



## Workflows

### NetApp Solutions

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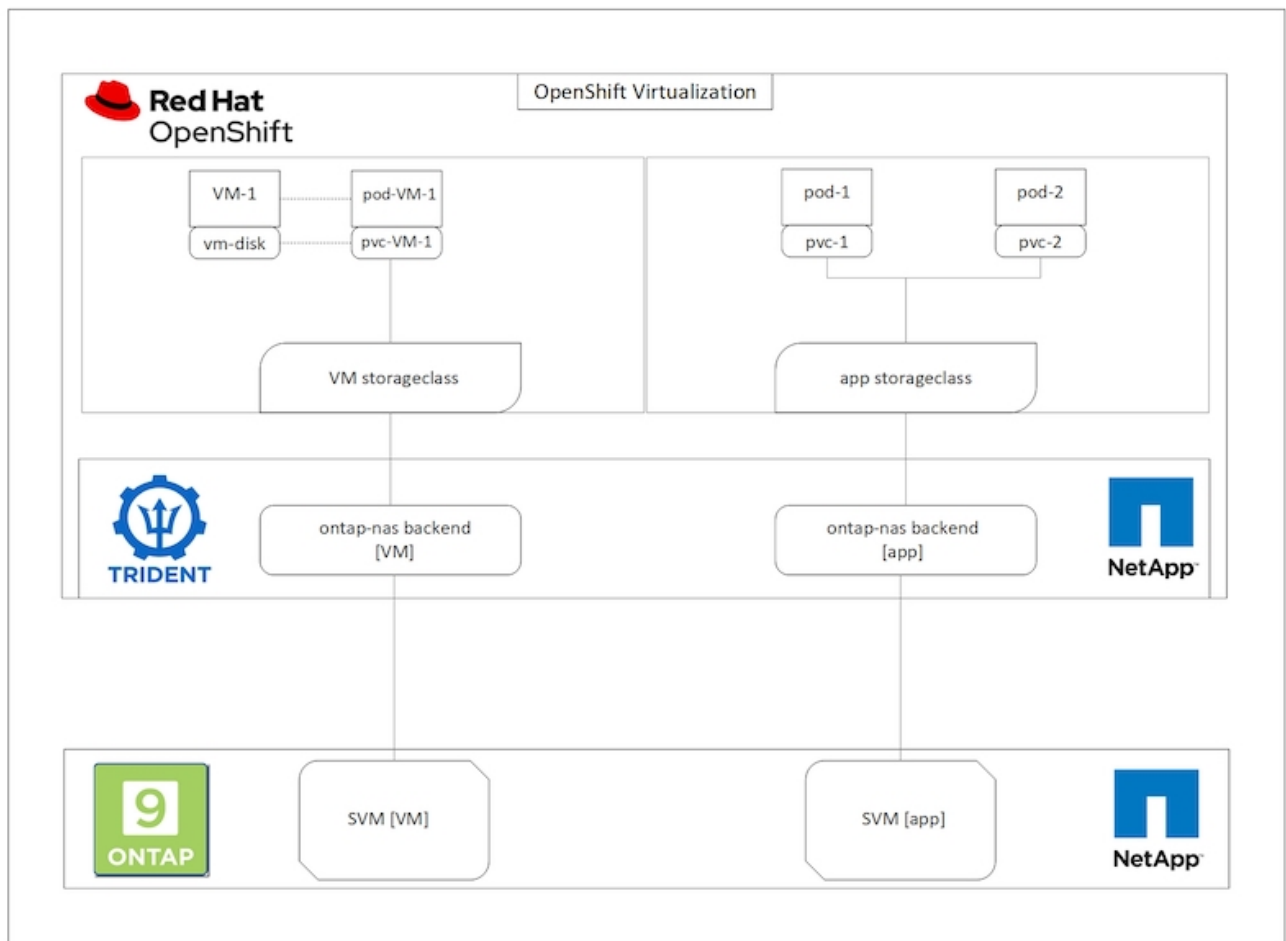
# Workflows

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

1. Navigate to Workloads > Virtualization > Virtual Machines and click Create > With Wizard.
2. Select the desired the operating system and click Next.
3. If the selected operating system has no boot source configured, you must configure it. For Boot Source, select whether you want to import the OS image from an URL or from a registry and provide the corresponding details. Expand Advanced and select the Trident-backed StorageClass. Then click Next.

## Boot source

This template does not have a boot source. Provide a custom boot source for this **CentOS 8.0+ VM** virtual machine.

### Boot source type \*

Import via URL (creates PVC) ▼

### Import URL \*

<https://access.cdn.redhat.com/content/origin/files/sha256/58/588167f828001e57688ec4b9b31c11a59d532489f527488ebc89ac5e952...>

Example: For RHEL, visit the [RHEL download page](#) (requires login) and copy the download link URL of the KVM guest image

Mount this as a CD-ROM boot source [?](#)

### Persistent Volume Claim size \*

5

GiB ▼

Ensure your PVC size covers the requirements of the uncompressed image and any other space requirements. More storage can be added later.

### ▼ Advanced

#### Storage class \*

basic (default) ▼

#### Access mode \*

Single User (RWO) ▼

#### Volume mode \*

Filesystem ▼

4. If the selected operating system already has a boot source configured, the previous step can be skipped.
5. In the Review and Create pane, select the project you want to create the VM in and furnish the VM details. Make sure that the boot source is selected to be Clone and boot from CD-ROM with the appropriate PVC assigned for the selected OS.

- 1 Select template
- 2 Review and create

### Review and create

You are creating a virtual machine from the **Red Hat Enterprise Linux 8.0+** VM template.

Project \* ▼  
 PR default

Virtual Machine Name \* ⓘ  
 rhel8-light-bat

Flavor \* ▼  
 Small: 1 CPU | 2 GiB Memory

Storage                      Workload profile ⓘ  
 40 GiB                      server

Boot source  
 Clone and boot from CD-ROM  
 PVC rhel8

ⓘ A new disk has been added to support the CD-ROM boot source. Edit this disk by customizing the virtual machine.  
 ▼ Disk details

rootdisk-install - Blank - 20GiB - virtio - default Storage class

Start this virtual machine after creation

[Create virtual machine](#)   [Customize virtual machine](#)   [Back](#)   [Cancel](#)

6. If you wish to customize the virtual machine, click **Customize Virtual Machine** and modify the required parameters.
7. Click **Create Virtual Machine** to create the virtual machine; this spins up a corresponding pod in the background.

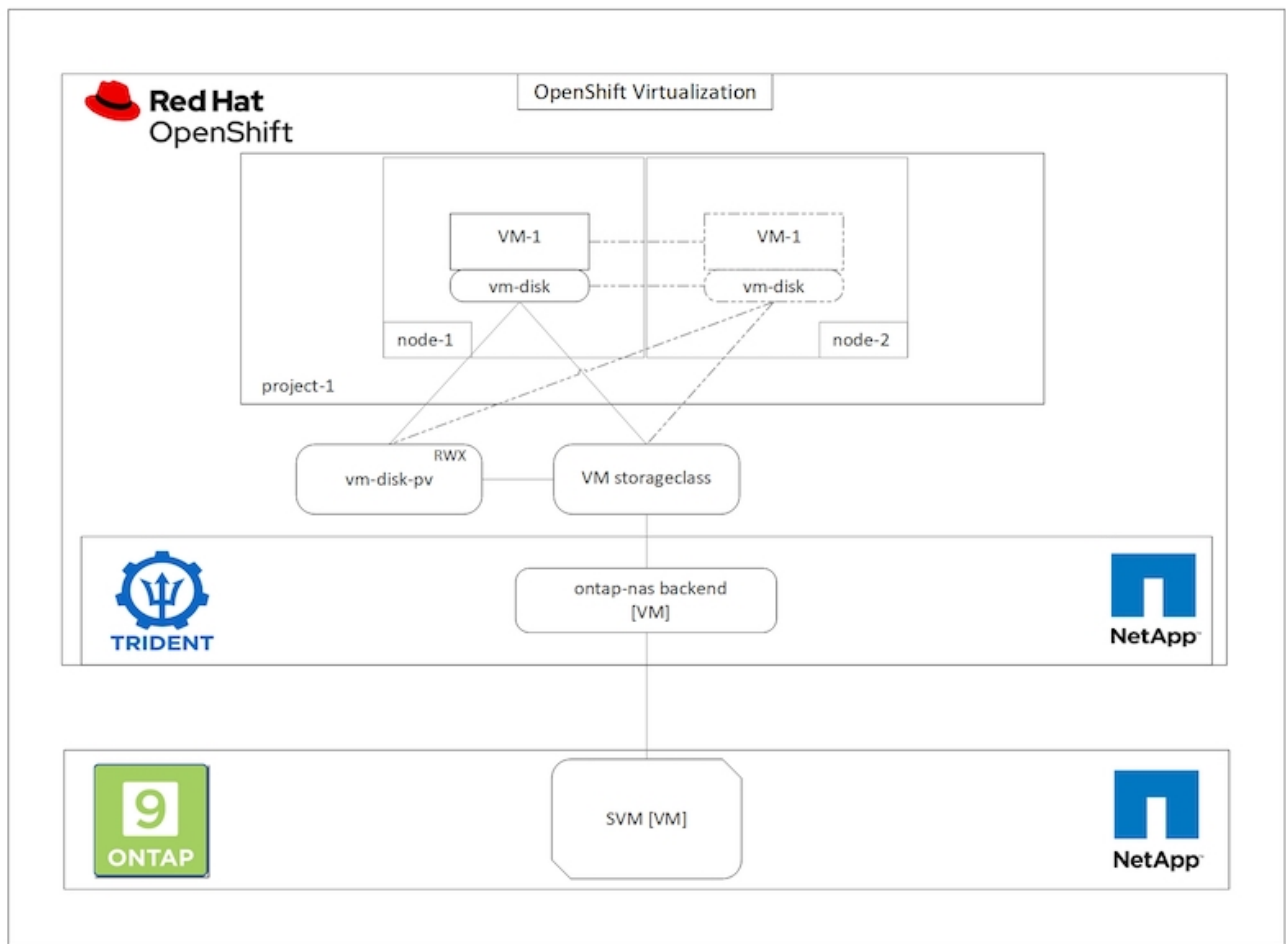
When a boot source is configured for a template or an operating system from an URL or from a registry, it creates a PVC in the `openshift-visualization-os-images` project and downloads the KVM guest image to the PVC. You must make sure that template PVCs have enough provisioned space to accommodate the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

## Workflows: Red Hat OpenShift Virtualization with NetApp ONTAP

This section covers the how to migrate a virtual machine between clusters with Red Hat OpenShift Virtualization.

### 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 backend configured with an SVM on a NetApp ONTAP cluster that is enabled for NFS protocol supports shared ReadWriteMany access for PVCs. Therefore, the VMs with PVCs that are requested from StorageClasses provisioned by Trident from NFS-enabled SVM can be migrated with no downtime.



To create a VM bound to PVCs with shared ReadWriteMany access:

1. Navigate to Workloads > Virtualization > Virtual Machines and click Create > With Wizard.
2. Select the desired the operating system and click Next. Let us assume the selected OS already had a boot source configured with it.
3. In the Review and Create pane, select the project you want to create the VM in and furnish the VM details. Make sure that the boot source is selected to be Clone and boot from CD-ROM with the appropriate PVC assigned for the selected OS.
4. Click Customize Virtual Machine and then click Storage.
5. Click the ellipsis next to rootdisk, and make sure that the storageclass provisioned using Trident is selected. Expand Advanced and select Shared Access (RWX) for Access Mode. Then click Save.

# Edit Disk

Type

Disk

Interface \*

virtio

Storage Class

basic (default)

Advanced

Volume Mode

Filesystem

Volume Mode is set by Source PVC

Access Mode

Shared Access (RWX) - Not recommended for basic storage class

**i** Access and Volume modes should follow storage feature matrix  
[Learn more](#)

Cancel Save

6. Click Review and confirm and then click Create Virtual Machine.

To manually migrate a VM to another node in the OpenShift cluster, complete the following steps.

1. Navigate to Workloads > Virtualization > Virtual Machines.

2. For the VM you wish to migrate, click the ellipsis, and then click Migrate the Virtual Machine.
3. Click Migrate when the message pops up to confirm.



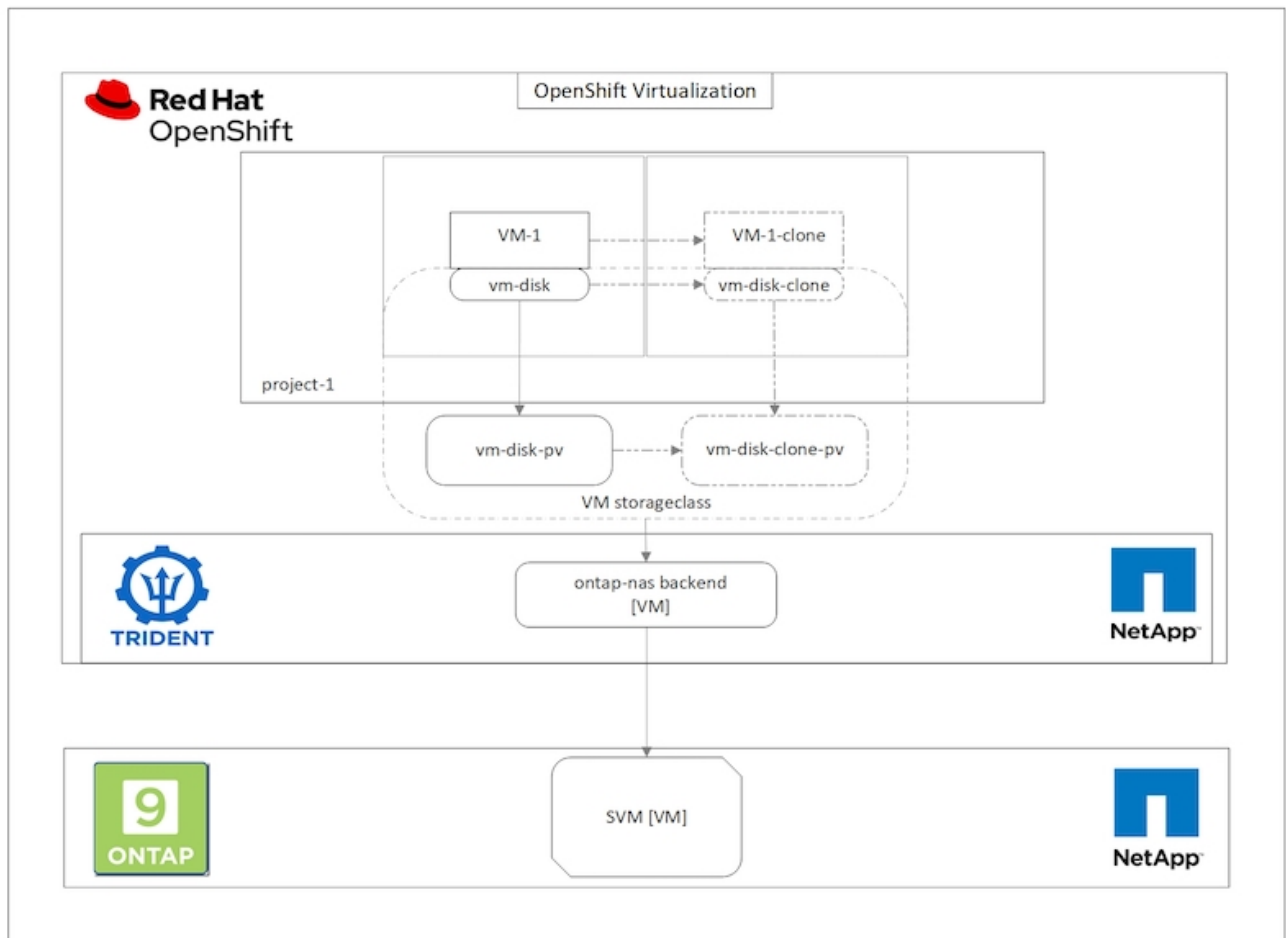
A VM instance in an OpenShift cluster automatically migrates to another node when the original node is placed into maintenance mode if the evictionStrategy is set to LiveMigrate.

## 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

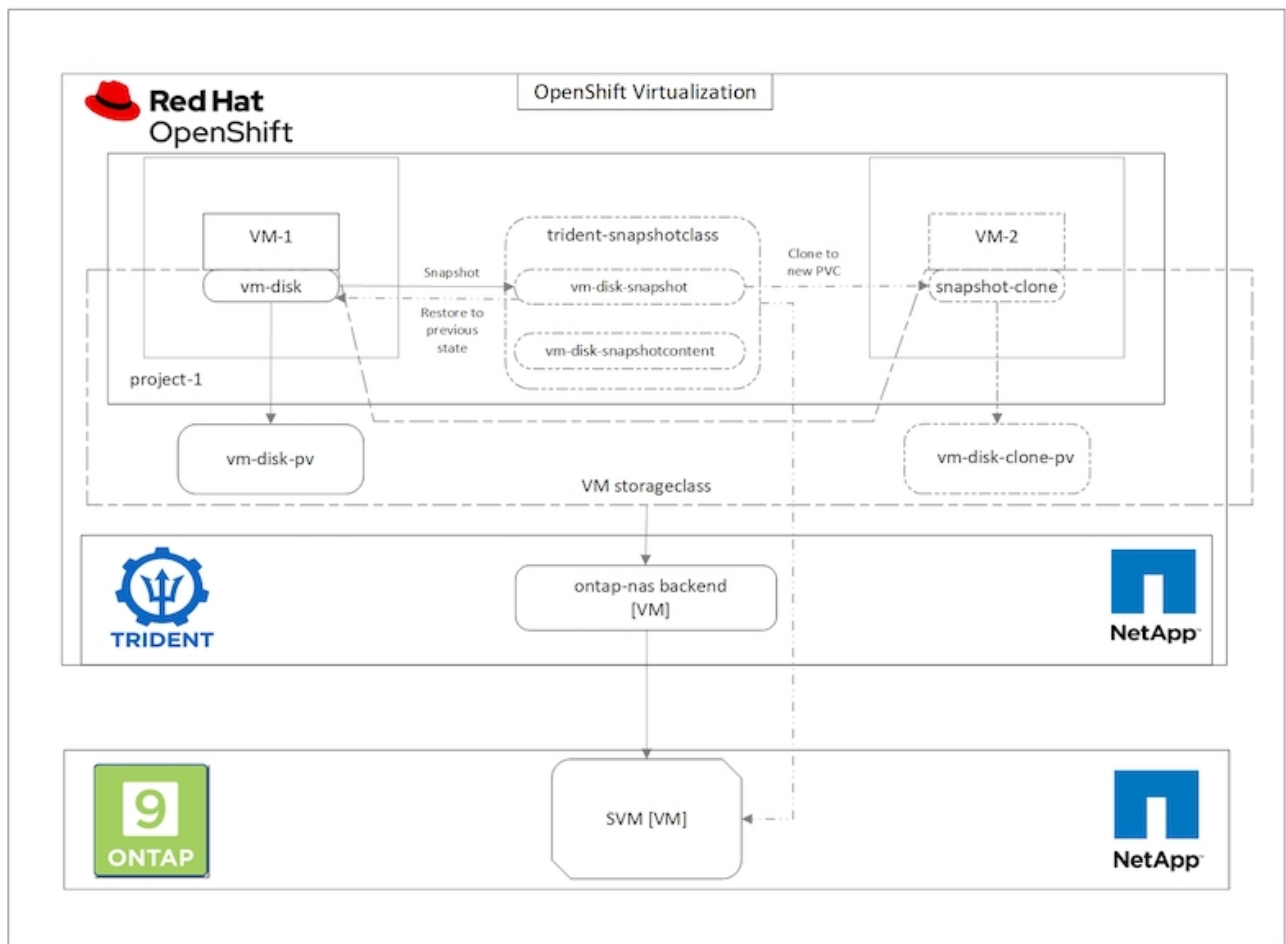
This section covers the how to create a virtual machine from a Snapshot with Red Hat OpenShift Virtualization.

### 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
```

[Create](#)[Cancel](#)[Download](#)

3. 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`.
4. 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 \*

**PVC** rhel8-short-frog-rootdisk-28dvv

Name \*

rhel8-short-frog-rootdisk-28dvv-snapshot

Snapshot Class \*

**VSC** trident-snapshot-class

[Create](#)[Cancel](#)

5. 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-28dvv-snapshot** is finished a new crash-consistent PVC copy will be created.

Name \*

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

Storage Class \*

SC 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 Workloads > 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 clusters 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.

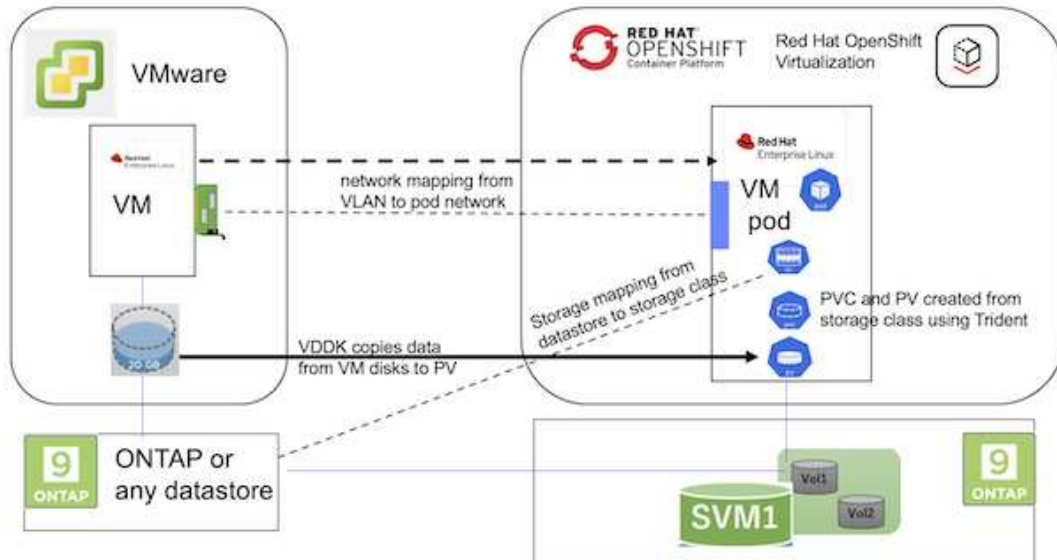
The following video shows a demonstration of the migration of a RHEL VM from VMware to OpenShift Virtualization using `ontap-san` for persistent storage.

[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:

Select provider type \*

**vm vSphere**

Provider resource name \*

vmware-source ✓

Unique Kubernetes resource name identifier

URL \*

URL of the vCenter SDK endpoint. Ensure the URL includes the "/sdk" path. For example: https://vCenter-host-example.com/sdk ✓

VDDK init image:

docker.repo.eng.netapp.com/banum/vddk:801 ✓

VDDK container image of the provider, when left empty some functionality will not be available

Username \*

administrator@vsphere.local ✓

vSphere REST API user name.

Password \*

..... ✓

vSphere REST API password credentials.

SSHA-1 fingerprint \*

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



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

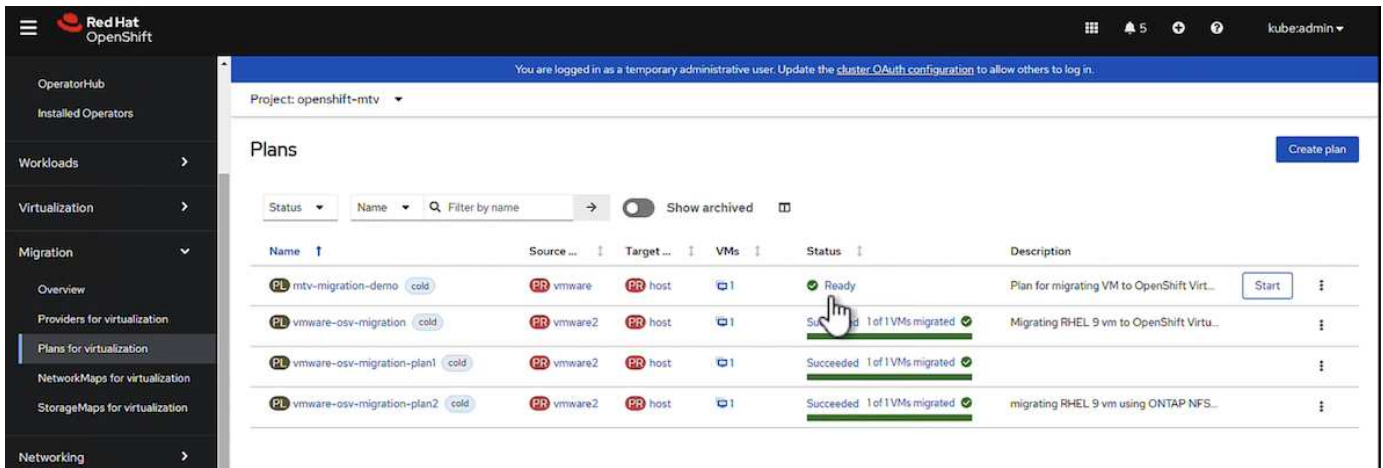
The host cluster is automatically added as the OpenShift virtualization provider is the source provider.

### Create Migration Plan

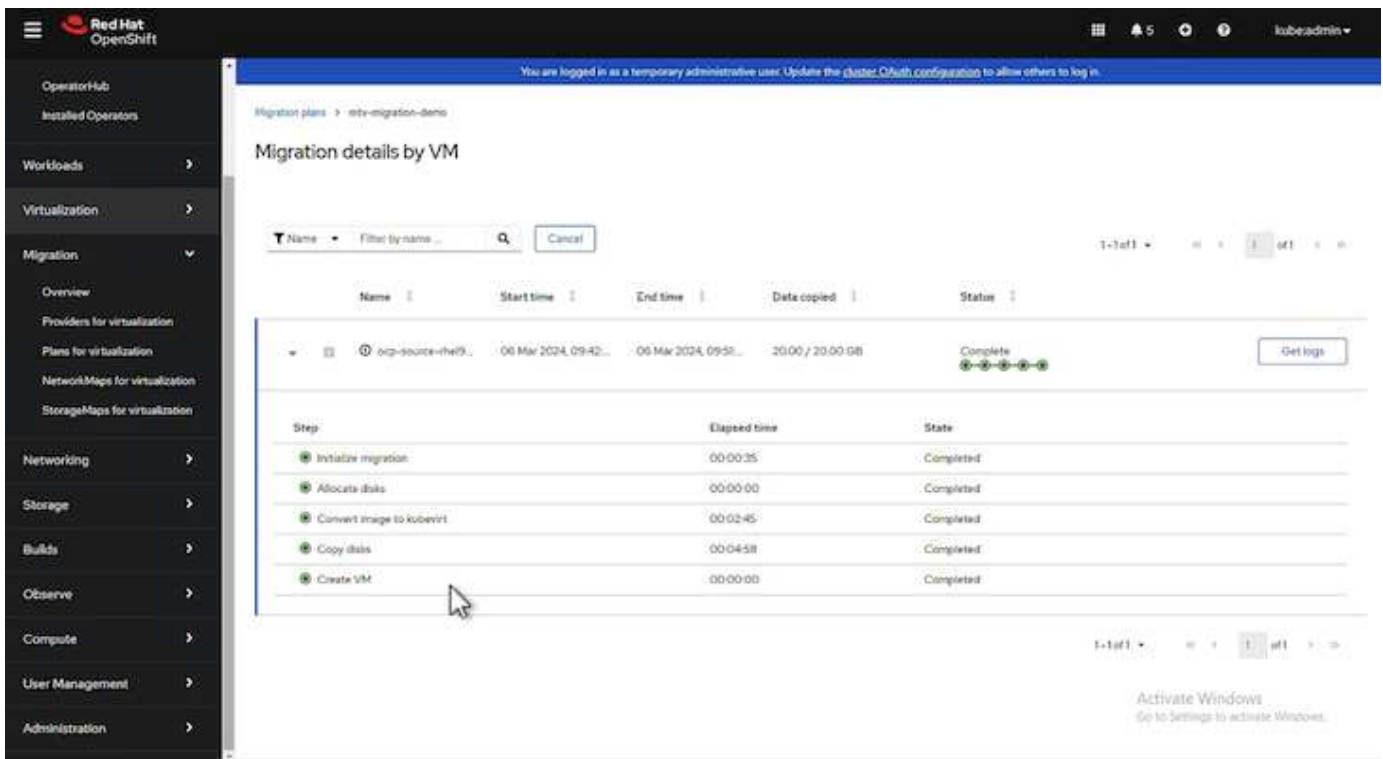
Follow the instructions provided [here](#) to create a migration plan.

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.



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.

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