



# **Best practices to deploy VMs in Red Hat OpenShift Virtualization**

NetApp virtualization solutions

NetApp

August 02, 2025

# Table of Contents

Best practices to deploy VMs in Red Hat OpenShift Virtualization .....	1
VM performance .....	1
High Availability of VM workloads .....	1
Storage Configuration .....	1
<b>Storage Configuration Best Practices</b> .....	3
<b>Dedicated Storage Virtual Machines (SVMs)</b> .....	3
<b>Limit the maximum volume count on the SVM</b> .....	3
<b>Limit the maximum size of volumes created by Trident</b> .....	3
<b>Use SVM QOS policy</b> .....	4
<b>Limit storage resource access to Kubernetes cluster members</b> .....	4
<b>OpenShift Virtualization - Tuning &amp; Scaling Guide</b> .....	5
<b>Migrating VMs from VMware environment</b> .....	5

# Best practices to deploy VMs in Red Hat OpenShift Virtualization

Learn about the best practices to deploy new VMs in OpenShift Virtualization and import existing VMs from a VMware vSphere into OpenShift Virtualization on an OpenShift container platform.

## VM performance

When creating a new VM in OpenShift Virtualization, you need to consider the access pattern along with performance (IOPs and throughput) requirements of the workload that will run on the VM. This will influence the number of VMs you will need to run on the OpenShift Virtualization in an OpenShift Container platform and the type of storage that you need to use for the VM disks.

The type of storage you want to choose for your VM disks are influenced by the following factors:

- The protocol access you need for data access of your workloads
- The access modes you need (RWO vs RWX)
- The performance characteristics you need for your workloads

See the Storage Configuration section below for more details.

## High Availability of VM workloads

OpenShift Virtualization supports Live migrations of a VM. Live migration allows a running Virtual Machine Instance (VMI) to move to another node without interrupting the workload. Migration can be helpful for a smooth transition during cluster upgrades or any time a node needs to be drained for maintenance or configuration changes.

Live migration requires the use of a shared storage solution that provides ReadWriteMany (RWX) access mode. The VM disks should be backed by storage option that provides RWX access mode. OpenShift Virtualization will check that a VMI is **live migratable** and if so the **evictionStrategy** will be set to **LiveMigrate**. See [About live migration section in Red Hat documentation](#) for details.

It is important that you use a driver that supports **RWX** access mode.

See the Storage Configuration section below for more details about what ONTAP drivers support RWX access mode.

## Storage Configuration

Trident CSI provisioner provides several drivers (nas, nas-economy, nas-flexgroup, san and san-economy) for provisioning storage backed by NetApp storage options.

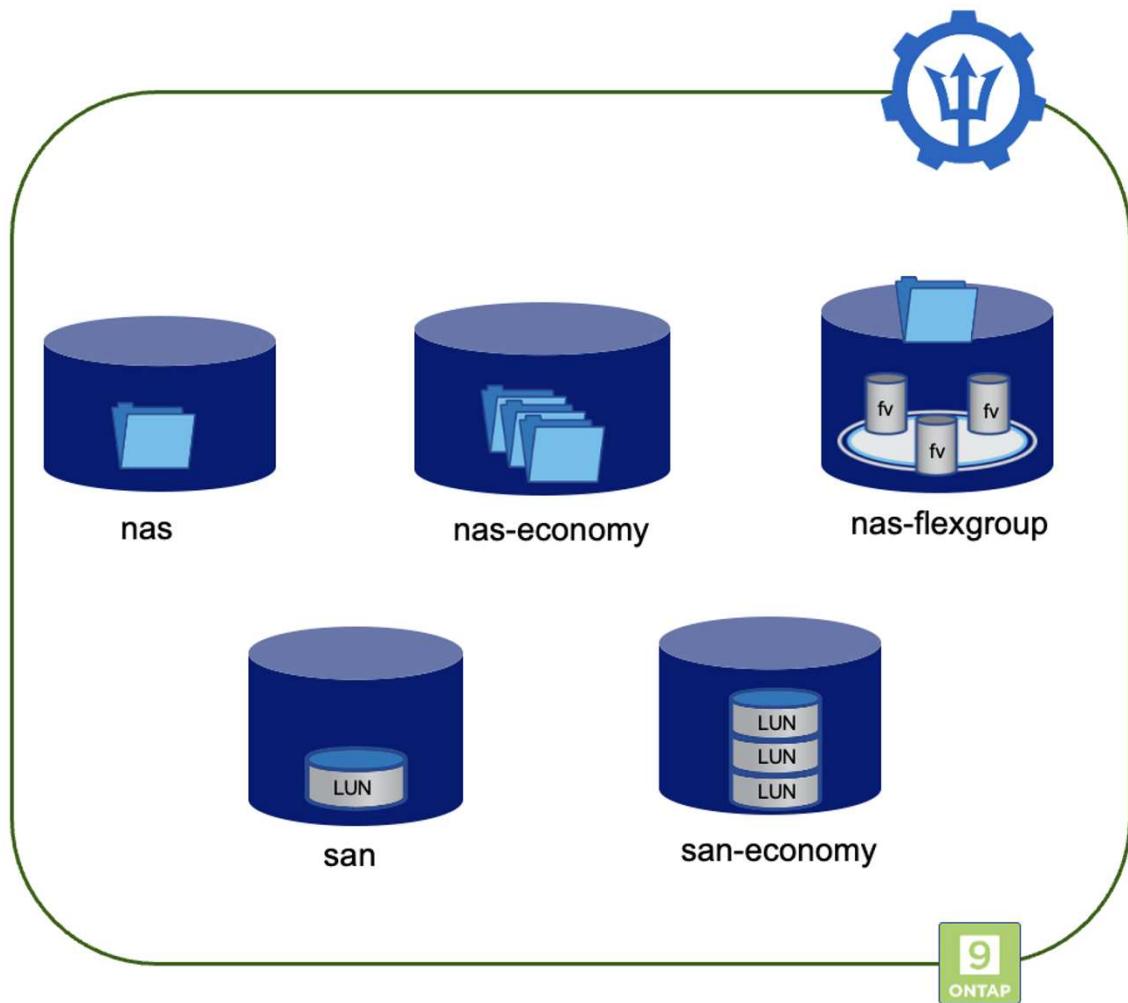
### Protocols used:

- \* nas drivers use NAS protocols (NFS and SMB)
- \* san drivers use iSCSI or NVMe/TCP protocol

The following can help you decide how you want the storage configuration based on the workload requirements and storage utilization.

- **nas** driver creates one persistent volume (PV) on one FlexVolume.
- **nas-economy** driver creates one PV on a qtree on a shared FlexVolume. (one FlexVolume for every 200 PVs, configurable between 50 and 300)
- **nas-flexgroup** driver creates one PV on one FlexGroup
- **san** driver creates one PV on LUN on a dedicated FlexVolume
- **san-economy** driver creates one PV on LUN on shared FlexVolume (one FlexVolume for every 100 PVs, configurable between 50 and 200)

The following diagram illustrates this.



Also, the access modes supported by the drivers differ.

#### ONTAP nas drivers support

- Filesystem access and RWO, ROX, RWX, RWOP access modes.

#### ONTAP san drivers support raw block as well as filesystem modes

- In the raw block mode, it can support RWO, ROX, RWX, RWOP access modes.
- In the filesystem mode, only RWO, RWOP access modes are permitted.

Live migration of OpenShift Virtualization VMs require the disks to have RWX access modes. So, it is important that you choose nas drivers or san drivers in raw block volume mode to create PVCs and PVs backed by ONTAP.

## Storage Configuration Best Practices

### Dedicated Storage Virtual Machines (SVMs)

Storage Virtual Machines (SVMs) provide isolation and administrative separation between tenants on an ONTAP system. Dedicating an SVM to OpenShift containers and to OpenShift Virtualization VMs enables the delegation of privileges and enables applying best practices for limiting resource consumption.

#### Limit the maximum volume count on the SVM

To prevent Trident from consuming all the available volumes on the storage system, you should set a limit on the SVM. You can do this from the command line:

```
vserver modify -vserver <svm_name> -max-volumes <num_of_volumes>
```

The max-volumes value is the total volumes provisioned across all the nodes in the ONTAP cluster, and not on an individual ONTAP node. As a result, you might encounter some conditions where an ONTAP cluster node might have far more or less Trident provisioned volumes than another node. To avoid this, ensure that equal number of aggregates from each node in the cluster are assigned to the SVM used by Trident.

#### Limit the maximum size of volumes created by Trident

You can set a maximum volume size limit on a per SVM basis in ONTAP:

1. Create the SVM with the vserver create command and set the storage limit:

```
vserver create -vserver vserver_name -aggregate aggregate_name -rootvolume
root_volume_name -rootvolume-security-style {unix|ntfs|mixed} -storage
-limit value
```

1. To modify the storage limit on an existing SVM:

```
vserver modify -vserver vserver_name -storage-limit value -storage-limit
-threshold-alert percentage
```



Storage limits cannot be configured for any SVM that contains data protection volumes, volumes in a SnapMirror relationship, or in a MetroCluster configuration.

In addition to controlling the volume size at the storage array, you should also leverage Kubernetes

capabilities.

1. To configure the maximum size for volumes that can be created by Trident, use the **limitVolumeSize** parameter in your backend.json definition.
2. To configure the maximum size for FlexVols used as pools for ontap-san-economy and ontap-nas-economy drivers, use the **limitVolumePoolSize** parameter in your backend.json definition.

## Use SVM QOS policy

Apply Quality of service (QoS) policy to the SVM to limit the number of IOPS consumable by the Trident provisioned volumes. This helps to prevent workloads using Trident provisioned storage from affecting workloads outside of the Trident SVM.

ONTAP QoS policy groups provide QoS options for volumes and enable users to define the throughput ceiling for one or more workloads.

For more information about QoS policy groups, refer to [ONTAP 9.15 QoS commands](#)

## Limit storage resource access to Kubernetes cluster members

### Use Namespaces

Limiting access to the NFS volumes and iSCSI LUNs created by Trident is a critical component of the security posture for your Kubernetes deployment. Doing so prevents hosts that are not a part of the Kubernetes cluster from accessing the volumes and potentially modifying data unexpectedly.

Also, a process in a container can access storage mounted to the host, but which is not intended for the container. Using Namespaces to provide logical boundary for resources can avoid this issue. However,

It's important to understand that namespaces are the logical boundary for resources in Kubernetes. Thus, it is critical to ensure that namespaces are used to provide separation when appropriate. However, privileged containers run with substantially more host-level permissions than normal. So, disable this capability by using [pod security policies](#).

### Use a dedicated export policy

For OpenShift deployments which have dedicated infrastructure nodes or other nodes which are unable to schedule user applications, separate export policies should be used to further limit access to storage resources. This includes creating an export policy for services which are deployed to those infrastructure nodes (for example, the OpenShift Metrics and Logging services), and standard applications which are deployed to non-infrastructure nodes.

Trident can automatically create and manage export policies. This way, Trident limits access to the volumes it provisions to the nodes in the Kubernetes cluster and simplifies the addition/deletion of nodes.

But if you choose to create an export policy manually, then populate it with one or more export rules that process each node access request.

### Disable showmount for the application SVM

A pod deployed to the Kubernetes cluster can issue the showmount -e command against the data LIF and receive a list of available mounts, including those which it does not have access to. To prevent this, disable the showmount feature using the following CLI:

```
vserver nfs modify -vserver <svm_name> -showmount disabled
```



For additional details about Best Practices for Storage Configuration and Trident usage, review [Trident documentation](#)

# OpenShift Virtualization - Tuning & Scaling Guide

Red Hat has documented [OpenShift Cluster Scaling Recommendations and limitations](#).

In addition, they have also documented [OpenShift Virtualization tuning guide](#) and [Supported Limits for OpenShift Virtualization 4.x](#).



An active Red Hat subscription is required to access the above content.

The tuning guide contains information about many tuning parameters including:

- Tuning parameters to create many VMs at once or in large batches
- Live migration of VMs
- [Configuring a dedicated network for live migration](#)
- Customizing a VM template by including a workload type

The supported limits document the tested object maximums when running VMs on OpenShift

## Virtual Machine Maximums including

- Max virtual CPUs per VM
- Max and min memory per VM
- Max Single disk size per VM
- Max number of hot pluggable disk per VM

## Host Maximums including

\* Simultaneous live migrations (per node and per cluster)

## Cluster Maximums including

\* Maximum number of defined VMs

## Migrating VMs from VMware environment

Migration ToolKit for OpenShift Virtualization is a Red Hat provided operator available from the OperatorHub of the OpenShift Container Platform. This tool can be used to migrate VMs from vSphere, Red Hat Virtualization, OpenStack, and OpenShift Virtualization.

Details about migrating VMs from VSphere can be found under [Workflows > Red Hat OpenShift Virtualization with NetApp ONTAP](#)

You can configure limits for various parameters either from the CLI or from the Migration web console. Some samples are given below

### 1. Max concurrent virtual machine migrations

Sets the maximum number of VMs that can be migrated simultaneously. The default value is 20 virtual machines.

## 2. Precopy interval (minutes)

Controls the interval at which a new snapshot is requested prior to initiating a warm migration. The default value is 60 minutes.

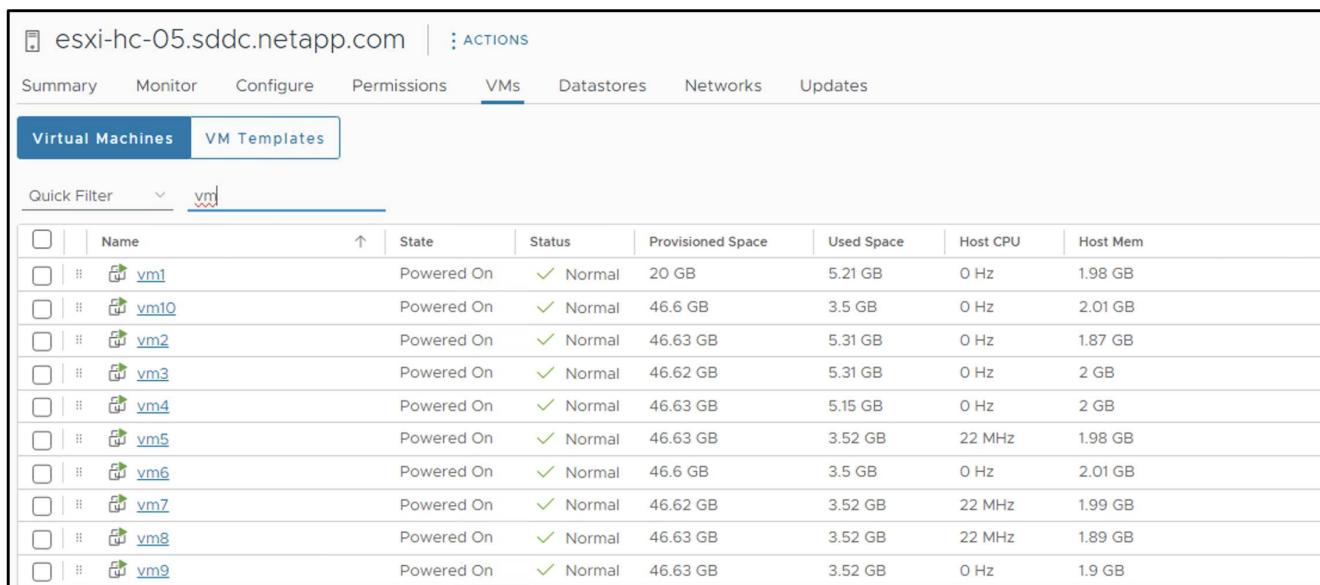
## 3. Snapshot polling interval (seconds)

Determines the frequency with which the system checks the status of snapshot creation or removal during oVirt warm migration. The default value is 10 seconds.

If you are migrating more than 10 VMs from an ESXi host in the same migration plan, you must increase the NFC service memory of the host. Otherwise, the migration will fail because the NFC service memory is limited to 10 parallel connections. For additional details see the Red Hat documentation: [Increasing the NFC service memory of an ESXi host](#)

Here is a successful parallel migration of 10 VMs from the same host in VSphere to OpenShift Virtualization using Migration Toolkit for Virtualization.

### VMs on the same ESXi host



The screenshot shows the Migration Toolkit for Virtualization interface for the host 'esxi-hc-05.sddc.netapp.com'. The 'VMs' tab is selected. A 'Virtual Machines' tab is highlighted. A 'Quick Filter' is set to 'vm'. The table lists 10 VMs:

	Name	State	Status	Provisioned Space	Used Space	Host CPU	Host Mem
<input type="checkbox"/>	vm1	Powered On	Normal	20 GB	5.21 GB	0 Hz	1.98 GB
<input type="checkbox"/>	vm10	Powered On	Normal	46.6 GB	3.5 GB	0 Hz	2.01 GB
<input type="checkbox"/>	vm2	Powered On	Normal	46.63 GB	5.31 GB	0 Hz	1.87 GB
<input type="checkbox"/>	vm3	Powered On	Normal	46.62 GB	5.31 GB	0 Hz	2 GB
<input type="checkbox"/>	vm4	Powered On	Normal	46.63 GB	5.15 GB	0 Hz	2 GB
<input type="checkbox"/>	vm5	Powered On	Normal	46.63 GB	3.52 GB	22 MHz	1.98 GB
<input type="checkbox"/>	vm6	Powered On	Normal	46.6 GB	3.5 GB	0 Hz	2.01 GB
<input type="checkbox"/>	vm7	Powered On	Normal	46.62 GB	3.52 GB	22 MHz	1.99 GB
<input type="checkbox"/>	vm8	Powered On	Normal	46.63 GB	3.52 GB	22 MHz	1.89 GB
<input type="checkbox"/>	vm9	Powered On	Normal	46.63 GB	3.52 GB	0 Hz	1.9 GB

### A plan is first created for migrating 10 VMs from VMware

Project: openshift-mtv

1 Select source provider  
2 Create migration plan

Select source provider

Type:  Filter provider:

**VM vmware-source** Ready

Click to unselect:

Select virtual machines

Concerns Host Name Filter by name

Host: esxi-hc-05.sddc.netapp.com Name: vm

Clear all filters

Name	Concerns	Template	Host	Folder	Powerstate
vm1	0 1 2	false	esxi-hc-05.sddc.netapp.com	ocp-mtv-source-vms	On
vm2	0 1 2	false	esxi-hc-05.sddc.netapp.com	ocp-mtv-source-vms	On
vm3	0 1 2	false	esxi-hc-05.sddc.netapp.com	ocp-mtv-source-vms	On
vm4	0 1 2	false	esxi-hc-05.sddc.netapp.com	ocp-mtv-source-vms	On
vm5	0 1 2	false	esxi-hc-05.sddc.netapp.com	ocp-mtv-source-vms	On
vm6	0 1 2	false	esxi-hc-05.sddc.netapp.com	ocp-mtv-source-vms	On
vm7	0 1 2	false	esxi-hc-05.sddc.netapp.com	ocp-mtv-source-vms	On
vm8	0 1 2	false	esxi-hc-05.sddc.netapp.com	ocp-mtv-source-vms	On
vm9	0 1 2	false	esxi-hc-05.sddc.netapp.com	ocp-mtv-source-vms	On
vm10	0 1 2	false	esxi-hc-05.sddc.netapp.com	ocp-mtv-source-vms	On

1-10 of 10 | < | 1 of 1 | > | >>

Next Back Cancel

## Migration plan has started executing

Project: openshift-mtv

Plans > Plan Details

**PL ten-vms-migration** Running

Actions

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	Sep 16, 2024, 12:09 AM	-	0 / 20480 MB	- / 1 Disks	
vm2	Sep 16, 2024, 12:08 AM	-	0 / 20480 MB	- / 1 Disks	
vm3	Sep 16, 2024, 12:08 AM	-	0 / 20480 MB	- / 1 Disks	
vm4	Sep 16, 2024, 12:09 AM	-	0 / 20480 MB	- / 1 Disks	
vm5	Sep 16, 2024, 12:09 AM	-	0 / 20480 MB	- / 1 Disks	
vm6	Sep 16, 2024, 12:09 AM	-	0 / 20480 MB	- / 1 Disks	
vm7	Sep 16, 2024, 12:09 AM	-	0 / 20480 MB	- / 1 Disks	
vm8	Sep 16, 2024, 12:08 AM	-	0 / 20480 MB	- / 1 Disks	
vm9	Sep 16, 2024, 12:09 AM	-	0 / 20480 MB	- / 1 Disks	
vm10	Sep 16, 2024, 12:09 AM	-	0 / 20480 MB	- / 1 Disks	

All 10 VMs have successfully migrated

Project: openshift-mtv ▾

Plans > Plan Details

PL ten-vms-from-same-host Succeeded

Actions ▾

Details YAML Virtual Machines Resources Mappings Hooks

Virtual Machines

Pipeline status ▾ Name ▾ Filter by name ▾ Remove virtual machines

Name	Started at	Completed at	Disk transfer	Disk counter	Pipeline status
vm1	Sep 16, 2024, 10:23 AM	Sep 16, 2024, 10:41 AM	20480 / 20480 MB	- / 1 Disks	● ● ● ● ●
vm2	Sep 16, 2024, 10:23 AM	Sep 16, 2024, 10:41 AM	20480 / 20480 MB	- / 1 Disks	● ● ● ● ●
vm3	Sep 16, 2024, 10:23 AM	Sep 16, 2024, 10:38 AM	20480 / 20480 MB	- / 1 Disks	● ● ● ● ●
vm4	Sep 16, 2024, 10:23 AM	Sep 16, 2024, 10:42 AM	20480 / 20480 MB	- / 1 Disks	● ● ● ● ●
vm5	Sep 16, 2024, 10:23 AM	Sep 16, 2024, 10:42 AM	20480 / 20480 MB	- / 1 Disks	● ● ● ● ●
vm6	Sep 16, 2024, 10:23 AM	Sep 16, 2024, 10:37 AM	20480 / 20480 MB	- / 1 Disks	● ● ● ● ●
vm7	Sep 16, 2024, 10:23 AM	Sep 16, 2024, 10:38 AM	20480 / 20480 MB	- / 1 Disks	● ● ● ● ●
vm8	Sep 16, 2024, 10:23 AM	Sep 16, 2024, 10:37 AM	20480 / 20480 MB	- / 1 Disks	● ● ● ● ●
vm9	Sep 16, 2024, 10:23 AM	Sep 16, 2024, 10:38 AM	20480 / 20480 MB	- / 1 Disks	● ● ● ● ●
vm10	Sep 16, 2024, 10:23 AM	Sep 16, 2024, 10:37 AM	20480 / 20480 MB	- / 1 Disks	● ● ● ● ●

All 10 VMs are in a running state in OpenShift Virtualization

Project: ten-vms-from-same-host ▾

VirtualMachines

Create ▾

Filter ▾ Name ▾ Search by name... ▾

1 - 10 of 10 ▾ 1 of 1 ▾

Name	Status	Conditions	Node	IP address
vm1	Running		ocp7-worker3	-
vm2	Running		ocp7-worker1	-
vm3	Running		ocp7-worker2	-
vm4	Running		ocp7-worker1	-
vm5	Running		ocp7-worker2	-
vm6	Running		ocp7-worker2	-
vm7	Running		ocp7-worker1	-
vm8	Running		ocp7-worker3	-
vm9	Running		ocp7-worker2	-
vm10	Running		ocp7-worker1	-

## Copyright information

Copyright © 2026 NetApp, Inc. All Rights Reserved. Printed in the U.S. No part of this document covered by copyright may be reproduced in any form or by any means—graphic, electronic, or mechanical, including photocopying, recording, taping, or storage in an electronic retrieval system—without prior written permission of the copyright owner.

Software derived from copyrighted NetApp material is subject to the following license and disclaimer:

THIS SOFTWARE IS PROVIDED BY NETAPP “AS IS” AND WITHOUT ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WHICH ARE HEREBY DISCLAIMED. IN NO EVENT SHALL NETAPP BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

NetApp reserves the right to change any products described herein at any time, and without notice. NetApp assumes no responsibility or liability arising from the use of products described herein, except as expressly agreed to in writing by NetApp. The use or purchase of this product does not convey a license under any patent rights, trademark rights, or any other intellectual property rights of NetApp.

The product described in this manual may be protected by one or more U.S. patents, foreign patents, or pending applications.

**LIMITED RIGHTS LEGEND:** Use, duplication, or disclosure by the government is subject to restrictions as set forth in subparagraph (b)(3) of the Rights in Technical Data -Noncommercial Items at DFARS 252.227-7013 (FEB 2014) and FAR 52.227-19 (DEC 2007).

Data contained herein pertains to a commercial product and/or commercial service (as defined in FAR 2.101) and is proprietary to NetApp, Inc. All NetApp technical data and computer software provided under this Agreement is commercial in nature and developed solely at private expense. The U.S. Government has a non-exclusive, non-transferrable, nonsublicensable, worldwide, limited irrevocable license to use the Data only in connection with and in support of the U.S. Government contract under which the Data was delivered. Except as provided herein, the Data may not be used, disclosed, reproduced, modified, performed, or displayed without the prior written approval of NetApp, Inc. United States Government license rights for the Department of Defense are limited to those rights identified in DFARS clause 252.227-7015(b) (FEB 2014).

## Trademark information

NETAPP, the NETAPP logo, and the marks listed at <http://www.netapp.com/TM> are trademarks of NetApp, Inc. Other company and product names may be trademarks of their respective owners.