



## Workflows

### NetApp Solutions

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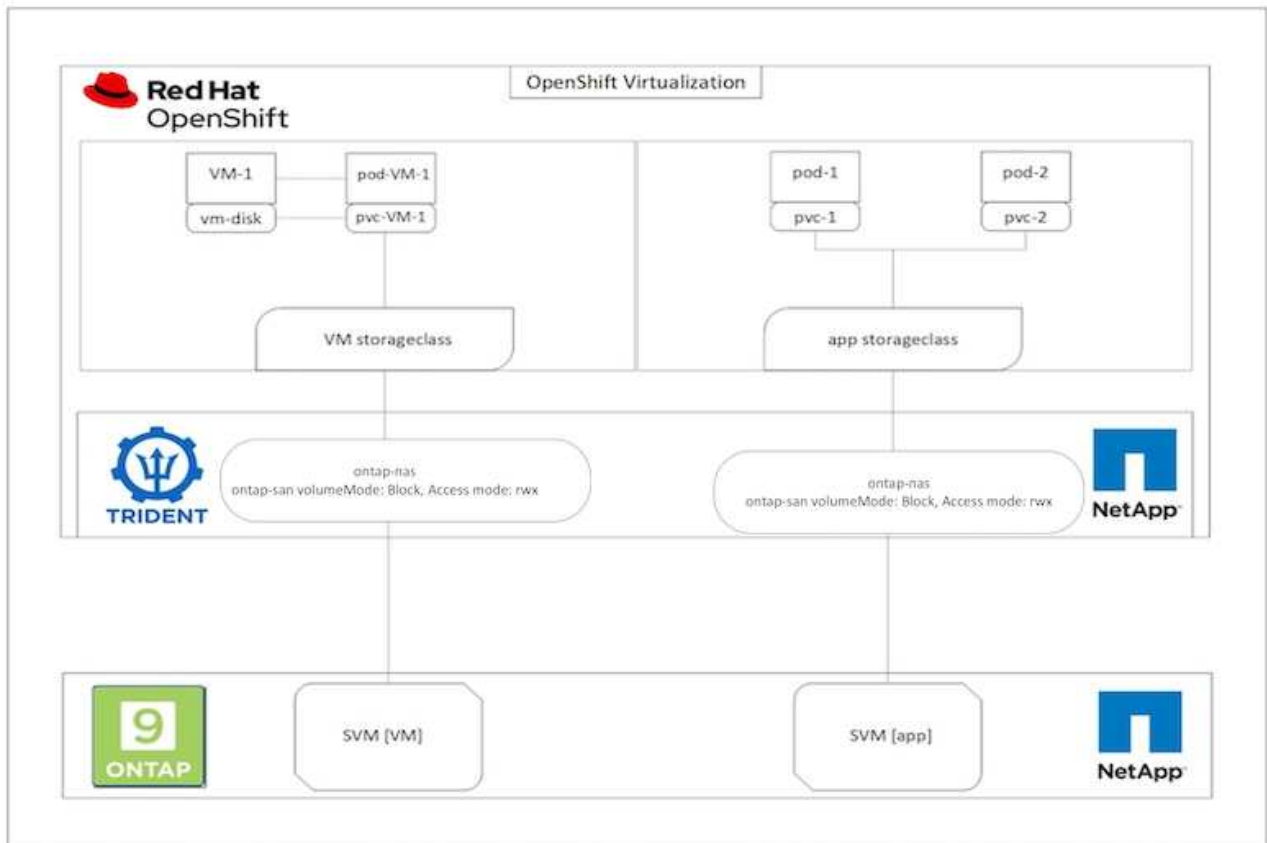
# Workflows

## 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 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.

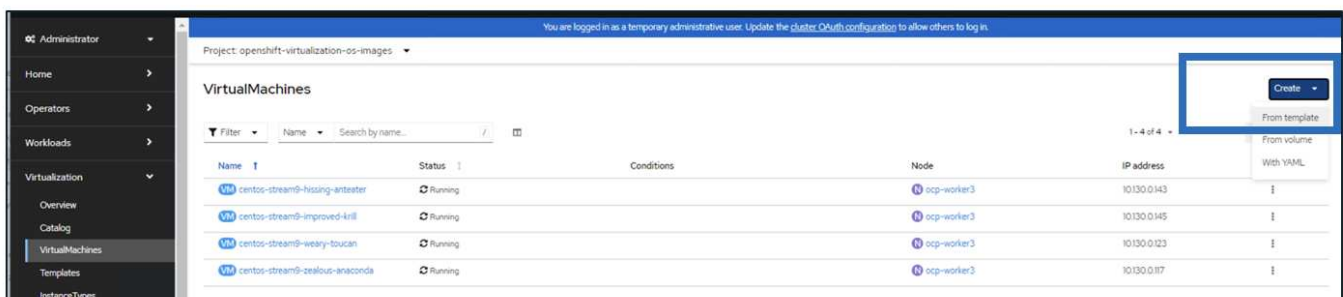
Typically block access mode is preferred compared to file systems while provisioning the VM disks.

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-virtualization-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

Default templates

User templates

☐ Boot source available

Operating system

☐ CentOS

☐ Fedora

☐ Other

☐ RHEL

☐ Windows

Workload

☐ Desktop


☐ High performance

☐ Server

Default templates

Q Filter by keyword...

13 items



Source available

CentOS Stream 8 VM

centos-stream8-server-small


Project openshift

Boot source PVC (auto import)

Workload Server

CPU 1

Memory 2 GiB



Source available

CentOS Stream 9 VM

centos-stream9-server-small


Project openshift

Boot source PVC (auto import)

Workload Server

CPU 1

Memory 2 GiB



Source available

CentOS 7 VM

centos7-server-small


Project openshift

Boot source PVC (auto import)

Workload Server

CPU 1

Memory 2 GiB



Source available

Fedora VM

fedora-server-small


Project openshift

Boot source PVC (auto import)

Workload Server

CPU 1

Memory 2 GiB



Source available

Red Hat Enterprise Linux 7 VM

rhel7-server-small


Project openshift

Boot source PVC (auto import)

Workload Server

CPU 1

Memory 2 GiB



Source available

Red Hat Enterprise Linux 8 VM

rhel8-server-small


Project openshift

Boot source PVC (auto import)

Workload Server

CPU 1

Memory 2 GiB



Source available

Red Hat Enterprise Linux 9 VM

rhel9-server-small


Project openshift

Boot source PVC (auto import)

Workload Server

CPU 1

Memory 2 GiB



Source available

Microsoft Windows 10 VM

windows10-desktop-medium


Project openshift

Boot source PVC

Workload Desktop

CPU 1

Memory 4 GiB



Source available

Microsoft Windows 11 VM

windows11-desktop-medium


Project openshift

Boot source PVC

Workload Desktop

CPU 2

Memory 4 GiB



Source available

Microsoft Windows Server 2012 R2 VM

windows2k12r2-server-medium

Project openshift

Boot source PVC

Workload Server

CPU 1

Memory 4 GiB



## 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-virtualization-os-images

☒ Start this VirtualMachine after creation

Quick create VirtualMachine

Customize VirtualMachine

Cancel

Activate Windows

Go to Settings to activate Windows.

Project: openshift-virtualization-os-images

Catalog > Customize template parameters > Customize VirtualMachine

## Customize and create VirtualMachine

Template: CentOS Stream 9 VM

Overview YAML Scheduling Environment Network interfaces Disks Scripts Metadata

**Name**

centos-stream9-pleased-hamster

**Namespace**

openshift-virtualization-os-images

**Description**

Not available

**Operating system**

CentOS Stream 9 VM

**CPU | Memory**

1 CPU | 2 GiB Memory

**Machine type**

pc-q35-rhel9.2.0

**Boot mode**

BIOS

**Start in pause mode**

☐

**Workload profile**

Server

**Network interfaces (1)**

Name	Network	Type
default	Pod networking	Masquerade

**Disks (2)**

Name	Drive	Size
rootdisk	Disk	30 GiB
cloudinitdisk	Disk	-

**Hardware devices**

**GPU devices**

Not available

**Host devices**

Not available

**Headless mode**

☐

**Hostname**

centos-stream9-pleased-hamster

☒ Start this VirtualMachine after creation

Create VirtualMachine Cancel

VirtualMachines > VirtualMachine details

VM centos-stream9-zealous-anaconda Running

Overview Details Metrics YAML Configuration Events Console Snapshots Diagnostics

**Disks**

[Add disk](#)

Filter Search by name... Mount Windows drivers disk

Name	Source	Size	Drive	Interface	Storage class
cloudinitdisk	Other	-	Disk	virtio	-
data-disk1 (Persistent Hotplug)	PVC centos-stream9-zealous-anaconda-data-disk1	30.00 GiB	Disk	SCSI	ontap-san-block
rootdisk (bootable)	PVC centos-stream9-zealous-anaconda	30.00 GiB	Disk	virtio	ontap-san-block

**File systems**

Name	File system type	Mount point	Total bytes	Used bytes
vdal	xfs	/	29.94 GiB	1.30 GiB

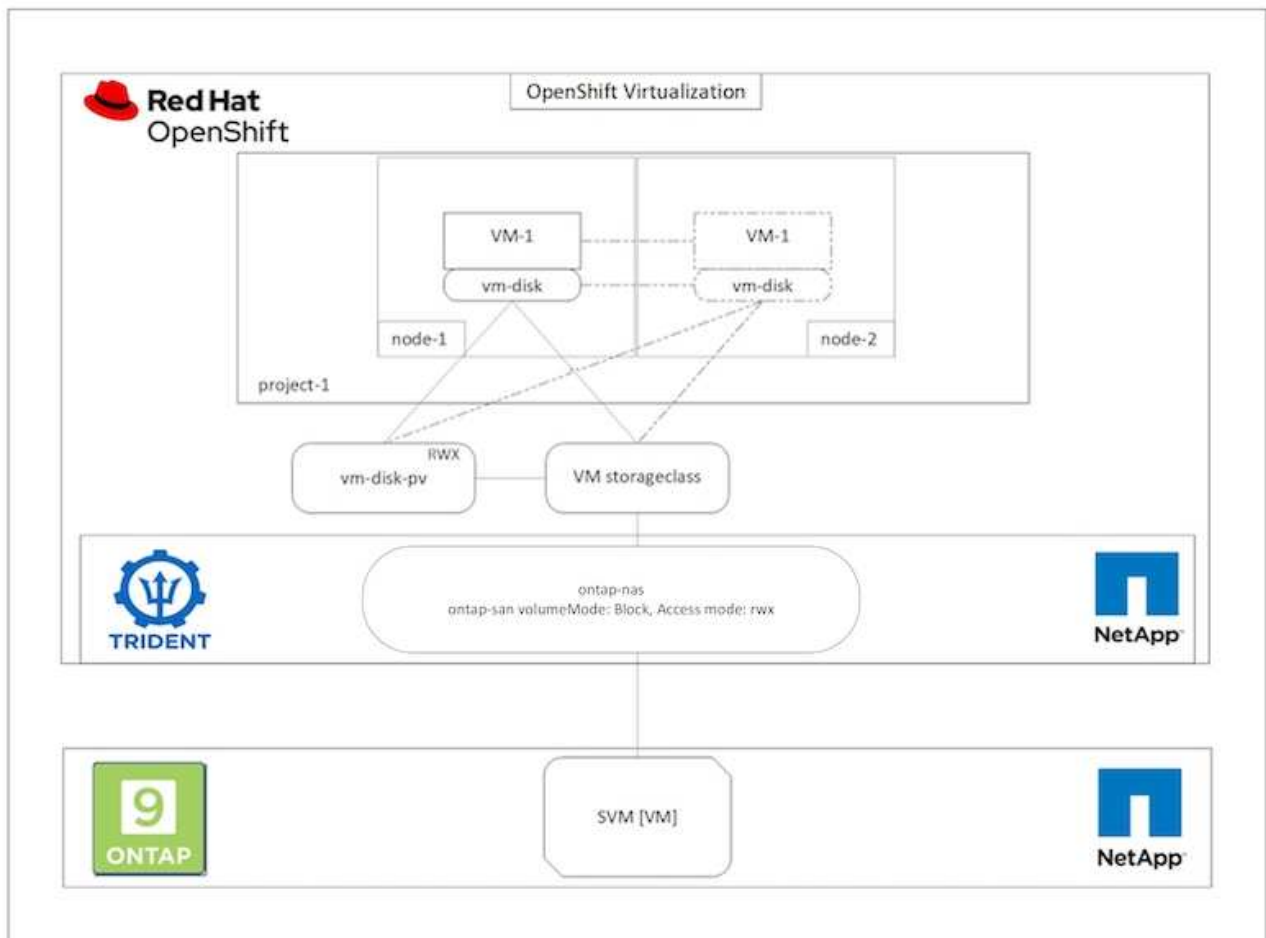
## Workflows: Red Hat OpenShift Virtualization with NetApp ONTAP

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:

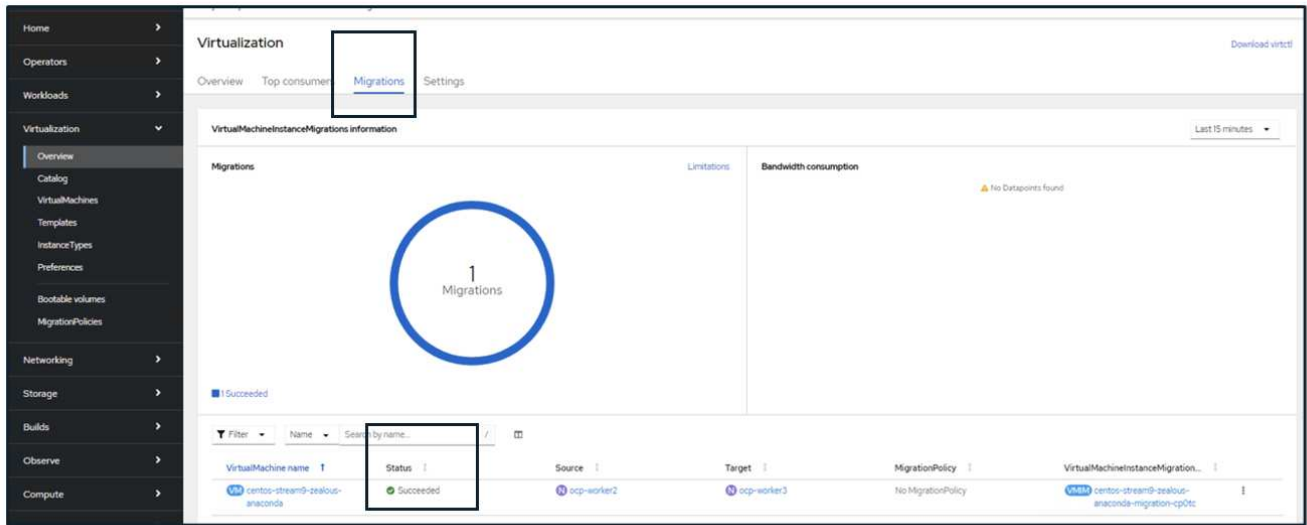
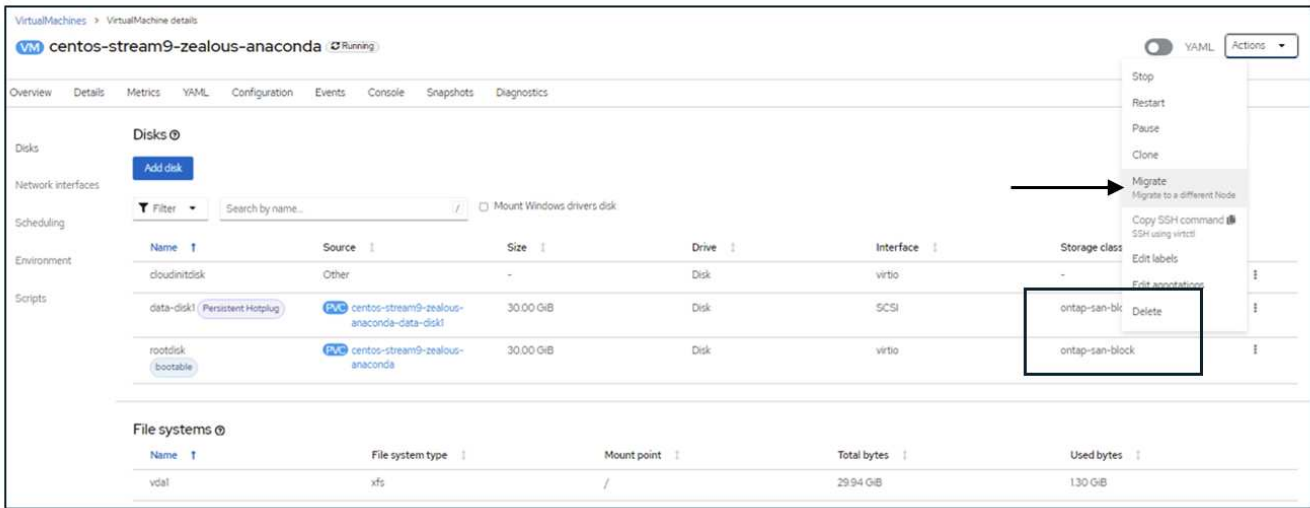
1. Select the VM that you want to live-migrate.
2. Click on **Configuration** tab.
3. Ensure that all the disks of the VM are created using Storage classes that can support RWX access mode.
4. Click on **Actions** on the right corner and then select **Migrate**.
5. To look at the progression of the Migration,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



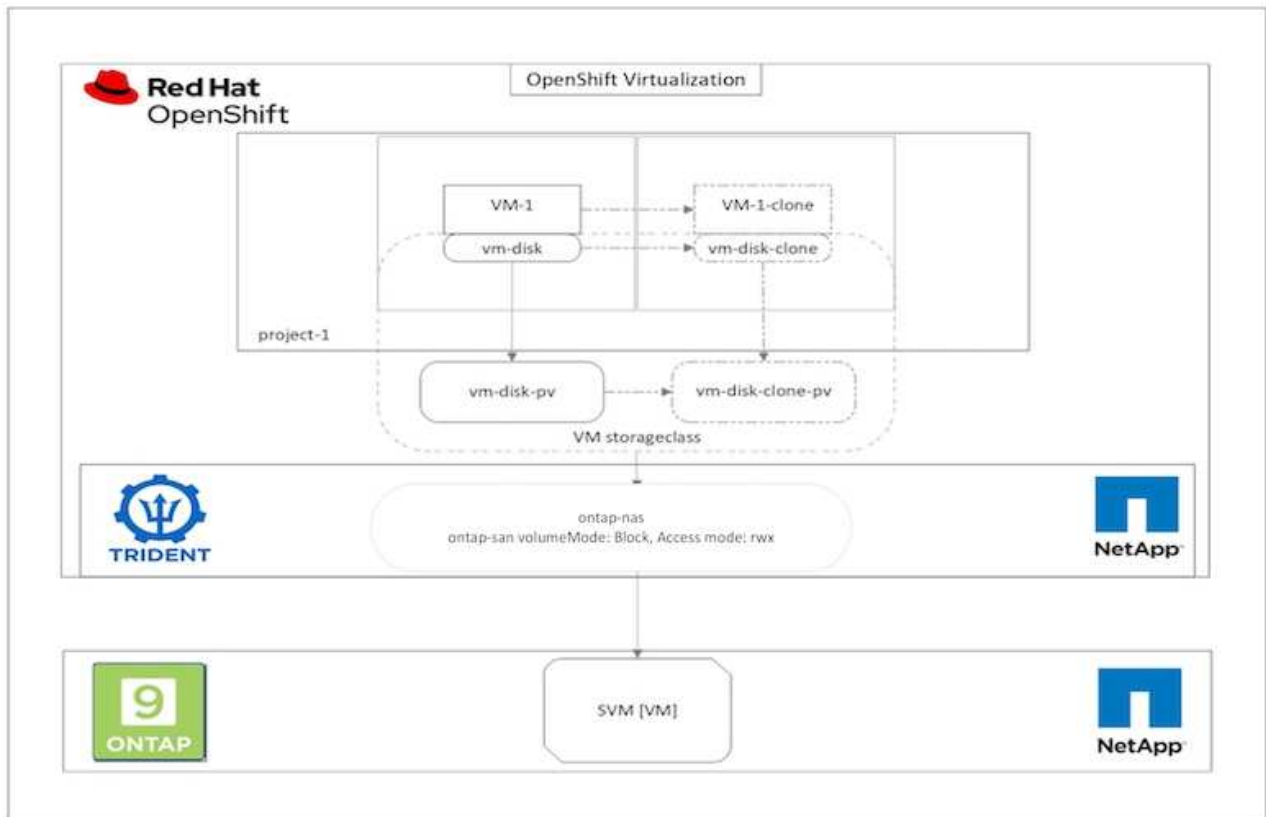
## Workflows: Red Hat OpenShift Virtualization with NetApp ONTAP

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 \*

rhel8-short-frog-rootdisk-28dvv-clone

Access Mode \*

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

Size \*

20

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

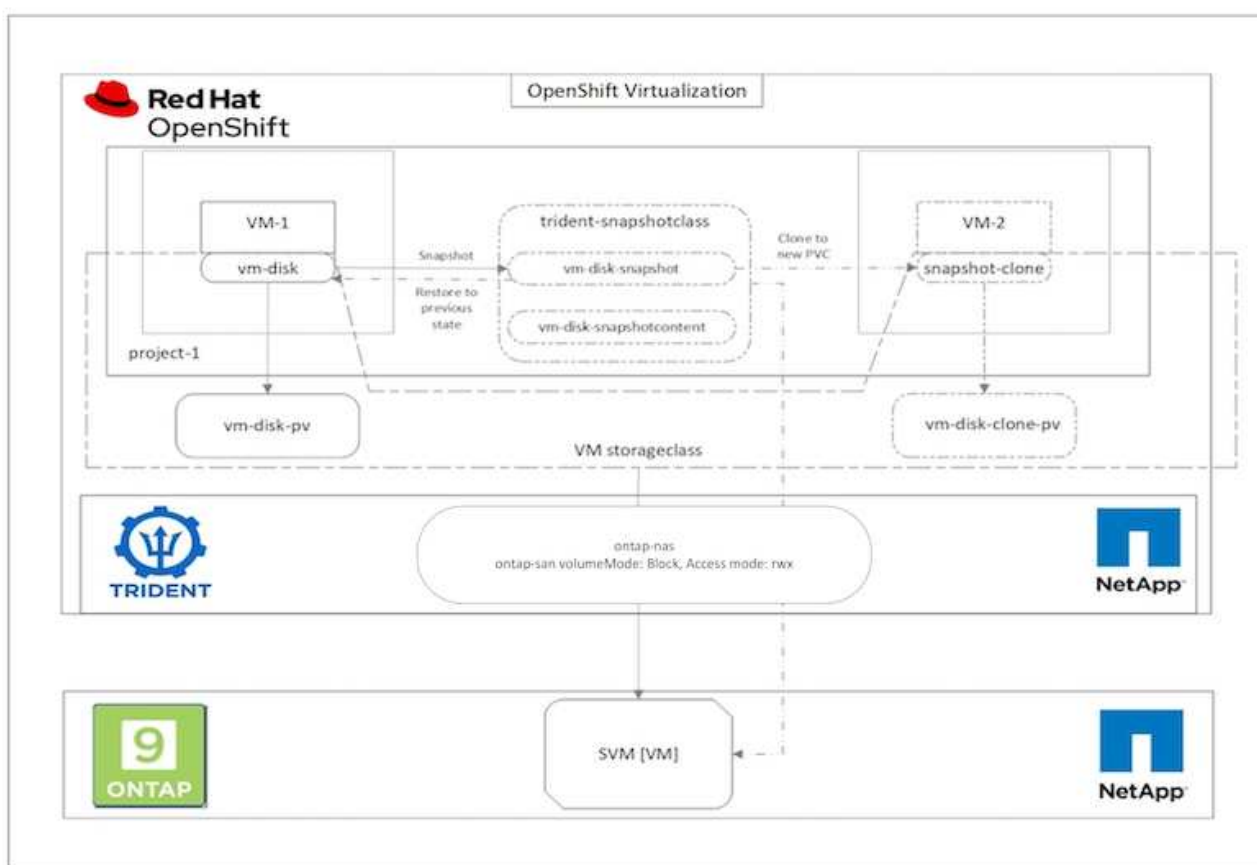
This section shows how to create a virtual machine from a Snapshot with Red Hat OpenShift Virtualization.

### 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
```

[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-28dvb ▼

Name \*

rhel8-short-frog-rootdisk-28dvb-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-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

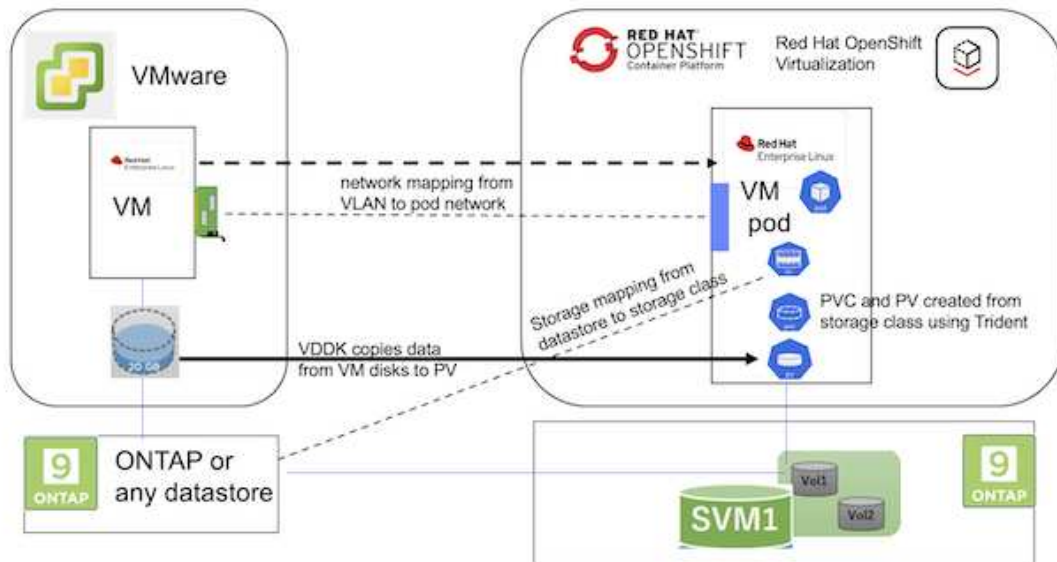
In this section, we will see how to use the Migration Toolkit for Virtualization (MTV) to migrate virtual machines from VMware to OpenShift Virtualization running on OpenShift Container platform and integrated with NetApp ONTAP storage using Astra Trident.

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:

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

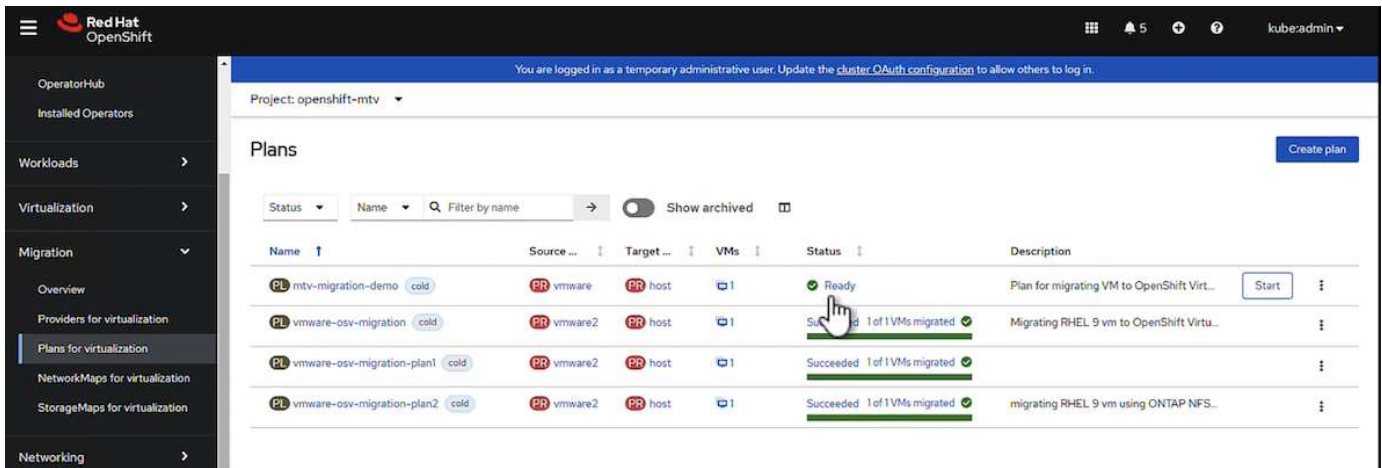
The host cluster is automatically added as the OpenShift virtualization provider is the source provider.

## Create Migration Plan

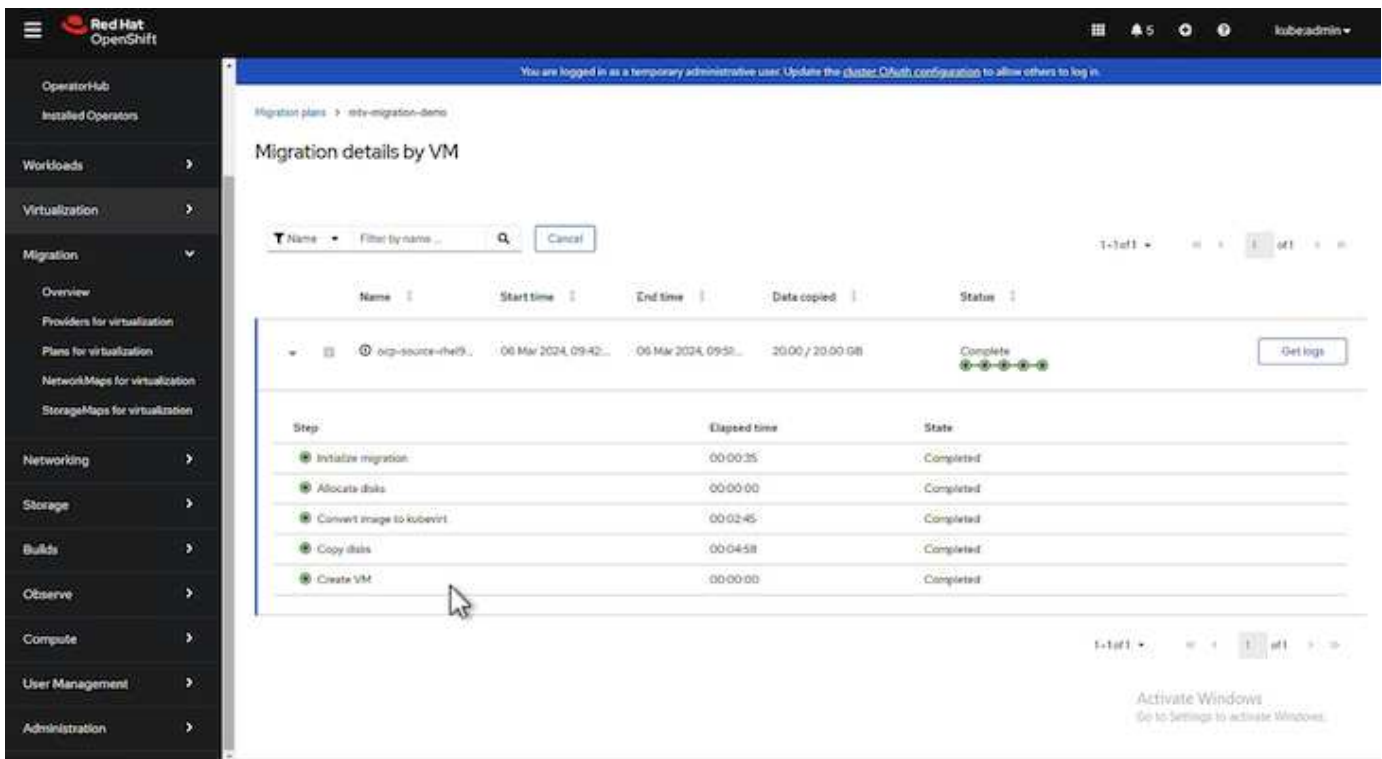
Follow the instructions provided [here](#) to create a migration plan.

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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