



Red Hat OpenShift Virtualization with NetApp ONTAP

NetApp Solutions

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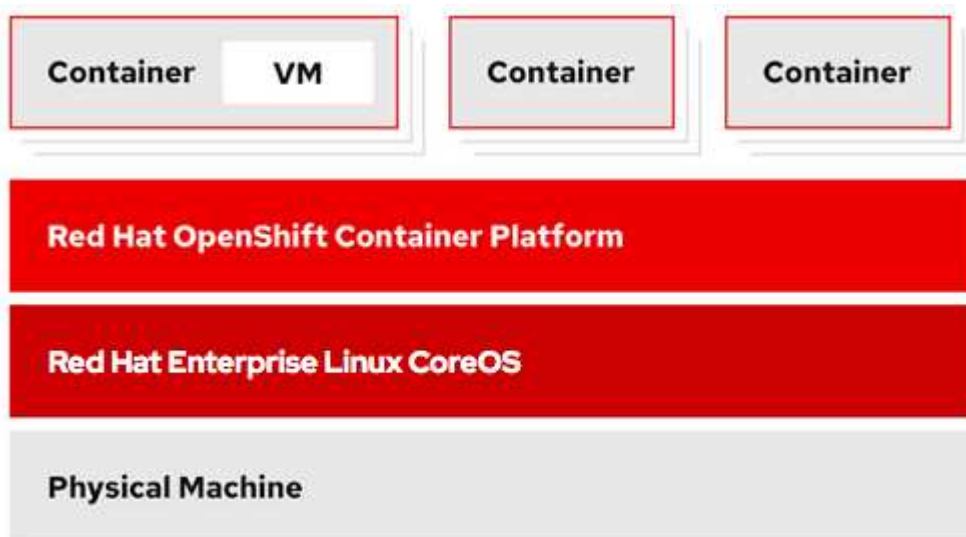
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Red Hat OpenShift Virtualization with NetApp ONTAP

Red Hat OpenShift Virtualization with NetApp ONTAP

Depending on the specific use case, both containers and virtual machines (VMs) can serve as optimal platforms for different types of applications. Therefore, many organizations run some of their workloads on containers and some on VMs. Often, this leads organizations to face additional challenges by having to manage separate platforms: a hypervisor for VMs and a container orchestrator for applications.

To address this challenge, Red Hat introduced OpenShift Virtualization (formerly known as Container Native Virtualization) starting from OpenShift version 4.6. The OpenShift Virtualization feature enables you to run and manage virtual machines alongside containers on the same OpenShift Container Platform installation, providing hybrid management capability to automate deployment and management of VMs through operators. In addition to creating VMs in OpenShift, with OpenShift Virtualization, Red Hat also supports importing VMs from VMware vSphere, Red Hat Virtualization, and Red Hat OpenStack Platform deployments.



Certain features like live VM migration, VM disk cloning, VM snapshots and so on are also supported by OpenShift Virtualization with assistance from Astra Trident when backed by NetApp ONTAP. Examples of each of these workflows are discussed later in this document in their respective sections.

To learn more about Red Hat OpenShift Virtualization, see the documentation [here](#).

Deployment for OpenShift Virtualization

Deploy Red Hat OpenShift Virtualization with NetApp ONTAP

This section details how to deploy Red Hat OpenShift Virtualization with NetApp ONTAP.

Prerequisites

- A Red Hat OpenShift cluster (later than version 4.6) installed on bare-metal infrastructure with RHCOS

worker nodes

- The OpenShift cluster must be installed via installer provisioned infrastructure (IPI)
- Deploy Machine Health Checks to maintain HA for VMs
- A NetApp ONTAP cluster
- Astra Trident installed on the OpenShift cluster
- A Trident backend configured with an SVM on ONTAP cluster
- A StorageClass configured on the OpenShift cluster with Astra Trident as the provisioner
- Cluster-admin access to Red Hat OpenShift cluster
- Admin access to NetApp ONTAP cluster
- An admin workstation with tridentctl and oc tools installed and added to \$PATH

Because OpenShift Virtualization is managed by an operator installed on the OpenShift cluster, it imposes additional overhead on memory, CPU, and storage, which must be accounted for while planning the hardware requirements for the cluster. See the documentation [here](#) for more details.

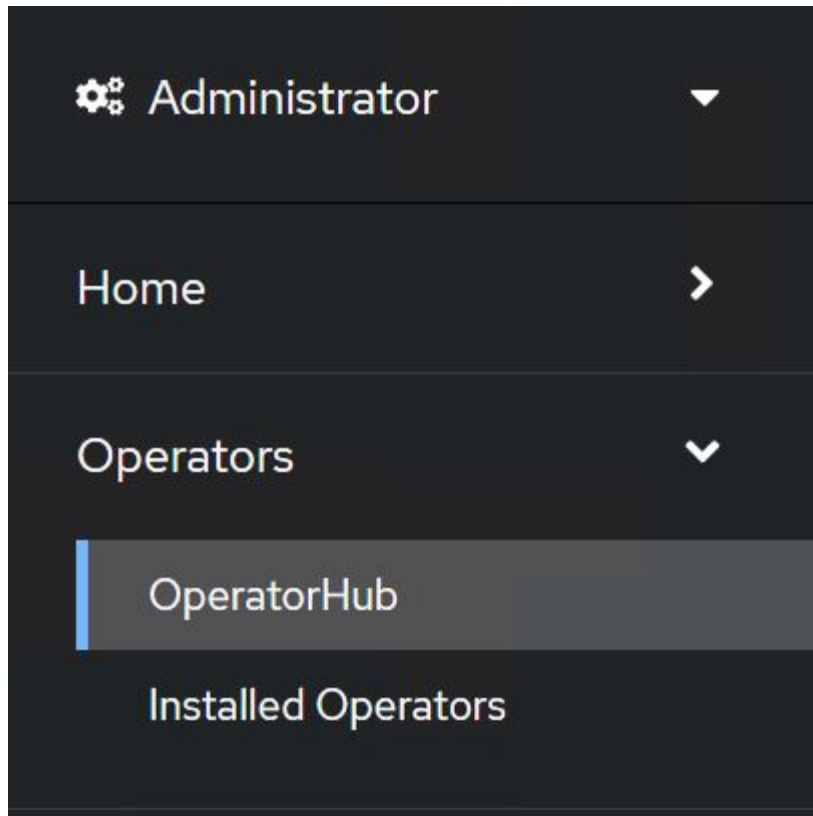
Optionally, you can also specify a subset of the OpenShift cluster nodes to host the OpenShift Virtualization operators, controllers, and VMs by configuring node placement rules. To configure node placement rules for OpenShift Virtualization, follow the documentation [here](#).

For the storage backing OpenShift Virtualization, NetApp recommends having a dedicated StorageClass that requests storage from a particular Trident backend, which in turn is backed by a dedicated SVM. This maintains a level of multitenancy with regard to the data being served for VM-based workloads on the OpenShift cluster.

Deploy Red Hat OpenShift Virtualization with NetApp ONTAP

To install OpenShift Virtualization, complete the following steps:

1. Log into the Red Hat OpenShift bare-metal cluster with cluster-admin access.
2. Select Administrator from the Perspective drop down.
3. Navigate to Operators > OperatorHub and search for OpenShift Virtualization.



4. Select the OpenShift Virtualization tile and click Install.

OpenShift Virtualization 2.6.2 provided by Red Hat

[Install](#)

Latest version
2.6.2

Capability level

- Basic Install
- Seamless Upgrades
- Full Lifecycle
- Deep Insights
- Auto Pilot

Provider type
Red Hat

Provider
Red Hat

Requirements
Your cluster must be installed on bare metal infrastructure with Red Hat Enterprise Linux CoreOS workers.

Details
OpenShift Virtualization extends Red Hat OpenShift Container Platform, allowing you to host and manage virtualized workloads on the same platform as container-based workloads. From the OpenShift Container Platform web console, you can import a VMware virtual machine from vSphere, create new or clone existing VMs, perform live migrations between nodes, and more. You can use OpenShift Virtualization to manage both Linux and Windows VMs.

The technology behind OpenShift Virtualization is developed in the [KubeVirt](#) open source community. The KubeVirt project extends [Kubernetes](#) by adding additional virtualization resource types through [Custom Resource Definitions](#) (CRDs). Administrators can use Custom Resource Definitions to manage [VirtualMachine](#) resources alongside all other resources that Kubernetes provides.

5. On the Install Operator screen, leave all default parameters and click Install.

Update channel *

- 2.1
- 2.2
- 2.3
- 2.4
- stable

Installation mode *

- All namespaces on the cluster (default)
This mode is not supported by this Operator
- A specific namespace on the cluster
Operator will be available in a single Namespace only.

Installed Namespace *

- Operator recommended Namespace: **PR** openshift-cnv


Namespace creation
Namespace **openshift-cnv** does not exist and will be created.

- Select a Namespace

Approval strategy *

- Automatic
- Manual

Install Cancel

 OpenShift Virtualization
provided by Red Hat

Provided APIs

HC OpenShift Virtualization Deployment **Required**

Represents the deployment of OpenShift Virtualization

6. Wait for the operator installation to complete.

 OpenShift Virtualization
2.6.2 provided by Red Hat

Installing Operator

The Operator is being installed. This may take a few minutes.

[View installed Operators in Namespace openshift-cnv](#)

7. After the operator has installed, click Create HyperConverged.



OpenShift Virtualization

2.6.2 provided by Red Hat



Installed operator - operand required

The Operator has installed successfully. Create the required custom resource to be able to use this Operator.

HC HyperConverged **Required**

Creates and maintains an OpenShift Virtualization Deployment

[Create HyperConverged](#)

[View installed Operators in Namespace openshift-cnv](#)

8. On the Create HyperConverged screen, click Create, accepting all default parameters. This step starts the installation of OpenShift Virtualization.

Name *

Labels

Infra >

infra HyperConvergedConfig influences the pod configuration (currently only placement) for all the infra components needed on the virtualization enabled cluster but not necessarily directly on each node running VMs/VMLs.

Workloads >

workloads HyperConvergedConfig influences the pod configuration (currently only placement) of components which need to be running on a node where virtualization workloads should be able to run. Changes to Workloads HyperConvergedConfig can be applied only without existing workload.

Bare Metal Platform

true

BareMetalPlatform indicates whether the infrastructure is baremetal.

Feature Gates >

featureGates is a map of feature gate flags. Setting a flag to `true` will enable the feature. Setting `false` or removing the feature gate, disables the feature.

Local Storage Class Name





LocalStorageClassName the name of the local storage class.

- After all the pods move to the Running state in the openshift-cnv namespace and the OpenShift Virtualization operator is in the Succeeded state, the operator is ready to use. VMs can now be created on the OpenShift cluster.

Project: openshift-cnv ▾

Installed Operators

Installed Operators are represented by ClusterServiceVersions within this Namespace. For more information, see the [Understanding Operators documentation](#) or create an Operator and ClusterServiceVersion using the [Operator SDK](#).

Name	Managed Namespaces	Status	Last updated	Provided APIs
 OpenShift Virtualization 2.6.2 provided by Red Hat	 openshift-cnv	 Succeeded Up to date	 May 18, 8:02 pm	OpenShift Virtualization Deployment HostPathProvisioner deployment

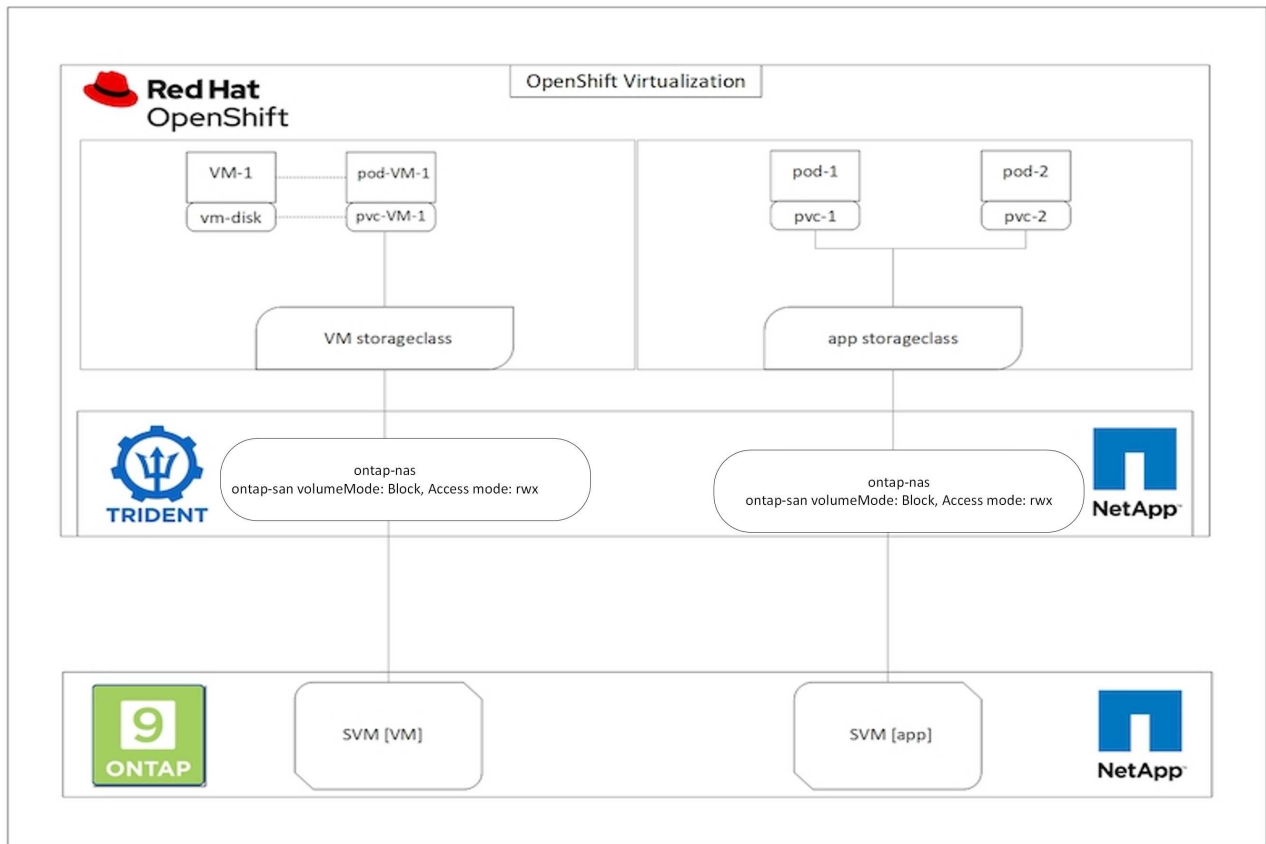
Workflows

Workflows: Red Hat OpenShift Virtualization with NetApp ONTAP

This section covers the how to create a virtual machine with Red Hat OpenShift Virtualization.

Create VM

VMs are stateful deployments that require volumes to host the operating system and data. With CNV, because the VMs are run as pods, the VMs are backed by PVs hosted on NetApp ONTAP through Trident. These volumes are attached as disks and store the entire filesystem including the boot source of the VM.



To quickly create a virtual machine on the OpenShift cluster, complete the following steps:

1. Navigate to Virtualization > Virtual Machines and click Create.
2. Select From template.
3. Select the desired operating system for which the boot source is available.
4. Check the checkbox Start the VirtualMachine after creation.
5. Click Quick create VirtualMachine.

The virtual machine is created and started and comes to the **Running** state. It automatically creates a PVC and a corresponding PV for the boot disk using the default storage class. In order to be able to live migrate the VM in the future, you must ensure that the storage class used for the disks can support RWX volumes. This is a requirement for live migration. ontap-nas and ontap-san (volumeMode block for iSCSI and NVMe/TCP protocols) can support RWX access modes for the volumes created using the respective storage classes.

To configure ontap-san storage class on the cluster see the [Section for Migrating a VM from VMware to OpenShift Virtualization](#).



You can set up ontap NAS or iSCSI as the default storage class for the cluster. Clicking on Quick create VirtualMachine will use the default storage class to create the PVC and PV for the bootable root disk for the VM. If your default storage class is not ontap-nas or ontap-san, you can select the storage class for the disk, by selecting **Customize VirtualMachine > Customize VirtualMachine parameters > Disks** and then editing the disk to use the required storage class.

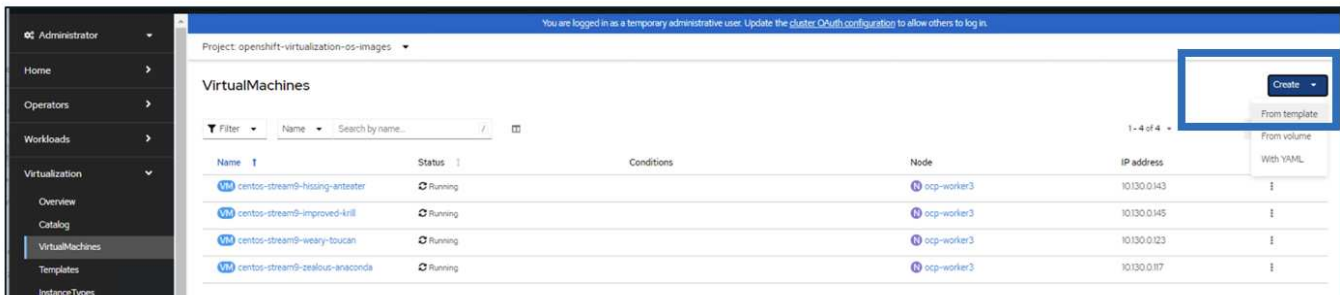
Typically block access mode is preferred compared to file systems while provisioning the VM disks.

To customize the virtual machine creation after you have selected the OS template, click on **Customize VirtualMachine** instead of **Quick create**.

1. If the selected operating system has boot source configured, you can click on **Customize VirtualMachine parameters**.
2. If the selected operating system has no boot source configured, you must configure it. You can see details about the procedures shown in the [documentation](#).
3. After Configuring the boot disk, you can click on **Customize VirtualMachine parameters**.
4. You can customize the VM from the tabs on this page. For eg. click on the **Disks** tab and then click on **Add disk** to add another disk to the VM.
5. Click **Create Virtual Machine** to create the virtual machine; this spins up a corresponding pod in the background.



When a boot source is configured for a template or an operating system from an URL or from a registry, it creates a PVC in the `openshift-visualization-os-images` project and downloads the KVM guest image to the PVC. You must make sure that template PVCs have enough provisioned space to accommodate the KVM guest image for the corresponding OS. These PVCs are then cloned and attached as rootdisk to virtual machines when they are created using the respective templates in any project.



Create new VirtualMachine

Select an option to create a VirtualMachine from.

Template catalog
 InstanceTypes

Template project
 All projects ▾
 All items 13 items

Default templates
 User templates

Boot source available

Operating system
 CentOS
 Fedora
 Other
 RHEL
 Windows

Workload
 Desktop
 High performance
 Server

<p>CentOS Stream 8 VM centos-stream8-server-small</p> <p>Project openshift Boot source PVC (auto import) Workload Server CPU 1 Memory 2 GiB</p>	<p>CentOS Stream 9 VM centos-stream9-server-small</p> <p>Project openshift Boot source PVC (auto import) Workload Server CPU 1 Memory 2 GiB</p>	<p>CentOS 7 VM centos7-server-small</p> <p>Project openshift Boot source PVC (auto import) Workload Server CPU 1 Memory 2 GiB</p>	<p>Fedora VM fedora-server-small</p> <p>Project openshift Boot source PVC (auto import) Workload Server CPU 1 Memory 2 GiB</p>	<p>Red Hat Enterprise Linux 7 VM rhel7-server-small</p> <p>Project openshift Boot source PVC Workload Server CPU 1 Memory 2 GiB</p>
<p>Red Hat Enterprise Linux 8 VM rhel8-server-small</p> <p>Project openshift Boot source PVC (auto import) Workload Server CPU 1 Memory 2 GiB</p>	<p>Red Hat Enterprise Linux 9 VM rhel9-server-small</p> <p>Project openshift Boot source PVC (auto import) Workload Server CPU 1 Memory 2 GiB</p>	<p>Microsoft Windows 10 VM windows10-desktop-medium</p> <p>Project openshift Boot source PVC Workload Desktop CPU 1 Memory 4 GiB</p>	<p>Microsoft Windows 11 VM windows11-desktop-medium</p> <p>Project openshift Boot source PVC Workload Desktop CPU 2 Memory 4 GiB</p>	<p>Microsoft Windows Server 2012 R2 VM windows2k12r2-server-medium</p> <p>Project openshift Boot source PVC Workload Server CPU 1 Memory 4 GiB</p>



CentOS Stream 9 VM

centos-stream9-server-small



Template info

Operating system

CentOS Stream 9 VM

Workload type

Server (default)

Description

Template for CentOS Stream 9 VM or newer. A PVC with the CentOS Stream disk image must be available.

Documentation

[Refer to documentation](#)

CPU | Memory

1 CPU | 2 GiB Memory

Network interfaces (1)

Name	Network	Type
default	Pod networking	Masquerade

Disks (2)

Name	Drive	Size
rootdisk	Disk	30 GiB
cloudinitdisk	Disk	-

Hardware devices (0)

GPU devices

Not available

Host devices

Not available

Quick create VirtualMachine

VirtualMachine name *

centos-stream9-pleased-ham...

Project

openshift-visualization-os-images

Start this VirtualMachine after creation

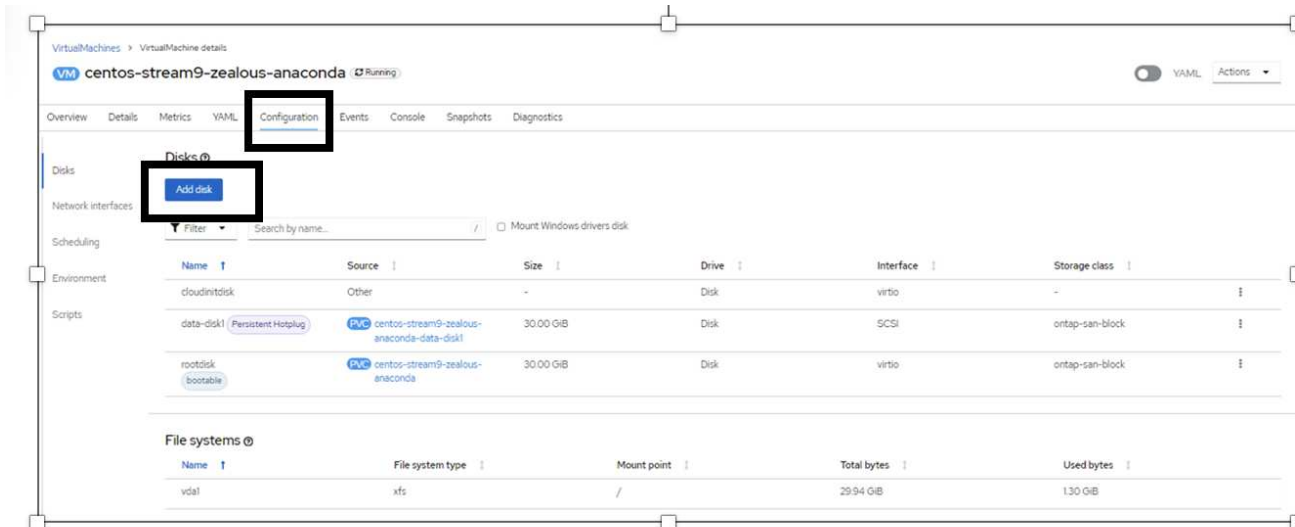
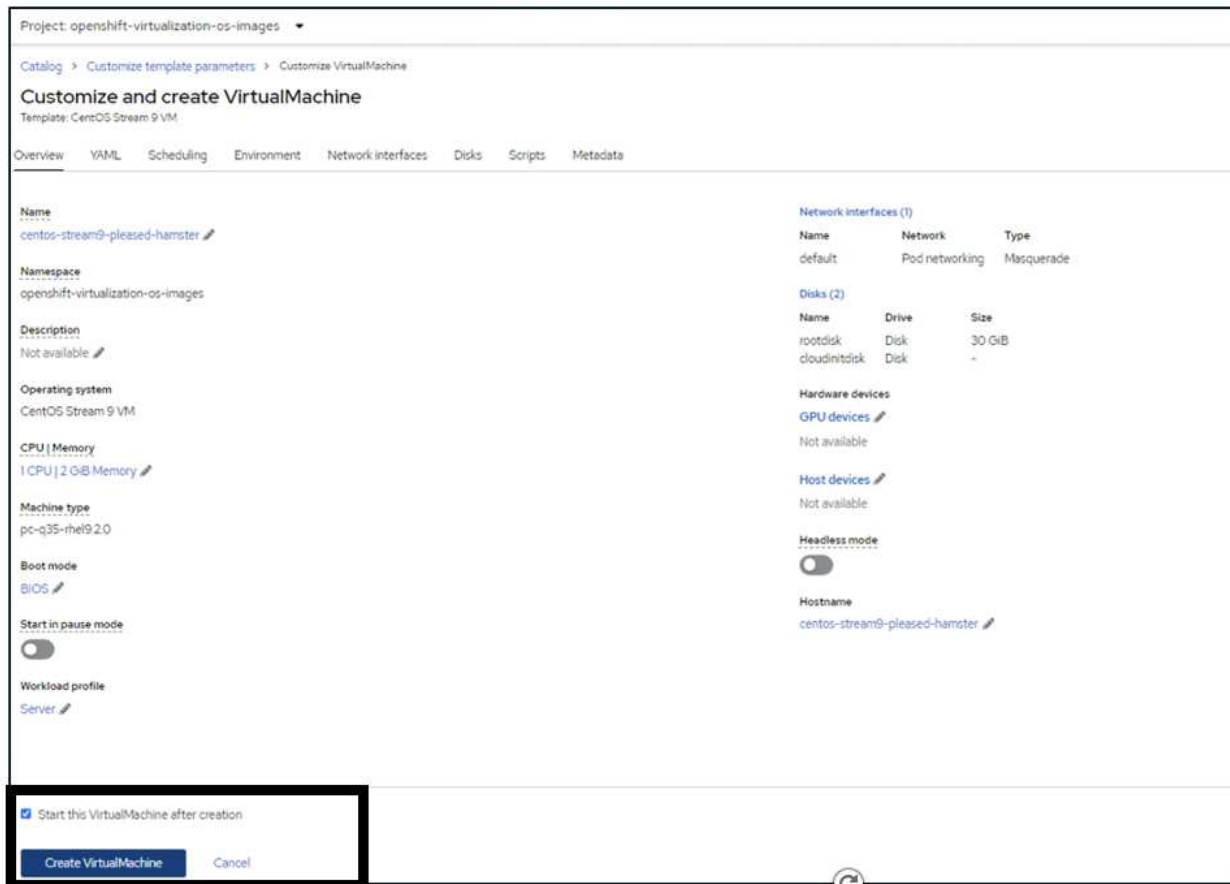
Quick create VirtualMachine

Customize VirtualMachine

Cancel

Activate Windows

Go to Settings to activate Windows.



Workflows: Red Hat OpenShift Virtualization with NetApp ONTAP

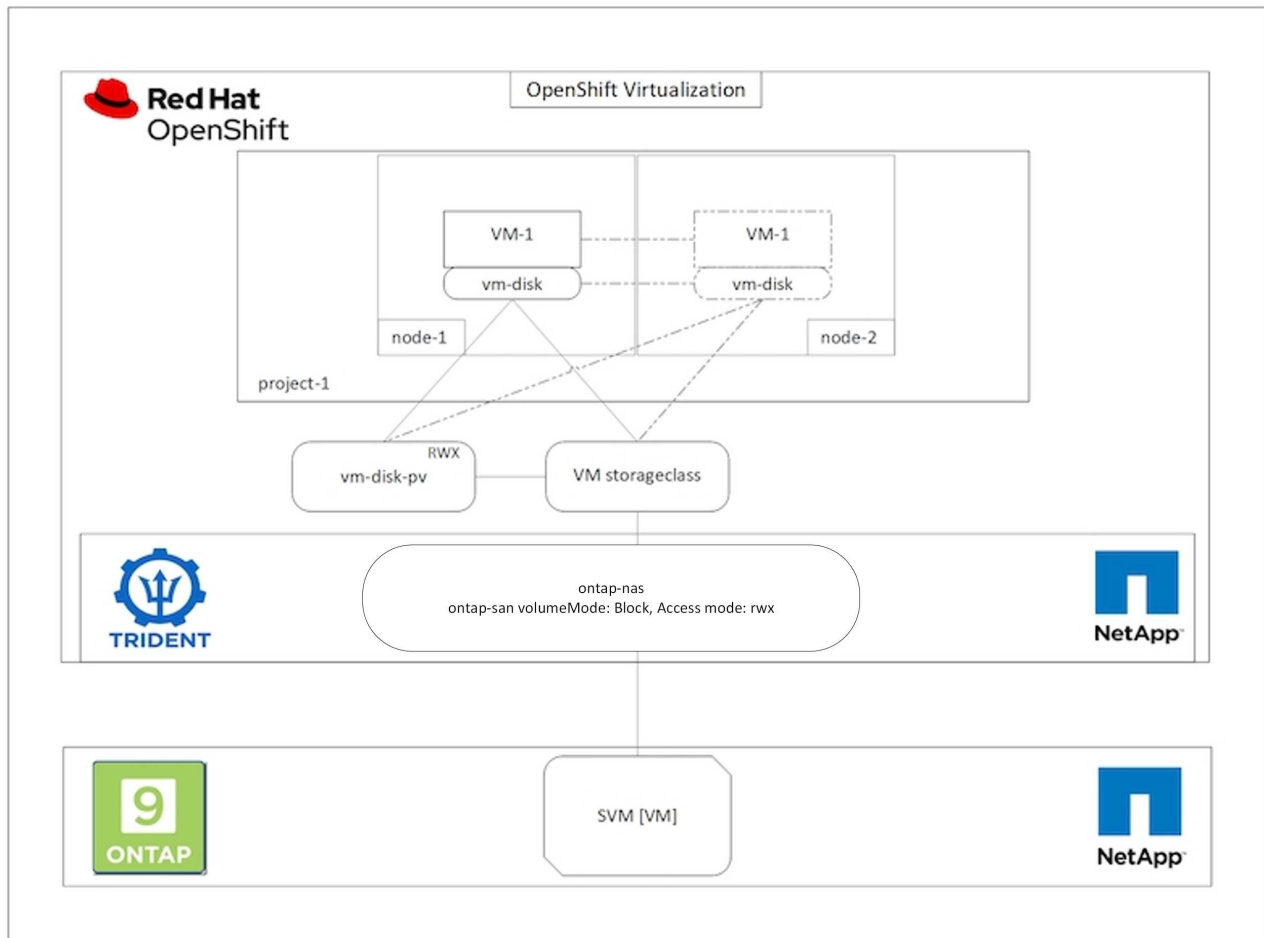
This section shows how to migrate a virtual machine in OpenShift Virtualization between nodes in the cluster .

VM Live Migration

Live Migration is a process of migrating a VM instance from one node to another in an OpenShift cluster with no downtime. For live migration to work in an OpenShift cluster, VMs must be bound to PVCs with shared

ReadWriteMany access mode. Astra Trident backends configured using ontap-nas drivers support RWX access mode for FileSystem protocols nfs and smb. Refer to the documentation [here](#). Astra Trident backends configured using ontap-san drivers support RWX access mode for block volumeMode for iSCSI and NVMe/TCP protocols. Refer to the documentation [here](#).

Therefore, for live migration to succeed, the VMs must be provisioned with disks (boot disks and additional hot plug disks) with PVCs using ontap-nas or ontap-san (volumeMode: Block) storage classes. When the PVCs are created, Trident creates ONTAP volumes in an SVM which is NFS-enabled or iSCSI enabled.



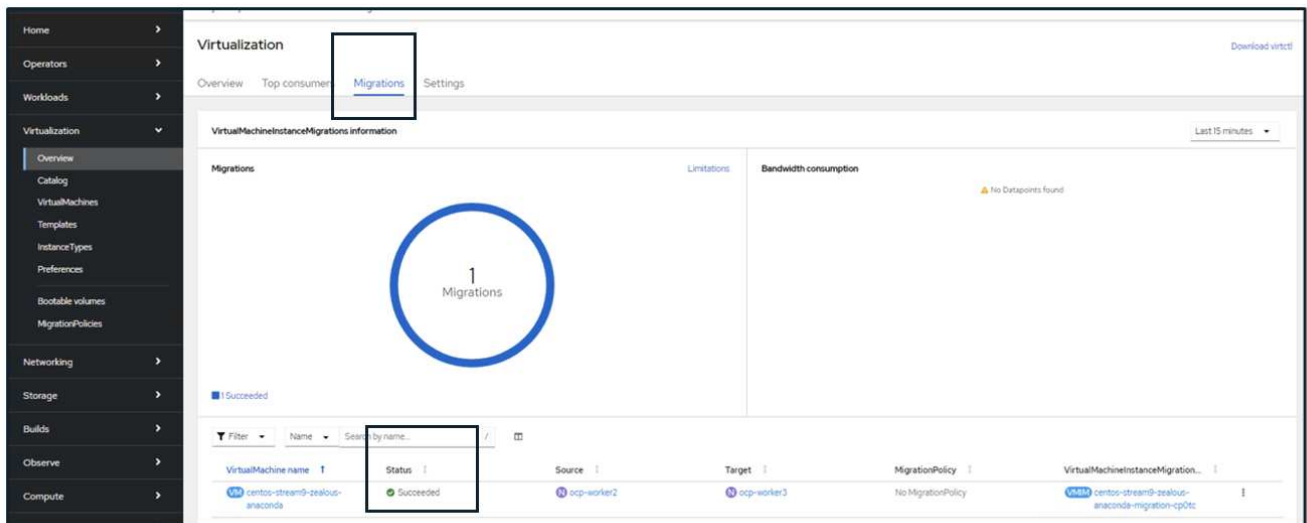
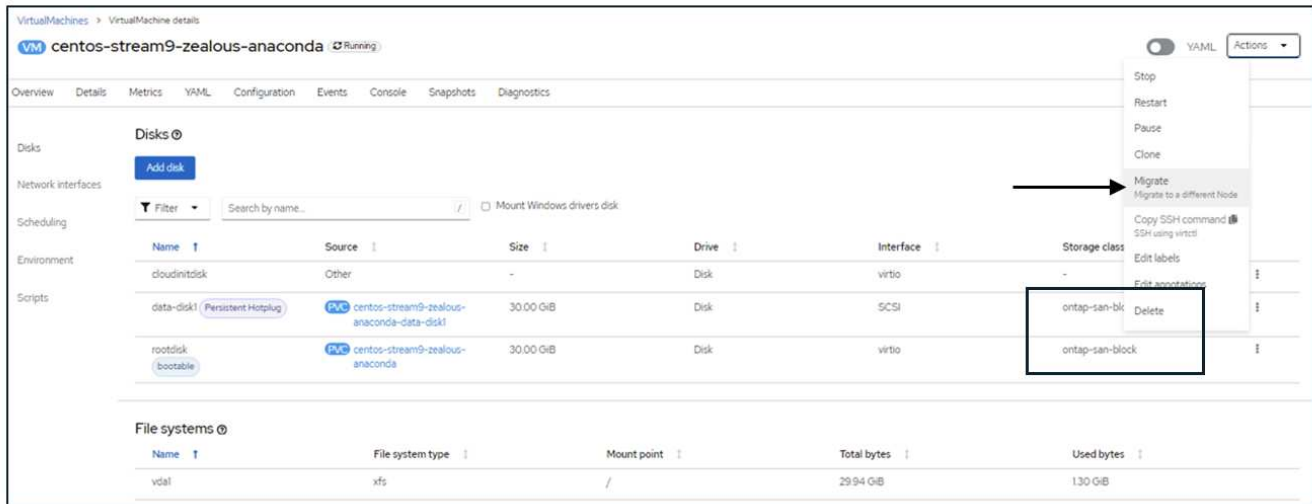
To perform a live migration of a VM that has been created previously and is in a Running state perform the following steps:

1. Select the VM that you want to live-migrate.
2. Click on **Configuration** tab.
3. Ensure that all the disks of the VM are created using Storage classes that can support RWX access mode.
4. Click on **Actions** on the right corner and then select **Migrate**.
5. To look at the progression of the Migration, go to Virtualization > Overview on the left hand side menu and then click on the **Migrations** tab.

The Migration of the VM will transition from **Pending** to **Scheduling** to **Succeeded**



A VM instance in an OpenShift cluster automatically migrates to another node when the original node is placed into maintenance mode if the evictionStrategy is set to LiveMigrate.

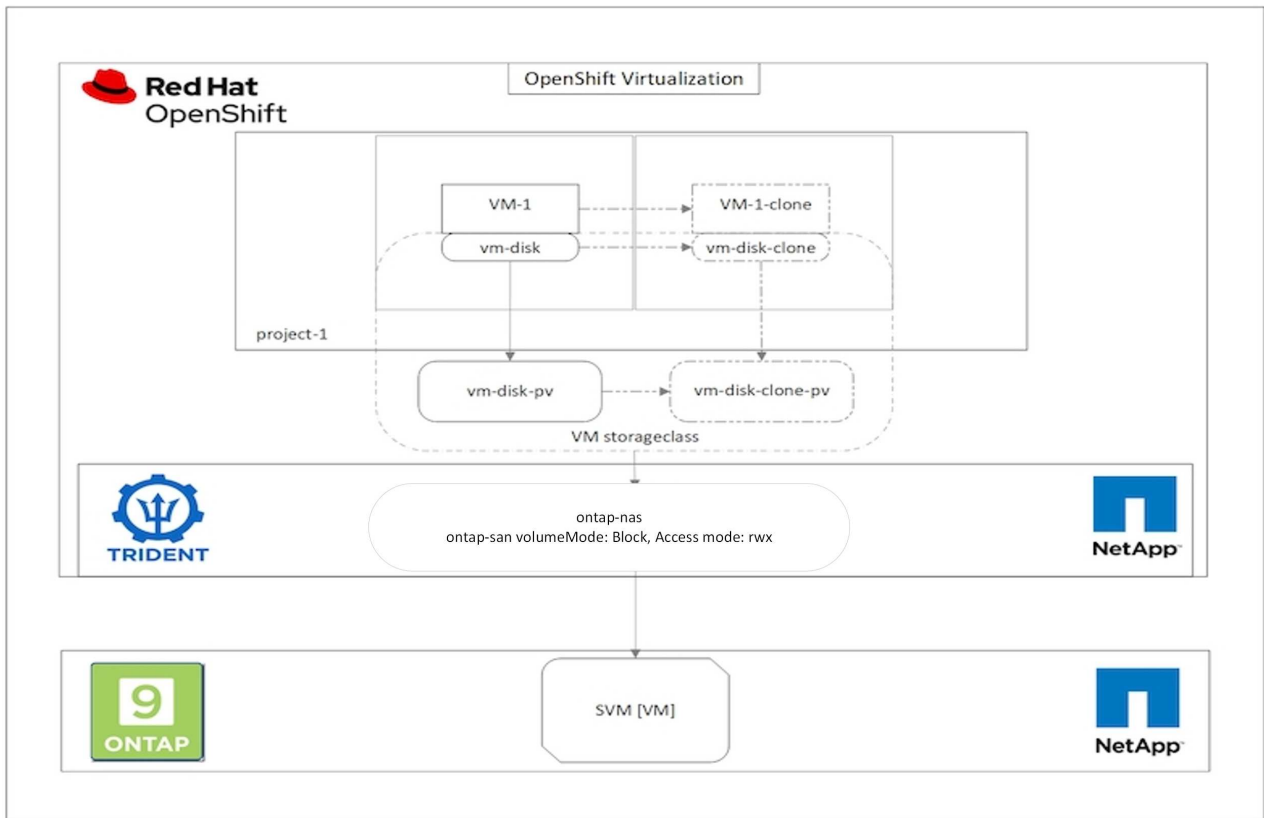


Workflows: Red Hat OpenShift Virtualization with NetApp ONTAP

This section covers the how to clone a virtual machine with Red Hat OpenShift Virtualization.

VM cloning

Cloning an existing VM in OpenShift is achieved with the support of Astra Trident's Volume CSI cloning feature. CSI volume cloning allows for creation of a new PVC using an existing PVC as the data source by duplicating its PV. After the new PVC is created, it functions as a separate entity and without any link to or dependency on the source PVC.



There are certain restrictions with CSI volume cloning to consider:

1. Source PVC and destination PVC must be in the same project.
2. Cloning is supported within the same storage class.
3. Cloning can be performed only when source and destination volumes use the same VolumeMode setting; for example, a block volume can only be cloned to another block volume.

VMs in an OpenShift cluster can be cloned in two ways:

1. By shutting down the source VM
2. By keeping the source VM live

By Shutting down the source VM

Cloning an existing VM by shutting down the VM is a native OpenShift feature that is implemented with support from Astra Trident. Complete the following steps to clone a VM.

1. Navigate to Workloads > Virtualization > Virtual Machines and click the ellipsis next to the virtual machine you wish to clone.
2. Click Clone Virtual Machine and provide the details for the new VM.

Clone Virtual Machine

Name *

rhel8-short-frog-clone

Description

Namespace *

default

Start virtual machine on clone

Configuration

Operating System

Red Hat Enterprise Linux 8.0 or higher

Flavor

Small: 1 CPU | 2 GiB Memory

Workload Profile

server

NICs

default - virtio

Disks

cloudinitdisk - cloud-init disk

rootdisk - 20Gi - basic



The VM rhel8-short-frog is still running. It will be powered off while cloning.

Cancel

Clone Virtual Machine

3. Click Clone Virtual Machine; this shuts down the source VM and initiates the creation of the clone VM.
4. After this step is completed, you can access and verify the content of the cloned VM.

By keeping the source VM live

An existing VM can also be cloned by cloning the existing PVC of the source VM and then creating a new VM using the cloned PVC. This method does not require you to shut down the source VM. Complete the following steps to clone a VM without shutting it down.

1. Navigate to Storage > PersistentVolumeClaims and click the ellipsis next to the PVC that is attached to the source VM.
2. Click Clone PVC and furnish the details for the new PVC.

Clone

Name *

Access Mode *


Single User (RWO) Shared Access (RWX) Read Only (ROX)

Size *

GiB ▼

PVC details

Namespace

 default

Requested capacity

20 GiB

Access mode

Shared Access (RWX)

Storage Class

 basic

Used capacity

2.2 GiB

Volume mode

Filesystem

Cancel

Clone

3. Then click Clone. This creates a PVC for the new VM.
4. Navigate to Workloads > Virtualization > Virtual Machines and click Create > With YAML.
5. In the spec > template > spec > volumes section, attach the cloned PVC instead of the container disk. Provide all other details for the new VM according to your requirements.

```
- name: rootdisk
  persistentVolumeClaim:
    claimName: rhel8-short-frog-rootdisk-28dvv-clone
```

6. Click Create to create the new VM.
7. After the VM is created successfully, access and verify that the new VM is a clone of the source VM.

Workflows: Red Hat OpenShift Virtualization with NetApp ONTAP

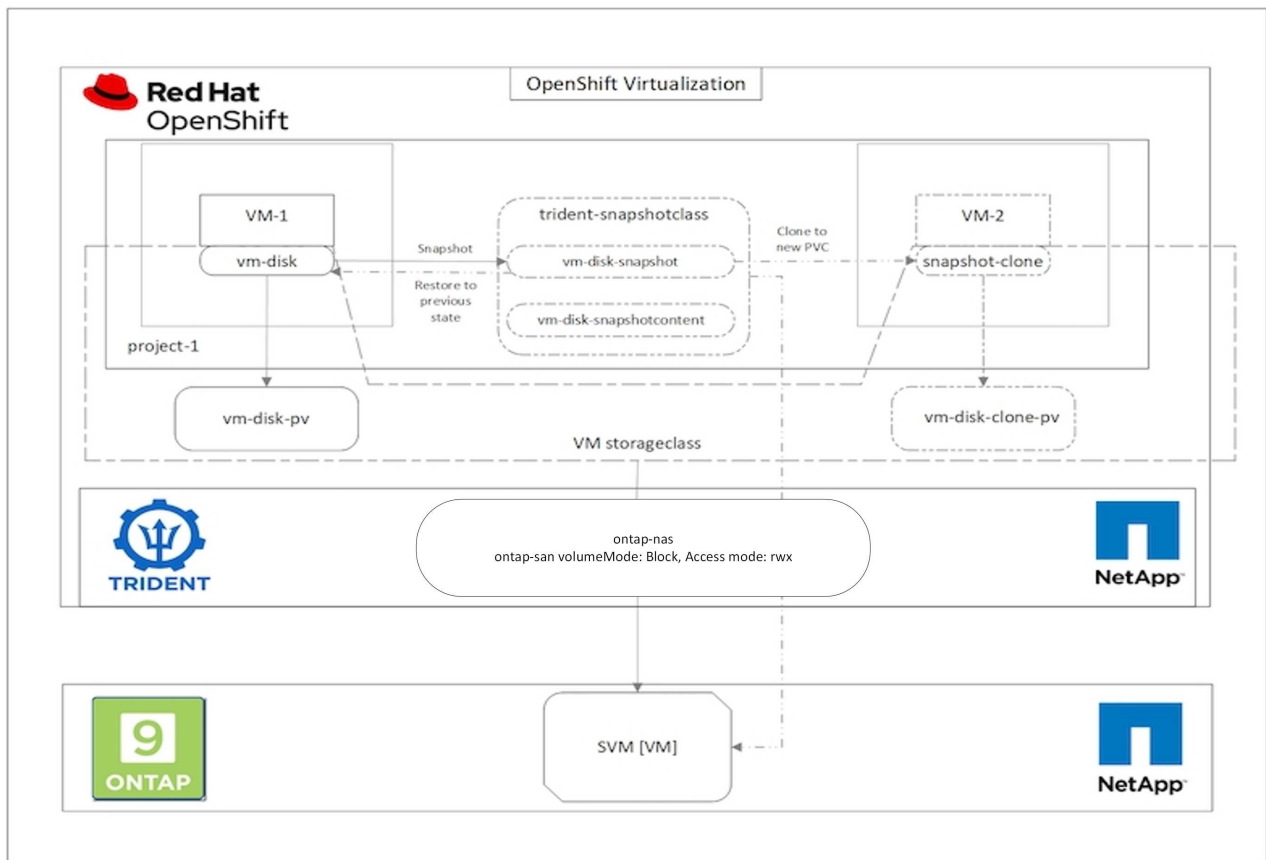
This section shows how to create a virtual machine from a Snapshot with Red Hat OpenShift Virtualization.

Create VM from a Snapshot

With Astra Trident and Red Hat OpenShift, users can take a snapshot of a persistent volume on Storage Classes provisioned by it. With this feature, users can take a point-in-time copy of a volume and use it to create a new volume or restore the same volume back to a previous state. This enables or supports a variety of use-cases, from rollback to clones to data restore.

For Snapshot operations in OpenShift, the resources `VolumeSnapshotClass`, `VolumeSnapshot`, and `VolumeSnapshotContent` must be defined.

- A `VolumeSnapshotContent` is the actual snapshot taken from a volume in the cluster. It is cluster-wide resource analogous to `PersistentVolume` for storage.
- A `VolumeSnapshot` is a request for creating the snapshot of a volume. It is analogous to a `PersistentVolumeClaim`.
- `VolumeSnapshotClass` lets the administrator specify different attributes for a `VolumeSnapshot`. It allows you to have different attributes for different snapshots taken from the same volume.



To create Snapshot of a VM, complete the following steps:

1. Create a VolumeSnapshotClass that can then be used to create a VolumeSnapshot. Navigate to Storage > VolumeSnapshotClasses and click Create VolumeSnapshotClass.
2. Enter the name of the Snapshot Class, enter `csi.trident.netapp.io` for the driver, and click Create.

```
1  apiVersion: snapshot.storage.k8s.io/v1
2  kind: VolumeSnapshotClass
3  metadata:
4    name: trident-snapshot-class
5  driver: csi.trident.netapp.io
6  deletionPolicy: Delete
7
```

- Identify the PVC that is attached to the source VM and then create a Snapshot of that PVC. Navigate to Storage > VolumeSnapshots and click Create VolumeSnapshots.
- Select the PVC that you want to create the Snapshot for, enter the name of the Snapshot or accept the default, and select the appropriate VolumeSnapshotClass. Then click Create.

Create VolumeSnapshot

[Edit YAML](#)

PersistentVolumeClaim *

Name *

Snapshot Class *

- This creates the snapshot of the PVC at that point in time.

Create a new VM from the snapshot

1. First, restore the Snapshot into a new PVC. Navigate to Storage > VolumeSnapshots, click the ellipsis next to the Snapshot that you wish to restore, and click Restore as new PVC.
2. Enter the details of the new PVC and click Restore. This creates a new PVC.

Restore as new PVC

When restore action for snapshot **rhel8-short-frog-rootdisk-28dvb-snapshot** is finished a new crash-consistent PVC copy will be created.

Name *

rhel8-short-frog-rootdisk-28dvb-snapshot-restore

Storage Class *

 basic

Access Mode *

Single User (RWO) Shared Access (RWX) Read Only (ROX)

Size *

20

GiB

VolumeSnapshot details

Created at

 May 21, 12:46 am

Namespace

 default

Status

 Ready

API version

snapshot.storage.k8s.io/v1

Size

20 GiB

3. Next, create a new VM from this PVC. Navigate to Virtualization > Virtual Machines and click Create > With YAML.
4. In the spec > template > spec > volumes section, specify the new PVC created from Snapshot instead of

from the container disk. Provide all other details for the new VM according to your requirements.

```
- name: rootdisk
  persistentVolumeClaim:
    claimName: rhel8-short-frog-rootdisk-28dvh-snapshot-restore
```

5. Click Create to create the new VM.
6. After the VM is created successfully, access and verify that the new VM has the same state as that of the VM whose PVC was used to create the snapshot at the time when the snapshot was created.

Workflows: Red Hat OpenShift Virtualization with NetApp ONTAP

This section covers the how to migrate a virtual machine between from VMware to an OpenShift Cluster using Red Hat OpenShift Virtualization migration toolkit.

Migration of VM from VMware to OpenShift Virtualization using Migration Toolkit for Virtualization

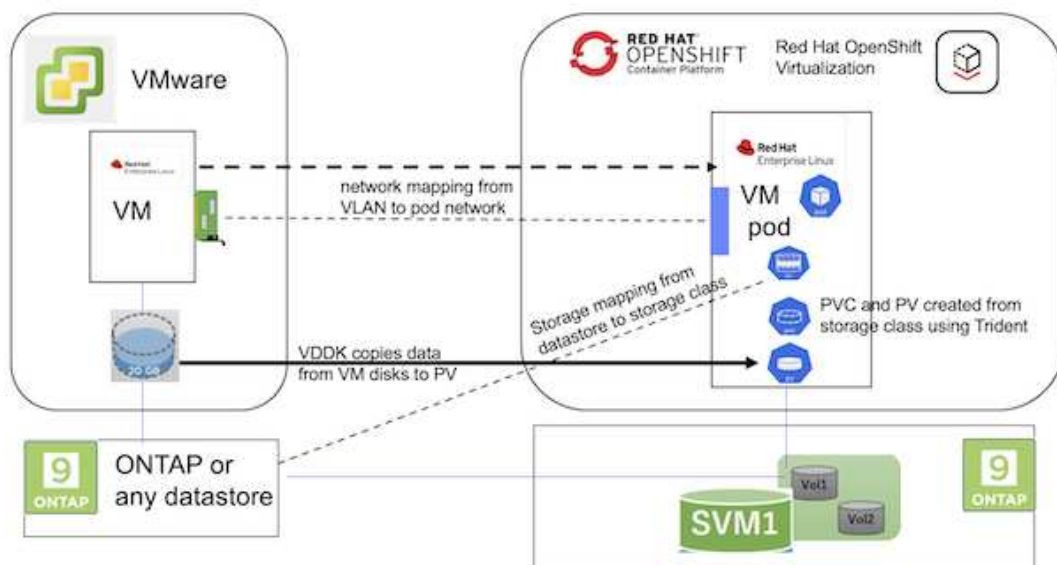
In this section, we will see how to use the Migration Toolkit for Virtualization (MTV) to migrate virtual machines from VMware to OpenShift Virtualization running on OpenShift Container platform and integrated with NetApp ONTAP storage using Astra Trident.

The following video shows a demonstration of the migration of a RHEL VM from VMware to OpenShift Virtualization using ontap-san storage class for persistent storage.

[Using Red Hat MTV to migrate VMs to OpenShift Virtualization with NetApp ONTAP Storage](#)

The following diagram shows a high level view of the migration of a VM from VMware to Red Hat OpenShift Virtualization.

Migration of VM from VMware to OpenShift Virtualization



Prerequisites for the sample migration

On VMware

- A RHEL 9 VM using rhel 9.3 with the following configurations were installed:
 - CPU: 2, Memory: 20 GB, Hard disk: 20 GB
 - user credentials: root user and an admin user credentials
- After the VM was ready, postgresql server was installed.
 - postgresql server was started and enabled to start on boot

```
systemctl start postgresql.service`  
systemctl enable postgresql.service  
The above command ensures that the server can start in the VM in  
OpenShift Virtualization after migration
```

- Added 2 databases, 1 table and 1 row in the table were added. Refer [here](#) for the instructions for installing postgresql server on RHEL and creating database and table entries.



Ensure that you start the postgresql server and enable the service to start at boot.

On OpenShift Cluster

The following installations were completed before installing MTV:

- OpenShift Cluster 4.13.34
- [Astra Trident 23.10](#)
- Multipath on the cluster nodes enabled for iSCSI (for ontap-san storage class). See the provided yaml to create a daemon set that enables iSCSI on each node in the cluster.
- Trident backend and Storage class for ontap SAN using iSCSI. See the provided yaml files for trident backend and storage class.
- [OpenShift Virtualization](#)

To install iscsi and multipath on the OpenShift Cluster nodes use the yaml file given below

Preparing the cluster nodes for iSCSI

```
apiVersion: apps/v1  
kind: DaemonSet  
metadata:  
  namespace: trident  
  name: trident-iscsi-init  
  labels:  
    name: trident-iscsi-init  
spec:  
  selector:  
    matchLabels:
```



```

    name: trident-iscsi-init
template:
  metadata:
    labels:
      name: trident-iscsi-init
  spec:
    hostNetwork: true
    serviceAccount: trident-node-linux
    initContainers:
    - name: init-node
      command:
        - nsenter
        - --mount=/proc/1/ns/mnt
        - --
        - sh
        - -c
      args: ["$(STARTUP_SCRIPT)"]
      image: alpine:3.7
      env:
      - name: STARTUP_SCRIPT
        value: |
          #!/bin/bash
          sudo yum install -y lsscsi iscsi-initiator-utils sg3_utils
device-mapper-multipath
          rpm -q iscsi-initiator-utils
          sudo sed -i 's/^\(node.session.scan\).*\/\1 = manual/'
/etc/iscsi/iscsid.conf
          cat /etc/iscsi/initiatorname.iscsi
          sudo mpathconf --enable --with_multipathd y --find_multipaths
n
          sudo systemctl enable --now iscsid multipathd
          sudo systemctl enable --now iscsi
      securityContext:
        privileged: true
    hostPID: true
    containers:
    - name: wait
      image: k8s.gcr.io/pause:3.1
    hostPID: true
    hostNetwork: true
    tolerations:
    - effect: NoSchedule
      key: node-role.kubernetes.io/master
updateStrategy:
  type: RollingUpdate

```

Use the following yaml file to create trident backend configuration for using ontap san storage

Trident backend for iSCSI

```
apiVersion: v1
kind: Secret
metadata:
  name: backend-tbc-ontap-san-secret
type: Opaque
stringData:
  username: <username>
  password: <password>
---
apiVersion: trident.netapp.io/v1
kind: TridentBackendConfig
metadata:
  name: ontap-san
spec:
  version: 1
  storageDriverName: ontap-san
  managementLIF: <management LIF>
  backendName: ontap-san
  svm: <SVM name>
  credentials:
    name: backend-tbc-ontap-san-secret
```

Use the following yaml file to create trident storage class configuration for using ontap san storage

Trident storage class for iSCSI

```
apiVersion: storage.k8s.io/v1
kind: StorageClass
metadata:
  name: ontap-san
provisioner: csi.trident.netapp.io
parameters:
  backendType: "ontap-san"
  media: "ssd"
  provisioningType: "thin"
  snapshots: "true"
allowVolumeExpansion: true
```

Install MTV

Now you can install the Migration Toolkit for virtualization (MTV). Refer to the instructions provided [here](#) for help with the installation.

The Migration Toolkit for Virtualization (MTV) user interface is integrated into the OpenShift web console. You can refer [here](#) to start using the user interface for various tasks.

Create Source Provider

In order to migrate the RHEL VM from VMware to OpenShift Virtualization, you need to first create the source provider for VMware. Refer to the instructions [here](#) to create the source provider.

You need the following to create your VMware source provider:

- VCenter url
- VCenter Credentials
- VCenter server thumbprint
- VDDK image in a repository

Sample source provider creation:

The screenshot displays a form for creating a vSphere source provider. The form includes the following fields and options:

- Select provider type ***: A dropdown menu with 'vm vSphere' selected.
- Provider resource name ***: A text input field containing 'vmware-source' with a green checkmark.
- URL ***: A text input field with a greyed-out placeholder and a green checkmark. Below it, a note reads: 'URL of the vCenter SDK endpoint. Ensure the URL includes the "/sdk" path. For example: https://vCenter-host-example.com/sdk'.
- VDDK init image**: A text input field containing 'docker.repo.eng.netapp.com/banum/vddk:801' with a green checkmark. Below it, a note reads: 'VDDK container image of the provider, when left empty some functionality will not be available'. A 'Text' button is visible to the right.
- Username ***: A text input field containing 'administrator@vsphere.local' with a green checkmark. Below it, a note reads: 'vSphere REST API user name.'.
- Password ***: A password input field with a green checkmark and an eye icon for toggling visibility. Below it, a note reads: 'vSphere REST API password credentials.'.
- SSHA-1 fingerprint ***: A text input field with a greyed-out placeholder and a green checkmark. Below it, a note reads: 'The provider currently requires the SHA-1 fingerprint of the vCenter Server's TLS certificate in all circumstances. vSphere calls this the server's thumbprint.'.
- Skip certificate validation**: A checkbox that is checked.



The Migration Toolkit for Virtualization (MTV) uses the VMware Virtual Disk Development Kit (VDDK) SDK to accelerate transferring virtual disks from VMware vSphere. Therefore, creating a VDDK image, although optional, is highly recommended. To make use of this feature, you download the VMware Virtual Disk Development Kit (VDDK), build a VDDK image, and push the VDDK image to your image registry.

Follow the instructions provided [here](#) to create and push the VDDK image to a registry accessible from the OpenShift Cluster.

Create Destination provider

The host cluster is automatically added as the OpenShift virtualization provider is the source provider.

Create Migration Plan

Follow the instructions provided [here](#) to create a migration plan.

While creating a plan, you need to create the following if not already created:

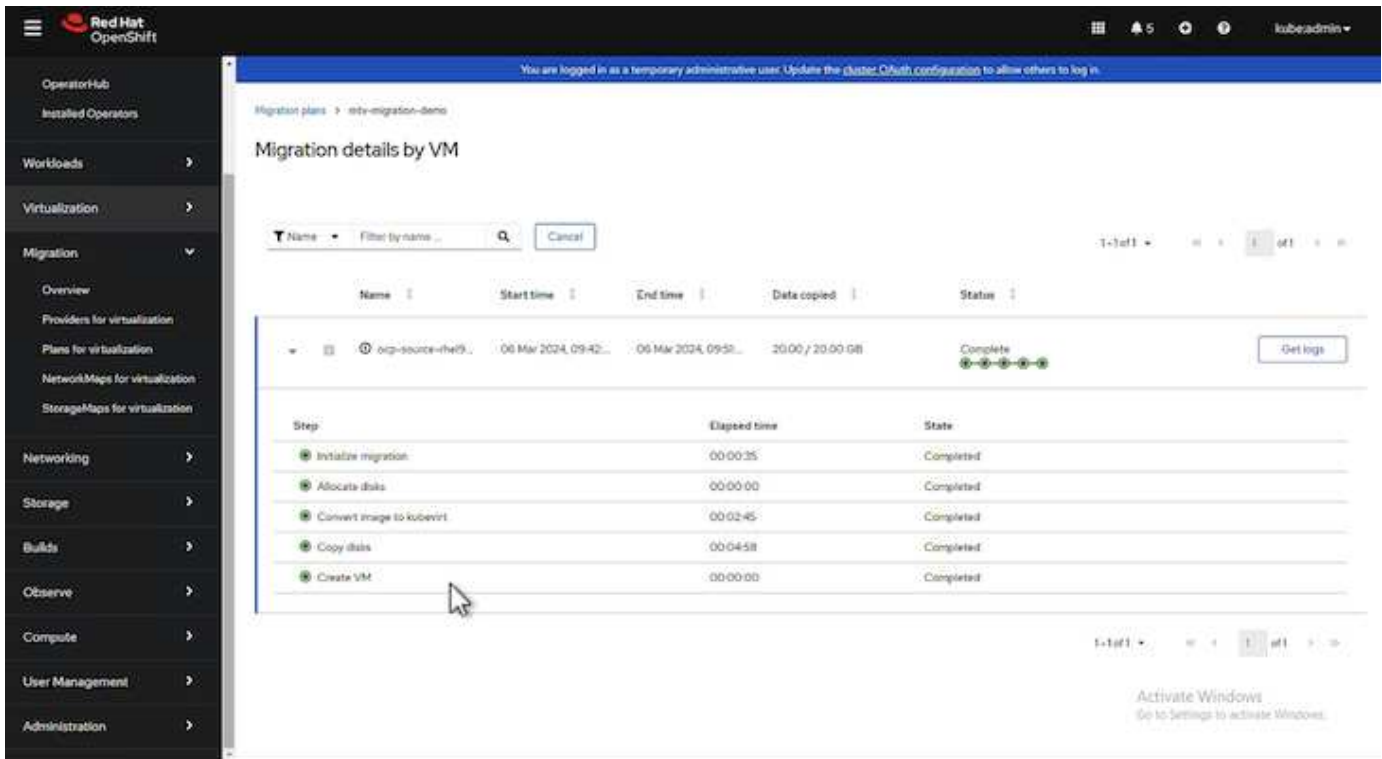
- A network mapping to map the source network to the target network.
- A storage mapping to map the source datastore to the target storage class. For this you can choose ontap-san storage class.

Once the migration plan is created, the status of the plan should show **Ready** and you should now be able to **Start** the plan.

The screenshot shows the OpenShift console interface for migration plans. The left sidebar contains navigation options like OperatorHub, Workloads, Virtualization, and Migration. The main content area displays a table of migration plans. The first plan, 'mtv-migration-demo', is in a 'Ready' state and has a 'Start' button. Other plans are in 'Succeeded' or 'Failed' states.

Name	Source	Target	VMs	Status	Description
mtv-migration-demo	vmware	host	1	Ready	Plan for migrating VM to OpenShift Virt...
vmware-osv-migration	vmware2	host	1	Succeeded	Migrating RHEL 9 vm to OpenShift Virtu...
vmware-osv-migration-plan1	vmware2	host	1	Succeeded	1 of 1 VMs migrated
vmware-osv-migration-plan2	vmware2	host	1	Succeeded	migrating RHEL 9 vm using ONTAP NFS...

Clicking on **Start** will run through a sequence of steps to complete the migration of the VM.



When all steps are completed, you can see the migrated VMs by clicking on the **virtual machines** under **Virtualization** in the left-side navigation menu. Instructions to access the virtual machines are provided [here](#).

You can log into the virtual machine and verify the contents of the postgresql databases. The databases, tables and the entries in the table should be the same as what was created on the source VM.

Data Protection of VMs using Third Party Tools

Data protection for VMs in OpenShift Virtualization using OpenShift API for Data Protection (OADP)

Author: Banu Sundhar, NetApp

This section of the reference document provides details for creating backups of VMs using the OpenShift API for Data Protection (OADP) with Velero on NetApp ONTAP S3 or NetApp StorageGRID S3. The backups of Persistent Volumes(PVs) of the VM disks are created using CSI Astra Trident Snapshots.

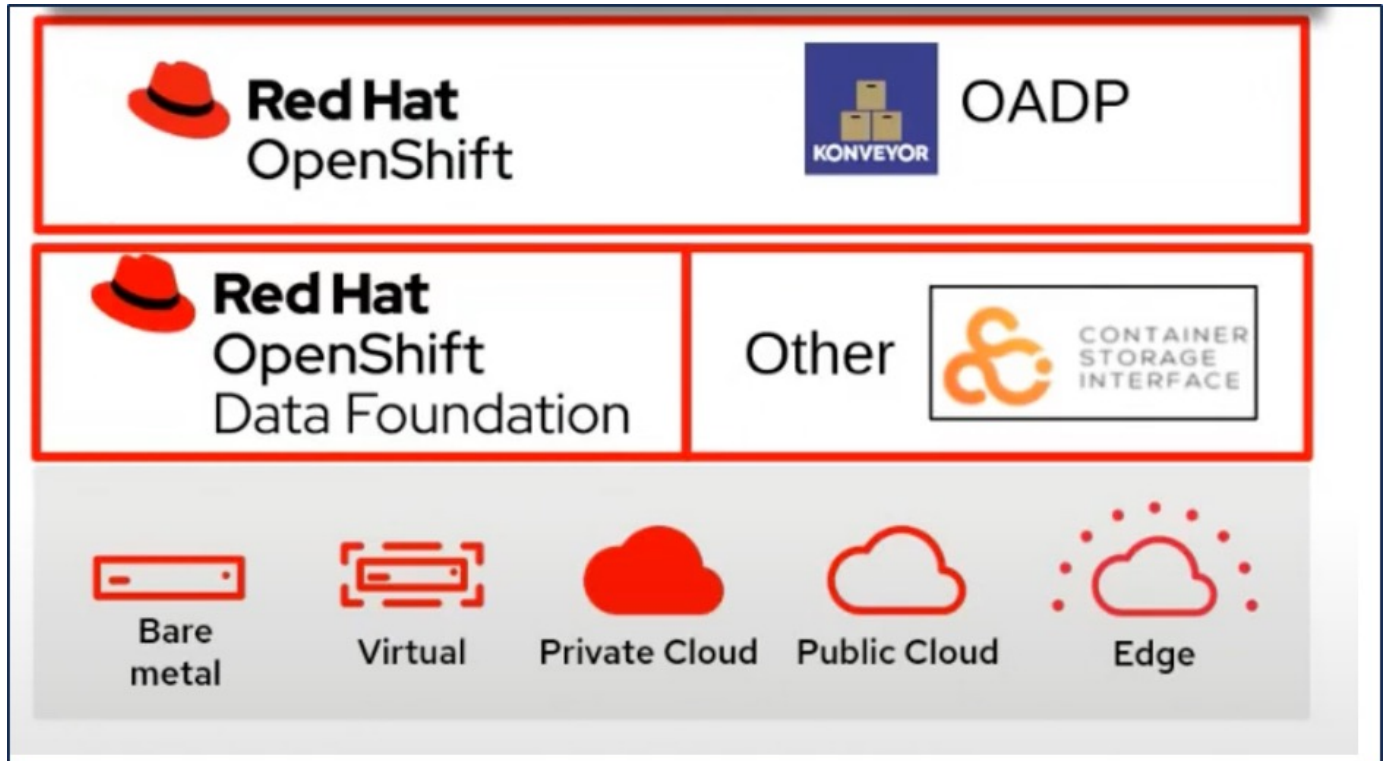
Virtual machines in the OpenShift Virtualization environment are containerized applications that run in the worker nodes of your OpenShift Container platform. It is important to protect the VM metadata as well as the persistent disks of the VMs, so that when they are lost or corrupted, you can recover them.

The persistent disks of the OpenShift Virtualization VMs can be backed by ONTAP storage integrated to the OpenShift Cluster using [Astra Trident CSI](#). In this section we use [OpenShift API for Data Protection \(OADP\)](#) to perform backup of VMs including its data volumes to

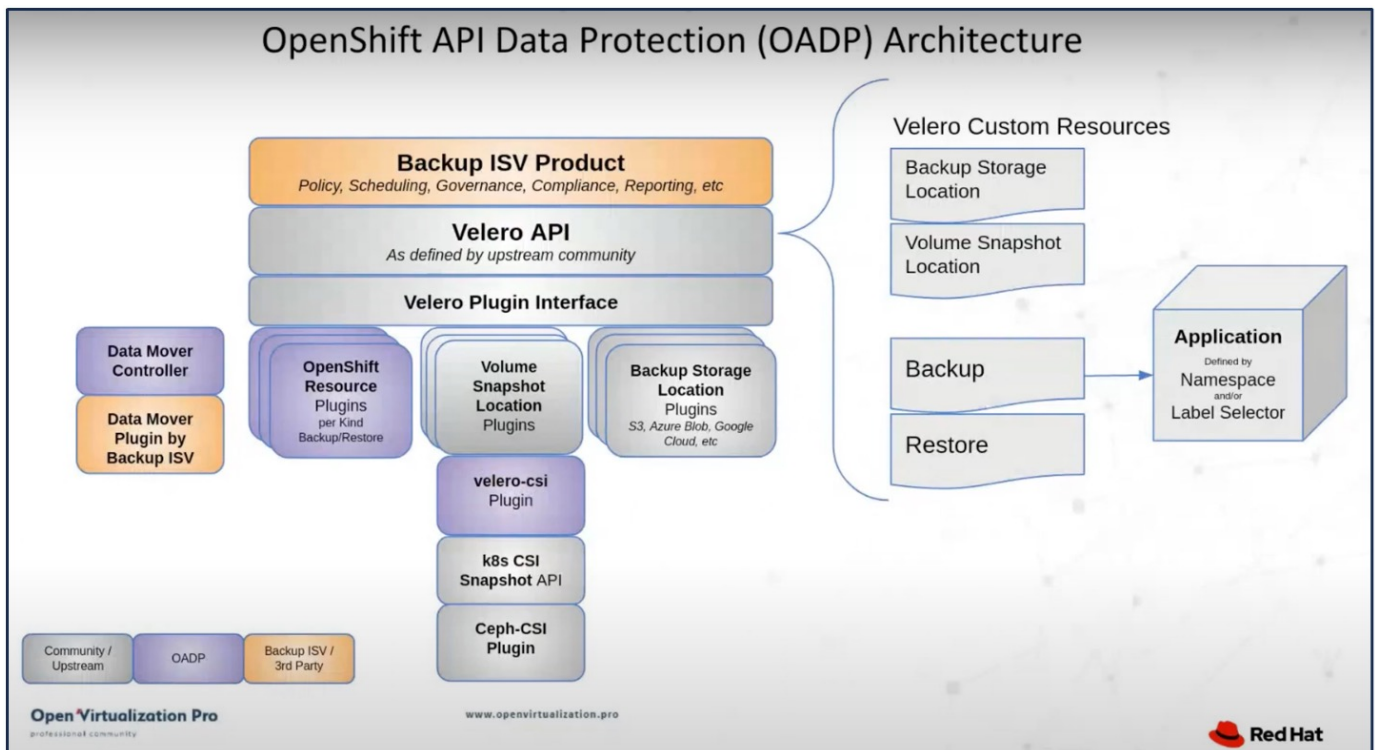
- ONTAP Object Storage
- StorageGrid

We then restore from the backup when needed.

OADP enables backup, restore, and disaster recovery of applications on an OpenShift cluster. Data that can be protected with OADP include Kubernetes resource objects, persistent volumes, and internal images.



Red Hat OpenShift has leveraged the solutions developed by the OpenSource communities for data protection. [Velero](#) is an open-source tool to safely backup and restore, perform disaster recovery, and migrate Kubernetes cluster resources and persistent volumes. To use Velero easily, OpenShift has developed the OADP operator and the Velero plugin to integrate with the CSI storage drivers. The core of the OADP APIs that are exposed are based on the Velero APIs. After installing the OADP operator and configuring it, the backup/restore operations that can be performed are based on the operations exposed by the Velero API.



OADP 1.3 is available from the operator hub of OpenShift cluster 4.12 and later. It has a built-in Data Mover that can move CSI volume snapshots to a remote object store. This provides portability and durability by moving snapshots to an object storage location during backup. The snapshots are then available for restoration after disasters.

The following are the versions of the various components used for the examples in this section

- OpenShift Cluster 4.14
- OpenShift Virtualization installed via OperatorOpenShift Virtualization Operator provided by Red Hat
- OADP Operator 1.13 provided by Red Hat
- Velero CLI 1.13 for Linux
- Astra Trident 24.02
- ONTAP 9.12

[Astra Trident CSI](#)
[OpenShift API for Data Protection \(OADP\)](#)
[Velero](#)

Installation of OpenShift API for Data Protection (OADP) Operator

This section outlines the installation of OpenShift API for Data Protection (OADP) Operator.

Prerequisites

- A Red Hat OpenShift cluster (later than version 4.12) installed on bare-metal infrastructure with RHCOS worker nodes
- A NetApp ONTAP cluster integrated with the cluster using Astra Trident

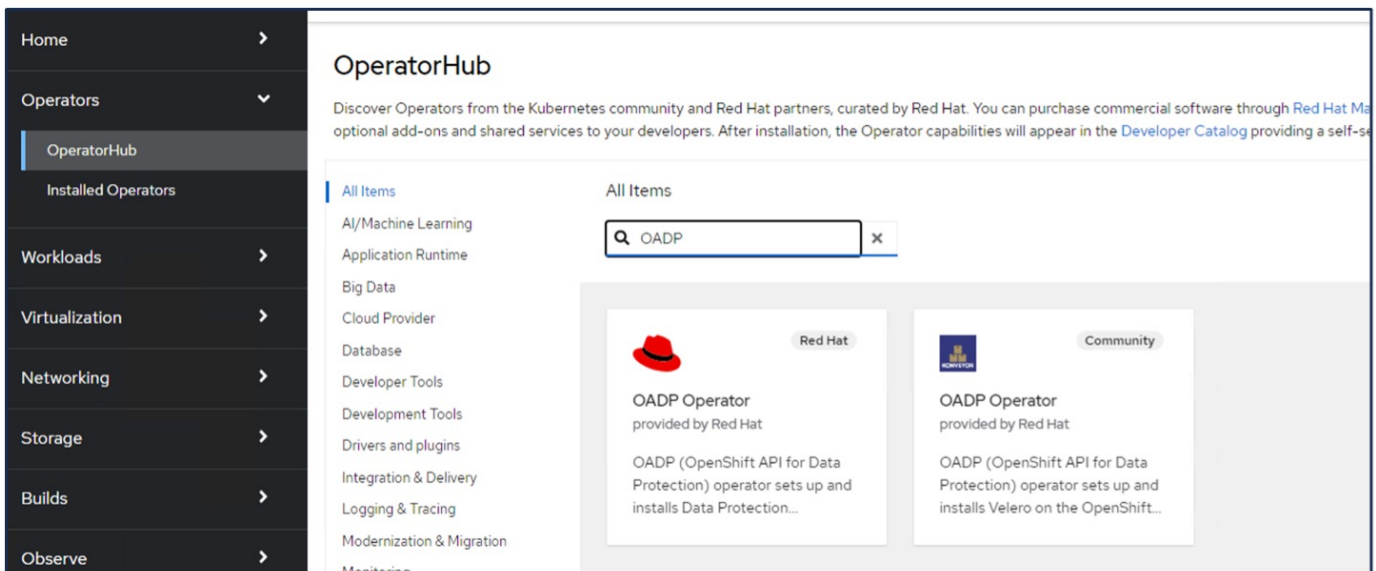
- A Trident backend configured with an SVM on ONTAP cluster
- A StorageClass configured on the OpenShift cluster with Astra Trident as the provisioner
- Trident Snapshot class created on the cluster
- Cluster-admin access to Red Hat OpenShift cluster
- Admin access to NetApp ONTAP cluster
- OpenShift Virtualization operator installed and configured
- VMs deployed in a Namespace on OpenShift Virtualization
- An admin workstation with tridentctl and oc tools installed and added to \$PATH



If you want to take a backup of a VM when it is in the Running state, then you must install the QEMU guest agent on that virtual machine. If you install the VM using an existing template, then QEMU agent is installed automatically. QEMU allows the guest agent to quiesce in-flight data in the guest OS during the snapshot process, and avoid possible data corruption. If you do not have QEMU installed, you can stop the virtual machine before taking a backup.

Steps to install OADP Operator

1. Go to the Operator Hub of the cluster and select Red Hat OADP operator. In the Install page, use all the default selections and click install. On the next page, again use all the defaults and click Install. The OADP operator will be installed in the namespace openshift-adp.





OADP Operator

1.3.0 provided by Red Hat

Install

Channel

stable-1.3

OpenShift API for Data Protection (OADP) operator sets up and installs Velero on the OpenShift platform, allowing users to backup and restore applications.

Version

1.3.0

Backup and restore Kubernetes resources and internal images, at the granularity of a namespace, using a version of Velero appropriate for the installed version of OADP.

Capability level

- Basic Install
- Seamless Upgrades
- Full Lifecycle
- Deep Insights
- Auto Pilot

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 or Kopia.

- [Installing OADP for application backup and restore](#)
- [Installing OADP on a ROSA cluster and using STS, please follow the Getting Started Steps 1-3 in order to obtain the role ARN needed for using the standardized STS configuration flow via OLM](#)
- [Frequently Asked Questions](#)

Source

Red Hat

Provider

Red Hat

Infrastructure features

Disconnected

Activate Windows

Project: All Projects

Installed Operators

Installed Operators are represented by ClusterServiceVersions within this Namespace. For more information, see the [Understanding Operators documentation](#) Operator and ClusterServiceVersion using the [Operator SDK](#).

Name Search by name... /

Name	Namespace	Managed Namespaces	Status
OpenShift Virtualization 4.14.4 provided by Red Hat	NS openshift-cnv	NS openshift-cnv	✓ Succeeded Up to date
OADP Operator 1.3.0 provided by Red Hat	NS openshift-adp	NS openshift-adp	✓ Succeeded Up to date
Package Server 0.0.1-snapshot provided by	NS openshift-operator-lifecycle-manager	NS openshift-operator-lifecycle-manager	✓ Succeeded

Prerequisites for Velero configuration with Ontap S3 details

After the installation of the operator succeeds, configure the instance of Velero.

Velero can be configured to use S3 compatible Object Storage. Configure ONTAP S3 using the procedures shown in the [Object Storage Management section of ONTAP documentation](#). You will need the following information from your ONTAP S3 configuration to integrate with Velero.

- A Logical Interface (LIF) that can be used to access S3
- User credentials to access S3 that includes the access key and the secret access key
- A bucket name in S3 for backups with access permissions for the user
- For secure access to the Object storage, TLS certificate should be installed on the Object Storage server.

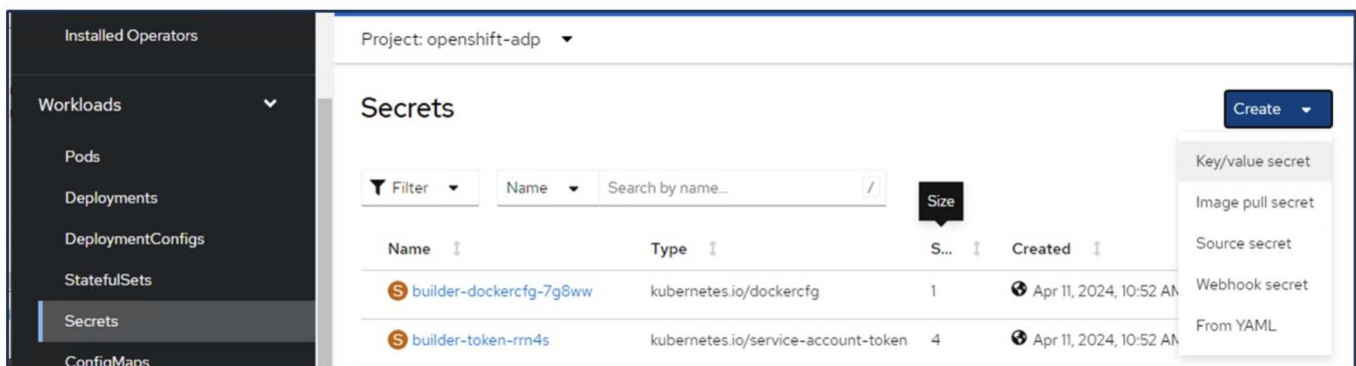
Prerequisites for Velero configuration with StorageGrid S3 details

Velero can be configured to use S3 compatible Object Storage. You can configure StorageGrid S3 using the procedures shown in the [StorageGrid documentation](#). You will need the following information from your StorageGrid S3 configuration to integrate with Velero.

- The endpoint that can be used to access S3
- User credentials to access S3 that includes the access key and the secret access key
- A bucket name in S3 for backups with access permissions for the user
- For secure access to the Object storage, TLS certificate should be installed on the Object Storage server.

Steps to configure Velero

- First, create a secret for an ONTAP S3 user credential or StorageGrid Tenant user credentials. This will be used to configure Velero later. You can create a secret from the CLI or from the web console. To create a secret from the web console, select Secrets, then click on Key/Value Secret. Provide the values for the credential name, key and the value as shown. Be sure to use the Access Key Id and Secret Access Key of your S3 user. Name the secret appropriately. In the sample below, a secret with ONTAP S3 user credentials named `ontap-s3-credentials` is created.



The screenshot shows the OpenShift web console interface for the 'Project: openshift-adp'. The left sidebar contains navigation options: Installed Operators, Workloads (expanded), Pods, Deployments, DeploymentConfigs, StatefulSets, Secrets (selected), and ConfigMaps. The main content area is titled 'Secrets' and includes a 'Create' button. Below the title is a search bar with a 'Filter' dropdown and a search input field. A table lists the following secrets:

Name	Type	Size	Created
builder-dockercfg-7g8ww	kubernetes.io/dockercfg	1	Apr 11, 2024, 10:52 AM
builder-token-rm4s	kubernetes.io/service-account-token	4	Apr 11, 2024, 10:52 AM

A dropdown menu is open from the 'Create' button, showing the following options: Key/value secret, Image pull secret, Source secret, Webhook secret, and From YAML.

Project: openshift-adp ▾

Edit key/value secret

Key/value secrets let you inject sensitive data into your application as files or environment variables.

Secret name *

 Unique name of the new secret.

Key *

Value

 Browse...

Drag and drop file with your value here or browse to upload it.

```
[default]
aws_access_key_id=
aws_secret_access_key=
```

+ Add key/value

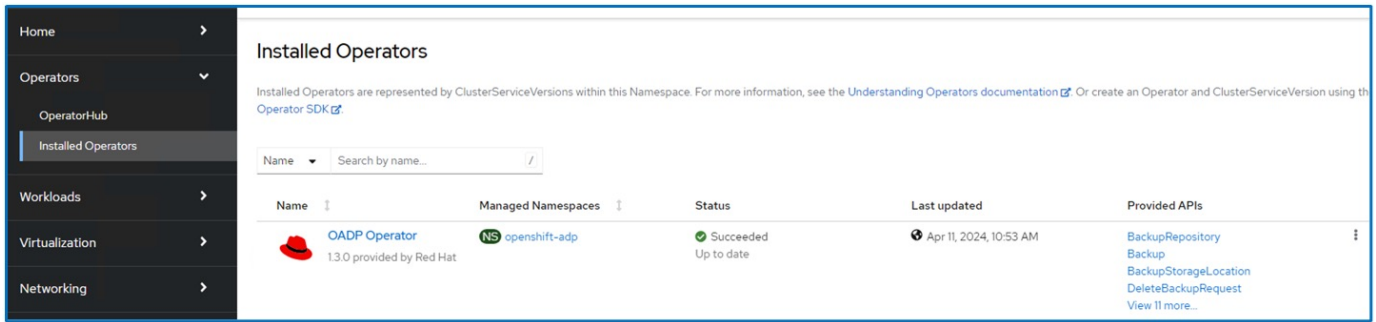
To create a secret named sg-s3-credentials from the CLI you can use the following command.

```
# oc create secret generic sg-s3-credentials --namespace openshift-adp --from-file
cloud=cloud-credentials.txt
```

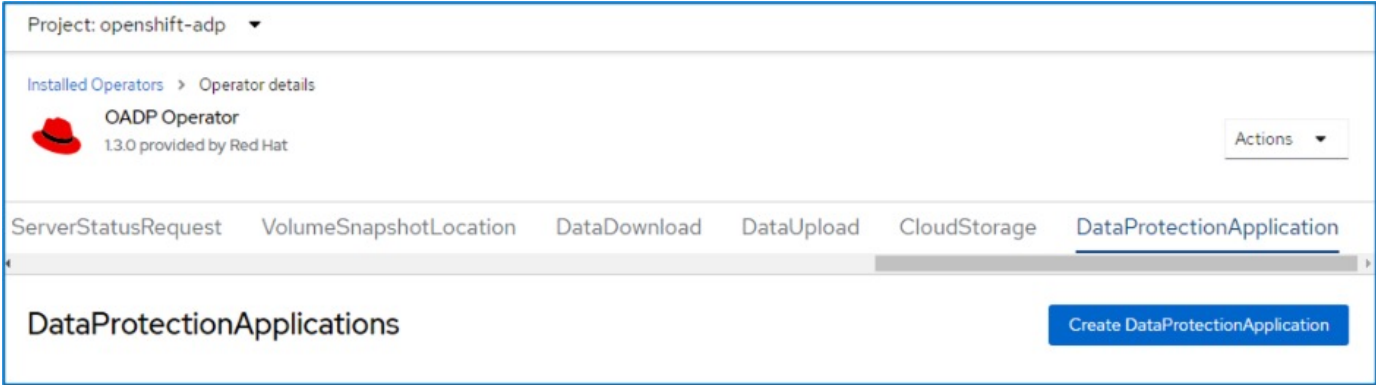
Where credentials.txt file contains the Access Key Id and the Secret Access Key of the S3 user in the following format:

```
[default]
aws_access_key_id=< Access Key ID of S3 user>
aws_secret_access_key=<Secret Access key of S3 user>
```

- Next, to configure Velero, select Installed Operators from the menu item under Operators, click on OADP operator, and then select the DataProtectionApplication tab.



Click on Create DataProtectionApplication. In the form view, provide a name for the DataProtection Application or use the default name.



Now go to the YAML view and replace the spec information as shown in the yml file examples below.

Sample yml file for configuring Velero with ONTAP S3 as the backupLocation

```

spec:
  backupLocations:
    - velero:
      config:
        insecureSkipTLSVerify: 'false' ->use this for https
communication with ONTAP S3
        profile: default
        region: us-east-1
        s3ForcePathStyle: 'True' ->This allows use of IP in s3URL
        s3Url: 'https://10.xx.xx.xx' ->LIF to access S3. Ensure TLS
certificate for S3 is configured
        credential:
          key: cloud
          name: ontap-s3-credentials ->previously created secret
        default: true
        objectStorage:
          bucket: velero ->Your bucket name previously created in S3 for
backups
          prefix: demobackup ->The folder that will be created in the
bucket
          provider: aws
        configuration:
          nodeAgent:
            enable: true
            uploaderType: kopia
            #default Data Mover uses Kopia to move snapshots to Object Storage
          velero:
            defaultPlugins:
              - csi ->Add this plugin
              - openshift
              - aws
              - kubevirt ->Add this plugin

```

Sample yaml file for configuring Velero with StorageGrid S3 as the backupLocation and snapshotLocation

```

spec:
  backupLocations:
    - velero:
      config:
        insecureSkipTLSVerify: 'true'
        profile: default
        region: us-east-1 ->region of your StorageGrid system
        s3ForcePathStyle: 'True'
        s3Url: 'https://172.21.254.25:10443' ->the IP used to access S3
      credential:
        key: cloud
        name: sg-s3-credentials ->secret created earlier
      default: true
      objectStorage:
        bucket: velero
        prefix: demobackup
      provider: aws
  configuration:
    nodeAgent:
      enable: true
      uploaderType: kopia
    velero:
      defaultPlugins:
        - csi
        - openshift
        - aws
        - kubevirt

```

The spec section in the yaml file should be configured appropriately for the following parameters similar to the example above

backupLocations

ONTAP S3 or StorageGrid S3 (with its credentials and other information as shown in the yaml) is configured as the default BackupLocation for velero.

snapshotLocations

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. In our example, you use Astra Trident CSI and you have previously created VolumeSnapShotClass CR using the Trident CSI driver.

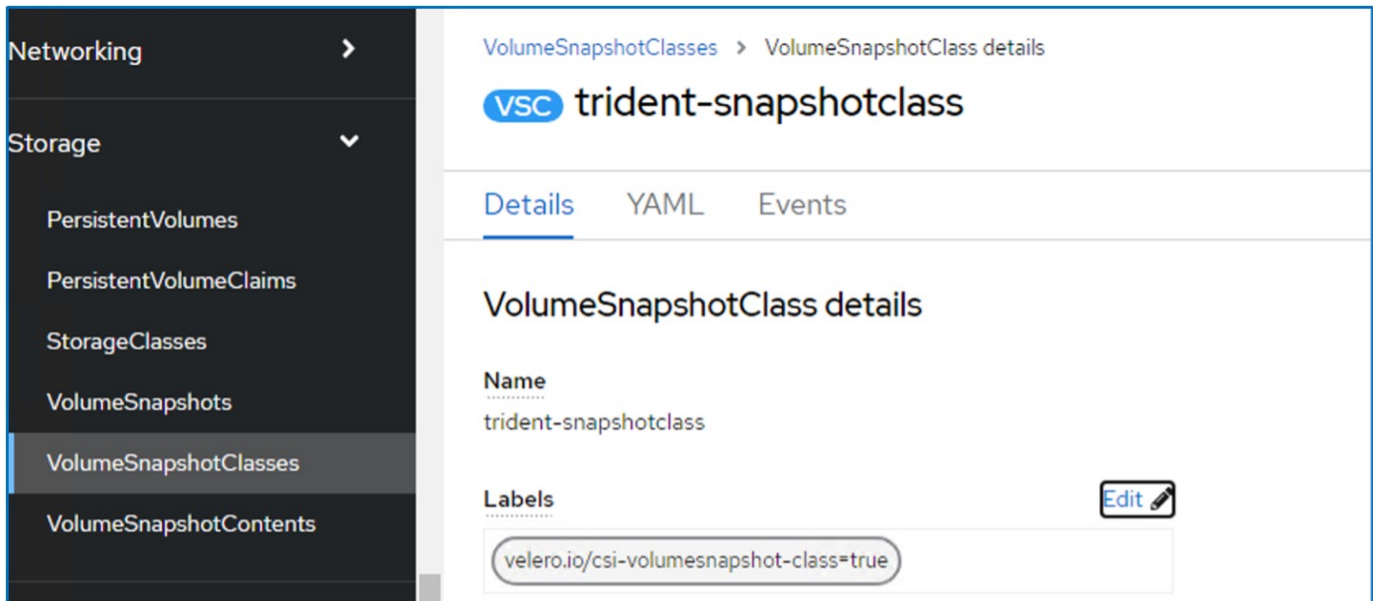
Enable CSI plugin

Add csi to the defaultPlugins for Velero to back up persistent volumes with CSI snapshots.

The Velero CSI plugins, to backup CSI backed PVCs, will choose the VolumeSnapshotClass in the cluster that has **velero.io/csi-volumesnapshot-class** label set on it. For this

- You must have the trident VolumeSnapshotClass created.
- Edit the label of the trident-snapshotclass and set it to

`velero.io/csi-volumesnapshot-class=true` as shown below.



The screenshot displays the Kubernetes dashboard interface. On the left, a dark sidebar contains a navigation menu with 'Storage' expanded and 'VolumeSnapshotClasses' selected. The main panel shows the 'VolumeSnapshotClass details' for 'trident-snapshotclass'. The 'Name' field is 'trident-snapshotclass'. The 'Labels' field contains the value 'velero.io/csi-volumesnapshot-class=true' and has an 'Edit' button next to it.

Ensure that the snapshots can persist even if the VolumeSnapshot objects are deleted. This can be done by setting the **deletionPolicy** to Retain. If not, deleting a namespace will completely lose all PVCs ever backed up in it.

```
apiVersion: snapshot.storage.k8s.io/v1
kind: VolumeSnapshotClass
metadata:
  name: trident-snapshotclass
driver: csi.trident.netapp.io
deletionPolicy: Retain
```


VolumeSnapshotClasses > VolumeSnapshotClass details

VSC trident-snapshotclass


Details | YAML | Events

VolumeSnapshotClass details

Name
trident-snapshotclass

Labels Edit 

velero.io/csi-volumesnapshot-class=true



Annotations
1 annotation 

Driver
csi.trident.netapp.io

Deletion policy
Retain

Ensure that the DataProtectionApplication is created and is in condition:Reconciled.


Installed Operators > Operator details







 **OADP Operator**
1.3.0 provided by Red Hat Actions 

ServerStatusRequest | VolumeSnapshotLocation | DataDownload | DataUpload | CloudStorage | DataProtectionApplication

DataProtectionApplications

Create DataProtectionApplication


Name  Search by name... /

Name 	Kind 	Status 	Labels 
 velero-demo	DataProtectionApplication	Condition: Reconciled	No labels 

The OADP operator will create a corresponding BackupStorageLocation. This will be used when creating a backup.

Project: openshift-adp ▾

Installed Operators > Operator details

 **OADP Operator**
1.3.0 provided by Red Hat


Actions ▾

Repository Backup BackupStorageLocation DeleteBackupRequest DownloadRequest PodVolumeBackup PodVolumeRe

BackupStorageLocations

Create BackupStorageLocation

Name ▾ Search by name... /

Name ↕	Kind ↕	Status ↕	Labels ↕
 velero-demo-1	BackupStorageLocation	Phase: Available	<ul style="list-style-type: none"> app.kubernetes.io/component=bsl app.kubernetes.io/instance=velero-demo-1 app.kubernetes.io/manager=oadp-oper... app.kubernetes.io/n...=oadp-operator-ve... openshift.io/oadp=True openshift.io/oadp-registry=True

Creating on-demand backup for VMs in OpenShift Virtualization

This section outlines how to create on-demand backup for VMs in OpenShift Virtualization.

Steps to create a backup of a VM

To create an on-demand backup of the entire VM (VM metadata and VM disks), click on the **Backup** tab. This creates a Backup Custom Resource (CR). A sample yaml is provided to create the Backup CR. Using this yaml, the VM and its disks in the specified namespace will be backed up. Additional parameters can be set as shown in the [documentation](#).

A snapshot of the persistent volumes backing the disks will be created by the CSI. A backup of the VM along with the snapshot of its disks are created and stored in the backup location specified in the yaml. The backup will remain in the system for 30 days as specified in the ttl.

```

apiVersion: velero.io/v1
kind: Backup
metadata:
  name: backup1
  namespace: openshift-adp
spec:
  includedNamespaces:
  - virtual-machines-demo
  snapshotVolumes: true
  storageLocation: velero-demo-1 -->this is the backupStorageLocation
  previously created
                                     when Velero is configured.
  ttl: 720h0m0s

```

Once the backup completes, its Phase will show as completed.

The screenshot shows the OpenShift console interface for the OADP Operator. The 'Backup' tab is active, showing a list of backups. The table has columns for Name, Kind, Status, and Labels. A single backup named 'backup1' is listed with a status of 'Completed' and a label 'velero.io/storage-location=velero-demo-1'. A 'Create Backup' button is visible in the top right corner of the backup list area.

Name	Kind	Status	Labels
backup1	Backup	Phase: ✔ Completed	velero.io/storage-location=velero-demo-1

You can inspect the backup in the Object storage with the help of an S3 browser application. The path of the backup shows in the configured bucket with the prefix name (velero/demobackup). You can see the contents of the backup includes the volume snapshots, logs, and other metadata of the virtual machine.



In StorageGrid, you can also use the S3 console that is available from the Tenant Manager to view the backup objects.

Name	Size	Type	Last Modified	Storage Class
backup1.tar.gz	230.36 KB	GZ File	4/15/2024 10:26:29 PM	STANDARD
velero-backup.json	3.35 KB	JSON File	4/15/2024 10:26:29 PM	STANDARD
backup1-resource-list.json.gz	1.12 KB	GZ File	4/15/2024 10:26:29 PM	STANDARD
backup1-itemoperations.json.gz	600 bytes	GZ File	4/15/2024 10:26:28 PM	STANDARD
backup1-volumesnapshots.json.gz	29 bytes	GZ File	4/15/2024 10:26:28 PM	STANDARD
backup1-podvolumebackups.json.gz	29 bytes	GZ File	4/15/2024 10:26:28 PM	STANDARD
backup1-results.gz	49 bytes	GZ File	4/15/2024 10:26:28 PM	STANDARD
backup1-csi-volumesnapshotclasses.json.gz	426 bytes	GZ File	4/15/2024 10:26:28 PM	STANDARD
backup1-csi-volumesnapshotcontents.json.gz	1.43 KB	GZ File	4/15/2024 10:26:28 PM	STANDARD
backup1-csi-volumesnapshots.json.gz	1.34 KB	GZ File	4/15/2024 10:26:28 PM	STANDARD
backup1-logs.gz	13.49 KB	GZ File	4/15/2024 10:26:28 PM	STANDARD

Creating scheduled backups for VMs in OpenShift Virtualization

To create backups on a schedule, you need to create a Schedule CR.

The schedule is simply a Cron expression allowing you to specify the time at which you want to create the backup. A sample yaml to create a Schedule CR.

```

apiVersion: velero.io/v1
kind: Schedule
metadata:
  name: <schedule>
  namespace: openshift-adp
spec:
  schedule: 0 7 * * *
  template:
    hooks: {}
    includedNamespaces:
      - <namespace>
    storageLocation: velero-demo-1
    defaultVolumesToFsBackup: true
    ttl: 720h0m0s

```


The Cron expression 0 7 * * * means a backup will be created at 7:00 every day.

The namespaces to be included in the backup and the storage location for the backup are also specified. So instead of a Backup CR, Schedule CR is used to create a backup at the specified time and frequency.

Once the schedule is created, it will be Enabled.

Project: openshift-adp ▾



Installed Operators > Operator details

 **OADP Operator**
1.3.0 provided by Red Hat

storageLocation DeleteBackupRequest DownloadRequest PodVolumeBackup PodVolumeRestore Restore Schedule

Schedules


Name ▾ Search by name... /

Name	Kind	Status	Labels
 schedule1	Schedule	Phase:  Enabled	No labels

Backups will be created according to this schedule, and can be viewed from the Backup tab.

Project: openshift-adp ▾

Installed Operators > Operator details


 **OADP Operator**
1.3.0 provided by Red Hat

Events All instances BackupRepository Backup BackupStorageLocation DeleteBackupRequest DownloadRequest

Backups

[Create Backup](#)

Name ▾ Search by name... /

Name	Kind	Status	Labels
 schedule1-20240416140507	Backup	Phase: InProgress	<ul style="list-style-type: none"> velero.io/schedule-name=schedule1 velero.io/storage-location=velero-demo-1

Restore a VM from a backup

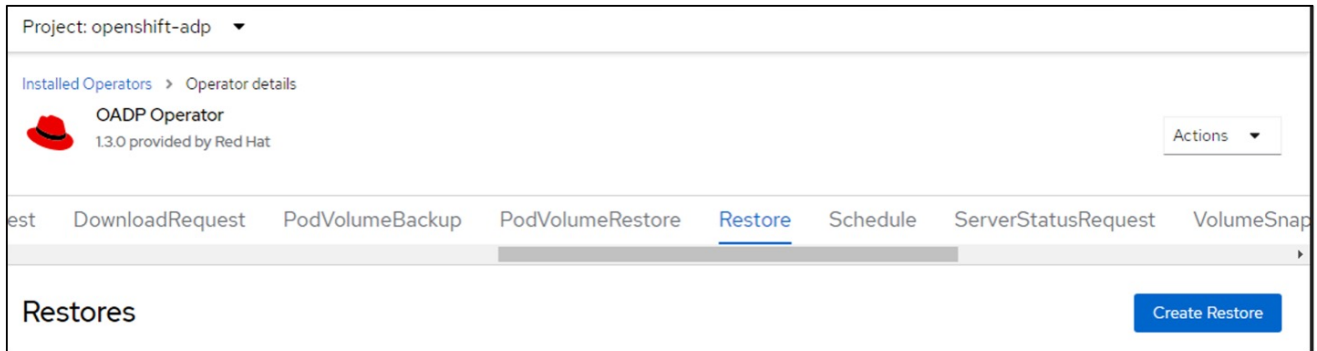
This section describes how to restore virtual machine(s) from a backup.

Prerequisites

To restore from a backup, let us assume that the namespace where the virtual machine existed got accidentally deleted.

Restore to the same namespace

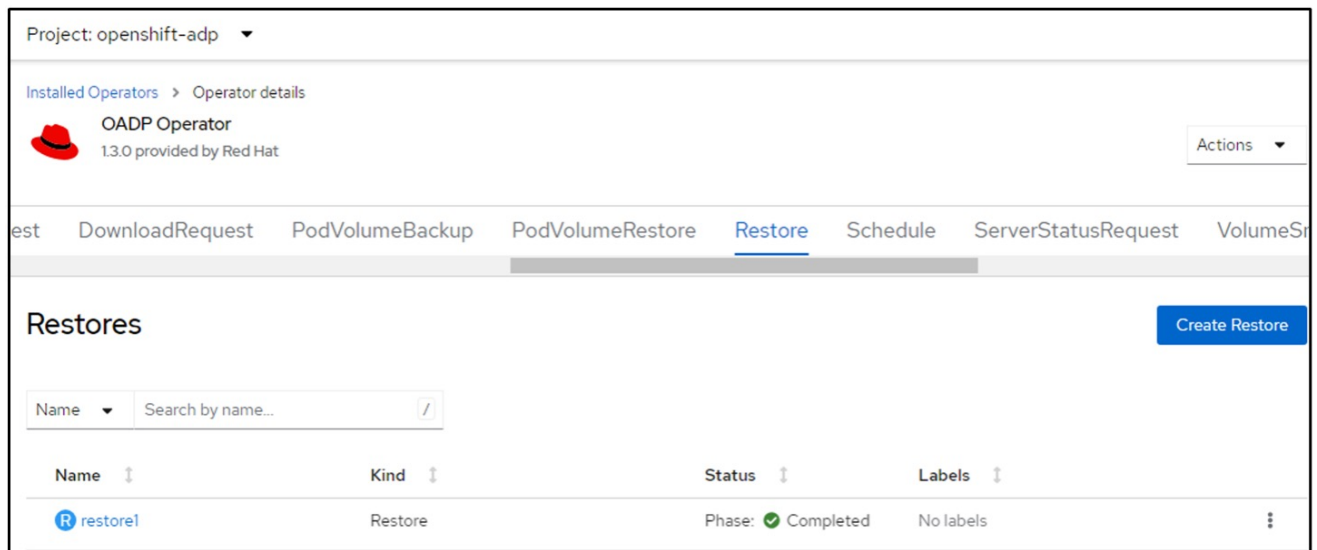
To restore from the backup that we just created, we need to create a Restore Custom Resource (CR). We need to provide it a name, provide the name of the backup that we want to restore from and set the restorePVs to true. Additional parameters can be set as shown in the [documentation](#). Click on Create button.





The screenshot shows the OADP Operator interface. At the top, it says "Project: openshift-adp". Below that, it shows "Installed Operators > Operator details" for the "OADP Operator" (13.0 provided by Red Hat). A navigation bar includes "DownloadRequest", "PodVolumeBackup", "PodVolumeRestore", "Restore" (selected), "Schedule", "ServerStatusRequest", and "VolumeSnap". Below the navigation bar, the "Restores" section is visible with a "Create Restore" button.

```
apiVersion: velero.io/v1
kind: Restore
metadata:
  name: restore1
  namespace: openshift-adp
spec:
  backupName: backup1
  restorePVs: true
```

When the phase shows completed, you can see that the virtual machines have been restored to the state when the snapshot was taken. (If the backup was created when the VM was running, restoring the VM from the backup will start the restored VM and bring it to a running state). The VM is restored to the same namespace.



The screenshot shows the OADP Operator interface with the "Restores" section. A search bar is present with "Name" and "Search by name...". Below it, a table lists the restore operation:

Name	Kind	Status	Labels
 restore1	Restore	Phase:  Completed	No labels

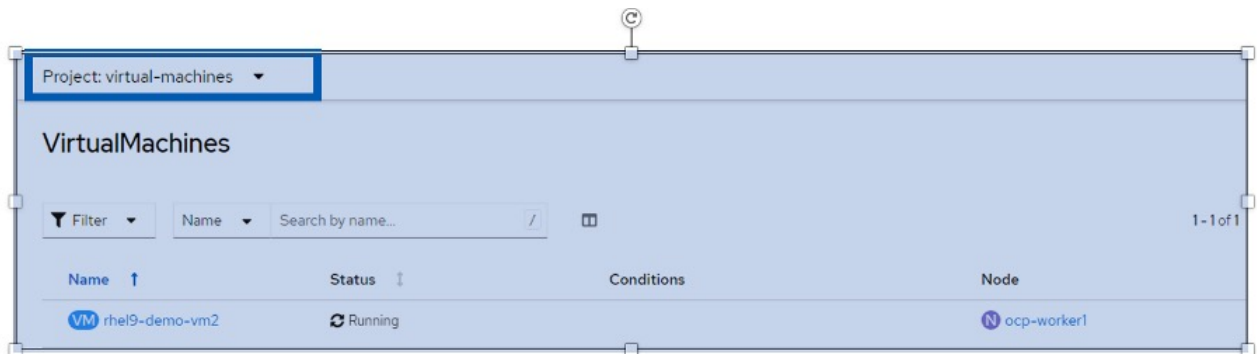
Restore to a different namespace




To restore the VM to a different namespace, you can provide a namespaceMapping in the yaml definition of the Restore CR.

The following sample yaml file creates a Restore CR to restore a VM and its disks in the virtual-machines-demo namespace when the backup was taken to the virtual-machines namespace.

```
apiVersion: velero.io/v1
kind: Restore
metadata:
  name: restore-to-different-ns
  namespace: openshift-adp
spec:
  backupName: backup
  restorePVs: true
  includedNamespaces:
  - virtual-machines-demo
  namespaceMapping:
    virtual-machines-demo: virtual-machines
```

When the phase shows completed, you can see that the virtual machines have been restored to the state when the snapshot was taken. (If the backup was created when the VM was running, restoring the VM from the backup will start the restored VM and bring it to a running state). The VM is restored to a different namespace as specified in the yaml.



Name ↑	Status ↓	Conditions	Node
 rhel9-demo-vm2	 Running		 ocp-worker1

Restore to a different storage class

Velero provides a generic ability to modify the resources during restore by specifying json patches. The json patches are applied to the resources before they are restored. The json patches are specified in a configmap and the configmap is referenced in the restore command. This feature enables you to restore using different storage class.

In the example below, the virtual machine, during creation uses ontap-nas as the storage class for its disks. A backup of the virtual machine named backup1 is created.

The screenshot shows the configuration page for a virtual machine named 'rhel9-demo-vm1' in the 'virtual-machines-demo' project. The 'Disks' section is expanded, showing a table of disks. The 'disk1' and 'rootdisk' are both backed up from PVCs named 'rhel9-demo-vm1-disk1' and 'rhel9-demo-vm1' respectively, both using the 'ontap-nas' storage class.

Name	Source	Size	Drive	Interface	Storage class
cloudinitdisk	Other	-	Disk	virtio	-
disk1	PVC rhel9-demo-vm1-disk1	31.75 GiB	Disk	virtio	ontap-nas
rootdisk	PVC rhel9-demo-vm1	31.75 GiB	Disk	virtio	ontap-nas

The screenshot shows the backup details for the OADP Operator in the 'openshift-adp' project. A backup named 'backup1' is listed with a status of 'Completed'.

Name	Kind	Status
backup1	Backup	Phase: Completed

Simulate a loss of the VM by deleting the VM.

To restore the VM using a different storage class, for example, ontap-nas-eco storage class, you need to do the following two steps:

Step 1

Create a config map (console) in the openshift-adp namespace as follows:

Fill in the details as shown in the screenshot:

Select namespace : openshift-adp

Name: change-storage-class-config (can be any name)

Key: change-storage-class-config.yaml:

Value:

```
version: v1
resourceModifierRules:
- conditions:
  groupResource: persistentvolumeclaims
  resourceNameRegex: "^rhel*"
  namespaces:
  - virtual-machines-demo
patches:
- operation: replace
  path: "/spec/storageClassName"
  value: "ontap-nas-eco"
```

The screenshot shows the 'Edit ConfigMap' interface in the OpenShift console. The left sidebar lists various Kubernetes resources, with 'ConfigMaps' selected. The main content area shows the configuration for a ConfigMap named 'change-storage-class-config'. The 'Name' field is filled with 'change-storage-class-config'. Below the name, there is a checkbox for 'Immutable' which is unchecked. The 'Data' section shows a key-value pair where the key is 'change-storage-class-config.yaml' and the value is the YAML configuration shown in the previous block. The 'Value' field has a 'Browse...' button and a text area containing the YAML content. At the bottom, there is a '+ Add key/value' button.

The resulting config map object should look like this (CLI):


```

# kubectl describe cm/change-storage-class-config -n openshift-
adp
Name:          change-storage-class-config
Namespace:    openshift-adp
Labels:       velero.io/change-storage-class=RestoreItemAction
              velero.io/plugin-config=
Annotations:  <none>

Data
====
change-storage-class-config.yaml:
----
version: v1
resourceModifierRules:
- conditions:
    groupResource: persistentvolumeclaims
    resourceNameRegex: "^rhel*"
    namespaces:
    - virtual-machines-demo
patches:
- operation: replace
  path: "/spec/storageClassName"
  value: "ontap-nas-eco"

BinaryData
====

Events:  <none>

```

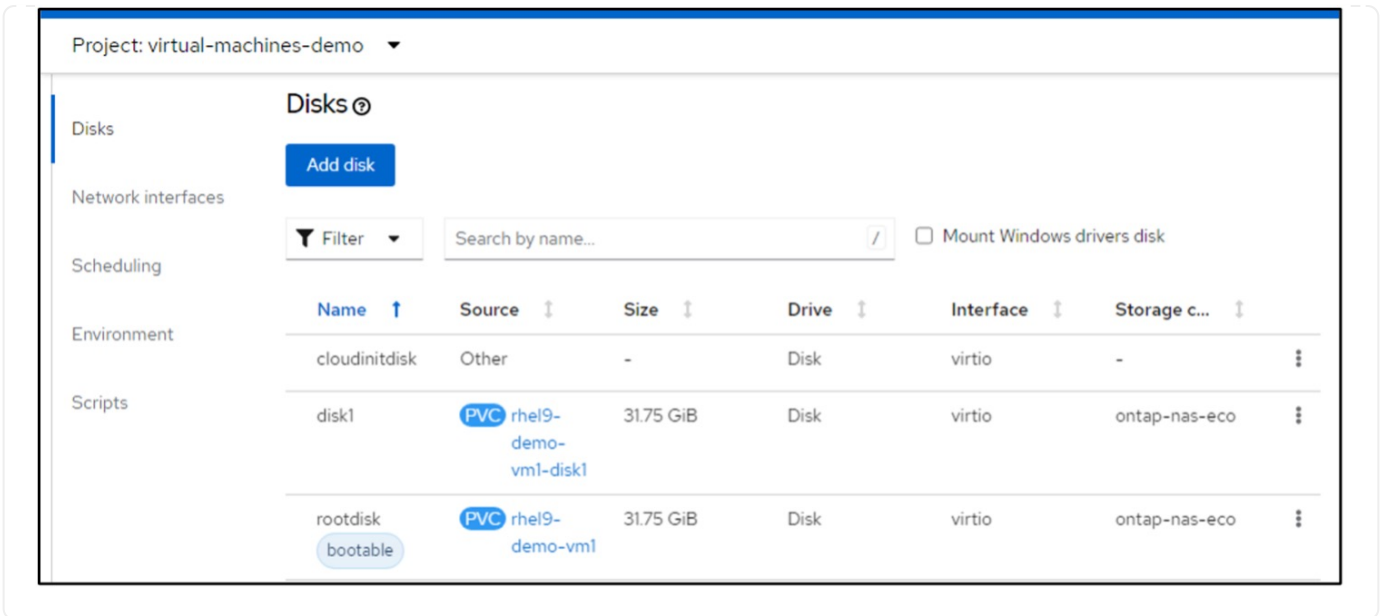
This config map will apply the resource modifier rule when the restore is created. A patch will be applied to replace the storage class name to ontap-nas-eco for all persistent volume claims starting with rhel.

Step 2

To restore the VM use the following command from the Velero CLI:

```
#velero restore create restore1 --from-backup backup1 --resource
-modifier-configmap change-storage-class-config -n openshift-adp
```

The VM is restored in the same namespace with the disks created using the storage class ontap-nas-eco.



Deleting backups and restores in using Velero

This section outlines how to delete backups and restores for VMs in OpenShift Virtualization using Velero.

Deleting a backup

You can delete a Backup CR without deleting the Object Storage data by using the OC CLI tool.

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

If you want to delete the Backup CR and delete the associated object storage data, you can do so by using the Velero CLI tool.

Download the CLI as given in the instructions in the [Velero documentation](#).

Execute the following delete command using the Velero CLI

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

Deleting a Restore

You can delete the Restore CR using the Velero CLI

```
velero restore delete restore --namespace openshift-adp
```

You can use oc command as well as the UI to delete the restore CR

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

Monitoring using Cloud Insights

Monitoring using Cloud Insights for VMs in Red Hat OpenShift Virtualization

Author: Banu Sundhar, NetApp

This section of the reference document provides details for integrating NetApp Cloud Insights with a Red Hat OpenShift Cluster to monitor OpenShift Virtualization VMs.

NetApp Cloud Insights is a cloud infrastructure monitoring tool that gives you visibility into your complete infrastructure. With Cloud Insights, you can monitor, troubleshoot, and optimize all your resources including your public clouds and your private data centers. For more information about NetApp Cloud Insights, refer to the [Cloud Insights documentation](#).

To start using Cloud Insights, you must sign up on the NetApp BlueXP portal. For details, refer to the [Cloud Insights Onboarding](#)

Cloud Insights has several features that enable you to quickly and easily find data, troubleshoot issues, and provide insights into your environment. You can find data easily with powerful queries, you can visualize data in dashboards, and send email alerts for data thresholds you set. Refer to the [video tutorials](#) to help you understand these features.

For Cloud Insights to start collecting data you need the following

Data Collectors

There are 3 types of Data Collectors:

- * Infrastructure (storage devices, network switches, compute infrastructure)
- * Operating Systems (such as VMware or Windows)
- * Services (such as Kafka)

Data Collectors discover information from the data sources, such as ONTAP storage device (infrastructure data collector). The information gathered is used for analysis, validation, monitoring, and troubleshooting.

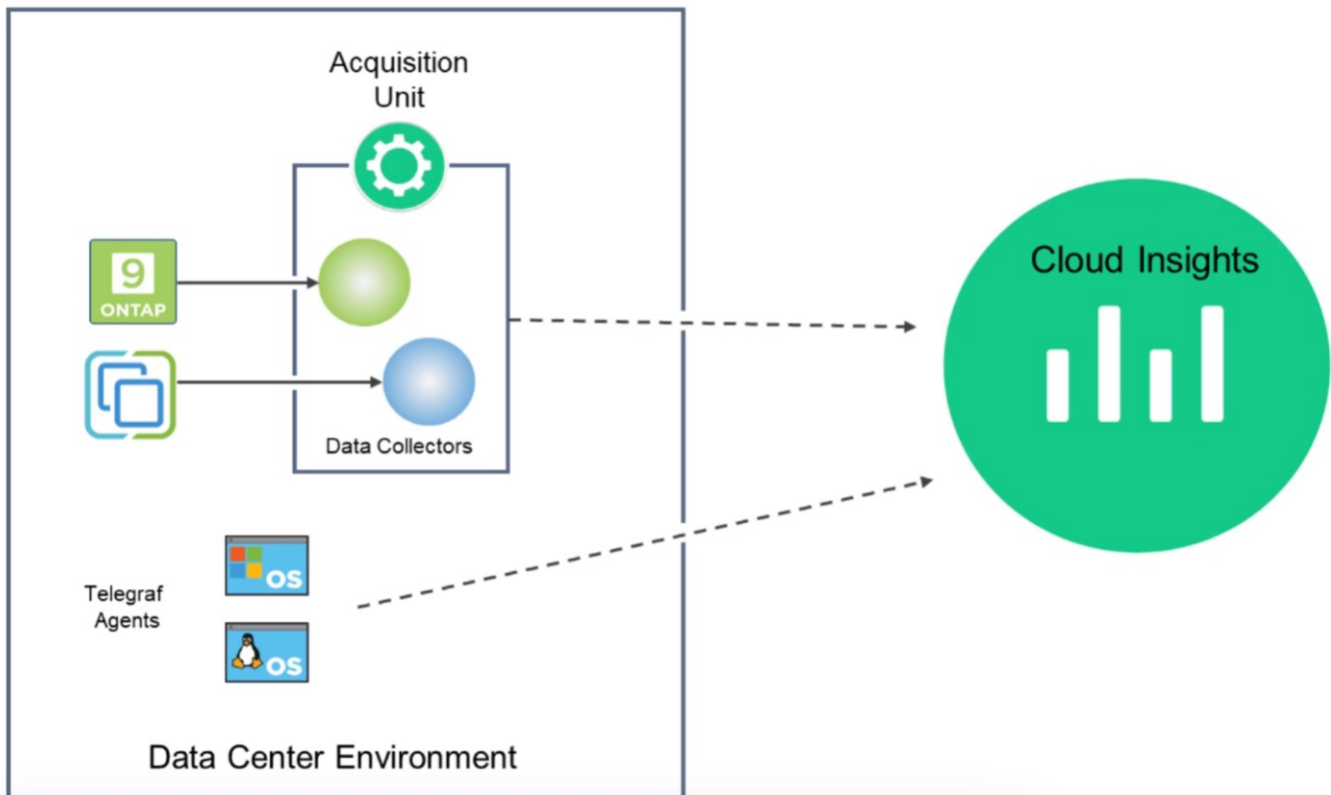
Acquisition Unit

If you are using an infrastructure Data Collector, you also need an Acquisition Unit to inject data into Cloud Insights. An Acquisition Unit is a computer dedicated to hosting data collectors, typically a Virtual Machine. This computer is typically located in the same data center/VPC as the monitored items.

Telegraf Agents

Cloud Insights also supports Telegraf as its agent for collection of integration data. Telegraf is a plugin-driven server agent that can be used to collect and report metrics, events, and logs.

Cloud Insights Architecture



Integration with Cloud Insights for VMs in Red Hat OpenShift Virtualization

To start collecting data for VMs in OpenShift Virtualization you will need to install:

1. A Kubernetes monitoring operator and data collector to collect Kubernetes data
For complete instructions, refer to the [documentation](#).
2. An acquisition unit to collect data from ONTAP storage that provides persistent storage for the VM disks
For complete instructions, refer to the [documentation](#).
3. A data collector for ONTAP
For complete instructions, refer to the [documentation](#)

Additionally, if you are using StorageGrid for VM backups, you need a data collector for the StorageGRID as well.

Sample Monitoring capabilities for VMs in Red Hat OpenShift Virtualization

This section discusses monitoring using Cloud Insights for VMs in Red Hat OpenShift Virtualization.

Monitoring based on events and creating Alerts

Here is a sample where the namespace that contains a VM in OpenShift Virtualization is monitored based on events. In this example, a monitor is created based on `logs.kubernetes.event` for the specified namespace in the cluster.

NetApp PCS Sandbox / Observability / Alerts / Manage Monitors / Monitor virtual-machines-demo-ns

Edit log monitor

Filter/Advanced Query and Group by in section 1 must not be empty. If alert resolution is based on log entry, section 3 filter/advanced query also must not be empty.

1 Select the log to monitor

Log Source: logs.kubernetes.event

Filter By: kubernetes_cluster: ocp-cluster4, involvedobject.namespace: virtual-machines-demo

Group By: reason

27 Items found

timestamp ↓	type	source	message
04/19/2024 10:31:18 AM	logs.kubernetes.event	kubernetes_cluster:ocp-cluster4;namespace:cloudi nsights- monitoring;pod_name:net app-ci-event-exporter- 7f7c8d84c4-sk7t9;	VirtualMachineInstance started.
04/19/2024 10:31:18 AM	logs.kubernetes.event	kubernetes_cluster:ocp-cluster4;namespace:cloudi nsights- monitoring;pod_name:net app-ci-event-exporter- 7f7c8d84c4-sk7t9;	VirtualMachineInstance defined.

2 Define alert behavior

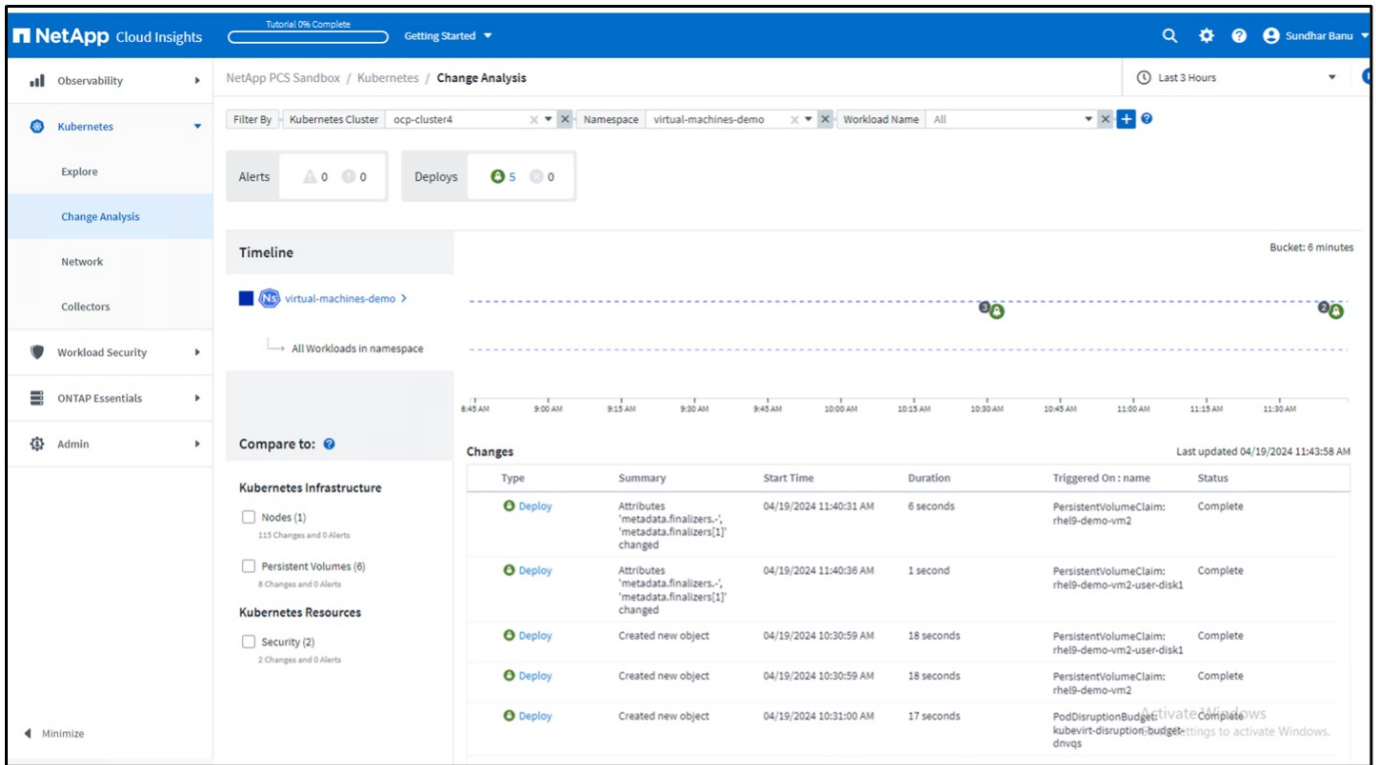
Create an alert at severity: Warning when the conditions above occur 1 time

This query provides all the events for the virtual machine in the namespace. (There is only one virtual machine in the namespace). An advanced query can also be constructed to filter based on the event where the reason is “failed” or “FailedMount” These events are typically created when there is an issue in creating a PV or mounting the PV to a pod indicating issues in the dynamic provisioner for creating persistent volumes for the VM.

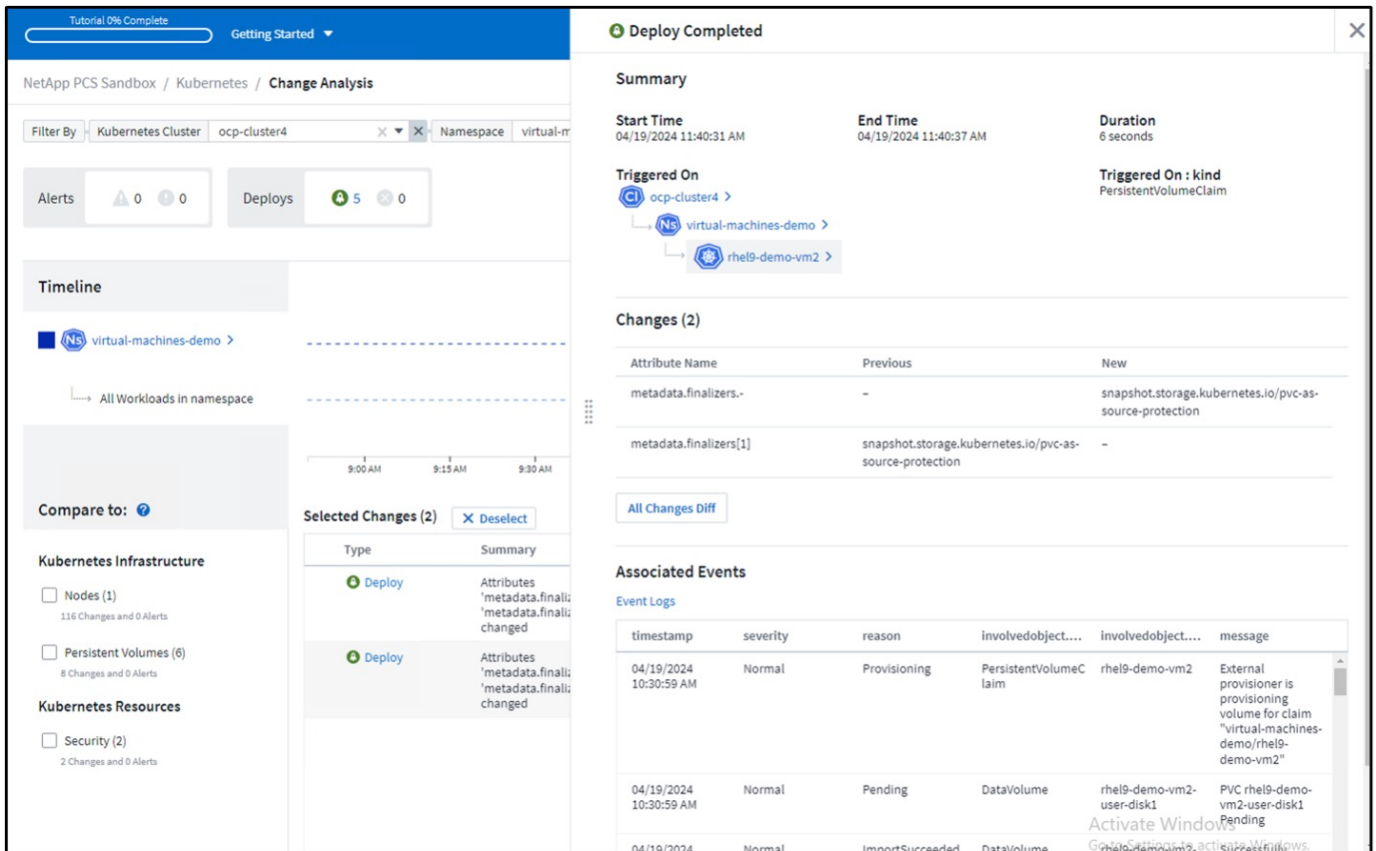
While creating the Alert Monitor as shown above, you can also configure notification to recipients. You can also provide corrective actions or additional information that can be useful to resolve the error. In the above example, additional information could be to look into the Trident backend configuration and storage class definitions for resolving the issue.

Change Analytics

With Change Analytics, you can get a view of what changed in the state of your cluster including who made that change which can help in troubleshooting issues.



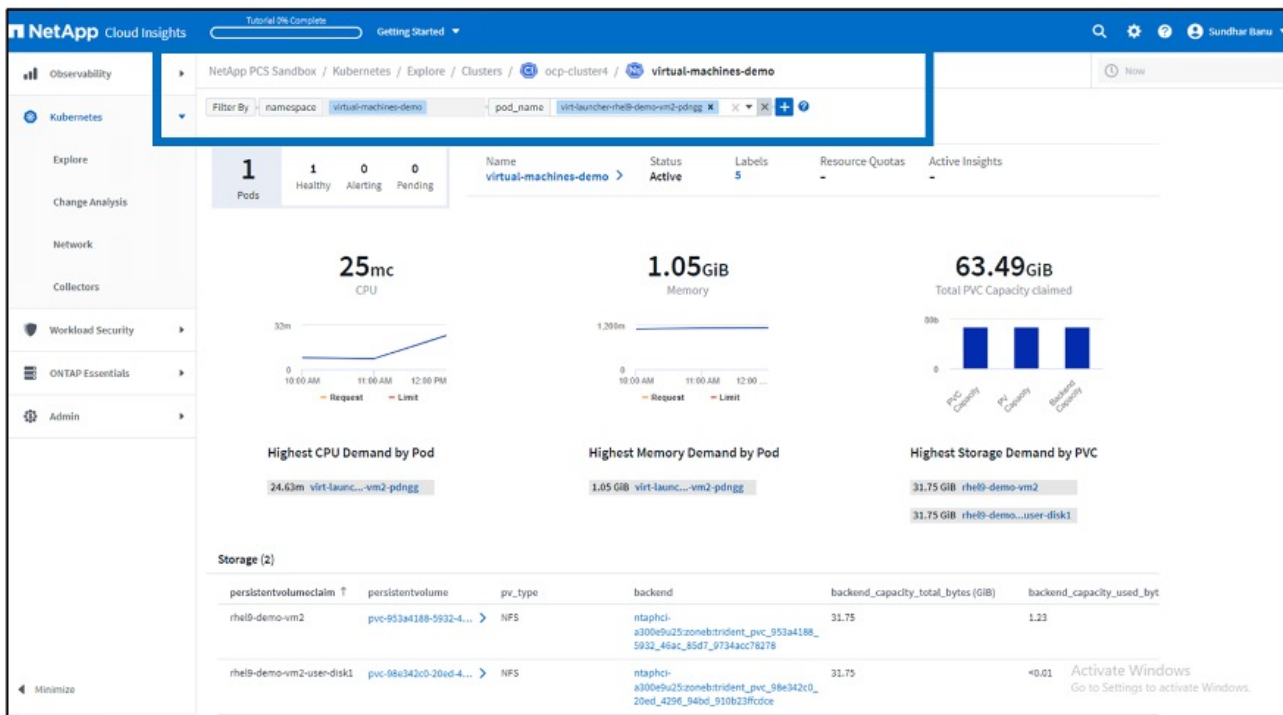
In the above example, Change Analysis is configured on the OpenShift cluster for the namespace that contains an OpenShift Virtualization VM. The dashboard shows changes against the timeline. You can drill down to see what changed and the click on All Changes Diff to see the diff of the manifests. From the manifest, you can see that a new backup of the persistent disks was created.



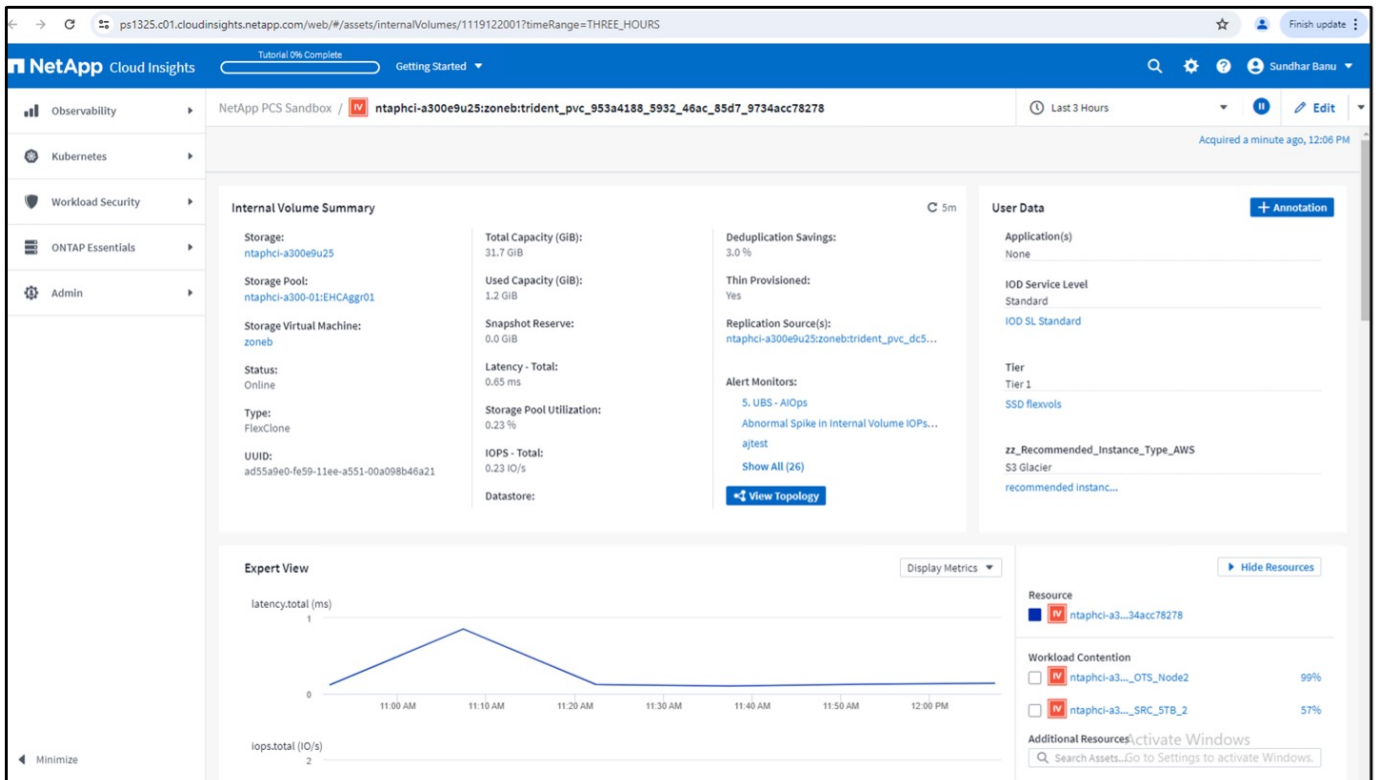
All Changes Diff			
Previous		New	
Expand 45 lines ...			
46	kind: DataVolume	46	kind: DataVolume
47	name: rhel9-demo-vm2	47	name: rhel9-demo-vm2
48	uid: dcf93b7a-71bc-409b-ad12-4916d05e0980	48	uid: dcf93b7a-71bc-409b-ad12-4916d05e0980
49	- resourceVersion: "8569671"	49	+ resourceVersion: "8619670"
50	uid: 953a4188-5932-46ac-85d7-9734acc78278	50	uid: 953a4188-5932-46ac-85d7-9734acc78278
51	spec:	51	spec:
52	accessModes:	52	accessModes:
Expand 15 lines ...			

Backend Storage Mapping

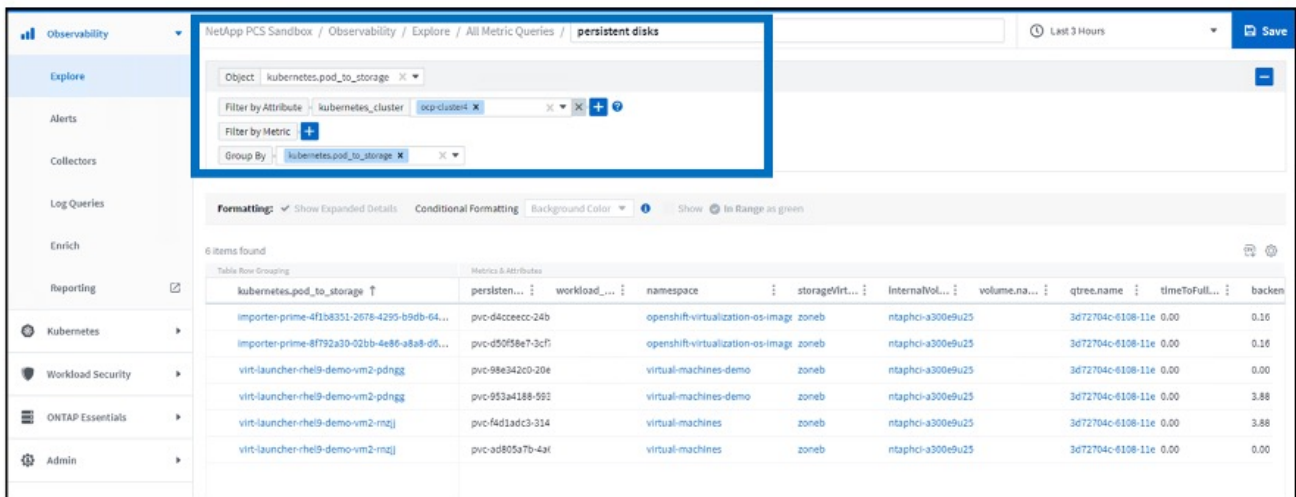
With Cloud Insights, you can easily see the backend storage of the VM disks and several statistics about the PVCs.



You can click on the links under the backend column, which will pull data directly from the backend ONTAP storage.



Another way to look at all the pod to storage mapping is creating an All Metrics query From Observability menu under Explore.



Clicking on any of the links will give you the corresponding details from ONTP storage. For example, clicking on an SVM name in the storageVirtualMachine column will pull details about the SVM from ONTAP. Clicking on an internal volume name will pull details about the volume in ONTAP.

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