

Dell EMC PowerStore

Virtualization Infrastructure Guide

Version 2.x

Notes, cautions, and warnings

 **NOTE:** A NOTE indicates important information that helps you make better use of your product.

 **CAUTION:** A CAUTION indicates either potential damage to hardware or loss of data and tells you how to avoid the problem.

 **WARNING:** A WARNING indicates a potential for property damage, personal injury, or death.

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As part of an improvement effort, revisions of the software and hardware are periodically released. Some functions that are described in this document are not supported by all versions of the software or hardware currently in use. The product release notes provide the most up-to-date information about product features. Contact your service provider if a product does not function properly or does not function as described in this document.

Where to get help

Support, product, and licensing information can be obtained as follows:

- **Product information**

For product and feature documentation or release notes, go to the PowerStore Documentation page at <https://www.dell.com/powerstoredocs>.

- **Troubleshooting**

For information about products, software updates, licensing, and service, go to <https://www.dell.com/support> and locate the appropriate product support page.

- **Technical support**

For technical support and service requests, go to <https://www.dell.com/support> and locate the **Service Requests** page. To open a service request, you must have a valid support agreement. Contact your Sales Representative for details about obtaining a valid support agreement or to answer any questions about your account.

Introduction

Topics:

- [Purpose](#)
- [Audience](#)

Purpose

This document provides an overview of how virtualization is implemented on PowerStore clusters.

This document contains the following information:

- Hypervisor configuration for a PowerStore cluster.
- How to manage virtualization components in PowerStore Manager.
- How to add an external ESXi host to a PowerStore cluster in vCenter Server.
- How to add the ESXi hosts in a PowerStore X model cluster to VMware NSX-V.
- Best practices and limitations for PowerStore, vCenter Server, and vSphere.

Audience

The information in this guide is primarily intended for:

- System administrators who are responsible for a wide range of technologies in their organization including basic storage management
- Storage administrators who manage the operations of storage infrastructure within their organization
- Virtualization administrators who deliver and maintain the virtual infrastructure for their organization

Users should have current practical experience with the following topics:

- Managing virtual machines and ESXi hypervisors with the VMware vSphere Client
- Accessing the ESXi Shell in order to use ESXCLI commands
- Using other VMware management interfaces such as PowerCLI

Overview of the PowerStore Virtualization Infrastructure

Topics:

- [PowerStore virtualization terminology](#)
- [Virtualization architecture and configuration](#)
- [Network configuration for PowerStore X model appliances](#)
- [Hypervisor configuration for PowerStore X model appliances](#)

PowerStore virtualization terminology

PowerStore clusters use a specific implementation of virtualization concepts that are based in a VMware vSphere framework.

PowerStore T model and PowerStore X model clusters are both designed to be integrated with VMware vSphere. These integrations include:

- vCenter Server
- Virtual machines
- VMFS Datastores
- Virtual Volumes
- Protocol Endpoints
- VASA provider
- Storage containers
- Storage Policy Based Management

vCenter Server

A vCenter Server must be registered in PowerStore Manager to enable virtual machine (VM) discovery, monitoring, and snapshot management. When a vCenter Server is connected to a PowerStore cluster, PowerStore Manager can be used to monitor VM attributes, capacity, storage and compute performance, and virtual volumes.

- On a PowerStore X model cluster, a connection to an external vCenter Server is required and it is set up during the initial system configuration.
 - **NOTE:** To view the vCenter Server versions supported by PowerStore X model appliances, see the **VMware Licensing and Support for PowerStore X** table in the *PowerStore Simple Support Matrix*, which can be downloaded from the PowerStore Documentation page at: <https://www.dell.com/powerstoredocs>.
- On a PowerStore T model cluster, a connection to a vCenter Server is optional and it can be set up during the initial system configuration.
 - **NOTE:** A PowerStore T model cluster supports vCenter Server 6.0 Update 2 and later.

Virtual machines

VMs that are stored on vVol datastores in a PowerStore cluster are automatically discovered and displayed in PowerStore OS. The VMs that are displayed include VMs using internal compute resources on a PowerStore X model cluster and external compute resources on ESXi hosts.

PowerStore clusters support both VMFS and vVol datastores. PowerStore clusters also support serving storage externally using Fibre Channel (FC), iSCSI, or NVMe over Fibre Channel (NVMeoFC) protocols. Support for FC and iSCSI protocols enables VMs on external ESXi hosts to use the VMFS and vVols storage on PowerStore clusters. Support for the NVMeoFC protocol enables

VMs on external ESXi hosts to use the VMFS storage on PowerStore clusters. However, support for the NVMeoFC protocol does not enable VMs on external hosts to use vVol storage on PowerStore clusters.

A PowerStore X model cluster can consist of four PowerStore X model appliances. A single PowerStore X model appliance contains two internal nodes with the ESXi hypervisors that are installed on each node. The ESXi host on each node is provisioned with a controller VM that runs the PowerStore OS. The PowerStore X model appliance reserves CPU and memory resources for the PowerStore OS controller VMs, while the rest of CPU and memory resources are available for users to create and run VMs.

VMFS Datastores

VMFS datastores are used as repositories for virtual machines that use block-based storage. It is a special high-performance file system format that is optimized for storing virtual machines. You can store multiple virtual machines on the same VMFS datastore. Each virtual machine, encapsulated in a set of files, occupies a single directory. In addition to the virtual machines, the VMFS datastores can store other files, such as the virtual machine templates and ISO images.

CAUTION: Do not provision user VMs on the private VMFS datastores of a PowerStore X model cluster. The private VMFS datastores are named PRIVATE-`<Service_Tag>.A.INTERNAL` and PRIVATE-`<Service_Tag>.B.INTERNAL`, and they are reserved for the controller nodes on a PowerStore X model cluster.

However, agent virtual machines should be provisioned on the private VMFS datastores of a PowerStore X model cluster to allow the agent VMs to start before the controller VMs.

NOTE: An agent virtual machine is a virtual machine that performs a specific function for the virtualization infrastructure. An example of an agent VM is a vShield Endpoint appliance, which is an anti-virus solution.

Virtual Volumes

Virtual Volumes (vVols) are an object type that corresponds to VM disks and snapshots. vVols are supported on a PowerStore cluster using the VASA protocol.

vVols are stored in storage containers that are known as vVols datastores. vVols datastores allow vVols to be mapped directly to a PowerStore cluster. A VM can consist of multiple vVols depending on its configuration and status. The different types of vVol objects are Data vVol, Config vVol, Memory vVol, and Swap vVol.

For more information, see [Virtual Volumes overview](#) on page 9.

Protocol Endpoints

Protocol Endpoints (PEs) are used as I/O access points from ESXi hosts to a PowerStore cluster. These endpoints establish a data path on-demand for virtual machines and their respective vVol datastores.

For more information, see [Protocol Endpoints and vVols](#) on page 9.

VASA provider

The vSphere APIs for Storage Awareness (VASA) provider is a software component that enables vSphere to determine the capabilities of a storage system. VASA enables the basic information about the storage system and storage resources on a PowerStore cluster to be made available to the vCenter Server. This information includes storage policies, properties, and health status.

A PowerStore cluster includes a native VASA Provider. The VASA provider is automatically registered in vSphere during the initial configuration of a PowerStore X model cluster. The VASA Provider can be optionally registered in vSphere during the initial configuration of a PowerStore T model cluster.

Storage containers

A storage container is used to present vVol storage from a PowerStore cluster to vSphere. vSphere mounts the storage container as a vVol datastore and makes it available for VM storage. When a PowerStore cluster is used to provide VM storage, user VMs should be provisioned on the vVol datastores. The default storage container is mounted automatically on the nodes of the cluster.

For more information, see [Storage containers overview](#) on page 9.

Storage Policy Based Management

vVols use Storage Policy Based Management (SPBM) to ensure that VMs have the appropriate storage capabilities through their entire life cycle. Storage QoS policies can be created in vCenter after the storage provider is registered.

NOTE: The name of storage type to use when creating storage QoS policies for a PowerStore cluster is `DELLEMC.POWERSTORE.VVOL`.

These policies are used to determine the storage capabilities when a VM is provisioned. For information about creating a VM storage policy, see the VMware vSphere documentation.

Virtual Volumes overview

Virtual Volumes (vVols) are storage objects that are provisioned automatically on a storage container and store VM data.

vVol provisioning

Different management actions generate different vVols that are associated with a VM.

Table 1. Types of vVols

| vVol | Description |
|-------------|------------------------------------------------------------------------------------------------------------------------------------|
| Data vVol | A data virtual volume corresponds directly to each virtual disk .vmdk file. |
| Config vVol | A configuration virtual volume represents a small directory that contains metadata files for a virtual machine. |
| Memory vVol | A memory virtual volume that holds the contents of virtual machine memory for a snapshot. |
| Swap vVol | A swap virtual volume is created when a VM is first powered and holds copies of VM memory pages that cannot be retained in memory. |

On the PowerStore cluster, each vVol provisioned in vCenter Server is visible as a vVol in PowerStore Manager. For more information, see [Monitoring and managing vVols](#) on page 19.

Protocol Endpoints and vVols

A Protocol Endpoint is an internal object in storage systems and appliances that is required for working with vVols.

A PowerStore cluster can manage vVols without a Protocol Endpoint, but the ESXi host cannot access the vVols. To gain access, ESXi hosts communicate with vVols through a Protocol Endpoint. The Protocol Endpoint serves as a logical I/O proxy that enables the ESXi host to establish data paths to vVols and their associated VMs.

PowerStore clusters automatically create and provision Protocol Endpoints when adding an ESXi host. PowerStore X model appliances support only the iSCSI protocol for internal ESXi hosts, but support both iSCSI and Fibre Channel protocols for external hosts.

Storage containers overview

Storage containers on PowerStore appliances act as a logical grouping of vVols that enable vVols to map directly to the cluster.

A storage container spans all appliances in a cluster and uses storage from each. On PowerStore appliances, vVols reside in storage containers, which enable vVols to map directly to an appliance within the PowerStore cluster. The specific appliance that a given vVol resides on is not visible to vSphere, and a vVol can migrate between appliances without disrupting vSphere operations. With storage containers, VMs or VMDKs can be managed independently.

For information about managing storage containers in PowerStore Manager, see [Monitoring and managing storage containers](#) on page 20.

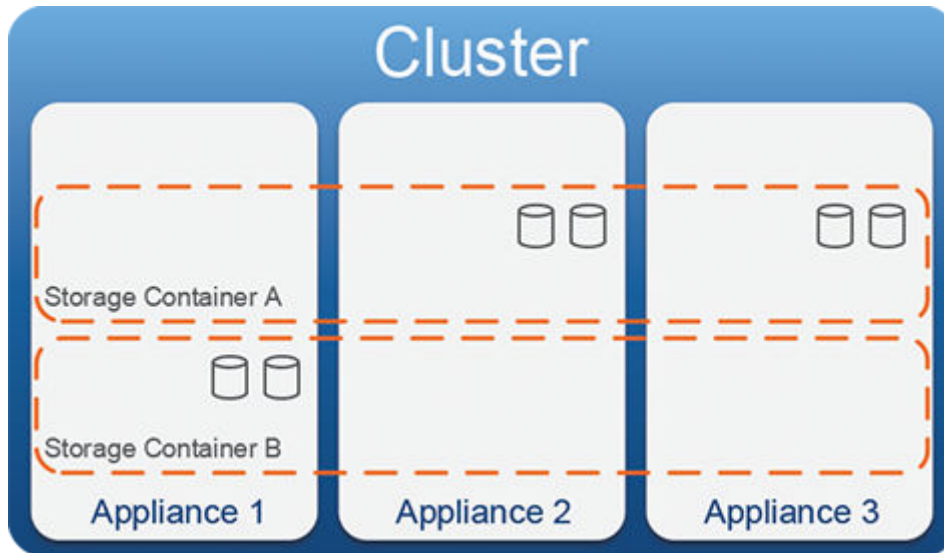


Figure 1. Storage containers spanning appliances in a PowerStore cluster

Multitenancy

PowerStore appliances support multiple storage containers on a cluster to support multitenancy requirements. Multiple storage containers can be created allowing the separation of VMs and associated vVols from one tenant to another.

ISOs vVol

During PowerStore X model cluster initialization, a 500 GB config-vVol that is named `ISOs` is created in the default storage container. This vVol can store any type of file, but is intended to hold ISO images, such as guest operating system installation files, and VM templates. Use this vVol to hold large ISO images that do not fit in a vSphere-created datastore folder, which has a default size of 4 GB.

The `ISOs` vVol is listed in the vSphere datastore browser as a directory and appears on the **vVols** card of the default storage container in PowerStore Manager. Because a storage container cannot be deleted if it contains a vVol, the default storage container cannot be deleted while it contains the `ISOs` vVol.

Storage containers for ESXi hosts

During the initial PowerStore X model appliance configuration, a default storage container that is named **(PowerStore <cluster name>)** is automatically provisioned on the cluster. The default storage container on PowerStore X model appliance is mounted to the internal ESXi hosts during initial configuration.

About this task

To use storage containers with an external ESXi host:

Steps

1. Connect an external ESXi host to your PowerStore cluster.
2. Create an ESXi host in PowerStore Manager.
3. Use PowerStore Manager to create a storage container.
For more information, see [Create a storage container](#) on page 20.
4. Use the vSphere Client or CLI to mount the storage container on the external ESXi host.
For more information, see VMware vSphere product documentation.
5. Create a vVol datastore from the storage container.
6. Create VMs on the vVol datastore.

Virtualization architecture and configuration

PowerStore T model configuration

The PowerStore OS runs directly on the PowerStore hardware of a PowerStore T model cluster.

A connection to a vCenter Server is optional, and can be set up during initial system configuration or later in PowerStore Manager. Using vVol-based VMs on a PowerStore T model cluster requires registering the PowerStore VASA provider in vCenter.

NOTE: A vCenter Server connection with a registered VASA provider is not required to manage VMFS-based VMs, but it is still recommended.

If the VASA provider is not registered during initial system configuration, it can be registered in one of the following ways:

- The VASA provider can be registered when a connection to vCenter Server is configured in PowerStore Manager.
- The VASA provider can also be registered directly from vCenter, but additional steps are required.

NOTE: If a VASA provider is registered directly from vCenter, but a vCenter Server connection is not configured, PowerStore Manager cannot manage vVol-based VMs. Therefore, registering the VASA provider during the configuration of a vCenter Server connection in PowerStore Manager is recommended.

The PowerStore Resource Balancer manages the placement of vVols and keeps vVols for the same VM on the same appliance in a cluster. You can also manually migrate a vVol from one appliance to another using the **Virtual Volumes** card of the associated VM in PowerStore Manager.

PowerStore X model configuration

The PowerStore X model configuration provides a hypervisor layer in addition to block storage. VMware ESXi is the base operating system running on the PowerStore hardware, with the PowerStore OS running as a VM. A PowerStore X model appliance reserves 50% of the CPU and memory resources to run the controller VMs. The remaining CPU and memory resources are available for user VMs.

This application-centric configuration enables you to run applications as VMs on the PowerStore cluster.

The PowerStore Resource Balancer works with vSphere DRS to automatically manage the placement of VMs and vVols to balance the load across the PowerStore X model appliances. Resources are moved and deployed to locations based on rules to facilitate high availability (HA). HA is enabled by default, and VMs fail over as necessary based on resource availability on the remaining nodes.

In general, this behavior does not impact the daily operation or management of PowerStore X model appliances. However, there are some considerations for storage administrators. PowerStore X model appliances use federated rather than distributed storage. This configuration may impact where a storage administrator chooses to locate resources within a data center, and how VM loads are set up for satisfactory performance.

Network configuration for PowerStore X model appliances

Plan your network configuration before setting up your PowerStore X model appliance.

The PowerStore X model appliance has some specific requirements and considerations that do not apply to PowerStore T model clusters. For detailed information about network configuration with PowerStore X model appliances, see the *PowerStore Networking Guide for PowerStore T Models* or *PowerStore Networking Guide for PowerStore X Models*. The document includes:

- Planning and preparation information
- Configuration recommendations and best practices
- Network configuration, VLAN, and IP address requirements
- Switch configuration and cabling procedures
- Network configuration validation instructions

NOTE: If the configuration is modified, there are some consequences and limitations that impact HA.

Virtual network configuration

Networking on a PowerStore X model appliance is controlled by ESXi, which uses a virtual switch to share network devices with the controller VM. As a part of cluster creation, a vSphere Distributed Switch (vDS) is set up to manage network traffic. The vDS enables features such as advanced QoS priority configuration with Network I/O Control (NIOC).

In general, this configuration does not impact the management of a PowerStore X model appliance. However, there are some considerations for HA if the default configuration is modified.

NOTE: Do not upgrade a vDS even if there are upgrade notifications or options available in vCenter Server.

User VM Networking

Before deploying user VMs on the internal ESXi hosts, create a distributed port group in vCenter Server for your external network. When you deploy user VMs, use that port group for external network connectivity.

NOTE: For information about configuring NSX controller VMs, see [VMware NSX-V](#) on page 25

NTP server requirements

To prevent issues with lag time between vCenter Server and ESXi hosts when creating your cluster, ensure that they are using the same NTP server.

Hypervisor configuration for PowerStore X model appliances

CPU and memory settings

The following table displays the default CPU and memory reservations of the PowerStore OS controller VMs for each PowerStore X model:

Table 2. Default CPU and memory reservations

| PowerStore X model name | PowerStore X model number | CPU reservation | Memory reservation |
|-------------------------|---------------------------|-----------------|--------------------|
| PowerStore 1000X | 900-564-100 | 14400 MHz | 98304 MB |
| PowerStore 3000X | 900-564-101 | 25200 MHz | 196608 MB |
| PowerStore 5000X | 900-564-102 | 33600 MHz | 294912 MB |
| PowerStore 7000X | 900-564-103 | 48000 MHz | 393216 MB |
| PowerStore 9000X | 900-564-008 | 58800 MHz | 655360 MB |

vSphere Distributed Switch

You cannot use an existing vSphere Distributed Switch (vDS) configuration with your PowerStore X model appliance. PowerStore creates its own vDS and does not use the existing vDS configuration.

The vDS configuration contains one uplink port group and nine distributed port groups by default. The following table displays the default configurations for port groups on a PowerStore X model appliance:

Table 3. Port group configurations

| Name | NIC teaming | VLAN type | VLAN ID |
|-----------|-------------|---------------------|---------|
| DVUplinks | None | VLAN trunking (VGT) | 0-4094 |

Table 3. Port group configurations (continued)

| Name | NIC teaming | VLAN type | VLAN ID |
|------------------|-------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|---------|
| PG_MGMT | Active: Uplink1, Uplink2 Standby: Uplink3, Uplink4 | VLAN trunking (VGT) | 0-4094 |
| PG_MGMT_ESXi | Active: Uplink1, Uplink2 Standby: Uplink3, Uplink4 | PV_MGMT_ESXi can be configured to use VLAN (VST) and a unique VLAN ID, or it can be configured as None (0). | |
| PG_Storage_INIT1 | Active: Uplink1 Standby: None | PV_Storage_INIT1 can be configured to use VLAN (VST) and a unique VLAN ID, or it can be configured as None (0). | |
| PG_Storage_INIT2 | Active: Uplink2 Standby: None | PV_Storage_INIT2 can be configured to use VLAN (VST) and a unique VLAN ID, or it can be configured as None (0). | |
| PG_Storage_TGT1 | Active: Uplink1 Standby: Uplink2, Uplink3, Uplink4 | VLAN trunking (VGT) | 0-4094 |
| PG_Storage_TGT2 | Active: Uplink2 Standby: Uplink1, Uplink3, Uplink4 | VLAN trunking (VGT) | 0-4094 |
| PG_Storage_TGT3 | Active: Uplink3 Standby: Uplink1, Uplink2, Uplink4 | VLAN trunking (VGT) | 0-4094 |
| PG_Storage_TGT4 | Active: Uplink4 Standby: Uplink1, Uplink2, Uplink3 | VLAN trunking (VGT) | 0-4094 |
| PG_vMotion1 | Active: Uplink3 Standby: Uplink1, Uplink2, Uplink4 | PV_vMotion1 can be configured to use VLAN (VST) and a unique VLAN ID, or it can be configured as None (0). | |

Network I/O Control (NIOC) is enabled by default on the vDS. The following table displays the default settings for traffic types on a PowerStore X model appliance:

Table 4. Default traffic settings in NIOC

| Traffic type | Shares | Shares Value | Reservation (10 GbE) | Reservation (25 GbE) |
|----------------------------------------|--------|--------------|----------------------|----------------------|
| Management Traffic | Low | 25 | 500 Mbps | 1 Gbps |
| Fault Tolerance Traffic | Normal | 50 | 0 Mbps | 0 Mbps |
| vMotion Traffic | Low | 25 | 0 Mbps | 0 Mbps |
| Virtual Machine Traffic | High | 100 | 4 Gbps | 8 Gbps |
| iSCSI Traffic | High | 100 | 1.5 Gbps | 3 Gbps |
| NFS Traffic | Normal | 50 | 0 Mbps | 0 Mbps |
| vSphere Replication Traffic | Normal | 50 | 0 Mbps | 0 Mbps |
| vSAN Traffic | Normal | 50 | 0 Mbps | 0 Mbps |
| vSphere Data Protection Backup Traffic | Normal | 50 | 0 Mbps | 0 Mbps |

The following table displays the VMkernel adapters for PowerStore X model controller VMs and the default settings for each VMkernel adapter:

Table 5. VMkernel adapter settings

| Device | Label | Switch | TCP/IP Stack | Management |
|--------|-----------|--------|--------------|------------|
| vmk0 | MGMT_ESXi | DVS | Default | Enabled |

Table 5. VMkernel adapter settings (continued)

| Device | Label | Switch | TCP/IP Stack | Management |
|--------|---------------|------------------|--------------|------------|
| vmk1 | Storage_INIT1 | DVS | Default | Disabled |
| vmk2 | Storage_INIT2 | DVS | Default | Disabled |
| vmk3 | vMotion1 | DVS | vMotion | Disabled |
| vmk10 | Internal_ESX | vSwitch_Internal | Default | Disabled |

All the other VMkernel adapter settings are set to Disabled by default.

VMware licensing

vSphere licensing

The appliances in a PowerStore X model cluster contain embedded instances of VMware vSphere 6.7 that require vSphere licenses. You can use licenses from an existing VMware ELA or purchase licenses from Dell EMC, VMware, or a partner.

PowerStore X model appliances support two types of vSphere licenses:

- vSphere Enterprise Plus or higher
 - vSphere Remote Office Branch Office (ROBO) - Enterprise or Advanced licenses only; Standard licenses are not supported.
- NOTE:** A vSphere ROBO license supports a maximum of 25 virtual machines.

However, the vSphere ROBO Enterprise and vSphere ROBO Advanced licenses do not support the following features:

- vSphere ROBO Advanced does not support DRS, and vSphere ROBO Enterprise only supports DRS for entering maintenance mode.
- NOTE:** DRS is enabled by default on PowerStore X model appliances, and it must be manually disabled before applying a vSphere ROBO license to an appliance.
- vSphere Network I/O Control and vSphere Storage I/O Control
 - Single Root I/O Virtualization (SR-IOV)
 - Persistent memory (PMem)
 - Proactive HA
 - Predictive DRS
 - NVIDIA Grid vGPU
 - Dynamic DirectPath I/O - Supports vGPU and vSphere DirectPath I/O initial VM placement
 - Accelerated graphics for VMs

Purchasing a vSphere license with the cluster

The simplest way to license vSphere on the appliances in your PowerStore X model cluster is to purchase Enterprise Plus licenses with the cluster. Enterprise Plus licenses that are purchased with the cluster are automatically loaded on the appliances during manufacturing and additional steps are not required to activate the licenses.

Providing your own vSphere license

A 180-day evaluation license is configured when a PowerStore X model appliance is manufactured. If you choose to supply your own vSphere licenses, you must apply the license keys to the appliances before the vSphere evaluation license expires. If you fail to apply vSphere licenses before the evaluation license expires, you must contact your service provider for a resolution. The resolution to this issue might require reinitializing the PowerStore X model cluster. To avoid this outcome, ensure that you apply your vSphere licenses within 180 days of the manufacture date of the appliances in the cluster.

A customer supplied vSphere license must support four CPUs for each appliance in a PowerStore X model cluster. The vSphere license must support four CPUs because each appliance has two nodes and each node contains two CPUs. To use a vSphere ROBO license, you must disable DRS on the PowerStore X model cluster in vCenter Server before applying the ROBO license to the cluster.

vCenter Server requirements

PowerStore X model appliances require an external vCenter Server instance running vCenter 6.7 or later with a Standard edition license.

If an external vCenter Server instance is connected to a PowerStore T model cluster, the vCenter Server instance must be running vCenter 6.0 Update 2 (Build: 3634793) or later with a Standard edition license.

i **NOTE:** Optionally, if your deployment is limited to four hosts managed by the vCenter Server instance, you can use a vCenter Server Foundation edition license. This Foundation edition license limits the PowerStore X model deployments to two single-appliance clusters or one single-appliance cluster and two external ESXi hosts.

vSphere configuration settings

During PowerStore X model cluster initialization, a vSphere cluster is created with specific configuration settings in vCenter. Some of these settings are listed below and should not be changed because they are specific to the PowerStore X model cluster.

Before changing any settings in vCenter or vSphere, review the following configuration details:

Table 6. vSphere Distributed Resource Scheduler (DRS) policy

| Default vSphere value | Recommended PowerStore value | Notes |
|-----------------------|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| -- | Partially Automated | If a user selects a different setting, PowerStore reverts it to Partially Automated. i NOTE: DRS is set to Partially Automated automatically, and works with the Resource Balancer that is built into PowerStore to provide optimal placement of virtual machines based on available resources. If a user selects a different setting when DRS is enabled, PowerStore reverts it back to Partially Automated. However, a user can disable DRS if needed, such as using a vSphere ROBO license. |

Table 7. vSphere High Availability (HA)

| Default vSphere value | Recommended PowerStore value | Notes |
|-----------------------|------------------------------|------------------------------------------------------------------------------------|
| Disabled | Enabled | If a user disables vSphere HA, user VMs are not protected from ESXi host failures. |


Table 8. vSphere HA Admission Control for a cluster with a single appliance or different appliance models

| Default vSphere value | Recommended PowerStore value | Notes |
|-----------------------|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Disabled | Disabled | vSphere does not differentiate between PowerStore OS VMs and user-created VMs. If HA Admission Control is enabled, vSphere reserves resources for the PowerStore OS VMs and user VMs cannot be failed over. i NOTE: Enabling HA Admission Control might prevent the PowerStore OS VMs from powering on. |

Table 9. vSphere HA Admission Control for a cluster with appliances that are the same models

| Default vSphere value | Recommended PowerStore value | Notes |
|-----------------------|------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| Disabled | Cluster resource percentage | When HA Admission Control is enabled, vSphere reserves resources for the PowerStore OS VMs and user VMs cannot be failed over. |

Table 9. vSphere HA Admission Control for a cluster with appliances that are the same models

| Default vSphere value | Recommended PowerStore value | Notes |
|-----------------------|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | |  NOTE: Enabling HA Admission Control might prevent the PowerStore OS VMs from powering on. |

To configure vSphere HA Admission Control for a PowerStore X model cluster:

1. In the vSphere Client, browse to the vSphere HA cluster and select the **Configure** tab
2. Select **vSphere Availability** and select **Edit** to configure vSphere HA.
3. Select **Admission Control** to display the configuration options.
4. Set the number of host failures to tolerate in **Host failures cluster tolerates** field. The recommended value for a PowerStore X model cluster is 1.
5. Select **Cluster resource percentage** from the **Define host failover capacity by** drop-down menu.
6. Select the **Override calculated failover capacity** check box.
7. Set the failover capacity percentages in the **Reserved failover CPU capacity** and **Reserved failover Memory capacity** fields. The failover capacity percentages depend on the number of appliances in the cluster.

Table 10. Failover capacity percentages

| Number of appliances | Reserved failover CPU capacity | Reserved failover Memory capacity |
|----------------------|--------------------------------|-----------------------------------|
| 1 | 25% | 25% |
| 2 | 12.5% | 12.5% |
| 3 | 8.33% | 8.33% |
| 4 | 6.25% | 6.25% |

8. Select **OK**.

Table 11. vSphere HA Advanced Options

| Default vSphere value | Recommended PowerStore value | Notes |
|-------------------------------------------|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| das.ignoreInsufficientHbDatastore = false | das.ignoreInsufficientHbDatastore = true | The default value for this setting causes vSphere to display a warning when there are fewer than two datastores in the cluster. This warning is unnecessary and misleading because the default PowerStore X model configuration has a single vVol datastore. If this setting is changed, vSphere displays the warning message: The number of heartbeat datastores for host is 1, which is less than required: 2 |

Table 12. VMware Enhanced vMotion Compatibility (EVC)

| Default vSphere value | Recommended PowerStore value | Notes |
|-----------------------|------------------------------|----------------------------------------------------------------------------------------|
| Disabled | Disabled | All VMs including the PowerStore controller VM must be shut down to change this value. |

Table 13. Path selection policy for a Protocol Endpoint (PE)


| Default vSphere value | Recommended PowerStore value | Notes |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> • Path Selection Policy = Most Recently Used • iops = 1000 • Number of outstanding I/Os with competing worlds = 32 | <ul style="list-style-type: none"> • Path Selection Policy = Round Robin • iops = 1 • Number of outstanding I/Os with competing worlds = <ul style="list-style-type: none"> ○ 128, if only the first port on the embedded 4-port card is mapped | The Round Robin policy allows the optimized use of multiple paths. The other parameter settings are recommendations for better performance and are based on testing. Changing these values can cause I/O performance degradation.  NOTE: For more information, see KB article 131406. |

Table 13. Path selection policy for a Protocol Endpoint (PE)

| Default vSphere value | Recommended PowerStore value | Notes |
|-----------------------|----------------------------------------------------------------------------------------------------------------------|-------|
| | <ul style="list-style-type: none">○ 256, if the first two ports on the embedded 4-port card are mapped | |

Table 14. LLDP for virtual switches (vSS or vDS)

| Default vSphere value | Recommended PowerStore value | Notes |
|-----------------------|------------------------------|-------------------------------------------------------------|
| Disabled | Disabled | To prevent networking problems, do not change this setting. |

ESXi passwords

The default root password for ESXi on a PowerStore X model appliance is in the following format: **<Service_Tag>_123!**, where **<Service_Tag>** is the seven-character Dell Service Tag for the appliance.

Do not change the default ESXi password until the initial cluster configuration is complete. For more information about changing an ESXi password, see the VMware ESXi documentation.

⚠ CAUTION: It is critical that you do not lose the ESXi password. If ESXi goes down and you do not have the password, the appliance must be reinitialized. This behavior is normal for ESXi, however reinitializing due to a lost password can result in data loss.

⚠ CAUTION: The default ESXi password is uniquely configured for each PowerStore X model appliance. The password is used to authenticate with the ESXi host when the nodes in the appliance are added to a vCenter cluster. If you change the default password before the cluster is fully configured, you will have to reinitialize the appliance.

Virtualization configuration in PowerStore appliances

Topics:

- [Managing virtualization components in the PowerStore Manager](#)
- [Configure a vCenter Server connection](#)
- [Updating internal ESXi hosts on PowerStore X model appliances](#)
- [Adding an external ESXi host to a PowerStore X model vSphere cluster](#)
- [Using an external ESXi host with a PowerStore cluster](#)
- [Additional VMware software and configuration](#)

Managing virtualization components in the PowerStore Manager

You can monitor and manage basic properties of VMs, vVols, and storage containers from the PowerStore Manager. Advanced management capabilities are available with the vSphere Client.

Working with virtual resources

The PowerStore Manager provides detailed monitoring capabilities for connected VMs.

PowerStore Manager operations

The Virtual Machines page in PowerStore Manager allows you to view capacity, performance, and alerts for a VM. You can also manage data protection policies for a VM and manage the associated virtual volumes on the PowerStore cluster.

VMs that are deployed on vVols are displayed in PowerStore Manager. However, VMs on legacy non-vVol datastores are not displayed in PowerStore Manager.

For detailed information about the VM operations that you can perform from the PowerStore Manager, see [Monitoring and managing VMs](#) on page 18.

vCenter Server operations

Any VM operations that cannot be performed from the PowerStore Manager must be completed from the vCenter Server. In the PowerStore Manager, select **Compute > vCenter Server Connection > Launch vSphere** to start the vSphere Client and log in to the vCenter Server. For additional guidance, see the product documentation for the version of vCenter Server you are using.

Monitoring and managing VMs

The **Compute > Virtual Machines** page in the PowerStore Manager displays essential information about all connected vVol-based VMs in a centralized location.

The main view shows essential details for each VM. The table can be filtered, sorted, refreshed to show changes, and exported to a spreadsheet. VMs that are provisioned on a connected ESXi host are added to the table automatically. You can select one or more VMs to add or remove them from the dashboard watchlist or assign or remove a protection policy.

To view more details about a VM, select the name of the VM . You can monitor and manage the VM properties available on the following cards:

- **Capacity**

This card displays interactive line charts with storage usage history for the VM. You can view data for the past two years, month, or 24 hours and print or download the chart data as an image or CSV file.

- **Compute Performance**

This card displays interactive line charts with CPU usage, memory usage, and system uptime history for the VM. You can view data for the past year, week, 24 hours, or hour and download the chart data as an image or CSV file.

- **Storage Performance**

This card displays interactive line charts with latency, IOPS, bandwidth, and I/O operation size history for the VM. You can view data for the two years, month, 24 hours, or hour and download the chart data as an image or CSV file.

- **Alerts**

This card displays alerts for the VM. The table can be filtered, sorted, refreshed to show changes, and exported to a spreadsheet. To view more details, select the description of the alert you are interested in.

- **Protection**

This card displays snapshots for the VM. The table can be filtered, sorted, refreshed to show changes, and exported to a spreadsheet. To view more details, select the name of the snapshot that you are interested in. You can also assign or remove a protection policy for the VM from this card.

VM snapshots, whether manual or scheduled, create VMware–managed snapshots. You can take snapshots from PowerStore Manager or vSphere. Whether the snapshots are taken from PowerStore Manager or vSphere, snapshots of vVols based VMs are offloaded to the native snapshot engine on the PowerStore cluster. For more information, see [VMware snapshot limitations](#) on page 32.

- **Virtual Volumes**

This card displays the vVols associated with the VM. The table can be filtered, sorted, refreshed to show changes, and exported to a spreadsheet. To view more details, select the name of the vVol you are interested in.

Monitoring and managing vVols

You can use PowerStore Manager to view essential information about vVols through the storage container or VM to which they are connected.

- From the **Storage > Storage Containers** page, select the storage container name. On the details page for the storage container, select the **Virtual Volumes** card.
- If the PowerStore cluster is connected to a vCenter Server, you can view vVols in the context of their VMs. From the **Compute > Virtual Machines** page, select the name of the VM . On the details page for the VM, select the **Virtual Volumes** card.

The main view shows the name of each vVol, what type of vVol it is, the amount of logical used space, the amount of space that is provisioned, when it was created, its storage container, and its I/O priority. The table can be filtered, sorted, refreshed to show changes, and exported to a spreadsheet. You can select a single vVol for migration to another appliance. You can select multiple vVols to collect support materials or add or remove them from the dashboard watchlist.

To view more details about a vVol, select the name of vVol. You can monitor and manage the vVol properties available on the following cards:

- **Capacity**

This card displays current and historical usage details for the vVol. You can view data for the past two years, one month, or 24 hours, print the chart, and download the chart data as an image or CSV file.

- **Performance**


This card displays interactive line charts with latency, IOPS, bandwidth, and I/O operation size history for the vVol. You can view data for the past two years, one month, 24 hours, or one hour and download the chart data as an image or CSV file.

To view the properties of the vVol, select the pencil icon next to the vVol name.

Monitoring and managing storage containers

The **Storage > Storage Containers** page in the PowerStore Manager displays essential information about all storage containers in a centralized location.

The main view shows the name of each storage container, any current alerts, and capacity details. The table can be filtered, sorted, refreshed to show changes, and exported to a spreadsheet. You can perform the following actions on a storage container:

- [Create a storage container](#) on page 20.
- Change the name of a storage container. If the PowerStore cluster is connected to a vCenter Server, the name of the storage container is updated in vCenter to match the name in the PowerStore Manager.
- [Limit space usage by a storage container](#) on page 20.
- Delete a storage container.
 -  **NOTE:** You cannot delete a storage container when there are VMs on the associated storage containers in vCenter.
- Monitor current and historical space usage.

To view current and historical usage details for a storage container, select the name of the storage container. You can view data for the past two years, one month, or 24 hours, print the chart, and download the chart data as an image or CSV file. The PowerStore Manager raises an alert when usage of a storage container reaches or exceeds 85% of its available space.

Create a storage container

About this task

Use PowerStore Manager to create storage container on a PowerStore cluster.

Steps

1. Under **Storage**, select **Storage Containers**.
2. Select **Create**.
3. Enter a name for the storage container.
4. Optionally, select the **Enable storage container capacity quota** checkbox to specify a capacity quota for the storage container.
5. Select **Create**.

Results

For PowerStore X model appliances, a datastore is automatically created with the same name as the storage container. For PowerStore T model clusters, the user must create a datastore from the storage container in vCenter.

Limit space usage by a storage container

About this task

To limit the amount of space a storage container consumes, set a quota on that storage container. The quota represents the total maximum size of the data that can be written to the vVols in the storage container. Space that snapshots and thin clones consume does not count towards the quota.

Steps

1. Under **Storage**, select **Storage Containers**.
2. Select the storage container for which you want to set a quota and select **Modify**.
3. Select the **Enable storage container capacity quota** checkbox to enable a quota and specify the limit that you want, then select **Apply**.

Results

When the space that the storage container is using reaches or exceeds the high watermark for the quota, the system generates a notification. If the space used falls below the high watermark for the quota, the notification clears automatically. By default, the high watermark for the quota is 85%, but you can change this value.


To remove the quota on a storage container, clear the **Enable storage container capacity quota** checkbox on the **Properties** panel for that storage container.

Monitoring ESXi hosts

When a PowerStore cluster is connected to a vCenter Server, the cluster becomes aware of ESXi hosts and associates PowerStore hosts with ESXi hosts.



This functionality allows the PowerStore Manager to:

- Associate a host registered in the PowerStore Manager to its corresponding name in vCenter
- Display the ESXi host name on which vVol-based VM is running.

 **NOTE:** For PowerStore X model appliances, the internal nodes are displayed as ESXi hosts on the **Compute > Hosts & Host Groups** page.

Manage Local Users

Steps

1. Select the **Settings** icon, and then select **Users** in the **Users** section.
2. If not already selected, select **Local**.
3. Do any of the following:
 - Add a user. When you add a user, you select the role of the user.
 - View or change the role of a user.
 - Delete a user.
 **NOTE:** The built-in Administrator account cannot be deleted.
 - Change the password of a user.
 - Lock or unlock a user.
 **NOTE:** Logged-in users with either an Administrator or Security Administrator role cannot lock their own account.

Configure a vCenter Server connection


Connecting to a vCenter Server and registering a PowerStore VASA provider are optional during the initial configuration of a PowerStore T model cluster. Establishing a connection to a vCenter Server and registering a VASA provider can also be performed after the initial configuration of a PowerStore T model cluster is complete. However, during the initial configuration of a PowerStore X model cluster, connecting to an external vCenter Server and registering a PowerStore VASA provider are both required and performed automatically. The vCenter Server connection on a PowerStore X model cluster cannot be modified after the initial configuration is complete.

Prerequisites

Ensure that you have the IP address, username, and password for the vCenter Server.

About this task

PowerStore T model clusters can host traditional (VMFS) datastores without connecting to a vCenter Server or registering a VASA provider. However, connecting a vCenter Server to a PowerStore T model cluster enables additional management options in PowerStore Manager. In addition, registering a PowerStore VASA provider in vCenter Server is required to use vVols.

 **NOTE:** A PowerStore cluster cannot be connected to more than one vCenter Server at a time.

Perform the following steps in PowerStore Manager to manually establish a connection to a vCenter server and register the VASA provider to use vVols:

Steps

1. If a VM Administrator user account does not exist on the PowerStore T model cluster, use PowerStore Manager to add a user account and select **VM Administrator** as the user role.

2. Select **Compute > vCenter Server Connection**.
3. Select **Connect**.
The vCenter Server Configuration slide-out panel is displayed.
 - a. Type the IP address, username, and password of the vCenter Server.
 - b. To register the VASA provider, type the username and password of the VM Administrator user account that was created in step 1.
 - c. Select **Connect**.
If the connection to the vCenter Server is successful, the status of the connection updates and new options become available on the vCenter Server Connection page.

Next steps

- To open vSphere Client in a new tab, select **Launch vSphere**.
- To update the stored IP address or credentials for vCenter Server on a PowerStore T model cluster, select **Update Connection**.
i **NOTE:** You cannot change the vCenter Server that a PowerStore T model cluster is connected to by updating the IP address. To change the vCenter Server that a PowerStore T model cluster is connected to, see [Change a vCenter Server connection](#) on page 23.
- To disconnect the vCenter Server from a PowerStore T model cluster and unregister the VASA provider, select **Disconnect**.
i **NOTE:** You can no longer use the PowerStore T model cluster to manage VMs after the vCenter Server is disconnected.

Manually register the VASA provider in vCenter Server

If you are unable to register the VASA provider in PowerStore Manager, you can manually register the VASA provider on the vCenter Server.

About this task

Perform the following steps to manually register VASA provider for a PowerStore T model cluster using vCenter Server:

Steps

1. If a VM Administrator user account does not exist on the PowerStore T model cluster, use PowerStore Manager to add a user account and select **VM Administrator** as the user role.
2. Log in to the vCenter Server and select the datacenter for the PowerStore T model cluster.
3. Select the **Configure** tab, and select **Storage Providers**.
4. Click the **Add** icon.
5. Enter the connection information for the VASA provider in the following fields.
 - a. **Name** - Name for the storage provider. For example, *PowerStore VASA provider*.
 - b. **URL** - VASA provider URL. The URL must be in the format: **https://<IP address>:8443/version.xml**, where *<IP address>* is the management IP address of the PowerStore T model cluster.
 - c. The **User name** - Username of the VM Administrator user account from step 1.
 - For local users, use **local/<user name>**
 - For LDAP users, use **<domain>/<user name>**
 - d. **Password** - Password of the VM Administrator user account from step 1.
6. Do not select the **Use storage provider certificate** checkbox.
7. Click **OK**.
Verify that the VASA provider information was entered correctly in vCenter Server.

Change a vCenter Server connection

To change the vCenter Server that your PowerStore T model cluster is connected to, you must first remove the existing connection and then register a new vCenter Server connection.

Prerequisites

Ensure that you have the IP address, username, and password for the new vCenter Server.

About this task

NOTE: The vCenter Server that a PowerStore X model cluster is connected to cannot be changed using these steps. To change the vCenter Server that a PowerStore X model cluster is connected to, contact your service provider.

Steps

1. Under **Compute**, select **vCenter Server Connection**.
2. Select **Disconnect**.

The Disconnect vCenter Server dialog box is displayed.

- a. To disconnect the vCenter Server that is registered in PowerStore, select the **Confirm you want to disconnect the vCenter server** check box.
- b. To unregister the VASA provider, select the **Disconnect the VASA Provider** check box.
- c. Select **Disconnect**.

When the vCenter Server is disconnected, you can no longer manage VMs on the PowerStore T model cluster. When the VASA provide is unregistered, vVols datastores appear as disconnected, but any VMs that are already running are not impacted. New operations such as powering up VMs are blocked when there is no active VASA connection.

3. Configure a vCenter Server connection to the new vCenter Server and register the VASA provider.
For more information, see [Configure a vCenter Server connection](#) on page 21.

Updating internal ESXi hosts on PowerStore X model appliances

The ESXi version running on the internal ESXi hosts of PowerStore X model appliances is visible in PowerStore Manager.

To view the current ESXi version on the internal nodes of an appliance, select **Hardware** and look at the **ESXi Version** column on the **Appliances** tab. If the **ESXi Version** column is not visible, select the **Show/Hide Columns** icon and select **ESXi Version** to display it on the **Hardware** page.

NOTE: The ESXi version on the internal nodes of an appliance is also visible in the **ESXi Version** column on the **Compute > Hosts & Host Groups** page. If the **ESXi Version** column is not visible, select the **Show/Hide Columns** icon and select **ESXi Version** to display it on the **Hosts & Hosts Groups** page.

For instructions on updating the internal ESXi hosts on a PowerStore X model appliance, see the *PowerStore Software Upgrade Guide*.

CAUTION: The internal nodes of a PowerStore X model appliance can only use ESXi updates that are validated by Dell EMC and available for download from the Dell Digital Locker. Do not use ESXi updates that are obtained from VMware or any other source. To view a list of supported ESXi versions for each release of PowerStore software, see the VMware Licensing and Support for PowerStore X table in the *PowerStore Simple Support Matrix*. The *PowerStore Simple Support Matrix* can be downloaded from the PowerStore Documentation page at: <https://www.dell.com/powerstoredocs>.

Adding an external ESXi host to a PowerStore X model vSphere cluster

During the initialization of a PowerStore X model cluster, the system creates a vSphere cluster under a new or existing data center in vCenter. The vSphere cluster contains the internal ESXi nodes of the appliances in the PowerStore cluster.

Adding an external ESXi host to the vSphere cluster enables additional compute resources, VM load balancing, and high availability within the cluster. For more information about adding an external ESXi host to a PowerStore X model vSphere cluster, go to <https://solveonline.emc.com> and select **PowerStore > PowerStore X Procedures > Miscellaneous > Adding an external ESXi host into an existing PowerStore X vSphere cluster** to generate step-by-step instructions.

NOTE: External ESXi hosts do not have to be in the same PowerStore X model vSphere cluster to enable vSphere vMotion or Storage vMotion between the internal ESXi nodes and external ESXi hosts.

Using an external ESXi host with a PowerStore cluster

If you have another ESXi host that is connected to a vCenter Server in your environment, you can grant the host access to your PowerStore cluster.

- ESXi host configuration guidelines – For information about configuring an external ESXi host on a PowerStore cluster, see the *PowerStore Host Configuration Guide*.
- vCenter Server requirements – The vCenter Server version and licensing requirements for PowerStore clusters are listed in [vCenter Server requirements](#) on page 15.
- Recommended vCenter Server settings – Use the appropriate size vCenter Server Appliance to hold the expected number of objects. The options are Tiny, Small, Medium, Large, and X-Large.

For information about the resources that are required and number of objects that are supported at each size level, see the VMware vCenter documentation.

Additional VMware software and configuration

VMware integration

You can use many VMware products with PowerStore the same way you would in your existing VMware environment. The following products are supported in this release:

- VMware vRealize Orchestrator (vRO)
- Dell EMC Virtual Storage Integrator (VSI) for VMware vSphere Client
- VMware Storage Replication Adapters (SRA)
- VMware NSX-V

For more information, see VMware documentation about working with Dell and Dell EMC plugins.

VMware NSX-V


Topics:


- [VMware NSX-V introduction](#)
- [Add internal ESXi hosts to an existing NSX-V deployment](#)

VMware NSX-V introduction

PowerStore X model appliances include support for VMware NSX Data Center for vSphere (NSX-V). NSX-V is a network virtualization and security platform that enables the implementation of virtual networks on a physical network.

NSX-V provides the network architecture with features such as rapid provisioning, deployment, reconfiguration, and destruction of on-demand virtual networks. This design uses the vSphere distributed switch (vDS) and VMware NSX-V to implement virtual networking.

 **NOTE:** PowerStore X model appliances support NSX-V version 6.4.6 or later.

 **CAUTION:** The NSX controller VMs cannot be deployed on PowerStore X model nodes because the NSX Controller cluster requires three nodes. Per VMware NSX-V requirements for resiliency and performance, the NSX controller VMs must be deployed on three distinct hosts.


Add internal ESXi hosts to an existing NSX-V deployment

Perform the following steps to add the internal ESXi hosts of a PowerStore X model appliance to an existing deployment of NSX-V:

Steps

1. Prepare the internal ESXi hosts.

Use the NSX Manager to prepare each host by installing the NSX-V VIBs.

 **CAUTION:** If the NSX-V controller cluster is using Guest Introspection services, do not deploy Guest Introspection services on the vSphere cluster using PowerStore vVol datastores. Deploying the Guest Introspection services using PowerStore vVol datastores will result in appliance boot issues after a power failure. Instead, deploy the Guest Introspection services on a vSphere cluster using the PowerStore private datastores, which are named `PRIVATE-<service_tag>.A.INTERNAL` and `PRIVATE-<service_tag>.B.INTERNAL`.

2. Exclude virtual machines from firewall protection.

Add the PowerStore X model controller VMs to the firewall exclusion list during NSX-V configuration to avoid potential issues with the NSX-V DFW firewall rules.

For more information about using NSX-V, see the VMware NSX documentation.

Best practices and limitations

Topics:

- [Performance best practices for PowerStore X model clusters](#)
- [Creating VM clones](#)
- [Using vVols across multiple vCenter Servers](#)
- [vSphere host profiles](#)
- [Internal PowerStore X model cluster components visible in vCenter](#)
- [Block access for LUNs](#)
- [Service and recovery](#)
- [PowerStore limitations](#)
- [vSphere limitations](#)

Performance best practices for PowerStore X model clusters

During the initial configuration of a PowerStore X model cluster, best practice settings can be automatically applied to the cluster to enable maximum performance.

If the best practice settings are not applied during the initial configuration of a PowerStore X model appliance, the steps to apply some of the settings after the initial configuration have been automated. However, not all the configuration steps have been automated. It is recommended that you apply the best practices during the initial configuration of an appliance.

The best practice settings include:

- Changing the Cluster MTU size to 9000.
- Changing the Storage MTU size to 9000.
- Providing two additional IP addresses used to configure a second iSCSI target.

For more information, see KB article 110933 *PowerStore X Performance Best Practice Tuning* or see the *PowerStore Virtualization Integration White Paper*.

When changes are made to the MTU settings, the PowerStore X model cluster automatically reconfigures the ESXi hosts.

NOTE: The MTU settings must be changed using PowerStore Manager or the REST API. Do not change the MTU setting directly on the distributed switch in vCenter.

Performance best practices for multi-appliance PowerStore X model clusters

When multiple appliances are clustered together in a scaled-out configuration, DRS may move the compute for a VM away from the appliance where the storage for the VM resides. This moving of resources results in cross-appliance I/O, where a VM residing on one appliance must access storage from a second appliance. However, best practices recommend keeping compute and storage co-located on the same appliance, which can be done by using a VM/Host affinity rule on the PowerStore X model cluster in vCenter.

When a PowerStore X model cluster is created, the system creates the following VM/Host Groups and VM/Host Rules for each appliance in the cluster:

- A Host Group that is named *Appliance name*. The internal ESXi hosts on the appliance are automatically added to this Host Group.
- A VM Group that is named *Appliance name* VMs. The VM Group is empty by default.
- A VM/Host Rule that is named *Appliance name*. The VM/Host Rule is a **Should run on hosts in group**, which specifies that VMs in the VM Group should run on the hosts in the Host Group.

To configure these groups and rules in vCenter, select the PowerStore X model ESXi cluster and select the **Configure** tab. The VM/Host Groups and VM/Host Rules are located under Configuration on the **Configure** tab.

To co-locate storage and compute for performance benefits, add VMs to the VM Group that corresponds to the location of the VM storage for the appliance.

To determine the PowerStore X model appliance on which the storage for a VM is located:

1. In PowerStore Manager, select **Compute > Virtual Machines**.
2. Select the name of the VM.
3. Select the **Virtual Volumes** card.
4. Select **Appliance** from **Show/Hide Table Columns** to display the Appliance row. The Appliance row shows the name of the PowerStore X model appliance on which the primary Data vVol for the VM is located.

Creating VM clones

The best practices for creating clones of vVol-based VMs on a PowerStore cluster depend on application and cluster type. The best practices also depend on how you plan to distribute VM clones.

Distributing VM clones across a multi-appliance cluster

When a linked clone is created from a base VM, the PowerStore resource balancer selects an appliance on which to create the VM and it places the config vVol on that appliance. However, the data vVol for the linked clone is created on the same appliance as the base VM.

This issue can lead to following inefficiencies:

- Storage - The base VM and its VM clones only use storage on a single appliance.
- I/O load - The compute for VM clones might be distributed among multiple appliances, however all I/O is directed to the single appliance hosting the storage. This issue increases the I/O load and network traffic on the appliance.
- Increased fault domains - The config vVols and data vVols for VM clones are on multiple fault domains.

The best practices solution is to create a base VM on each appliance in the cluster. When create a clone from a base VM, select the appliance with the fewest clones of the base VM.

i **NOTE:** Distributing VM clones among appliances is typically performed when there are many clones of a base VM, such as 100 clones. If there are only a few VM clones, placing all the VM clones on a single appliance, and using the other appliances for other workloads may be sufficient.

For instructions on distributing VM clones across a multi-appliance PowerStore cluster, see [Distribute VM clones across an existing PowerStore T model cluster](#) on page 28 or [Distribute VM clones across an existing PowerStore X model cluster](#) on page 28.

Distributing VM clones to a new appliance in a cluster

When an appliance is added to an existing PowerStore cluster, VM clones are stored on the same appliance as the base VM.

This issue can lead to following inefficiencies:

- Storage - The base VM and its clone only use storage on a single appliance.
- I/O load - The compute for VM clones might be distributed among multiple appliances, however all I/O is directed to the single appliance hosting the storage. This issue increases the I/O load and network traffic on the appliance.

The best practices solution is to manually migrate some of the VM clones to the new appliance in the cluster.


i **NOTE:** Migrating vVols for linked VM clones transforms them into full clones, which can lead to increased storage utilization. However, the PowerStore cluster can compensate for this issue by using storage deduplication.

For instructions on migrating VM clones to a new appliance in a PowerStore cluster, see [Distribute VM clones to a new appliance in a PowerStore cluster](#) on page 28.

Distribute VM clones across an existing PowerStore T model cluster

To create VM clones on a PowerStore T model cluster with multiple appliances, create a base VM on each appliance, migrate the vVols for each base VM to the appropriate appliance, then create VM clones from the base VMs.

Steps

1. Use vSphere to create a base VM on each appliance in the cluster.
Use a name for the base VM that reflects the appliance on which the base VM is located. For example, use the name `BaseVM-Appliance1` for appliance one and use the name `BaseVM-Appliance2` for appliance two.
 **NOTE:** If a base VM was not created on the appropriate appliance, use PowerStore Manager to migrate the vVols for the base VM to the correct appliance. For instructions, see [Migrate vVols to another appliance](#) on page 28.
2. Use vSphere to create VM clones from the base VMs.
Remember to evenly distribute the VM clones across the appliances in the cluster to avoid possible cluster inefficiencies.

Distribute VM clones across an existing PowerStore X model cluster

To create VM clones on a PowerStore X model cluster with multiple appliances, create a base VM on each appliance, then create linked VM clones from the base VMs.


Steps

1. Use vSphere to create a base VM on each appliance in the cluster.
Use a name for the base VM that reflects the appliance on which the base VM is located. For example, use the name `BaseVM-Appliance1` for appliance one and use the name `BaseVM-Appliance2` for appliance two.
2. Use vSphere to create VM clones from the base VMs.
Remember to evenly distribute the VM clones across the appliances in the cluster to avoid possible cluster inefficiencies.

Distribute VM clones to a new appliance in a PowerStore cluster

When an appliance is added to an existing PowerStore cluster, VM clones are stored on the same appliances as the base VMs.

The best practices solution is to migrate some of the VM clones to the new appliance in the cluster using PowerStore Manager. For instructions on migrating vVols for VM clones, see [Migrate vVols to another appliance](#) on page 28.

 **NOTE:** Migrating vVols for linked clones transforms them into full clones, which can lead to increased storage utilization. However, the PowerStore cluster can compensate for this issue by using storage deduplication.

Migrate vVols to another appliance

Use this feature to migrate vVols to another appliance in the cluster without any disruption to host I/O.

About this task

When you migrate a vVol, all associated fast clones and snapshots also migrate with the storage resource. During the migration, additional work space is allocated on the source appliance to facilitate data movement. The amount of space that is needed depends on the number of storage objects and amount of data being migrated. This work space is released and freed up after the migration is complete.

Steps

1. Under **Storage**, select **Storage Containers**.
2. Select the storage container that contains the vVol that you want to migrate and select the **Virtual Volumes** card.

3. To display vSphere host names and the appliances on which vVols are located, select **Show/Hide Columns**, then select **vSphere Host Name** and **Appliance** to display those columns in the **Virtual Volumes** card.
4. Select the vVol to migrate and select **Migrate**.
The **Migrate** slide-out panel is displayed.
5. Select an appliance that best meets the requirements for the vVol that you are migrating.
6. Select **Next**.
A migration session with a status of Pending is created in the background.
7. Select **Finish**.
The migration session is displayed on the **Migration Actions** page, and then the **Required Action for Migration** slide-out panel is displayed.
8. Select **Start Migration** and click **Migrate Now**.
Depending on the amount of data that is being migrated, it may take several minutes, hours, or days to complete the migration. It may also have an impact on the overall system performance.

Using vVols across multiple vCenter Servers

Per VMware design, the process for using vVols across multiple vCenter Servers is different than the process with only one vCenter Server.

The available options for using the PowerStore VASA provider across multiple vCenter Servers are described in KB article number 000186239.

vSphere host profiles

A host profile can be used to reset the root password of the internal ESXi hosts on the nodes of a PowerStore cluster.

If you create a host profile, ensure that the **SSH public key** field is cleared before applying the host profile to the ESXi hosts.

CAUTION: If the SSH public key field is not cleared before the host profile is applied to the internal ESXi hosts, the PowerStore cluster might experience communication issues between the VM controllers and the internal ESXi hosts.

The **SSH public key** field is in the **Security and Services > Security Settings > Security > User Configuration > root** entry on the **Settings** tab of the **Edit host profile** dialog box in vCenter server.

Internal PowerStore X model cluster components visible in vCenter

Some PowerStore X model cluster components are visible as manageable objects in the vCenter, but modifying them can cause data loss or unavailability.

Critical system components


CAUTION: Do not modify or change the name of the following PowerStore internal components in vCenter:

- Configuration files
- BIOS settings
- PowerStore X model controller VMs
- PowerStore X model internal ESXi nodes
- Internal datastores
- vSphere Distributed Switch (VDS)

You can modify or change the name of the following PowerStore internal components in vCenter:

- Datacenter
- Host cluster

- Default vVol datastore (Storage container)

 **NOTE:** All other changes to the internal components are considered unsupported and must be requested using a Request for Production Qualification (RPQ) before making a change.

Internal datastores

For each node in the cluster, the vSphere Client displays and enables modification of the internal datastore that the PowerStore X model controller VM uses. Do not create VMs on internal datastore, or otherwise modify it. The names of the internal datastores are:

- PRIVATE-*<serial-number>*.A.INTERNAL
- PRIVATE-*<serial-number>*.B.INTERNAL

Internal network

An internal switch is displayed in the vSphere Client as an object that can be managed, but the switch should not be modified or deleted.


The port groups on the switch are displayed in the vSphere Client as objects that can be managed, but the port groups should not be modified or deleted. The names of the port groups are:

- DVUplinks
- PG_MGMT
- PG_MGMT_ESXi
- PG_Storage_INIT1
- PG_Storage_INIT2
- PG_Storage_TGT1
- PG_Storage_TGT2
- PG_Storage_TGT3
- PG_Storage_TGT4
- PG_vMotion1

PowerStore X model controller VMs

The PowerStore X model controller VMs are displayed in the vSphere Client as objects that can be managed, but some operations should not be performed on them.

 **CAUTION: Do not power off the PowerStore X model controller VMs.**

 **CAUTION: Do not migrate the PowerStore X model controller VMs to a user-created resource pool. The PowerStore X model controller VMs must remain in the default resource pool on the cluster.**

VM/Host Groups and VM/Host Rules

When a PowerStore X model cluster is created, a Host Group, VM Group, and VM/Host Rule is automatically created for each appliance in the cluster.

You can modify or change VM Groups, but you should not modify or change Host Groups and VM/Host Rules.

Block access for LUNs

VMs running on internal PowerStore X model nodes can use either vVol-based storage or VMFS-based storage.

By default, virtual machines on a PowerStore X model cluster leverage the vVol implementation due to the design optimizations and integration within PowerStore Manager. However, PowerStore X model clusters also support VMFS datastores for VMs by mapping block volumes to internal ESXi hosts using the PowerStore REST API or CLI. See KB Article Number 182813 for more details.

PowerStore X model appliances can also be used as external block storage using Fibre Channel (FC), iSCSI, or NVMe over Fibre Channel (NVMeoFC). The block storage can be formatted as VMFS datastores and be presented to external servers and VMs running outside of the internal PowerStore X model nodes.

Service and recovery

The PowerStore virtualization configuration affects some of the troubleshooting processes that an experienced virtualization administrator may be familiar with.

To collect diagnostic information for appliances in your PowerStore cluster, go to **Support > Gather Support Materials** under **Settings** in PowerStore Manager.

To export support logs from vCenter, select the vCenter Server in the vSphere Client and select **Actions > Export System Logs**. You can export ESXi host log bundles and include vCenter Server and vSphere Client log files within the same bundle.

Support for VSS

PowerStore clusters support third-party snapshot integration for Microsoft Volume Shadow Copy Service (VSS) to simplify protection of Microsoft applications such as SQL Server and Outlook.

PowerStore limitations

The following limitations apply to this release of PowerStore:

- PowerStore clusters support up to four appliances.
- PowerStore clusters support up to 2000 initiators.
- PowerStore clusters support up to 2000 block volumes/clones per appliance.
- PowerStore clusters support up to 500 VMFS datastores per appliance
- PowerStore clusters support up to 50 storage containers per appliance
- PowerStore clusters support up to 19000 vVols per appliance

vSphere limitations

PowerStore X model appliances inherit some limitations that are inherent to vSphere.

Number of supported objects

vSphere has a limit to the number of VMs, and other objects it can support. For information, see the VMware vSphere documentation.

CAUTION: Use individual hosts instead of host groups in large scale vVol based vSphere environments with more than 4096 vVols.

CPU and memory usage

PowerStore X model controller VMs always report high CPU and memory usage in vSphere. The high CPU and memory usage is normal because PowerStore X model appliances reserve 50% of the CPU and memory resources to run controller VMs. PowerStore X model controller VMs might trigger memory usage alarms in ESXi 6.x. For more information, see VMware KB article 2149787.

CAUTION: Do not overload the CPU resources on the internal ESXi hosts. Using more the 80% of the CPU resources can lead to ESXi host crashes. Using more the 80% of the CPU also can also affect UDP heartbeats between vCenter and ESXi hosts, which can cause the ESXi hosts to appear as disconnected in vCenter.

VMware snapshot limitations

vSphere allows a maximum snapshot tree depth of 31 for a VM. Scheduled and manual snapshots interact with this limit in different ways.

Scheduled snapshots

When you create a VM snapshot schedule as a part of a protection policy, you can set a retention policy specifying how long to keep snapshots. Snapshots older than the age that the retention policy specifies are deleted. This policy helps keep the total number of snapshots below the limit.

If the maximum number of snapshots is reached, the oldest snapshot is automatically deleted when the protection policy creates the next snapshot. Although manual snapshots count towards this limit, they are never deleted automatically unless the expiration date is reached.

Manual snapshots

Manual snapshots that are created with PowerStore Manager or vSphere cannot have a retention policy and are never deleted without user action. If the maximum number of snapshots is reached, no more can be created unless you delete snapshots to make room.