has cluster-level access across namespaces. OpenShift Container Platform administrators need to review security and RBAC settings carefully and make any necessary changes to them to ensure that each OADP instance has the correct permissions.

#### Additional resources

- [Cluster service version](#)

#### 4.4.1.5. 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.

#### 4.4.1.5.1. 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
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] DataMover	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 utilize large amounts of resources. The [Velero](#) documentation references 500m as a supplied default, for most of our testing we found 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. DataMover - DataMover 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.

#### 4.4.2. Installing the OADP Operator

You can install the OpenShift API for Data Protection (OADP) Operator on OpenShift Container Platform 4.14 by using Operator Lifecycle Manager (OLM).

The OADP Operator installs [Velero 1.11](#).

### 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.

#### 4.4.2.1. OADP-Velero-OpenShift Container Platform version relationship

OADP version	Velero version	OpenShift Container Platform version
1.1.0	<a href="#">1.9</a>	4.9 and later
1.1.1	<a href="#">1.9</a>	4.9 and later
1.1.2	<a href="#">1.9</a>	4.9 and later
1.1.3	<a href="#">1.9</a>	4.9 and later
1.1.4	<a href="#">1.9</a>	4.9 and later
1.1.5	<a href="#">1.9</a>	4.9 and later
1.1.6	<a href="#">1.9</a>	4.11 and later
1.1.7	<a href="#">1.9</a>	4.11 and later
1.2.0	<a href="#">1.11</a>	4.11 and later
1.2.1	<a href="#">1.11</a>	4.11 and later
1.2.2	<a href="#">1.11</a>	4.11 and later
1.2.3	<a href="#">1.11</a>	4.11 and later

### 4.4.3. Configuring the OpenShift API for Data Protection with Amazon Web Services

You install the OpenShift API for Data Protection (OADP) with Amazon Web Services (AWS) by installing the OADP Operator. The Operator installs [Velero 1.11](#).



#### NOTE

Starting from OADP 1.0.4, all OADP 1.0.z versions can only be used as a dependency of the MTC 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 on restricted networks](#) for details.

#### 4.4.3.1. 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

- Set the **BUCKET** variable:

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

- Set the **REGION** variable:

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

- 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**.

- 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.

#### 4.4.3.2. 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 specify S3-compatible object storage, such as Multicloud Object Gateway or MinIO, as a backup location.

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 Restic, you do not need to specify a snapshot location because Restic 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.

#### 4.4.3.2.1. 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.
- You must create a **credentials-velero** file for the object storage in the appropriate format.

### Procedure

- Create a **Secret** 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.

#### 4.4.3.2.2. 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:
  - name: default
    velero:
      provider: aws
      config:
        region: us-west-2
        profile: "volumeSnapshot"
```

#### 4.4.3.3. Configuring the Data Protection Application

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

##### 4.4.3.3.1. 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 1 Specify the node selector to be supplied to Velero podSpec.

2 The **resourceAllocations** listed are for average usage.

#### 4.4.3.3.2. 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> ❶
    config:
      insecureSkipTLSVerify: "false" ❷
...
```

- ❶ Specify the Base64-encoded CA certificate string.
- ❷ 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.

#### 4.4.3.4. 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 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.



## NOTE

Velero creates a secret named **velero-repo-credentials** in the OADP namespace, which contains a default backup repository password. You can update the secret with your own password encoded as base64 **before** you run your first backup targeted to the backup repository. The value of the key to update is **Data[repository-password]**.

After you create your DPA, the first time that you run a backup targeted to the backup repository, Velero creates a backup repository whose secret is **velero-repo-credentials**, which contains either the default password or the one you replaced it with. If you update the secret password **after** the first backup, the new password will not match the password in **velero-repo-credentials**, and therefore, Velero will not be able to connect with the older backups.

## 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
spec:
  configuration:
    velero:
      defaultPlugins:
        - openshift ❶
        - aws
      resourceTimeout: 10m ❷
    restic:
      enable: true ❸
      podConfig:
        nodeSelector: <node_selector> ❹
  backupLocations:
    - name: default
      velero:
        provider: aws
        default: true
        objectStorage:
          bucket: <bucket_name> ❺
          prefix: <prefix> ❻
        config:
          region: <region>
          profile: "default"
        credential:
          key: cloud
          name: cloud-credentials ❼
      snapshotLocations: ❽
        - name: default
```

```

velero:
  provider: aws
  config:
    region: <region> 9
    profile: "default"

```

- 1 The **openshift** plugin is mandatory.
- 2 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.
- 3 Set this value to **false** if you want to disable the Restic installation. Restic deploys a daemon set, which means that Restic pods run on each working node. In OADP version 1.2 and later, you can configure Restic for backups by adding **spec.defaultVolumesToFsBackup: true** to the **Backup** CR. In OADP version 1.1, add **spec.defaultVolumesToRestic: true** to the **Backup** CR.
- 4 Specify on which nodes Restic is available. By default, Restic runs on all nodes.
- 5 Specify a bucket as the backup storage location. If the bucket is not a dedicated bucket for Velero backups, you must specify a prefix.
- 6 Specify a prefix for Velero backups, for example, **velero**, if the bucket is used for multiple purposes.
- 7 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.
- 8 Specify a snapshot location, unless you use CSI snapshots or Restic to back up PVs.
- 9 The snapshot location must be in the same region as the PVs.

4. Click **Create**.

5. Verify the installation by viewing the OADP resources:

```
$ 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
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

```

#### 4.4.3.4.1. 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:

```

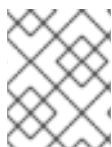
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
...
spec:
  configuration:
    velero:
      defaultPlugins:
        - openshift
        - csi 1

```

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

#### 4.4.4. 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 1.11](#).



#### NOTE

Starting from OADP 1.0.4, all OADP 1.0.z versions can only be used as a dependency of the MTC 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 on restricted networks](#) for details.

#### 4.4.4.1. Configuring Microsoft Azure

You configure a Microsoft Azure for the OpenShift API for Data Protection (OADP).

##### Prerequisites

- You must have the [Azure CLI](#) installed.

##### Procedure

1. Log in to Azure:

```
$ az login
```

2. Set the **AZURE\_RESOURCE\_GROUP** variable:

```
$ AZURE_RESOURCE_GROUP=Velero_Backups
```

3. Create an Azure resource group:

```
$ az group create -n $AZURE_RESOURCE_GROUP --location CentralUS 1
```

- 1 Specify your location.

4. Set the **AZURE\_STORAGE\_ACCOUNT\_ID** variable:

```
$ AZURE_STORAGE_ACCOUNT_ID="velero$(uuidgen | cut -d '-' -f5 | tr 'A-Z' '[a-z])"
```

5. Create an Azure storage account:

```
$ az storage account create \
  --name $AZURE_STORAGE_ACCOUNT_ID \
  --resource-group $AZURE_RESOURCE_GROUP \
  --sku Standard_GRS \
  --encryption-services blob \
  --https-only true \
  --kind BlobStorage \
  --access-tier Hot
```

6. Set the **BLOB\_CONTAINER** variable:

```
$ BLOB_CONTAINER=velero
```

7. Create an Azure Blob storage container:

```
$ az storage container create \
  -n $BLOB_CONTAINER \
  --public-access off \
  --account-name $AZURE_STORAGE_ACCOUNT_ID
```

8. Obtain the storage account access key:

```
$ AZURE_STORAGE_ACCOUNT_ACCESS_KEY=`az storage account keys list \
--account-name $AZURE_STORAGE_ACCOUNT_ID \
--query "[?keyName == 'key1'].value" -o tsv`
```

9. Create a custom role that has the minimum required permissions:

```
AZURE_ROLE=Velero
az role definition create --role-definition '{
  "Name": "$AZURE_ROLE",
  "Description": "Velero related permissions to perform backups, restores and deletions",
  "Actions": [
    "Microsoft.Compute/disks/read",
    "Microsoft.Compute/disks/write",
    "Microsoft.Compute/disks/endGetAccess/action",
    "Microsoft.Compute/disks/beginGetAccess/action",
    "Microsoft.Compute/snapshots/read",
    "Microsoft.Compute/snapshots/write",
    "Microsoft.Compute/snapshots/delete",
    "Microsoft.Storage/storageAccounts/listkeys/action",
    "Microsoft.Storage/storageAccounts/regeneratekey/action"
  ],
  "AssignableScopes": ["/subscriptions/$AZURE_SUBSCRIPTION_ID"]
}'
```

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

```
$ cat << EOF > ./credentials-velero
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_RESOURCE_GROUP=${AZURE_RESOURCE_GROUP}
AZURE_STORAGE_ACCOUNT_ACCESS_KEY=${AZURE_STORAGE_ACCOUNT_ACCESS_KEY} ❶
AZURE_CLOUD_NAME=AzurePublicCloud
EOF
```

- ❶ Mandatory. You cannot back up internal images if the **credentials-velero** file contains only the service principal credentials.

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

#### 4.4.4.2. 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 specify S3-compatible object storage, such as Multicloud Object Gateway or MinIO, as a backup location.

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.

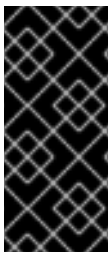
If you use Restic, you do not need to specify a snapshot location because Restic backs up the file system on object storage.

### 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

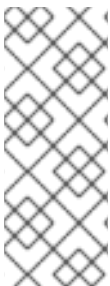
The Data Protection Application requires a default **Secret**. Otherwise, the installation will fail.

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.

#### 4.4.4.2.1. 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.
- You must create a **credentials-velero** file for the object storage in the appropriate format.

### Procedure

- Create a **Secret** 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.

#### 4.4.4.2.2. 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> ❶
    provider: azure
    default: true
    objectStorage:
      bucket: <bucket_name>
      prefix: <prefix>
    snapshotLocations:
      - velero:
          config:
            resourceGroup: <azure_resource_group>
            subscriptionId: <azure_subscription_id>
            incremental: "true"
          name: default
          provider: azure

```

- ❶ Backup location **Secret** with custom name.

#### 4.4.4.3. Configuring the Data Protection Application

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

##### 4.4.4.3.1. 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> ❶
        resourceAllocations: ❷
          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.

#### 4.4.4.3.2. 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.

#### 4.4.4.4. 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 the default name, **cloud-credentials-azure**, for the snapshot location. This **Secret** is not referenced in 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.



#### NOTE

Velero creates a secret named **velero-repo-credentials** in the OADP namespace, which contains a default backup repository password. You can update the secret with your own password encoded as base64 **before** you run your first backup targeted to the backup repository. The value of the key to update is **Data[repository-password]**.

After you create your DPA, the first time that you run a backup targeted to the backup repository, Velero creates a backup repository whose secret is **velero-repo-credentials**, which contains either the default password or the one you replaced it with. If you update the secret password **after** the first backup, the new password will not match the password in **velero-repo-credentials**, and therefore, Velero will not be able to connect with the older backups.

### 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
spec:
  configuration:
    velero:
      defaultPlugins:
        - azure
```



```

- openshift ❶
resourceTimeout: 10m ❷
restic:
  enable: true ❸
  podConfig:
    nodeSelector: <node_selector> ❹
backupLocations:
- velero:
  config:
    resourceGroup: <azure_resource_group> ❺
    storageAccount: <azure_storage_account_id> ❻
    subscriptionId: <azure_subscription_id> ❼
    storageAccountKeyEnvVar: AZURE_STORAGE_ACCOUNT_ACCESS_KEY
  credential:
    key: cloud
    name: cloud-credentials-azure ❽
  provider: azure
  default: true
  objectStorage:
    bucket: <bucket_name> ❾
    prefix: <prefix> ❿
snapshotLocations: ⓫
- velero:
  config:
    resourceGroup: <azure_resource_group>
    subscriptionId: <azure_subscription_id>
    incremental: "true"
  name: default
  provider: azure

```

- ❶ The **openshift** plugin is mandatory.
- ❷ 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.
- ❸ Set this value to **false** if you want to disable the Restic installation. Restic deploys a daemon set, which means that Restic pods run on each working node. In OADP version 1.2 and later, you can configure Restic for backups by adding **spec.defaultVolumesToFsBackup: true** to the **Backup** CR. In OADP version 1.1, add **spec.defaultVolumesToRestic: true** to the **Backup** CR.
- ❹ Specify on which nodes Restic is available. By default, Restic runs on all nodes.
- ❺ Specify the Azure resource group.
- ❻ Specify the Azure storage account ID.
- ❼ Specify the Azure subscription ID.
- ❽ 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.
- ❾ Specify a bucket as the backup storage location. If the bucket is not a dedicated bucket for Velero backups, you must specify a prefix.

- 10 Specify a prefix for Velero backups, for example, **velero**, if the bucket is used for multiple purposes.
- 11 You do not need to specify a snapshot location if you use CSI snapshots or Restic to back up PVs.

4. Click **Create**.

5. Verify the installation by viewing the OADP resources:

```
$ 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
```

#### 4.4.4.4.1. 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:

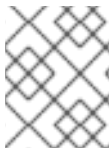
```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
```

```
...
spec:
  configuration:
    velero:
      defaultPlugins:
        - openshift
        - csi ❶
```

- ❶ Add the **csi** default plugin.

#### 4.4.5. 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 1.11](#).



##### NOTE

Starting from OADP 1.0.4, all OADP 1.0.z versions can only be used as a dependency of the MTC 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 on restricted networks](#) for details.

##### 4.4.5.1. 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> ❶
```

- ❶ Specify your bucket name.

3. Create the storage bucket:

```
$ gsutil mb gs://$BUCKET/
```

- Set the **PROJECT\_ID** variable to your active project:

```
$ PROJECT_ID=$(gcloud config get-value project)
```

- Create a service account:

```
$ gcloud iam service-accounts create velero \
  --display-name "Velero service account"
```

- List your service accounts:

```
$ gcloud iam service-accounts list
```

- 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)')
```

- 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
)
```

- Create the **velero.server** custom role:

```
$ gcloud iam roles create velero.server \
  --project $PROJECT_ID \
  --title "Velero Server" \
  --permissions "$(IFS=","; echo "${ROLE_PERMISSIONS[*]}")"
```

- 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
```

- 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.

#### 4.4.5.2. 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 specify S3-compatible object storage, such as Multicloud Object Gateway or MinIO, as a backup location.

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.

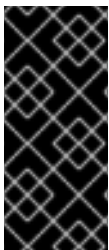
If you use Restic, you do not need to specify a snapshot location because Restic backs up the file system on object storage.

##### 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.

##### 4.4.5.2.1. 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.
- You must create a **credentials-velero** file for the object storage in the appropriate format.

## Procedure

- Create a **Secret** 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.

### 4.4.5.2.2. 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.

#### 4.4.5.3. Configuring the Data Protection Application

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

##### 4.4.5.3.1. 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> ❶
        resourceAllocations: ❷
          limits:
            cpu: "1"
            memory: 1024Mi
          requests:
            cpu: 200m
            memory: 256Mi

```

❶ Specify the node selector to be supplied to Velero podSpec.

❷ The **resourceAllocations** listed are for average usage.

#### 4.4.5.3.2. 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> ❶

```



```

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.

#### 4.4.5.4. 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-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 the default name, **`cloud-credentials-gcp`**, for the snapshot location. This **`Secret`** is not referenced in 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.



## NOTE

Velero creates a secret named **velero-repo-credentials** in the OADP namespace, which contains a default backup repository password. You can update the secret with your own password encoded as base64 **before** you run your first backup targeted to the backup repository. The value of the key to update is **Data[repository-password]**.

After you create your DPA, the first time that you run a backup targeted to the backup repository, Velero creates a backup repository whose secret is **velero-repo-credentials**, which contains either the default password or the one you replaced it with. If you update the secret password **after** the first backup, the new password will not match the password in **velero-repo-credentials**, and therefore, Velero will not be able to connect with the older backups.

## 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
spec:
  configuration:
    velero:
      defaultPlugins:
        - gcp
        - openshift 1
      resourceTimeout: 10m 2
  restic:
    enable: true 3
    podConfig:
      nodeSelector: <node_selector> 4
  backupLocations:
    - velero:
        provider: gcp
        default: true
        credential:
          key: cloud
          name: cloud-credentials-gcp 5
        objectStorage:
          bucket: <bucket_name> 6
          prefix: <prefix> 7
  snapshotLocations: 8
    - velero:
        provider: gcp
        default: true
```

```
config:
  project: <project>
  snapshotLocation: us-west1 9
```

- 1** The **openshift** plugin is mandatory.
- 2** 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.
- 3** Set this value to **false** if you want to disable the Restic installation. Restic deploys a daemon set, which means that Restic pods run on each working node. In OADP version 1.2 and later, you can configure Restic for backups by adding **spec.defaultVolumesToFsBackup: true** to the **Backup** CR. In OADP version 1.1, add **spec.defaultVolumesToRestic: true** to the **Backup** CR.
- 4** Specify on which nodes Restic is available. By default, Restic runs on all nodes.
- 5** 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.
- 6** Specify a bucket as the backup storage location. If the bucket is not a dedicated bucket for Velero backups, you must specify a prefix.
- 7** Specify a prefix for Velero backups, for example, **velero**, if the bucket is used for multiple purposes.
- 8** Specify a snapshot location, unless you use CSI snapshots or Restic to back up PVs.
- 9** The snapshot location must be in the same region as the PVs.

4. Click **Create**.

5. Verify the installation by viewing the OADP resources:

```
$ 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
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	<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

#### 4.4.5.4.1. 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.

#### 4.4.6. Configuring the OpenShift API for Data Protection with Multicloud Object Gateway

You install the OpenShift API for Data Protection (OADP) with Multicloud Object Gateway (MCG) by installing the OADP Operator. The Operator installs [Velero 1.11](#).



#### NOTE

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

You configure [Multicloud Object Gateway](#) as a backup location. MCG is a component of OpenShift Data Foundation. You configure MCG as a backup location in the **DataProtectionApplication** custom resource (CR).



## 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 create a **Secret** for the backup location and then you 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 on restricted networks](#).

### 4.4.6.1. Retrieving Multicloud Object Gateway credentials

You must retrieve the Multicloud Object Gateway (MCG) credentials in order to create a **Secret** custom resource (CR) for the OpenShift API for Data Protection (OADP).

MCG is a component of OpenShift Data Foundation.

#### Prerequisites

- You must deploy OpenShift Data Foundation by using the appropriate [OpenShift Data Foundation deployment guide](#).

#### Procedure

- Obtain the S3 endpoint, **AWS\_ACCESS\_KEY\_ID**, and **AWS\_SECRET\_ACCESS\_KEY** by running the [describe command](#) on the **NooBaa** custom resource.
- 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 when you install the Data Protection Application.

### 4.4.6.2. 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 specify S3-compatible object storage, such as Multicloud Object Gateway or MinIO, as a backup location.

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.

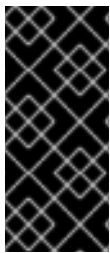
If you use Restic, you do not need to specify a snapshot location because Restic backs up the file system on object storage.

### 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.

#### 4.4.6.2.1. 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.
- You must create a **credentials-velero** file for the object storage in the appropriate format.

## Procedure

- Create a **Secret** 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.

### 4.4.6.2.2. 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: minio
          s3Url: <url>
          insecureSkipTLSVerify: "true"
```

```
s3ForcePathStyle: "true"
provider: aws
default: true
credential:
  key: cloud
  name: <custom_secret> ❶
objectStorage:
  bucket: <bucket_name>
  prefix: <prefix>
```

- ❶ Backup location **Secret** with custom name.

#### 4.4.6.3. Configuring the Data Protection Application

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

##### 4.4.6.3.1. 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> ❶
        resourceAllocations: ❷
        limits:
          cpu: "1"
          memory: 1024Mi
        requests:
          cpu: 200m
          memory: 256Mi
```

- ❶ Specify the node selector to be supplied to Velero podSpec.
- ❷ The **resourceAllocations** listed are for average usage.



#### 4.4.6.3.2. 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.

#### 4.4.6.4. 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 the default name, **cloud-credentials**, for the snapshot location. This **Secret** is not referenced in 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.



#### NOTE

Velero creates a secret named **velero-repo-credentials** in the OADP namespace, which contains a default backup repository password. You can update the secret with your own password encoded as base64 **before** you run your first backup targeted to the backup repository. The value of the key to update is **Data[repository-password]**.

After you create your DPA, the first time that you run a backup targeted to the backup repository, Velero creates a backup repository whose secret is **velero-repo-credentials**, which contains either the default password or the one you replaced it with. If you update the secret password **after** the first backup, the new password will not match the password in **velero-repo-credentials**, and therefore, Velero will not be able to connect with the older backups.

### 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
spec:
  configuration:
    velero:
      defaultPlugins:
        - aws
        - openshift ❶
      resourceTimeout: 10m ❷
  restic:
    enable: true ❸
```

```

podConfig:
  nodeSelector: <node_selector> 4
backupLocations:
- velero:
  config:
    profile: "default"
    region: minio
    s3Url: <url> 5
    insecureSkipTLSVerify: "true"
    s3ForcePathStyle: "true"
  provider: aws
  default: true
  credential:
    key: cloud
    name: cloud-credentials 6
  objectStorage:
    bucket: <bucket_name> 7
    prefix: <prefix> 8

```

- 1 The **openshift** plugin is mandatory.
- 2 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.
- 3 Set this value to **false** if you want to disable the Restic installation. Restic deploys a daemon set, which means that Restic pods run on each working node. In OADP version 1.2 and later, you can configure Restic for backups by adding **spec.defaultVolumesToFsBackup: true** to the **Backup** CR. In OADP version 1.1, add **spec.defaultVolumesToRestic: true** to the **Backup** CR.
- 4 Specify on which nodes Restic is available. By default, Restic runs on all nodes.
- 5 Specify the URL of the S3 endpoint.
- 6 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.
- 7 Specify a bucket as the backup storage location. If the bucket is not a dedicated bucket for Velero backups, you must specify a prefix.
- 8 Specify a prefix for Velero backups, for example, **velero**, if the bucket is used for multiple purposes.

4. Click **Create**.

5. Verify the installation by viewing the OADP resources:

```
$ 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

```

#### 4.4.6.4.1. 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.

#### 4.4.7. 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 MTC Operator and are not available as a standalone Operator.

You can configure [Multicloud Object Gateway](#) or any 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 create a **Secret** for the backup location and then you 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 on restricted networks](#).

#### 4.4.7.1. 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 specify S3-compatible object storage, such as Multicloud Object Gateway or MinIO, as a backup location.

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 Restic, you do not need to specify a snapshot location because Restic 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](#) .

#### 4.4.7.1.1. 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.



### 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.
- You must create a **credentials-velero** file for the object storage in the appropriate format.

### Procedure

- Create a **Secret** 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.

#### 4.4.7.2. Configuring the Data Protection Application

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

#### 4.4.7.2.1. 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.

#### 4.4.7.2.2. 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> ❶
        config:
          insecureSkipTLSVerify: "false" ❷
  ...

```

- ❶ Specify the Base64-encoded CA certificate string.
- ❷ 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.

#### 4.4.7.3. 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**.



##### 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.





## NOTE

Velero creates a secret named **velero-repo-credentials** in the OADP namespace, which contains a default backup repository password. You can update the secret with your own password encoded as base64 **before** you run your first backup targeted to the backup repository. The value of the key to update is **Data[repository-password]**.

After you create your DPA, the first time that you run a backup targeted to the backup repository, Velero creates a backup repository whose secret is **velero-repo-credentials**, which contains either the default password or the one you replaced it with. If you update the secret password **after** the first backup, the new password will not match the password in **velero-repo-credentials**, and therefore, Velero will not be able to connect with the older backups.

## 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:
4. Click **Create**.
5. Verify the installation by viewing the OADP resources:

```
$ 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
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	<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

#### 4.4.7.3.1. 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](#).

#### 4.4.7.3.2. 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.

## 4.5. UNINSTALLING OADP

### 4.5.1. 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.

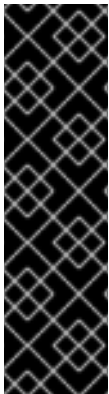
## 4.6. OADP BACKING UP

### 4.6.1. Backing up applications

You back up applications by creating a **Backup** custom resource (CR). See [Creating a Backup CR](#).

The **Backup** CR creates backup files for Kubernetes resources and internal images, on S3 object storage, and snapshots for persistent volumes (PVs), if the cloud provider uses a native snapshot API or the Container Storage Interface (CSI) to create snapshots, such as OpenShift Data Foundation 4.

For more information about CSI volume snapshots, see [CSI volume snapshots](#).

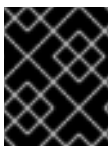


#### IMPORTANT

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](#).

- 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](#).
- If your cloud provider does not support snapshots or if your applications are on NFS data volumes, you can create backups by using Restic. See [Backing up applications with Restic](#).



#### IMPORTANT

The OpenShift API for Data Protection (OADP) does not support backing up volume snapshots that were created by other software.

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](#).

#### 4.6.1.1. Known issues

OpenShift Container Platform 4.14 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 4.14 due to changed PSA policy](#) .

### Additional resources

- [Installing Operators on clusters for administrators](#)
- [Installing Operators in namespaces for non-administrators](#)

## 4.6.2. Creating a Backup CR

You back up Kubernetes images, 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 -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** of 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 backup -n openshift-adp <backup> -o jsonpath='{.status.phase}'
```

### 4.6.3. 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

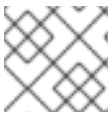
- Add the **metadata.labels.velero.io/csi-volumesnapshot-class: "true"** key-value pair to the **VolumeSnapshotClass** CR:

```
apiVersion: snapshot.storage.k8s.io/v1
kind: VolumeSnapshotClass
metadata:
  name: <volume_snapshot_class_name>
  labels:
    velero.io/csi-volumesnapshot-class: "true"
driver: <csi_driver>
deletionPolicy: Retain
```

You can now create a **Backup** CR.

### 4.6.4. Backing up applications with Restic

If your cloud provider does not support snapshots or if your applications are on NFS data volumes, you can create backups by using Restic.



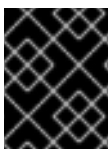
#### NOTE

[Restic](#) is installed by the OADP Operator by default.

Restic integration with OADP provides a solution for backing up and restoring almost any type of Kubernetes volume. This integration is an addition to OADP's capabilities, not a replacement for existing functionality.

You back up Kubernetes resources, internal images, and persistent volumes with Restic by editing the **Backup** custom resource (CR).

You do not need to specify a snapshot location in the **DataProtectionApplication** CR.



#### IMPORTANT

Restic does not support backing up **hostPath** volumes. For more information, see [additional Restic limitations](#).

## Prerequisites

- You must install the OpenShift API for Data Protection (OADP) Operator.
- You must not disable the default Restic installation by setting **spec.configuration.restic.enable** to **false** 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 ❶
...

```

- ❶ In OADP version 1.2 and later, add the **defaultVolumesToFsBackup: true** setting within the **spec** block. In OADP version 1.1, add **defaultVolumesToRestic: true**.

#### 4.6.5. 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 run after the backup.

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> ❶
        excludedNamespaces: ❷
          - <namespace>
        includedResources: []
        - pods ❸
        excludedResources: [] ❹
      labelSelector: ❺
        matchLabels:
          app: velero
          component: server
      pre: ❻
        - exec:
            container: <container> ❼

```

```

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 namespaces.
- 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.

#### 4.6.6. Scheduling backups using Schedule CR

The schedule operation allows you to create a backup of your data at a specified time, defined 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 * * * ❶
  template:
    hooks: {}
    includedNamespaces:
      - <namespace> ❷
    storageLocation: <velero-sample-1> ❸
    defaultVolumesToFsBackup: true ❹
    ttl: 720h0m0s
EOF
```

- ❶ **cron** expression to schedule the backup, for example, **0 7 \* \* \*** to perform a backup every day at 7:00.
- ❷ Array of namespaces to back up.
- ❸ Name of the **backupStorageLocations** CR.
- ❹ 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 1.1, add the **defaultVolumesToRestic: true** key-value pair when you back up volumes with Restic.

3. 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}'
```

## 4.6.7. Deleting backups

You can remove backup files by deleting the **Backup** custom resource (CR).

**WARNING**

After you delete the **Backup** CR and the associated object storage data, you cannot recover the deleted data.

**Prerequisites**

- You created a **Backup** CR.
- You know the name of the **Backup** CR and the namespace that contains it.
- You downloaded the Velero CLI tool.
- You can access the Velero binary in your cluster.

**Procedure**

- Choose one of the following actions to delete the **Backup** CR:
  - To delete the **Backup** CR and keep the associated object storage data, issue the following command:

```
$ oc delete backup <backup_CR_name> -n <velero_namespace>
```

- To delete the **Backup** CR and delete the associated object storage data, issue the following command:

```
$ velero backup delete <backup_CR_name> -n <velero_namespace>
```

Where:

**<backup\_CR\_name>**

Specifies the name of the **Backup** custom resource.

**<velero\_namespace>**

Specifies the namespace that contains the **Backup** custom resource.

## 4.7. OADP RESTORING

### 4.7.1. 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 while restoring your application by editing the **Restore** (CR). See [Creating restore hooks](#)

#### 4.7.1.1. Creating a Restore CR

You restore a **Backup** custom resource (CR) by creating a **Restore** CR.

## 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.
- Adjust the requested size so the persistent volume (PV) capacity matches the requested size at backup time.

## 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> ❶
  includedResources: [] ❷
  excludedResources:
    - nodes
    - events
    - events.events.k8s.io
    - backups.velero.io
    - restores.velero.io
    - resticrepositories.velero.io
  restorePVs: true ❸
```

- ❶ Name of the **Backup** CR.
- ❷ 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.
- ❸ Optional: The **restorePVs** parameter can be set to **false** in order 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 restore -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> ❶
```

- ❶ Namespace that you backed up.

4. If you use Restic to restore **DeploymentConfig** objects or if you use post-restore hooks, run the **dc-restic-post-restore.sh** cleanup script by entering the following command:

```
$ bash dc-restic-post-restore.sh <restore-name>
```



## NOTE

In the course of the restore process, the OADP Velero plug-ins scale down the **DeploymentConfig** objects and restore the pods as standalone pods to prevent the cluster from deleting the restored **DeploymentConfig** pods immediately on restore and to allow Restic and post-restore hooks to complete their actions on the restored pods. The cleanup script removes these disconnected pods and scale any **DeploymentConfig** objects back up to the appropriate number of replicas.

### Example 4.1. dc-restic-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}"
}

OADP_NAMESPACE=${OADP_NAMESPACE:=openshift-adp}

if [[ $# -ne 1 ]]; then
    echo "usage: ${BASH_SOURCE} restore-name"
    exit 1
fi

echo using OADP Namespace $OADP_NAMESPACE
echo restore: $1

label=$(label_name $1)
echo label: $label

echo Deleting disconnected restore pods
oc delete pods -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

```

#### 4.7.1.2. Creating restore hooks

You create restore hooks to run commands in a container in a pod while restoring your application 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> ❶
        excludedNamespaces:
          - <namespace>
        includedResources:
          - pods ❷
        excludedResources: []
        labelSelector: ❸
          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 amount 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**.

## 4.8. OADP DATA MOVER

### 4.8.1. OADP Data Mover Introduction

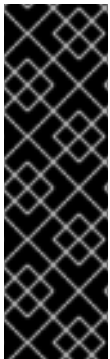
OADP Data Mover allows you to restore stateful applications from the store if a failure, accidental deletion, or corruption of the cluster occurs.



## NOTE

The OADP 1.1 Data Mover is a Technology Preview feature.

The OADP 1.2 Data Mover has significantly improved features and performances, but is still a Technology Preview feature.



## IMPORTANT

The OADP Data Mover 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 use OADP Data Mover to back up Container Storage Interface (CSI) volume snapshots to a remote object store. See [Using Data Mover for CSI snapshots](#).
- You can use OADP 1.2 Data Mover to backup and restore application data for clusters that use CephFS, CephRBD, or both. See [Using OADP 1.2 Data Mover with Ceph storage](#).
- You must perform a data cleanup after you perform a backup, if you are using OADP 1.1 Data Mover. See [Cleaning up after a backup using OADP 1.1 Data Mover](#).

### 4.8.1.1. OADP Data Mover prerequisites

- You have a stateful application running in a separate namespace.
- You have installed the OADP Operator by using Operator Lifecycle Manager (OLM).
- You have created an appropriate **VolumeSnapshotClass** and **StorageClass**.
- You have installed the VolSync operator using OLM.

### 4.8.2. Using Data Mover for CSI snapshots

The OADP Data Mover enables customers to back up Container Storage Interface (CSI) volume snapshots to a remote object store. When Data Mover is enabled, you can restore stateful applications, using CSI volume snapshots pulled from the object store if a failure, accidental deletion, or corruption of the cluster occurs.

The Data Mover solution uses the Restic option of VolSync.

Data Mover supports backup and restore of CSI volume snapshots only.

In OADP 1.2 Data Mover **VolumeSnapshotBackups** (VSBs) and **VolumeSnapshotRestores** (VSRs) are queued using the VolumeSnapshotMover (VSM). The VSM's performance is improved by specifying a concurrent number of VSBs and VSRs simultaneously **InProgress**. After all async plugin operations are complete, the backup is marked as complete.

**NOTE**

The OADP 1.1 Data Mover is a Technology Preview feature.

The OADP 1.2 Data Mover has significantly improved features and performances, but is still a Technology Preview feature.

**IMPORTANT**

The OADP Data Mover 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**

Red Hat recommends that customers who use OADP 1.2 Data Mover in order to back up and restore ODF CephFS volumes, upgrade or install OpenShift Container Platform version 4.12 or later for improved performance. OADP Data Mover can leverage CephFS shallow volumes in OpenShift Container Platform version 4.12 or later, which based on our testing, can improve the performance of backup times.

- [CephFS ROX details](#)

**Prerequisites**

- You have verified that the **StorageClass** and **VolumeSnapshotClass** custom resources (CRs) support CSI.
- You have verified that only one **VolumeSnapshotClass** CR has the annotation **snapshot.storage.kubernetes.io/is-default-class: "true"**.

**NOTE**

In OpenShift Container Platform version 4.12 or later, verify that this is the only default **VolumeSnapshotClass**.

- You have verified that **deletionPolicy** of the **VolumeSnapshotClass** CR is set to **Retain**.
- You have verified that only one **StorageClass** CR has the annotation **storageclass.kubernetes.io/is-default-class: "true"**.
- You have included the label **velero.io/csi-volumesnapshot-class: "true"** in your **VolumeSnapshotClass** CR.
- You have verified that the **OADP namespace** has the annotation **oc annotate --overwrite namespace/openshift-adp volsync.backube/privileged-movers="true"**.



**NOTE**

In OADP 1.1 the above setting is mandatory.

In OADP 1.2 the **privileged-movers** setting is not required in most scenarios. The restoring container permissions should be adequate for the Volsync copy. In some user scenarios, there may be permission errors that the **privileged-mover=true** setting should resolve.

- You have installed the VolSync Operator by using the Operator Lifecycle Manager (OLM).

**NOTE**

The VolSync Operator is required for using OADP Data Mover.

- You have installed the OADP operator by using OLM.

**Procedure**

1. Configure a Restic secret by creating a **.yaml** file as following:

```
apiVersion: v1
kind: Secret
metadata:
  name: <secret_name>
  namespace: openshift-adp
type: Opaque
stringData:
  RESTIC_PASSWORD: <secure_restic_password>
```

**NOTE**

By default, the Operator looks for a secret named **dm-credential**. If you are using a different name, you need to specify the name through a Data Protection Application (DPA) CR using **dpa.spec.features.dataMover.credentialName**.

2. Create a DPA CR similar to the following example. The default plugins include CSI.

**Example Data Protection Application (DPA) CR**

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: velero-sample
  namespace: openshift-adp
spec:
  backupLocations:
    - velero:
        config:
          profile: default
          region: us-east-1
        credential:
          key: cloud
```

```

    name: cloud-credentials
    default: true
    objectStorage:
      bucket: <bucket_name>
      prefix: <bucket-prefix>
    provider: aws
  configuration:
    restic:
      enable: <true_or_false>
    velero:
      itemOperationSyncFrequency: "10s"
      defaultPlugins:
        - openshift
        - aws
        - csi
        - vsm 1
  features:
    dataMover:
      credentialName: restic-secret
      enable: true
      maxConcurrentBackupVolumes: "3" 2
      maxConcurrentRestoreVolumes: "3" 3
      pruneInterval: "14" 4
      volumeOptions: 5
      sourceVolumeOptions:
        accessMode: ReadOnlyMany
        cacheAccessMode: ReadWriteOnce
        cacheCapacity: 2Gi
      destinationVolumeOptions:
        storageClass: other-storageclass-name
        cacheAccessMode: ReadWriteMany
  snapshotLocations:
    - velero:
        config:
          profile: default
          region: us-west-2
          provider: aws

```

- 1** OADP 1.2 only.
- 2** OADP 1.2 only. Optional: Specify the upper limit of the number of snapshots allowed to be queued for backup. The default value is 10.
- 3** OADP 1.2 only. Optional: Specify the upper limit of the number of snapshots allowed to be queued for restore. The default value is 10.
- 4** OADP 1.2 only. Optional: Specify the number of days, between running Restic pruning on the repository. The prune operation repacks the data to free space, but it can also generate significant I/O traffic as a part of the process. Setting this option allows a trade-off between storage consumption, from no longer referenced data, and access costs.
- 5** OADP 1.2 only. Optional: Specify VolumeSync volume options for backup and restore.

The OADP Operator installs two custom resource definitions (CRDs), **VolumeSnapshotBackup** and **VolumeSnapshotRestore**.

### Example VolumeSnapshotBackup CRD

```

apiVersion: datamover.oadp.openshift.io/v1alpha1
kind: VolumeSnapshotBackup
metadata:
  name: <vsb_name>
  namespace: <namespace_name> ❶
spec:
  volumeSnapshotContent:
    name: <snapcontent_name>
  protectedNamespace: <adp_namespace> ❷
  resticSecretRef:
    name: <restic_secret_name>

```

- ❶ Specify the namespace where the volume snapshot exists.
- ❷ Specify the namespace where the OADP Operator is installed. The default is **openshift-adp**.

### Example VolumeSnapshotRestore CRD

```

apiVersion: datamover.oadp.openshift.io/v1alpha1
kind: VolumeSnapshotRestore
metadata:
  name: <vsr_name>
  namespace: <namespace_name> ❶
spec:
  protectedNamespace: <protected_ns> ❷
  resticSecretRef:
    name: <restic_secret_name>
  volumeSnapshotMoverBackupRef:
    sourcePVCData:
      name: <source_pvc_name>
      size: <source_pvc_size>
    resticrepository: <your_restic_repo>
    volumeSnapshotClassName: <vsclass_name>

```

- ❶ Specify the namespace where the volume snapshot exists.
- ❷ Specify the namespace where the OADP Operator is installed. The default is **openshift-adp**.

3. You can back up a volume snapshot by performing the following steps:

- a. Create a backup CR:

```

apiVersion: velero.io/v1
kind: Backup
metadata:
  name: <backup_name>
  namespace: <protected_ns> ❶
spec:

```

```
includedNamespaces:
- <app_ns> 2
storageLocation: velero-sample-1
```

**1** Specify the namespace where the Operator is installed. The default namespace is **openshift-adp**.

**2** Specify the application namespace or namespaces to be backed up.

- b. Wait up to 10 minutes and check whether the **VolumeSnapshotBackup** CR status is **Completed** by entering the following commands:

```
$ oc get vsb -n <app_ns>
```

```
$ oc get vsb <vsb_name> -n <app_ns> -o jsonpath="{.status.phase}"
```

A snapshot is created in the object store was configured in the DPA.



#### NOTE

If the status of the **VolumeSnapshotBackup** CR becomes **Failed**, refer to the Velero logs for troubleshooting.

4. You can restore a volume snapshot by performing the following steps:
- Delete the application namespace and the **VolumeSnapshotContent** that was created by the Velero CSI plugin.
  - Create a **Restore** CR and set **restorePVs** to **true**.

#### Example Restore CR

```
apiVersion: velero.io/v1
kind: Restore
metadata:
  name: <restore_name>
  namespace: <protected_ns>
spec:
  backupName: <previous_backup_name>
  restorePVs: true
```

- c. Wait up to 10 minutes and check whether the **VolumeSnapshotRestore** CR status is **Completed** by entering the following command:

```
$ oc get vsr -n <app_ns>
```

```
$ oc get vsr <vsr_name> -n <app_ns> -o jsonpath="{.status.phase}"
```

- d. Check whether your application data and resources have been restored.

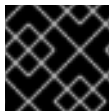
**NOTE**

If the status of the **VolumeSnapshotRestore** CR becomes 'Failed', refer to the Velero logs for troubleshooting.

### 4.8.3. Using OADP 1.2 Data Mover with Ceph storage

You can use OADP 1.2 Data Mover to backup and restore application data for clusters that use CephFS, CephRBD, or both.

OADP 1.2 Data Mover leverages Ceph features that support large-scale environments. One of these is the shallow copy method, which is available for OpenShift Container Platform 4.12 and later. This feature supports backing up and restoring **StorageClass** and **AccessMode** resources other than what is found on the source persistent volume claim (PVC).

**IMPORTANT**

The CephFS shallow copy feature is a back up feature. It is not part of restore operations.

#### 4.8.3.1. Prerequisites for using OADP 1.2 Data Mover with Ceph storage

The following prerequisites apply to all back up and restore operations of data using OpenShift API for Data Protection (OADP) 1.2 Data Mover in a cluster that uses Ceph storage:

- You have installed OpenShift Container Platform 4.12 or later.
- You have installed the OADP Operator.
- You have created a secret **cloud-credentials** in the namespace **openshift-adp**.
- You have installed Red Hat OpenShift Data Foundation.
- You have installed the latest VolSync Operator using the Operator Lifecycle Manager.

#### 4.8.3.2. Defining custom resources for use with OADP 1.2 Data Mover

When you install Red Hat OpenShift Data Foundation, it automatically creates default CephFS and a CephRBD **StorageClass** and **VolumeSnapshotClass** custom resources (CRs). You must define these CRs for use with OpenShift API for Data Protection (OADP) 1.2 Data Mover.

After you define the CRs, you must make several other changes to your environment before you can perform your back up and restore operations.

##### 4.8.3.2.1. Defining CephFS custom resources for use with OADP 1.2 Data Mover

When you install Red Hat OpenShift Data Foundation, it automatically creates a default CephFS **StorageClass** custom resource (CR) and a default CephFS **VolumeSnapshotClass** CR. You can define these CRs for use with OpenShift API for Data Protection (OADP) 1.2 Data Mover.

**Procedure**

1. Define the **VolumeSnapshotClass** CR as in the following example:

#### Example VolumeSnapshotClass CR

```

apiVersion: snapshot.storage.k8s.io/v1
deletionPolicy: Retain 1
driver: openshift-storage.cephfs.csi.ceph.com
kind: VolumeSnapshotClass
metadata:
  annotations:
    snapshot.storage.kubernetes.io/is-default-class: true 2
  labels:
    velero.io/csi-volumesnapshot-class: true 3
  name: ocs-storagecluster-cephfsplugin-snapclass
parameters:
  clusterID: openshift-storage
  csi.storage.k8s.io/snapshotter-secret-name: rook-csi-cephfs-provisioner
  csi.storage.k8s.io/snapshotter-secret-namespace: openshift-storage

```

**1** Must be set to **Retain**.

**2** Must be set to **true**.

**3** Must be set to **true**.

2. Define the **StorageClass** CR as in the following example:

#### Example StorageClass CR

```

kind: StorageClass
apiVersion: storage.k8s.io/v1
metadata:
  name: ocs-storagecluster-cephfs
  annotations:
    description: Provides RWO and RWX Filesystem volumes
    storageclass.kubernetes.io/is-default-class: true 1
provisioner: openshift-storage.cephfs.csi.ceph.com
parameters:
  clusterID: openshift-storage
  csi.storage.k8s.io/controller-expand-secret-name: rook-csi-cephfs-provisioner
  csi.storage.k8s.io/controller-expand-secret-namespace: openshift-storage
  csi.storage.k8s.io/node-stage-secret-name: rook-csi-cephfs-node
  csi.storage.k8s.io/node-stage-secret-namespace: openshift-storage
  csi.storage.k8s.io/provisioner-secret-name: rook-csi-cephfs-provisioner
  csi.storage.k8s.io/provisioner-secret-namespace: openshift-storage
  fsName: ocs-storagecluster-cephfilesystem
reclaimPolicy: Delete
allowVolumeExpansion: true
volumeBindingMode: Immediate

```

**1** Must be set to **true**.

#### 4.8.3.2.2. Defining CephRBD custom resources for use with OADP 1.2 Data Mover

When you install Red Hat OpenShift Data Foundation, it automatically creates a default CephRBD **StorageClass** custom resource (CR) and a default CephRBD **VolumeSnapshotClass** CR. You can define these CRs for use with OpenShift API for Data Protection (OADP) 1.2 Data Mover.

## Procedure

1. Define the **VolumeSnapshotClass** CR as in the following example:

### Example VolumeSnapshotClass CR

```
apiVersion: snapshot.storage.k8s.io/v1
deletionPolicy: Retain 1
driver: openshift-storage.rbd.csi.ceph.com
kind: VolumeSnapshotClass
metadata:
  labels:
    velero.io/csi-volumesnapshot-class: true 2
  name: ocs-storagecluster-rbdplugin-snapclass
parameters:
  clusterID: openshift-storage
  csi.storage.k8s.io/snapshotter-secret-name: rook-csi-rbd-provisioner
  csi.storage.k8s.io/snapshotter-secret-namespace: openshift-storage
```

**1** Must be set to **Retain**.

**2** Must be set to **true**.

2. Define the **StorageClass** CR as in the following example:

### Example StorageClass CR

```
kind: StorageClass
apiVersion: storage.k8s.io/v1
metadata:
  name: ocs-storagecluster-ceph-rbd
  annotations:
    description: 'Provides RWO Filesystem volumes, and RWO and RWX Block volumes'
provisioner: openshift-storage.rbd.csi.ceph.com
parameters:
  csi.storage.k8s.io/fstype: ext4
  csi.storage.k8s.io/provisioner-secret-namespace: openshift-storage
  csi.storage.k8s.io/provisioner-secret-name: rook-csi-rbd-provisioner
  csi.storage.k8s.io/node-stage-secret-name: rook-csi-rbd-node
  csi.storage.k8s.io/controller-expand-secret-name: rook-csi-rbd-provisioner
  imageFormat: '2'
  clusterID: openshift-storage
  imageFeatures: layering
  csi.storage.k8s.io/controller-expand-secret-namespace: openshift-storage
  pool: ocs-storagecluster-cephblockpool
  csi.storage.k8s.io/node-stage-secret-namespace: openshift-storage
reclaimPolicy: Delete
allowVolumeExpansion: true
volumeBindingMode: Immediate
```

#### 4.8.3.2.3. Defining additional custom resources for use with OADP 1.2 Data Mover

After you redefine the default **StorageClass** and CephRBD **VolumeSnapshotClass** custom resources (CRs), you must create the following CRs:

- A CephFS **StorageClass** CR defined to use the shallow copy feature
- A Rustic **Secret** CR

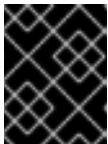
#### Procedure

1. Create a CephFS **StorageClass** CR and set the **backingSnapshot** parameter set to **true** as in the following example:

#### Example CephFS StorageClass CR with backingSnapshot set to true

```
kind: StorageClass
apiVersion: storage.k8s.io/v1
metadata:
  name: ocs-storagecluster-cephfs-shallow
  annotations:
    description: Provides RWO and RWX Filesystem volumes
    storageclass.kubernetes.io/is-default-class: false
provisioner: openshift-storage.cephfs.csi.ceph.com
parameters:
  csi.storage.k8s.io/provisioner-secret-namespace: openshift-storage
  csi.storage.k8s.io/provisioner-secret-name: rook-csi-cephfs-provisioner
  csi.storage.k8s.io/node-stage-secret-name: rook-csi-cephfs-node
  csi.storage.k8s.io/controller-expand-secret-name: rook-csi-cephfs-provisioner
  clusterID: openshift-storage
  fsName: ocs-storagecluster-cephfilesystem
  csi.storage.k8s.io/controller-expand-secret-namespace: openshift-storage
  backingSnapshot: true 1
  csi.storage.k8s.io/node-stage-secret-namespace: openshift-storage
reclaimPolicy: Delete
allowVolumeExpansion: true
volumeBindingMode: Immediate
```

- <sup>1</sup> Must be set to **true**.



#### IMPORTANT

Ensure that the CephFS **VolumeSnapshotClass** and **StorageClass** CRs have the same value for **provisioner**.

2. Configure a Restic **Secret** CR as in the following example:

#### Example Restic Secret CR

```
apiVersion: v1
kind: Secret
metadata:
  name: <secret_name>
```



```
namespace: <namespace>
type: Opaque
stringData:
  RESTIC_PASSWORD: <restic_password>
```

#### 4.8.3.3. Backing up and restoring data using OADP 1.2 Data Mover and CephFS storage

You can use OpenShift API for Data Protection (OADP) 1.2 Data Mover to back up and restore data using CephFS storage by enabling the shallow copy feature of CephFS.

##### Prerequisites

- A stateful application is running in a separate namespace with persistent volume claims (PVCs) using CephFS as the provisioner.
- The **StorageClass** and **VolumeSnapshotClass** custom resources (CRs) are defined for CephFS and OADP 1.2 Data Mover.
- There is a secret **cloud-credentials** in the **openshift-adp** namespace.

##### 4.8.3.3.1. Creating a DPA for use with CephFS storage

You must create a Data Protection Application (DPA) CR before you use the OpenShift API for Data Protection (OADP) 1.2 Data Mover to back up and restore data using CephFS storage.

##### Procedure

1. Verify that the **deletionPolicy** field of the **VolumeSnapshotClass** CR is set to **Retain** by running the following command:

```
$ oc get volumesnapshotclass -A -o jsonpath='{range .items[*]}{"Name: "}{.metadata.name}{" "}"{"Retention Policy: "}{.deletionPolicy}{"\n"}{"end}"}
```

2. Verify that the labels of the **VolumeSnapshotClass** CR are set to **true** by running the following command:

```
$ oc get volumesnapshotclass -A -o jsonpath='{range .items[*]}{"Name: "}{.metadata.name}{" "}"{"labels: "}{.metadata.labels}{"\n"}{"end}"}
```

3. Verify that the **storageclass.kubernetes.io/is-default-class** annotation of the **StorageClass** CR is set to **true** by running the following command:

```
$ oc get storageClass -A -o jsonpath='{range .items[*]}{"Name: "}{.metadata.name}{" "}"{"annotations: "}{.metadata.annotations}{"\n"}{"end}"}
```

4. Create a Data Protection Application (DPA) CR similar to the following example:

##### Example DPA CR

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: velero-sample
```

```

namespace: openshift-adp
spec:
  backupLocations:
    - velero:
        config:
          profile: default
          region: us-east-1
        credential:
          key: cloud
          name: cloud-credentials
        default: true
        objectStorage:
          bucket: <my_bucket>
          prefix: velero
        provider: aws
  configuration:
    restic:
      enable: false ❶
    velero:
      defaultPlugins:
        - openshift
        - aws
        - csi
        - vsm
  features:
    dataMover:
      credentialName: <restic_secret_name> ❷
      enable: true ❸
      volumeOptionsForStorageClasses:
        ocs-storagecluster-cephfs:
          sourceVolumeOptions:
            accessMode: ReadOnlyMany
            cacheAccessMode: ReadWriteMany
            cacheStorageClassName: ocs-storagecluster-cephfs
            storageClassName: ocs-storagecluster-cephfs-shallow

```

- ❶ There is no default value for the **enable** field. Valid values are **true** or **false**.
- ❷ Use the Restic **Secret** that you created when you prepared your environment for working with OADP 1.2 Data Mover and Ceph. If you do not use your Restic **Secret**, the CR uses the default value **dm-credential** for this parameter.
- ❸ There is no default value for the **enable** field. Valid values are **true** or **false**.

#### 4.8.3.3.2. Backing up data using OADP 1.2 Data Mover and CephFS storage

You can use OpenShift API for Data Protection (OADP) 1.2 Data Mover to back up data using CephFS storage by enabling the shallow copy feature of CephFS storage.

#### Procedure

1. Create a **Backup** CR as in the following example:

#### Example Backup CR

```

apiVersion: velero.io/v1
kind: Backup
metadata:
  name: <backup_name>
  namespace: <protected_ns>
spec:
  includedNamespaces:
    - <app_ns>
  storageLocation: velero-sample-1

```

2. Monitor the progress of the **VolumeSnapshotBackup** CRs by completing the following steps:

- a. To check the progress of all the **VolumeSnapshotBackup** CRs, run the following command:

```
$ oc get vsb -n <app_ns>
```

- b. To check the progress of a specific **VolumeSnapshotBackup** CR, run the following command:

```
$ oc get vsb <vsb_name> -n <app_ns> -ojsonpath='{.status.phase}'
```

3. Wait several minutes until the **VolumeSnapshotBackup** CR has the status **Completed**.
4. Verify that there is at least one snapshot in the object store that is given in the Restic **Secret**. You can check for this snapshot in your targeted **BackupStorageLocation** storage provider that has a prefix of **/<OADP\_namespace>**.

#### 4.8.3.3.3. Restoring data using OADP 1.2 Data Mover and CephFS storage

You can use OpenShift API for Data Protection (OADP) 1.2 Data Mover to restore data using CephFS storage if the shallow copy feature of CephFS storage was enabled for the back up procedure. The shallow copy feature is not used in the restore procedure.

#### Procedure

1. Delete the application namespace by running the following command:

```
$ oc delete vsb -n <app_namespace> --all
```

2. Delete any **VolumeSnapshotContent** CRs that were created during backup by running the following command:

```
$ oc delete volumesnapshotcontent --all
```

3. Create a **Restore** CR as in the following example:

#### Example Restore CR

```

apiVersion: velero.io/v1
kind: Restore
metadata:
  name: <restore_name>

```

```
namespace: <protected_ns>
spec:
  backupName: <previous_backup_name>
```

4. Monitor the progress of the **VolumeSnapshotRestore** CRs by doing the following:

- a. To check the progress of all the **VolumeSnapshotRestore** CRs, run the following command:

```
$ oc get vsr -n <app_ns>
```

- b. To check the progress of a specific **VolumeSnapshotRestore** CR, run the following command:

```
$ oc get vsr <vsr_name> -n <app_ns> -jsonpath="{.status.phase}"
```

5. Verify that your application data has been restored by running the following command:

```
$ oc get route <route_name> -n <app_ns> -jsonpath="{.spec.host}"
```

#### 4.8.3.4. Backing up and restoring data using OADP 1.2 Data Mover and split volumes (CephFS and Ceph RBD)

You can use OpenShift API for Data Protection (OADP) 1.2 Data Mover to back up and restore data in an environment that has *split volumes*, that is, an environment that uses both CephFS and CephRBD.

##### Prerequisites

- A stateful application is running in a separate namespace with persistent volume claims (PVCs) using CephFS as the provisioner.
- The **StorageClass** and **VolumeSnapshotClass** custom resources (CRs) are defined for CephFS and OADP 1.2 Data Mover.
- There is a secret **cloud-credentials** in the **openshift-adp** namespace.

##### 4.8.3.4.1. Creating a DPA for use with split volumes

You must create a Data Protection Application (DPA) CR before you use the OpenShift API for Data Protection (OADP) 1.2 Data Mover to back up and restore data using split volumes.

##### Procedure

- Create a Data Protection Application (DPA) CR as in the following example:

##### Example DPA CR for environment with split volumes

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: velero-sample
  namespace: openshift-adp
spec:
  backupLocations:
```

```

- velero:
  config:
    profile: default
    region: us-east-1
  credential:
    key: cloud
    name: cloud-credentials
  default: true
  objectStorage:
    bucket: <my-bucket>
    prefix: velero
  provider: aws
configuration:
  restic:
    enable: false
  velero:
    defaultPlugins:
      - openshift
      - aws
      - csi
      - vsm
features:
  dataMover:
    credentialName: <restic_secret_name> ❶
    enable: true
    volumeOptionsForStorageClasses: ❷
      ocs-storagecluster-cephfs:
        sourceVolumeOptions:
          accessMode: ReadOnlyMany
          cacheAccessMode: ReadWriteMany
          cacheStorageClassName: ocs-storagecluster-cephfs
          storageClassName: ocs-storagecluster-cephfs-shallow
      ocs-storagecluster-ceph-rbd:
        sourceVolumeOptions:
          storageClassName: ocs-storagecluster-ceph-rbd
          cacheStorageClassName: ocs-storagecluster-ceph-rbd
        destinationVolumeOptions:
          storageClassName: ocs-storagecluster-ceph-rbd
          cacheStorageClassName: ocs-storagecluster-ceph-rbd

```

❶ Use the Restic **Secret** that you created when you prepared your environment for working with OADP 1.2 Data Mover and Ceph. If you do not, then the CR will use the default value **dm-credential** for this parameter.

❷ A different set of **VolumeOptionsForStorageClass** labels can be defined for each **storageClass** volume, thus allowing a backup to volumes with different providers.

#### 4.8.3.4.2. Backing up data using OADP 1.2 Data Mover and split volumes

You can use OpenShift API for Data Protection (OADP) 1.2 Data Mover to back up data in an environment that has split volumes.

#### Procedure

1. Create a **Backup** CR as in the following example:

#### Example Backup CR

```
apiVersion: velero.io/v1
kind: Backup
metadata:
  name: <backup_name>
  namespace: <protected_ns>
spec:
  includedNamespaces:
    - <app_ns>
  storageLocation: velero-sample-1
```

2. Monitor the progress of the **VolumeSnapshotBackup** CRs by completing the following steps:
  - a. To check the progress of all the **VolumeSnapshotBackup** CRs, run the following command:
 

```
$ oc get vsb -n <app_ns>
```
  - b. To check the progress of a specific **VolumeSnapshotBackup** CR, run the following command:
 

```
$ oc get vsb <vsb_name> -n <app_ns> -ojsonpath='{.status.phase}'
```
3. Wait several minutes until the **VolumeSnapshotBackup** CR has the status **Completed**.
4. Verify that there is at least one snapshot in the object store that is given in the Restic **Secret**. You can check for this snapshot in your targeted **BackupStorageLocation** storage provider that has a prefix of **/<OADP\_namespace>**.

#### 4.8.3.4.3. Restoring data using OADP 1.2 Data Mover and split volumes

You can use OpenShift API for Data Protection (OADP) 1.2 Data Mover to restore data in an environment that has split volumes, if the shallow copy feature of CephFS storage was enabled for the back up procedure. The shallow copy feature is not used in the restore procedure.

#### Procedure

1. Delete the application namespace by running the following command:

```
$ oc delete vsb -n <app_namespace> --all
```

2. Delete any **VolumeSnapshotContent** CRs that were created during backup by running the following command:

```
$ oc delete volumesnapshotcontent --all
```

3. Create a **Restore** CR as in the following example:

#### Example Restore CR

```

apiVersion: velero.io/v1
kind: Restore
metadata:
  name: <restore_name>
  namespace: <protected_ns>
spec:
  backupName: <previous_backup_name>

```

4. Monitor the progress of the **VolumeSnapshotRestore** CRs by doing the following:

- a. To check the progress of all the **VolumeSnapshotRestore** CRs, run the following command:

```
$ oc get vsr -n <app_ns>
```

- b. To check the progress of a specific **VolumeSnapshotRestore** CR, run the following command:

```
$ oc get vsr <vsr_name> -n <app_ns> -jsonpath="{.status.phase}"
```

5. Verify that your application data has been restored by running the following command:

```
$ oc get route <route_name> -n <app_ns> -jsonpath="{.spec.host}"
```

#### 4.8.4. Cleaning up after a backup using OADP 1.1 Data Mover

For OADP 1.1 Data Mover, you must perform a data cleanup after you perform a backup.

The cleanup consists of deleting the following resources:

- Snapshots in a bucket
- Cluster resources
- Volume snapshot backups (VSBs) after a backup procedure that is either run by a schedule or is run repetitively

##### 4.8.4.1. Deleting snapshots in a bucket

OADP 1.1 Data Mover might leave one or more snapshots in a bucket after a backup. You can either delete all the snapshots or delete individual snapshots.

##### Procedure

- To delete all snapshots in your bucket, delete the /<protected\_namespace> folder that is specified in the Data Protection Application (DPA) **.spec.backupLocation.objectStorage.bucket** resource.
- To delete an individual snapshot:
  1. Browse to the /<protected\_namespace> folder that is specified in the DPA **.spec.backupLocation.objectStorage.bucket** resource.

2. Delete the appropriate folders that are prefixed with **/<volumeSnapshotContent name>-pvc** where **<VolumeSnapshotContent\_name>** is the **VolumeSnapshotContent** created by Data Mover per PVC.

#### 4.8.4.2. Deleting cluster resources

OADP 1.1 Data Mover might leave cluster resources whether or not it successfully backs up your container storage interface (CSI) volume snapshots to a remote object store.

##### 4.8.4.2.1. Deleting cluster resources following a successful backup and restore that used Data Mover

You can delete any **VolumeSnapshotBackup** or **VolumeSnapshotRestore** CRs that remain in your application namespace after a successful backup and restore where you used Data Mover.

##### Procedure

1. Delete cluster resources that remain on the application namespace, the namespace with the application PVCs to backup and restore, after a backup where you use Data Mover:

```
$ oc delete vsb -n <app_namespace> --all
```

2. Delete cluster resources that remain after a restore where you use Data Mover:

```
$ oc delete vsr -n <app_namespace> --all
```

3. If needed, delete any **VolumeSnapshotContent** resources that remain after a backup and restore where you use Data Mover:

```
$ oc delete volumesnapshotcontent --all
```

##### 4.8.4.2.2. Deleting cluster resources following a partially successful or a failed backup and restore that used Data Mover

If your backup and restore operation that uses Data Mover either fails or only partially succeeds, you must clean up any **VolumeSnapshotBackup** (VSB) or **VolumeSnapshotRestore** custom resource definitions (CRDs) that exist in the application namespace, and clean up any extra resources created by these controllers.

##### Procedure

1. Clean up cluster resources that remain after a backup operation where you used Data Mover by entering the following commands:
  - a. Delete VSB CRDs on the application namespace, the namespace with the application PVCs to backup and restore:

```
$ oc delete vsb -n <app_namespace> --all
```

- b. Delete **VolumeSnapshot** CRs:

```
$ oc delete volumesnapshot -A --all
```



- c. Delete **VolumeSnapshotContent** CRs:

```
$ oc delete volumesnapshotcontent --all
```

- d. Delete any PVCs on the protected namespace, the namespace the Operator is installed on.

```
$ oc delete pvc -n <protected_namespace> --all
```

- e. Delete any **ReplicationSource** resources on the namespace.

```
$ oc delete replicationsource -n <protected_namespace> --all
```

2. Clean up cluster resources that remain after a restore operation using Data Mover by entering the following commands:

- a. Delete VSR CRDs:

```
$ oc delete vsr -n <app-ns> --all
```

- b. Delete **VolumeSnapshot** CRs:

```
$ oc delete volumesnapshot -A --all
```

- c. Delete **VolumeSnapshotContent** CRs:

```
$ oc delete volumesnapshotcontent --all
```

- d. Delete any **ReplicationDestination** resources on the namespace.

```
$ oc delete replicationdestination -n <protected_namespace> --all
```

## 4.9. TROUBLESHOOTING

You can 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.

You can check [installation issues](#), [backup and restore CR issues](#), and [Restic issues](#).

You can collect logs and CR information by using the [must-gather tool](#).

You can obtain the Velero CLI tool by:

- Downloading the Velero CLI tool
- Accessing the Velero binary in the Velero deployment in the cluster

### 4.9.1. 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 **kubectrl** 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.

### 4.9.1.1. OADP-Velero-OpenShift Container Platform version relationship

OADP version	Velero version	OpenShift Container Platform version
1.1.0	<a href="#">1.9</a>	4.9 and later
1.1.1	<a href="#">1.9</a>	4.9 and later
1.1.2	<a href="#">1.9</a>	4.9 and later
1.1.3	<a href="#">1.9</a>	4.9 and later
1.1.4	<a href="#">1.9</a>	4.9 and later
1.1.5	<a href="#">1.9</a>	4.9 and later
1.1.6	<a href="#">1.9</a>	4.11 and later
1.1.7	<a href="#">1.9</a>	4.11 and later
1.2.0	<a href="#">1.11</a>	4.11 and later
1.2.1	<a href="#">1.11</a>	4.11 and later
1.2.2	<a href="#">1.11</a>	4.11 and later
1.2.3	<a href="#">1.11</a>	4.11 and later

### 4.9.2. 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'
```

### 4.9.3. 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 **debug** for most logs.

#### 4.9.4. 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
```

##### 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
```

### 4.9.5. 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.

#### Additional resources

- [CPU and memory requirements](#)

#### 4.9.5.1. 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.

#### 4.9.5.2. 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.

## IMPORTANT

The values for the resource request fields must follow the same format as Kubernetes resource requirements. Also, if you do not specify **configuration.velero.podConfig.resourceAllocations** or **configuration.restic.podConfig.resourceAllocations**, the default **resources** specification for a Velero pod or a Restic pod is as follows:

```
requests:
  cpu: 500m
  memory: 128Mi
```

### 4.9.6. 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.

#### 4.9.6.1. Restoring workarounds for Velero backups that use admission webhooks

This section describes the additional steps required to restore resources for several types of Velero backups that use admission webhooks.

##### 4.9.6.1.1. 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.knative.dev Service** resource:

```
$ velero restore <restore_name> \
  --from-backup=<backup_name> --include-resources \
  service.serving.knative.dev
```

#### 4.9.6.1.2. Restoring IBM AppConnect resources

If you experience issues when you use Velero to 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.

#### Additional resources

- [Admission plugins](#)
- [Webhook admission plugins](#)
- [Types of webhook admission plugins](#)

### 4.9.7. Installation issues

You might encounter issues caused by using invalid directories or incorrect credentials when you install the Data Protection Application.

#### 4.9.7.1. Backup storage contains invalid directories

The **Velero** pod log displays the 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.

#### 4.9.7.2. Incorrect AWS credentials

The **oadp-aws-registry** pod log displays the error message, **InvalidAccessKeyId: The AWS Access Key Id you provided does not exist in our records**.

The **Velero** pod log displays the 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] ❶
aws_access_key_id=AKIAIOSFODNN7EXAMPLE ❷
aws_secret_access_key=wJalrXUtnFEMI/K7MDENG/bPxRfiCYEXAMPLEKEY
```

- ❶ AWS default profile.
- ❷ Do not enclose the values with quotation marks (" , ').

## 4.9.8. OADP timeouts

Extending a timeout allows complex or resource-intensive processes to complete successfully without premature termination. This configuration can reduce the likelihood of 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. Carefully consider and monitor an appropriate timeout value that meets the needs of the process and the overall system performance.

The following are various OADP timeouts, with instructions of how and when to implement these parameters:

### 4.9.8.1. Restic timeout

**timeout** defines the Restic timeout. The default value is **1h**.

Use the Restic **timeout** 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.restic.timeout** block of the **DataProtectionApplication** CR manifest, as in the following example:

```
apiVersion: oadp.openshift.io/v1alpha1
kind: DataProtectionApplication
metadata:
  name: <dpa_name>
```



```
spec:
  configuration:
    restic:
      timeout: 1h
# ...
```

#### 4.9.8.2. 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
# ...
```

#### 4.9.8.3. 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
# ...
```

#### 4.9.8.4. 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
# ...
```

#### 4.9.8.5. 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
# ...
```

### 4.9.8.6. 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
# ...
```

#### 4.9.8.7. 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
# ...
```

#### 4.9.9. Backup and Restore CR issues

You might encounter these common issues with **Backup** and **Restore** custom resources (CRs).

##### 4.9.9.1. Backup CR cannot retrieve volume

The **Backup** CR displays the 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.

##### 4.9.9.2. 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:

```
$ oc -n {namespace} exec deployment/velero -c velero -- ./velero \
  backup describe <backup>
```

2. Delete the **Backup** CR:

```
$ oc delete backup <backup> -n openshift-adp
```

You do not need to clean up the backup location because a **Backup** CR in progress has not uploaded files to object storage.

3. Create a new **Backup** CR.

### 4.9.9.3. Backup CR status remains in PartiallyFailed

The status of a **Backup** CR without Restic in use remains in the **PartiallyFailed** phase and does not complete. A snapshot of the affiliated PVC is not created.

## Cause

If the backup is created based on the CSI snapshot class, but the label is missing, CSI snapshot plugin fails to create a snapshot. As a result, the **Velero** pod logs an error similar to the following:

```
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:

```
$ oc delete backup <backup> -n openshift-adp
```

2. If required, clean up the stored data on the **BackupStorageLocation** to free up space.
3. Apply label **velero.io/csi-volumesnapshot-class=true** to the **VolumeSnapshotClass** object:

```
$ oc label volumesnapshotclass/<snapclass_name> velero.io/csi-volumesnapshot-class=true
```

4. Create a new **Backup** CR.

### 4.9.10. Restic issues

You might encounter these issues when you back up applications with Restic.

#### 4.9.10.1. Restic permission error for NFS data volumes with root\_squash enabled

The **Restic** pod log displays the 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.restrict.supplementalGroups** parameter and the group ID to the **DataProtectionApplication** manifest, as in the following example:

```
spec:
  configuration:
    restrict:
      enable: true
      supplementalGroups:
        - <group_id> 1
```

- 1 Specify the supplemental group ID.

4. Wait for the **Restic** pods to restart so that the changes are applied.

#### 4.9.10.2. 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.\nls 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_reestic_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
```

#### 4.9.10.3. 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": 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/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
```

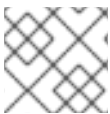
### Example DPA CR

```
# ...
configuration:
  restic:
    enable: true
  velero:
    args:
      restore-resource-priorities:
        'securitycontextconstraints,customresourcedefinitions,namespaces,storageclasses,volumesnap:
        hotclass.snapshot.storage.k8s.io,volumesnapshotcontents.snapshot.storage.k8s.io,volumesnap
        hots.snapshot.storage.k8s.io,datauploads.velero.io,persistentvolumes,persistentvolumeclaims,s
        rvicaccounts,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](#)

### 4.9.11. 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.

## 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.

## 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:

```
$ oc adm must-gather --image=registry.redhat.io/oadp/oadp-mustgather-rhel8:v1.1
```

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](#).

```
$ oc adm must-gather --image=registry.redhat.io/oadp/oadp-mustgather-rhel8:v1.1 \
-- /usr/bin/gather_metrics_dump
```

This operation can take a long time. The data is saved as **must-gather/metrics/prom\_data.tar.gz**.

## 4.9.12. OADP Monitoring

The OpenShift Container Platform provides a monitoring stack that allows users and administrators to effectively monitor and manage their clusters, as well as monitor and analyze the workload performance of user applications and services running on the clusters, including receiving alerts if an event occurs.

### Additional resources

- [Monitoring stack](#)

### 4.9.12.1. 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
```

#### 4.9.12.2. 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

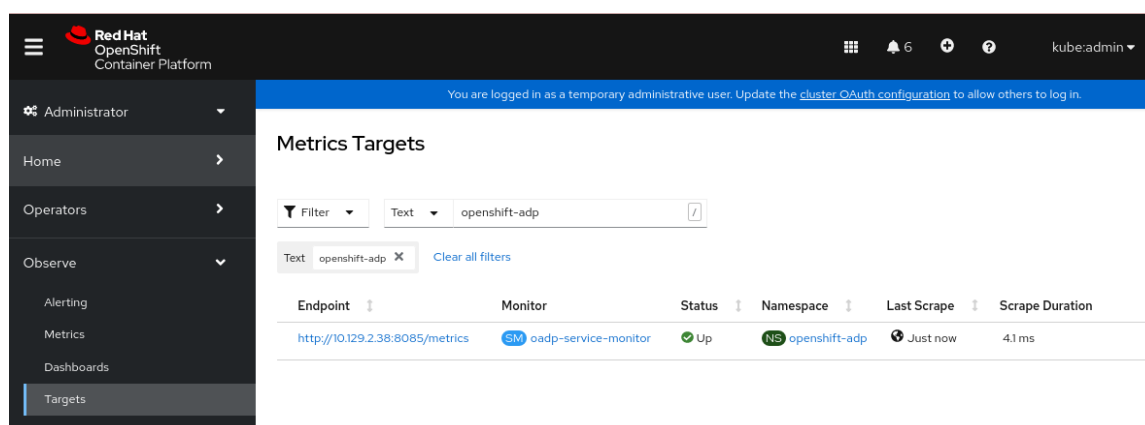
```
servicemonitor.monitoring.coreos.com/oadp-service-monitor created
```

■

## 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 4.1. OADP metrics targets



### 4.9.12.3. 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
```

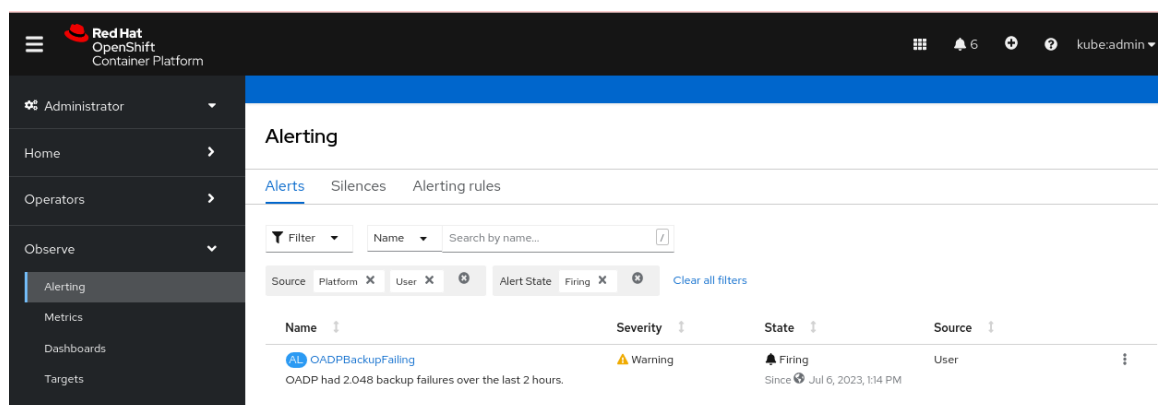
### Example output

```
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 4.2. OADP backup failing alert



### Additional resources

- [Managing alerts](#)

#### 4.9.12.4. List of available metrics

These are the list of metrics provided by the OADP together with their [Types](#).

Metric name	Description	Type
<b>kopia_content_cache_hit_bytes</b>	Number of bytes retrieved from the cache	Counter
<b>kopia_content_cache_hit_count</b>	Number of times content was retrieved from the cache	Counter
<b>kopia_content_cache_malformed</b>	Number of times malformed content was read from the cache	Counter
<b>kopia_content_cache_miss_count</b>	Number of times content was not found in the cache and fetched	Counter
<b>kopia_content_cache_missed_bytes</b>	Number of bytes retrieved from the underlying storage	Counter
<b>kopia_content_cache_miss_error_count</b>	Number of times content could not be found in the underlying storage	Counter
<b>kopia_content_cache_store_error_count</b>	Number of times content could not be saved in the cache	Counter
<b>kopia_content_get_bytes</b>	Number of bytes retrieved using <b>GetContent()</b>	Counter
<b>kopia_content_get_count</b>	Number of times <b>GetContent()</b> was called	Counter
<b>kopia_content_get_error_count</b>	Number of times <b>GetContent()</b> was called and the result was an error	Counter
<b>kopia_content_get_not_found_count</b>	Number of times <b>GetContent()</b> was called and the result was not found	Counter
<b>kopia_content_write_bytes</b>	Number of bytes passed to <b>WriteContent()</b>	Counter
<b>kopia_content_write_count</b>	Number of times <b>WriteContent()</b> was called	Counter
<b>velero_backup_attempt_total</b>	Total number of attempted backups	Counter
<b>velero_backup_deletion_attempt_total</b>	Total number of attempted backup deletions	Counter

Metric name	Description	Type
<b>velero_backup_deletion_failure_total</b>	Total number of failed backup deletions	Counter
<b>velero_backup_deletion_success_total</b>	Total number of successful backup deletions	Counter
<b>velero_backup_duration_seconds</b>	Time taken to complete backup, in seconds	Histogram
<b>velero_backup_failure_total</b>	Total number of failed backups	Counter
<b>velero_backup_items_errors</b>	Total number of errors encountered during backup	Gauge
<b>velero_backup_items_total</b>	Total number of items backed up	Gauge
<b>velero_backup_last_status</b>	Last status of the backup. A value of 1 is success, 0.	Gauge
<b>velero_backup_last_successful_timestamp</b>	Last time a backup ran successfully, Unix timestamp in seconds	Gauge
<b>velero_backup_partial_failure_total</b>	Total number of partially failed backups	Counter
<b>velero_backup_success_total</b>	Total number of successful backups	Counter
<b>velero_backup_tarball_size_bytes</b>	Size, in bytes, of a backup	Gauge
<b>velero_backup_total</b>	Current number of existent backups	Gauge
<b>velero_backup_validation_failure_total</b>	Total number of validation failed backups	Counter
<b>velero_backup_warning_total</b>	Total number of warned backups	Counter
<b>velero_csi_snapshot_attempt_total</b>	Total number of CSI attempted volume snapshots	Counter
<b>velero_csi_snapshot_failure_total</b>	Total number of CSI failed volume snapshots	Counter

Metric name	Description	Type
<b>velero_csi_snapshot_successes_total</b>	Total number of CSI successful volume snapshots	Counter
<b>velero_restore_attempt_total</b>	Total number of attempted restores	Counter
<b>velero_restore_failed_total</b>	Total number of failed restores	Counter
<b>velero_restore_partial_failure_total</b>	Total number of partially failed restores	Counter
<b>velero_restore_success_total</b>	Total number of successful restores	Counter
<b>velero_restore_total</b>	Current number of existent restores	Gauge
<b>velero_restore_validation_failed_total</b>	Total number of failed restores failing validations	Counter
<b>velero_volume_snapshot_attempt_total</b>	Total number of attempted volume snapshots	Counter
<b>velero_volume_snapshot_failure_total</b>	Total number of failed volume snapshots	Counter
<b>velero_volume_snapshot_success_total</b>	Total number of successful volume snapshots	Counter

#### 4.9.12.5. Viewing metrics using the Observe UI

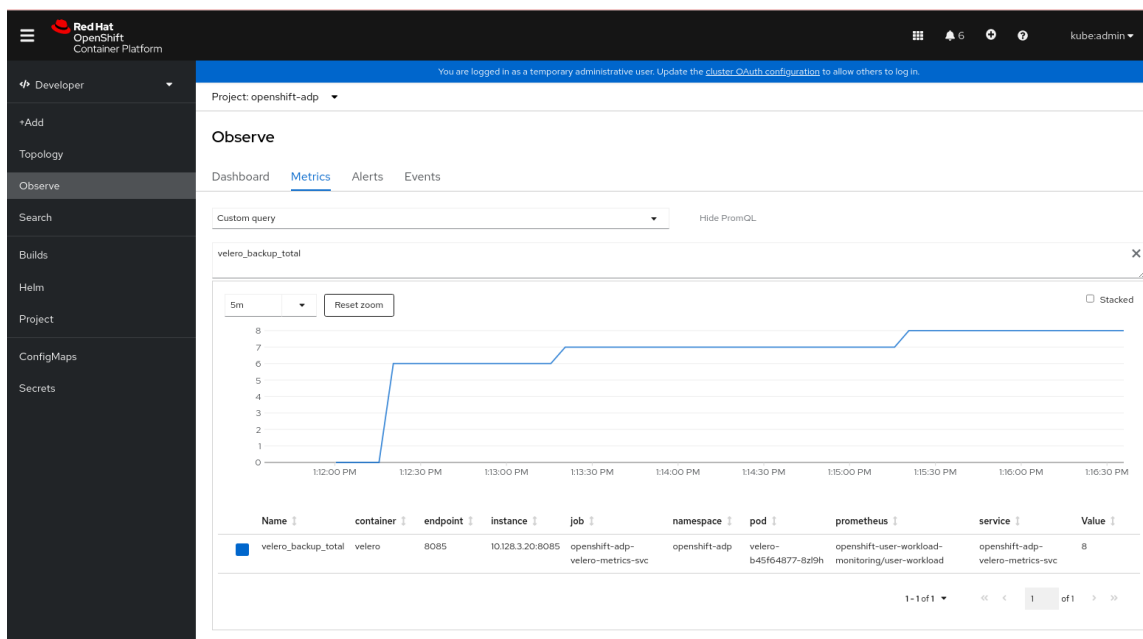
You can view metrics in the OpenShift Container Platform web console from the **Administrator** or **Developer** perspective, which must have access to the **openshift-adp** project.

##### 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 4.3. OADP metrics query



## 4.10. APIS USED WITH OADP

The document provides information about the following APIs that you can use with OADP:

- Velero API
- OADP API

### 4.10.1. Velero API

Velero API documentation is maintained by Velero, not by Red Hat. It can be found at [Velero API types](#).

### 4.10.2. OADP API

The following tables provide the structure of the OADP API:

Table 4.2. DataProtectionApplicationSpec

Property	Type	Description
<b>backupLocations</b>	<code>[] BackupLocation</code>	Defines the list of configurations to use for <b>BackupStorageLocations</b> .
<b>snapshotLocations</b>	<code>[] SnapshotLocation</code>	Defines the list of configurations to use for <b>VolumeSnapshotLocations</b> .

Property	Type	Description
<b>unsupportedOverrides</b>	map [ <a href="#">UnsupportedImageKey</a> ] <a href="#">string</a>	Can be used to override the deployed dependent images for development. Options are <b>veleroImageFqin</b> , <b>awsPluginImageFqin</b> , <b>openshiftPluginImageFqin</b> , <b>azurePluginImageFqin</b> , <b>gcpPluginImageFqin</b> , <b>csiPluginImageFqin</b> , <b>dataMoverImageFqin</b> , <b>resticRestoreImageFqin</b> , <b>kubevirtPluginImageFqin</b> , and <b>operator-type</b> .
<b>podAnnotations</b>	map [ <a href="#">string</a> ] <a href="#">string</a>	Used to add annotations to pods deployed by Operators.
<b>podDnsPolicy</b>	<a href="#">DNSPolicy</a>	Defines the configuration of the DNS of a pod.
<b>podDnsConfig</b>	<a href="#">PodDNSConfig</a>	Defines the DNS parameters of a pod in addition to those generated from <b>DNSPolicy</b> .
<b>backupImages</b>	* <a href="#">bool</a>	Used to specify whether or not you want to deploy a registry for enabling backup and restore of images.
<b>configuration</b>	* <a href="#">ApplicationConfig</a>	Used to define the data protection application's server configuration.
<b>features</b>	* <a href="#">Features</a>	Defines the configuration for the DPA to enable the Technology Preview features.

[Complete schema definitions for the OADP API](#).

Table 4.3. BackupLocation

Property	Type	Description
<b>velero</b>	* <a href="#">velero.BackupStorageLocationSpec</a>	Location to store volume snapshots, as described in <a href="#">Backup Storage Location</a> .

Property	Type	Description
<b>bucket</b>	* <a href="#">CloudStorageLocation</a>	[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 4.4. SnapshotLocation

Property	Type	Description
<b>velero</b>	* <a href="#">VolumeSnapshotLocationSpec</a>	Location to store volume snapshots, as described in <a href="#">Volume Snapshot Location</a> .

Complete schema definitions for the type [SnapshotLocation](#).

Table 4.5. ApplicationConfig

Property	Type	Description
<b>velero</b>	* <a href="#">VeleroConfig</a>	Defines the configuration for the Velero server.
<b>restic</b>	* <a href="#">ResticConfig</a>	Defines the configuration for the Restic server.

Complete schema definitions for the type [ApplicationConfig](#).

Table 4.6. VeleroConfig

Property	Type	Description
<b>featureFlags</b>	[] <a href="#">string</a>	Defines the list of features to enable for the Velero instance.

Property	Type	Description
<b>defaultPlugins</b>	[] <a href="#">string</a>	The following types of default Velero plugins can be installed: <b>aws</b> , <b>azure</b> , <b>csi</b> , <b>gcp</b> , <b>kubevirt</b> , and <b>openshift</b> .
<b>customPlugins</b>	[] <a href="#">CustomPlugin</a>	Used for installation of custom Velero plugins.  Default and custom plugins are described in <a href="#">OADP plugins</a>
<b>restoreResourcesVersionPriority</b>	<a href="#">string</a>	Represents a config map that is created if defined for use in conjunction with the <b>EnableAPIGroupVersions</b> feature flag. Defining this field automatically adds <b>EnableAPIGroupVersions</b> to the Velero server feature flag.
<b>noDefaultBackupLocation</b>	<a href="#">bool</a>	To install Velero without a default backup storage location, you must set the <b>noDefaultBackupLocation</b> flag in order to confirm installation.
<b>podConfig</b>	* <a href="#">PodConfig</a>	Defines the configuration of the <b>Velero</b> pod.
<b>logLevel</b>	<a href="#">string</a>	Velero server's log level (use <b>debug</b> for the most granular logging, leave unset for Velero default). Valid options are <b>trace</b> , <b>debug</b> , <b>info</b> , <b>warning</b> , <b>error</b> , <b>fatal</b> , and <b>panic</b> .

Complete schema definitions for the type [VeleroConfig](#).

Table 4.7. CustomPlugin

Property	Type	Description
<b>name</b>	<a href="#">string</a>	Name of custom plugin.
<b>image</b>	<a href="#">string</a>	Image of custom plugin.

Complete schema definitions for the type [CustomPlugin](#).

Table 4.8. ResticConfig

Property	Type	Description
<b>enable</b>	* <a href="#">bool</a>	If set to <b>true</b> , enables backup and restore using Restic. If set to <b>false</b> , snapshots are needed.
<b>supplementalGroups</b>	<a href="#">[]int64</a>	Defines the Linux groups to be applied to the <b>Restic</b> pod.
<b>timeout</b>	<a href="#">string</a>	A user-supplied duration string that defines the Restic timeout. Default value is <b>1hr</b> (1 hour). A duration string is a possibly signed sequence of decimal numbers, each with optional fraction and a unit suffix, such as <b>300ms</b> , <b>-1.5h</b> or <b>2h45m</b> . Valid time units are <b>ns</b> , <b>us</b> (or <b>µs</b> ), <b>ms</b> , <b>s</b> , <b>m</b> , and <b>h</b> .
<b>podConfig</b>	* <a href="#">PodConfig</a>	Defines the configuration of the <b>Restic</b> pod.

Complete schema definitions for the type [ResticConfig](#).

Table 4.9. PodConfig

Property	Type	Description
<b>nodeSelector</b>	map [ <a href="#">string</a> ] <a href="#">string</a>	Defines the <b>nodeSelector</b> to be supplied to a <b>Velero podSpec</b> or a <b>Restic podSpec</b> .
<b>tolerations</b>	<a href="#">[]Toleration</a>	Defines the list of tolerations to be applied to a Velero deployment or a Restic <b>daemonset</b> .
<b>resourceAllocations</b>	<a href="#">ResourceRequirements</a>	Set specific resource <b>limits</b> and <b>requests</b> for a <b>Velero</b> pod or a <b>Restic</b> pod as described in <a href="#">Setting Velero CPU and memory resource allocations</a> .
<b>labels</b>	map [ <a href="#">string</a> ] <a href="#">string</a>	Labels to add to pods.

Complete schema definitions for the type [PodConfig](#).

Table 4.10. Features

Property	Type	Description
<b>dataMover</b>	* <a href="#">DataMover</a>	Defines the configuration of the Data Mover.

[Complete schema definitions for the type \*\*Features\*\*.](#)

Table 4.11. DataMover

Property	Type	Description
<b>enable</b>	<a href="#">bool</a>	If set to <b>true</b> , deploys the volume snapshot mover controller and a modified CSI Data Mover plugin. If set to <b>false</b> , these are not deployed.
<b>credentialName</b>	<a href="#">string</a>	User-supplied Restic <b>Secret</b> name for Data Mover.
<b>timeout</b>	<a href="#">string</a>	A user-supplied duration string for <b>VolumeSnapshotBackup</b> and <b>VolumeSnapshotRestore</b> to complete. Default is <b>10m</b> (10 minutes). A duration string is a possibly signed sequence of decimal numbers, each with optional fraction and a unit suffix, such as <b>300ms</b> , <b>-1.5h</b> or <b>2h45m</b> . Valid time units are <b>ns</b> , <b>us</b> (or <b>µs</b> ), <b>ms</b> , <b>s</b> , <b>m</b> , and <b>h</b> .

The OADP API is more fully detailed in [OADP Operator](#).

## 4.11. ADVANCED OADP FEATURES AND FUNCTIONALITIES

This document provides information about advanced features and functionalities of OpenShift API for Data Protection (OADP).

### 4.11.1. Working with different Kubernetes API versions on the same cluster

#### 4.11.1.1. 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
```

### 4.11.1.2. 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:

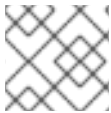
1. Preferred version of the *destination* cluster
2. Preferred version of the *source\_* cluster
3. Common non-preferred supported version with the highest Kubernetes version priority

## Additional resources

- [Enable API Group Versions Feature](#)

### 4.11.1.3. 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](#)

**4.11.2. Backing up data from one cluster and restoring it to another cluster****4.11.2.1. 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

**4.11.2.1.1. Operators**

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

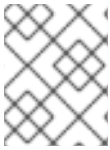
**4.11.2.1.2. Use of Velero**

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 filesystem 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**.

**NOTE**

Velero's file system backup feature supports both Kopia and Restic, but currently OADP supports only Restic.

- 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.

**4.11.2.1.3. UID and GID ranges**

When you back up data from one cluster and restore it to another cluster, there are potential issues that might arise with UID (User ID) and GID (Group ID) ranges. The following section explains these potential issues and mitigations:

**Summary of issues**

The UID and GID ranges of the namespace might change on the destination cluster. OADP does not back up and restore OpenShift UID range metadata. If the backed application requires a specific UID, ensure the range is available when restored. For more information about OpenShift's UID and GID ranges, see [A Guide to OpenShift and UIDs](#).

**Detailed description of 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 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 one of the following is true:

- There is a pre-existing namespace with different SCC annotations, for example, on a different cluster. In this case, at backup time, OADP reuses the pre-existing namespace instead of the namespace you are trying to restore.

- The backup used a label selector, but the namespace where workloads run on does not have the label on it. In this case, OADP does not back up the namespace, but instead creates a new namespace during restore that does not include the annotations of the namespace you backed up. This causes a new UID range to be assigned to the namespace.  
This might be an issue for customer workloads if OpenShift Container Platform assigns a pod a **securityContext** UID based on namespace annotations that have changed from the time the persistent volume data was backed up.
- The container UID no longer matches the UID of the file owner.
- An error occurs because OpenShift Container Platform did not modify the UID range of the destination cluster to match the data of the backup cluster. As a result, the backup cluster has a different UID than the destination cluster, which means the application cannot read or write data to 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 performing steps 1-4 of [Fixing UID ranges 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](#).

### 4.11.2.2. 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

- 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**.

### 4.11.3. Additional resources

For more information about API group versions, see [Working with different Kubernetes API versions on the same cluster](#).

For more information about OADP Data Mover, see [Using Data Mover for CSI snapshots](#).

For more information about using Restic with OADP, see [Backing up applications with Restic](#).

## CHAPTER 5. CONTROL PLANE BACKUP AND RESTORE

### 5.1. 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 after you upgrade your cluster. This 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.y.z cluster must use an etcd backup that was taken from 4.y.z.



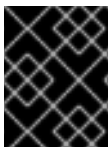
#### IMPORTANT

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](#).

#### 5.1.1. 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, be sure that you have exported the **NO\_PROXY**, **HTTP\_PROXY**, and **HTTPS\_PROXY** environment variables.
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\_kuberresources\_<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.

**5.1.2. Additional resources**

- [Backing up and restoring etcd on a hosted cluster](#)

**5.1.3. 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](#).

**5.1.3.1. Enabling automated etcd backups**

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

```

#### 5.1.3.2. 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**).
- You have a PVC to save backup data to.

##### Procedure

1. 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 <.>

```

<.> The name of the persistent volume claim (PVC) to save the backup to. Adjust this value according to your environment.

2. Apply the CR to start a single backup:

```
$ oc apply -f etcd-single-backup.yaml
```

### 5.1.3.3. 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 <.>
  storageClassName: standard-csi <.>
  volumeMode: Filesystem
```

<.> The amount of storage available to the PVC. Adjust this value for your requirements. <.>  
The name of the **StorageClass** required by the claim. Adjust this value according to your environment.



**NOTE**

Each of the following providers require changes to the **accessModes** and **storageClassName** keys:

Provider	<b>accessModes</b> value	<b>storageClassName</b> value
AWS with the <b>versioned-installer-efc_operator-ci</b> profile	<b>- ReadWriteMany</b>	<b>efs-sc</b>
Google Cloud Platform	<b>- ReadWriteMany</b>	<b>filestore-csi</b>
Microsoft Azure	<b>- ReadWriteMany</b>	<b>azurefile-csi</b>

- 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  Pending                standard-csi  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: WaitForFirstConsumer
```

- 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 content such as the following example:

```
apiVersion: v1
kind: PersistentVolume
metadata:
  name: etcd-backup-pv-fs
spec:
  capacity:
    storage: 100Gi <.>
  volumeMode: Filesystem
  accessModes:
    - ReadWriteMany
  persistentVolumeReclaimPolicy: Delete
  storageClassName: local-storage
  local:
    path: /mnt/
  nodeAffinity:
    required:
      nodeSelectorTerms:
        - matchExpressions:
            - key: kubernetes.io/hostname
              operator: In
              values:
                - <example-master-node> <.>
```

<.> The amount of storage available to the PV. Adjust this value for your requirements. <.> Replace this value with the 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	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 <.>
  storageClassName: local-storage
```

<.> 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 * * *" <.>
    timeZone: "UTC"
    pvcName: etcd-backup-pvc
```

<.> 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 <.>
      retentionNumber:
        maxNumberOfBackups: 5 <.>
```

<.> The retention type. Defaults to **RetentionNumber** if unspecified. <.> 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 <.>
```

<.> 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
```

## 5.2. 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.

### 5.2.1. Prerequisites

- Take an [etcd backup](#) prior to replacing an unhealthy etcd member.

### 5.2.2. 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.

### 5.2.3. 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 v1.27.3 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	v1.27.3
ip-10-0-164-97.ec2.internal	Ready	master	6h13m	v1.27.3
ip-10-0-154-204.ec2.internal	Ready	master	6h13m	v1.27.3

- 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

NAME	READY	STATUS	RESTARTS	AGE
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.

## 5.2.4. 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](#)
- [Replacing an unhealthy etcd member whose etcd pod is crashlooping](#)
- [Replacing an unhealthy stopped baremetal etcd member](#)

### 5.2.4.1. 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 the other control plane nodes are powered off. 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

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. 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.



### 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.

- 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
```

4. Delete and recreate the control plane machine. After this machine is recreated, 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 master 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 \
  -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.

It is recommended to 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 NODE	PHASE PROVIDERID	TYPE	REGION STATE	ZONE	AGE
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-lrdb 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 using the **new-master-machine.yaml** file:

```
$ oc apply -f new-master-machine.yaml
```

- g. Verify that the new machine has been created:

```
$ oc get machines -n openshift-machine-api -o wide
```

### Example output

NAME NODE	PHASE PROVIDERID	TYPE	REGION STATE	ZONE	AGE
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			
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-lrdb	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 will automatically sync when the machine or node returns to a healthy state.

5. Turn the quorum guard back on by entering the following command:

```
$ oc patch etcd/cluster --type=merge -p '{"spec": {"unsupportedConfigOverrides": null}}'
```

6. You can verify that the **unsupportedConfigOverrides** section is removed from the object by entering this command:

```
$ oc get etcd/cluster -oyaml
```

- 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 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
```

- The **forceRedeploymentReason** value must be unique, which is why a timestamp is appended.

- Verify that 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-ip-10-0-154-204.ec2.internal
```

- 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

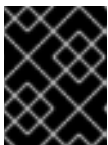
- [Recovering a degraded etcd Operator](#)

### 5.2.4.2. 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
```

#### 5.2.4.3. 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 |                      |                            |
+-----+-----+-----+-----+-----+
+-----+
| 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 |
+-----+-----+-----+-----+-----+
+-----+
```

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. Delete the control plane machine.

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.

- 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	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**.

- b. Save the machine configuration to a file on your file system:

```
$ oc get machine examplecluster-control-plane-2 \ 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: ""
      type: InternalIP
    - address: fe80::4adf:37ff:feb0:8aa1%ens1f1.373
      type: InternalDNS
    - address: fe80::4adf:37ff:feb0:8aa1%ens1f1.371
      type: Hostname
  lastUpdated: "2020-04-20T17:44:29Z"
  nodeRef:
    kind: Machine
    name: fe80::4adf:37ff:feb0:8aa1%ens1f1.372
    uid: acca4411-af0d-4387-b73e-52b2484295ad
  phase: Running
  providerStatus:
    apiVersion: machine.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: Machine

```

5. Change the **metadata.name** field to a new name.

It is recommended to keep the same base name as the old machine and change the ending number to the next available number. In this example, **examplecluster-control-plane-2** is changed to **examplecluster-control-plane-3**.

For example:

```

apiVersion: machine.openshift.io/v1beta1
kind: Machine
metadata:
...
name: examplecluster-control-plane-3
...

```

- a. Remove the **spec.providerID** field:

```

providerID: baremetalhost:///openshift-machine-api/openshift-control-plane-2/3354bdac-
61d8-410f-be5b-6a395b056135

```

- b. Remove the **metadata.annotations** and **metadata.generation** fields:

```

annotations:
  machine.openshift.io/instance-state: externally provisioned
...
generation: 2

```

- c. Remove the **spec.conditions**, **spec.lastUpdated**, **spec.nodeRef** and **spec.phase** fields:

```

lastTransitionTime: "2022-08-03T08:40:36Z"
message: 'Drain operation currently blocked by: [{Name:EtcdQuorumOperator
Owner:clusteroperator/etcd}]'
reason: HookPresent
severity: Warning
status: "False"

type: Drainable
lastTransitionTime: "2022-08-03T08:39:55Z"
status: "True"
type: InstanceExists

lastTransitionTime: "2022-08-03T08:36:37Z"
status: "True"
type: Terminable

```



```
lastUpdated: "2022-08-03T08:40:36Z"
nodeRef:
kind: Node
name: openshift-control-plane-2
uid: 788df282-6507-4ea2-9a43-24f237ccbc3c
phase: Running
```

6. 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  4.14.0   True       False        False     3d15h
```

7. Remove the old **BareMetalHost** object by running the following command:

```
$ oc delete bmh openshift-control-plane-2 -n openshift-machine-api
```

#### Example output

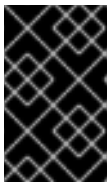
```
baremetalhost.metal3.io "openshift-control-plane-2" deleted
```

8. 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. 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
```

9. 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
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					

10. 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	v1.27.3
openshift-control-plane-1	Ready	master	3h24m	v1.27.3
openshift-compute-0	Ready	worker	176m	v1.27.3
openshift-compute-1	Ready	worker	176m	v1.27.3

11. 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.

12. 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. Create the new control plane machine using the **new-master-machine.yaml** file:

```
$ oc apply -f new-master-machine.yaml
```

- b. Verify that the new machine has been created:

```
$ oc get machines -n openshift-machine-api -o wide
```

## Example output

```
■
```

NAME	PHASE	TYPE	REGION	ZONE	AGE	NODE 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 <b>1</b>						
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.

- c. 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

- d. 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	v1.27.3

```

openshift-control-plane-1 Ready master 4h26m v1.27.3
openshift-control-plane-2 Ready master 12m v1.27.3
openshift-compute-0 Ready worker 3h58m v1.27.3
openshift-compute-1 Ready worker 3h58m v1.27.3

```

13. Turn the quorum guard back on by entering the following command:

```
$ oc patch etcd/cluster --type=merge -p '{"spec": {"unsupportedConfigOverrides": null}}'
```

14. You can verify that the **unsupportedConfigOverrides** section is removed from the object by entering this command:

```
$ oc get etcd/cluster -oyaml
```

15. 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
```

## 5.2.5. Additional resources

- [Quorum protection with machine lifecycle hooks](#)

## 5.3. DISASTER RECOVERY

### 5.3.1. 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.

#### 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. This also includes situations where you have lost the majority of your control plane hosts, leading to etcd quorum loss and the cluster going offline. As long as you have taken an etcd backup, you can follow this procedure to restore your cluster to a previous state.

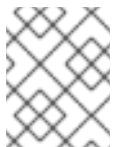
If applicable, you might also need to [recover from expired control plane certificates](#).



#### WARNING

Restoring to a previous cluster state is a destructive and destabilizing 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.



#### NOTE

If you have a majority of your masters still available and have an etcd quorum, then follow the procedure to [replace a single unhealthy etcd member](#).

#### 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.

### 5.3.2. Restoring to a previous cluster state

To restore the cluster to a previous state, you must have previously [backed up etcd data](#) by creating a snapshot. You will use this snapshot to restore the cluster state.

#### 5.3.2.1. 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 destabilizing 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, SDN controllers, and persistent volume controllers.

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, reimagine machines, and rewrite CA bundles with expired certificates.

#### 5.3.2.2. 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.



### NOTE

If your cluster uses a control plane machine set, see "Troubleshooting the control plane machine set" for a more simple etcd recovery procedure.



### IMPORTANT

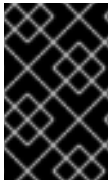
When you restore your cluster, you must use an etcd backup that was taken from the same z-stream release. For example, an OpenShift Container Platform 4.7.2 cluster must use an etcd backup that was taken from 4.7.2.

#### Prerequisites

- Access to the cluster as a user with the **cluster-admin** role 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.
- 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\_<timestamp>.db** and **static\_kubernetes\_<timestamp>.tar.gz**.

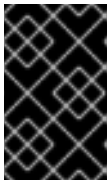


### IMPORTANT

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 will run the restore operation on.
2. Establish SSH connectivity to each of the control plane nodes, including the recovery host. 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 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. 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.
4. Stop the static pods on any other control plane nodes.



### NOTE

You do not need to stop the static pods on the recovery host.

- a. Access a control plane host that is not the recovery host.
- b. Move the existing etcd pod file out of the kubelet manifest directory:

```
$ sudo mv /etc/kubernetes/manifests/etcd-pod.yaml /tmp
```

- c. Verify that the etcd pods are stopped.

```
$ sudo crictl ps | grep etcd | egrep -v "operator|etcd-guard"
```

The output of this command should be empty. If it is not empty, wait a few minutes and check again.

- d. Move the existing Kubernetes API server pod file out of the kubelet manifest directory:

```
$ sudo mv /etc/kubernetes/manifests/kube-apiserver-pod.yaml /tmp
```

- e. Verify that the Kubernetes API server pods are stopped.

```
$ sudo crictl ps | grep kube-apiserver | egrep -v "operator|guard"
```

The output of this command should be empty. If it is not empty, wait a few minutes and check again.

- f. Move the etcd data directory to a different location:

```
$ sudo mv /var/lib/etcd/ /tmp
```

- g. Repeat this step on each of the other control plane hosts that is not the recovery host.

5. Access the recovery control plane host.
6. If the cluster-wide proxy is enabled, be sure that you have exported the **NO\_PROXY**, **HTTP\_PROXY**, and **HTTPS\_PROXY** environment variables.

### TIP

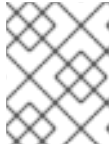
You can check whether the proxy is enabled by reviewing the output of **oc get proxy cluster -o yaml**. The proxy is enabled if the **httpProxy**, **httpsProxy**, and **noProxy** fields have values set.

7. Run the restore script on the recovery control plane host and pass in the path to the etcd backup directory:

```
$ sudo -E /usr/local/bin/cluster-restore.sh /home/core/backup
```

### Example script output

```
...stopping kube-scheduler-pod.yaml
...stopping kube-controller-manager-pod.yaml
...stopping etcd-pod.yaml
...stopping kube-apiserver-pod.yaml
Waiting for container etcd to stop
.complete
Waiting for container etcdctl to stop
.....complete
Waiting for container etcd-metrics to stop
complete
Waiting for container kube-controller-manager to stop
complete
Waiting for container kube-apiserver to stop
.....complete
Waiting for container kube-scheduler to stop
complete
Moving etcd data-dir /var/lib/etcd/member to /var/lib/etcd-backup
starting restore-etcd static pod
starting kube-apiserver-pod.yaml
static-pod-resources/kube-apiserver-pod-7/kube-apiserver-pod.yaml
starting kube-controller-manager-pod.yaml
static-pod-resources/kube-controller-manager-pod-7/kube-controller-manager-pod.yaml
starting kube-scheduler-pod.yaml
static-pod-resources/kube-scheduler-pod-8/kube-scheduler-pod.yaml
```

**NOTE**

The restore process can cause nodes to enter the **NotReady** state if the node certificates were updated after the last etcd backup.

8. Check the nodes to ensure they are in the **Ready** state.

- a. Run the following command:

```
$ oc get nodes -w
```

**Sample output**

NAME	STATUS	ROLES	AGE	VERSION
host-172-25-75-28	Ready	master	3d20h	v1.27.3
host-172-25-75-38	Ready	infra,worker	3d20h	v1.27.3
host-172-25-75-40	Ready	master	3d20h	v1.27.3
host-172-25-75-65	Ready	master	3d20h	v1.27.3
host-172-25-75-74	Ready	infra,worker	3d20h	v1.27.3
host-172-25-75-79	Ready	worker	3d20h	v1.27.3
host-172-25-75-86	Ready	worker	3d20h	v1.27.3
host-172-25-75-98	Ready	infra,worker	3d20h	v1.27.3

It can take several minutes for all nodes to report their state.

- b. If any nodes are in the **NotReady** state, log in to the nodes and remove all of the PEM files from the **/var/lib/kubelet/pki** directory on each node. You can SSH into the nodes or use the terminal window in the web console.

```
$ ssh -i <ssh-key-path> core@<master-hostname>
```

**Sample pki directory**

```
sh-4.4# pwd
/var/lib/kubelet/pki
sh-4.4# ls
kubelet-client-2022-04-28-11-24-09.pem  kubelet-server-2022-04-28-11-24-15.pem
kubelet-client-current.pem             kubelet-server-current.pem
```

9. Restart the kubelet service on all control plane hosts.

- a. From the recovery host, run the following command:

```
$ sudo systemctl restart kubelet.service
```

- b. Repeat this step on all other control plane hosts.

10. Approve the pending CSRs:

**NOTE**

Clusters with no worker nodes, such as single-node clusters or clusters consisting of three schedulable control plane nodes, will not have any pending CSRs to approve. You can skip all the commands listed in this step.

- a. 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 2
csr-4hl85  13m   kubernetes.io/kube-apiserver-client-kubelet
system:serviceaccount:openshift-machine-config-operator:node-bootstrapper Pending
3
csr-zh4hp  3m8s  kubernetes.io/kube-apiserver-client-kubelet
system:serviceaccount:openshift-machine-config-operator:node-bootstrapper Pending
4
...
```

**1** **2** A pending kubelet service CSR (for user-provisioned installations).

**3** **4** A pending **node-bootstrapper** 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 **node-bootstrapper** CSR:

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

- d. For user-provisioned installations, approve each valid kubelet service CSR:

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

11. Verify that the single member control plane has started successfully.

- a. From the recovery host, verify that the etcd container is running.

```
$ sudo crictl ps | grep etcd | egrep -v "operator|etcd-guard"
```

**Example output**

```

3ad41b7908e32
36f86e2eeaafe662df0d21041eb22b8198e0e58abeeae8c743c3e6e977e8009
About a minute ago   Running           etcd               0
7c05f8af362f0

```

- b. From the recovery host, verify that the etcd pod is running.

```
$ oc -n openshift-etcd get pods -l k8s-app=etcd
```

### Example output

```

NAME                                READY STATUS  RESTARTS  AGE
etcd-ip-10-0-143-125.ec2.internal  1/1   Running    1         2m47s

```

If the status is **Pending**, or the output lists more than one running etcd pod, wait a few minutes and check again.

12. If you are using the **OVNKubernetes** network plugin, you must restart **ovnkube-controlplane** pods.

- a. Delete all of the **ovnkube-controlplane** pods by running the following command:

```
$ oc -n openshift-ovn-kubernetes delete pod -l app=ovnkube-control-plane
```

- b. Verify that all of the **ovnkube-controlplane** pods were redeployed by running the following command:

```
$ oc -n openshift-ovn-kubernetes get pod -l app=ovnkube-control-plane
```

13. If you are using the OVN-Kubernetes network plugin, restart the Open Virtual Network (OVN) Kubernetes pods on all the nodes one by one. Use the following steps to restart OVN-Kubernetes pods on each node:

### IMPORTANT

Restart OVN-Kubernetes pods in the following order:

1. The recovery control plane host
2. The other control plane hosts (if available)
3. The other nodes

### NOTE

Validating and mutating admission webhooks can reject pods. If you add any additional webhooks with the **failurePolicy** set to **Fail**, then they can reject pods and the restoration process can fail. You can avoid this by saving and deleting webhooks while restoring the cluster state. After the cluster state is restored successfully, you can enable the webhooks again.

Alternatively, you can temporarily set the **failurePolicy** to **Ignore** while restoring the cluster state. After the cluster state is restored successfully, you can set the **failurePolicy** to **Fail**.

- a. Remove the northbound database (nbdb) and southbound database (sbdb). Access the recovery host and the remaining control plane nodes by using Secure Shell (SSH) and run the following command:

```
$ sudo rm -f /var/lib/ovn-ic/etc/*.db
```

- b. Restart the OpenVSwitch services. Access the node by using Secure Shell (SSH) and run the following command:

```
$ sudo systemctl restart ovs-vswitchd ovssdb-server
```

- c. Delete the **ovnkube-node** pod on the node by running the following command, replacing **<node>** with the name of the node that you are restarting:

```
$ oc -n openshift-ovn-kubernetes delete pod -l app=ovnkube-node --field-selector=spec.nodeName==<node>
```

- d. Verify that the **ovnkube-node** pod is running again with the following command:

```
$ oc -n openshift-ovn-kubernetes get pod -l app=ovnkube-node --field-selector=spec.nodeName==<node>
```



#### NOTE

It might take several minutes for the pods to restart.

14. Delete and re-create other non-recovery, control plane machines, one by one. 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 lost control plane hosts.

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 lost control plane host, **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 lost control plane host.

- 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.

It is recommended to 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**:

```
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
```

- iv. Remove the **metadata.annotations** and **metadata.generation** fields:

```
annotations:
  machine.openshift.io/instance-state: running
  ...
generation: 2
```



- v. Remove the **metadata.resourceVersion** and **metadata.uid** fields:

```
resourceVersion: "13291"
uid: a282eb70-40a2-4e89-8009-d05dd420d31a
```

- d. Delete the machine of the lost control plane host:

```
$ oc delete machine -n openshift-machine-api clustername-8qw5l-master-0 1
```

- 1 Specify the name of the control plane machine for the lost control plane host.

- 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-10-0-143-125.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
```

- f. Create a machine by using the **new-master-machine.yaml** file:

```
$ oc apply -f new-master-machine.yaml
```

- g. Verify that the new machine has been created:

```
$ oc get machines -n openshift-machine-api -o wide
```

Example output:

```
NAME                                PHASE  TYPE      REGION  ZONE    AGE
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 ❶
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

```

- ❶ 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 sync when the machine or node returns to a healthy state.

h. Repeat these steps for each lost control plane host that is not the recovery host.

15. 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.

16. In a separate terminal window within the recovery host, export the recovery **kubeconfig** file by running the following command:

```
$ export KUBECONFIG=/etc/kubernetes/static-pod-resources/kube-apiserver-certs/secrets/node-kubeconfigs/localhost-recovery.kubeconfig
```

17. Force etcd redeployment.

In the same terminal window where you exported the recovery **kubeconfig** file, run the following command:

```
$ oc patch etcd cluster -p='{"spec": {"forceRedeploymentReason": "recovery-"$( date --rfc-3339=ns )"'}}' --type=merge ❶
```

- ❶ The **forceRedeploymentReason** value must be unique, which is why a timestamp is appended.

When the etcd cluster Operator performs a redeployment, the existing nodes are started with new pods similar to the initial bootstrap scale up.

18. Turn the quorum guard back on by entering the following command:

```
$ oc patch etcd/cluster --type=merge -p '{"spec": {"unsupportedConfigOverrides": null}}'
```

19. You can verify that the **unsupportedConfigOverrides** section is removed from the object by entering this command:

```
$ oc get etcd/cluster -oyaml
```

20. Verify all nodes are updated to the latest revision.

In a terminal that has access to the cluster as a **cluster-admin** user, run the following command:

```
$ oc get etcd -o=jsonpath='{range .items[0].status.conditions[?(@.type=="NodeInstallerProgressing")]}{.reason}{"\n"}{.message}{"\n"}'
```

Review the **NodeInstallerProgressing** status condition for etcd to verify that all nodes are at the latest revision. The output shows **AllNodesAtLatestRevision** upon successful update:

```
AllNodesAtLatestRevision
3 nodes are at revision 7 1
```

- 1** In this example, the latest revision number is **7**.

If the output includes multiple revision numbers, such as **2 nodes are at revision 6; 1 nodes are at revision 7**, this means that the update is still in progress. Wait a few minutes and try again.

21. After etcd is redeployed, force new rollouts for the control plane. The Kubernetes API server will reinstall itself on the other nodes because the kubelet is connected to API servers using an internal load balancer.

In a terminal that has access to the cluster as a **cluster-admin** user, run the following commands.

- a. Force a new rollout for the Kubernetes API server:

```
$ oc patch kubeapiserver cluster -p='{ "spec": { "forceRedeploymentReason": "recovery-"'$( date --rfc-3339=ns )'" } }' --type=merge
```

Verify all nodes are updated to the latest revision.

```
$ oc get kubeapiserver -o=jsonpath='{range .items[0].status.conditions[?(@.type=="NodeInstallerProgressing")]}{.reason}{"\n"}{.message}{"\n"}'
```

Review the **NodeInstallerProgressing** status condition to verify that all nodes are at the latest revision. The output shows **AllNodesAtLatestRevision** upon successful update:

```
AllNodesAtLatestRevision
3 nodes are at revision 7 1
```

- 1** In this example, the latest revision number is **7**.

If the output includes multiple revision numbers, such as **2 nodes are at revision 6; 1 nodes are at revision 7**, this means that the update is still in progress. Wait a few minutes and try again.

- b. Force a new rollout for the Kubernetes controller manager:

```
$ oc patch kubecontrollermanager cluster -p='{ "spec": { "forceRedeploymentReason": "recovery-"'$( date --rfc-3339=ns )'" } }' --type=merge
```

Verify all nodes are updated to the latest revision.

```
$ oc get kubecontrollermanager -o=jsonpath='{range .items[0].status.conditions[?(@.type=="NodeInstallerProgressing")]}{.reason}{"\n"}{.message}{"\n"}'
```

Review the **NodeInstallerProgressing** status condition to verify that all nodes are at the latest revision. The output shows **AllNodesAtLatestRevision** upon successful update:

```
AllNodesAtLatestRevision
3 nodes are at revision 7 1
```

**1** In this example, the latest revision number is **7**.

If the output includes multiple revision numbers, such as **2 nodes are at revision 6; 1 nodes are at revision 7**, this means that the update is still in progress. Wait a few minutes and try again.

- c. Force a new rollout for the Kubernetes scheduler:

```
$ oc patch kubescheduler cluster -p='{ "spec": { "forceRedeploymentReason": "recovery-$( date --rfc-3339=ns )"' --type=merge
```

Verify all nodes are updated to the latest revision.

```
$ oc get kubescheduler -o=jsonpath='{range .items[0].status.conditions[?(@.type=="NodeInstallerProgressing")]}{.reason}{"\n"}{.message}{"\n"}'
```

Review the **NodeInstallerProgressing** status condition to verify that all nodes are at the latest revision. The output shows **AllNodesAtLatestRevision** upon successful update:

```
AllNodesAtLatestRevision
3 nodes are at revision 7 1
```

**1** In this example, the latest revision number is **7**.

If the output includes multiple revision numbers, such as **2 nodes are at revision 6; 1 nodes are at revision 7**, this means that the update is still in progress. Wait a few minutes and try again.

22. Verify that all control plane hosts have started and joined the cluster.

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-10-0-143-125.ec2.internal	2/2	Running	0	9h
etcd-ip-10-0-154-194.ec2.internal	2/2	Running	0	9h
etcd-ip-10-0-173-171.ec2.internal	2/2	Running	0	9h

To ensure that all workloads return to normal operation following a recovery procedure, restart each pod that stores Kubernetes API information. This includes OpenShift Container Platform components such as routers, Operators, and third-party components.



## NOTE

On completion of the previous procedural steps, you might need to wait a few minutes for all services to return to their restored state. For example, authentication by using **oc login** might not immediately work until the OAuth server pods are restarted.

Consider using the **system:admin kubeconfig** file for immediate authentication. This method basis its authentication on SSL/TLS client certificates as against OAuth tokens. You can authenticate with this file by issuing the following command:

```
$ export KUBECONFIG=<installation_directory>/auth/kubeconfig
```

Issue the following command to display your authenticated user name:

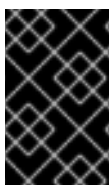
```
$ oc whoami
```

### 5.3.2.3. Additional resources

- [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](#)

### 5.3.2.4. 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*).

### 5.3.3. Recovering from expired control plane certificates

#### 5.3.3.1. 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
csr-2s94x	8m3s	kubernetes.io/kubelet-serving	system:node:<node_name>
Pending <b>1</b>			
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 <b>2</b>			
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>
```