Implementing Hyper-V

PowerVault MD3000i and MD3000 Storage Arrays

www.dell.com/MD3000

www.dell.com/MD3000i

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Implementing Hyper-V on the MD3000 Storage Array and the MD3000i Storage Array

This document provides information about implementing Microsoft Hyper-V technology with the Dell PowerVault MD3000 / MD3000i storage arrays.

Hyper-V provides the software infrastructure and management tools in Windows Server 2008 to create and manage a virtualized server computing environment. The configuration in this document uses Windows 2008 Server Release 2 with the following enhancements to Hyper-V:

- **Live Migration** – A transparent move of virtual machines from one cluster-node to another with no loss of virtual machine connectivity between nodes. Live Migration uses Clustered Shared Volumes (CSV).

- **Dynamic Virtual Machine Storage** – Support for hot plug-in and hot removal of storage

- **Enhanced Processor Support** – Up to 32 physical cores

- **Enhanced Networking Support** – Support for jumbo frames on virtual machines

For information about planning the implementation of Hyper-V, refer to *Planning for Hyper-V on the DELL PowerVault MD3000 / MD3000i*. For information about Backup and Recovery options, refer to *Data Protection on the DELL PowerVault MD3000 / MD3000i in a Hyper-V Environment*.

This document is intended to provide useful information for system administrators and IT planners or designers who are implementing Hyper-V in their environment.

Disclaimer

The steps in this document were performed on a test setup. There was no live data involved. This document implies no warranties. These instructions are not guaranteed to work in every situation. For the latest information about Dell IP San storage arrays, refer to the Dell storage array installation guides. Go to:

http://www.dell.com

Supported Hardware and Software

Microsoft Hyper-V requires specific hardware. Refer to the Microsoft Windows Server catalog for Hyper-V to find out if your systems qualify.

http://go.microsoft.com/fwlink/?LinkId=111228

You also can check the DELL supported hardware for Microsoft Hyper-V contained in the *Dell Solutions Overview Guide for Microsoft Hyper-V*.

http://support.dell.com/support/edocs/software/HyperV/en

If you need additional information, go to the following website.

http://www.dell.com/hyperv

Both the MD3000 and MD3000i storage arrays are supported with Microsoft Windows Server 2008 Release 2 running the Hyper-V role.

Pre-Installation Requirements

You must have the following hardware and software installed and set up to use Hyper-V on an MD3000 / MD3000i storage array.

Hardware Requirements

To install and use the Hyper-V role make sure that you have the following processing features on your system:

- A x64-based processor

    - Hyper-V is not available for 32-bit systems or Itanium-based systems.

    - The AMD utility for Hyper-V compatibility can be downloaded from the following website:

        http://support.amd.com/us/Processor_TechDownloads/AMD-V_Hyper-V_Compatibility_Check_Utility.zip

- Hardware-assisted virtualization

    - Processors with Intel Virtualization Technology (Intel VT)

    - AMD Virtualization Technology (AMD-V)

- Hardware-enforced data execution prevention (DEP) must be available and enabled.

  - The Intel XD bit must be enabled (execution disable bit).

  - The AMD NX bit must be enabled (no execute bit).

Software and Configuration Requirements

Install the updates that you need. To receive a current list of all of the updates, go to:

http://technet.microsoft.com/en-us/library/dd430893.aspx

Figure 1 shows how a Microsoft Hyper-V environment can be configured with a MD3000.

Figure 1 DELL PowerVault MD3000 (Direct Attach)
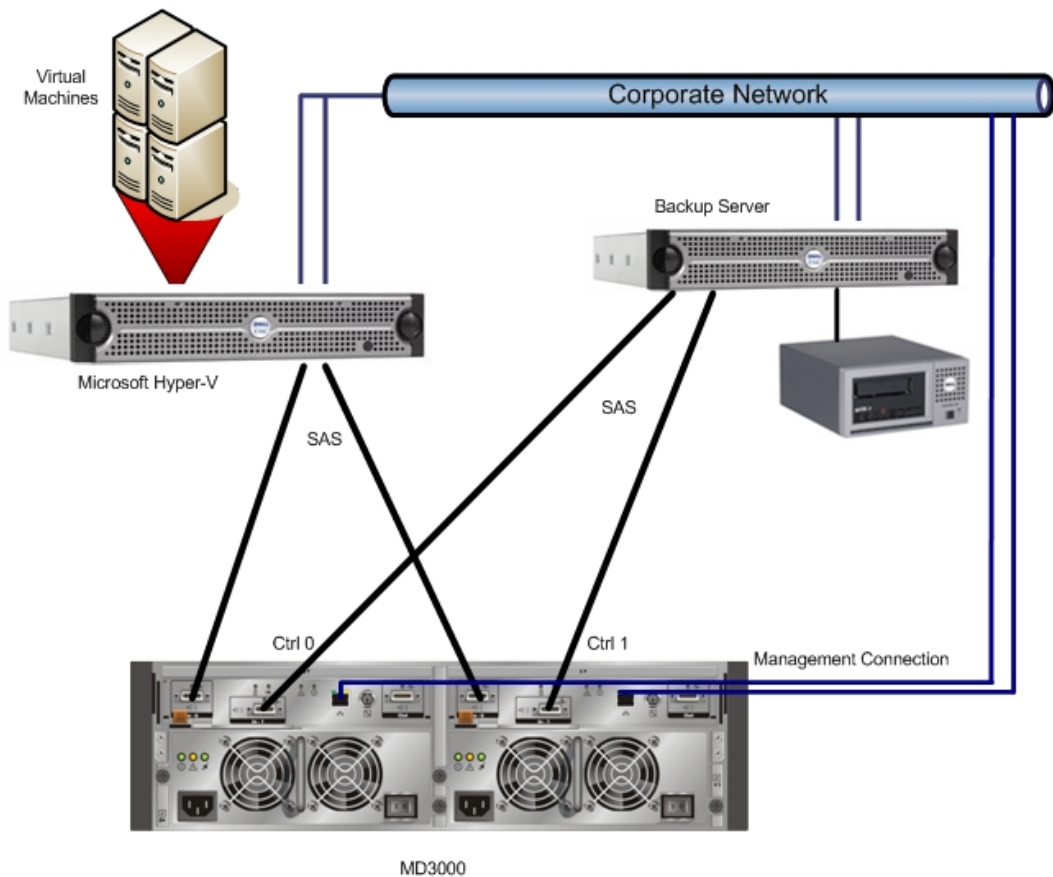
Note:	It is best to install two dual-ported HBAs and use a port from each one to improve availability. With this configuration either a cable or a SAS HBA can fail and the access to the data is still guaranteed.

For more information about the MD3000 storage array, go to:

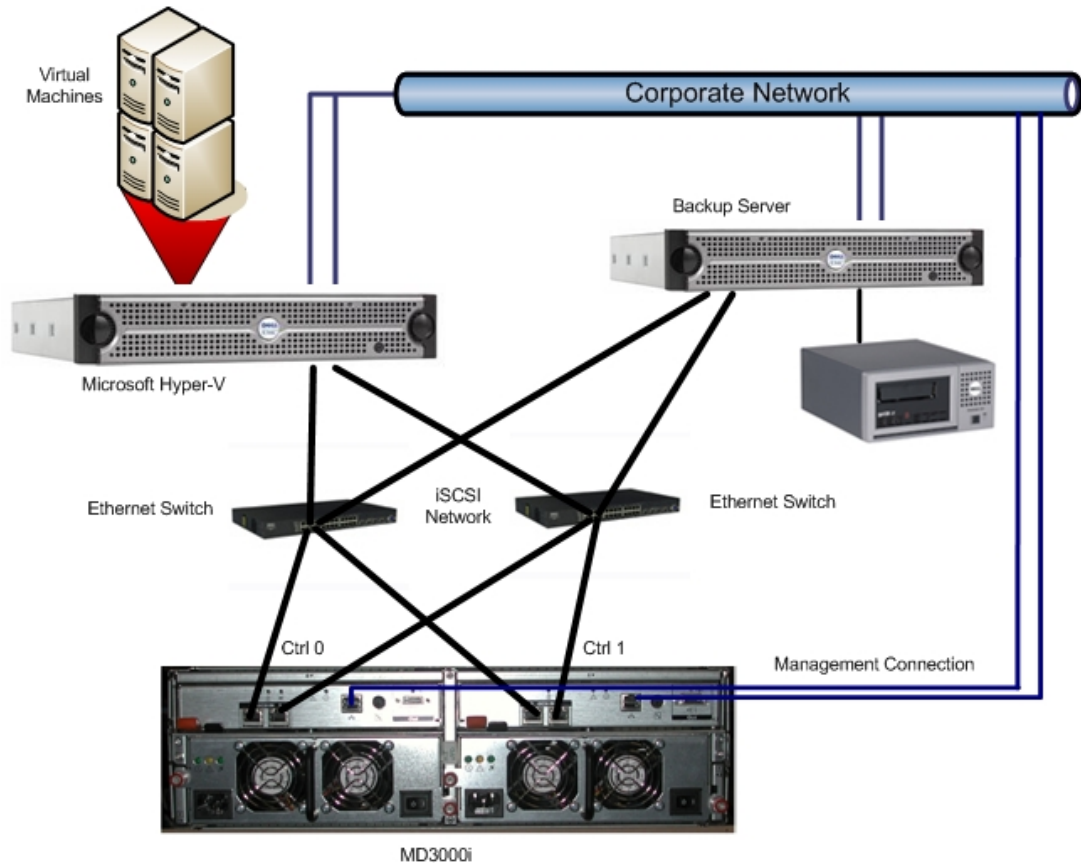http://www.dell.com/content/products/productdetails.aspx/pvaul_md3000?c=us&cs=555&l=en&s=biz&dgc=IR&cid=14054&lid=407200

Figure 12 demonstrates how a Microsoft Hyper-V environment can be configured with a MD3000i.

Figure 2 DELL PowerVault MD3000i (IP-SAN)

**For the iSCSI-based MD3000i storage array, you must have two NICs for I/O communication to occur between the storage array and each server. It is best practice to set up the management ports (Out-of-Band) for managing the MD3000i as they will be required for the initial configuration. For best performance when planning the network connection to the MD3000i storage array, make sure that the cabling looks similar to**

Figure 3.

Figure 3 MD3000i Network Configuration
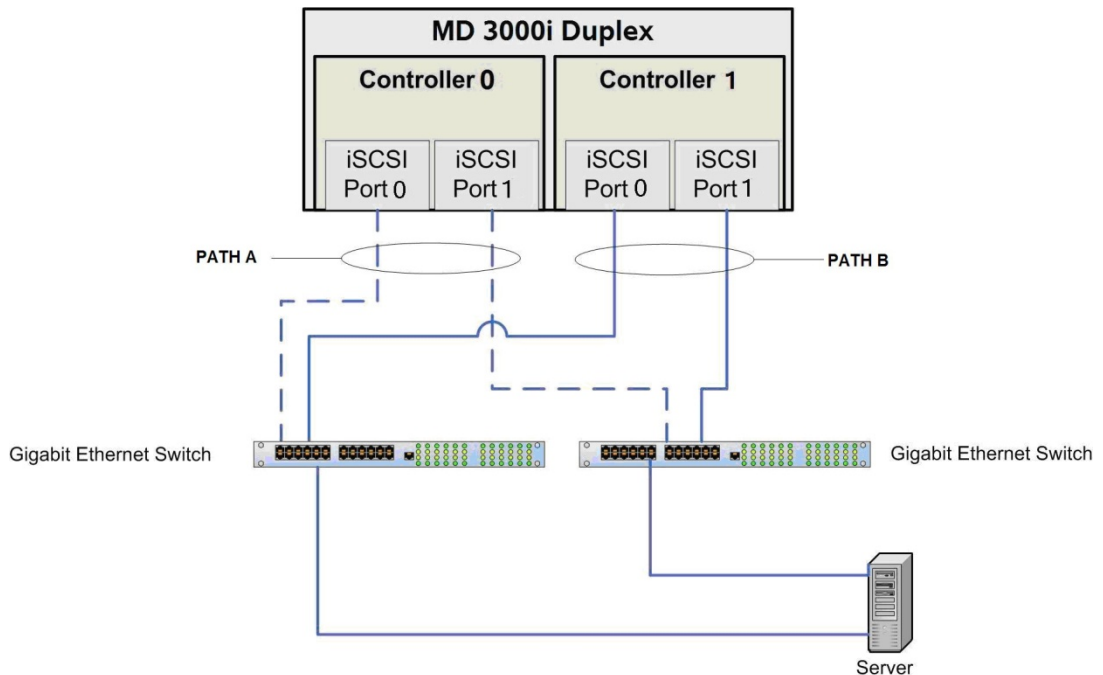
The Module Disk Storage Manager comes with the device specific module (DSM) for Microsoft multi-path I/O (MPIO). MPIO provides load balancing between the two ports of one RAID controller module. For best performance, make sure that load balancing is enabled and active. Load balancing allows you to use up to 2Gb/s for each virtual disk on the MD3000i storage array.

You can choose one of these load balance policies to optimize I/O performance:

Round Robin with Subset
The round-robin, with subset I/O load balance policy, routes I/O requests in rotation, to each available data path to the RAID controller module that owns the virtual disks. This policy treats all paths to the RAID controller module that owns the virtual disk equally for I/O activity. Paths to the secondary RAID controller module are ignored until ownership changes. The basic assumption for the round-robin policy is that the data paths are equal. With mixed host support, the data paths might have different bandwidths or different data transfer speeds.

Least Queue Depth with Subset

The least queue depth with subset policy is also known as the least I/Os, or least requests, policy. This policy routes the next I/O request to a data path that has the least outstanding I/O requests queued. For this policy, an I/O request is simply a command in the queue. This type of command, or the number of blocks that are associated with the command, are not considered. The least queue depth with subset policy treats large block requests and small block requests equally. The data path selected is in the path group of the RAID controller module that owns the virtual disk**.**

Least Path Weight with Subset
The least path weight with subset policy assigns a weight factor to each data path to a virtual disk. An I/O request is routed to the path with the lowest weight value to the RAID controller module that owns the virtual disk. If more than one data path to the virtual disk has the same weight value, the round-robin with subset path selection policy is used to route I/O requests between paths with the same weight value.

Changing the Load Balance Policy Using the Windows 2008 Disk Management Options
From the desktop of the host, right-click the **My Computer** icon and select Manage to open the Computer Management dialog. Click **Disk Management** to show the list of virtual disks are attached to the host. Right-click the virtual disk on which you want to set the load balance policy, then click **Properties**. From the MPIO tab, select the load balance policy that you want to set for this virtual disk.

For more Information about the MD3000i storage array, go to:

http://www.dell.com/content/products/productdetails.aspx/pvaul_md3000i?c=us&cs=555&l=en&s=biz&dgc=IR&cid=14054&lid=407200

For more information about how to plan for an IP-SAN network with the MD3000i storage array, refer to the *IP-SAN-Best-Practices* at:

http://www.dell.com/downloads/global/solutions/public/white_papers/IP-SAN-BestPractice-WP.pdf

Enabling the Hyper-V Role on the Parent Server

After you have installed the Windows 2008 Release 2 servers, you can enable the Hyper-V Role on those servers.

1. Go to **Computer Management**, expand the role section on the left hand pane and click **Add Roles** in the middle pane.

2. Follow the instructions in the Add Roles wizard.

Table 1 Add Roles Wizard

Page	Action
Server Manager	1. Select the Hyper-V Role. 2. Click **Next**.
Virtual Networks	3. Specify which network connections you want to use for Virtual Machine (VM) network traffic. 4. Click **Next**.
Confirm Installation Selections	5. Verify your selections. 6. Click **Install**.
Installation Results	7. Click **Close**.

Note It is best to have dedicated network connections for the VMs.

After you restart the server, you can create virtual machines.

Considerations for the Virtual Storage

Multiple ways exist to assign physical storage to a virtual machine. For an out-of-band MD3000 /MD3000i storage array, you have these options:

- Assign the virtual disk to the parent server and create a file system and a virtual hard drive (VHD) for the virtual machine.

- Assign an unformatted, pass-through physical disk directly to the virtual machine.

With the MD3000i storage array, in addition to the previously mentioned options, you have a third option. You can assign a physical disk directly to the virtual machine by installing the iSCSI software initiator on the virtual machine similar to as you would on a physical server.

Figure 4 Virtual Storage Configuration
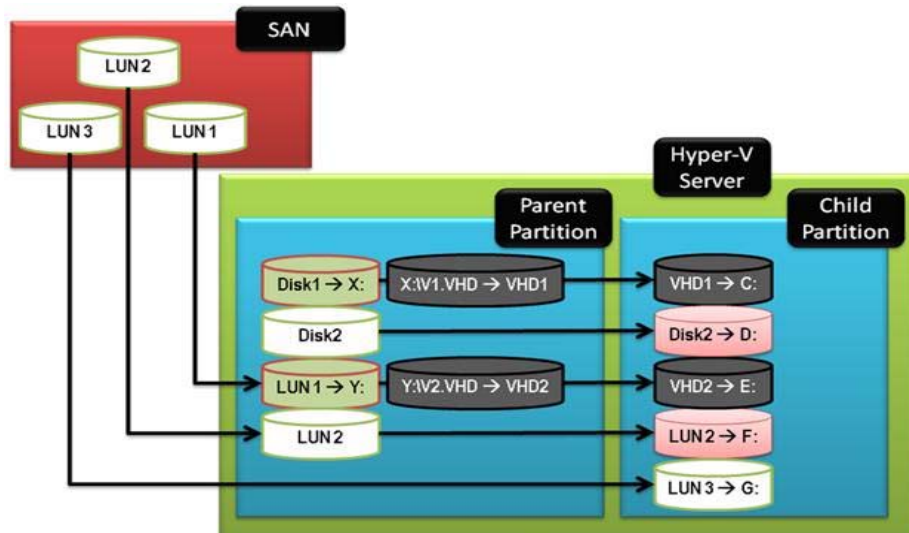
Size each LUN to support the target VHD. To avoid warning messages generated by the parent partition regarding the physical disk running out of capacity, allocate an additional 200 MB to the LUN. Leave this additional 200 MB as empty space on the virtual disk.

Considerations When Using Pass-through Physical Disks or Virtual Hard Drives

Keep in mind the following considerations when using pass-through physical disks or VHDs:

- Pass-through physical disks offer slightly higher performance than VHD devices and support virtual disk sizes greater than 2 TB. However, pass-through physical disks do not support VSS-based backup or checkpoints. VSS-based backup with hardware providers works as long as the backup is initiated from the parent. Inside the virtual machine, only software-based VSS backup is supported.

- VHDs support the ability to export the drive to another parent server.

- VHDs support Virtual Machine (VM) checkpoints.

- Both VHDs and pass-through physical disks can be utilized in clustered environments.

- If you are booting from a pass-through physical disk, store the VM files in a different location.

- For each virtual machine, create a separate pass-through physical disk. You cannot share a pass-through physical disk for two virtual machines.

- The physical layout of the pass-through physical disk is the same as for any physical server.

Note: For the highest performance, use pass-through physical disks, but only as data devices. If you need optimal flexibility, assign fixed size VHDs.

For more information about how to maximize performance for different applications on the DELL Powervault MD3000 / MD3000i storage arrays, go to:

http://www.dell.com/downloads/global/products/pvaul/en/pvault_md3000_whitepaper.pdf

Note: The configuration of your physical disk layout for performance on the DELL PowerVault MD3000 / MD3000i storage array depends on the application requirements of your virtual machine (child partition), not on the Hyper-V parent server.

Directly-Mapped iSCSI Virtual Disks to the Virtual Machine (MD3000i)

You can easily transfer the virtual disk from a physical server to the virtual machine. However, it is important to note that transferring the virtual disk reduces the number of hosts connected to the MD3000i storage array. Each virtual machine uses exactly one host partition. VSS-based backup from the parent does not include the directly mapped iSCSI LUNs of the child partition. Booting also is not possible unless you use third-party software. The MD3000i storage array only requires a software initiator. The iSCSI HBA is not supported with the MD3000i storage array. Only software initiators are supported with the MD3000i storage array.

Note: You can use direct mapping for data devices that were originally used on a physical server or for data devices that you want to move back to a physical server.

Setting Up Virtual Machines with Virtual Hard Drives

First, confirm that the Dell PowerVault MD3000 /MD3000i storage array is correctly installed and configured. For information about installing and configuring the storage array, refer to the following documents:
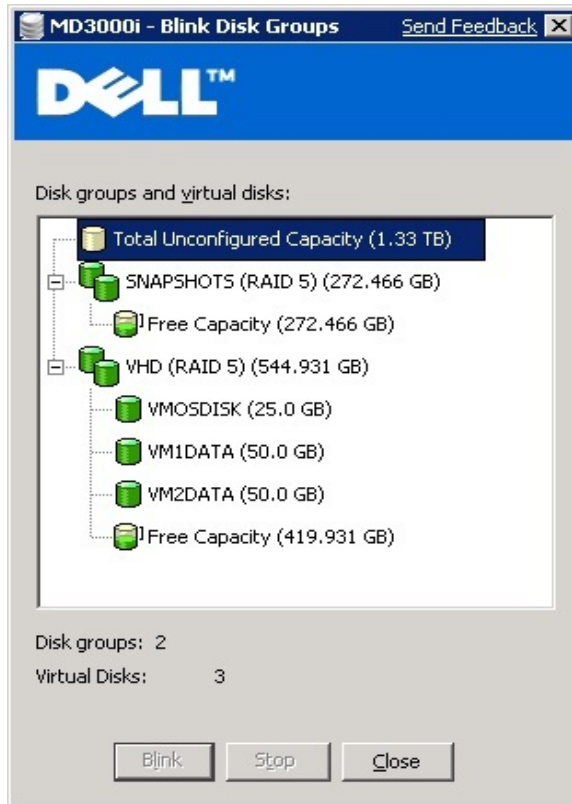
http://support.dell.com/support/edocs/systems/md3000/en/UG/HTML/iscsi.htm

1. Create virtual disks on the MD3000 / MD3000i storage array for use as VHDs.

    In the example, one virtual disk was created for the OS drivers and two data virtual disks were created for user data on the VMs.

Figure 5 Example of Virtual Disks Created

Note	If you plan to use VSS-based snapshots for backup purposes, it is best to create a blank, empty Virtual Disk Group for the snapshot repositories. This process requires second generation firmware. Creating a blank and empty Virtual Disk Group improves performance, because the Snapshot access is separate from other data access.

2. Map the newly created virtual disks to the Hyper-V Parent Server.

3. Go to Computer Management and select **Disk Management** under the Storage section in the left pane.

4. Right-click all of the new drives and select the **Online** option.

5. Initialize all of the new drives.

6. Create the partitions and format the new drives.

> For easy reference, name the test drives in Windows with the same names as they were given in the MD Storage Manager.

7. Start setting up the first virtual machine. To perform this task, go back to the **Roles** option and select the **Hyper-V Role**.

8. Click the right pane and select **New** to start the Virtual Machine wizard.

Table 2 Virtual Machine Wizard

Page	Action
Specify Name and Location	1. Enter a name for the new virtual machine. 2. Make sure that you select the **Store Virtual Machine in a Different Location** checkbox to save the virtual machine configuration data on the drive that was created on the MD3000 / MD3000i storage array (called VMOSDISK in the test example). 3. Enter the location where you want the virtual machine to reside. 4. Click **Next**.
Assign Memory	5. Enter the amount of memory to allocate to the virtual machine. 6. Click **Next**.
Configure Networking	7. Select the type of network connection you want to use for the virtual machine. 8. Click **Next**.
Connect Virtual Hard Disk	9. You can create a new virtual hard disk, use an existing hard disk, or attach a virtual hard disk later. • If you want to create a virtual hard disk, select **Create a virtual hard disk**, and enter the name, location, and size. • If you want to select an existing virtual hard disk, select **Use an existing virtual hard disk**, and then enter the location. In the example, VMOSDISK (E:\) was selected and placed in the Windows2003 folder.

	10. If you do not want to attach a virtual hard disk right now, select **Attach a Virtual Hard Disk Later**. *11.* Click **Next**.
Installation Options	*12.* Install an operating system on the virtual hard disk. You can install the operating system from the following sources: • A physical CD/DVD drive • An image (.iso) file • A boot floppy disk • A network-based installation server *13.* Click **Finish**.
An ISO image of an OS CD is easy to use to install the operating system of the virtual machine.	

10. After creating the virtual machine, change the settings of the virtual machine to add a physical disk to the virtual machine.

In the example, the VM1DATA physical disk was added to the VM Windows2003.

Table 3 Windows Server Settings Wizard

Page	Action
Settings for Windows2003 – IDE Controller	*1.* In the settings for your virtual machine, select the IDE Controller where you want to add the physical disk. *2.* You also can create a new SCSI controller and attach the physical disk to the SCSI controller. However, because everything is virtual, there is no performance difference between the IDE and SCSI controller. The SCSI controller contains the advantage that you can attach more physical disks if needed. The IDE controller is limited to two physical disks per controller. The boot disk must be IDE. *3.* Click **Add**.
New Virtual Hard Disk Wizard –	*4.* In the New Virtual Hard Disk dialog box,

Choose Disk Type	select the options for VHD. • **Dynamic expansion** – The VHD file grows as data is stored to the physical disk with a maximum size not exceeding the size specified during creation. Select **Dynamically Expanding** when creating a new virtual machine using the new virtual machine wizard in Hyper-V Manager. • **Fixed size** – The VHD file uses the full amount of space specified during creation. • **Differencing** – The VHD file exists as a child disk in a parent/child relationship with an existing VHD. The parent VHD is left intact and changes that occur are stored on the child (differencing) VHD 5. Click **Next**.
Note:	For the best performance in production environments, use fixed size VHDs because it eliminates the overhead created by expanding the VHD in a normal production environment.
Specify Name and Location	6. Specify the name and the location of the new physical disk. 7. Click **Next**.
In the example, the VM1DATA disk formatted as drive F:\ was used.	
Configure Disk	8. Create a new blank virtual disk. 9. If you have data stored on a different physical disk and you want to make the data available to your virtual disk, select the appropriate physical disk. Hyper-V converts the disk into a VHD. 10. Click **Finish**.

After finishing this wizard, you can view the new physical disk in the settings window.

Figure 6 Settings for New Physical Disk
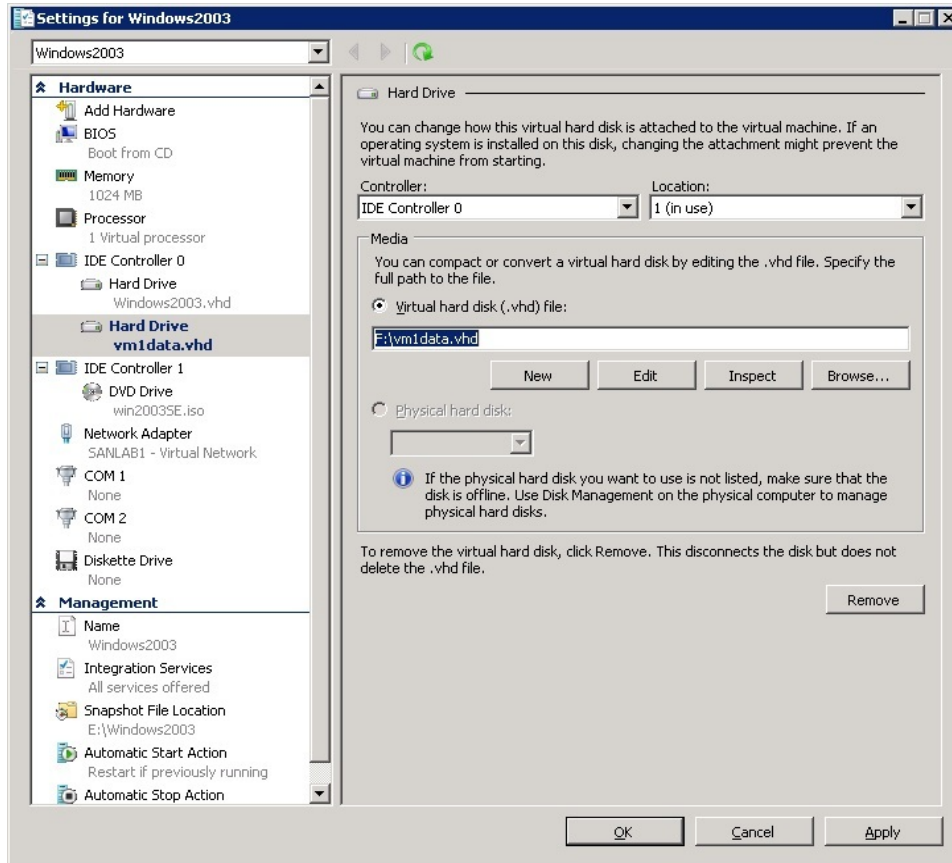
Your virtual machine is ready to use. You can install the operating system. If you need to attach more VHDs, repeat the above procedure.

Setting Up Virtual Machines with Pass-through Devices

This section describes how to set up virtual machines with pass-through devices. You can add a pass-through device to an existing virtual machine or create a new virtual machine using pass-through devices only.

Adding a Pass-through Device to an Existing Virtual Machine

1. Create virtual disks for recently defined VMs on the MD3000 / MD3000i storage array.

2. Map the virtual disk to the virtual machine.

In the example, the VM1PASSTHROUGH virtual disk was mapped to the Windows2003 VM.

3. View these disks in the Windows Disk Management window to make sure that they are in the offline state.

4. Attach the virtual disk to the VM as a SCSI device. Go into the VM settings and add a SCSI controller by clicking **Add Hardware** in the left pane of the Settings window for your virtual machine.

5. Select the SCSI controller in the left pane and click **Add Hard Drive**.

6. Select the **Hard Drive** option and associate it with a LUN. In the example, LUN 3 was associated with Windows2003 VM.

7. Click **OK**. The Pass-through device is ready to use.

Creating a New Virtual Machine Using Pass-through Disks Only

This section shows you how to create a VM using pass-through disks only. You can boot from a pass-through device, but you need a regular virtual disk on which to store the configuration data for the virtual machine. In the example, three virtual disks were created on the MD3000 / MD3000i storage array.

Figure 7 shows a boot disk for the operating system of the VM, a data disk, and a 1GB disk for the VM's configuration.

Figure 7 Blink Disk Groups of Example Virtual Machine
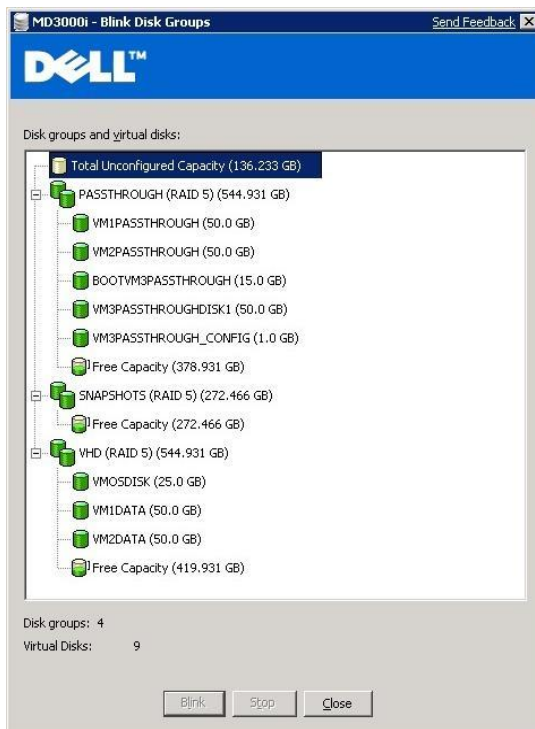
1. Map the BOOTVM3PASSTHROUGH, VMPASSTHROUGHDISK1, and the VMPASSTHROUGH_CONFIG to the host.

2. Create a partition on the 1GB VM3PASSTHROUGH_CONFIG and format it with a file system.

   The other two disks remain offline.

3. Using the New Virtual Machine Wizard, go to the Hyper-V configuration and create a new virtual machine.

Table 4 New Virtual Machine Wizard

Page	Action
Specify Name and Location	1. Enter a name for the new virtual machine. 2. Select **Store the virtual machine in a different location**. 3. Select a location for the virtual machine. 4. Click **Next**.
Configure Networking	5. Associate the VM configuration with the newly-created drive H:\. 6. Click Next.
Assign Memory	7. Assign memory and networking. 8. Click **Next**.
Connect Virtual Hard Disk	9. When the wizard asks you which physical disk you want to attach, select the **Attach Virtual Hard Drive Later** option. 10. Click **Finish**.

4. Go to the settings of the newly created VM.

5. Select the IDE controller and add a physical disk. The boot disk must be attached to the IDE Controller.

6. Associate the physical disk with the BOOTVM3PASSTHROUGH disk.

7. Add the data disk as a SCSI controller device. Select **Add Hardware**.

8. Add the SCSI controller and the `VM3DATAPASSTHROUGH` disk as the physical disk for this controller.

Figure 8 Settings for Win2003_PT_Boot
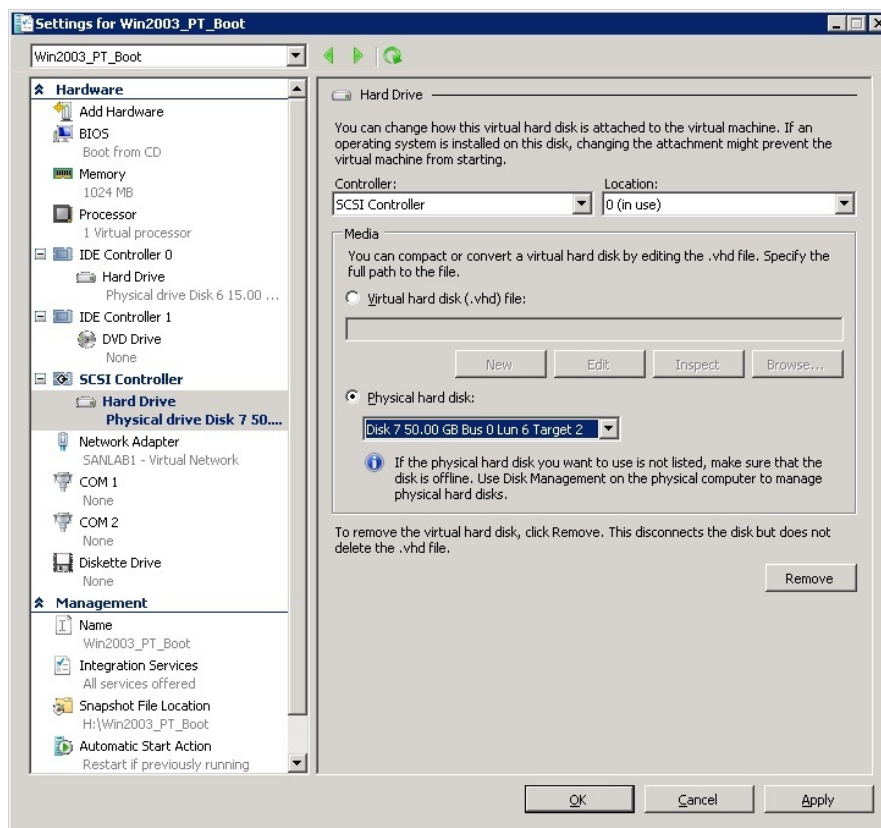
The virtual machine is ready for the installation of the operating system.

Clustering with Hyper-V

If you want to use clustering for Hyper-V, carefully observe the following requirements.

- Use identical server hardware. This will eliminate issues regarding failover.

- Avoid having a single point of failure in your communications network. It is recommended to connect cluster-nodes through a network that uses redundant switches or similar hardware.

  Note: You can connect cluster nodes with a single network. However, it is best to use a redundant communications network.

- All cluster disks must be basic disks. Dynamic disks are not supported.

MD3000-specific cluster requirements:

- Only use two dual ported SAS adapters for each server and connect one port of each adapter to the MD3000 storage array in clustered environments to achieve the highest level of redundancy.

MD3000i-specific cluster requirements:

- The storage configuration must be redundant. Only use two or more network connections for iSCSI traffic to the MD3000i storage array.

- Use dedicated iSCSI network adaptors for iSCSI environments. You cannot share communication and iSCSI traffic on the same adapter in clustered configurations.

All cluster-nodes must be able to communicate with the same virtual disks on the MD3000 / MD3000i storage array. You can use storage partitioning to create a server group with the cluster nodes and assign the necessary virtual disk to them. Make sure that only the cluster nodes have access to those virtual disks. Make sure that other servers do not have access to those virtual disks.

When planning, create an additional virtual disk for the quorum disk. Make this virtual disk at least 1 GB in size. This disk contains the quorum information and is used as the witness disk. Format the quorum virtual disk with NTFS. More details on creating a quorum disk are covered in the following section.

Figure 9 SAS MD3000 Configuration in a Clustered Environment
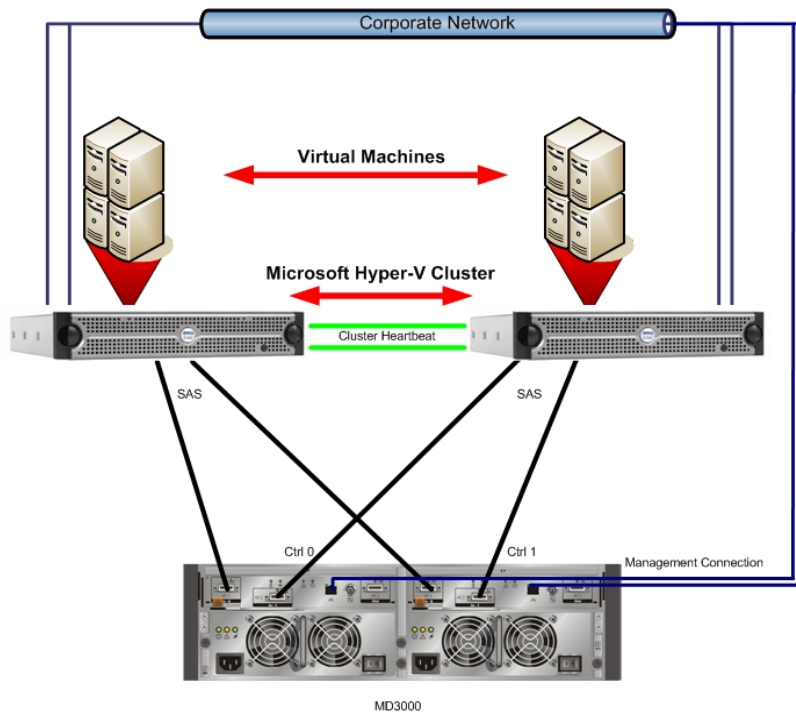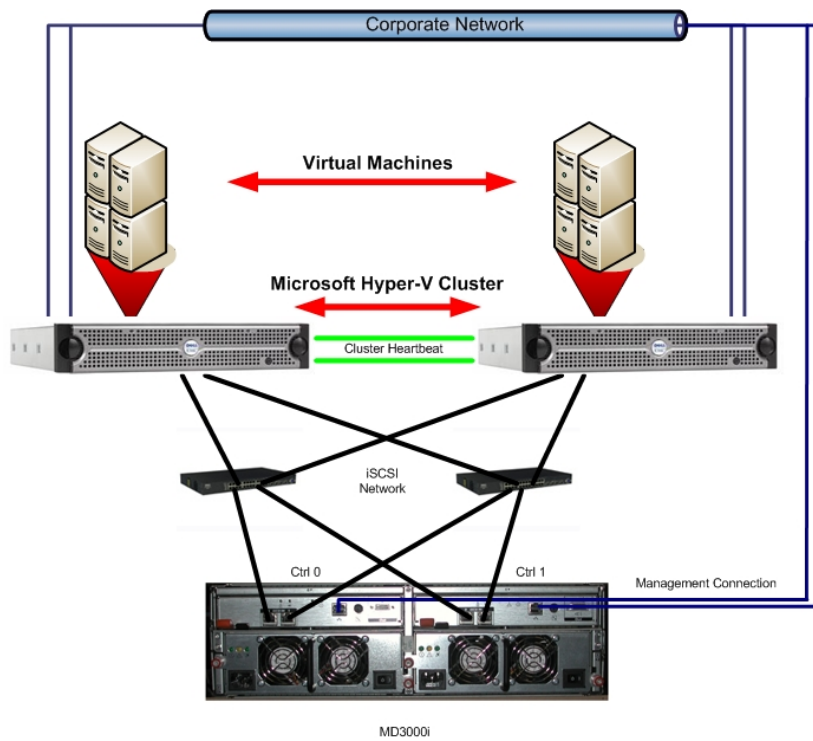

Figure 10 MD3000i iSCSI Configuration in a Clustered Environment

Creating Clusters

1. Create a quorum device.

   If you are planning to use pass-through devices on your virtual machines, you must make sure that the virtual machine configuration files are also stored on the shared storage and that the shared storage is available to all cluster nodes. You can create an additional virtual disk on the MD3000 / MD3000i storage array or increase the size of the quorum virtual disk to store the configuration files there. You also might create an additional virtual disk with approximately 300 MB to 500 MB allocated for each virtual machine. For example, 10 virtual machines equal a 5 GB disk size.

2. Create a host group for the servers and make sure that all of the servers that are part of the cluster have access to the MD3000 / MD3000i storage array.

3. Enable the High Availability feature of the Windows 2008 server by performing these steps. Start with using the Computer Management Wizard.

Table 5 Computer Management Wizard

Page	Action
Computer Management	*1.* Select **Features Task**.
Select Features	*2.* Click **Add Feature** and select the **Failover Clustering** option. *3.* Click **Next**.
Administrative Tools – Failover Cluster Manager	*4.* In Administrative Tools, open **Failover Cluster Manager** and select the **Create New Cluster** option.
Create Cluster – Select Servers	*5.* In the Create Cluster wizard, specify the first member of the cluster by entering the server name and selecting the server. *6.* Click **Next**.
Access Point for Administering the Cluster	*7.* Enter the network configuration for the cluster and specify a cluster IP address for all of the networks you want to use in the cluster. *8.* Click **Next**.
Add Node Wizard	*9.* Confirm your selections and click **Add Node**.

	10. Click **Next**
Select Servers	*11.* Select all of the servers that you want to add to this cluster.
	12. Click **Next**.
Configure Storage Witness	*13.* Confirm the selection and select a Storage Witness disk.
	14. Click **Next**.

Your storage configuration appears in the Failover Cluster Manager.

Adding Hyper-V to the Cluster

You can add the Hyper-V to the cluster. Select **Services and Applications** in the High Availability wizard.

Table 6 High Availability Wizard

Page	Action
Select Services and Applications	*1.* Click **Add**.
	2. Select the application that you want to create.
	3. Click **Next**.
Select Virtual Machine	*4.* Select **Virtual Machine** and select all of the previously-configured VMs that you want to add.
	5. Click **Next**.

Important:	If you add VMs to a cluster that was previously defined without the high availability option, you must manually add the dependencies of your storage to your VMs. If you do not perform this task, the VMs fail during cluster movements. To perform this task, go to the Storage section of the Failover Cluster Manager. Right-click the drives and select the **Add to Resource** option. Pass-through devices will not show up in this section and do not need to be added to the dependency option.

If you have multiple VMs on a single physical disk, the VMs have the same dependencies. If you want to move one of the physical disks to another node, you have to move all of the physical disks. To avoid this issue, create VMs on separate dedicated physical disks.

The storage section is shown in the Failover Cluster Manager. All VMs should have dedicated storage assigned as dependencies.

Figure 11 Storage Section
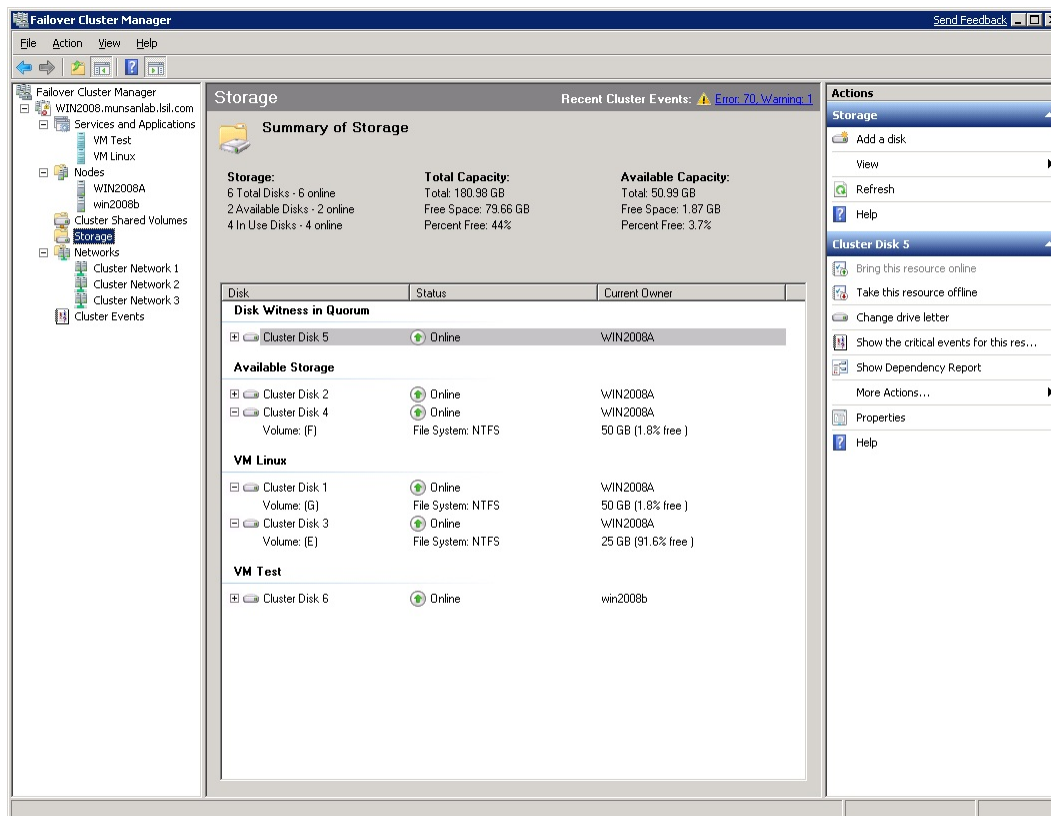
Your VM is now highly available. You can click **Live Migrate** to move the VM without down time to another node. This process lets you balance the load between nodes without affecting your VMs or lets you move VMs to another node if you need to do maintenance on one node. The Live Migration feature is new in Windows 2008 Release 2 and is transparent to the VM.

Configuring a Virtual Machine for Live Migration

After you have Hyper-V Cluster running correctly, you can use the Live Migration feature of Windows 2008 Release 2 for Virtual Machines.

Live Migration can be very useful if you need to balance workloads between different nodes in your cluster, or if you need to shut-down one node for maintenance. Live Migration is transparent to the VM.

To use Live Migration, you must use Cluster-Shared Volumes (CSV) for your virtual machines. CSV must be available for all of the nodes in the cluster.

1. Open the Failover Cluster Manager and click **Cluster Shared Volumes**.

2. Click the right pane and select **Add Storage**.

3. Select the disk that you want to add.

After you add the drive, the drive appears in the disk column. Make sure that you remember the path of the drive. In the example, the path is `C:\ClusterStorage\Volume1`.

4. Configure a virtual machine using this cluster shared volume.

5. Open the Hyper-V manager and select **Add Virtual Machine**.

6. Using the New Virtual Machine wizard, go to the Hyper-V configuration and create a new virtual machine.

Table 7 New Virtual Machine Wizard

Page	Action
Specify Name and Location	*1.* Enter a name for the new virtual machine. *2.* Select **Store the virtual machine in a different location**. *3.* Select the path created in the previous step 3 for the Virtual Machine configuration. *4.* Click **Next**.
Connect Virtual Hard Disk	The `.vhd` location for the virtual hard drive of this location must be on a cluster shared volume. *5.* Select **Create a virtual hard disk**. *6.* For the location, select the same directory as you did in step 3. If you plan to use another cluster shared volumes for the `.vhd`, select the appropriate directory.
Configure Networking	*7.* Associate the VM configuration with the newly-created drive. *8.* Click **Next**.
Assign Memory	*9.* Assign memory and networking. *10.* Click **Finish**.

Note: Make sure that the VM is powered down before you proceed with the next step.

After you have enabled CSV, you can make your VM highly available.

1. Open the Failover Cluster Manager and right-click **Services and Applications**.

2. Use the Configure Service or Application Wizard to add a virtual machine.

**Table 8 Configure Service or Application Wizard**

Page	Action
Select Service or Application	1. Select **Virtual Machine**. 2. Click **Next**.
Select Virtual Machine	3. Select your newly-created virtual machine. 4. Click **Next**.
Confirmation	This page shows the virtual machine you chose in step 3. 5. Click **Next**.
Configure High Availability	A status bar shows the progress of the configuration.
Summary	This page shows if the configuration was successful. 6. Click **View Report** to see the report. 7. Click **Finish**.

You can now turn on the virtual machine. You can select the virtual machine and use Live Migration to move the VM from one node in the cluster to another node.

Figure 12 Summary of Virtual Machine Using Live Migration
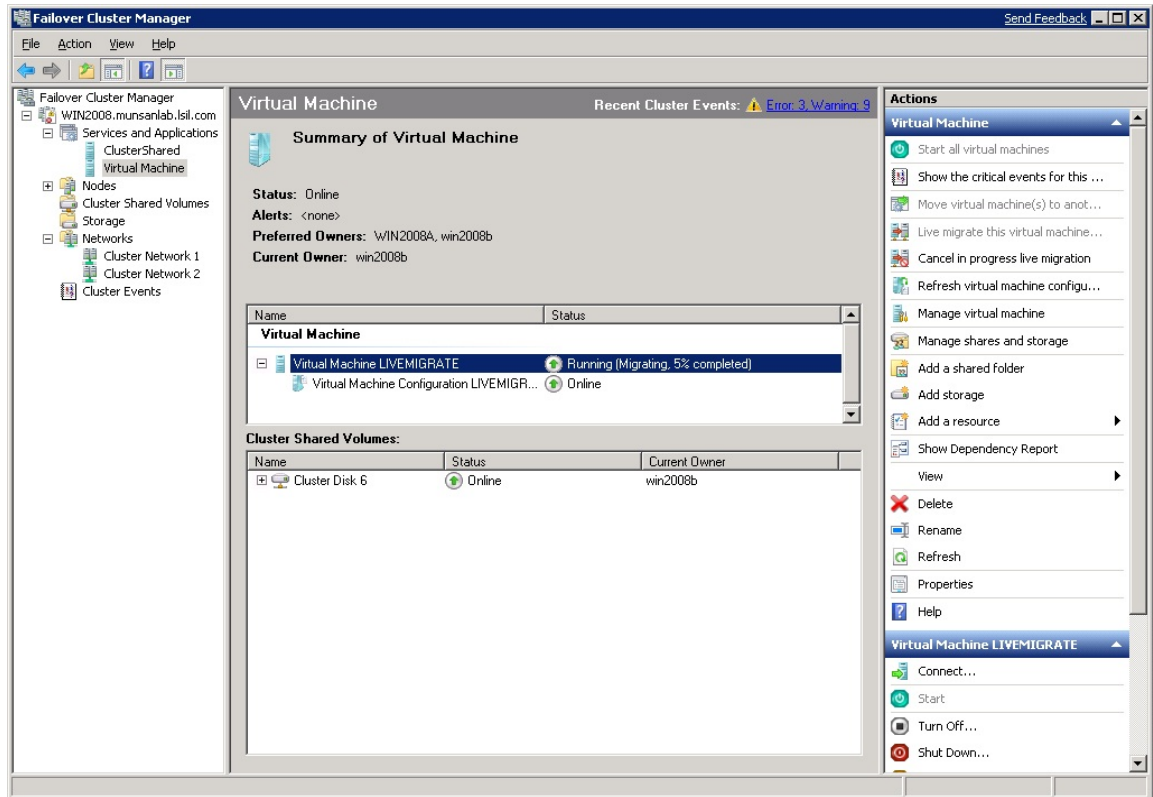
Troubleshooting

It is important that your storage status runs Optimal. If an issue occurs, you can correct problems by clicking on the Recovery Guru.

- If you cannot access a virtual disk on the MD3000 / MD3000i storage array, make sure that the Host-to-Virtual Disk mapping is correct. On the iSCSI initiator, make sure that you have access to all of the targets of the MD3000i storage array. Check any network problems.

- Run the `dsmUtil` command to make sure that all paths are available. This utility comes with the MDSM MPIO and it is located in the following directory (on x64 Servers):

```
C:\Program Files (x86)\DSMDrivers\md3dsm>
```

- Use the `-g` option and enter the target ID of your MD3000/3000i storage array. The storage arrays should be numbered sequentially.

```
C:\Program Files (x86)\DSMDrivers\md3dsm>dsmutil -g0
```

The paths appear in the output extract.

```
Lun #0 - WWN: 600a0b800036e4cd00000f9a47affbca
```

```
----------------
LunObject: 0x0
CurrentOwningPath: A
RemoveEligible: N
BootOwningPath: A
NotConfigured: N
PreferredPath: A
DevState: OPTIMAL
NeedsReservationCheck: N
TASBitSet: Y
NotReady: N
Busy: N
Quiescent: N
Controller 'A' Path
--------------------
NumLunObjects: 1
RoundRobinIndex: 0
Path #1: LunPathDevice: 0xFFFFFADF9C1E2290
IoCount: 0
DevState: OPTIMAL
RemoveState: 0x0  StartState: 0x0  PowerState: 0x0


Controller 'B' Path
--------------------
NumLunObjects: 1
RoundRobinIndex: 1
Path #1: LunPathDevice: 0xFFFFFADF98793410
IoCount: 0
DevState: OPTIMAL
RemoveState: 0x0  StartState: 0x0  PowerState: 0x0
```

- If you have issues with clustering, make sure that all of the cluster nodes can access the storage array. Test to see if you can move a VM without Live Migration to another node before you start testing the Live Migration

feature. Check the dependencies of the VM. Make sure that all of the physical disks involved appear as dependencies, except pass-through disks.

- Run the cluster verification test and correct any outstanding clustering issues.

For information about troubleshooting MD3000 storage arrays, refer to the "Troubleshooting Problems" chapter of the *Dell™ PowerVault™ Modular Disk Storage Manager User's Guide.* Go to:

http://support.dell.com/support/edocs/systems/md3000/en/index.htm

Contact Information

Go to:

http://www.dell.com/

or call 1-800-WWW-DELL

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Appendix B: Terminology

Bandwidth – The amount of data that the storage array can process over time. Bandwidth is measured in megabytes per second (MB/s).

Initiator – The system component that originates an input/output (I/O) command over an I/O bus or network. I/O adapters, network interface cards, and intelligent RAID controller module device I/O bus control Application Specific Integrated Circuits (ASICs) are typical initiators. A peripheral device is a target. (*The Dictionary of Storage Networking Terminology*)

Latency – The interval of time between submitting a request and receiving a response.

MPIO (Multi Path I/O) – In computer storage, an arrangement whereby more than one logical path exists between the central processing unit (CPU) in a computer system and its storage devices. This path is routed through the buses and bridge devices that connect the CPU and its storage devices. If one RAID controller module, port, or switch fails, the operating system can route I/O through the remaining RAID controller module so that work can continue.

NIC (Network Interface Card) – An adapter that connects an intelligent device to a network. The common terminology is a network interface card or an Ethernet NIC network.

Node – An addressable entity connected to an input/output (I/O) bus or network and used primarily to refer to computers, storage devices, and storage arrays. The component of a node that connects to the bus or network is a port. (*The Dictionary of Storage Networking Terminology*).

Pass-through Physical Disk – An unformatted physical disk directly assigned to the virtual machine.

Portal – A service that links initiators and targets when their IP addresses are not known.

Quorum Virtual Disk –A virtual disk on the shared storage array that stores the quorum information.

Response time – The interval of time between submitting a request and receiving a response.

Session – A group of iSCSI connections. As each connection is established, the session can negotiate its own unique parameters.

Signature – An embedded code that identifies the device. The signature is used when passing information between devices.

Target – The storage destination. In this document, the target is the MD3000i storage array.

TCP/IP (Transmission Control Protocol/ Internet Protocol – A suite of protocols that includes Transmission Control Protocol (TCP), Internet Protocol (IP), User Datagram Protocol (UDP), and Internet Control Message Protocol (ICMP). These protocols form the basic set of communication protocols used on the Internet. (*The Dictionary of Storage Networking Terminology*)

Throughput – The number of individual I/Os the storage array can process over time. Throughput is measured in I/Os per second (IOPS).

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