



Deploy on premises

NetApp virtualization solutions

NetApp

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Deploy on premises

Requirements to deploy Red Hat OpenShift Virtualization with ONTAP

Review the requirements to install and deploy OpenShift virtualization with ONTAP storage systems.

Prerequisites

- A Red Hat OpenShift cluster (later than version 4.6) installed on bare-metal infrastructure with RHCOS worker nodes
- Deploy Machine Health Checks to maintain HA for VMs
- A NetApp ONTAP cluster, with SVM configured with the correct protocol.
- Trident installed on the OpenShift cluster
- A Trident backend configuration created
- A StorageClass configured on the OpenShift cluster with Trident as the provisioner

For the above Trident prerequisites, see [Trident installation section](#) for details.

- 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.

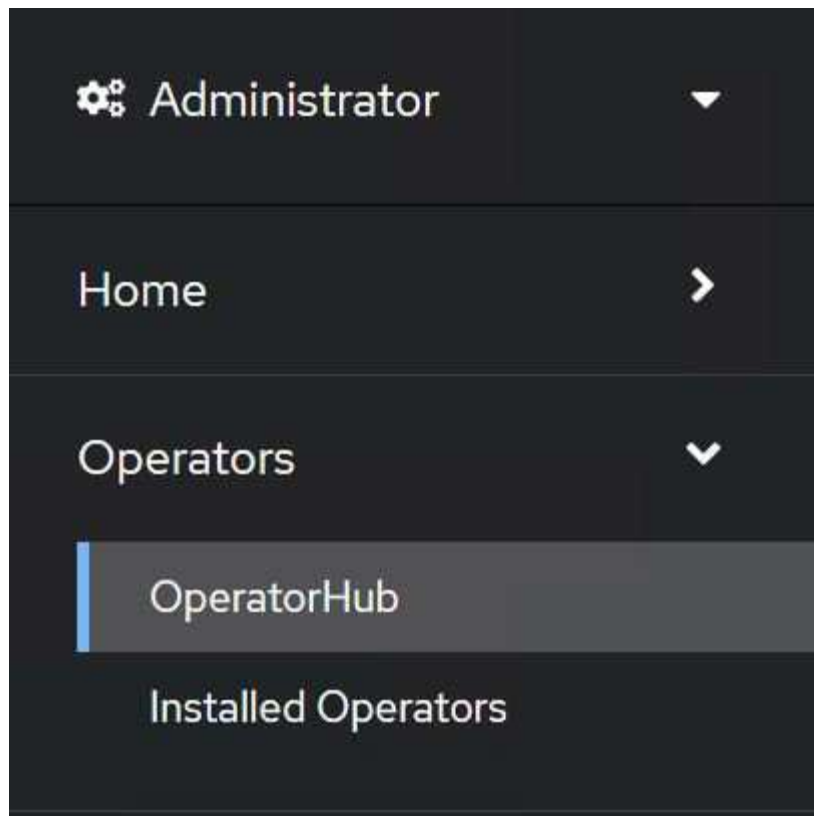
Optionally, you can also specify a subset of the OpenShift cluster nodes to host the OpenShift Virtualization operators, controllers, and VMs by configuring node placement rules. To configure node placement rules for OpenShift Virtualization, follow the documentation [here](#).

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 ONTAP

Install OpenShift Virtualization on a Red Hat OpenShift bare-metal cluster. This procedure includes logging in with cluster-admin access, navigating to the OperatorHub, and installing the OpenShift Virtualization operator.

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

i 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.



Installed operator - operand required

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



HyperConverged



Required

Creates and maintains an OpenShift Virtualization Deployment

Create HyperConverged

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

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

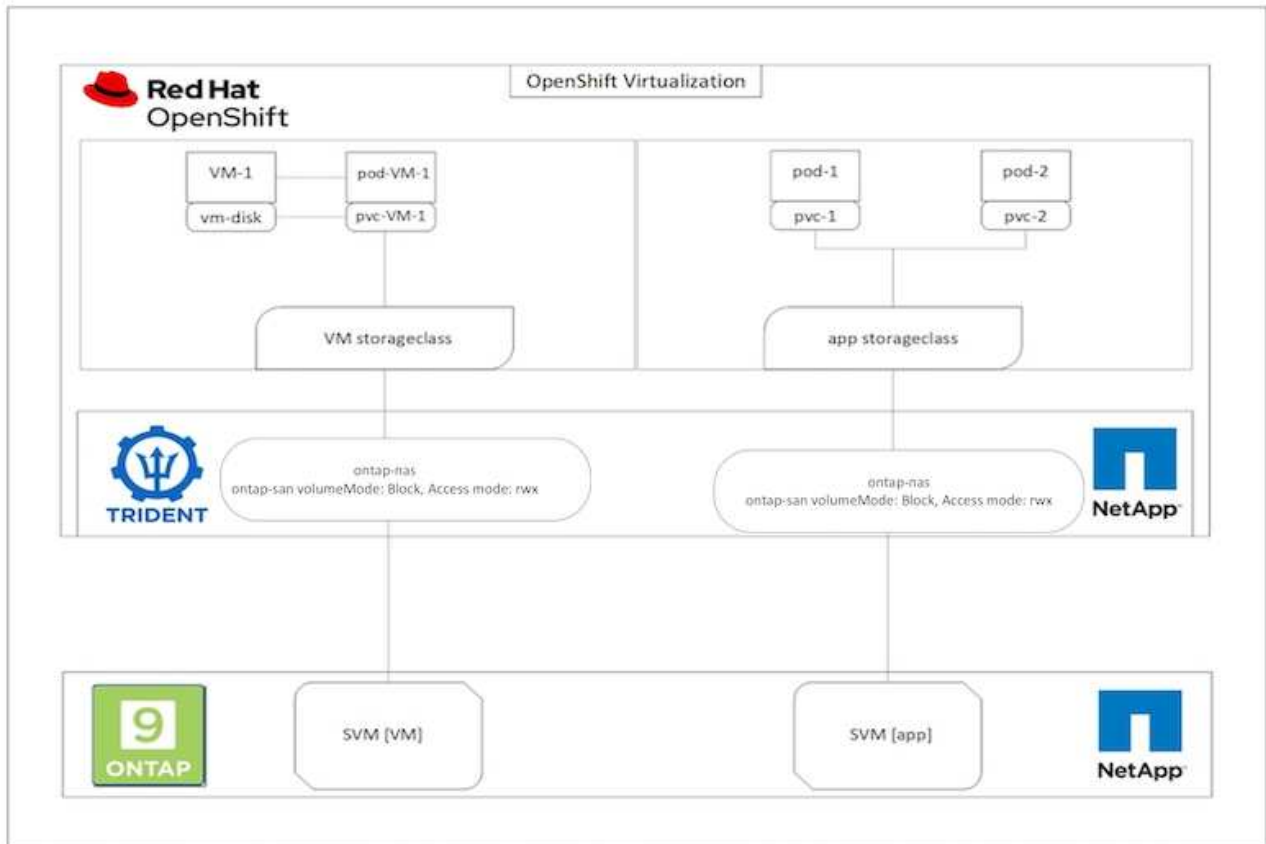
Create a VM on ONTAP storage with Red Hat OpenShift Virtualization

Create a VM with OpenShift Virtualization. This procedure includes selecting an operating system template, configuring storage classes, and customizing VM parameters to meet specific requirements.

As a pre-requisite, you should have already created the trident backend, the storage class and the volume snapshot class objects. You can refer to the [Trident installation section](#) for details.

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](#).



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. You can select a different 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.

The screenshot shows the OpenShift Virtualization console interface. On the left is a sidebar with navigation links: Administrator, Home, Operators, Workloads, Virtualization (selected), Overview, Catalog, VirtualMachines, Templates, and InstanceTypes. The main panel displays the 'VirtualMachines' page for the 'openshift-virtualization-os-images' project. It includes a 'Filter' dropdown, a search bar, and a table of VMs. A 'Create' button is highlighted in the top right corner. The table lists four VMs, all in 'Running' status, each with a unique name, node, and IP address.

Name	Status	Conditions	Node	IP address
VM centos-stream9-hissing-antester	Running		ocp-worker3	10.130.0.143
VM centos-stream9-improved-kill	Running		ocp-worker3	10.130.0.145
VM centos-stream9-weary-toucan	Running		ocp-worker3	10.130.0.123
VM centos-stream9-zealous-anaconda	Running		ocp-worker3	10.130.0.137

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

Video Demonstration

The following video shows a demonstration of creating a VM in OpenShift Virtualization using iSCSI storage.

[Create a VM in OpenShift Virtualization using Block Storage](#)

Migrate a VM from VMware to Red Hat OpenShift cluster

Migrate VMs from VMware to an OpenShift cluster using the OpenShift Virtualization migration toolkit. This migration involves installing the Migration Toolkit for Virtualization (MTV), creating source and destination providers, creating a migration plan and performing a cold or warm migration.

Cold Migration

This is the default migration type. The source virtual machines are shut down while the data is copied.

Warm Migration

In this type of migration, most of the data is copied during the precopy stage while the source virtual machines (VMs) are running. Then the VMs are shut down and the remaining data is copied during the cutover stage.

Video Demonstration

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

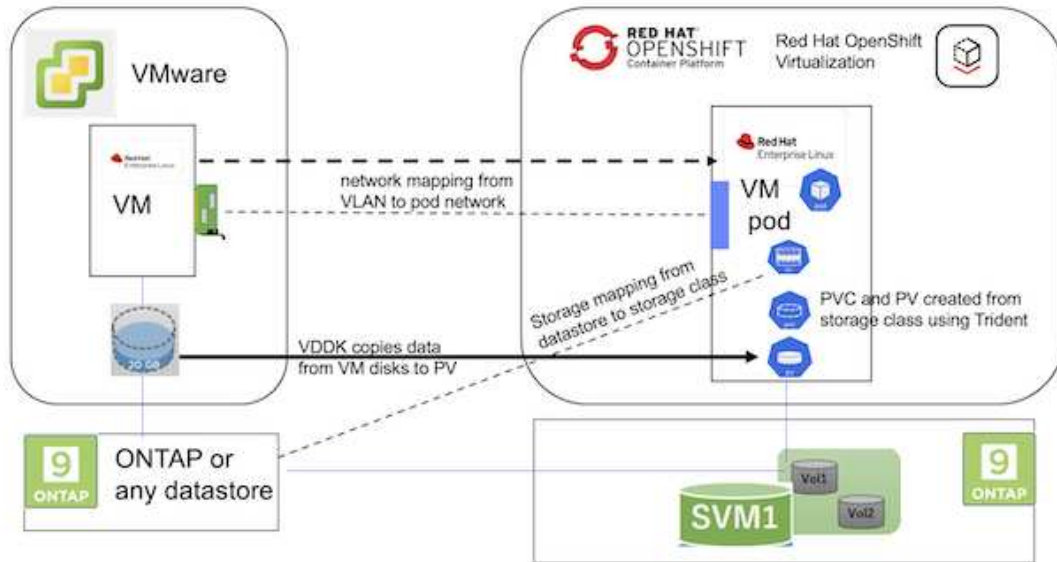
[Using Red Hat MTV to migrate VMs to OpenShift Virtualization with NetApp ONTAP Storage](#)

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 Trident.

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 4.17 or later
- Multipath on the cluster nodes enabled for iSCSI (for ontap-san storage class). Multi-pathing can be enabled easily if you install Trident 25.02 using the node-prep flag. You can refer to the [Trident installation section](#) for details.

- Install the required backend and storage classes and the snapshot class. Refer to the [Trident installation section](#) for details.
- [OpenShift Virtualization](#)

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 *

Text

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

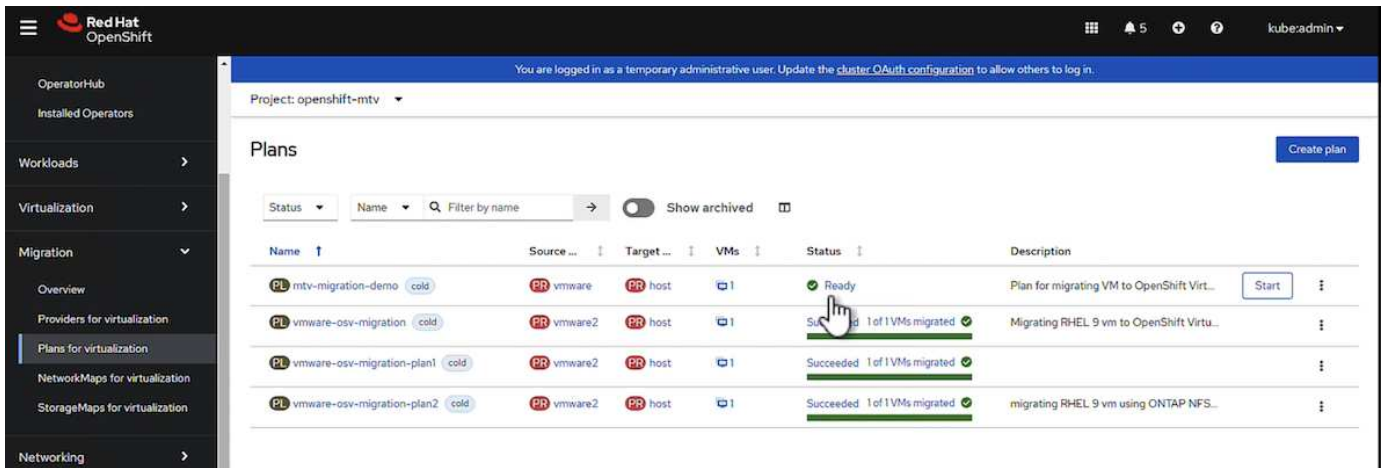
The host cluster is automatically added as the OpenShift virtualization provider is the source provider.

Create Migration Plan

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

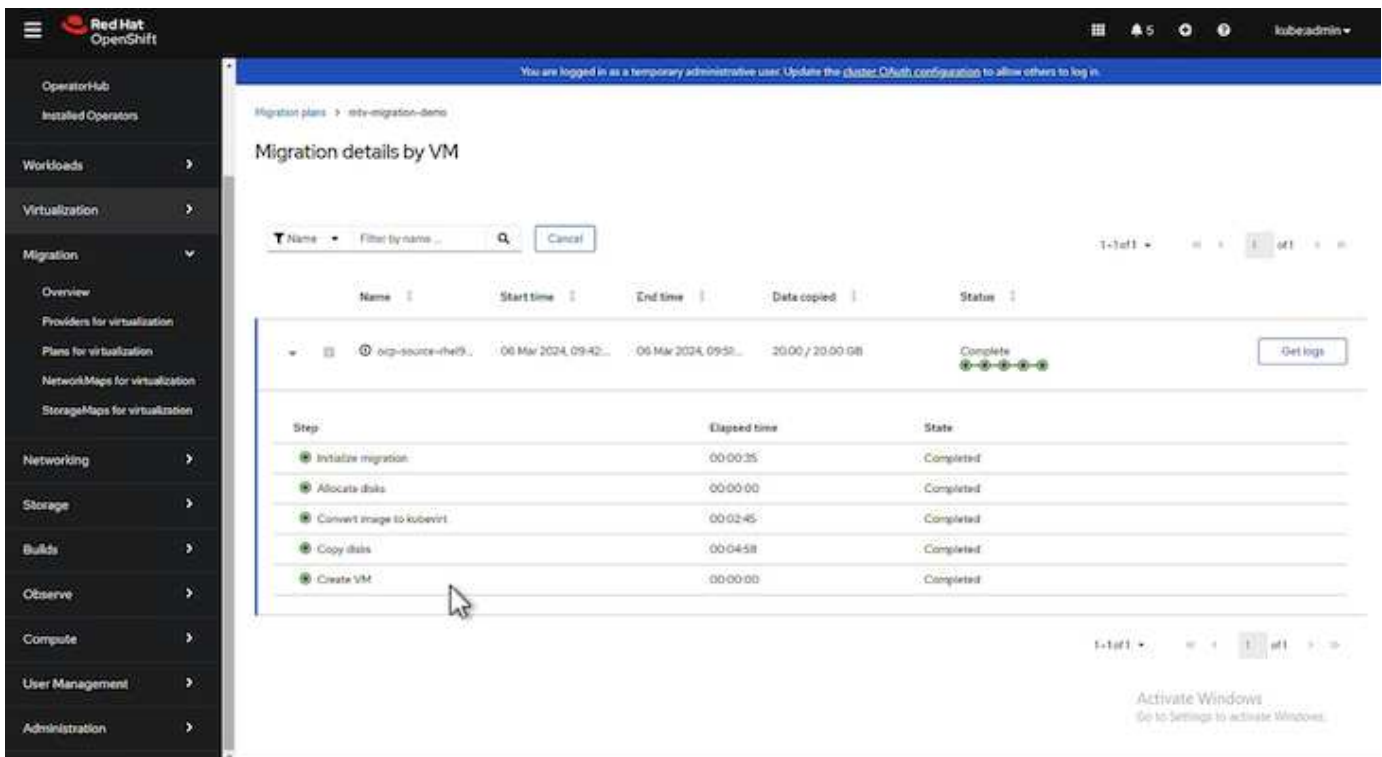
While creating a plan, you need to create the following if not already created:

- 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.



Perform Cold Migration

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](#).

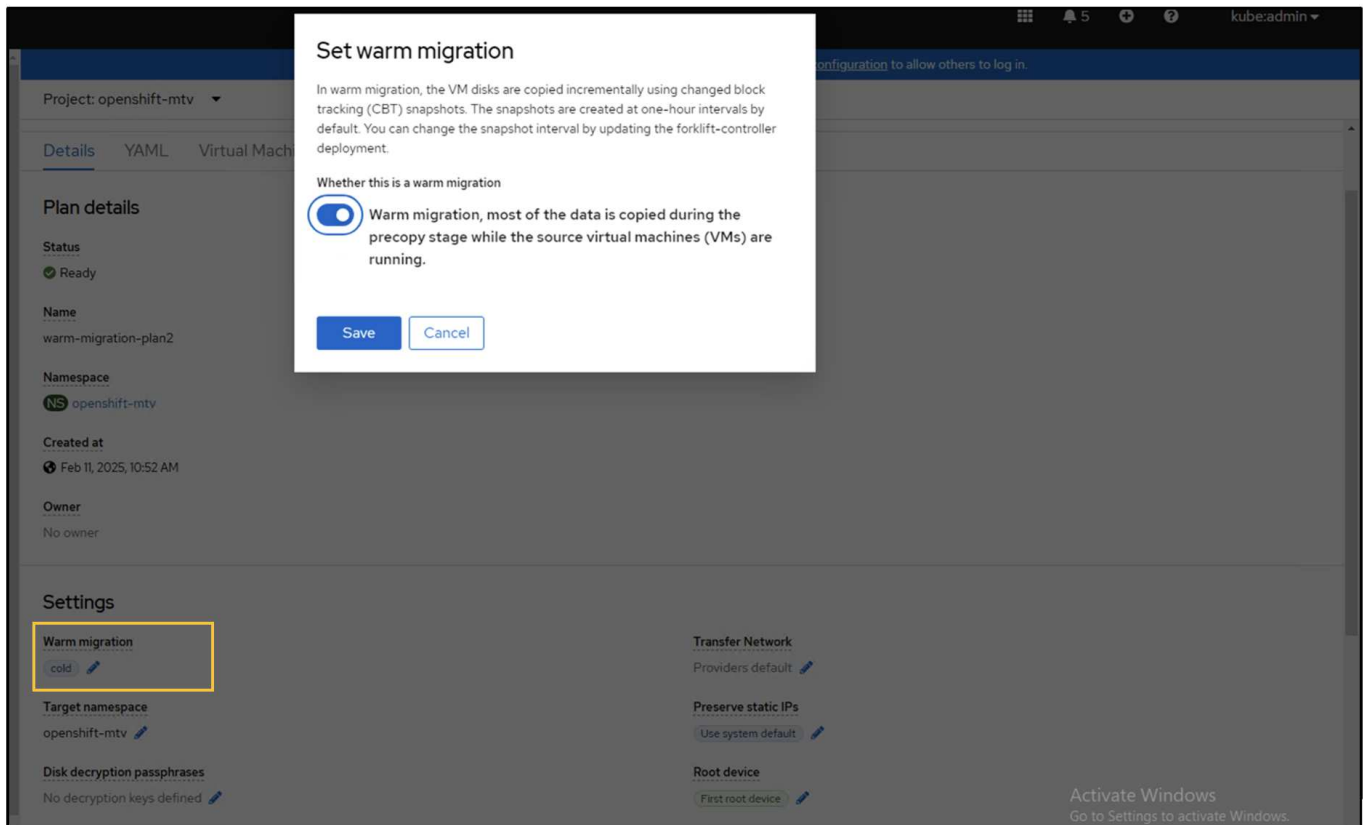
You can log into the virtual machine and verify the contents of the postgresql databases. The databases, tables and the entries in the table should be the same as what was created on the source VM.

Perform Warm Migration

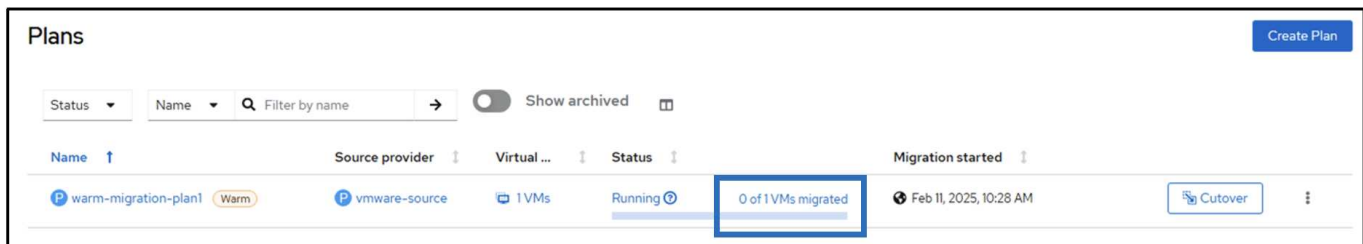
To perform a warm migration, after creating a migration plan as shown above, you need to edit the plan settings to change the default migration type. Click on the edit icon next to the cold migration and toggle the button to set it to warm migration. Click on **Save**. Now click on **Start** to start the migration.



Ensure that when you are moving from block storage in VMware, you have block storage class selected for the OpenShift Virtualization VM. Additionally, the volumeMode should be set to block and access mode should be rwx so that you can perform live migration of the VM at a later time.



Click on **0 of 1 vms completed**, expand the vm and you can see the progress of the migration.



After some time, the disk transfer is completed, and the migration waits to proceed to the Cutover state. The DataVolume is in a Paused state. Go back to the plan and click on the **Cutover** button.

Project: openshift-mtv

Plans > Plan Details

warm-migration-plan1 Running

Details YAML Virtual Machines Resources Mappings Hooks

Virtual Machines

Pipeline status: ▼ Name: ▼ Filter by name → Cancel virtual machines

Name	Started at	Completed at	Disk transfer	Disk counter	Pipeline status
vm1	Feb 11, 2025, 10:28 AM	-	20480 / 20480 MB	1 / 1 Disks	● ● ● ● ●

PersistentVolumeClaims

Name	Status
PVC warm-migration-plan1-vm-43432-464rs	⌘ Pending

DataVolumes

Name	Status
DV warm-migration-plan1-vm-43432-464rs	Paused

Pipeline

Name	Description	Tasks	Started at	Error
● Initialize	Initialize migration.		Feb 11, 2025, 10:28 AM	
● DiskTransfer	Transfer disks.	■ 1 / 1	Feb 11, 2025, 10:28 AM	
○ Cutover	Finalize disk transfer.	■ 0 / 1	-	
○ ImageConversion	Convert image to kubevirt.		-	
○ VirtualMachineCreation	Create VM.		-	

Activate Windows

Plans

Status: ▼ Name: ▼ Filter by name → Show archived Create Plan

Name	Source provider	Virtual machines	Status	Migration started
● warm-migration-plan1 Warm	■ vmware-source	■ 1 VMs	Running ●	0 of 1 VMs migrated ● Feb 11, 2025, 10:28 AM

Cutover

The current time will be shown in the dialog box. Change the time to a future time if you want to schedule a cutover to a later time. If not, to perform a cutover now, click on **Set cutover**.

Cutover

Schedule the cutover for migration `warm-migration-plan1?`

You can schedule cutover for now or a future date and time. VMs included in the migration plan will be shut down when cutover starts.

2025-02-11

11:04 AM

Set cutover

Remove cutover

Cancel

After a few seconds, the DataVolume goes from the paused to the ImportScheduled to ImportInProgress state when the cutover phase starts.

Virtual Machines

Pipeline status

Name

Filter by name

Cancel virtual machines

Name	Started at	Completed at	Disk transfer	Disk counter	Pipeline status
vm1	Feb 11, 2025, 10:28 AM	-	20480 / 20480 MB	1 / 1 Disks	<div></div>

PersistentVolumeClaims

Name	Status
warm-migration-plan1-vm-43432-464rs	Pending

DataVolumes

Name	Status
warm-migration-plan1-vm-43432-464rs	ImportInProgress

Pipeline

Name	Description	Tasks	Started at	Error
Initialize	Initialize migration.		Feb 11, 2025, 10:28 AM	
DiskTransfer	Transfer disks.	1 / 1	Feb 11, 2025, 10:28 AM	
Cutover	Finalize disk transfer.	0 / 1	Feb 11, 2025, 11:07 AM	
ImageConversion	Convert image to kubvirt.		-	
VirtualMachineCreation	Create VM.		-	

When the cutover phase is completed, the DataVolume comes to the succeeded state and the PVC is bound.

Virtual Machines

Pipeline status

Name

Filter by name

Cancel virtual machines

Name	Started at	Completed at	Disk transfer	Disk counter	Pipeline status
vm1	Feb 11, 2025, 10:28 AM	-	20480 / 20480 MB	1 / 1 Disks	

Pods

Pod	Status	Pod logs	Created at
warm-migration-plan1-vm-43432-lpkdt	Pending	Logs	Feb 11, 2025, 11:17 AM

PersistentVolumeClaims

Name	Status
PVC warm-migration-plan1-vm-43432-464rs	Bound

DataVolumes

Name	Status
DV warm-migration-plan1-vm-43432-464rs	Succeeded

The migration plan proceeds to complete the ImageConversion phase and finally, the VirtualMachineCreation Phase is completed. The VM comes to the running state on OpenShift Virtualization.

VirtualMachines

Filter

Name

Search by name...

Name	Namespace	Status	Conditions	Node	Created
VM vm1	NS test-migrations	Running		N worker2	7 minutes ago

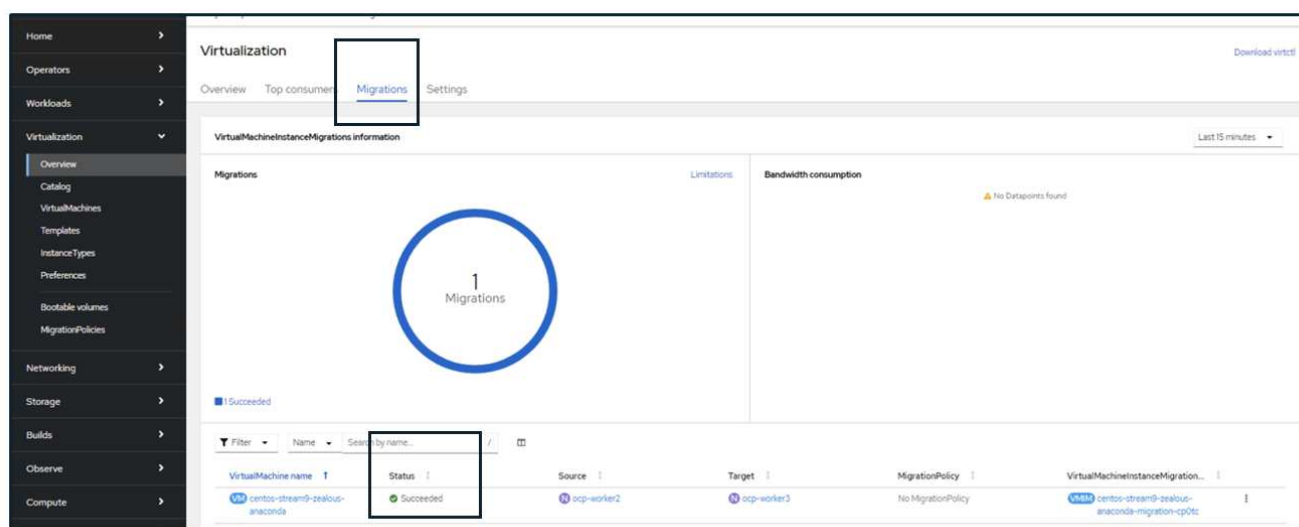
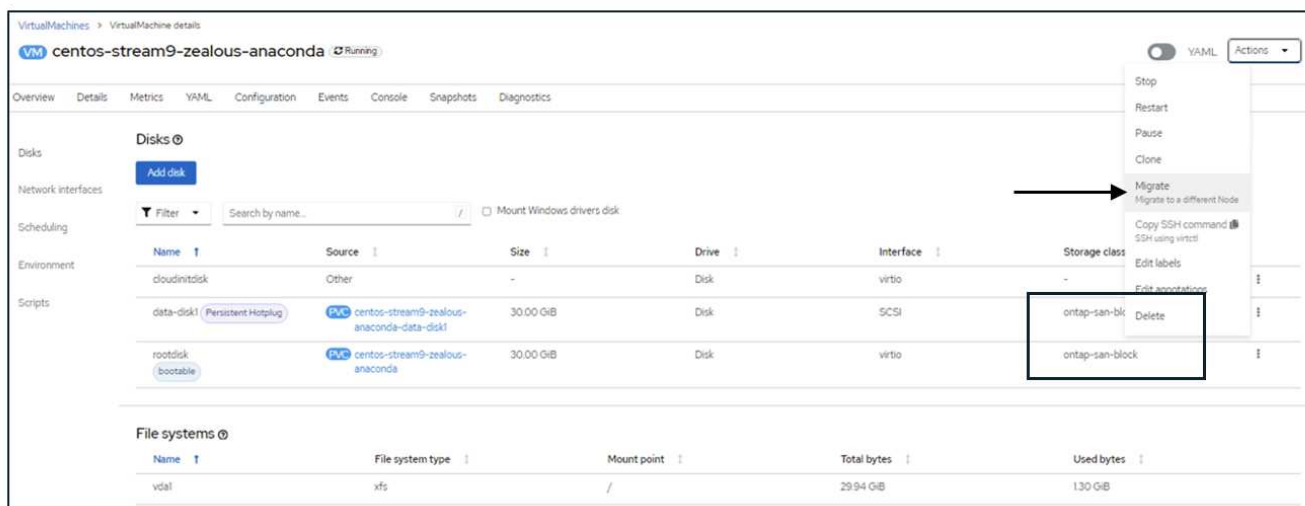
Migrate a VM between two nodes in a Red Hat OpenShift cluster

Migrate a VM in OpenShift Virtualization between two nodes in the cluster with no downtime. This procedure includes confirming the disks use RWX-compatible storage classes, initiating the migration, and monitoring the progress.

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. Trident backends configured using ontap-nas drivers support RWX access mode for FileSystem protocols nfs and smb. Refer to the documentation [here](#). 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.

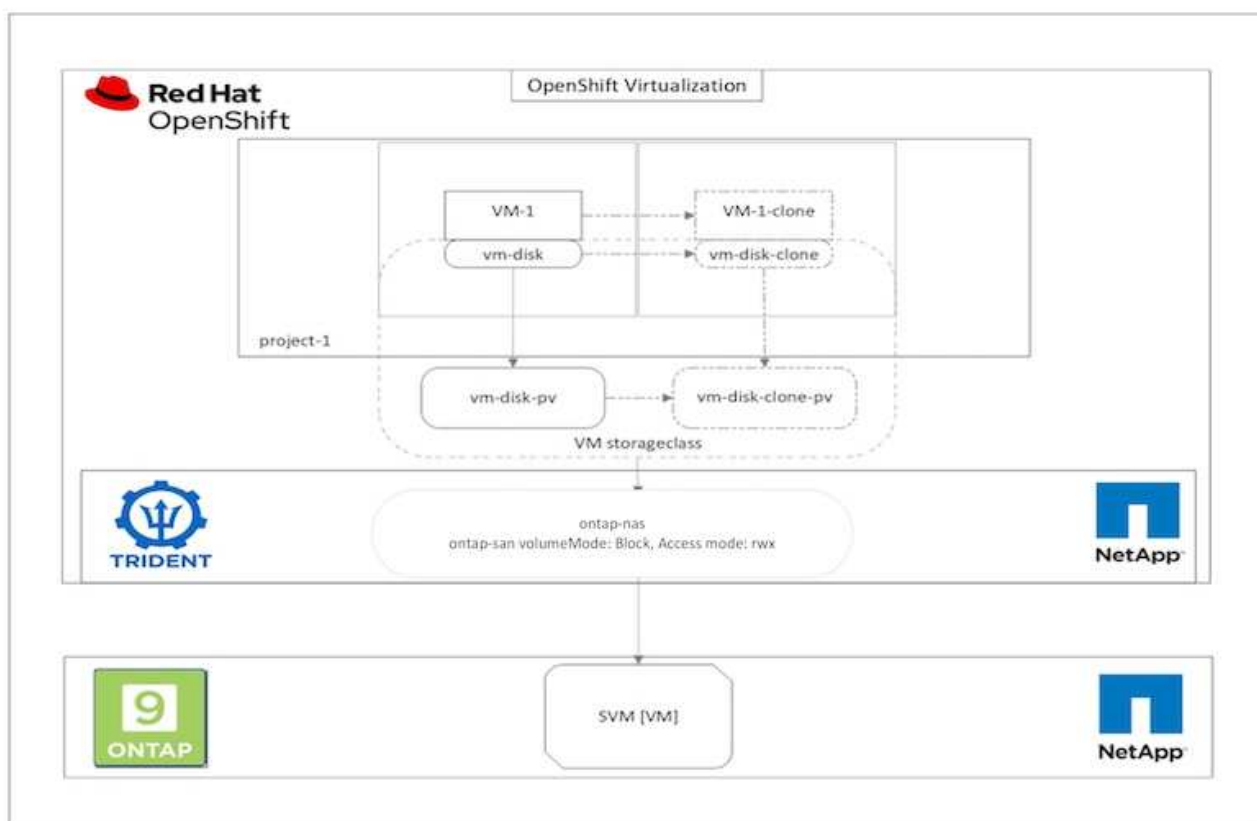


Clone a VM with Red Hat OpenShift Virtualization

Clone a VM in OpenShift Virtualization using Trident. This procedure includes leveraging Trident CSI volume cloning, allowing you to create a new VM by shutting down the source VM or keep it running.

VM cloning

Cloning an existing VM in OpenShift is achieved with the support of 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 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 *	<input type="text" value="rhel8-short-frog-clone"/>
Description	<div></div>
Namespace *	<div>default</div>
	<input checked="" type="checkbox"/> Start virtual machine on clone
Configuration	<div><div>Operating System</div><div>Red Hat Enterprise Linux 8.0 or higher</div><div>Flavor</div><div>Small: 1 CPU 2 GiB Memory</div><div>Workload Profile</div><div>server</div><div>NICs</div><div>default - virtio</div><div>Disks</div><div>cloudinitdisk - cloud-init disk</div><div>rootdisk - 20Gi - basic</div></div>

 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-28dvvb-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.

Create a VM from a snapshot copy with Red Hat OpenShift Virtualization

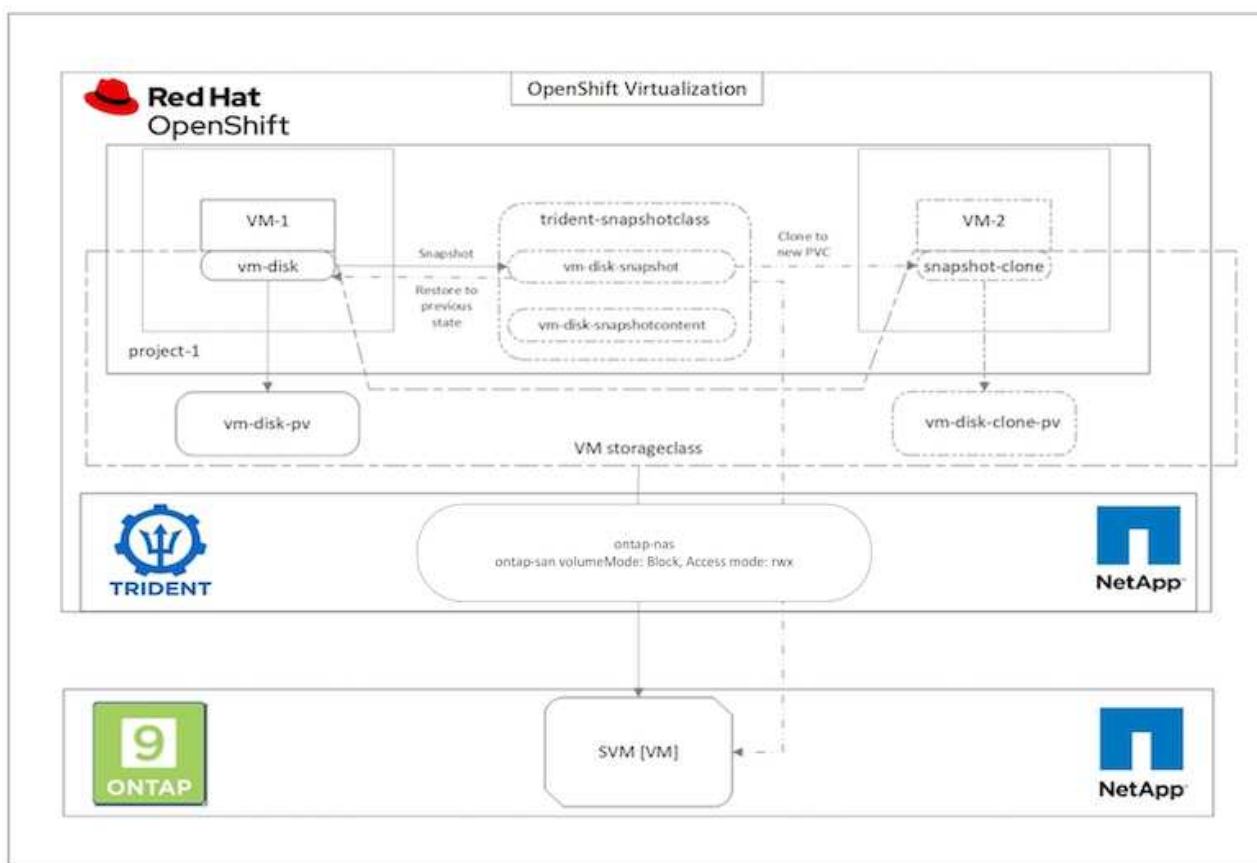
Create a VM from a snapshot with OpenShift Virtualization. This procedure includes creating a VolumeSnapshotClass, taking a snapshot of the VM's persistent volume claim (PVC), restoring the snapshot to a new PVC, and deploying a new VM that uses the restored PVC as the root disk.

Create VM from a Snapshot

With 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.

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