



High Availability and Veritas Storage Foundation 5.1 for Windows from Symantec

Enhancing storage management and availability in a Hyper-V environment

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Introduction

With the adoption of virtual server environments accelerating, IT organizations are faced with several new challenges, such as ensuring high availability and implementing an effective disaster recovery strategy. These organizations must also take advantage of server virtualization to facilitate the sharing of resources among different operating systems throughout an IT environment while supporting increased utilization and consolidating hardware and storage.

There are several platforms for virtualization available today, such as VMware's ESX, Hyper-V™ in Windows Server® 2008 R2 from Microsoft, and Citrix XenServer. Although many perceive VMware as the leader in virtualization solutions¹, the virtualization space is still in its infancy and growing rapidly. By offering Hyper-V, Microsoft has demonstrated its commitment to providing solutions for virtual server environments.

This paper gives a high-level overview of Veritas Storage Foundation™ 5.1 for Windows® from Symantec™ and explains how it can serve as a central control point for advanced management of storage resources that virtual machines use from the perspective of the Hyper-V parent partition. In addition, this paper will discuss how some of the innovative capabilities in Veritas Storage Foundation 5.1 for Windows provide:

- Advanced path management between parent and storage partitions.
- Full-volume snapshots as a first line of defense to quickly recover from disaster and for off-hosting.
- Replication for a robust, flexible disaster recovery solution.
- Easy migration of running virtual machines to new storage locations.

With these and other features, such as monitoring volume capacity, automatically remedying low storage conditions, securely erasing volumes, and optimizing thick and thin storage environments, the solution provides a key building block for making the data center more robust and efficient.

Microsoft Technologies Used in This Solution

- Hyper-V™
- Windows Server® 2008 R2
- Microsoft® Multipath I/O
- Microsoft System Center Virtual Machine Manager

¹ "Market leader VMware, ... has 75%-plus of the server virtualization market" – [Yankee Group Report, July 2008](#).

Hyper-V

Overview

Hyper-V™, formerly known as Windows Server® Virtualization, is the hypervisor-based virtualization technology in Windows Server 2008 R2 that enables organizations to virtualize multiple operating system instances onto a single physical server. By using Hyper-V, IT organizations can take advantage of a flexible, reliable virtualization platform to better support virtual data centers and increase availability. Hyper-V is also available as a Server Core role running on a full version of Windows Server 2008 R2, where IT administrators can control operations through a management console.

Architecture

Hyper-V separates operating system instances by partitions, which are logical units of isolation that sit on top of the hypervisor, abstracting it so that multiple guest operating systems can share access to the host's hardware.

Each instance of a hypervisor has to have at least one control partition, called the parent (or root) partition, which runs on an instance of Windows Server 2008 R2. The parent partition runs the virtualization stack and has direct access to the hardware devices. From the parent partition, child partitions, which run instances of guest operating systems, can be created via the hypercall API. Child partitions access hardware resources through the parent partition via the virtual machine bus (VMBus), which is a logical channel for communication between partitions.

The Virtualization Service Provider runs in the parent partition, connects to the VMBus, and handles requests from the child partition for device access. Virtual devices in the child partition run the Virtualization Service Client, which redirects requests from the child partition to the Virtualization Service Provider in the parent partition via the VMBus.

For guest operating systems that support it, Hyper-V offers the enlightened I/O feature. This feature enables virtual devices, such as storage and networking subsystems, to take advantage of direct communication with the VMBus, bypassing any device emulation layer and making communication more efficient.

Hyper-V saves each guest operating systems in its entirety to a .vhd file. IT administrators can configure other files with data, such as undo information, to revert to previous states and store application data.

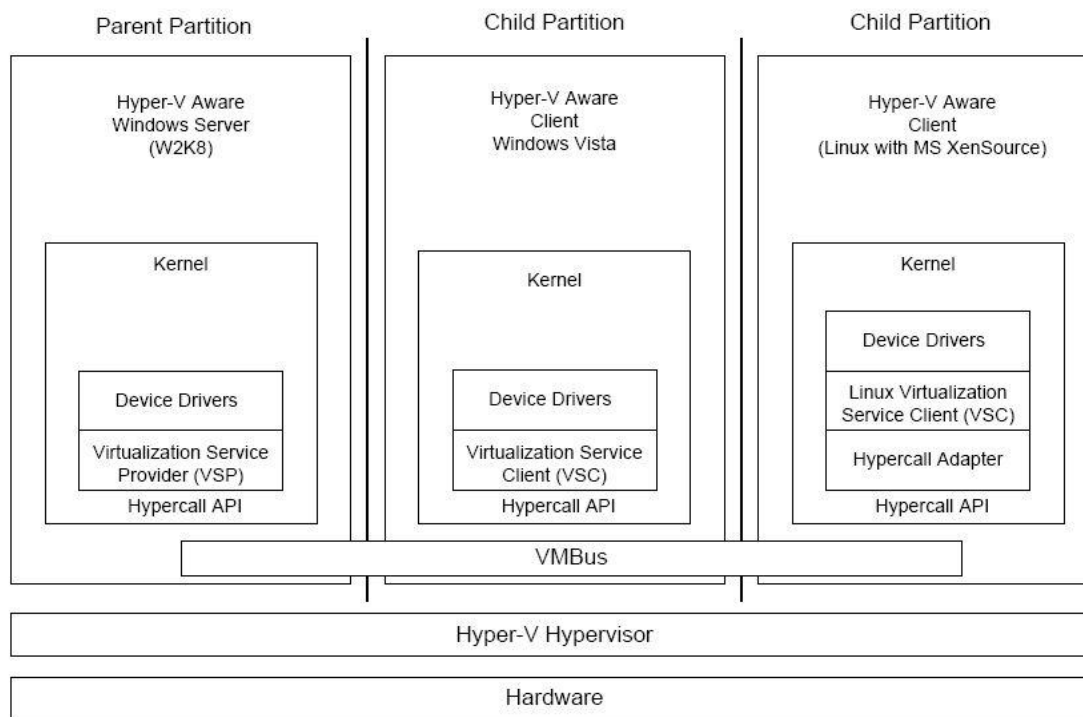


Figure 1. Hyper-V architecture overview.²

Virtual Hard Disks

Virtual hard disks (VHDs) are stored as .vhd files and contain everything—from contents to structure—that is needed to represent a hard disk that Hyper-V uses. VHDs store guest operating systems and their associated programs in a single file. In addition, VHDs that IT organizations use to store data for applications that run in the guest operating system can also be provisioned as individual .vhd files. A .vhd file can be local or located anywhere the host can access them.

Hyper-V supports secure access to files within a VHD without having to interact with a virtual machine. This enhancement enables IT organizations to perform a variety of virtual machine management tasks while offline.

Pass-Through Disks

Pass-through disks let a physical disk or logical unit number (LUN) directly map to a virtual machine. By using pass-through disks, IT administrators can bypass the NTFS file system in the parent partition during disk operations, minimizing CPU overhead and maximizing I/O performance.

Quick Migration

Quick migration takes advantage of failover clustering in Windows Server 2008 R2 and Hyper-V to enable IT organizations to move running virtual machines from one host server to other host servers with minimal downtime. In the event of a physical host server experiencing either scheduled or unscheduled service interruption, another physical server can quickly take over hosting duties for its virtual machines.

² NOTE: See the Glossary at the end of this document for an explanation of acronyms and terms used in Figure 1.

During a planned interruption, quick migration assists with saving the state of a running virtual machine (its memory is saved to a disk on shared storage), moving storage connections to a new physical server, and restoring the virtual machine to the new server. The time it takes to migrate depends on the amount of memory that has to be written to the disk and the speed of the storage connection. With unplanned interruptions, the virtual machine is failed over automatically without its state being saved.

Previous versions of Windows Server didn't recognize virtual machines—just the LUNs on which the VHD files were stored. Therefore, IT administrators were unable to control operations such as shutting down, moving, and restarting those virtual machines. Windows Server 2008 R2 recognizes virtual machines and IT administrators can control them as they are moved from one physical host to another.

Because quick migration requires an underlying cluster, the feature is only supported in Windows Server 2008 Enterprise and Windows Server 2008 Datacenter.

Hyper-V

Hyper-V in Windows Server 2008 R2 adds several new features, including live migration, which facilitates uninterrupted service during relocation of virtual machines, and dynamic virtual machine storage, which supports adding and removing virtual machine storage.

Live Migration

Live migration provides functionality that enables active virtual machines to be moved from one physical, Hyper-V-based host server to another virtual machine within a cluster without any disruption or noticeable loss of service. As noted in the [Windows Server 2008 R2 Hyper-V Live Migration](#) white paper from Microsoft, “Live migration provides the core technology required for dynamic load balancing, virtual machine (VM) placement, high availability for virtualized workloads during physical computer maintenance and reduced data center power consumption.”

Cluster Shared Volumes

IT organizations can configure cluster shared volumes, which were introduced in Windows Server 2008 R2, by using the Hyper-V role to enable multiple nodes to simultaneously access shared LUNs. Cluster shared volumes provide a single, consistent file name space, providing the same name and path from all nodes in the cluster. Drive letter limitations are no longer an issue with cluster shared volumes because each volume can host multiple virtual machines. Cluster shared volumes support live migration of virtual machines.

Dynamic Virtual Machine Storage

With Hyper-V, IT organizations can add VHD files and pass-through disks to a virtual machine while it is running, making it possible to quickly reconfigure virtual machines as they are needed. IT administrators must install Hyper-V Integration Services on the guest operating system for dynamic virtual machine storage to be supported.

Microsoft System Center Virtual Machine Manager

Microsoft® System Center Virtual Machine Manager belongs to Microsoft System Center, a family of system management products. The latest release, System Center Virtual Machine Manager 2008, provides support for consolidating multiple

physical servers onto a virtual infrastructure and enables IT organizations to rapidly provision virtual machines. System Center Virtual Machine Manager provides support for managing virtual machines running on Windows Server 2008 R2 with Hyper-V, Microsoft Hyper-V Server, Microsoft Virtual Server, and VMware ESX. The system management solution also includes virtualization support features, such as Performance and Resource Optimization for dynamic and responsive management of the virtual infrastructure and Intelligent Placement for placing virtual workloads on the most suitable physical host servers.

Central-Point Control with Veritas Storage Foundation 5.1 for Windows

Veritas Storage Foundation™ 5.1 for Windows® from Symantec™ is a host-level volume manager that provides a means to virtualize storage seen by the host it runs on. With this solution, IT organizations gain advanced management capabilities of that storage space and various features and functionality, including multipathing, replication data migration, and snapshots, which further extend the capabilities of Windows Server® 2008 R2. By running Veritas Storage Foundation 5.1 for Windows in the Hyper-V™ parent partition, these features and functionalities extend to virtual machines, offering benefits such as increased flexibility, maximized availability through reduced planned and unplanned downtime, and optimized storage utilization, which would otherwise be unavailable at the guest level.

Veritas Storage Foundation 5.1 for Windows in the Parent

In virtual environments, managing the storage that guests use is a difficult task because, typically, the guest is separated from the physical storage. With Hyper-V, guests are placed on VHD files, which are located on volumes that sit on physical storage. However, guests lack direct access to those volumes or the logical unit numbers that they sit on, making it difficult to effectively manage space requirements on an ongoing basis or to relocate a guest from one storage location to another.

Virtual machines sit on VHD files, which the parent provisions when the parent partition accesses storage. As storage needs change in the child partition, they may require additional space. Veritas Storage Foundation 5.1 for Windows supports dynamic growth of the volumes that host the guest VHDs. Because the virtualization solution supports growth of all volume types, IT organizations can configure the volumes that host the VHD files for performance enhancements via RAID 5, striping, or mirrored stripes. Additionally, in environments that use thin-provisioned storage, organizations can configure Veritas Storage Foundation 5.1 for Windows to automatically grow volumes based on user-defined space thresholds and policies for the amount to grow the volume by and whether that growth should be restricted or unrestricted. By creating small volumes on the thin storage, which will grow automatically when the corresponding growth in the hardware is triggered, it will counter the effects of the uncontrolled growth tendencies of the NTFS file system in a thin environment.

As a host-level volume manager, Veritas Storage Foundation 5.1 for Windows also supports mirroring volumes across arrays and, with its support for dynamic disk operations in a cluster, the creation of stretch clusters.

Setting Up the Environment

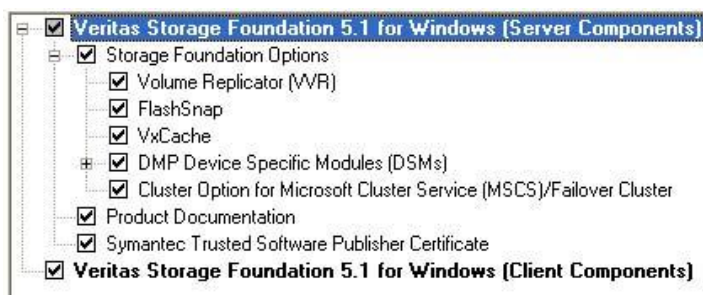
In addition to setting up Hyper-V and creating virtual machines in child partitions to host guest operating systems and applications, additional steps are required to take advantage of Veritas Storage Foundation 5.1 for Windows in the parent partition.

Veritas Storage Foundation 5.1 Service Pack 2 for Windows should be installed in the parent instance of Windows Server 2008 R2. Required options should be selected during the installation.

Installing Veritas Storage Foundation 5.1 for Windows in the Parent

IT administrators can install Veritas Storage Foundation 5.1 for Windows by running Setup.exe and selecting the following options to enable the functionality as described:

- **Cluster Option for Microsoft Cluster Service (MSCS)/Failover Cluster** – Provides dynamic disk support in a cluster.
- **DMP Device Specific Modules (DSMs)** – Lets you select the appropriate arrays from the list for multipathing support.
- **FlashSnap** – Offers snapshot support.
- **Volume Replicator (VVR)** – Provides replication support.



A screenshot of the installation options in Veritas Storage Foundation 5.1 for Windows.

Patches

The following patches should also be installed:

Symantec Patches

- No patches are required if using Veritas Storage Foundation 5.1 SP2 for Windows or later. Symantec recommends using the latest release of Storage Foundation for Windows.

Microsoft Patches

- You cannot configure a Hyper-V virtual machine by using Windows Server 2008 Failover Clustering when the virtual machine uses a storage device that is managed by a third-party clustered file system or a third-party replication solution – support.microsoft.com/default.aspx?scid=kb;EN-US;958065. This patch is not required if using Windows Server 2008 R2.
- Recommended hotfixes for System Center Virtual Machine Manager 2008 – support.microsoft.com/default.aspx?scid=kb;EN-US;962941. No patches are required if using System Center Virtual Machine Manager 2008 R2.

Dynamic Multipathing

Multipathing software provides the intelligence necessary to manage multiple I/O paths between a server and a storage subsystem. This becomes even more important in virtual environments, where a single physical server hosts multiple operating system instances and applications. Loss of access to storage due to a host bus adapter (HBA), cable, or controller failure can cause widespread impact, with potential for greater disruption compared to a similar situation with a single physical system.

Although storage vendors develop most multipathing solutions for their specific brand of storage, solutions such as Veritas Storage Foundation™ 5.1 for Windows® from Symantec™ Dynamic Multipathing (DMP) and Microsoft® Multipath I/O (MPIO) inbox capability offer more wide-ranging support from a single control point, which allows for easier management and increased return-on-investment. The Microsoft solution provides support for heterogeneous environments through its generic device-specific modules (DSMs); MSDSM (Microsoft Device-Specific Module) for Windows Server® 2008 R2; and the iSCSI DSM included with the Microsoft iSCSI Software Initiator for Windows Server 2003. The Veritas Storage Foundation 5.1 for Windows DMP option is also a heterogeneous solution that fully integrates with the MPIO architecture and includes several array-specific DSMs that provide support for a wide variety of the most popular array families from today's leading storage vendors.³

In virtual environments, the hypervisor separates virtual machines from the physical hardware. This makes it difficult to directly map virtual HBAs in the guest system to the physical HBAs that service the physical host, and to therefore have a true multipathing solution when run from a guest system. With Hyper-V, solutions like Veritas Storage Foundation 5.1 for Windows, which runs on Windows Server 2008 R2, can be installed in the parent partition to allow valid multipathing capabilities, providing failover and load balancing to the logical unit numbers that host the virtual machines in the child partition. This capability in Hyper-V provides IT administrators with an advantage over competing solutions by enabling truly advanced multipathing in a virtual environment.

³ The Veritas Storage Foundation 5.1 for Windows hardware compatibility list provides a complete listing of supported arrays.

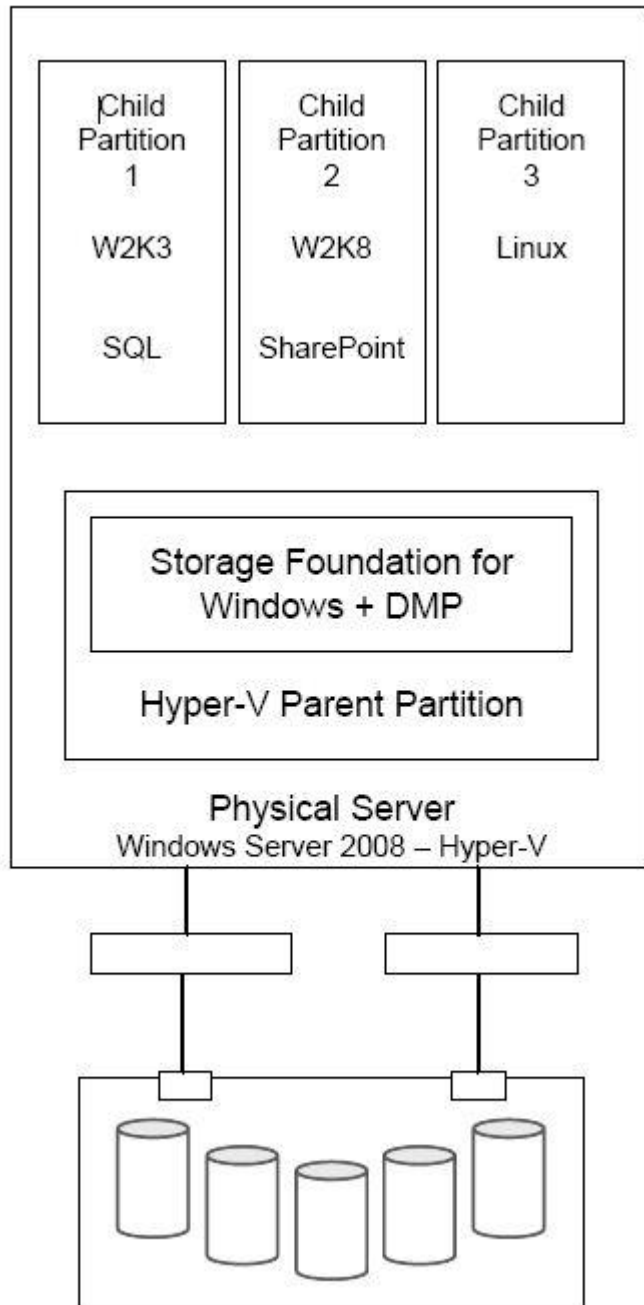


Figure 2. DMP in the Parent Partition.

In Figure 2, the physical server that hosts the parent partition connects to its storage via two paths. DMP in the parent provides path management, load balancing, and fault tolerance for the virtual machines running in child partitions.

Although live migration of virtual machines is not supported with Veritas Storage Foundation 5.1 for Windows because of its dependence on cluster shared volumes, it is supported with DMP when basic disks are used.

Virtual Machine Volume Snapshots

Snapshot technology is available with the FlashSnap option in Veritas Storage Foundation™ 5.1 for Windows® from Symantec™. IT administrators can create snapshot copies of data that is running in the guest system, enabling the organization to quickly recover from a disaster. IT organizations can also use these snapshot copies for off-host operations, which can occur to another virtual machine or to a physical server connected to storage that it shares with the guest system when it uses pass-through disks.

Expanding this concept into the parent partition, the ability to capture a full copy of the volumes that host virtual hard disk (VHD) files provides IT organizations with an effective method to recover entire virtual machines in the event of a disaster. With Veritas Storage Foundation 5.1 for Windows running in the parent partition, administrators can create fully redundant snapshots of the volumes hosting virtual machines and their associated data, enabling them to quickly recover from disaster or to move them to another server for off-host operations, such as backup or testing.

Quick Recovery

Setting up a quick recovery environment for virtual machines is simple with Veritas Storage Foundation 5.1 for Windows and FlashSnap running in the parent partition. Volumes that host the VHD files for the virtual machines can be snapshotted, which creates fully redundant, point-in-time copies that IT organizations can use to recover from a disaster. Veritas Storage Foundation 5.1 for Windows also supports Volume Shadow Copy Service in Windows Server 2008 R2 for creating consistent snapshots.

IT administrators can create snapshots directly from the Veritas Storage Foundation 5.1 for Windows graphical user interface, also known as the Veritas™ Enterprise Administrator, or by using the vxsnap command-line utility. They can also create multiple snapshots simultaneously so that snapshots of interdependent volumes can maintain consistency.

Prior to creating snapshots, administrators need to prepare to create snapshot mirrors of the volumes. This operation only has to be performed once; the snapshot volumes remain attached to and synchronized with the original volumes until a snapshot operation is performed. After a snapshot is completed, the volumes are separated but remain associated with the original volumes so that they can be resynchronized later to either update them or recover from a disaster.

Creating Snapshots from the Veritas Enterprise Administrator

To create snapshots of the VHD volumes, IT administrators should follow these steps:

- 1) Open the **Veritas Enterprise Administrator**.
- 2) Connect to the server that is running in the parent partition.
- 3) Expand **Disk Groups** in the tree view in the left pane.
- 4) Click on the disk group that contains the disks that host the files for the virtual machines to be backed up.
- 5) Select the **Volumes** tab in the right pane.

- 6) Right-click the volume that contains the VHD files, hover over **Snap**, and then select **Snap Shot** from the context menu.
- 7) Click **Next** in the **Snap Shot Volume Wizard**.
- 8) Select additional volumes under **Available Volumes** that should be included in the snapshot set, and then click **Add** to add them to **Selected Volumes**. Click **Next**.
- 9) Modify attributes in the **Change Attributes** screen if desired, and then click **Next**.
- 10) Click **Finish**.

Creating Snapshots by Using vxsnap

IT administrators can use the following command-line syntax to create snapshots with the vxsnap utility:

```
vxsnap -x <Filename> create source=<Volume>
[/DriveLetter=<DriveLetter>][/DrivePath=<DrivePath>]
[/Newvol=<NewVolName>][/Plex=<PlexName>]...[-o]
```

Attributes:	
-x <Filename>	Indicates the name to be assigned to the XML metadata file that will be created with the command. The file name must include the .xml extension.
source=<Volume>	Indicates the source volume for the split-mirror snapshot specified by a drive letter, drive path (mount point), or volume name of the form "\\?\Volume{GUID}\". Repeat this parameter for each volume associated with the specified component.
[/plex=<PlexName>]	Specifies the name of the mirror or plex that is to be detached. Use this parameter if there are multiple snapplexes available to be snapshotted.
[/DriveLetter=<DriveLetter >]	Specifies the drive letter to be assigned to the new snapshot volume.
[/DrivePath=<DrivePath>]	Specifies the drive path to be assigned to the new snapshot volume. The drive path must reference an empty local NTFS folder, which was created beforehand. The path must include the drive letter and folder to be mounted, for example, C:\DB1VOL.
[/Newvol=<NewVolName>]	Specifies the name of the new snapshot volume that is created. If the name is not specified by using this option, the form "SnapVolume01" is created. The full device path becomes "\\Device\HarddiskDmVolumes\ <DiskGroupName>\<NewVolName>".
-o	Allows an existing XML file of the same name to be overwritten. If "-o" is not specified, the vxsnap create command does not overwrite an existing XML file of the same name and the operation fails.

Example:

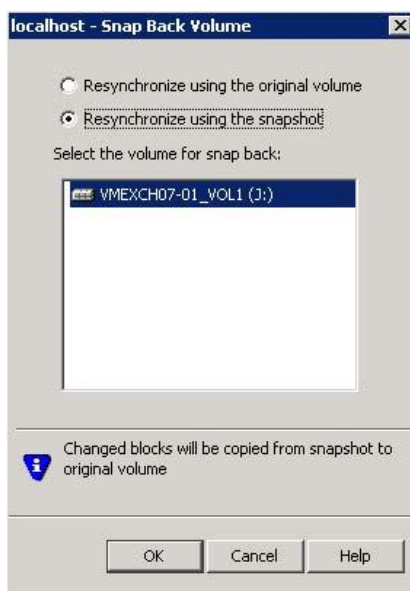
```
vxsnap -x hyperbackup.xml create source=E: /DriveLetter=J source=F: /DriveLetter=K -o
```

The above command will create simultaneous snapshots of the volumes in drives E and F, assigning drives J and K to the respective snapshots. The XML metadata file will be given a name hyperbackup.xml. The -o attribute specifies that existing XML files with that name will be overwritten.

Performing Snapshot Recovery from the Veritas Enterprise Administrator

To perform a snapshot recovery, IT administrators should follow these steps:

- 1) Open the **Veritas Enterprise Administrator**.
- 2) Connect to the server that is running in the parent partition.
- 3) Expand **Disk Groups** in the tree view in the left pane.
- 4) Click on the disk group that contains the snapshot volumes to be used for recovery.
- 5) Select the **Volumes** tab in the right pane.
- 6) Right-click a snapshot volume, hover over **Snap**, and select **Snap Back** from the context menu.
- 7) Select **Resynchronize** by using the snapshot. Click **OK**.
- 8) Click **Yes** to acknowledge the warning that this procedure will overwrite existing data on the original volume. The volumes will resynchronize and the original volume will be recovered with the data from the snapshot.
- 9) Repeat steps 6 through 8 for the other volumes in the snapshot set.



Window in the Veritas Enterprise Administrator program.

Performing Snapshot Recovery by Using vxsnap

IT administrators can use the following command to restore the volumes in a snapshot set:

```
vxsnap -x <Filename> [-f] [-b] restore
```

Attributes:	
-x <Filename>	Indicates the file created by the vxsnap create command. Each snapshot set must have a unique name for the metadata file.
-f	Forces the snapback. Ensure that another application is not using the volume before using this command. Use this option with care.
-b	Resynchronizes the volume in the background. A new snapshot cannot be made until the resynchronization is complete.

Example:

```
vxsnap -x hyperbackup.xml restore
```

The above command will restore the volumes in the snapshot set associated with the XML metadata file hyperbackup.xml.

Additional information on snapshots is available in the [Veritas Storage Foundation 5.1 for Windows Administrator's Guide](#).

Replicating Virtual Machines

Copying data across distances lays a foundation for disaster recovery at the site level. Although there are host-based technologies for replicating data across distances, they are usually expensive and require more storage and the exact same hardware at both ends. The technologies can also be limited in their ability to provide a solution that accounts not only for the data but also for the applications that access it.

Veritas™ Volume Replicator runs at the host level, making it possible to replicate data volumes across distances and to extend disaster recovery without requiring the exact same hardware at both ends and additional storage. This method works well to protect application data in the guest system, enabling the IT organization to recover from a disaster at the remote site.

By installing Veritas Storage Foundation™ 5.1 for Windows® and Veritas Volume Replicator in the parent partition, volumes that contain virtual hard disk files used for virtual machines and/or application data can be selectively replicated to remote sites. IT administrators can perform this operation either synchronously or asynchronously over an IP network. Veritas Volume Replicator uses a storage replicator log to store all writes to the volumes that are grouped together in a replicated volume group in the correct order. Then, Veritas Volume Replicator replicates the volumes to the remote, secondary site, maintaining write-order fidelity and consistency, as seen in Figure 3. The replicated virtual machines remain offline at the secondary site until they need to be brought online, either due to an intentional migration of services from the primary site or an outage at the primary site, requiring the secondary site to take over services.

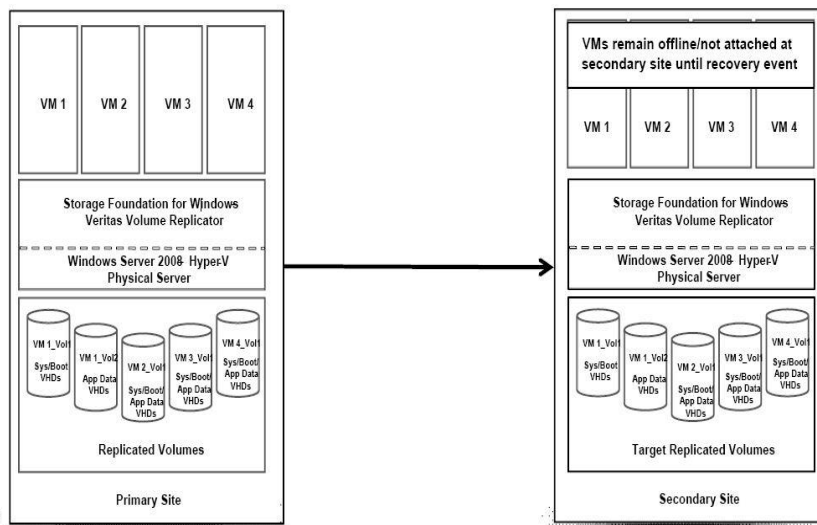


Figure 3. Veritas Volume Replicator parent partition.

Migrating the Primary Role

For planned outages at the primary site—for a maintenance window, for example—IT organizations can migrate the primary role to a secondary site, bringing the virtual machines that have been replicated online and enabling applications that run on them to access data that has also been replicated to the secondary site.

Disaster Recovery Takeover

For unplanned outages at the primary site, IT organizations can move operations to a secondary site via a takeover procedure. This procedure turns the secondary site into an active primary site, enabling virtual machines to be brought online. Depending on the mode of replication, the virtual machines can either be completely up-to-date or behind the previous primary site. In either event, the sites will maintain consistency and applications will be able to successfully attach to their data. IT organizations can migrate the primary site back to the original primary site when it becomes available.

Migrating VMs to New Storage

With its ability to move volumes to new storage locations via the Move Subdisk feature, Veritas Storage Foundation™ 5.1 for Windows® from Symantec™ running in the parent partition enables IT administrators to move virtual machines to new storage locations without needing to take the virtual machine offline. This gives administrators a lot of flexibility when deploying new hardware because they can move virtual machines to a new, higher-performing array or to logical unit numbers (LUNs) that are configured differently for performance reasons.

SmartMove

With the SmartMove feature in Veritas Storage Foundation 5.1 for Windows, the time it takes to complete mirror operations that result in resynchronization of a volume is directly proportional to the amount of space that the file system uses. For example, with a volume that has 50 percent used space and 50 percent free space, operations that would trigger mirror resynchronization, such as adding a mirror or migrating the volume to a new storage location, would take twice as long to complete without SmartMove because both used and free blocks are resynchronized. With SmartMove, only the used blocks are resynchronized, resulting in a proportional reduction in the time it takes to complete the operation.

SmartMove functionality is based in its interaction with the NTFS to identify which portions of the volume it's using and synchronizes only those used blocks, resulting in improved performance for operations that take advantage of mirror functionality. As volumes become larger, this feature becomes more beneficial.

Drag and Drop

With Veritas Storage Foundation 5.1 for Windows, IT administrators can easily relocate volumes by using the graphical user interface to perform a drag-and-drop operation on volume subdisks from one storage location, such as a LUN or disk, to another while the volume remains online and accessible. The process uses mirror functionality in Veritas Storage Foundation 5.1 for Windows to create a mirror of the volume subdisk at the new location. After resynchronization completes, it removes the mirror plex at the original location, leaving the plex at the new location as a stand-alone volume subdisk.

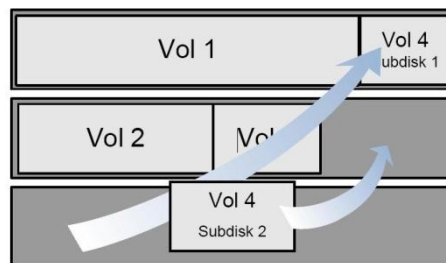
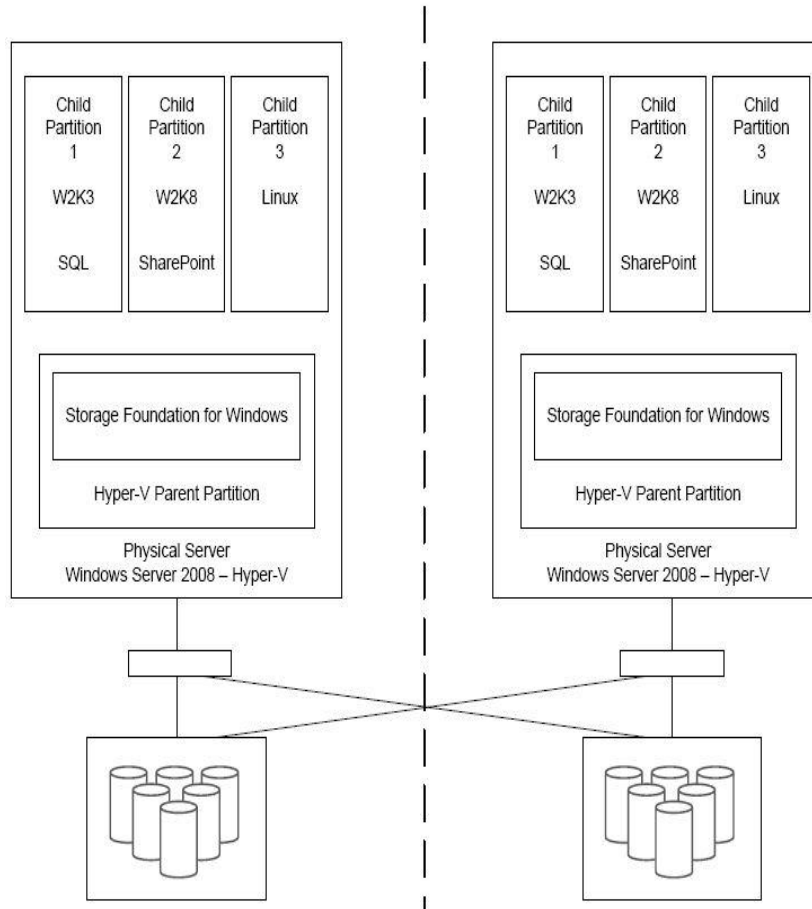


Figure 4. Architecture for moving subdisks.

In the Figure 4, the Move Subdisk feature is used to move the subdisks onto free space on the other two disks while the volume remains online and accessible.

Stretch Clusters

Another advantage of using a host-based volume manager such as Veritas Storage Foundation™ 5.1 for Windows® is the ability to mirror volumes across arrays. This enables clusters that rely on shared storage to be stretched beyond the confines of a single data center to a remote, secondary site, as long as the distance between the two data centers doesn't exceed Fibre Channel latency limitations. These stretch clusters, also known as campus clusters, provide a level of high availability that can withstand a complete site failure.



Parent partition stretch cluster.

With Veritas Storage Foundation 5.1 for Windows running in the parent partition, the solution can facilitate stretching of the failover cluster to another site by providing support for dynamic disks through its Volume Manager Disk Group cluster resource. With dynamic disks now available in the cluster, volumes can be mirrored across arrays that are located in different data centers and are seen and shared by cluster nodes that are located in those respective data centers. If the active, primary site experiences a failure, virtual machines that were running at that site can be failed over to the cluster node at the other data center and applications running on the virtual machines can be brought back online.

Summary

The complexities of managing storage in virtual environments built on hypervisors that limit hardware resources for the guest systems is a factor that businesses should consider when moving to server virtualization. By supporting Veritas Storage Foundation™ 5.1 for Windows® in the parent partition, Hyper-V™ demonstrates its advantages of competing virtualization solutions when it comes to providing protection for the virtual machines that run in its child partition. With features such as multipathing with Dynamic Multipathing, quick recovery with FlashSnap, site-to-site replication of virtual machines with Veritas™ Volume Replicator, and dynamic disk support in failover clustering, Hyper-V is a robust virtualization solution that can help IT organizations take advantage of their virtualized environment.

Glossary

- **Child partition** – Guest operating systems are run in the child partition. Child partitions communicate with physical resources via the virtual machine bus (VMBus) or the hypervisor. The parent partition creates the child partition.
- **Hypercall** – The guest systems communicate with the hypervisor through the hypercall interface to request actions or information. The hypercall interface accommodates access to the optimizations that the hypervisor provides.
- **Hypervisor** – A hypervisor is a software layer that sits directly on top of the hardware layer and abstracts it so that multiple guest operating systems above can share access to the host's hardware. In Hyper-V™, it isolates environments into partitions and controls access to the underlying hardware.
- **Integration component** – The integration component is a function that enables child partitions to communication with other partitions and the hypervisor. Integration components include Time Synchronization, Heartbeat, Shutdown, Key/Value Pair Exchange, and Volume Shadow Copy Service.
- **Integration services** – Integration services are installed in child partitions that run supported guest operating systems. They communicate with virtual devices in the parent partition and provide support for components that require a secure interface between parent and child partitions.
- **I/O stack** – The I/O stack facilitates communication between machines.
- **Parent partition** – Also known as the root partition, the root partition manages functions, such as device drivers, power management, and the addition and removal of devices at the host level. The root is the only partition that has direct access to physical memory and devices at the host.
- **VMBus** – Installed with Hyper-V Integration Services, the VMBus is used for communication between partitions and enumerating devices on systems that have multiple partitions.
- **Virtualization Service Provider** – The Virtualization Service Provider runs in the parent partition and connects to the VMBus to handle requests for device access from child partitions.
- **Virtualization Service Client** – The Virtualization Service Client resides in a child partition and uses hardware resources that the Virtualization Service Provider supplies in the parent partition to satisfy a child partition's I/O requests. Communication takes place over the VMBus.

Resources

- Microsoft – microsoft.com
- Microsoft Technet – technet.microsoft.com
- Hyper-V™ Architecture – msdn.microsoft.com/en-us/library/cc768520.aspx
- Microsoft® System Center Virtual Machine Manager 2008 datasheet – download.microsoft.com/download/6/6/3/663a417a-d9b5-444e-ae8d-4c6a3f0c67ba/SCVMM08_Data_Sheet_updated_082708.pdf
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