

# Dell EMC Unity: Virtualization Integration

## Abstract

This document introduces the virtualization features and integration points available on Dell EMC Unity storage.

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## Revisions

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Author: [Wei.C.Chen@Dell.com](mailto:Wei.C.Chen@Dell.com)

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## Executive summary

Virtualization offers many benefits such as consolidation, performance, availability, business continuity, load balancing, and ease of maintenance. Because of these advantages, more and more applications are being virtualized today. It is important for data center components to not only support, but also provide integration with hypervisors and virtualized applications. One of these components is Dell EMC™ Unity storage, which includes many virtualization features and integration points that are detailed in this document.

## Audience

This white paper is intended for storage or virtualization architects, administrators, partners, Dell EMC employees and any other users involved in evaluating, acquiring, managing, operating, or designing a virtualized environment using Dell EMC Unity or Dell EMC UnityVSA solutions.

# 1 Introduction

Dell EMC Unity storage features multiple integration points with virtualization technologies that are used in data centers today such as VMware® vSphere® and Microsoft® Hyper-V®. Many of these powerful integration points are embedded in the system and are designed with the end-user experience in mind. They can be easily managed directly from the HTML5-based Unisphere™ graphical user interface. In addition to the integration points that are built into the system, off-array software is available to fit the specific requirements of each customer. Storage and virtualization administrators can leverage these features to create simple, modern, flexible, and affordable solutions.

## 1.1 Terminology

**Capability profile:** Used to advertise the available characteristics of a storage pool as part of Storage Policy Based Management (SPBM).

**Fibre Channel (FC) protocol:** Transfer protocol used to communicate IP and SCSI commands over an FC network.

**Internet Small Computer System Interface (iSCSI):** Provides a mechanism for accessing block-level data storage over network connections.

**Network File System (NFS):** A file access protocol that allows data access typically from Linux®/UNIX hosts located on a network.

**Protocol endpoint:** An NFS mount point or proxy LUN that is used as an I/O access point from the ESXi™ host to the storage system.

**Server Message Block (SMB):** A file access protocol that allows data access typically from Windows® hosts located on a network.

**Storage container:** A VMware term for a logical entity that consists of one or more capability profiles and their storage limits. This is known as a VMware vSphere Virtual Volumes™ (vVol) datastore in Dell EMC Unity storage.

**Storage Policy Based Management (SPBM):** Using storage policies to dictate where a VM will be stored, as opposed to choosing a datastore manually.

**Unisphere:** An HTML5 graphical user interface that is used to manage Dell EMC Unity systems.

**vCenter:** VMware vCenter® server that provides a centralized platform for managing VMware vSphere environments.

**Virtual machine:** An operating system running on a hypervisor, which is used to emulate physical hardware.

**Virtual Storage Appliance (VSA):** A software-defined storage solution that enables a storage software stack to be deployed as a virtual machine.

**VMware vSphere Virtual Volumes (vVols):** A VMware storage framework which allows VM data to be stored on individual Virtual Volumes. This allows for data services to be applied at a VM-level of granularity and according to SPBM. Virtual Volumes can also refer to the individual storage objects that are used to enable this functionality.

**VM storage policy:** A rule set that defines the desired attributes of a datastore. When a compatible datastore is selected, this is used for VM placement, migration, and monitoring.

**vSphere API for Array Integration (VAAI):** A VMware API that improves ESXi host utilization by offloading storage-related tasks to the storage system.

**vSphere API for Storage Awareness (VASA):** A VMware vendor-neutral API that enables vSphere to determine the capabilities of a storage system. This requires a VASA provider on the storage system for communication.

## 2 Dell EMC UnityVSA

Dell EMC Unity Virtual Storage Appliance (Dell EMC Unity VSA) is a unified software-defined storage (SDS) solution that runs on the VMware ESXi™ platform. Dell EMC UnityVSA is a flexible storage option for environments that do not require dedicated storage systems such as test/development or remote office/branch office (ROBO) environments. Users are able to quickly provision a Dell EMC UnityVSA solution on general-purpose server hardware, which can result in reduced infrastructure costs and a quicker rate of deployment.

In Dell EMC Unity OE version 4.5, Dell EMC UnityVSA HA is available. UnityVSA HA is an enhanced version of the single-SP UnityVSA solution. This is accomplished by adding high availability (HA) functionality whereby Dell EMC UnityVSA HA can recover from an SP or host failure which significantly increases the system's applicable use-case scenarios as well as enables non-disruptive upgrades (NDU). Dell EMC UnityVSA Dual-SP is only available with Professional Edition (PE) licenses in capacity choices of 10 TB, 25 TB, or 50 TB options.

For more information on Dell EMC UnityVSA and UnityVSA HA solutions, refer to the *Dell EMC UnityVSA* white paper available on [Dell EMC Support](#).



### 3 VMware-aware Unisphere

Dell EMC Unity systems feature tight integration with VMware vSphere to improve the ease of use, performance, and flexibility for VMware virtualized environments. Unisphere includes a dedicated access VMware page that allows for the end-to-end discovery of a VMware vSphere environment. Information about the VMware vCenters, ESXi hosts, virtual machines, and virtual disks is imported and displayed directly in Unisphere. The import process also registers the VMware hosts onto the Dell EMC Unity system so they can be granted access to LUNs, VMFS datastores, NFS file systems or datastores, or vVol datastores.

To import this information (shown in Figure 1), perform the following:

1. In the VMware page > **Access** area, click the **+** icon.
2. In the **Add vCenter** wizard, enter the **Network Name or Address**, **User Name**, and **Password** for the vCenter server or an individual ESXi host.
3. Click **Find**.

Figure 1 Add vCenter

If a vCenter is entered, all of the ESXi hosts managed by that vCenter are discovered and are eligible for import. You can select all or just a subset of the discovered ESXi hosts to be imported. Any Fibre Channel or iSCSI initiators on these ESXi hosts are also imported for host registration purposes.

Once imported, the following information is populated in each tab:

- **vCenters:** The name and software version of the vCenters are displayed in the vCenters page.
- **ESXi Hosts:** This page provides a list of ESXi hosts along with the vCenter they are managed by, the code version, and the number of initiators.
- **Virtual Machines:** This page provides a list of virtual machines along with the ESXi host they are hosted on and the size of the VM.
- **Virtual Disks:** This page provides a list of virtual disks that are provided from this Dell EMC Unity system along with the VM they are assigned to, the size of the virtual disk, and the datastore they came from.

In the **More Actions** drop-down menu, a vCenter or ESXi host can be polled for any software or hardware changes. In addition, the **Find ESXi Hosts** button on the **vCenters** page can be used to import any ESXi hosts that were previously skipped, as shown in Figure 2.

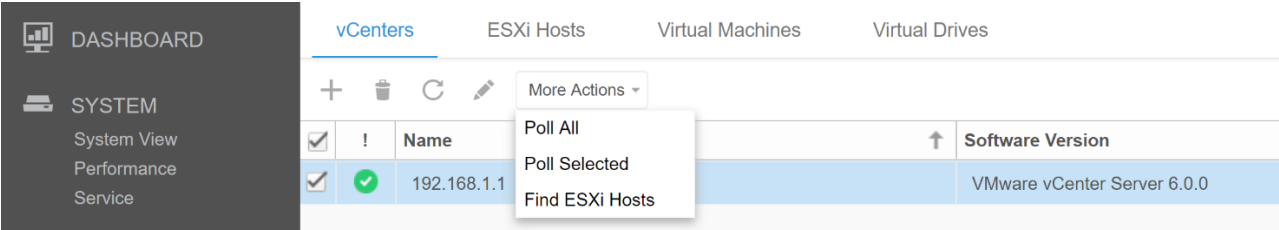


Figure 2 vCenters page

## 4 VMware datastores

Traditionally, when provisioning a datastore, a LUN or file system is created first and then access is granted to an ESXi host. Then, the VMware administrator performs a rescan and builds a Virtual Machine File System (VMFS) on the LUN or mounts the NFS export.

Unisphere allows for creation of VMFS and NFS datastores that are optimized for VMware. Dell EMC Unity simplifies datastore provisioning by automating the tasks that are normally performed by the VMware administrator. When a datastore is created and access is provided to an ESXi host, it is automatically rescanned and made available as a datastore in vSphere. These datastores can take advantage of the same data services that are available to LUNs and file systems, such as snapshots and replication.

### 4.1 VMFS datastores

VMFS datastores are accessed through block protocols, so iSCSI or Fibre Channel connectivity is required. Once the communication path has been established, ensure the VMware ESXi hosts for these datastores are registered. This process can be automated by importing the VMware vSphere information in to Unisphere. Once this is complete, VMFS datastores can be created.

In the VMFS datastore creation wizard, host access can be configured to ESXi hosts. For any ESXi hosts that are provided access to this datastore, the new storage is automatically rescanned and made available to the ESXi host. Hosts can be given access to the datastore on a LUN level, snapshot level, or both. After the creation of a VMFS datastore, the capacity can be increased, but not reduced.

In Dell EMC Unity OE version 4.3 or later, users are able to create version 6 VMware VMFS datastores from the Unisphere CLI or REST API. In Dell EMC Unity OE version 4.5 or later, users are able to create version-5 or version-6 VMware VMFS datastores from Unisphere.

### 4.2 VMware NFS datastores

NFS datastores leverage the Dell EMC Unity File System, a 64-bit file system architecture, which includes several advantages. Dell EMC Unity offers 64 TB file-system sizes, which were increased to a maximum potential capacity of 256 TB with the Dell EMC Unity OE version 4.2. Other features include file system shrink, replication, snapshots, increased limits, and more. For more information on Dell EMC Unity File System, see the *Dell EMC Unity: NAS Capabilities* white paper on [Dell EMC Support](#).

NFS datastores require a NFS-enabled NAS server to be created first. In the NFS datastore creation wizard, access can be configured to ESXi hosts. For any ESXi hosts that are provided access to this datastore, the new storage is automatically rescanned and made available to the ESXi host. The wizard also allows the Host IO Size to be selected, as shown in Figure 3.

The screenshot shows the 'Create VMware Datastore' wizard in the vSphere Client. The 'Configure the storage for this datastore' step is active. On the left, a sidebar lists the wizard steps: Type, Name, Storage (selected), Access, Snapshot, Replication, Summary, and Results. The main configuration area includes:
 

- Pool:** A dropdown menu showing 'Pool (Extreme Performance Tier, 727.7 GB free)'.
- Tiering Policy:** A dropdown menu showing 'Start High Then Auto-Tier'.
- Size:** A numeric input set to '100' and a unit dropdown set to 'GB'.
- Thin:** A checkbox labeled 'Yes'.
- Minimum Allocation Size:** A numeric input set to '3' and a unit dropdown set to 'GB'.
- Host IO Size:** A dropdown menu that is open, displaying a list of options. '8K (default)' is selected and highlighted in blue. Other options include 16K, 32K, 64K, Exchange 2007, Exchange 2010, Exchange 2013, Oracle, SQL Server, VMware Horizon VDI, SharePoint, and SAP.

 On the right side of the wizard, there are informational messages:
 

- 'What are the various Tiering Policies for this system?' with a link to 'Tiering Policies'.
- 'What are Host I/O Limits?' with a link to 'Host I/O Limits'.
- A detailed message about using the 'Host IO Size' setting to match storage block size with the I/O size of the application to maximize performance of VMware NFS datastores.
- A warning message: 'The selected pool is not tiered. The tiering policy will have no effect on the storage resource.'

 At the bottom right, there are three buttons: 'Cancel', 'Back', and 'Next'.

Figure 3 Host IO Size

The Host IO Size specifies the smallest guaranteed physical mapping within the file system. Select 8K (default), 16K, 32K, 64K, or a specific application from the drop-down menu. Matching this to the application's block size provides benefits such as eliminating the overhead and performance impact of unnecessarily granular mappings.

If unsure about this setting, or if the datastore is for general-purpose use, use the default of 8K since this setting cannot be changed after the datastore is created. Configuring this to be larger than the actual host I/O size could result in increased overhead, reduced performance, and higher flash wear. However, configuring this to be too small does not allow the datastore to fully take advantage of the performance optimizations when the I/O size is matched. It is recommended to leave this at the default value of 8K for general-purpose datastores, or if you are not certain which application or I/O size is used on this datastore. If the system detects the majority of I/Os are different than the configured file system size, a warning is generated in Unisphere to alert the administrator.

## 5 VMware VAAI

vStorage API for Array Integration (VAAI) improves ESXi host utilization by offloading storage-related tasks to the Dell EMC Unity system. Since these tasks are processed by the array, the ESXi host's CPU, memory, and network utilization is reduced. For example, an operation such as provisioning full clones from a template VM can be offloaded to Dell EMC Unity storage. The Dell EMC Unity system processes these requests internally, performs the write operations, and returns an update to the ESXi host once the requests are complete. The following primitives are supported with Dell EMC Unity storage:

### **Block:**

- Atomic Test and Set (ATS): This enables arrays to perform locking at a block level of a LUN, instead of the whole LUN. This is also known as Hardware-Assisted Locking.
- Block Zero: This enables arrays to zero out a large number of blocks to speed up virtual machine provisioning. This is also known as Hardware-Assisted Zeroing.
- Full Copy: This enables arrays to make full copies of data within the array without the need for the ESXi host to read and write the data. This is also known as Hardware-Assisted Move.
- Thin Provisioning: This enables arrays to reclaim unused blocks on a thin LUN. This is also known as Dead Space Reclamation.

### **File:**

- Fast File Clone: This enables the creation of virtual machine snapshots to be offloaded to the array.
- Full File Clone: This enables the offloading of virtual-disk cloning to the array.
- Reserve Space: This enables provisioning virtual disks using the Thick Lazy and Eager Zeroed options over NFS.

## 6 VMware VASA

vStorage API for Storage Awareness (VASA) is a VMware-defined and vendor-neutral API that enables vSphere to determine the capabilities of a storage system. The API requests basic storage information from the Dell EMC Unity system, which is used for monitoring and reporting storage details to the user. For example, if a datastore has FAST™ Cache, thin, and auto-tier capabilities, this information is displayed and also used to monitor whether or not it is compliant with defined policies.

Dell EMC Unity storage has a native VASA provider which supports VASA 1.0 through 3.0 protocols, so no external plugins or add-ons are required. In order to leverage VASA, the Dell EMC Unity system must be added as a vendor provider in vSphere. For more information, see section 7 on Virtual Volumes. Once the vendor provider has been added, VM storage policies can be created to determine the desired capabilities, as shown in Figure 4.

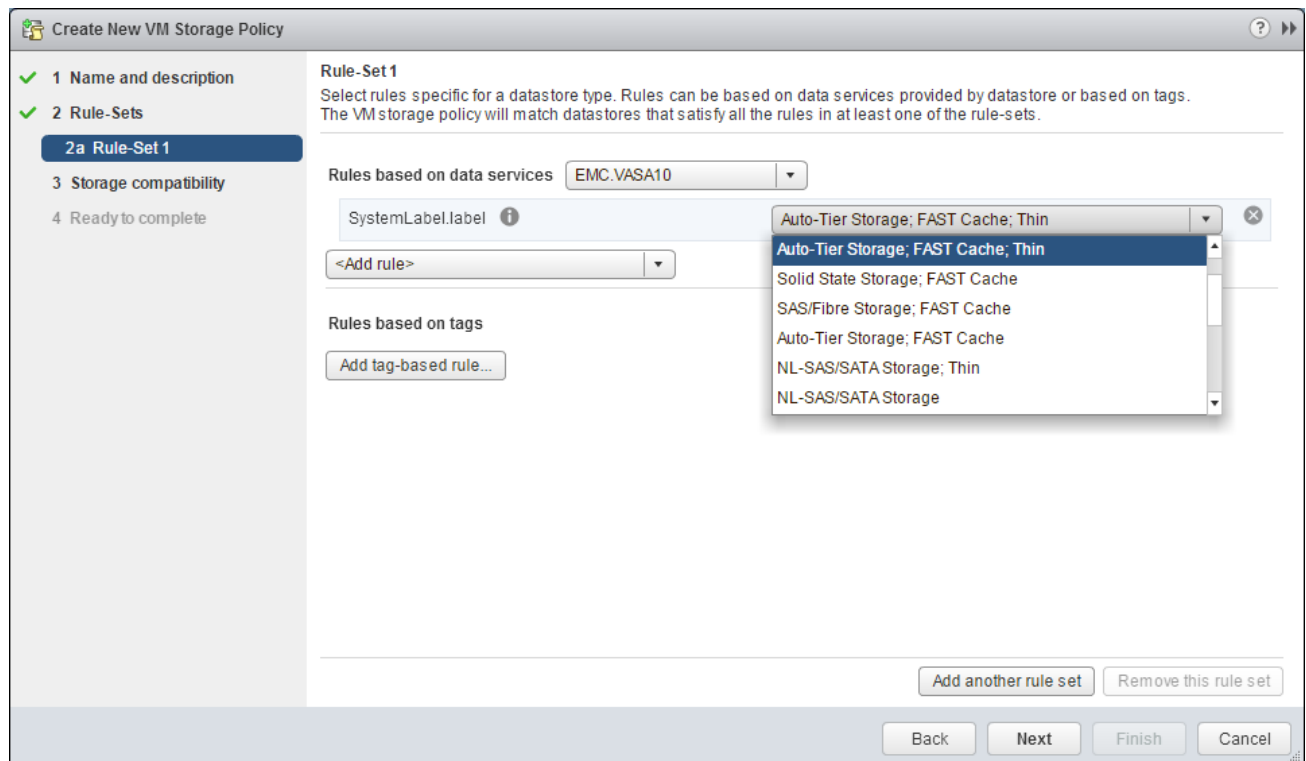


Figure 4 VM storage policies

If a policy is selected while provisioning a VM, the available datastores' capabilities are checked and categorized as either compatible or incompatible. After deployment, the VM is continuously monitored for compliance with the selected policy. If a VM becomes uncompliant, an alert is provided to the administrator.

## 7 VMware vVols

The Virtual Volumes (vVols) storage framework was introduced in VMware vSphere 6.0 and is based on the VASA 2.0+ protocol. Using vVols enables VM-granular data services and Storage Policy Based Management (SPBM). Configuring vVols requires the following:

- VMware vCenter 6.0 or newer
- VMware ESXi 6.0 or newer
- VMware vSphere Web Client

In traditional storage environments, LUNs formatted with VMFS or NFS mount points are used as datastores for virtual machines. Data services are applied at the LUN or file-system level, which means all virtual machines that reside on that particular datastore are also affected.

Using vVols enables storing VM data on individual virtual volumes, which reside on a vVol datastore, also known as a storage container. Data services, such as snapshots and clones, can be applied at a VM-level of granularity and are offloaded to the Dell EMC Unity system. Note that data reduction is not supported on vVols. Policies and profiles can be leveraged to ensure VMs are stored on compliant storage. Any VMs that become noncompliant result in an alert to the administrator.

The workflow for provisioning a vVol datastore differs from traditional NFS or VMFS datastore provisioning. Figure 5 shows the vVol-datastore provisioning model on Dell EMC Unity storage.

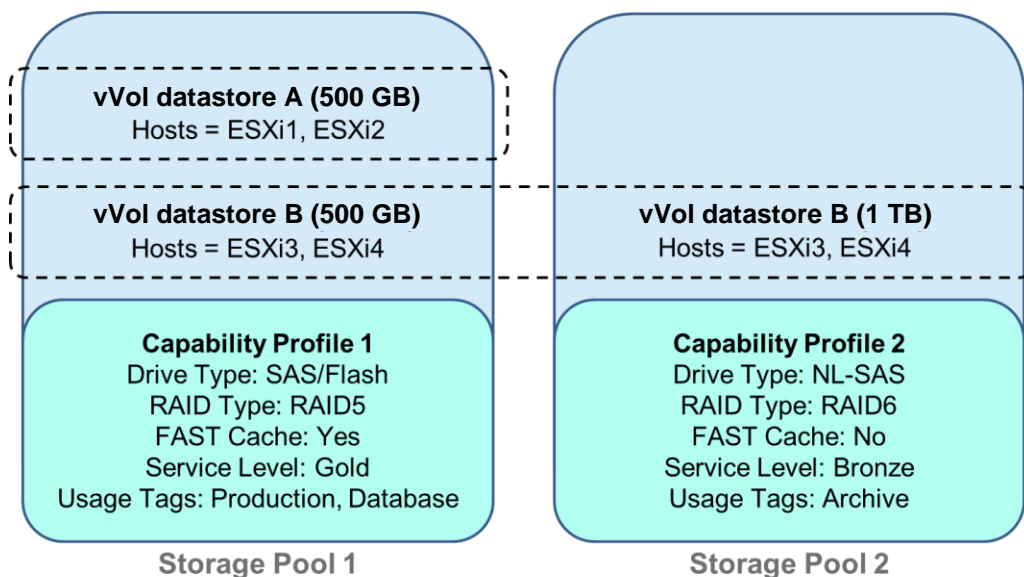


Figure 5 Provisioning model

The following is a high-level summary of the tasks that are completed by the storage administrator:

1. Create storage pools.
2. Create a capability profile for each storage pool.
3. Configure NAS, iSCSI, or FC access.
4. Register ESXi hosts.
5. Create vVol datastores.
6. Provide access to vVol datastores from ESXi hosts.

## 7.1 Capability profiles

Capability profiles are used to advertise the available characteristics of a storage pool as part of SPBM. These capabilities include tiering policies, FAST Cache, drive type, RAID level, and space efficiency which are exposed in vSphere as a service level (Bronze, Silver, Gold, or Platinum). The service level for a given capability profile is automatically calculated based on the aforementioned capabilities of the underlying storage pool. In addition to the service level, storage administrators have the ability to create custom usage tags which are also exposed in vSphere. This allows for an additional level of detail when differentiating between capability profiles. When creating a new storage pool, there is an option to also create a capability profile for that pool, as shown in Figure 6.

The screenshot shows the 'Create Pool' dialog box with a sidebar on the left containing a list of steps: 'Name and Description', 'Tiers', 'Drives', 'Capability Profile Name', 'Constraints' (selected), 'Summary', and 'Results'. The main area is titled 'VMware Capability Profile Constraints' and contains the following fields:

- Usage Tags:** A text input field with a '+' button to its right.
- Service Level:** A dropdown menu currently showing 'Gold'.
- Tiering Policies:** A text field showing 'Start High Then Auto-Tier; Auto-Tier; Highest Available Tier; Lowest Available Tier'.
- FAST Cache:** A dropdown menu currently showing 'On'.
- Drive Type:** A dropdown menu currently showing 'Extreme Multitier'.
- RAID Level:** A dropdown menu currently showing 'RAID 5'.
- Space Efficiency:** A dropdown menu currently showing 'Thin; Thick'.

On the right side of the main area, there are two informational notes:

- Individual Capabilities of the Capability Profile are calculated based on the pool configuration.
- Optional usage specific tags assigned to the Capability Profile are propagated to VMware vSphere environment and can be used in Policy Profiles.

Figure 6 Capability Profile Constraints

**Note:** Dell EMC UnityVSA, certain capabilities such as FAST Cache and RAID Type are not available, so they are omitted from the list below.

Capability profiles include the following capabilities:

**Usage tags:** These are user-defined tags that storage administrators create to designate what the capability profile is used for. Since these tags are also propagated to vSphere, they can be used as a communication mechanism between the storage and VMware administrators. For example, if the capability profile is tagged with **Database**, the VMware administrator can place database VMs on this capability profile.



**Service level:** This is a level such as Platinum, Gold, Silver, or Bronze that is calculated based on the tier and RAID types that comprise the pool. Due to the virtualized nature of the Dell EMC UnityVSA solution, the RAID level is not included in the service level calculation. Table 1 and Table 2 provide information on how service levels are calculated for the different platforms.

Table 1 Dell EMC Unity service levels

Type	Platinum	Gold	Silver	Bronze
Single-tier pool	Extreme performance	Performance (RAID10)	Performance (RAID5 or RAID6)	Capacity
Two-tier pool		Extreme performance Performance	Performance Capacity	Extreme performance Capacity
Three-tier pool		Extreme performance Performance Capacity		

Table 2 Dell EMC UnityVSA service levels

Type	Gold	Silver	Bronze
Single-tier pool	Extreme performance	Performance	Capacity
Two-tier pool	Extreme performance Performance	Performance Capacity	Extreme performance Capacity
Three-tier pool		Extreme performance Performance Capacity	

**Storage properties:** The detailed storage properties are listed below. When creating a VM storage policy, use either usage tags or a service level.

- **Tiering policies:** This property shows the available tiering policies for this capability profile. This is only available for pools that include multiple tiers.
- **FAST Cache:** This shows whether or not FAST Cache is enabled on this pool. This is not available on Dell EMC UnityVSA solutions.
- **Drive type:** This shows the drives that are in this pool, which can be the following:
  - Capacity tier: Pool with only NL-SAS drives
  - Extreme multitier: Multitiered pool including flash drives
  - Extreme performance tier: Pool with only flash drives
  - Multitier: Multitiered pool without any flash drives
  - Performance tier: Pool with only SAS drives

- **RAID level:** This shows the RAID level used for this pool. If the pool consists of different RAID levels for each tier, this displays **Mixed**. This is not available on Dell EMC UnityVSA solutions.
- **Space efficiency:** This is a standard VMware-defined capability that shows the thin and thick capabilities of this pool.

If the capability profile was not created during pool creation, it can also be created on an existing pool in the **Capability Profiles** tab of the VMware page. Create one capability profile for each storage pool that is used for vVols. This page displays all the existing capability profiles and their associated pools, as shown in Figure 7. You can also click the **Edit** button to see and update the details of the capability profile.

		Name	In Use	Pool
<input checked="" type="checkbox"/>	✓	Archive	No	Capacity
<input type="checkbox"/>	✓	Database	No	Extreme

Figure 7 Capability Profiles page

## 7.2 Connectivity

Dell EMC Unity supports access to vVol datastores over block and file protocols. Fibre Channel or iSCSI can be used for block access and NFSv3 is used for file access.

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**Note:** vVols with NFSv4 is not supported on Dell EMC Unity systems.

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For Fibre Channel, ensure the ESXi host is zoned to the FC ports on both SPs for multipathing purposes. Alternatively, the ESXi host can be directly connected to both SPs. Once the connection and zoning are complete, the Fibre Channel ports log in and the process is complete as soon as the World Wide Names (WWNs) are displayed in the Initiator Paths page.

If iSCSI is used, iSCSI interfaces must be created on both SPs. In the vSphere Web Client, add one of the iSCSI interfaces that was created as a dynamic discovery target. The iSCSI interface on the other SP is discovered automatically. Afterwards, run a rescan of the storage adapter and confirm the initiator IQNs are displayed in the Initiator Paths page.

File protocol access requires the creation of a NAS server, which contains file protocol configuration information such as networking, protocols, and DNS settings. It is highly advisable to create at least one vVols-enabled NAS server on each SP for load balancing and high availability purposes. Using vVols with IP multi-tenancy is not supported, and you cannot enable the vVol protocol endpoint on a NAS server that has a tenant association. To use vVols, you must use a NAS server that does not have a tenant assigned. In order to access vVol datastores, an NFS and vVols-enabled NAS server must be created, as shown in Figure 8.

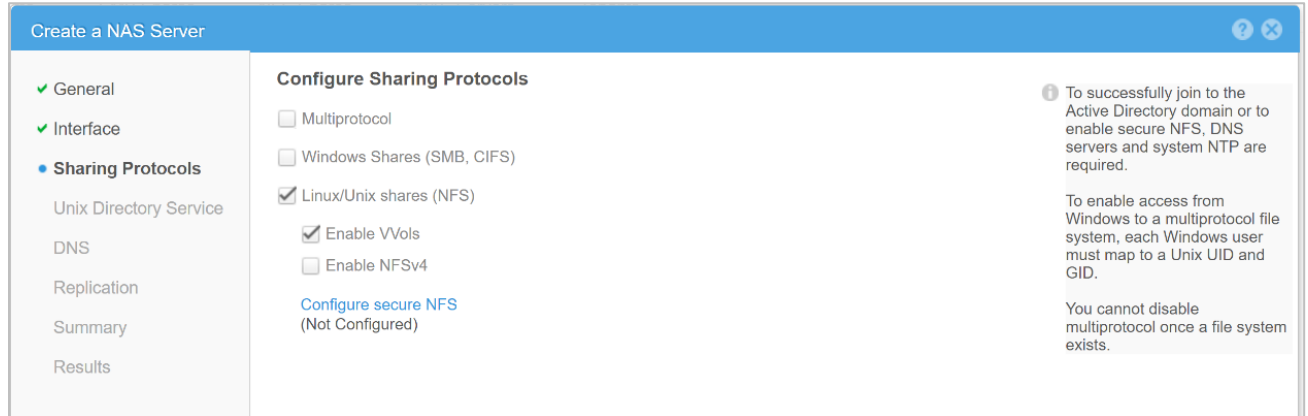


Figure 8 Creating a NAS server

## 7.3 vVol datastores

vVols can only be stored on vVol datastores; they cannot be stored on traditional NFS or VMFS datastores. In VMware terms, vVol datastores on Dell EMC Unity systems are also known as storage containers. Dell EMC Unity storage supports both block and file vVol datastores for access using iSCSI/Fibre Channel or NFS, respectively. When creating a new vVol datastore, choose the appropriate option depending on the connectivity method that is configured, as shown in Figure 9.

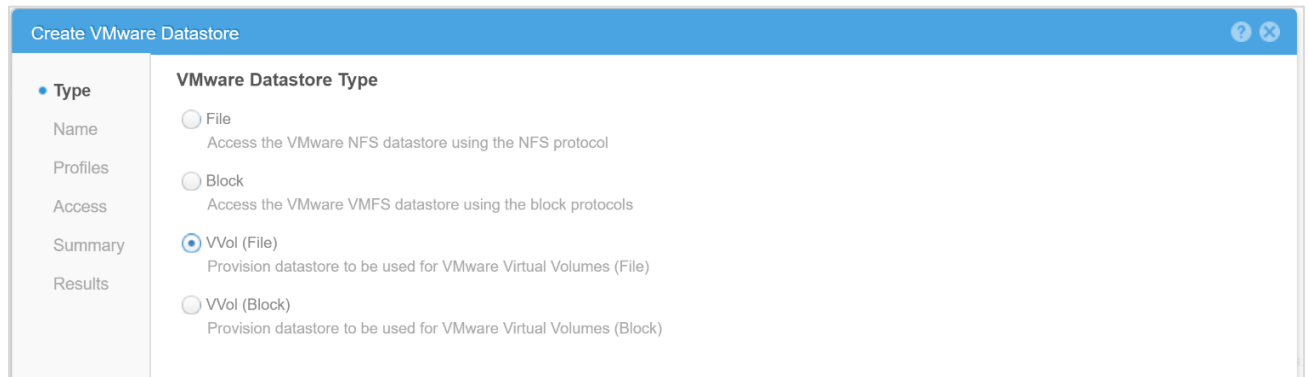


Figure 9 Choosing the VMware datastore type

All capability profiles that were previously created on the system are displayed in the datastore creation wizard. This allows you to select which capability profiles to include in this datastore. Selecting multiple capability profiles creates a vVol datastore that spans across multiple storage pools, which is a feature that is unique to Dell EMC Unity vVol datastores. Doing this enables the datastore to be compatible with multiple VMware storage policies so VMs can be easily migrated by updating the storage policy. If a datastore only contains a single capability profile, it can still be migrated to using VMware Storage vMotion®. In addition to selecting the capability profiles for this datastore, you can also configure how much storage to thinly allocate from each capability profile, as shown in Figure 10.

✓	Name	Pool	Available Size (...)	Subscription (%)	Datastore Size (GB)
<input checked="" type="checkbox"/>	Database	Extreme	732.5	0	732.5
<input checked="" type="checkbox"/>	Archive	Capacity	2,195.2	0.5	500

Figure 10 Configuring capability profiles

Regardless of which protocol is used for vVol datastore access, the ESXi hosts should be registered on the Dell EMC Unity system so they can be granted access to the datastore. The registration process can be automated by importing the VMware environment (see section 3). ESXi hosts that attempt to mount datastores that they do not have access to appear as inaccessible. Host access can be added during creation, as shown in Figure 11, or configured on an existing vVol datastore.

✓	!	Name	Network Address...	Protocols
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	192.168.1.1	192.168.1.1	iSCSI, FC, File

Figure 11 Configuring host access

## 7.4 Protocol endpoints

Protocol endpoints (PEs) are used as I/O access points from the ESXi host to the Dell EMC Unity system. These endpoints establish a data path on-demand for virtual machines and their respective vVol datastores. vVols must be bound to a PE in order to service I/O, and when the vVol no longer needs to service I/O, the vVol becomes unbound. I/O from VMs is communicated through the PE to the respective vVol datastore on the storage system. A single protocol endpoint can multiplex I/O requests from a large number of VM clients to their Virtual Volumes. PEs are automatically created when host access is configured for vVol datastores. Unisphere includes a page that lists all PEs that currently exist on the system.

The behavior of PEs depends on whether block or file vVol datastores are used. For file vVol datastores, the NAS PE looks similar to an NFS mount point. For each file vVol datastore, a single protocol endpoint is created on each vVols-enabled NAS server, regardless of how many ESXi hosts have access to the

datastore. All ESXi hosts share the same PE as a single I/O access point. A file vVol becomes bound to the associated NAS PE every time that VM is powered on. When the VM is powered off, the vVol is unbound from the PE. It is recommended to create at least one vVols-enabled NAS server on each SP for load balancing and high availability purposes.

Figure 12 shows a list of NAS PEs in Unisphere for two datastores.

Datastores		Capability Profiles		Protocol Endpoints		Datastore Shares		Virtual Volumes	
<div><div><div><div></div><div></div></div><div></div></div><div>2 items</div><div><div></div><div></div><div></div><div></div></div></div>									
<div></div>	<div>!</div>	<div>Name</div>	<div>↑</div>	<div>Type</div>	<div>NAS server</div>	<div>VMware UUID</div>	<div>Export Path</div>	<div>VVol datastore</div>	
<div><div><div></div></div></div>	<div><div><div></div></div></div>	<div>nas_pe_1</div>		<div>NAS</div>	<div>NAS_Server</div>	<div>rfc4122.a2a2752a-5b61-4c55-...</div>	<div>192.168.1.1:/rfc4122.2567af81-70ff-4350-9ebd-1c...</div>	<div>Datastore1</div>	
<div><div><div></div></div></div>	<div><div><div></div></div></div>	<div>nas_pe_2</div>		<div>NAS</div>	<div>NAS_Server</div>	<div>rfc4122.f5710697-d1ac-4701-...</div>	<div>192.168.1.1:/rfc4122.f5e9a936-cf45-4954-9603-0c...</div>	<div>Datastore2</div>	

Figure 12 NAS protocol endpoints

For block vVol datastores, the SCSI PE looks similar to a proxy LUN. However, unlike NAS PEs, each ESXi host that has access to the datastore has its own set of dedicated SCSI PEs. For each ESXi host that is granted access to a datastore, two SCSI PEs are automatically created for multipathing purposes. If the same host is granted access to another vVol datastore, two additional SCSI PEs are also created. The block vVol will be bound to the associated SCSI PE every time that the VM is powered on. When the VM is powered off, the PE is unbound. SCSI protocol endpoints are like LUN mount points that allow I/O access to vVols from the ESXi host to the storage system. Figure 13 shows a list of SCSI PEs in Unisphere for three hosts.

Datastores		Capability Profiles		Protocol Endpoints		Datastore Shares		Virtual Volumes	
<div><div><div><div></div><div></div></div></div><div>10 items</div><div><div></div><div></div><div></div><div></div></div></div>									
<div><div></div></div>	<div><div>!</div></div>	Name	Type	VMware UUID	Current ...	WWN	Host		
<div><div><div></div></div></div>	<div><div></div></div>	scsi_pe_1	SCSI	rfc4122.60060160-07a0-3d00-8f0b-c00b227...	SPA	60:06:01:60:07:A0:3D:00:8F:0B:C0:0B:22:76:B8:ED	<div><div></div></div>		
<div><div><div></div></div></div>	<div><div></div></div>	scsi_pe_2	SCSI	rfc4122.60060160-07a0-3d00-ab1a-8327d06...	SPB	60:06:01:60:07:A0:3D:00:AB:1A:83:27:D0:67:9C:F6	<div><div></div></div>		
<div><div><div></div></div></div>	<div><div></div></div>	scsi_pe_3	SCSI	rfc4122.60060160-07a0-3d00-9227-0342755...	SPA	60:06:01:60:07:A0:3D:00:92:27:03:42:75:54:94:9D	<div><div></div></div>		
<div><div><div></div></div></div>	<div><div></div></div>	scsi_pe_4	SCSI	rfc4122.60060160-07a0-3d00-9c87-e978c0f...	SPB	60:06:01:60:07:A0:3D:00:9C:87:E9:78:C0:F2:28:BC	<div><div></div></div>		
<div><div><div></div></div></div>	<div><div></div></div>	scsi_pe_5	SCSI	rfc4122.60060160-07a0-3d00-ba38-c737aef...	SPA	60:06:01:60:07:A0:3D:00:BA:38:C7:37:AE:F3:A4:D0	<div><div></div></div>		
<div><div><div></div></div></div>	<div><div></div></div>	scsi_pe_6	SCSI	rfc4122.60060160-07a0-3d00-9764-98a8723...	SPB	60:06:01:60:07:A0:3D:00:97:64:98:A8:72:3A:0D:CB	<div><div></div></div>		

Figure 13 SCSI protocol endpoints

## 7.5 VASA vendor provider

Dell EMC Unity storage has a native VASA provider that is used to facilitate communication between the vCenter and ESXi hosts and the Dell EMC Unity system. Some of the responsibilities of the VASA provider include facilitating the offloading of data services, managing VASA sessions, handling client authentication, generating events and alarms, and converting the array data model in to the generic VASA data model.

With the release of Dell EMC Unity OE version 4.2, you can select to have the VASA provider automatically registered when you configure VMware access to a vCenter in the **Add vCenter** wizard. Only Dell EMC Unity administrator credentials are required to add the VASA provider. If you are running an earlier version of code, in order to leverage the on-array VASA provider, you must manually add the Dell EMC Unity system as a VASA vendor provider in vSphere. This establishes the control path between the ESXi host and the Dell EMC Unity system.

As shown in Figure 14, enter the following information in to the **New Storage Provider** page:

- Name: <System\_Name>
- URL: https://<Management\_IP>:8443/vasa/version.xml
- Username: admin (or another account with VM Administrator privileges)
- Password: <Password>

Figure 14 Specifying a new storage provider

Once the vendor provider has been registered, ensure the **Status** shows **Online** and **Active**. After adding the storage provider, you may have to refresh the vSphere Web Client for the system to be displayed. Note that you can only register the VASA vendor provider on a Dell EMC Unity system to a single vCenter. Registering the same VASA vendor provider to another vCenter causes the original provider and its datastores to go offline.

## 7.6 Add datastores

Now that the VASA vendor provider has been added, the vVol-related information on the Dell EMC Unity system can be passed to vSphere. This enables vVol datastores to be mounted to ESXi hosts for use. With the release of Dell EMC Unity OE version 4.2, vVol datastores will be automatically mounted to ESXi hosts for use. Prior to Dell EMC Unity OE version 4.2, vVol datastores will need to be manually added to the ESXi hosts. The administrator needs to add it using the **New Datastore** wizard in the vSphere Web Client. When adding the datastore, select the **Type** of **VVOL**, as shown in Figure 15.

Figure 15 Adding vVol datastores

This displays a list of vVol datastores that are currently available on the Dell EMC Unity system. Select the appropriate datastore and provide a name to mount the vVol datastore to an ESXi host as shown in Figure 16. Once the datastore has been mounted on one ESXi host, right-click the datastore to easily mount the same datastore to other ESXi hosts.

**New Datastore**

✓ 1 Type  
 ✓ 2 **Name and container selection**  
 3 Ready to complete

Datastore name:

Backing Storage Container

Q Filter

Name	Identifier	Maximum Disk Size	Existing Datastore
VVol_Datastore	vol:624c1d1d34a04d66-...	16.00 TB	VVol_Datastore

1 items

**i** For SCSI-backed VVol datastores, PE LUNs need to be configured manually. Configure SCSI PE LUNs before creating a datastore. If the datastore is created without configuring PE LUNs, the ESXi host marks corresponding VVol datastore as inaccessible.

Backing Storage Container Details

Storage array(s)	FNM00160300650
Storage provider(s)	Vvols

Back Next Finish Cancel

Figure 16 New datastore

## 7.7 Host I/O limits

In Dell EMC Unity OE version 4.2, host I/O limits were expanded to support vVols. vVols support either an absolute limit or a density-based limit, defined by IOPS or IOPS per GB, respectively. Host I/O limits are supported on data vVols specifically, Host I/O limits cannot be applied to config, swap, or memory vVols. While the implementation of host I/O limits is the same for vVols and block resources, the management of vVol host I/O limits is done entirely through VMware vSphere. Host I/O limits can be created in vSphere as a rule for a storage policy and then assigned at either the VM or vVol level. Unisphere can be used to monitor the vVol rate limiting, with the capability to display any I/O limits associated with the vVol as well as real-time performance metrics, as shown in Figure 17.

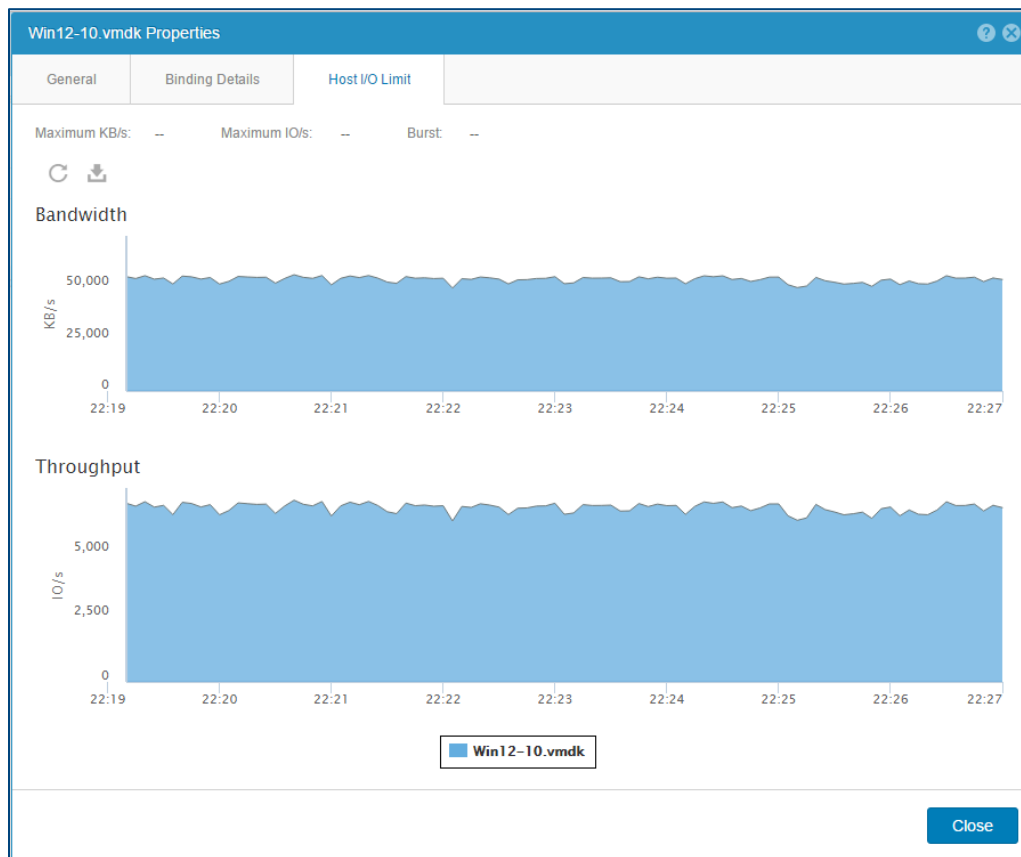


Figure 17 Viewing vVol real-time I/O metrics

In order to create a host I/O limit, when creating a VM storage policy, ensure that the field **Rules based on data services** field is set to **EMC.UNITY.VVOL**. Then, select **I/O Limit** as a new rule, and the configuration options for the I/O limit will be presented, as listed below. I/O limits can be created as either an absolute or density-based limit.

- **Maximum Rate (IOPS):** This field determines either the absolute limit or the IOPS per GB value, depending on which type of I/O limit is selected.
- **Burst Rate (%):** This field can be set between 0% and 100%. Setting this field to 0 results in an I/O limit without burst.
- **Burst Duration (per hour):** This field can be set to 1, 3, or 5 minutes. This is the length of time where the I/O limit will be temporarily raised by the burst percentage; this burst window will repeat every hour.



Host I/O limits can be configured within the same VM storage policy as the other capabilities, which are explained in section 7.8. Host I/O limits are compatible with any Dell EMC Unity vVol datastore, and no additional configuration is needed on the Dell EMC Unity side to support this feature. Any Virtual Volumes which have a VM storage policy applied to them will be subject to the I/O limit defined in the VM storage policy, if it exists. Find more information on creating, applying, and managing VM storage policies in section 7.8.

## 7.8 VM storage policies

VM storage policies, used for Storage Policy Based Management (SPBM), are authored by the VMware administrator to describe the desired capabilities when provisioning a VM. The storage and virtualization administrators can discuss policies in advance, ensuring the Dell EMC Unity system has capability profiles that are compliant with the configured VM storage policies. Any of the capabilities that are included in the capability profiles can be used to create policies. For example, the virtualization administrator can create a policy which will look for the usage tag **Database**. Any vVol datastores which contain a capability profile that has the usage tag database will be considered compliant. This ensures that any VMs with this storage policy are deployed on the storage pool that the storage administrator has designated for this purpose. Another example is creating a service level with a Platinum policy for when the best performance is required for a VM. When creating a VM storage policy, select **EMC.UNITY.VVOL** and choose the desired rule as shown in Figure 18.

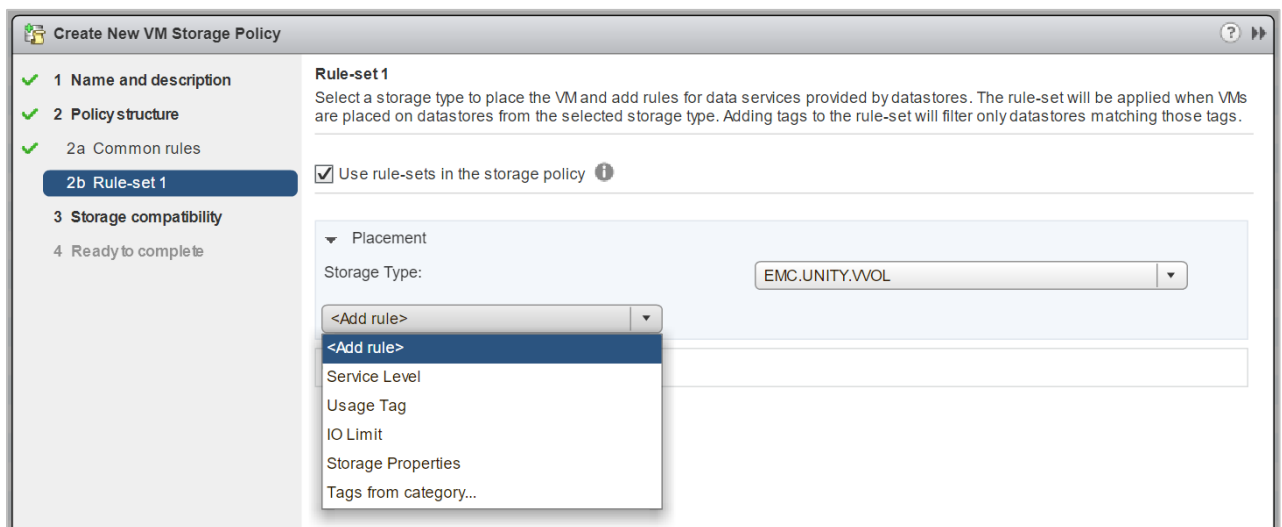


Figure 18 Creating a new VM storage policy

Low-level storage properties can also be selected when creating VM storage policies. These include characteristics such as drive type, FAST Cache, RAID type, and tiering policy. These are designed to enable advanced VMware administrators who are familiar with storage capabilities to customize their VM storage policies.

The next screen in the wizard displays a list of compatible and incompatible datastores based on the selected capabilities, as shown in Figure 19.

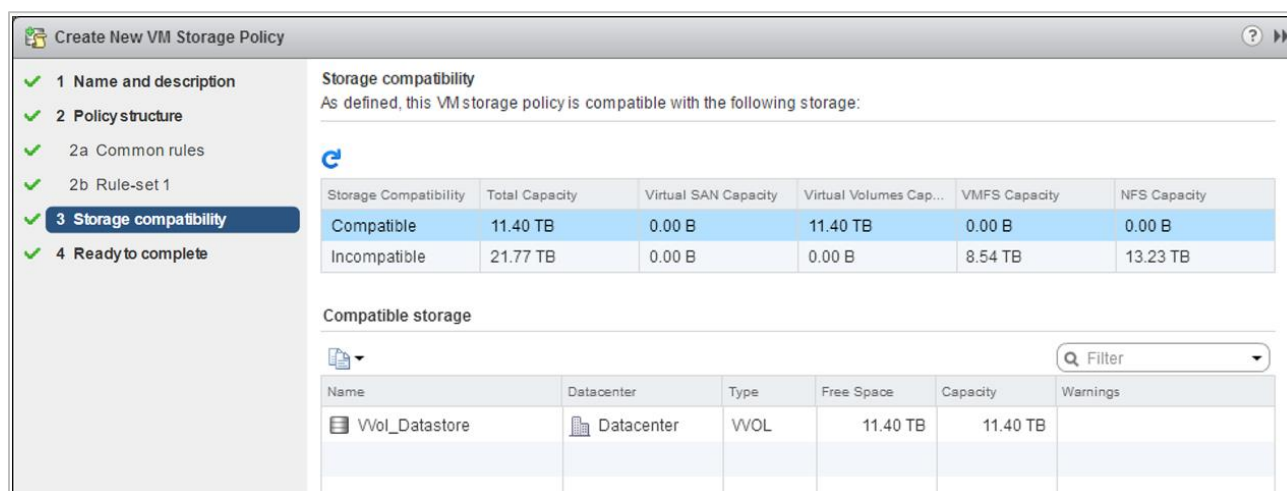


Figure 19 Viewing storage compatibility

After VM storage policies are configured, VMs can be deployed on vVol datastores similar to NFS and VMFS datastores. On the **Select Storage** step of the new VM wizard, there is a drop-down menu that displays the VM storage policies that were created in vSphere. When a policy is selected, its capabilities are compared with the capabilities of the available datastores. These datastores are categorized in compatible and incompatible categories to allow the administrator to easily identify datastores that are appropriate for that VM, as shown in Figure 20.

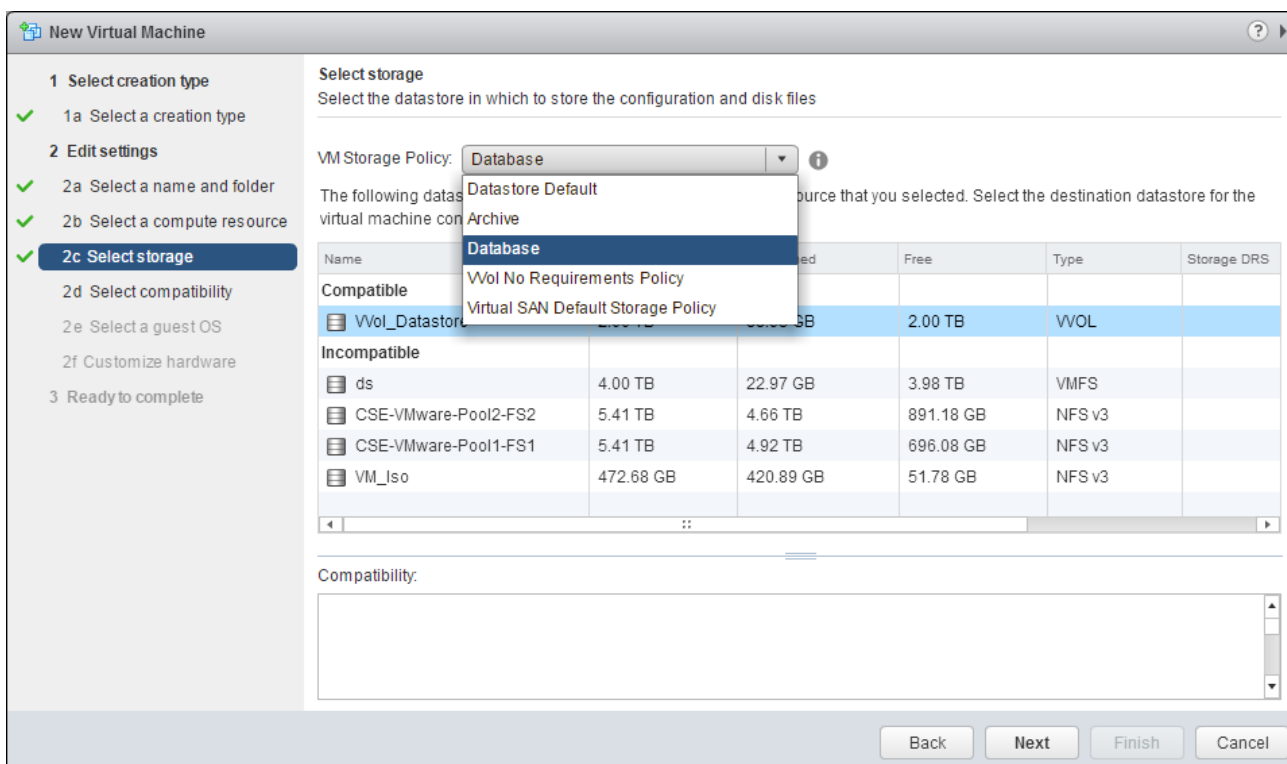


Figure 20 VM storage policies

After a VM is deployed using a VM storage policy, vSphere continues to periodically monitor the datastore to ensure continued compliance. The current compliance status and the last-checked date is displayed in the VM Summary page or the VM storage policy Monitor page. You can also initiate an on-demand compliance check on either of these pages. If the datastore falls out of compliance with the specified policy, this is displayed in vSphere Web Client to warn the administrator about the status, as shown in Figure 21.

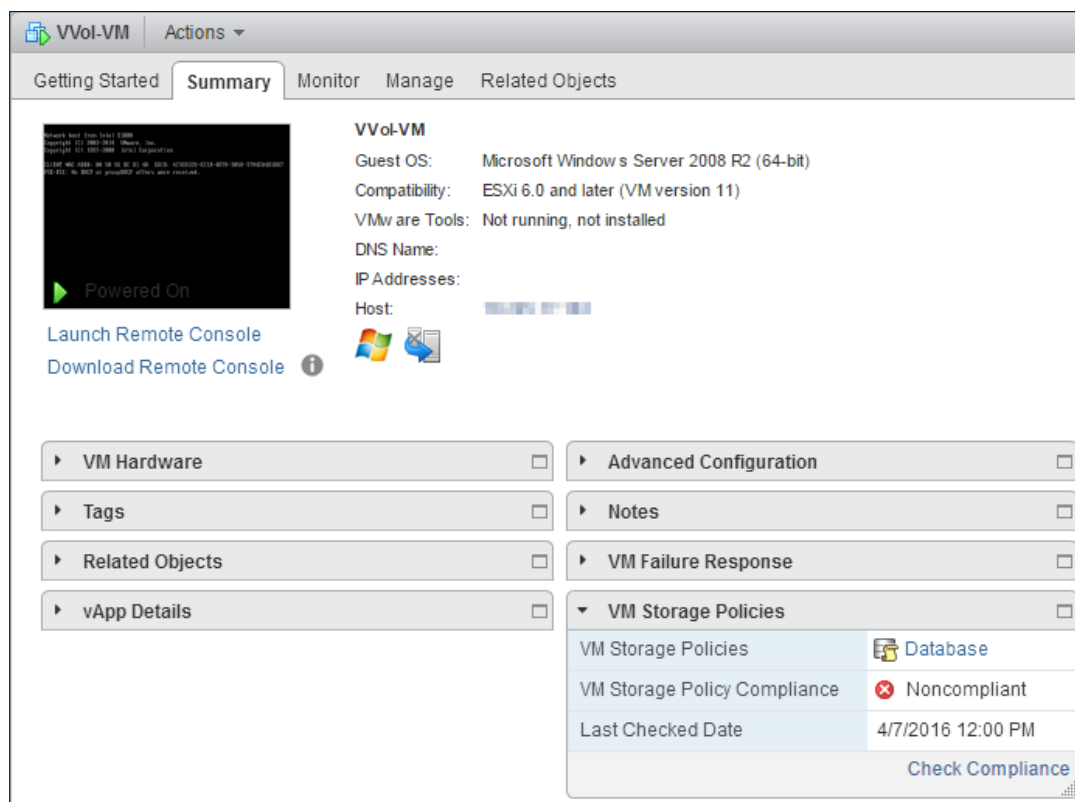


Figure 21 A noncompliant VM

It is possible to migrate VMs by using Storage vMotion. This provides the ability to move VMs to the datastores with the appropriate capabilities if the requirements change. VMs that have snapshots or fast clones cannot be migrated.

VMs can also be automatically migrated between back-end storage by changing the VM storage policy assigned to that VM. If the new VM storage policy is satisfied by a capability profile within the same vVol datastore, the VM is automatically migrated on the back end to ensure it resides on a pool with the appropriate capabilities. Migrating the vVol by updating the VM storage policy can only be done if the new policy that you want to use is also available on the same vVol datastore. For example, if a single datastore contains two capability profiles for the Platinum and Bronze service levels, a VM storage profile update can be used to automatically migrate the VM's vVols from one storage pool to the other.

To edit the VM storage policy assigned to a VM, right-click the VM to open the **Manage VM Storage Policies** page, as shown in Figure 22.

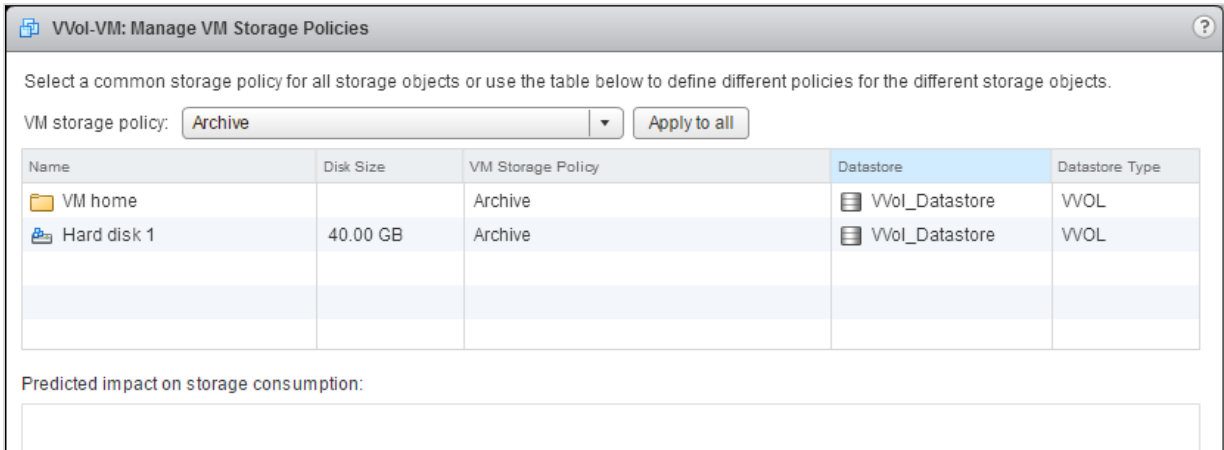


Figure 22 Editing the VM storage policy

Since each VM hard disk is stored on individual vVols, you also have the ability to apply a different VM storage policy to each individual hard disk. For example, for a database VM, you could put the database hard disk on the Platinum service level and put the log hard disk on the Gold service level.

If the current datastore does not have the required capabilities for the new VM storage policy, a VM storage policy update cannot be made. Instead, use Storage vMotion to migrate the VM to a different vVol datastore that has the appropriate capabilities. To do this, right-click the VM and click **Migrate** to move the VM to a different storage location. On the **Select storage** page, there is a drop-down menu for the VM storage policy. You can choose to keep the existing VM storage policy or select a new one on the new datastore. Similar to deploying a new VM, vSphere automatically categorizes the available datastores to help identify which datastores are compatible with this policy, as shown in Figure 23.

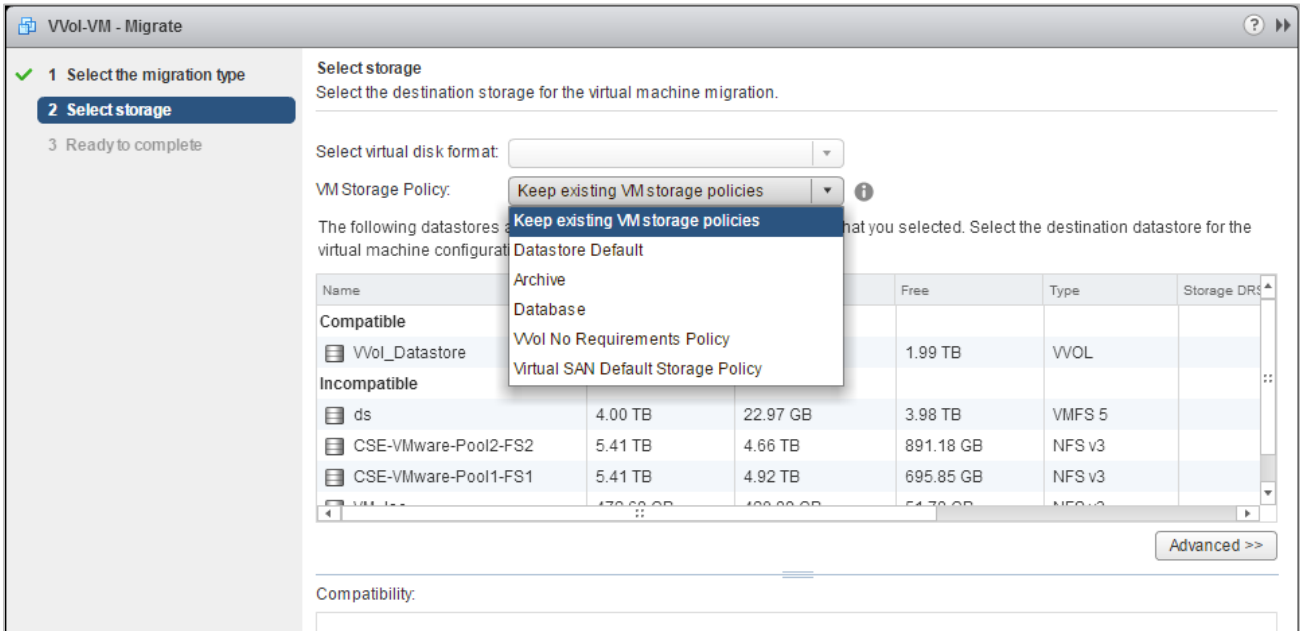


Figure 23 Using Storage vMotion

## 7.9 vVols

Traditionally, VM data is stored as a collection of files on a VMFS or NFS datastore, which is a LUN or file system on the storage system. With Virtual Volume (vVol) datastores, each file is stored on a dedicated storage object, called a Virtual Volume, on the storage system. Dell EMC Unity storage keeps track of the different types of vVols and maps them to the VM to which they belong. This enables data services to be applied only to the vVols that are associated with a particular VM, instead of to all of the VMs on the entire datastore.

Depending on the type of data that is being stored on the vVol, a certain type of vVol is provisioned:

- **Data:** Stores data such as VMDKs, snapshots, clones, and fast-clones. At least one data vVol is required per VM to store its hard disk.
- **Config:** Stores standard VM-level configuration data such as .vmx files, logs, and NVRAM. At least one config vVol is required per VM to store its .vmx configuration file.
- **Swap:** Stores a copy of a VM's memory pages when the VM is powered on. Swap vVols are automatically created and deleted when VMs are powered on and off. The swap vVol size matches the VMs memory size.
- **Memory:** Stores a complete copy of a VM's memory on disk when suspended, or for a with-memory snapshot.

At a minimum, three vVols are required for each powered-on VM: data for the hard disk, config for the configuration, and swap for the memory pages. Unisphere provides a list of the vVols that exist on the system. This is only for visibility and troubleshooting purposes since the management of vVols is handled automatically. Dell EMC Unity storage uses the VASA protocol to communicate with vSphere to create, bind, unbind, and delete vVols as needed. With the release of Dell EMC Unity OE version 4.1.2, support has been expanded to include VASA 3.0 as well as vSphere 6.5. The Virtual Volumes page in Unisphere is shown in Figure 24.















Datastores		Capability Profiles		Protocol Endpoints		Datastore Shares		Virtual Volumes			
<div></div>								3 items		  	
		Name	Type	Virtual Machine	Size(GB)	Datastore	Capability Profile	Replica Type			
		VVol-VM.vmdk	Data	VVol-VM	40.0	VVol_Datastore	Extreme_CP	Base			
		VVol-VM-6c254d9d.vswp	Swap	VVol-VM	4.0	VVol_Datastore	Extreme_CP	Base			
		VVol-VM	Config	VVol-VM	4.0	VVol_Datastore	Extreme_CP	Base			

Figure 24 Virtual Volumes page

Open the **Properties** page to view more details of each type of vVol as shown in Figure 25.

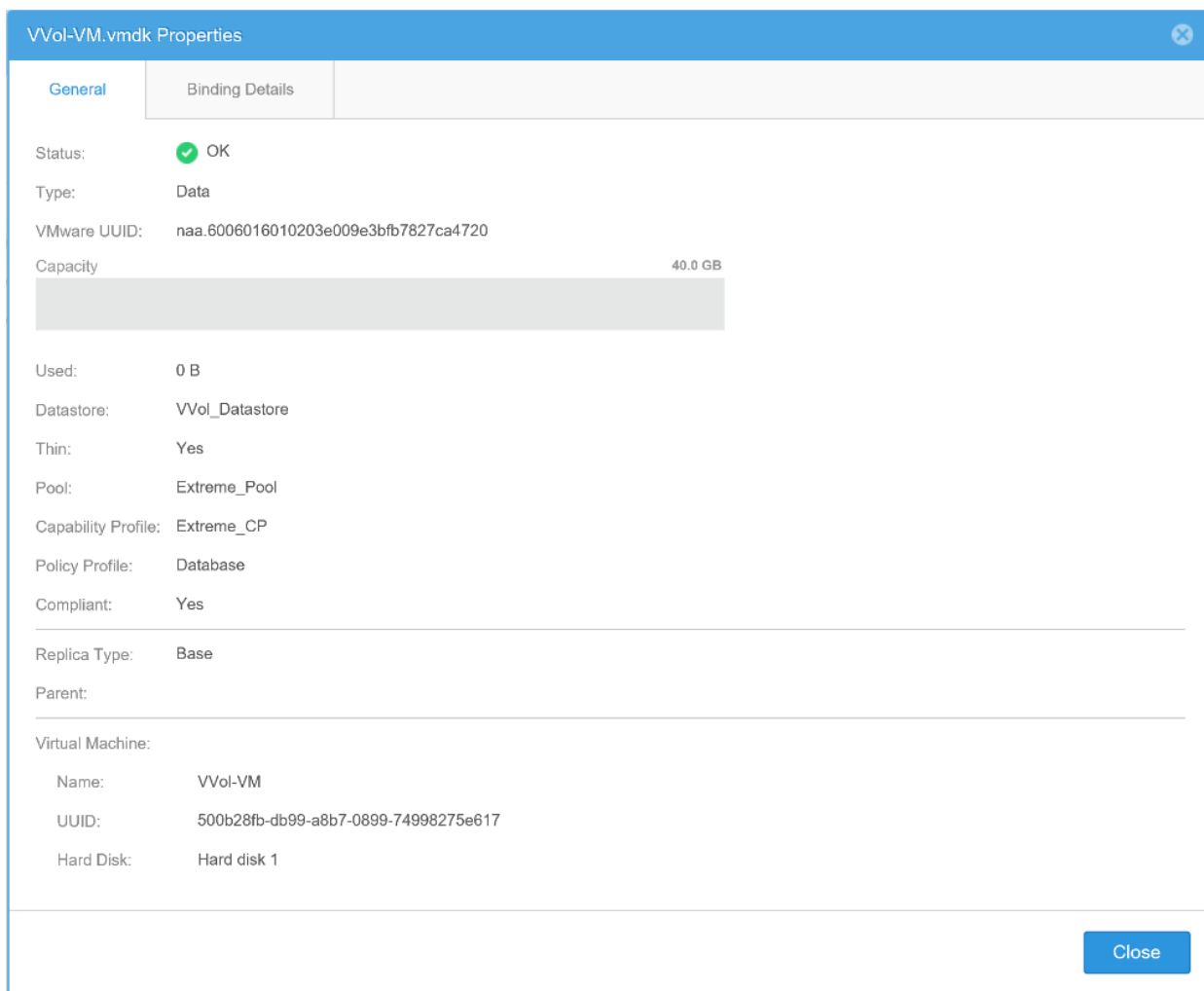


Figure 25 Viewing vVol properties

VMs could potentially utilize several more vVols, depending on the configuration. For example, if additional hard disks are added to a VM, an additional data vVol is created for each hard disk. Another example is when a snapshot is taken of a VM, and a new data vVol is created to store the snapshot. If the VM is powered on and its memory is also included in the snapshot, a memory vVol is created to store the contents of the VM's memory. As additional vVols are created, the Virtual Volumes page in Unisphere is updated with the latest information.

## 7.10 Data protection

Data protection features, such as snapshots and clones, can be applied at a VM-level of granularity by applying them only to the vVols that are related to a specific VM. Also, VASA allows vSphere to communicate with the Dell EMC Unity system to facilitate offloading of these storage-related tasks to the Dell EMC Unity system. Since these tasks are processed by the array, the ESXi host CPU, memory, and network utilization is reduced.

When a snapshot of a VM is initiated using the vSphere Web Client, it is offloaded to the Dell EMC Unity system. Dell EMC Unity storage creates a snapshot of the associated vVols for that particular VM, leaving

other VMs on the same datastore unaffected since they are stored on different vVols. After the snapshot is created, a new data vVol is created to store the snapshots contents. The **Replica Type** is **Ready Snap** for the snapshot vVol as shown in Figure 26.












Datastores		Capability Profiles		Protocol Endpoints		Datastore Shares		Virtual Volumes	
<div><div></div><div>4 items</div><div></div></div>									
	!	Name	Type	Virtual Machine	Size(GB)	Datastore	Capability Profile	Replica Type	
<input checked="" type="checkbox"/>		VVol-VM.vmdk	Data	VVol-VM	40.0	VVol_Datastore	Extreme_CP	Ready Snap	
<input type="checkbox"/>		VVol-VM.vmdk	Data	VVol-VM	40.0	VVol_Datastore	Extreme_CP	Base	
<input type="checkbox"/>		VVol-VM-6c254d9d.vswp	Swap	VVol-VM	4.0	VVol_Datastore	Extreme_CP	Base	
<input type="checkbox"/>		VVol-VM	Config	VVol-VM	4.0	VVol_Datastore	Extreme_CP	Base	

Figure 26 VM snapshot

The fast clones feature allows you to leverage snapshots to create a clone of a VM, which are offloaded to the Dell EMC Unity system. A common use case where fast clones can be leveraged are VDI environments. Since snapshots are used and a full clone is not required, space efficiency is increased, and clones can be deployed very quickly. These clones are linked to the parent VM, so they must exist on the same storage container as the parent VM. Any changes on the parent VM or the snapshot do not have any effect on each other.

VM full cloning operations are also offloaded to the Dell EMC Unity system. This significantly reduces ESXi host and network utilization since the data does not need to travel from the Dell EMC Unity system to the ESXi host for reading and then repeated again for writing. The VM storage policy can be selected when creating a clone, which allows for placement of the clone on to a different policy. After the clone is created, it can be managed as an independent VM. Any snapshots on the source VM do not get propagated to the clone. Dell EMC Unity automatically creates a set of vVols for the clone, as shown in Figure 27.
















Datastores		Capability Profiles		Protocol Endpoints		Datastore Shares		Virtual Volumes	
  		5 items    							
		Name 	Type	Virtual Machine	Size(GB)	Datastore	Capability Profile	Replica Type	
<input checked="" type="checkbox"/>		VVol-VM.vmdk	Data	VVol-VM	40.0	VVol_Datastore	Extreme_CP	Base	
<input type="checkbox"/>		VVol-VM-6c254d9d.vswp	Swap	VVol-VM	4.0	VVol_Datastore	Extreme_CP	Base	
<input type="checkbox"/>		VVol-VM	Config	VVol-VM	4.0	VVol_Datastore	Extreme_CP	Base	
<input type="checkbox"/>		Clone-000001.vmdk	Data	--	40.0	VVol_Datastore	Extreme_CP	Base	
<input type="checkbox"/>		Clone	Config	--	4.0	VVol_Datastore	Extreme_CP	Base	

Figure 27 VM clone

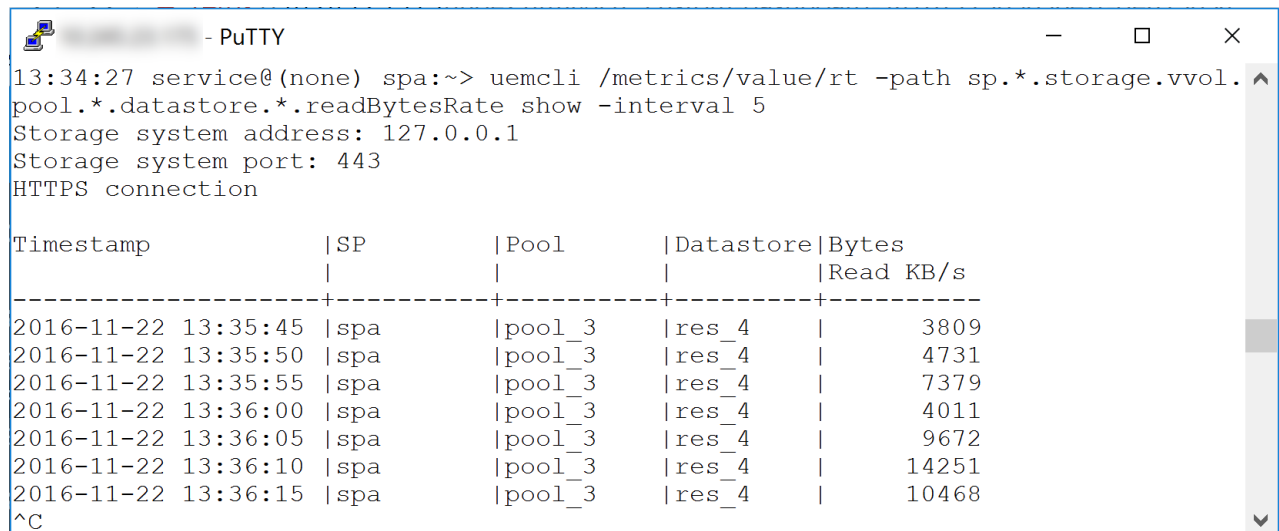
Although Dell EMC Unity storage includes a native VASA 3.0 provider, vVol replication is not supported. If VM-granular replication services are required, RecoverPoint™ for Virtual Machines can be leveraged. RecoverPoint for VMs is a software-only replication solution that provides any-point-in-time asynchronous and synchronous protection on a per-VM basis. It is storage agnostic, working in the hypervisor layer with all storage types supported by VMware, including vVols. For more information on RecoverPoint for VMs, reference the *RecoverPoint for Virtual Machines Administrator's Guide* on [Dell EMC Support](#).

## 7.11 vVol metrics

Real-time vVol metrics are available using the Unisphere CLI (UEMCLI) or REST API. When viewing vVol metrics, vVols are identified using their UUID, which is a unique ID assigned to each vVol by VMware vSphere.

The following is an example of the CLI command used to view real-time vVol metrics:

```
uemcli /metrics/value/rt -path
sp.*.storage.vvol.pool.*.datastore.*.readBytesRate show -interval 5
```



```
13:34:27 service@(none) spa:~> uemcli /metrics/value/rt -path sp.*.storage.vvol.
pool.*.datastore.*.readBytesRate show -interval 5
Storage system address: 127.0.0.1
Storage system port: 443
HTTPS connection
```

Timestamp	SP	Pool	Datastore	Bytes Read KB/s
2016-11-22 13:35:45	spa	pool_3	res_4	3809
2016-11-22 13:35:50	spa	pool_3	res_4	4731
2016-11-22 13:35:55	spa	pool_3	res_4	7379
2016-11-22 13:36:00	spa	pool_3	res_4	4011
2016-11-22 13:36:05	spa	pool_3	res_4	9672
2016-11-22 13:36:10	spa	pool_3	res_4	14251
2016-11-22 13:36:15	spa	pool_3	res_4	10468

Figure 28 Viewing real-time vVol metrics from UEMCLI

Figure 29 shows a list of real-time vVol metrics that are available on Dell EMC Unity storage.



```
02:46:10 service@(none) spa:~> uemcli /metrics/metric -availability real-time show | grep vvol
519: Path = sp.*.storage.vvol.block.*.readBlocksRate
520: Path = sp.*.storage.vvol.block.*.readBytesRate
521: Path = sp.*.storage.vvol.block.*.readsRate
522: Path = sp.*.storage.vvol.block.*.responseTime
523: Path = sp.*.storage.vvol.block.*.totalBytesRate
524: Path = sp.*.storage.vvol.block.*.totalCallsRate
525: Path = sp.*.storage.vvol.block.*.totalIoTime
526: Path = sp.*.storage.vvol.block.*.writeBlocksRate
527: Path = sp.*.storage.vvol.block.*.writeBytesRate
528: Path = sp.*.storage.vvol.block.*.writesRate
529: Path = sp.*.storage.vvol.file.*.readBytesRate
530: Path = sp.*.storage.vvol.file.*.readIoTime
531: Path = sp.*.storage.vvol.file.*.readResponseTime
532: Path = sp.*.storage.vvol.file.*.readsRate
533: Path = sp.*.storage.vvol.file.*.responseTime
534: Path = sp.*.storage.vvol.file.*.totalBytesRate
535: Path = sp.*.storage.vvol.file.*.totalCallsRate
536: Path = sp.*.storage.vvol.file.*.totalIoTime
537: Path = sp.*.storage.vvol.file.*.writeBytesRate
538: Path = sp.*.storage.vvol.file.*.writeIoTime
539: Path = sp.*.storage.vvol.file.*.writeResponseTime
540: Path = sp.*.storage.vvol.file.*.writesRate
541: Path = sp.*.storage.vvol.pool.*.datastore.*.readBytesRate
542: Path = sp.*.storage.vvol.pool.*.datastore.*.readsRate
543: Path = sp.*.storage.vvol.pool.*.datastore.*.responseTime
544: Path = sp.*.storage.vvol.pool.*.datastore.*.totalIoTimeRate
545: Path = sp.*.storage.vvol.pool.*.datastore.*.writeBytesRate
546: Path = sp.*.storage.vvol.pool.*.datastore.*.writesRate
02:46:14 service@(none) spa:~>
```

Figure 29 Real-Time vVol metrics



Starting with Dell EMC Unity OE version 4.1, historical vVol metrics are available using Unisphere, the Unisphere CLI (UEMCLI), and the REST API. Figure 30 shows the available vVol metrics when adding a new chart to a historical dashboard under the Performance page. On the left, the system-level metrics are shown, while on the right, the vVol datastore metrics are shown.

Figure 30 Adding historical charts

The following is an example of the CLI command to get historical vVol metrics:

```
uemcli /metrics/value/hist -path
sp.*.storage.vvol.pool.*.datastore.*.readBytesRate show -interval 60
```

- PuTTY

```
13:44:04 service@(none) spa:~> uemcli /metrics/value/hist -path sp.*.
.vvol.pool.*.datastore.*.readBytesRate show -interval 60
Storage system address: 127.0.0.1
Storage system port: 443
HTTPS connection
```

Timestamp	SP	Pool	Datastore	Bytes Read KB/s
2016-11-22 12:05:00	spa	pool_3	res_4	0
	spa	pool_4	res_4	0
	spb	pool_3	res_4	0
2016-11-22 12:06:00	spb	pool_4	res_4	0
	spa	pool_3	res_4	0
	spa	pool_4	res_4	0
	spb	pool_3	res_4	0
	spb	pool_4	res_4	0

Figure 31 Viewing historical vVol metrics from UEMCLI

Figure 32 shows a list of historical vVol metrics that are available in Dell EMC Unity storage.



```

02:44:47 service@(none) spa:~> uemcli /metrics/metric -availability historical show | grep vvol
73: Path = sp.*.storage.vvol.pool.*.datastore.*.readBytesRate
74: Path = sp.*.storage.vvol.pool.*.datastore.*.readsRate
75: Path = sp.*.storage.vvol.pool.*.datastore.*.responseTime
76: Path = sp.*.storage.vvol.pool.*.datastore.*.writeBytesRate
77: Path = sp.*.storage.vvol.pool.*.datastore.*.writesRate
02:44:51 service@(none) spa:~>

```

Figure 32 Viewing historical vVol metrics

For a vVol datastore that spans multiple pools, there is the option to view how much each pool contributes to the performance metric. The pool allocation per datastore can be seen by clicking the arrow next to the name of the datastore in the chart's legend. Figure 33 gives an example of the IOPS pool allocation per datastore for a vVol datastore that spans two pools: Extreme\_Pool and Capacity.

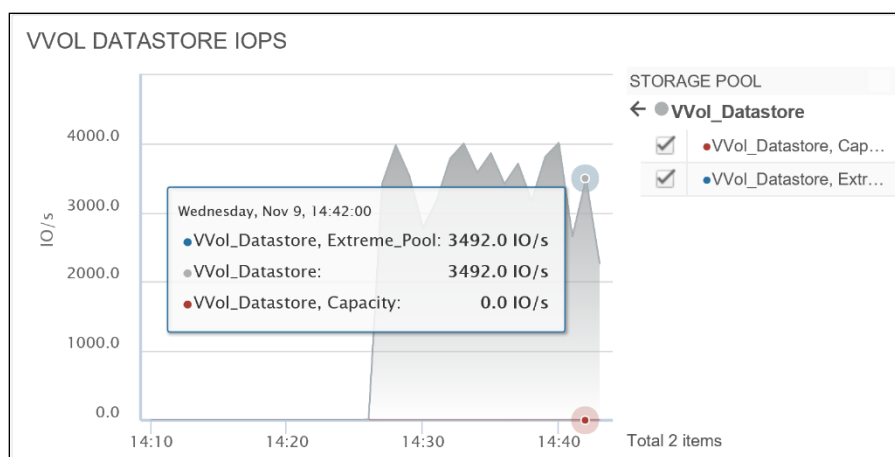


Figure 33 Pool allocation per datastore

Refer to the *Unisphere Command Line Interface User Guide* on [Dell EMC Support](#) for more information on viewing historical and real-time metrics using UEMCLI.

## 8 Virtual Storage Integrator

The Dell EMC Virtual Storage Integrator (VSI) for VMware vSphere Web Client is a free plug-in for VMware vCenter. It brings storage management capabilities to the VMware administrator through the standard VMware vSphere client interface. With VSI, there is no longer a need to use multiple management interfaces to view and perform various storage-related tasks. VSI enables administrators to view, manage, optimize, and map storage to VMware ESXi hosts. VSI for Dell EMC Unity includes support for provisioning datastores and RDMS, configuring multipathing policies, reclaiming space, and more. Figure 34 shows the VSI menu in the VMware vSphere Web Client.

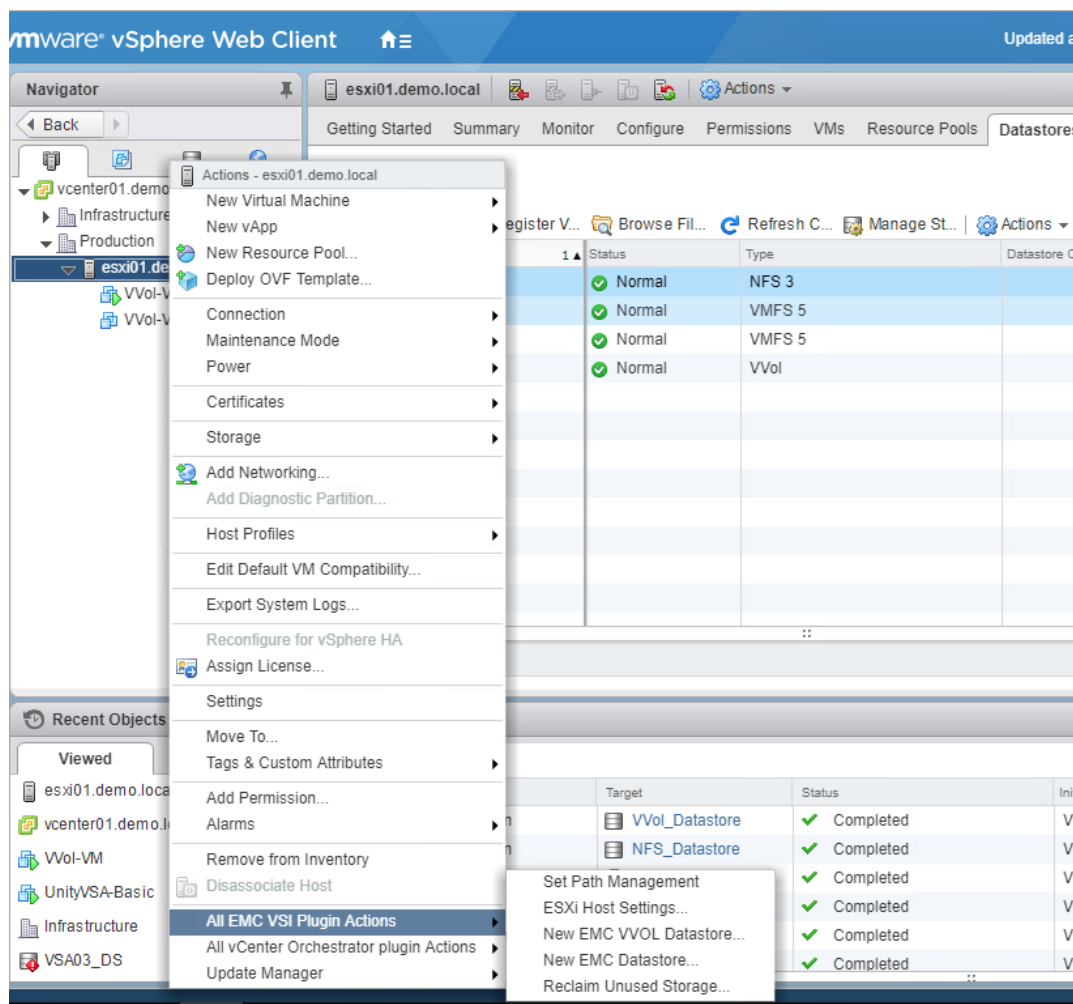


Figure 34 Virtual Storage Integrator menu

VSI also supports other Dell EMC platforms including VNX™, VNXe™, PowerMax/VMAX™, VPLEX™, XtremIO™, AppSync™, and RecoverPoint. For more information on VSI, refer to the *Dell EMC VSI for VMware vSphere Web Client Product Guide* on [Dell EMC Support](#).

## 9 Microsoft SMB3

SMB3 was introduced by Microsoft starting in Windows® 8 and Windows Server® 2012. Dell EMC Unity storage supports SMB1, SMB2, and SMB3.02. Compared to previous versions, SMB3.02 includes enhancements that can be leveraged by Hyper-V such as continuous availability, multichannel, offload copy, protocol encryption, and shared VHDX support. Figure 35 shows the options that can be configured when creating an SMB share. For more information about SMB3, refer to the *Dell EMC Unity: NAS Capabilities* white paper, available on [Dell EMC Support](#).

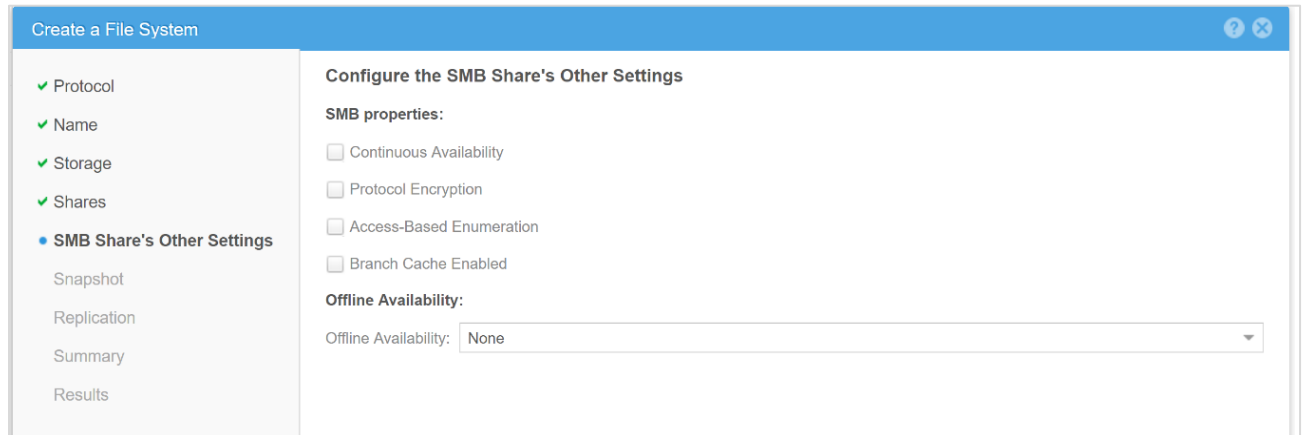


Figure 35 SMB share settings

## 10 Microsoft ODX

Offloaded Data Transfer (ODX), introduced in Microsoft Windows Server® 2012, is designed to offload operations from the Hyper-V host to the Dell EMC Unity storage system. Moving data using traditional methods for tasks such as migrating virtual machines, backing up data, or copying large data files can be a time-consuming and resource-intensive process. By offloading these functions, ODX lowers the Hyper-V server's CPU and network utilization to nearly zero during copy or move operations.

ODX accelerates copy operations using a token-based mechanism for reading and writing data within the Dell EMC Unity system. Since only the small token is transferred between the hosts, all of the actual data movement is accomplished by the Dell EMC Unity system. Once the data movement is complete, the Dell EMC Unity system sends the acknowledgement to the host to confirm the operation is complete. Figure 36 shows how ODX works.

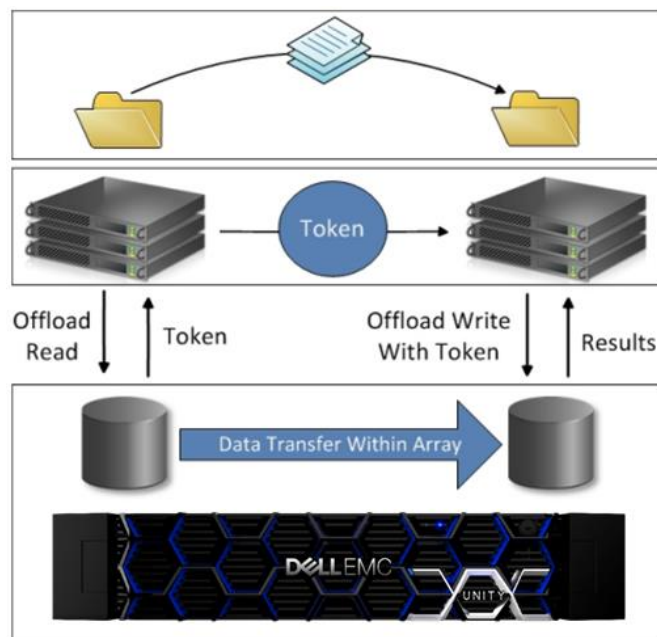


Figure 36 Offloaded data transfer

# 11 SMI-S

There is a strong focus in storage industry towards web-based management and the ability for applications to be able to manage various storage elements generically. The Storage Management Initiative Specification (SMI-S) is an industry-standard API that defines methods for management of a heterogeneous storage environment. Dell EMC Unity storage includes on-array SMI-S 1.6 compliant API that can be leveraged by any application that supports SMI-S. Microsoft has made SMI-S the primary storage management interface for Windows Server 2012, Windows Server 2016, and System Center Virtual Machine Manager (SCVMM), as shown in Figure 37. See the *SMI-S Programmers Guide for Unity* on [Dell EMC Support](#) for more information.

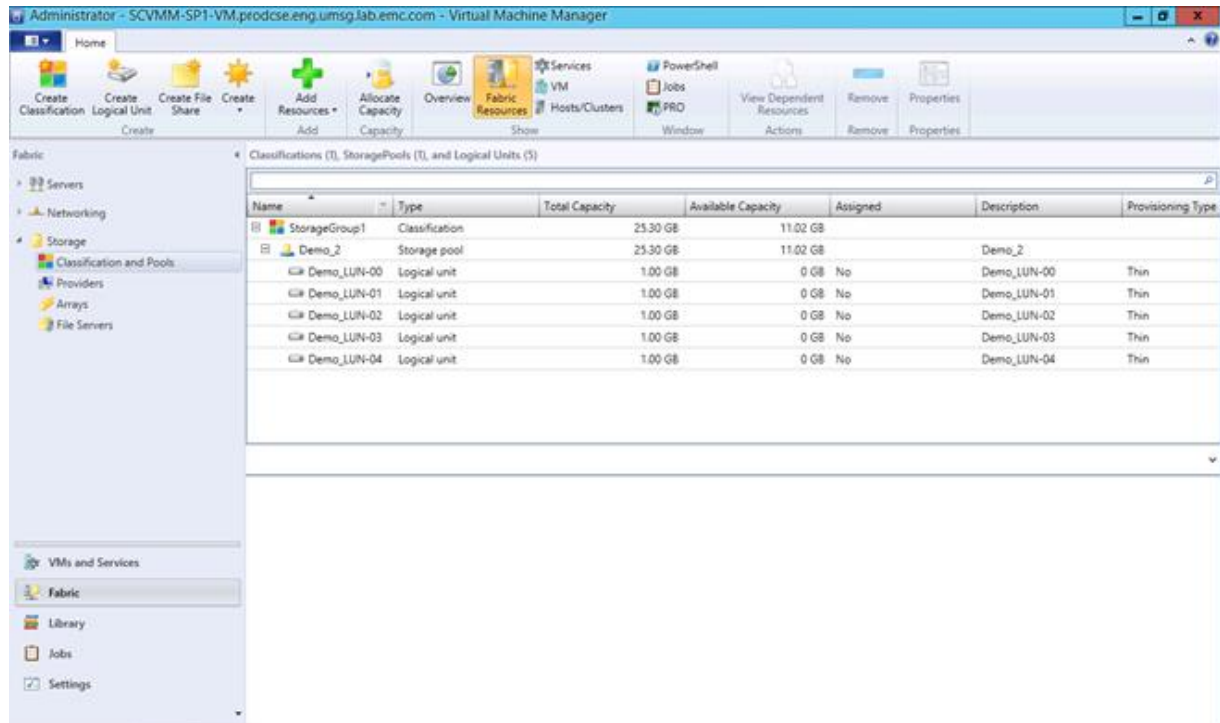


Figure 37 Microsoft SCVMM

## 12 Conclusion

Dell EMC Unity storage includes a comprehensive set of integration points with virtualization technologies, such as VMware vSphere and Microsoft Hyper-V. Many of these powerful integration points are embedded in the system and can be managed using the simple and intuitive HTML5-based Unisphere. In addition to the embedded integration points and features, there are also many additional integration points that are available using off-array tools. This vast collection of features, tools, and products enables Dell EMC Unity systems to fit the requirements of each customer. Both storage and virtualization administrations can leverage the Dell EMC Unity ecosystem to create a simple, modern, flexible, and affordable solution.

## A Technical support and resources

[Dell.com/support](http://Dell.com/support) is focused on meeting customer needs with proven services and support.

[Storage technical documents and videos](#) provide expertise that helps to ensure customer success on Dell EMC storage platforms.

### A.1 Related resources

For additional information, see the following documents on [Dell EMC Support](#):

- Dell EMC Unity: Introduction to the Platform
- Dell EMC Unity: Unisphere Overview
- Dell EMC UnityVSA
- Dell EMC Unity: FAST Technology Overview
- Dell EMC Unity: Snapshots and Thin Clones
- Dell EMC Unity: NAS Capabilities
- Unisphere Command Line Interface User Guide
- SMI-S Programmers Guide for Unity