Microsoft® Hyper-V™ R2 Reference Architecture for Dell® PowerEdge™ Rack Servers and Dell PowerVault™ Storage

Dell Virtualization Business Ready Configurations for Small and Medium Business

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1 Introduction

Business Ready Configurations for Virtualization are a family of reference configurations offered by Dell® that are designed to aid with the ordering, deployment, and maintenance of a virtualization infrastructure. These configurations are designed to meet specific customer needs through the use of various server, storage, and virtualization technologies available from Dell.

The Business Ready Configuration defined in this document is targeted at small and medium-sized business virtualization needs, although others might also benefit from this architecture. This solution includes Dell PowerEdge™ R710 servers, Dell MD3000i iSCSI storage, and Microsoft® Hyper-V technologies. Based on extensive design and engineering work, customers can quickly and confidently deploy this proven engineering architecture into production environments, thereby helping to eliminate much of the costly and time consuming trial and error work often encountered during complex deployments.

This white paper includes information useful both before and after purchase of the solution. Prior to purchase, this information can aid with the sizing of the solution, licensing selection, and preparation of the deployment environment for the solution. Post-purchase, this guide can aid with the setup, configuration, and deployment of the reference configuration. The solution will help customers achieve the full benefits of Microsoft Virtualization, Dell PowerEdge R710 servers, and Dell MD3000i storage.

2 Audience and Scope

The intended audience for this white paper is IT administrators, IT managers, and channel partners who are planning to deploy or resell Microsoft® Virtualization themselves or for their customers. This white paper provides an overview of the recommended servers, storage, software, and services. It can be used to plan, scope, and procure the components required to set up a virtualization infrastructure.

This white paper provides reference architecture and best practices for deploying and configuring Dell's 11th generation R710 server, using Dell™ MD3000i Storage Array and Microsoft Virtualization. The solution is based upon iSCSI storage technology as the storage environment.

3 Overview

As mentioned the reference configuration is centered on the Dell PowerEdge R710 and Dell PowerVault™ MD3000i components. In addition to these components, the reference configuration leverages the capabilities of Dell's PowerConnect™ 6200 family of networking devices for network connectivity and Dell's PowerVault DL2100 disk-to-disk backup solution with integrated PowerVault TL2000 device for disk-to-tape backup. As outlined here, this solution provides a powerful, expandable, and scalable platform for implementing Microsoft® Hyper-V™ R2 Virtualization technology. The ability to scale the High Availability and High Availability + Backup configurations is limited to five virtualization host servers. This is not to say that the solution cannot grow beyond five, but additional and advanced setup and configurations would be necessary. This section should be helpful for customers looking to size their solution prior to purchase.

In an effort to meet the needs of ever growing and changing customer requirements, this reference configuration is offered in three standard variations, each highly configurable. The table below lists typical use cases for each variation and the characteristics of each variation.

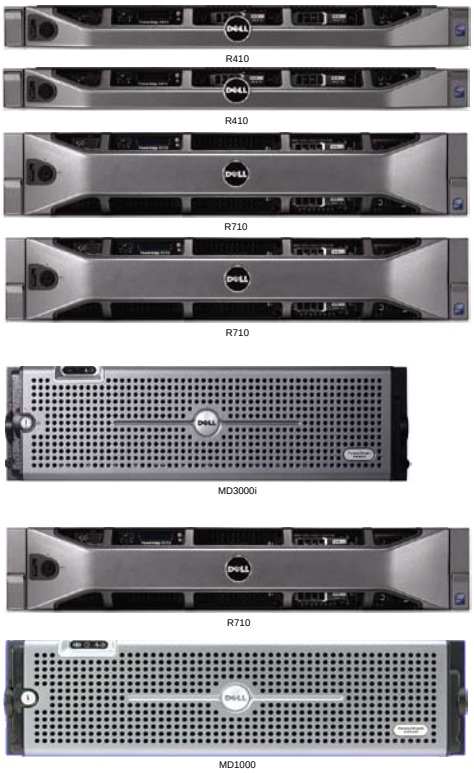
Consolidation	High Availability	High Availability + Backup
Ideal for customers looking to: • Consolidate existing workloads for increased ability to support and manage the solution	Ideal for customers looking to: • Consolidate existing workloads for increased ability to support and manage the solution • High-Availability through the use of Microsoft Failover Clustering • Improve ROI of storage resources through consolidation and reliability	Ideal for customers looking to: • Consolidate existing workloads for increased ability to support and manage the solution • High-Availability through the use of Microsoft Failover Clustering • Improve ROI of storage resources through consolidation and reliability • Implement datacenter-quality backup and recovery of computing resources and data • Enable offsite storage of critical data
• Ideal for consolidation or deployment of up to 14 operating system instances (i.e. virtual machines) • Single-server configuration • No external storage	• Ideal for consolidation or deployment of up to 22 (configurable) operating system instances (i.e. virtual machines) • Two-server configuration • Shared centralized iSCSI-based array (expandable to 90 TB) • High availability of operating system instances (virtual machines)	• Ideal for consolidation or deployment of up to 44 (configurable) operating system instances (i.e. virtual machines) • Three-server configuration • Shared centralized iSCSI-based storage array (expandable to 90 TB) • High availability of operating system instances (virtual machines) • Disk-to-Disk with optional Disk-to-Tape Backup

Table 1 Solution Configuration Variation Summary Table

The consolidation configuration is a single server with no shared storage. However, this configuration can be used as a building block to the high availability or high availability with backup. This enables you to grow your configuration as your business or workload grows and expands.

NOTE: Solution specifications (virtual machine counts, for example) can be expanded by increasing the configuration and/or quantity of solution variation components. For example, it is possible to create the High Availability + Backup solution from the Consolidation solution with the addition of Hyper-V host memory, shared centralized storage, and backup hardware.

NOTE: Virtual machine counts listed here are based upon virtual machines with an average of 3 GB of RAM, 40 GB of shared storage space. Actual results **will** vary.



Dell PowerEdge Server

- 11th Generation
  - Intel "Nehalem" processor
  - Intel QuickPath™ memory technology
  - Unified Server Configuration
  - Remote monitoring and administration

PowerEdge R410 Infrastructure Server

PowerEdge R410 Management Server

- Microsoft System Center Virtual Machine Manager 2008 R2 (*optional*)

PowerEdge R710 Virtualization Servers

- Microsoft Hyper-V R2 Virtualization Technology

Dell PowerVault MD3000i

- Expands up to 45 disk drives and 90TB of capacity
- Supports both SAS and SATA drives

Dell PowerVault DL2100 Disk to Disk Backup and integration with Dell PowerVault TL2000 Disk to Tape Backup

Figure 1 Reference Configuration Overview

For the discussions in this paper, the fully configured solution (High Availability + Backup) is referenced. Doing so enables a thorough discussion of how all the components are deployed and configured to work together. It should be understood that the information in this paper is also applicable to the other variations based upon the configuration ordered. *Exceptions to this will be noted.*

3.1 Dell™ PowerEdge™ R710 Server

The PowerEdge R710 from Dell uses next generation Intel® Xeon® processor 5500 series processors ('Nehalem") and Intel "Tylersburg" Chipset architecture in a slim 2U rack mount form factor. The next generation Dell PowerEdge R710 is customer inspired. By listening and focusing on the details, we have delivered on your inspiration with simplicity of operation and innovative features.

The PowerEdge R710 takes advantage of Dell's system commonality; when IT professionals learn one system, they have the skills to manage all of Dell's next generation servers.

In addition, Dell's latest PowerEdge servers provide a graphical and interactive LCD for system health monitoring, alerting, and control of basic management configuration located right in the front of the server. Customers have an AC power meter and ambient temperature thermometer built into the server which they can monitor on this display without any software tools. The server features 18 memory DIMM slots supporting 1, 2, 4, 8 GB DIMMs.

Increased Virtualization Performance

The PowerEdge R710 is designed with more memory capacity and more integrated I/O than the previous generation PowerEdge 2950 III. This increased capacity is crucial for virtualization performance and scalability.

New DDR3 memory offers higher bandwidth and lower power consumption than previous FBD or DDR2 technologies. Increased memory slots enable you to use smaller, less expensive DIMMs to meet computing needs and balance cost.

Simplified Systems Management

The Dell OpenManage™ suite offers enhanced operations and standards-based commands designed to integrate with existing systems for effective control.

The Lifecycle Controller is the engine for advanced systems management integrated on the server. Lifecycle Controller simplifies administrator tasks to perform a complete set of provisioning functions such as system deployment, system updates, hardware configuration and diagnostics from a single intuitive interface called Unified Server Configurator (USC) in a pre-OS environment. This eliminates the need to use and maintain multiple pieces of disparate CD/DVD media.

The Dell Unified Server Configurator delivers a single access point for secure, efficient, and user-friendly infrastructure management. Embedded and integrated into the system, it provides quick and consistent access, excellent flexibility and advanced capabilities. With built-in driver installations, firmware updates, hardware configuration and diagnostics, the USC tool is a one-stop shop for operating system deployment.

Energy-Efficient Design

The PowerEdge R710 features Energy Smart technologies that are designed to reduce power consumption while increasing performance capacity. Energy-efficient design features include power-supply units sized appropriately for system requirements, innovative system-level design efficiency, policy-driven power and thermal management, and highly efficient standards-based Energy Smart components. All these elements are designed to increase energy efficiency across our latest core data center servers while delivering the performance your business requires.

For more information on Dell servers, see www.dell.com/servers.

3.2 Dell PowerVault™ MD3000i Array

The PowerVault MD3000i is a high-performance iSCSI Storage Area Network (SAN) designed to deliver storage consolidation and data management capabilities in an easy-to-use, cost-effective solution:

- Wizard-based installation, intuitive management, and advanced data protection software
- Supports storage up to 90TB* (*Based on 2 TB hard drive configuration.)

Cost-Effective Storage for Virtual Environments

Shared storage is required to enable virtual machine high availability and live migration capabilities, a key benefit of virtual environments. The PowerVault MD3000i is a networked, shared storage solution.

Optimal Storage for Business Critical Applications

The PowerVault MD3000i iSCSI SAN with dual Ethernet ports per storage controller, redundant hardware, and proactive notification can deliver the availability required of applications that are critical for business. Support for 16 servers and modular scalability offer seamless growth to support your needs today and in the future.

Built for Availability

The Dell PowerVault MD3000i iSCSI offers functionality that helps provide the availability and protection needed without adding complexity.

Redundant components: Supports redundant active/active RAID controllers, management ports, and power/cooling to provide real security at the hardware level.

Automated drive-failure detection: Capable of automatically rebuilding a failing RAID group by using an available hot-spare drive.

Intelligent battery monitoring: Intelligent software notifies you before the cache battery fails; helping to reduce unplanned downtime.

Hot-pluggable components: Remove and replace disk drives, storage controllers, power supplies, and cooling fan modules while the system remains running, without impacting operations.

RAID Levels: Supports RAID levels (0, 1, 10, 5 and 6) offering flexibility in data protection and system performance characteristics.

Premium management functionality: Snapshot and virtual-disk copy capabilities that support hourly, real-time backups of your entire data environment.

NOTE: Premium features are not included in the base configurations. Please contact your Dell sales representative for more details.

Simple and Powerful Storage Management

The MD3000i iSCSI SAN delivers a seamless suite of intuitive task-based management capabilities. The Modular Disk Storage Manager can help automatically configure the system for optimal performance and availability.

Multi-host management: Flexibility to manage the entire network from a single console.

Recovery Guru: A support tool that can diagnose system problems and help determine an appropriate recovery procedure.

Enhanced data protection: Optional snapshot and virtual disk copy features.

For more information on Dell PowerVault storage, see www.dell.com/md3000i.

3.3 Dell PowerVault DL2100/TL2000 Backup

Simpler and Faster to Set Up and Manage

The Dell PowerVault DL2100 powered by CommVault® (part of the Dell TierDisk family of products) is the industry's first and only integrated solution for faster disk-based backups and recoveries that lets you start protecting your data in just 27 minutes.

Dell has simplified the backup process by offering the only integrated hardware, software and services solution powered by CommVault. The PowerVault DL2100 comes factory-installed with CommVault Simpana™ software and a unique wizard driven set up and management utility. The backup software comes with integrated, automated dynamic disk provisioning that configures and sets up the disks for immediate use. Set it up, configure storage, add more disks —it only takes a few clicks.

Integrated Tape Support

The PowerVault DL2100 is available with the Dell PowerVault TL2000, TL4000, or ML6000 tape library integrated into the full solution. Take advantage of backup-to-disk for quick availability then transfer to tape from the same management console for offsite disaster recovery.

Built-in Data Deduplication-Reduces Storage by up to 95%

The exponential growth in data has caused a similar growth in the need for storage. Deduplication technology can help reduce the need to store the same data repeatedly.

The PowerVault DL2100 – Powered by CommVault has a built-in compression and deduplication capability that stores blocks only once, eliminating redundant segments across consolidated backup sets. By storing only unique instances on disk and maximizing the number of recovery points, you are storing less redundant data for more rapid restores.

Faster, More Reliable Backups

Managing backups with tape can be complex and time-consuming. Backups to tape often exceed their backup window, and tape-based backups can be prone to failure.

Disk-based backup with the PowerVault DL2100 – Powered by CommVault are 52% faster than tape, and restores are 77% faster, with 19% greater reliability. CommVault's Simpana software reduces backup windows even more than traditional backup-to-disk software. It takes advantage of disk's random read/write capability and writes data faster, in chunks rather than as large, sequential files. Plus an integrated solution with hardware, software and services is a cost-effective way to reduce total cost of ownership.

Synthetic Full Backups Reduce Performance Impact on Applications

Frequent full backups take a toll on server I/O and can slow down user applications. The PowerVault DL2100 – Powered by CommVault removes that performance burden by continually backing up smaller, incremental changes from production servers and merging them with unchanged data to create a synthetic full backup copy. Patented Smart Client technology reduces the incremental backup time by tracking all of the files that have changed.

NOTE: Although Dell's PowerVault DL2100 Powered by CommVault offering is highlighted here, the PowerVault DL2100 Powered by Symantec can be ordered instead. Customer backup needs and requirements vary. Contact a Dell sales representative for further details.

4 Specifications

The following tables (Table 2 - Table 3) provide detailed summaries of the components included in each configuration variation. These parameters represent the default configuration of each solution; most parameters are adjustable, enabling specific modifications required by the customer.

The following list represents the reference configuration parameters that are most likely to be modified to scale the configuration:

- Quantity of Microsoft Hyper-V™ server nodes—increased to a maximum of 5 or decreased to a minimum of 1
- Amount of memory per Hyper-V server
- Number of hard drives per Hyper-V server and the size and speed of those hard drives
- Speed and power rating of processor per Hyper-V server
- MD3000i hard drive quantities and capacities

NOTE: [1]If you order the suggested Dell rack system and also modify the number of servers and/or add a backup solution, check that the rack is large enough to house all of the components. [2]A five host maximum is based on the network port capacity discussed here. Additional network configuration would be required with advanced configurations to increase beyond the five limit discussed here. [3]The maximum number of connections supported by the PowerVault MD3000i is sixteen. [4]The Solution identification shown in the table can be used to aid your Dell sales representative when modifying and/or ordering a solution. [5]The High Availability w/Backup + Consolidation solution can only be ordered by contacting your Dell sales representative. [6]Also, if a backup solution is required for either the Consolidation or High Availability + Consolidation solutions, a Dell sales representative will have to be contacted to complete the order.

	Consolidation	High Availability+ Consolidation	High Availability w/Backup + Consolidation
Base Unit	PowerEdge R710 with chassis for up to eight 2.5-inch hard drives	PowerEdge R710 with chassis for up to eight 2.5-inch hard drives	PowerEdge R710 with chassis for up to eight 2.5-inch hard drives
Quantity of Server	One	Two	Three
Processor	E5540 Intel Xeon processor, 2.53GHz 8-M cache, 5.86 GT/s QPI, TurboHT	E5540 Intel Xeon processor, 2.53GHz 8-M cache, 5.86 GT/s QPI, TurboHT	E5540 Intel Xeon processor, 2.53GHz 8-M cache, 5.86 GT/s QPI, TurboHT
Second Processor	E5540 Intel Xeon processor, 2.53GHz 8-M cache, 5.86 GT/s QPI, TurboHT	E5540 Intel Xeon processor, 2.53GHz 8-M cache, 5.86 GT/s QPI, TurboHT	E5540 Intel Xeon processor, 2.53GHz 8-M cache, 5.86 GT/s QPI, TurboHT
Memory	48-GB memory (12x4GB), 1066MHz dual-ranked RDIMMs for two processors, optimized	72-GB memory (18x4GB), 800-MHz dual-ranked RDIMMs for two processors, optimized	72-GB memory (18x4GB), 800-MHz dual-ranked RDIMMs for two processors, optimized
Hard Drive Controller	PERC 6/i SAS RAID Controller 2x4 connectors, internal, PCIe 256-MB cache, x8 chassis	PERC 6/i SAS RAID Controller 2x4 connectors, internal, PCIe 256-MB cache, x8 chassis	PERC 6/i SAS RAID Controller 2x4 connectors, internal, PCIe 256-MB cache, x8 chassis
Raid Level/Hard Drives	Raid 1: (2) 146-GB 10-K RPM serial-attach SCSI 2.5-inch hot-plug hard drive Raid 10: (6) 146-GB 10-K RPM serial-attach SCSI 2.5-inch hot-plug hard drive	Raid 1: (2) 146-GB 10-K RPM serial-attach SCSI 2.5-inch hot-plug hard drive	Raid 1: (2) 146-GB 10-K RPM serial-attach SCSI 2.5-inch hot-plug hard drive
BIOS Setting	Performance Setting	Performance Setting	Performance Setting
Remote Management Controller	iDRAC6 Enterprise	iDRAC6 Enterprise	iDRAC6 Enterprise

	Consolidation	High Availability+ Consolidation	High Availability w/Backup + Consolidation
Operating System	Windows Server 2008 R2 Enterprise x64, including Hyper-V, including 10 CALs	Windows Server 2008 R2 Enterprise x64, including Hyper-V, including 10 CALs	Windows Server 2008 R2 Enterprise x64, including Hyper-V, including 10 CALs
Riser Card	Riser with 2 PCIe x8 + 2 PCIe x4 Slot	Riser with 2 PCIe x8 + 2 PCIe x4 Slot	Riser with 2 PCIe x8 + 2 PCIe x4 Slot
Onboard Network Adapter	Dual Two-Port Embedded Broadcom NetXtreme II 5709 Gigabit Ethernet NIC	Dual Two-Port Embedded Broadcom NetXtreme II 5709 Gigabit Ethernet NIC	Dual Two-Port Embedded Broadcom NetXtreme II 5709 Gigabit Ethernet NIC
Additional Network Card	Intel PRO 1000VT Quad Port 1GbE NIC, PCIe-4	(2) Intel PRO 1000VT Quad Port 1GbE NIC, PCIe-4	(2) Intel PRO 1000VT Quad Port 1GbE NIC, PCIe-4
Power Supply	High Output Power Supply, Redundant, 870W	High Output Power Supply, Redundant, 870W	High Output Power Supply, Redundant, 870W
Power Cord	(2) Power cord, C13 to C14, PDU Style, 12 Amps, 2 meter	(2) Power cord, C13 to C14, PDU Style, 12 Amps, 2 meter	(2) Power cord, C13 to C14, PDU Style, 12 Amps, 2 meter
Rails	Sliding ready rails with cable management arm	Sliding ready rails with cable management arm	Sliding ready rails with cable management arm

Table 2 Hyper-V Server Default Configurations

	Infrastructure Server	**Management Server (Optional)**
Base Unit	PowerEdge R410 with chassis for up to four 3.5-inch hard drives	PowerEdge R410 with chassis for up to four 3.5-inch hard drives
Quantity of Server	One	One
Processor	E5520 Xeon processor, 2.26Hz 8MB Cache, 5.86 GT/s QPI, TurboHT	E5520 Xeon processor, 2.26Hz 8MB Cache, 5.86 GT/s QPI, TurboHT
2nd Processor	<None>	<None>
Memory	4GB Memory (2x2GB), 1066-MHz dual ranked UDIMMs for one processor, Adv ECC	4GB Memory (2x2GB), 1066-MHz dual ranked UDIMMs for one processor, Adv ECC
Hard Drive Controller	PERC 6/i SAS RAID Controller 2x4 connectors, internal, PCIe256-MB cache	PERC 6/i SAS RAID Controller 2x4 connectors, internal, PCIe256-MB cache
Raid Level/Hard Drives	Raid 1: (2) 146-GB 15-K RPM serial-attach SCSI 3.5-inch hot-plug hard drive	Raid 10: (4) 300-GB 15-K RPM serial-attach SCSI 3.5-inch hot-plug hard drive*
Remote Management Controller	iDRAC6 Enterprise	iDRAC6 Enterprise
Operating System	Windows Server 2008 R2, Standard x64, including Hyper-V, including 5 CALs	Windows Server 2008 R2, Standard x64, including Hyper-V, including 5 CALs
Additional Network Card	<None>	Single Broadcom 5709 Dual Port 1GbE NIC w/TOE (Optional for iSCSI connections)
Power Supply	Power Supply, Redundant, 500W	Power Supply, Redundant, 500W
Power Cord	(2) Power cord, C13 to C14, PDU-style, 12 Amps, 2 meters	(2) Power cord, C13 to C14, PDU-style, 12 Amps, 2 meters
Rails	Sliding ready rails with cable management arm	Sliding ready rails with cable management arm

Table 3 Infrastructure and Management Server Default Configurations

NOTE: The reference configuration does not include licenses for guest operating systems and the management or monitoring of those operating systems. These licenses must be added separately.
*Reduce drive size if iSCSI storage will be used for a Virtual Machined Library.

	Consolidation	High Availability+ Consolidation	High Availability w/Backup + Consolidation
Base Unit	N/A	Power Vault MD3000i	Power Vault MD3000i
Controllers		Dual	Dual
Hard Drives		(8) 450GB 15K RPM SAS	(15) 450GB 15K RPM SAS
Blank Hard Drive Covers		(7) Covers	<None>

Table 4 Shared Storage Default Configurations

5 Design Principles

The following principles were used during the design of the reference configuration.

Ease of deployment: The configuration is designed to be easily deployed. Design concepts are discussed with step-by-step deployment procedures provided.

Optimal hardware configuration for virtualized workloads: The reference configuration is designed with an optimal hardware configuration to support virtualized workloads. Each PowerEdge R710 server is configured with sufficient memory and network adapters required for Hyper-V™ R2 virtualization.

Scalability: Most aspects of the reference configuration can be configured, either through modification of configuration components (processor speed and memory) or through the addition of components (hard drive and Hyper-V servers).

Isolated and high-performance network design: The network architecture is designed to support isolation of various traffic types required in a virtualized environment. Flexible design enables modification as needed.

Integrated PowerVault DL2100 and TL2000: The reference configuration includes disk-to-disk data protection and disk-to-tape data retention capabilities designed to work side-by-side with other Dell hardware.

High-Availability and Live Migration Enabled: The reference configuration leverages Microsoft's Failover Clustering capabilities to enable virtual machines to move between Hyper-V servers using Quick Migration. Windows Server 2008 R2 version adds the ability to Live Migrate virtual machines between nodes without down time.

6 Architecture

The following sections discuss the architecture and design of the reference configuration. These sections lay the ground work for the deployment of the reference configuration discussed in section 9. A reference configuration overview appears in Figure 2.

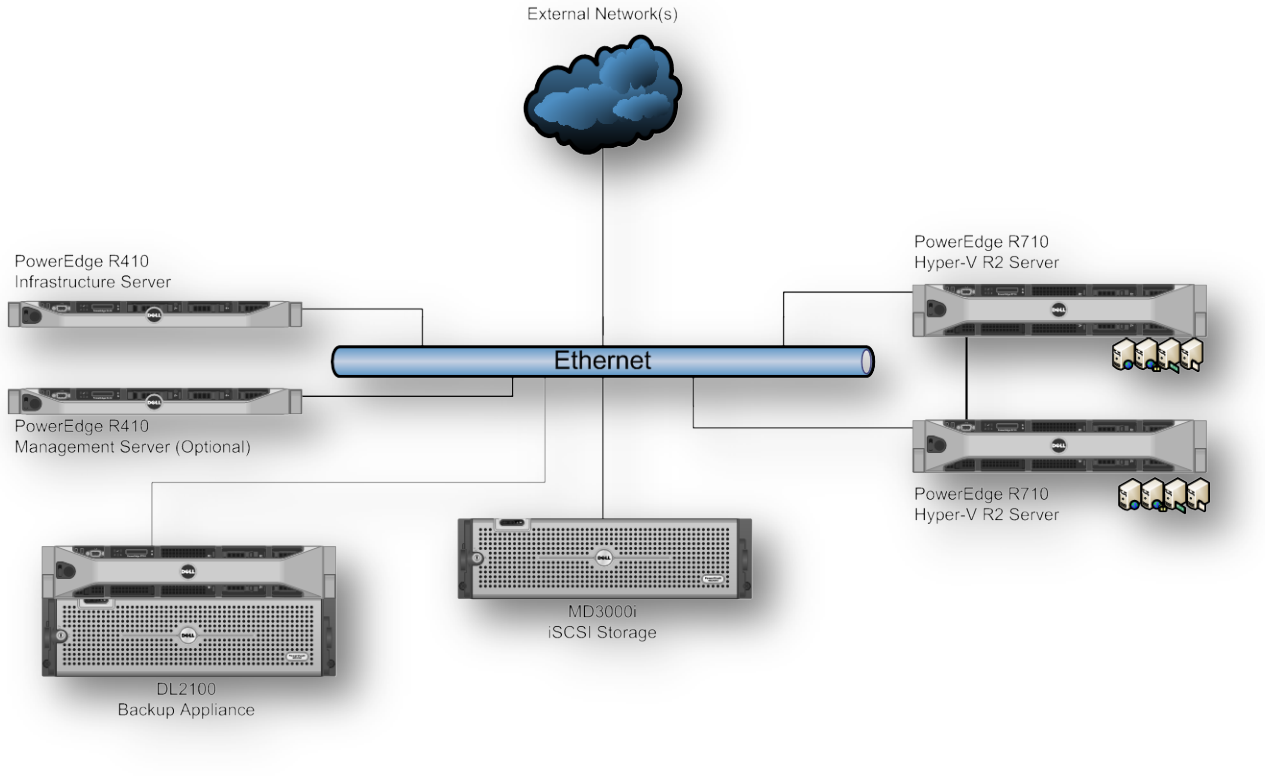


Figure 2 Configuration Architecture Summary

This configuration consists of Dell PowerEdge servers, PowerConnect networking, and PowerVault storage.

- Networking:
    - External Switch – CX-4 10Gb uplink compatible switch *(i.e. Dell PowerConnect 6248 switch with 10-GB uplink modules)*
    - Internal Switch – 2 x Dell PowerConnect 6248 switches stacked to create one virtual switch
- Infrastructure: Dell PowerEdge R410 running Windows 2008 Standard R2
- Management: Dell PowerEdge R410 running Windows 2008 Standard R2 (optional)
- Hyper-V R2 Servers (up to five): Dell PowerEdge R710 running Windows 2008 R2 Enterprise
    - Hyper-V - enabled

  - Failover clustering-enabled
  - Multi-path I/O enabled redundant iSCSI network adapters
  - Redundant parent partition network adapters
  - Redundant virtual machine network adapters
- Dell PowerVault MD3000i
- Dell PowerVault DL2100 Backup to Disk Appliance Powered by CommVault

6.1 Network Architecture

At the heart of the solutions network configuration are two Dell PowerConnect 6248 switches. This managed layer 3 gigabit ethernet switch offers the enterprise-class level of performance required for this configuration. The switches use a stacked configuration that enables connection redundancy and added bandwidth where required. Additionally, its 10Gb uplink enables design and implementation flexibility needed by advanced users.

The switch is capable of supporting all of the networks in the configuration with the use of VLANs for traffic isolation and network teaming for redundancy. As mentioned above and shown in Table 5, reference configuration network traffic is broken down by function and assigned to function-based VLANs. VLANs are represented by VLAN IDs ranging from 10-50.

The switch configuration in the appendix section of this whitepaper (Appendix A: Reference Network Configuration) was used during the development of this reference configuration. Although modifications are possible, this switch configuration serves as the baseline configuration for the discussion in this white paper. As is, it will support all of the hardware in this reference configuration (up to five Hyper-V servers).

6.1.1 Data Networks, Subnets, and VLANs

In keeping with Microsoft best-practice recommendations, Ethernet traffic is broken down into separate networks; each of these network types are assigned a different network ID or subnet. Sub-netting is used to break the configuration network into smaller, more efficient networks. This also prevents excessive Ethernet packet collision, as well as provides some security through switched-based isolation. Further isolation of network traffic types is achieved through the use of VLANs. As used in this configuration, a one-to-one correspondence exists between subnets and VLANs.

As shown in Figure 2, the configuration defines five network traffic types:

- *iSCSI Network* – Used for communication between the Hyper-V servers and shared storage (i.e. MD3000i). This network includes two subnets to enable the load balancing capabilities of the MD3000i.
- *Main or Public Network* – Used for operating system management connectivity
- *Cluster Networks* – Two VLAN separated networks used for private intra-node communication between Hyper-V servers and communication coordination in the use of cluster shared volumes and live migration between Hyper-V servers.
- *Hardware Management Network* – Used for hardware management including remote access (i.e. iDRAC, MD3000i, etc.)
- *Virtual Machine Network* – Used for virtual machine connectivity from Hyper-V servers to connect virtual machines, applications, and services to the rest of the network environment

NOTE: The virtual machine network shares a VLAN with the main/public network. This sharing simplifies the deployment of infrastructure services like DHCP. It is possible to use a sixth VLAN for the virtual machine network to further isolate the different traffic types. For more information, consult Microsoft's documentation concerning cross-subnet DHCP services (*http://support.microsoft.com/kb/120932*).

Network Function	Network VLAN ID
iSCSI Network #1	10
iSCSI Network #2	11
iSCSI Network #3	12
iSCSI Network #4	13
Main or "Public" Network / Virtual Machine Network	20
Cluster Network / CSV Network	30
Hardware Management Network	40
Live Migration Network	50

Table 5 Network Function to VLAN ID Mappings

This configuration uses static port VLAN assignments to simplify deployment and setup. With this approach, all traffic is tagged (or untagged) with the appropriate VLAN ID when it passes through a port of the network switch. It should be noted, VLAN tagging can also be performed at the software layer either through the use of Broadcom's Advanced Control Suite (BACS) or the Intel PRO software or through Hyper-V for virtual networks.

NOTE: Use of software-based VLAN tagging requires changes to the switch configuration in Appendix A. Specifically, the hardware port tagging used in the file must be removed and the port configured to accept pre-tagged traffic. Consult the PowerConnect 6200 manual and CLI configuration guide for further information. This information is located on *support.dell.com* in the section for the PowerConnect 6200 family devices.

Figure 3 illustrates both the VLAN tagging and network types as configured in the sample switch configuration file. The file configures the switch for the following connectivity:

- iSCSI Network #1 (VLAN 10)
    - One port (Port #1 on switch G1) for iSCSI connections to the MD3000i storage (one to each controller)
    - Seven ports (3,5,7,9,11,13,15 on switch G1) for iSCSI connections to the Hyper-V servers
- iSCSI Network #2 (VLAN 11)
    - One port (Port #2 on switch G1) for iSCSI connections to the MD3000i storage (one to each controller)
- Seven ports (4,6,8,10,12,14,16 on switch G1) for iSCSI connections to the Hyper-V servers iSCSI Network #3 (VLAN 12)
    - One port (Port #1 on switch G2) for iSCSI connections to the MD3000i storage (one to each controller)
    - Seven ports (3,5,7,9,11,13,15 on switch G2) for iSCSI connections to the Hyper-V servers
- iSCSI Network #4 (VLAN 13)

  - One port (Port #2 on switch G2) for iSCSI connections to the MD3000i storage (one to each controller)
  - Seven ports (4,6,8,10,12,14,16 on switch G2) for iSCSI connections to the Hyper-V servers
- Main, or Public, Network and Virtual Machine Network (VLAN 20)
  - Two ports (36 on switch G1 and G2) for primary connections to the management server
  - Two ports (38 on switch G1 and G2) for primary connections to the infrastructure server
  - Port 24 on switch G2 for the primary connection to the backup servers.
  - Fourteen ports (26, 28, 30, 32, 34 on switch G1 and switch G2) for the primary connections to the Hyper-V servers and the infrastructure server (two per server).
  - Twenty ports (39 - 48 on switch G1 and switch G2) for virtual machine connections
- Cluster Network / Cluster Shared Volumes (VLAN 30)
  - Five ports (17, 19, 21, 23, 25 on switch G1) for cluster connections to Hyper-V servers
- Hardware Management Network (VLAN 40)
  - Twelve ports (27, 29, 31, 33, 35, 37 on switch G1 and switch G2) for hardware management connections (iDRAC, MD3000i management, TL2000 management, etc.)
- Live Migration Network (VLAN 50)
  - Five ports (17, 19, 21, 23, 25 on switch G2) for cluster connections to Hyper-V servers
- Switch Stacking and Uplink ports
  - Two Ports (XG1 and XG2 in Bay 1 on switch G1 and switch G2) for switch stacking connections
  - Two Ports (XG3 and XG4 in Bay 2 on switch G1 and switch G2) for switching up linking connections

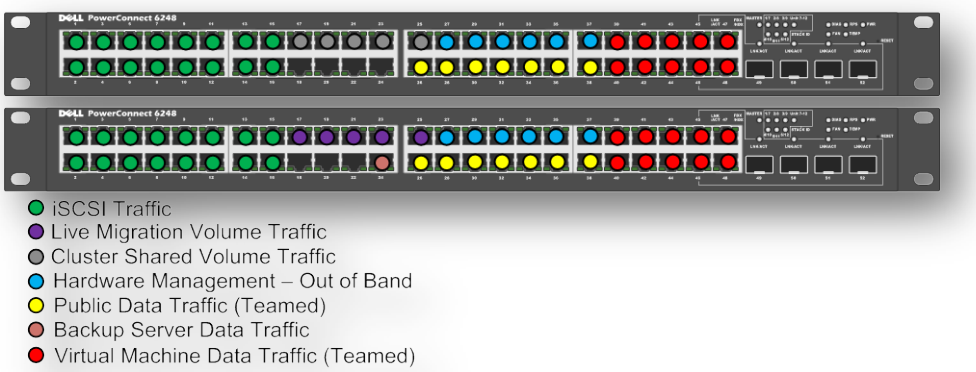


Figure 3 PowerConnect Port VLAN Tagging

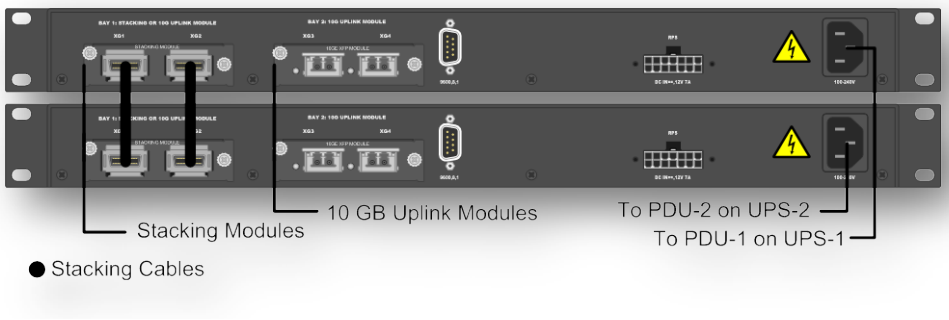


Figure 4 PowerConnect Stacking / Up links

6.1.2 Virtual Machine Network Connectivity

Virtualization offers the ability to consolidate many computing resources to improve management capabilities, to improve return on investment of hardware resources, and to increase network service availability metrics. Although these qualities are important, they often drive new design requirements that are not present in purely physical environments. One such consideration is the availability of network connectivity provided to the multiple virtual machines on a Hyper-V server. For example, in a non-virtualized environment, a physical network adapter carries the traffic for only one host. A loss of any networking component along the data path will only affect one physical server. In a virtual environment, that same physical networking adapter is carrying the traffic of all virtual machines running on the host at that time (tens of virtual machines). This places additional burden upon the design of the virtual machine network and highlights the need to reduce the loss of connectivity due to network data path hardware failures.

To lessen this burden, the reference switch configuration uses the link aggregation channel protocol (LACP) capability of the PowerConnect 6248 switch and Intel's PRO networking software on each Hyper-V server to permit four network connections to work together, allowing one link to fail without interruption of network connectivity. This aggregation has the additional benefit of increasing the effective bandwidth to four times that of a single connection.

NOTE: The reference switch configuration aggregates four network connections. It is possible to add additional connection to further improve fault tolerance and bandwidth. Adding connections will require additional Ethernet cards for each Hyper-V server, additional in rack switches, and modified configurations of those switches.

6.1.3 Other Network Connectivity

Other networks, such as the iSCSI, Public, and Cluster networks, are also critical to the reference configuration. These will be covered in later sections.

6.1.4 Uplinks (Off-Rack Connectivity)

Off-rack connectivity is provided by using an additional CX-4 10-GB uplink capable Ethernet switch (i.e. PowerEdge 62xx family switch). This switch, when connected to the in-rack PowerConnect 6248 using a PowerConnect 6200 family 10Gb uplink cable, provides extensive connectivity into customer environments and makes them highly configurable. For example, an extensive client-side network can be implemented as needed and simply connected to the reference configuration network through an uplink port of the PowerConnect 6248 for end-to-end configuration deployment. Customers wishing to increase their bandwidth to and from the reference configuration can use multiple PowerConnect 6200 family 10Gb uplink cards and cables. Additional switches can also be used to improve the fault tolerance of the deployment.

NOTE: The sample switch configuration shown in "Appendix A: Reference Network Configuration" includes configuration of the two uplink ports of the PowerConnect 6248 switches (ports xg3 and xg4).

6.2 Storage Architecture

The reference configuration uses Microsoft Failover Clustering to provide high availability of virtual machine resources. With Failover Clustering, two or more Hyper-V hosts work together to provide the computing resources needed to host virtual machines. This enables virtual machines to move between physical hosts, leveraging the encapsulation provided by Hyper-V virtualization. Because virtual machines can move between hosts, they cannot reside on local (i.e. server) storage which only one host can access; rather, they must reside on a shared storage that all Hyper-V hosts can access.

This shared storage is provided by a Dell PowerVault MD3000i storage array using the iSCSI protocol. This device holds up to 15 hard drives and contains two intelligent iSCSI controllers offering load balancing and fault tolerance across the controllers. The MD3000i can be expanded to 45 drives by attaching two MD1000 disk enclosures.

6.2.1 iSCSI Storage Network Connectivity

Although other shared storage technologies exist, iSCSI offers the needed shared functionality required at a lower cost than those other technologies. The iSCSI protocol (RFC 3720) enables traditional SCSI commands to be sent over a traditional Ethernet network using existing TCP/IP protocols. Using iSCSI-based storage in this reference configuration allows all Ethernet traffic to pass through the Dell PowerConnect 6248 enabling the configuration to be scaled at a lower initial cost than that of fiber channel solutions.

As mentioned earlier, the reference configuration uses two subnets for MD3000i connectivity. The use of two subnets ensures the load balancing algorithms of the MD3000i software work correctly. Please consult the PowerVault MD3000i manual for more information about these algorithms.

6.2.2 Jumbo Frame

Traditional Ethernet data (including iSCSI data) is typically sent in groups of data (called frames) of 1500 bytes. Due to Ethernet overhead, a frame is always made up of less than 1500 bytes of data. While this size may work for typical Ethernet data, it is far too small for storage data sent using iSCSI. The relatively small frame size introduces much more overhead, thus slowing storage transactions and causing network inefficiencies. To combat these inefficiencies, switch vendors (including Dell) have implemented RFC4638 to allow data packets of up to approximately 9 KB in size. Doing so allows more data to be sent at one time. These larger packets are referred to as jumbo frames.

The reference configuration takes advantage of jumbo frames on the iSCSI network. This involves special switch configuration for iSCSI network ports between the PowerConnect 6248, Hyper-V Servers, and PowerVault MD3000i. Step-by-step configuration steps for this are provided in Section 9.

7 Configuration

This section discusses how the components of the reference configuration have been designed and configured. Although other configurations are possible, they will not be discussed in great depth. Possible modifications are noted where appropriate.

Dell provides several documents intended to help customers understand, design, and deploy Dell-Hyper-V environments. These documents form the foundation of this reference configuration discussion. It is strongly recommended that these documents be reviewed prior to deploying this configuration. These documents include:

- *Hyper-V Solutions Overview Guide* (http://content.dell.com/us/en/business/d/business~solutions~engineering-docs~en/Documents~sova00.pdf.aspx)
- *Hyper-V High Availability Guide* (http://content.dell.com/us/en/business/d/business~solutions~engineering-docs~en/Documents~hsga00.pdf.aspx)
- *Hyper-V Storage Solutions Guide* (http://content.dell.com/us/en/corp/d/business~solutions~engineering-docs~en/Documents~ssga00.pdf.aspx)
- *Hyper-V Networking Guide* (http://content.dell.com/us/en/business/d/business~solutions~engineering-docs~en/Documents~hyper_network_guide_01.pdf.aspx)

NOTE: These documents do not cover the new and added features of Windows 2008 R2 or Windows Hyper-V R2. Instead they serve as a reference or guideline for general best practice information for complete virtualized environments.

The discussion in the rest of this section is not intended to serve as a deployment plan for the architecture. Deployment check lists are offered in section 9.

7.1 Networking

As discussed in section 6.1, two Dell PowerConnect 6248s are used for all networking on the reference configuration. The use of two enterprise-level switches involves a more complex configuration, but provides redundancy and added bandwidth for business critical applications. The use of stacking provides a simplified deployment, configuration, and ease of maintenance of the configuration. Stacking is required to support the Link Aggregation Control Protocol (LACP) teaming across switches, used by the virtual machine and parent partition networks.

To provide the network isolation outlined in section 6.1, the switch needs to be VLAN'ed or divided into logical networks (i.e. subnets) with the proper switch configuration for each network. As configured here, the ports of the switch are statically assigned to a VLAN as defined in Table 5. These static mappings are laid out in groups (Figure 3) to allow for easy deployment of both the base and additional Hyper-V servers (up to five servers) when used in conjunction with the reference switch configuration shown in "Appendix A: Reference Network Configuration."

The reference switch configuration can be broken down into sections:

- VLAN creation
- DHCP relay definition
- VLAN gateway and subnet definition
- Per-port definition VLAN assignment
- Virtual machine link aggregation definition
- Uplink port configuration

- Stacking membership

Consult the PowerConnect 6248 manual for more information about the settings in a sample switch configuration file, http://support.dell.com/support/edocs/network/pc62xx/.

7.2 Servers

Configuration of the servers in the reference configuration requires knowledge of several different vendors including Dell, Microsoft, Intel and Broadcom®. While all of these cannot be covered here, this section offers high-level configuration aspects as appropriate to each server function in the reference configuration. The three server types are:

- Infrastructure
- Management
- Hyper-V

Server Firmware, Drivers and Updates

Dell offers a simple way to ensure that each server has the latest Dell-approved system and peripheral firmware installed. In the download section of the server from support.dell.com there is a Dell OpenManage™ utility called Software Update Utility (SUU). Once you have downloaded and burned the utility onto a DVD, place the disk into the CD/DVD drive. If auto-play does not launch the utility automatically, manually launch it. Accept the software's update/installation recommendations, rebooting the server as needed. Once complete, the server will be ready to go with the latest firmware and operating system drivers.

At the time of this paper, some Microsoft updates were available and might apply to your configuration.

If you receive a `0x00000101 - CLOCK_WATCHDOG_TIMEOUT` message on an Intel Xeon 5500 series processor-based computer that is running Windows Server 2008 R2 and that has the Hyper-V role installed go to - http://support.microsoft.com/kb/975530

If you receive a `Stop 0x0000007E` error on the first restart after you enable Hyper-V on a Windows Server 2008 R2-based computer, go to - http://support.microsoft.com/kb/974598

NOTE: Other hot fixes and/or updates might be recommended by Microsoft. The Microsoft recommendations supersede the recommendations here. It is recommended to install the latest service pack and Windows updates available from Microsoft before enabling any server roles. Any hotfix is intended to correct only the problem that is described within the article. Apply the hotfix only to systems that are experiencing the problem described in the article. The hotfix might receive additional testing. Therefore, if you are not severely affected by this problem, we recommend that you wait for the next software update that contains the hotfix. Dell does NOT support the installation of any drivers from Microsoft.

The following table provides a break-down of the minimum driver / firmware version used in this reference configuration. These apply to each server.

Driver / Firmware	Version
BIOS	1.2.6
PERC 6/I Firmware	6.2.0-0013
SAS/SATA Backplane Firmware	1.07
Broadcom 5709 Driver	14.1.1
Broadcom 5709 Firmware	5.0.9
Intel 1000VT PRO Driver	11.5

Table 6 Driver Firmware Versions

NOTE: Other options are available from **support.dell.com** for your server hardware including Repository Manager and update via the iDRAC interface. For more information consult the driver help section or *support.dell.com*.

NOTE: Be sure to use the latest Dell approved drivers available from *support.dell.com*. To find the latest drivers, browse to the download section for the system. Dell does NOT support the installation of any drivers from Microsoft.

7.2.1 Infrastructure Server

The reference configuration includes this server to provide basic Microsoft infrastructure services such as Active Directory, DHCP and DNS services. Although it is possible to enable more server roles/features on this server, Microsoft best practices suggest this server functionality be limited to these three roles because the services provided by this server are critical to any environment. Additionally, this server should not be used for day-to-day management of the reference configuration.

NOTE: If you have an existing Active Directory, DHCP or DNS services running on an existing server in your environment, this server could be used as addition redundancy or backup for those services.

Operating System Installation

The Microsoft® Windows® 2008 R2 Standard Edition operating system should be installed on this server. This version enables the operating system to access up to 32 GB of RAM. For more information on Windows memory limits see http://msdn.microsoft.com/en-us/library/aa366778%28VS.85%29.aspx#physical_memory_limits_windows_server_2008_r2. If ordered with the server, Windows 2008 R2 will come pre-activated by Dell.

Network Configuration

This server uses a teamed 1Gb network connection. Special configuration of this connection is required. Please consult the Broadcom Advanced Configuration Suite™ (BACS) software users guide for more information.

NOTE: This server MUST have a static IP address. If you are using the sample switch configuration file (Appendix A: Reference Network Configuration), the address should be in the 172.20.1.0/24 network (i.e. 172.20.1.10). If a different address schema is used, the switch configuration file must be modified.

Server Role Activation

Only the active directory domain services, dynamic host configuration protocol and domain name services roles should be enable on this server.

Additional Considerations

It is suggested that an additional active directory server be added to the environment to provide redundancy to the physical infrastructure server. If you have an existing infrastructure environment with Active Directory, DHCP, and DNS services deployed, an option could be to use the infrastructure server referenced here to provide added redundancy or backup capacity in your environment. However, if that is not an available option or you do not have an existing infrastructure, an additional server can be added virtually. It is important to remember that any virtual instance of these services is to provide backup should the physical host fail. Hyper-V hosts depend on Active Directory, DNS, and DHCP in order to function properly. Should the virtual instance fail along with the physical instance, all services would be unavailable and you would be unable to log into the Hyper-V host to access and manage any virtual machines (including any virtual servers providing AD and DNS services). Please see the following for information on running active directory domain controllers in a virtualized environment. http://www.microsoft.com/downloads/details.aspx?displaylang=en&FamilyID=7425e34b-3990-43d8-b93b-cb6442858c21

NOTE: Although it might be possible to access a specific active directory server through Remote Desktop Protocol (RDP), this method might not be possible in the event of a network or DNS failure. A possible alternative to using a virtual machine for backup AD/DNS services is to use a second physical infrastructure server.

NOTE: When using the online Configurator, additional infrastructure servers can be ordered. Be sure that the racking solution you ordered has sufficient space for additional servers.

Consult Microsoft's documentation for information concerning proper setup up of these services at www.microsoft.com.

7.2.2 Management Server (Optional)

The reference configuration can include this server to host the System Center Virtual Machine Manager 2008 R2[1] and Dell Modular Disk Storage Manager (MDSM) software. Although it is possible to run additional software on this server, it is suggested that this be limited to only the software outlined here.

Operating System Installation

Windows 2008 R2 Standard edition should be installed on this server. This version allows the operating system to access up to 32 GB of RAM. For more information on Windows memory limits see http://msdn.microsoft.com/en-us/library/aa366778%28VS.85%29.aspx#physical_memory_limits_windows_server_2008_r2. If ordered in conjunction with the server, Windows 2008 R2 will come pre-activated by Dell.

Be sure to use the latest Dell-approved drivers available from **support.dell.com**. To find the latest drivers, browse to the download section for the system. Dell does NOT support the installation of any drivers from Microsoft.

Network Configuration

This server uses a teamed 1Gb network connection. Special configuration of this connection is required. Please consult the Broadcom Advanced Configuration Suite (BACS) software users guide for more information.

NOTE: This server MUST have a static IP address. If you are using the sample switch configuration file (Appendix A: Reference Network Configuration), the address should be in the 172.20.1.0/24 network (for example, 172.20.1.11). If a different address schema is used, the switch configuration file must be modified.

NOTE: Additional network configuration would be necessary if System Center Virtual Machine Manager 2008 R2 is used. Storage for the virtual machine library could be configured to use the iSCSI network storage of the MD3000i. This would require setup and configuration of the iSCSI initiator and network ports on this server. This setup would be similar but not identical to the Hyper-V host servers.

Server Feature Activation

This server can be used to remotely manage the Failover Clustering and Hyper-V services running on the Hyper-V servers. To enable remote management of these servers, install the following Remote Server Administration Tools:

- Role Administration Tools-> Hyper-V Tools
- Feature Administration Tools -> Failover Clustering Tools

Management Software Installation

The reference configuration includes additional optional management software from Microsoft (configurable at time of purchase). This software can aid in the management, deployment, and monitoring of servers and clients as well as to simplify the deployment and management of virtual machines.

The management software might include:

- System Center Virtual Machine Manager 2008 R2[1]
- Dell Modular Disk Storage Manager (MDSM)

NOTE: [1]System Center Virtual Machine Manager 2008 R2 is an optional software component that can be added at time of purchase but might require contacting your Dell sales representative for details. Configuration and use of SCVMM 2008 R2 will not be covered as part of this document. Consult Microsoft's documentation concerning the planning, installing, and operation of the management software present in the reference configuration.

NOTE: These are software versions are targeted at the medium-sized business market. Consult section 8.5 for more information about the limitations of these software packages.

7.2.3 Microsoft® Hyper-V™ Servers

Servers running the Hyper-V role form the center of the reference configuration.

Operating System Installation

Microsoft Windows® 2008 R2 Enterprise edition should be installed on this server. This version enables the operating system to access up to 2 TB of RAM, and provides support for high availability through failover clustering. If ordered with the server, Windows 2008 R2 will come pre-activated by Dell.

Be sure to use the latest Dell-approved drivers available from **support.dell.com**. To find the latest drivers, browse to the download section for the system. Dell does NOT support the installation of any drivers from Microsoft.

Activate the Needed Roles and Features

The following roles and features should be enabled on all the Hyper-V servers:

- Roles: Hyper-V
- Features: Failover Clustering and Multi-path I/O (MPIO

Enabling these will require the server to reboot a few times. Following the required reboots, you can install any recommended hot fixes as noted previously.

NOTE: Other hot fixes and/or updates may be recommended by Microsoft. The Microsoft recommendations supersede the recommendations here.

Network Configuration

The Hyper-V servers require multiple Ethernet ports and some advanced configuration provided by Broadcom software. Specifically, each server used twelve Ethernet ports – four on the system board and eight from two Intel Gigabit VT Quad Server Adapter add-in cards. The following table shows the functional breakdown (i.e. Network connections) of these ports:

Server Network Port	Network Name
LOM #1	Main or "Public" Network
LOM #2*	Cluster / CSV Network
LOM #3*	Live Migration Network
LOM #4	Main or "Public" Network
Add-in Card #1 Port #1	iSCSI #1 Network*
Add-in Card #1 Port #2	Virtual Machine Network

Server Network Port	Network Name
Add-in Card #1 Port #3	iSCSI #2 Network*
Add-in Card #1 Port #4	Virtual Machine Network
Add-in Card #2 Port #1*	iSCSI #1 Network*
Add-in Card #2 Port #2*	Virtual Machine Network
Add-in Card #2 Port #3*	iSCSI #2 Network*
Add-in Card #2 Port #4*	Virtual Machine Network

Table 7 Hyper-V Server Ethernet Port to Network Function Mappings

NOTE: Asterisked items above would not be present in the consolidation configuration. Shared storage is not present in the consolidation configuration and, therefore, no iSCSI connects are present. Only one quad port add-in adapter is present.
These connections map to the switch network port functions defined in section 6.1.1. In general, you should follow a connection pattern when connecting each NIC port to the switch to allow for a fully redundant configuration. The exceptions to this are the virtual machine, Hyper-V R2 servers, and Infrastructure server switch ports. Because link aggregation is used for this traffic, the pair of connections from each server must be connected to a port of the same group of two. Luckily, the pairs are reasonability laid out in up and down pairs and match from switch to switch to accommodate the maximum reference configuration Hyper-V server count of five.

All network ports on a Hyper-V server should have static addresses, with the exception of the virtual machine Ethernet ports (covered in the Virtual Machine section below).

Consult the Hyper-V Networking Guide for more information on the architecture of Hyper-V's virtual network stack as well as a discussion of deployment considerations and procedures. Additionally, this guide will aid with the mapping of physical Ethernet ports to Windows-enumerated network adapters, the configuration of virtual switches, and the optimization of Windows server to work with more than one Ethernet connection.

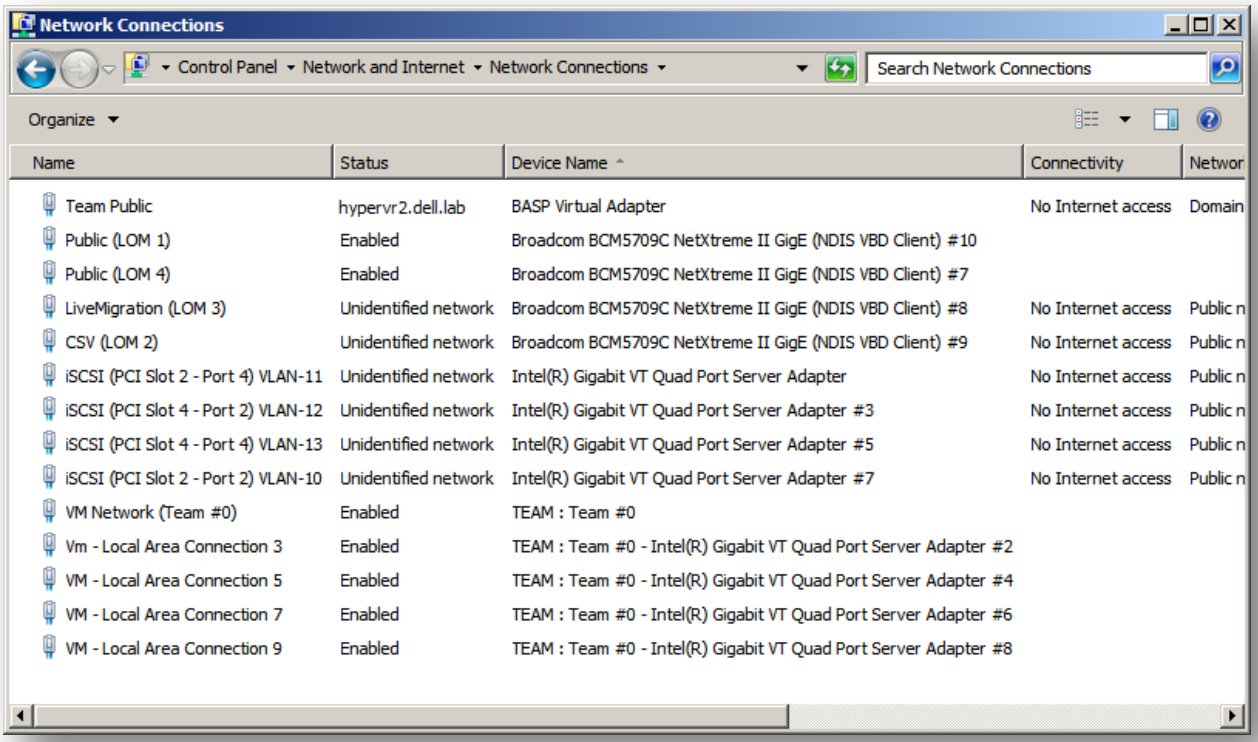


Figure 5 Sample Windows Network Connections

NOTE: Figure 5 shows the result of configuring a Hyper-V server per the Hyper-V Networking Guide and when network teaming is enabled. Read this white paper for basic server setup guidance and section 9 for guidance on teaming.

Main or "Public" Network

If using the sample switch configuration file (Appendix A: Reference Network Configuration), the address should be in the 172.20.1.0/24 network (i.e. 172.20.1.12). This network is referred to as Parent Partition in the Hyper-V Networking Guide and in Figure 5 above.

Cluster Network / Cluster Shared Volumes

If using the sample switch configuration file (Appendix A: Reference Network Configuration), the address should be in the 172.30.1.0/24 network (i.e. 172.30.1.12).

Cluster Network / Live Migration

If using the sample switch configuration file (Appendix A: Reference Network Configuration), the address should be in the 172.40.1.0/24 network (i.e. 172.40.1.12).

iSCSI Network

As mentioned, this reference configuration uses iSCSI shared storage provided by Dell's PowerVault MD3000i. This expandable array scales to provide up to 90TB of data, enough for most small and medium business needs.

Detailed setup instructions are available in the PowerVault MD3000i documentation.

Virtual Machine Network

As mentioned in section 6.1.2 Virtual Machine Network Connectivity, the reference configuration uses link aggregation (i.e. teaming) to provide both network link fault tolerance and improved bandwidth for the virtual machine connections of each Hyper-V server. This teaming capability also requires the use of

third-party software provided by Intel, as well as a special network switch port configuration. See Section 7.1 and Section 13 for more information about this special network configuration.

Figure 6 shows a configured teaming virtual adapter made up of the Intel devices labeled “Intel® Gigabit VT Quad Port Server Adapter” and “Intel® Gigabit VT Quad Port Server Adapter #2.” These adapter numeric references might vary from server to server. They need not match across servers, but the cabling of the physical adapters must be connected to Virtual Machine Network ports of the reference configuration switch.

It is important to note that the virtual adapter shown in this figure is not related to the virtual network of Microsoft Hyper-V, although this Intel virtual adapter is used as the outside network connection when creating the Hyper-V virtual switch.

The Dell Hyper-V Networking Guide white paper mentioned above shows how to create a Hyper-V virtual switch on top of a physical adapter. Because network teaming is used in the reference configuration, the Hyper-V virtual switch will be created on top of the Intel network team (as shown in Figure 25).

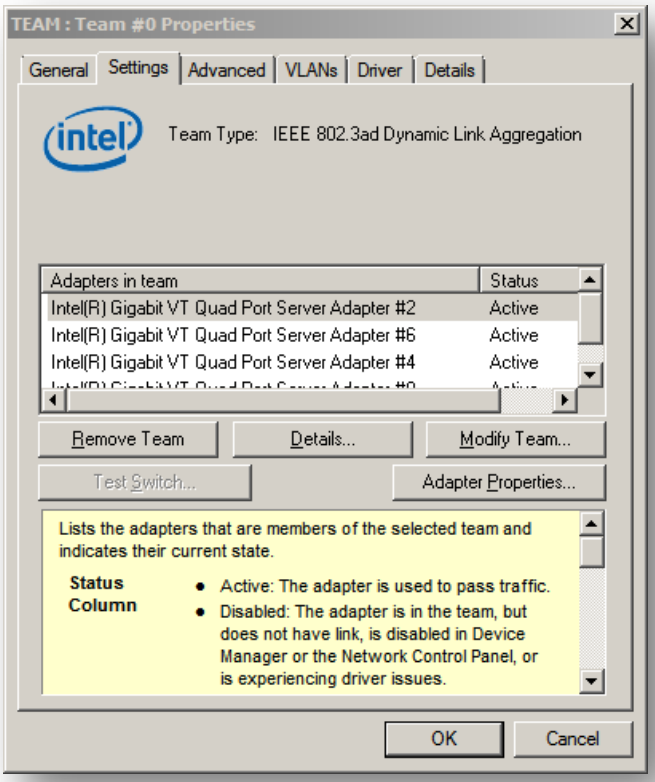


Figure 6 Intel Team Adapter Configuration

Detailed teaming adapter setup steps are discussed in the Deployment section of this document, section 9.

Adding Hyper-V Servers

The reference configuration is designed to support up to five Hyper-V servers. Although it is possible to extend the configuration beyond five, to a maximum of 16, changes to the configuration are required. This includes the addition of network switch ports.

Addition of Network Switch Ports

Each Hyper-V server requires thirteen Ethernet connections (including one for out-of-band server management through iDRAC). With five Hyper-V servers (and other support hardware), the 96 Ethernet

ports of the two PowerConnect 6248 switches will be exhausted. Additional PowerConnect 6248 switches can be added and connected together using additional stacking modules and cables. The reference switch configuration can be used for this switch, but it would require modifications to accommodate the added switches. See “Appendix A: Reference Network Configuration.”

NOTE: Expanding the reference configuration beyond five Hyper-V servers will require in-depth performance monitoring of other reference configuration sub-systems such as networking and storage to ensure that bottlenecks do not affect performance.

7.3 Storage

The shared storage used in the reference configuration is highly flexible, configurable, and expandable.

7.3.1 Shared-Storage Volume Size Considerations

Before you use the MD3000i in the reference configuration, the array (and any additional MD1000s) must be divided into logical units. These units are called disk groups and are made up of physical hard drives. Before they can be used, these disks groups must be further divided into virtual disks.

NOTE: The virtual disks referenced here are not related to Hyper-V virtualization or virtual disk files. In this section, the term virtual disk means a property of the MD3000i storage array, unless otherwise noted.

Virtual disks must be sized to accommodate not only the virtual machine hard drive (VHD), but also the size of the virtual memory of the virtual machine and enough space for any snapshots of the virtual machine.

NOTE: By default, when using Cluster Shared Volumes virtual machine snapshots are stored within the CSV on the shared storage. Ensure that enough space is available as snapshots are created.
The following equation can be used as a starting guideline for sizing shared storage virtual disks:

```
Required Shared Storage = 1.05 *(allocated virtual machine ram + Size of all VHDs + (Space for Snapshots))
```

Virtual machine snapshots record differences in VHD data between previous snapshots and the base VHD file. Snapshots with few changes are roughly 100 MB at minimum. Running out of shared storage **will** cause the virtual machine to pause and not restart until more disk space is made available. The equation above suggests an extra 5% of disk space be allocated to prevent this condition. This extra disk space will also prevent Windows from warning about low disk space.

7.3.2 Array RAID Configuration

The storage array RAID configuration is highly dependent on the workload in your virtual environment. The Dell PowerVault MD3000i array supports four RAID types— RAID 5, RAID 6, RAID 10, and RAID 50.

RAID 10 provides the best performance at the expense of storage capacity. RAID 50 generally provides more usable storage but has less performance than RAID 10 in random I/O situations and requires additional overhead in the case of a drive failure scenario. RAID 5 provides the highest storage capacity at the expense of slightly lower performance and availability.

The reference configuration used RAID 5 with disk groups of seven hard drives. This allows for two RAID 5 disk group to be created in one MD3000i array.

In the event of a disk failure, the RAID 5 configuration allows for one disk failure per disk group. Additionally, the use of a hot spare allows the first failed disk to be replaced automatically by the MD3000i. In the event of a failure, a rebuild operation will start once the failed disk is replaced. This rebuild operation might result in a performance impact during the rebuild process.

NOTE: A disk group of no more than seven hard drives should be used because it will leave fewer than seven disks for another disk group. A seven hard drive configuration offers a reasonable compromise between RAID set performance and failed disk recovery although advance users might use more disks and different RAID levels with different storage characteristics if desired (such as improved performance for high I/O applications). Additional disk enclosures (i.e. the MD1000) should be considered when using RAID levels other than RAID 5.

An MD1000 with an additional disk enclosure in a seven disk RAID 5 is recommended when expanding beyond three Hyper-V servers, although this will depend upon individual storage performance and sizing requirements. MD1000 disk enclosures must be daisy-chained to the base MD3000i.

7.3.3 Adding Storage Space

It is recommended that you add an MD1000 storage chassis to the MD3000i when expanding beyond three Hyper-V servers for the following reasons:

- More shared space might be required to physically support the space requirements of additional virtual machine (VHD files and support files) that would run on additional Hyper-V servers. Although it might be possible to use larger hard drives, this is not recommended.
- As with any storage array, I/O throughput is bounded by the capabilities of the storage controllers, the hard drive specifications, network, and RAID configuration. As a general rule, the more hard drives assigned to a RAID array, the higher its performance. Adding hard drives of greater capacity to achieve overall storage capacity needs can lead to an insufficient number of hard drives being used which might impact performance. Adding an MD1000 connected to the MD3000i with many cheaper drives in the MD1000 might offer a better price vs. performance trade off.

Consult the MD3000i/MD1000 documentation for more information.

7.4 Virtual Machines

When deploying virtual machines, be careful to install device drivers and storage-related operating system modifications. The following sections discuss these modifications.

7.4.1 Virtual Machine Drivers (Integration Services)

A Microsoft® Hyper-V™ R2 virtual machine provides an operating system with virtual devices; these devices require drivers just like physical servers. These drivers, called integration services, ensure proper usage of the virtual devices and also enable kernel-level interactions of guest operating systems. These services are available for all supported guest operating systems. A complete list of supported guest operating systems is available (http://support.microsoft.com/kb/954958).

7.4.2 Storage Device Modifications

Virtual machines must be modified to function optimally with the shared storage used in this reference configuration. Specifically, the guest operating system configuration files (i.e. the registry for Windows operating systems) must be configured to allow for the possibility that information from the shared storage could take longer to be serviced by the MD3000i during an unexpected failure of catastrophic error recovery procedure. This is done by adjusting time-out values of the Windows and Linux storage sub-systems. This procedure is outlined in the *Hyper-V Storage Solutions Guide* referenced at the beginning of this section.

8 Management

This section discusses several management aspects of the reference configuration. Each of the subsections represents a different aspect required for the overall management of the solution. We start with a discussion of low-level hardware management options and end with virtual machine management, which represents the order in which the reference configuration should be deployed.

8.1 Physical Server Management

The reference configuration is made up of several Dell PowerEdge servers. Although each of the servers plays a different role in the reference configuration, each can be managed in the same manner using both standard and optional server capabilities.

8.1.1 Keyboard, Video, Mouse (KVM)

Each server ships with integrated keyboard, video, and mouse interfaces. Although KVM devices can be connected directly to each server as needed, use of a KVM aggregation device is suggested. These devices can be considered as special switching devices that allow one or more users to be remotely connected to one or more servers at the same time.

KVM systems are available in analog and digital versions, each having different capabilities and limitations. An analog system can be considered as analogous to the old-time phone systems where an operator manually connected the wires between two points. A digital system can be considered as a modern-day Ethernet network. At the time of this writing, while digital systems are more expensive, they might offer greater flexibility.

NOTE: When you order a configuration online or with the help of a Dell representative, be sure to include a KVM system. The system should be large enough to cover the expected growth of your solution. The reference configuration is designed to support up to five Hyper-V servers, although more servers can be added by modifying the storage and network components of the reference configuration.

8.1.2 iDRAC

The Integrated Dell Remote Access Controller6 (iDRAC6) is a systems management hardware and software solution that provides remote management capabilities, crashed system recovery, and power control functions for Dell PowerEdge systems.

The iDRAC6 uses an integrated system-on-chip microprocessor for remote monitor/control systems. The iDRAC6 co-exists on the system board with the managed PowerEdge server. The server operating system executes applications while the iDRAC6 monitors and manages the server environment and state outside of the operating system.

The iDRAC is available in three versions—Express, Enterprise, and Enterprise with vFLASH. All versions offer basic connectivity KVM and basic authentication through a shared Ethernet port (configurable within the system BIOS). The Enterprise version offers additional features and a dedicated management port.

NOTE: The “High Availability” and “High Availability+Backup” version of the reference configuration includes the Enterprise version of Dell’s iDRAC 6; the “Consolidation” version includes the Express version. This is a configurable option.

Consult a PowerEdge server manual at support.dell.com for more information about the iDRAC version and configuration options.

8.2 Storage Management

The Dell PowerVault MD3000i features an easy-to-use management application. This application, Modular Disk Storage Manager (MDSM), enables complete setup and management of the storage array from one interface.

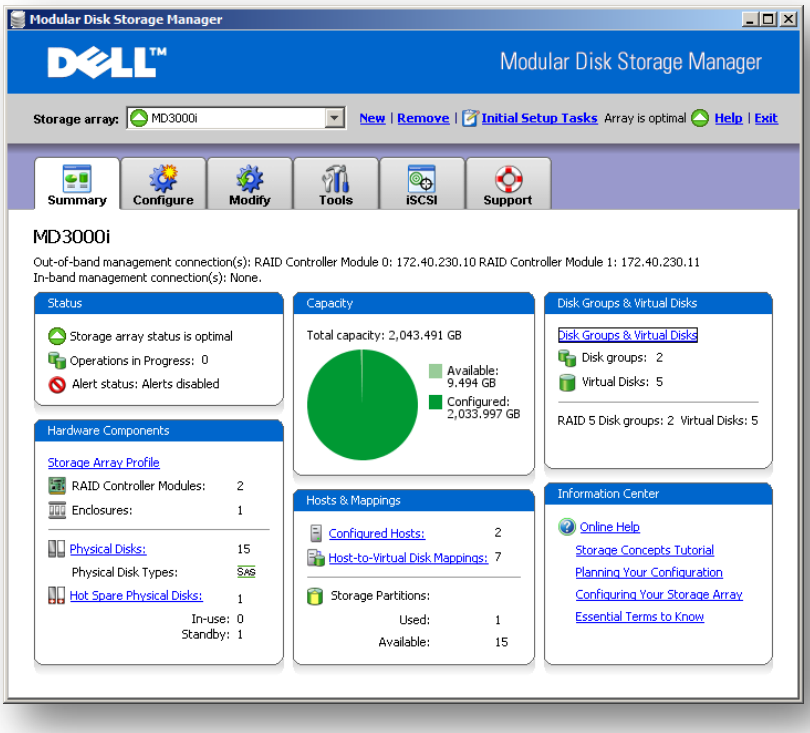


Figure 7 MD3000i Management Screen

For more information about the MD3000i, visit www.dell.com/md3000i.

8.3 Systems Management

Dell OpenManage: A security-rich Web tool, Dell OpenManage Server Administrator can help customers manage individual servers and their internal storage from virtually anywhere at any time. Dell OpenManage Server Administrator is available at no additional charge. The tool:

- Helps simplify single server monitoring with a secure command line or Web-based management graphical user interface
- Provides views of system configuration, health, and performance
- Provides online diagnostics to help isolate problems or shutdown and restart the server (see www.dell.com/openmanage for more information about Dell OpenManage)

Unified Server Configurator (USC): Dell PowerEdge R710 servers ship with USC which helps customers reduce operating costs by simplifying deployment and management. Key features include diagnostics, self-update (UEFI, driver pack update), firmware updates (BIOS, NIC FW, RAID Controllers), and hardware configuration.

Consult the server manuals at support.dell.com for more information about these and other system management tools.

8.4 Backup Management

The reference configuration uses the Dell PowerVault DL2100 Backup to Disk Appliance powered by CommVault to enable backup capabilities. This product is an enterprise-class appliance offering backup to disk capabilities and optional tape library support using the CommVault Simpana software and is tightly integrated with the Hyper-V software used in this reference configuration.

The DL2100 is easy to setup, deploy and use. Upon power-up, the software automatically launches a configuration wizard, which allows for automatic provisioning of the disks in the storage enclosure. Once the DL2100 configuration is complete, the appliance can backup Hyper-V virtual machines without interruption of the virtual machine (and guest service) capabilities as well other server services. For more information on CommVault's Virtual Server Agent see http://documentation.commvault.com/commvault/release_8_0_0/books_online_1/english_us/prod_info/virtual_server.htm

NOTE: To fully support Virtual Server Agent for Hyper-V on Windows 2008 R2 and its additional features, please download and apply Service Pack 3 (https://dell.commvault.com/support/advantage/service_packs.asp?fv=8.0) and these updates from CommVault: http://qupdate.commvault.com/files/W2K8-R2_updates.zip. At the time this document was released Service Pack 4 was not available. When Service Pack 4 is available it will supersede Service Pack 3 and the updates listed above.

8.5 Virtual Machine Management

Microsoft Windows 2008 R2 Enterprise natively ships with the ability to locally manage Hyper-V servers with limited cross-server manageability (power on, shut down, and migrate) using the Hyper-V Manager snap-in. For single server Hyper-V deployments, these functions might be sufficient. If multi-server management, rapid virtual machine deployment, and many-to-many administration are required, you can use Microsoft add-on management products such as System Center Virtual Machine Manager 2008 R2. The failover cluster feature does provide a single place to manage most of the critical functions of a virtualization environment. This would be available with either of the High Availability options. Additionally, Microsoft offers management products to aid with health monitoring and life cycle management as part of the System Center suite. More information can be found at www.microsoft.com/systemcenter.

8.6 Consolidation Management

Novell® PlateSpin® Workload Management enables you to profile, migrate, protect, and manage server workloads between physical and virtual infrastructures in heterogeneous IT environments. The PlateSpin Workload Management portfolio for Dell servers gives Dell customers a powerful data center management platform for Dell's 32- and 64-bit Windows and Linux servers with support for leading hypervisors. For more information on PlateSpin migration tools and other products, see www.dell.com/platespin.

9 Deployment

This section will aid in the deployment of the reference configuration. The steps outlined here do not address all possible configurations; rather, these steps should serve as a baseline step for the reference configuration. By following the steps and guidelines outlined, you can obtain a workable configuration with minimal effort.

9.1 Rack

The rack used in this configuration is a Dell PowerEdge 4220 with 42U's of usable space. Planning and setup of a rack and the rack components is important. You need a solid foundation in a room with plenty of air-flow, cooling, and electrical supply. Most IT-related equipment is in a rack form factor which enables easy installation and quick modification or expansion. Weight, heat, cabling, and accessibility must be considered when planning for a rack installation. The following steps make adding and changing equipment easier as your company's business grows:

Step 1.	Install the two uninterruptable power supply (UPS) units, starting at the bottom of the rack. This makes for an easier installation, and adds balance to the rack.
Step 2.	Install the Dell PowerVault Backup to Disk Appliance
Step 3.	Install the PowerVault MD3000i storage array. **NOTE:** Leave room if you are going to add additional MD1000 storage enclosures in the near future.
Step 4.	Install the infrastructure server.
Step 5.	Install the management server. (Optional)
Step 6.	Install the Hyper-V servers. This bottom up approach to adding the Hyper-V servers will enable you to easily add more Hyper-V servers in the future.
Step 7.	Install the Dell PowerConnect 6248 network switches from the back, top of the rack. This allows for expansion room in the middle of the rack. With the network ports on the back of the servers, and the switch mounted at the top, cabling clutter is kept to a minimum.

NOTE: Additional rack configurations are available for this reference configuration. Consult and review the specific rack and space requirements for the configuration prior to ordering. For a more detailed rack configuration, use the Dell Rack Advisor at *http://www.dell.com/html/us/products/rack_advisor/index.html*.

9.2 Cabling

Cabling is a key element in the simplification of a complex configuration. As discussed in the networking sections, a network VLAN configuration is used. This separates the different types of network traffic for which different cable colors are used. This helps in troubleshooting, as well as providing a visual representation of the network setup.

Infrastructure Server Network Connections

The infrastructure server network connections are the simplest in this reference configuration. The only infrastructure server network connections are the iDRAC (light blue) and LOM port 1 and LOM port 4 (yellow).

Management Server Network Connections

The management server network connections are similar to the infrastructure configuration. The only management server network connections are the iDRAC (light blue) and LOM port 1 (yellow).

Hyper-V Server Network Connections

Using Figure 8, you can match the colors from the switch to the network ports on the server and storage array.

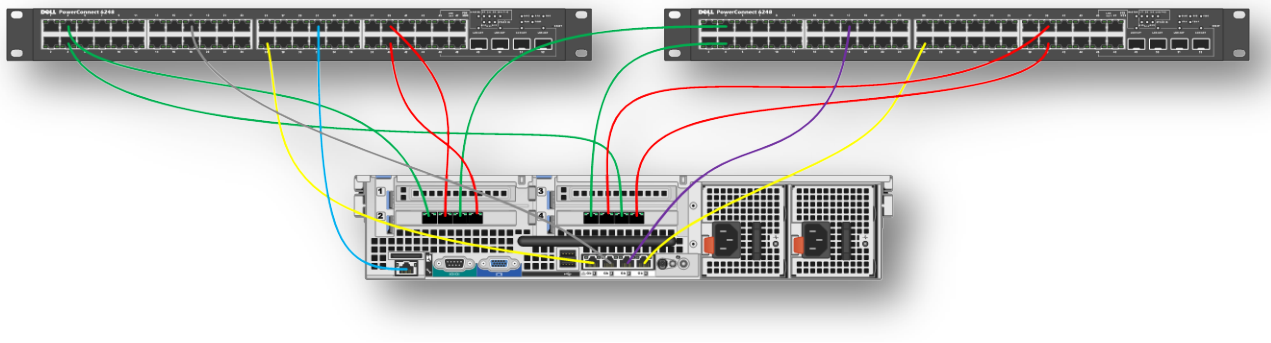


Figure 8 Server Network connections

NOTE: The consolidation server does use all of the networks ports shown in Figure 8.

Storage Network Connections

Using Figure 9, you can match the colors from the switch to the network ports on the storage array controllers: controller 0, port 0 to the top switch port #1 and controller 0, port 1 to the bottom switch port #1. Follow the same logic for controller 1, port 0 to the top switch port #2 and controller 1, port 1 to the bottom switch port #2.

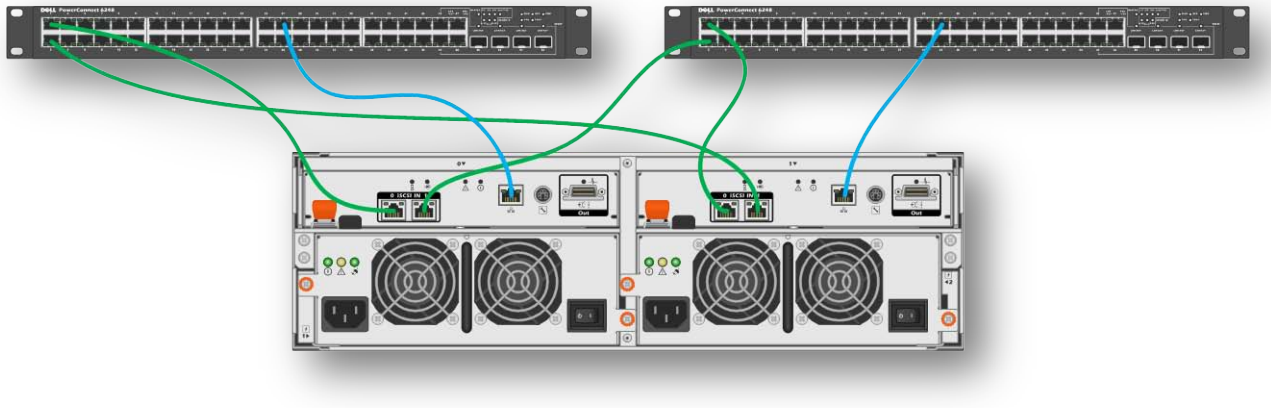


Figure 9 Storage Network connections

NOTE: The consolidation server does use iSCSI or shared storage as shown in this diagram.

Power cabling is done with the use of the two UPS units and power distribution units (PDU). The power is split equally between the two UPS units. Not only does this allow for a power failure, but it also provides even distribution of power. One of the PDUs is mounted on the back left and the other on the back right of the rack. If a third or fourth PDU are used, they should be mounted just below the two already installed in the rack.

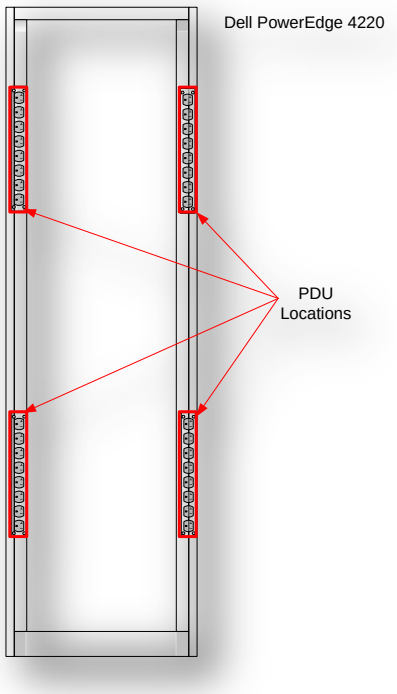


Figure 10 Sample PDU Locations

NOTE: Shorter 24U racks can use fewer PDUs.

9.3 Servers

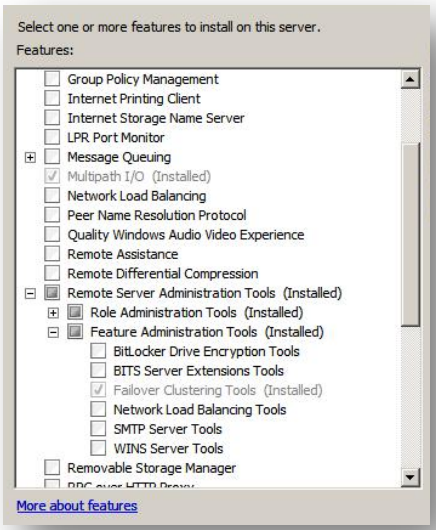
This section covers the setup of the different types of servers used in the reference solution. Since Dell pre-installs the operating system, the installation of the operating system is not covered, and the setup process begins after the operating system activation and registration process is completed.

9.3.1 Infrastructure Server

Step 1.	Using Microsoft Windows Update, install any needed security or program updates to the latest version supported by company policy. If no company policy governing updates exists, make sure to install all of the security updates at a minimum. **NOTE:** Do not install drivers available from the Microsoft site. Only drivers obtained from http://support.dell.com are supported by Dell
Step 2.	Run the Dell Server Update Utility (SUU) that came with the Dell PowerEdge R410. If the software is missing from the server box, it can be downloaded from http://support.dell.com. When running the SUU, it is best to update all hardware component devices on the server to the latest versions available.
Step 3.	Install active directory domain services. This also installs the DNS service needed for active directory to function. If DHCP is required, this role will also need to be installed, but must be done after the installation and configuration of the active directory domain services.
Step 4.	Configure the network:

a.	If the Broadcom Advanced Control Suite (BACS) was not installed during the installation of the network driver and software in step 2, install the BACS at this time to properly configure the networking devices for teaming.
b.	Assign the static IP address in the range associated with the proper VLAN ID. For this server use an address such as 172.20.1.10. Since this server is only used for infrastructure services no further network configuration is needed.

9.3.2 Management Server (Optional)

Step 1.	Using Microsoft Windows Update, install any needed security or program updates to the latest version supported by company policy. If no company policy governing updates exists, make sure to install all of the security updates at a minimum. **NOTE:** Do not install drivers available from the Microsoft site. Only drivers obtained from http://support.dell.com are supported by Dell
Step 2.	Run the Dell Server Update Utility (SUU) that came with the Dell PowerEdge R410. If the software is missing from the server box, it can be downloaded from http://support.dell.com. When running the SUU, it is best to update all hardware component devices on the server to latest versions available.
Step 3.	Join this server to the domain that you created above.
Step 4.	For feature Installation, install failover clustering tools as shown in Figure 11.  **Figure 11 Sample Failover Clustering Console Install**
Step 5.	Configure the network:
a.	If the Broadcom Advanced Control Suite (BACS) was not installed during the installation of the network driver and software in step 2, install the BACS at this time to properly configure the networking devices for teaming

b.	Assign the static IP address in the range associated with the proper VLAN ID. For this server, use an address such as 172.20.1.11. Since this server is only used for infrastructure services, no further network configuration is needed.
Step 6.	Install any additional software as needed following the manufacturer's recommended setup procedures and guidelines. This includes the shared storage management software, MDSM.

9.3.3 Microsoft® Windows 2008 R2 Hyper-V™ Servers

Step 1.	Enable Virtualization Technology in the server BIOS. For details on making changes to the BIOS, consult the documentation on http://support.dell.com
Step 2.	Using Microsoft Windows Update, install any needed security or program updates to the latest version supported by company policy. If no company policy governing updates exists, make sure to install all of the security updates at a minimum. **NOTE:** Do not install drivers available from the Microsoft site. Only drivers obtained from http://support.dell.com are supported by Dell
Step 3.	Run the SUU utility that came with the Dell PowerEdge R710. If the software is missing from the server box it can be downloaded from http://support.dell.com. When running the SUU, it is best to update all hardware component devices on the server to latest firmware and driver versions available.
Step 4.	iSCSI Network Setup Configure each of the four network adaptors with a static IP address, each being in a separate subnet, such as 172.10.1.4, 172.11.1.4, 172.12.1.4, 172.13.1.4 for each of the Hyper-V servers. Configure each of the network adaptors to use jumbo frames as shown below.

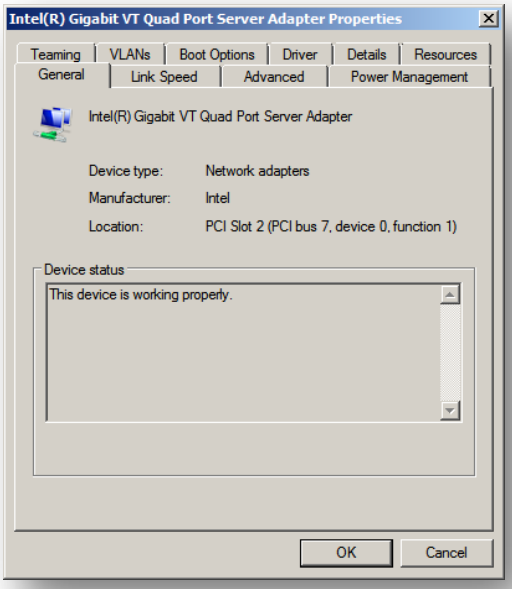


Figure 12 iSCSI Network Adaptor

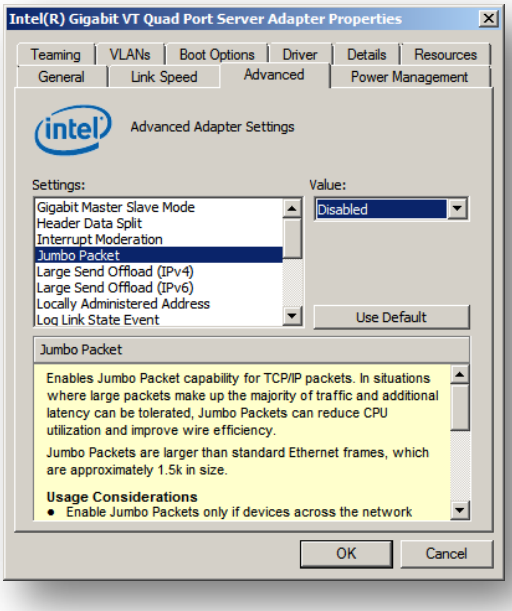
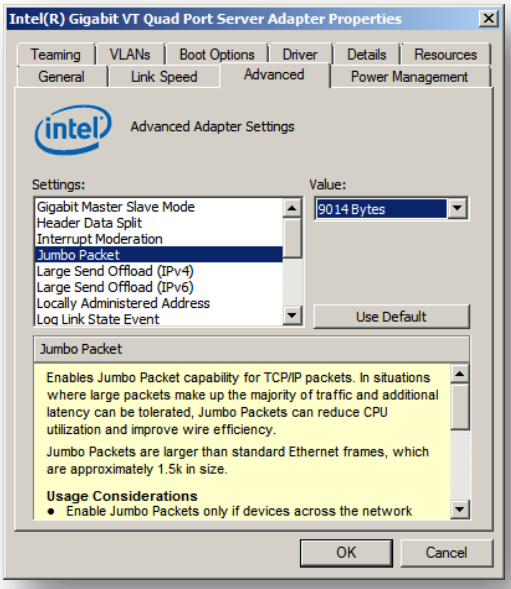


Figure 13 - iSCSI Network Jumbo Frames

	 **Figure 14 - iSCSI Network Jumbo Frames Enabled**
Step 5.	Install the PowerVault management software that came with the Dell PowerVault MD3000i. Select the host installation only, as this will install and enable the Microsoft iSCSI initiator service, Multi Path Input Output (MPIO) driver and the Device Specific Module (DSM). This software includes a host setup wizard that will configure each host with the proper configuration in order to communicate with the MD3000i storage array. **NOTE:** The MD3000i will need to have been already configured prior to completing this step. See section 9.5 for details.
Step 6.	Join this server to the domain that you created above.
Step 7.	Install the Hyper-V role. After the install has completed, check for any updates to the Hyper-V role available on Microsoft Windows Update.
Step 8.	Install the Failover Cluster feature. (See the section on **Failover Clustering** for details on cluster setup and configuration)

Virtual Machine Network Teaming Configuration

Step 1.	During the installation of the network driver and software in step 2, the Intel PRO software should have been installed. If it was not, it must be installed at this time to properly configure the networking devices.

Step 2.	Configure network teaming for virtual machine traffic. To do this, open the properties of Intel Gigabit VT Quad Port Server Adapter to bring up the screen in Figure 12.

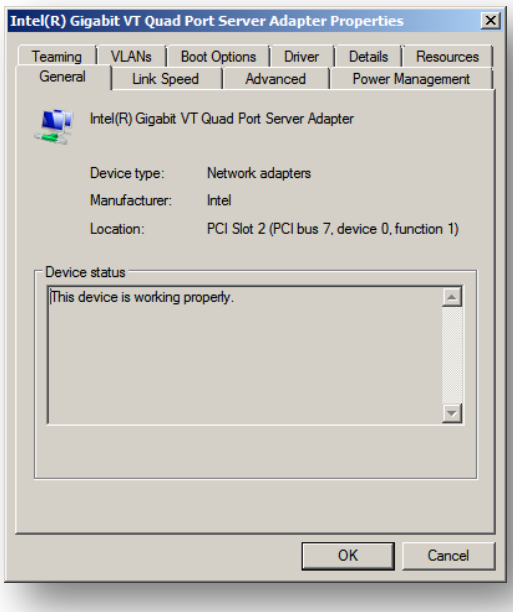


Figure 15 Sample network teaming (Prior to Setup)

Step 3.	Select the teaming tab.

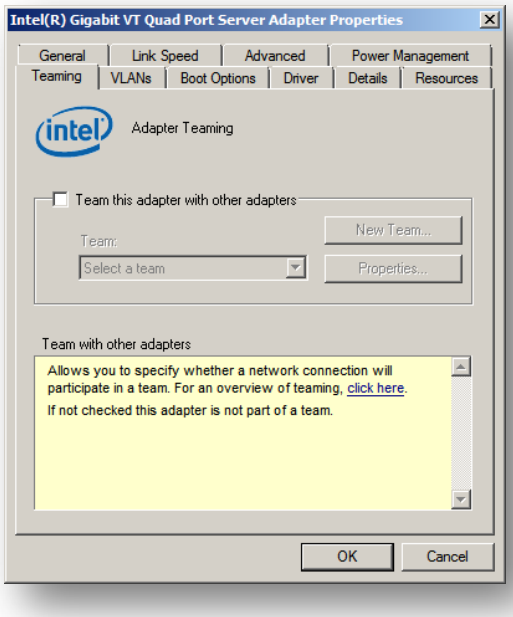


Figure 16 Intel Network Teaming Tab

Step 4.	Check the box **Team this adapter with other adapters**, then click **New Team**.

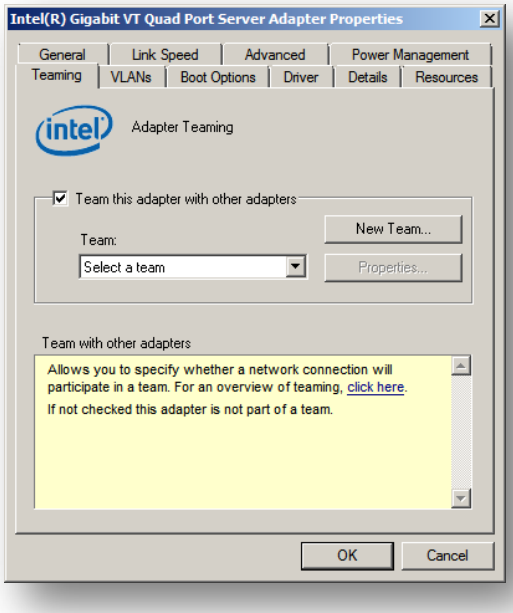


Figure 17 Sample Network Teaming NIC Selection

Step 5.	Create a name for your team.

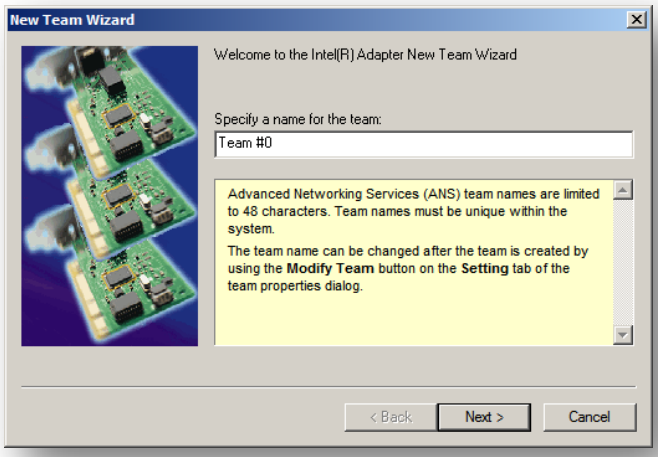
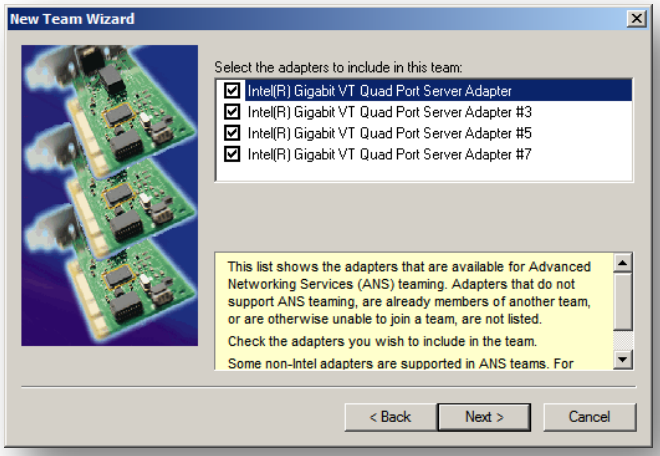
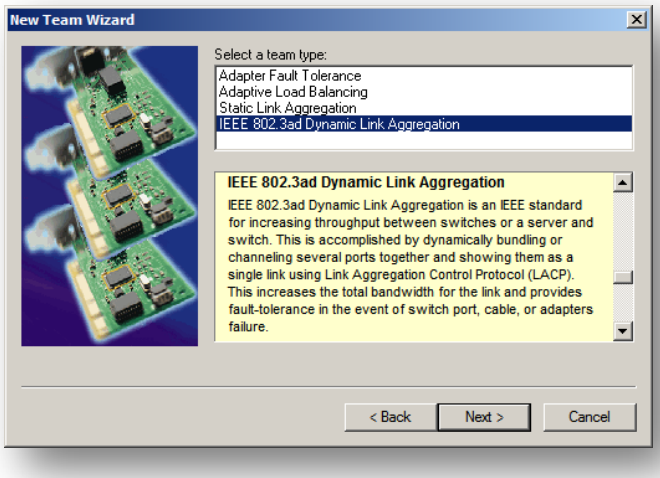
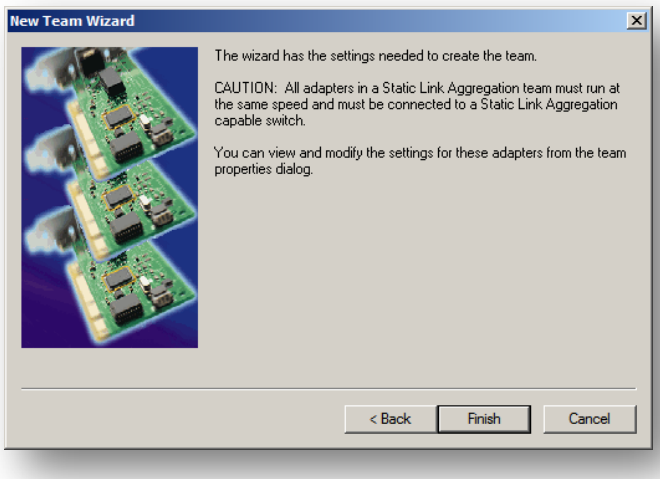


Figure 18 Intel Network Team Name

Step 6.	Select the proper adapters for the team.  **Figure 19 - Intel Network Team Adapter Selection**
Step 7.	Select the IEEE 802.3ad Dynamic Link Aggregation team type.  **Figure 20 Intel Network Team Type**

Step 8.	 **Figure 21 Intel Network Team Wizard**
Step 9.	Assign the static IP address in the range associated with the proper VLAN ID. For this server use an address such as 172.20.1.12.

Network Naming

For convenience and ease of setup, it is best to rename all the networking devices to names that best reflect their use. See the Figure 19 for more details.

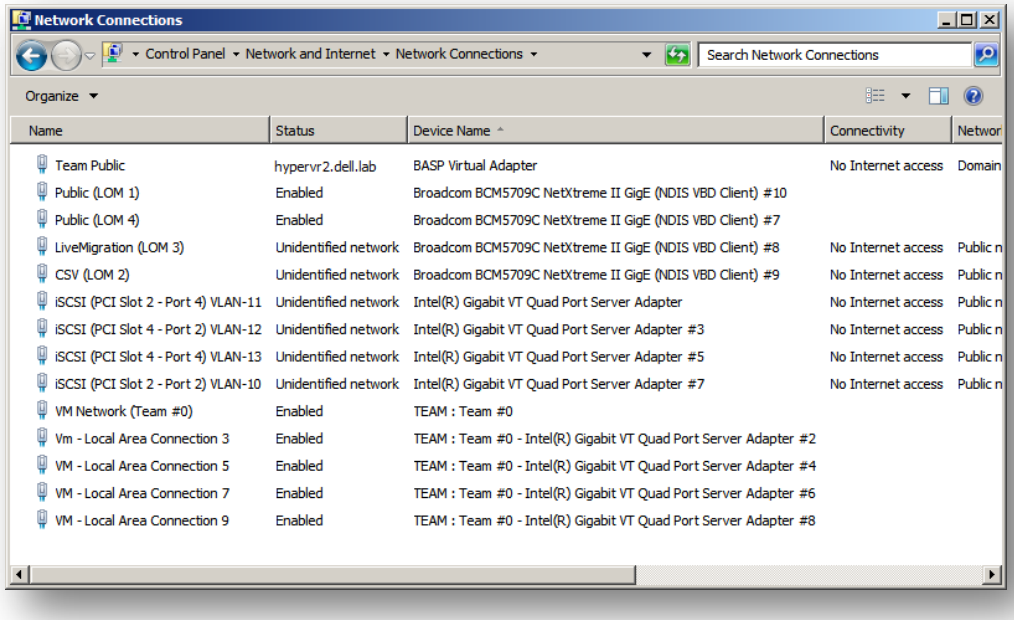
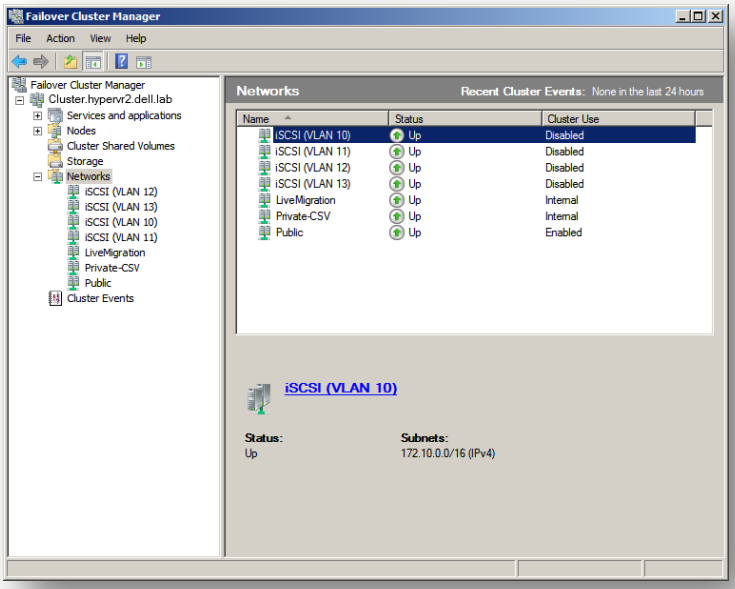


Figure 22 Network Naming

See the Network Solutions Guide for more details.
http://support.dell.com/support/edocs/software/HyperV/en/nsg/PDF/MHSNSGA01MR.pdf

Failover Clustering

After the installation of the Failover Clustering feature on at least two of the Hyper-V R2 server nodes, you will need to complete the steps below to configure the high availability functionality. These steps are high level configurations and might not apply to your needs or setup. This will not apply to the consolidation configuration, as there is only one server and clustering would not be possible.

Step 1.	• Make sure all network ports are active and configured with their proper static assigned IP address. • Makes sure all nodes in the cluster have access to the shared storage LUNs. • Make sure all nodes in the cluster have the same patch / hotfixes applied, as well as driver versions. • Run the Cluster Validation Wizard. • Consult Microsoft documentation for further details. http://technet.microsoft.com/en-us/library/cc732035(WS.10).aspx
Step 2.	Configure the Cluster networks. Choose names that are meaningful to the type of network traffic as below.  **Figure 23 Cluster Network Settings**

Allow cluster network traffic only on the proper networks. ISCSI traffic should not allow cluster network communication.

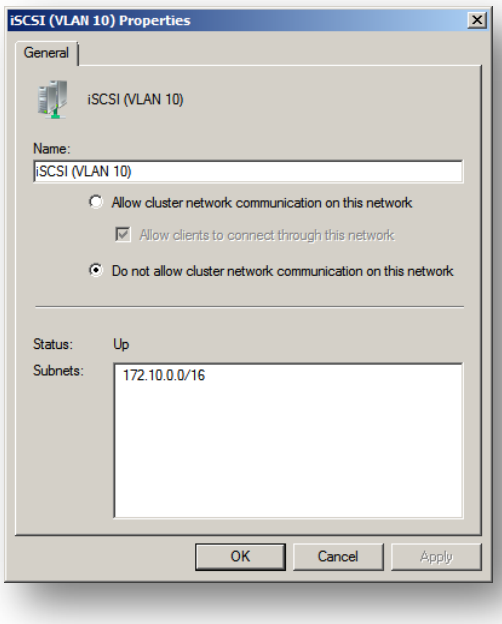


Figure 24 Cluster Network iSCSI

Allow clients to communicate with the cluster over the Public connection.

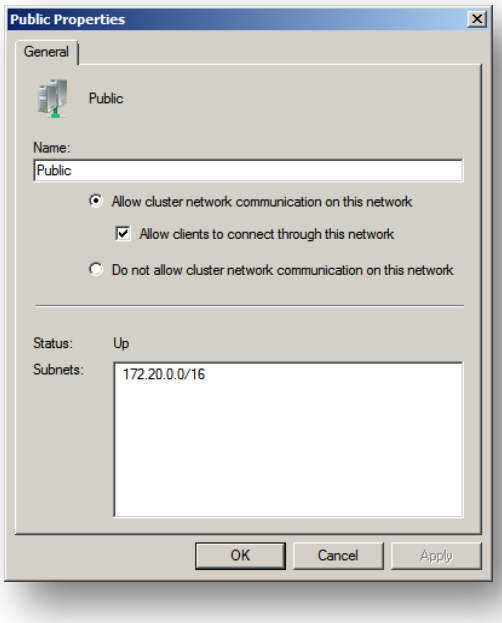


Figure 25 Cluster Network Public

Step 3.	Cluster Shared Volumes (CSV).

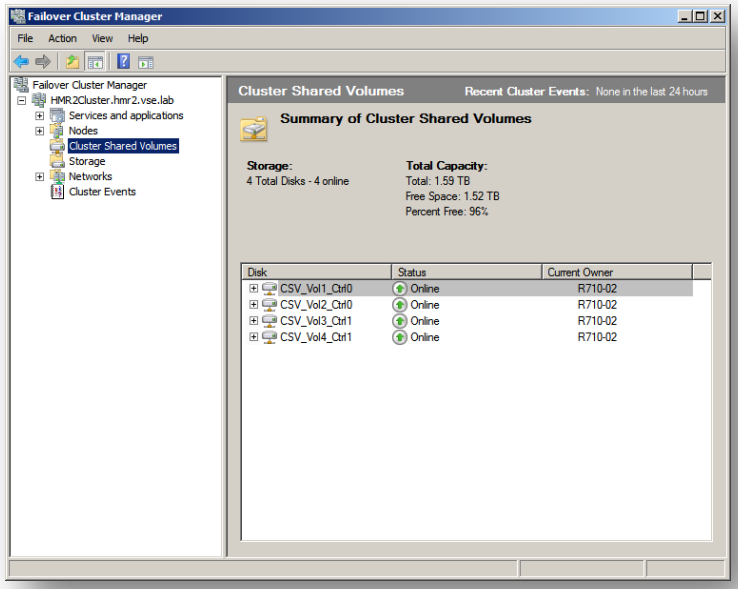


Figure 26 Cluster Shared Volumes

Step 4.	Live Migration Network Preferences.

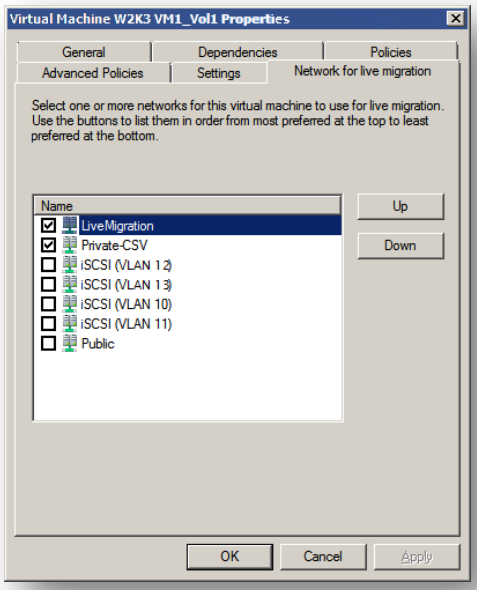


Figure 27 Live Migration Network Preferences

9.3.4 Back-Up

The backup solution for this reference configuration is the Dell PowerVault Backup to Disk Appliance powered by CommVault. There are different ways to install and configure the appliance to fit your needs. Consult the CommVault site for details on installation and configuration options at http://documentation.commvault.com/dell/release_8_0_0/books_online_1/english_us/prod_info/dell_appliance.htm

Follow the installation and setup guides found in the links below. These guides will provide information on installing the system and a quick start guide to get the backup appliance up and running.

NOTE: When deploying the Dell PowerVault Backup to Disk Appliance:

1. Be sure the storage array(s) (i.e. MD1000) are correctly cabled and connected to the appliance server prior to powering on the server. Failure to do so can hinder the setup process when it auto-launches on power-up
2. Power on the storage array(s) first and allow them to stabilize for a few minutes before turning on the server.

For more detailed information on the PowerVault Backup to Disk Appliance, see http://www.dell.com/content/products/productdetails.aspx/storage-dl2100-commvault?c=us&l=en&s=bsd&cs=04.

For more setup information for the Dell PowerVault Backup to Disk Appliance powered by CommVault, see http://support.dell.com/support/edocs/stor-sys/pvdl2100/comvault/en/UG/CV/PDF/CV_UG.pdf.

9.4 Network

The following section will aid with the setup of the reference configuration network switch and creation of the Hyper-V virtual switch.

9.4.1 Rack Switches

To configure the Dell PowerConnect 6248 switches, see the *Dell PowerConnect 6248 User's Guide* at http://support.dell.com for more information.

Step 1.	Perform the initial configuration.
Step 2.	Confirm that the Dell PowerConnect 6248 switches are running the latest firmware available from http://support.dell.com.
Step 3.	Stack the two Dell PowerConnect 6248 switches and take note of the Master.
Step 4.	Download the switch configuration file found in Appendix A of this document. This can be done from either a serial connection or the web management console.

9.4.2 Virtual Switch

Follow these steps to configure the virtual switch.

Step 1.	Start the Hyper-V Manager console and select Virtual Network Manager from the right task pane. Name and configure your switch similarly to that shown in the Figure 25. You need to use the Intel Teamed Adapter that was created earlier during the network teaming setup and configuration.

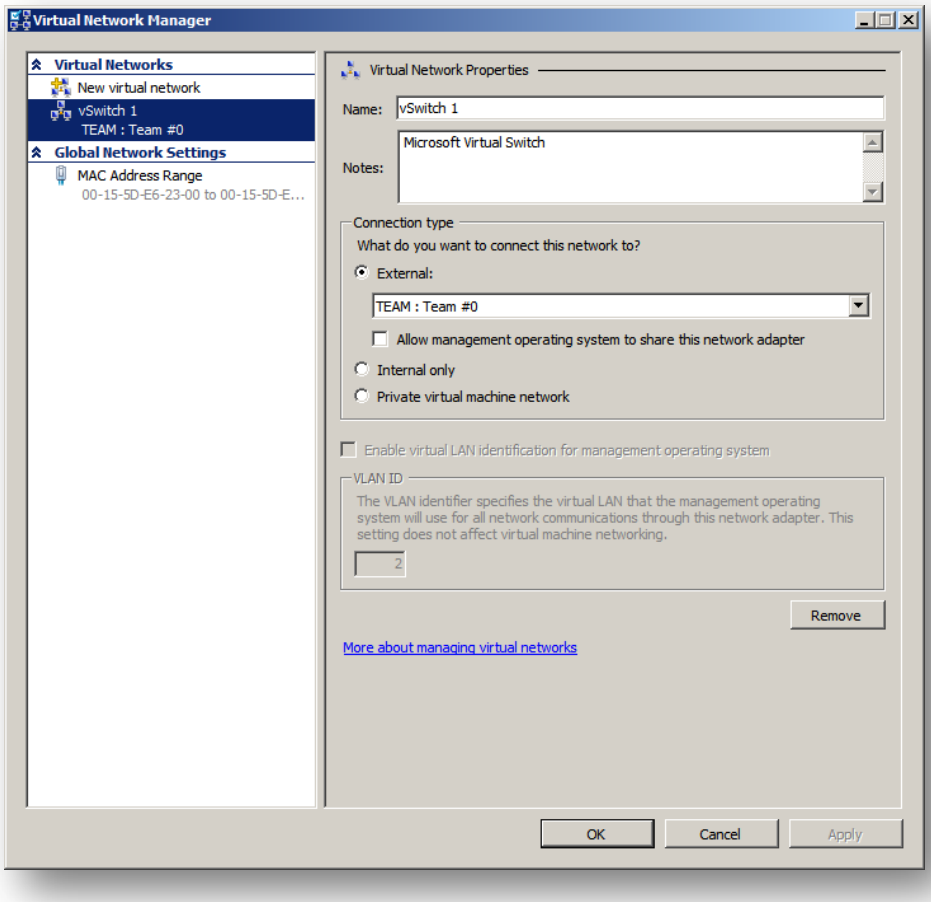


Figure 28 Virtual Network Configuration

For a more detailed virtual switch configuration, see the *Network Solutions Guide* found at http://support.dell.com/support/edocs/software/HyperV/en/nsg/PDF/MHSNSGA01MR.pdf.

9.5 Storage

The Dell PowerVault MD3000i storage array is configured with two disk groups, both configured as RAID 5, each with seven disks and one global hot spare.

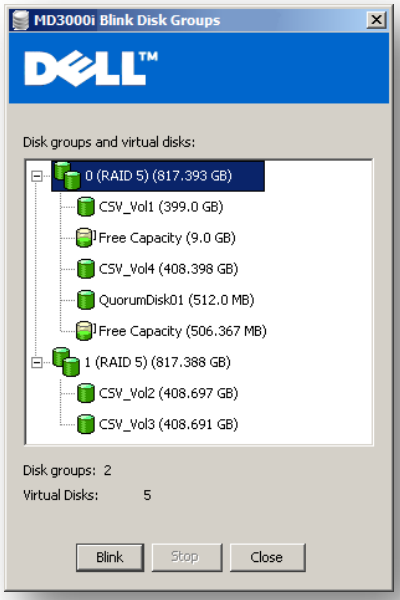


Figure 29 MD3000i Disk Configuration

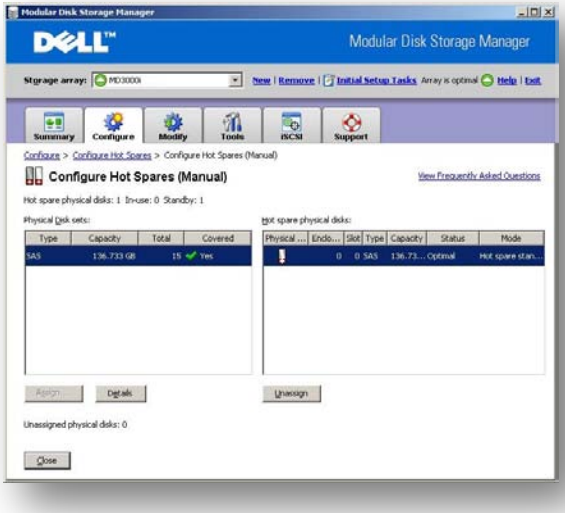


Figure 30 MD3000i Disk Hot Spare Configuration

Servers groups are assigned a Virtual Disk and are only allowed access based on a host ID configuration as shown in Figure 28.

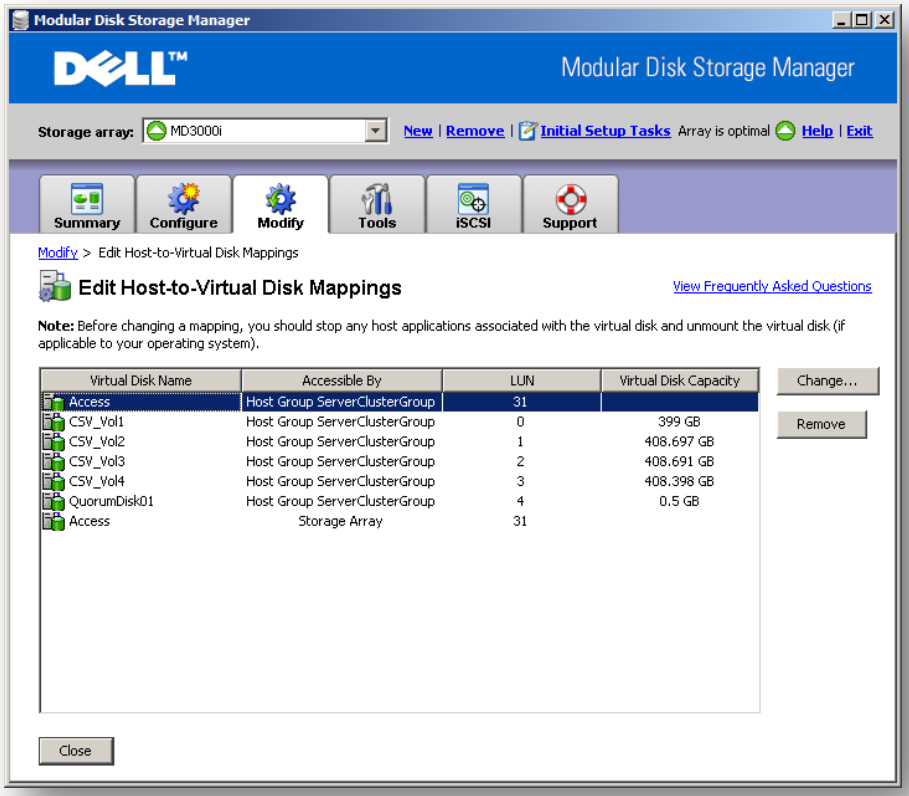


Figure 31 MD3000i Host Mapping

For detailed configuration information on the Dell PowerVault MD3000i, see the *Dell PowerVault MD3000i Users Guide* at http://support.dell.com.

10 How to Order the Reference Configuration

Dell simplifies the needs of IT customers by offering whitepapers, reference architectures, and video blogs to aid in the selection, deployment, and maintenance of solutions. In keeping with that methodology, it is Dell's intention to lessen the burden of ordering this reference configuration and to enable configuration as needed to fix the needs of our customers.

This reference configuration can be ordered one of two ways:

- By building the reference configuration from scratch using the information in Table 1 - Table 3.
- By ordering a pre-configured bill of materials. The solution ID listed at the top of Table 1 can be used to reference each of the reference configuration variations. This ID will greatly simplify the discussion with a Dell sales representative. The following is a link to all of Dell's business-ready configurations:

  http://content.dell.com/us/en/business/virtualization-business-ready-configurations.aspx

The High Availability plus Backup can only be ordered by speaking to a Dell sales representative.

11 Dell Global Services

Dell Global Services helps customers find a suitable virtualization option to reduce total cost of ownership, speed time to ROI, increase agility, and reclaim IT resources. Today's financial environment dictates that IT organizations reduce costs, while still providing ever-increasing infrastructure services. Dell Global Services believes that by heavily leveraging server virtualization and increasing the rate of adoption of this technology, you can accomplish this task.

Dell Global Services virtualization consultants work with customers to design and plan around the most common bottlenecks in virtualization implementations. Our methodology, tools, and processes are designed to speed up the implementation, ease migration scheduling, automate reporting, and provide transparency to the entire process. Dell Global Services also has the ability to offer end-to-end solutions with a single point-of-contact for hardware, software, services, and on-going support. Dell Global Services are focused on IT infrastructure services excellence.

To engage Dell Global Services, see http://www.dell.com/content/topics/global.aspx/services/adi/virtualization_new?c=us&cs=555&l=en&s=biz.

12 Additional Reading

Dell PowerEdge Server Documentation and Drivers (Chipset, Network, etc)

Visit **support.dell.com**, select **Drivers & Downloads**, enter a server service tag or select the server model and operating system version (Adobe Flash is required).

PowerVault Storage

PowerVault MD3000i Flash Demo

http://www.dell.com/html/global/products/pvault/md3000i_demo/index.swf

Data Protection with PowerVault MD3000i Whitepaper

http://www.dell.com/downloads/global/products/pvaul/en/data_protect_md3000i.pdf

Dell™ PowerVault™ DL Backup to Disk Appliance Powered by CommVault® Documentation
http://support.dell.com/support/edocs/stor-sys/pvdl2100/comvault/en/index.htm

Microsoft® Management Software

Microsoft Server Management Suite Enterprise (SMSE)

http://www.microsoft.com/systemcenter/en/us/management-suites.aspx

Microsoft System Center Virtual Machine Manager Enterprise

http://www.microsoft.com/systemcenter/virtualmachinemanager/en/us/pricing-licensing.aspx

Intel® Networking

Intel® Gigabit VT Quad Port Server Adapter Overview

http://www.dell.com/content/products/productdetails.aspx/nic_intel_gb_vt?c=us&l=en&s=biz&cs=555

Broadcom Networking

Broadcom Driver FAQ

http://www.broadcom.com/support/ethernet_nic/faq_drivers.php

Hyper-V Information

Supported Guest Operating Systems

http://support.microsoft.com/kb/954958

Virtual PC Guy Blog

http://blogs.msdn.com/virtual_pc_guy/default.aspx

Microsoft® Roles and Features

Introducing Windows Server 2008 Failover Clustering
http://technet.microsoft.com/en-us/magazine/2008.07.failover.aspx

13 Appendix A: Reference Network Configuration

This appendix contains a sample network configuration for the Dell PowerConnect 6248 used in this configuration. As is, this switch configuration will support five Hyper-V servers, an infrastructure server, a management server, out-of-band server management (via iDRAC), stacking and uplink to an out-of-rack switch.

This file includes the setup and configuration options used in the qualification of this configuration, including jumbo frames for iSCSI traffic and link aggregation for virtual machine, management and parent partition traffic. Customers are encouraged to use this file as a baseline for modification to the LAN setup and over all configuration architecture. The manuals for the PowerConnect 6200 family of switches will aid with modifications to this baseline file.

For more information on Dell PowerConnect switches, see http://www.dell.com/powerconnect

```
!Current Configuration:
!System Description "Dell 48 Port Gigabit Ethernet, 2.1.0.13, VxWorks5.5.1"
!System Software Version 2.1.0.13
!================================================================
!=        Dell Inc. Switch Configuration for Hyper-V R2          =
!================================================================
configure
vlan database
!
!  VLAN Definition
!   10: iSCSI Network - Ports Switch 1
!   11: iSCSI Network - Ports Switch 1
!   12: iSCSI Network - Ports Switch 2
!   13: iSCSI Network - Ports Switch 2
!   20: Software/Virtualization Management Network
!   30: Cluster Private/CSV
!   40: Hardware Management Network (OOB)
!   50: Live Migration
!
vlan  10-13,20,30,40,50
exit
ip routing
stack
member 1 2
member 2 2
exit
!
!  The following lines configure the switch to forward all DHCP
!    broadcasts to the configuration R610 management server.
!    Modify this address as needed for your environment.
```

```
!
bootpdhcprelay enable
bootpdhcprelay serverip 172.20.230.10
!
!  The following line defines a gateway for the 172.20 subnet. This
!    command is used for each of the subnets/VLANs defined on this
!    switch that require cross subnet communication.
interface vlan 20
routing
ip address  172.20.230.1  255.255.0.0
exit
interface vlan 40
routing
ip address  172.40.230.1  255.255.0.0
exit
!
! The following line defines the admin user and password used
!   to log into the switch.  The 2nd occurrence of 'password'
!   is the actual password.
!
username "admin" password password level 15
flowcontrol
!
! The following lines define the iSCSI ports.
!   - Odd-ports on switch 1 are part of VLAN 10
!   - Even-ports on switch 1 are part of VLAN 11
!   - Odd-ports on switch 2 are part of VLAN 12
!   - Even-ports on switch 2 are part of VLAN 13
!
interface ethernet 1/g1
switchport access vlan 10
mtu 9216
exit
!
interface ethernet 1/g3
switchport access vlan 10
mtu 9216
exit
!
interface ethernet 1/g5
switchport access vlan 10
mtu 9216
```

```
exit
!
interface ethernet 1/g7
switchport access vlan 10
mtu 9216
exit
!
interface ethernet 1/g9
switchport access vlan 10
mtu 9216
exit
!
interface ethernet 1/g11
switchport access vlan 10
mtu 9216
exit
!
interface ethernet 1/g13
switchport access vlan 10
mtu 9216
exit
!
interface ethernet 1/g15
switchport access vlan 10
mtu 9216
exit
!
!   VLAN 12 for iSCSI traffic
!
interface ethernet 2/g1
switchport access vlan 12
mtu 9216
exit
!
interface ethernet 2/g3
switchport access vlan 12
mtu 9216
exit
!
interface ethernet 2/g5
switchport access vlan 12
mtu 9216
```

```
exit
!
interface ethernet 2/g7
switchport access vlan 12
mtu 9216
exit
!
interface ethernet 2/g9
switchport access vlan 12
mtu 9216
exit
!
interface ethernet 2/g11
switchport access vlan 12
mtu 9216
exit
!
interface ethernet 2/g13
switchport access vlan 12
mtu 9216
exit
!
interface ethernet 2/g15
switchport access vlan 12
mtu 9216
exit
!
!   VLAN 11 for iSCSI traffic
!
interface ethernet 1/g2
switchport access vlan 11
mtu 9216
exit
!
interface ethernet 1/g4
switchport access vlan 11
mtu 9216
exit
!
interface ethernet 1/g6
switchport access vlan 11
mtu 9216
```

```
exit
!
interface ethernet 1/g8
switchport access vlan 11
mtu 9216
exit
!
interface ethernet 1/g10
switchport access vlan 11
mtu 9216
exit
!
interface ethernet 1/g12
switchport access vlan 11
mtu 9216
exit
!
interface ethernet 1/g14
switchport access vlan 11
mtu 9216
exit
!
interface ethernet 1/g16
switchport access vlan 11
mtu 9216
exit
!
!   VLAN 13 for iSCSI traffic
!
interface ethernet 2/g2
switchport access vlan 13
mtu 9216
exit
!
interface ethernet 2/g4
switchport access vlan 13
mtu 9216
exit
!
interface ethernet 2/g6
switchport access vlan 13
mtu 9216
```

```
exit
!
interface ethernet 2/g8
switchport access vlan 13
mtu 9216
exit
!
interface ethernet 2/g10
switchport access vlan 13
mtu 9216
exit
!
interface ethernet 2/g12
switchport access vlan 13
mtu 9216
exit
!
interface ethernet 2/g14
switchport access vlan 13
mtu 9216
exit
!
interface ethernet 2/g16
switchport access vlan 13
mtu 9216
exit
!
!
! The following VLAN's 30 and 50 define the configuration for cluster private/csv and live migration ports respectively.
!
interface ethernet 1/g17
switchport access vlan 30
exit
!
interface ethernet 1/g19
switchport access vlan 30
exit
!
interface ethernet 1/g21
switchport access vlan 30
exit
```

```
!
interface ethernet 1/g23
switchport access vlan 30
exit
!
interface ethernet 1/g25
switchport access vlan 30
exit
!
interface ethernet 2/g17
switchport access vlan 50
exit
!
interface ethernet 2/g19
switchport access vlan 50
exit
!
interface ethernet 2/g21
switchport access vlan 50
exit
!
interface ethernet 2/g23
switchport access vlan 50
exit
!
interface ethernet 2/g25
switchport access vlan 50
exit
!
!
! The following VLAN 40 ports define the configuration hardware
!   management ports (Out of Band).
!
interface ethernet 1/g27
switchport access vlan 40
exit
!
interface ethernet 1/g29
switchport access vlan 40
exit
!
interface ethernet 1/g31
```

```
switchport access vlan 40
exit
!
interface ethernet 1/g33
switchport access vlan 40
exit
!
interface ethernet 1/g35
switchport access vlan 40
exit
!
interface ethernet 1/g37
switchport access vlan 40
exit
!
interface ethernet 2/g27
switchport access vlan 40
exit
!
interface ethernet 2/g29
switchport access vlan 40
exit
!
interface ethernet 2/g31
switchport access vlan 40
exit
!
interface ethernet 2/g33
switchport access vlan 40
exit
!
interface ethernet 2/g35
switchport access vlan 40
exit
!
interface ethernet 2/g37
switchport access vlan 40
exit
!
! Teamed ports across switches for virtualization/software management
!
! Group #11 (Hyper-V Host #1)
```

```
!
interface ethernet 1/g26
channel-group 11 mode auto
switchport access vlan 20
exit
!
interface ethernet 2/g26
channel-group 11 mode auto
switchport access vlan 20
exit
!
! Group #12 (Hyper-V Host #2)
!
interface ethernet 1/g28
channel-group 12 mode auto
switchport access vlan 20
exit
!
interface ethernet 2/g28
channel-group 12 mode auto
switchport access vlan 20
exit
!
! Group #13 (Hyper-V Host #3)
!
interface ethernet 1/g30
channel-group 13 mode auto
switchport access vlan 20
exit
!
interface ethernet 2/g30
channel-group 13 mode auto
switchport access vlan 20
exit
!
! Group #14 (Hyper-V Host #4)
!
interface ethernet 1/g32
channel-group 14 mode auto
switchport access vlan 20
exit
interface ethernet 2/g32
```

```
channel-group 14 mode auto
switchport access vlan 20
exit
!
! Group #15 (Hyper-V Host #5)
!
interface ethernet 1/g34
channel-group 15 mode auto
switchport access vlan 20
exit
!
interface ethernet 2/g34
channel-group 15 mode auto
switchport access vlan 20
exit
!
! Group #16 (Infrastructure Host)
!
interface ethernet 1/g36
channel-group 16 mode auto
switchport access vlan 20
exit
!
interface ethernet 2/g36
channel-group 16 mode auto
switchport access vlan 20
exit
!
! Group #17 (Management Host)
!
interface ethernet 1/g38
channel-group 17 mode auto
switchport access vlan 20
exit
!
interface ethernet 2/g38
channel-group 17 mode auto
switchport access vlan 20
exit
!
! Backup Server data port
!
```

```
interface ethernet 2/g24
switchport access vlan 20
exit
!
! The following VLAN 20 lines define the configuration virtual
!   machine ports as well as define link aggregation for these
!   ports.  Note: Groups are 4 ports each, 2 ports per switch
!
! Group #1 (VM Group #1)
!
interface ethernet 1/g39
channel-group 1 mode auto
switchport access vlan 20
exit
interface ethernet 2/g39
channel-group 1 mode auto
switchport access vlan 20
exit
!
interface ethernet 1/g40
channel-group 1 mode auto
switchport access vlan 20
exit
interface ethernet 2/g40
channel-group 1 mode auto
switchport access vlan 20
exit
!
! Group #2 (Virtual Machine Group #2)
!
interface ethernet 1/g41
channel-group 2 mode auto
switchport access vlan 20
exit
interface ethernet 2/g41
channel-group 2 mode auto
switchport access vlan 20
exit
!
interface ethernet 1/g42
channel-group 2 mode auto
switchport access vlan 20
```

```
exit
interface ethernet 2/g42
channel-group 2 mode auto
switchport access vlan 20
exit
!
! Group #3 (Virtual Machine Group #3)
!
interface ethernet 1/g43
channel-group 3 mode auto
switchport access vlan 20
exit
interface ethernet 2/g43
channel-group 3 mode auto
switchport access vlan 20
exit
!
interface ethernet 1/g44
channel-group 3 mode auto
switchport access vlan 20
exit
interface ethernet 2/g44
channel-group 3 mode auto
switchport access vlan 20
exit
!
! Group #4 (Virtual Machine Group #4)
!
interface ethernet 1/g45
channel-group 4 mode auto
switchport access vlan 20
exit
interface ethernet 2/g45
channel-group 4 mode auto
switchport access vlan 20
exit
!
interface ethernet 1/g46
channel-group 4 mode auto
switchport access vlan 20
exit
interface ethernet 2/g46
```

```
channel-group 4 mode auto
switchport access vlan 20
exit
!
! Group #5 (Virtual Machine Group #5)
!
interface ethernet 1/g47
channel-group 5 mode auto
switchport access vlan 20
exit
interface ethernet 2/g47
channel-group 5 mode auto
switchport access vlan 20
exit
!
interface ethernet 1/g48
channel-group 5 mode auto
switchport access vlan 20
exit
interface ethernet 2/g48
channel-group 5 mode auto
switchport access vlan 20
exit
!
!
!Define the port groups to support LACP teams
!
!
interface port-channel 1
switchport access vlan 20
exit
!
interface port-channel 2
switchport access vlan 20
exit
!
interface port-channel 3
switchport access vlan 20
exit
!
interface port-channel 4
switchport access vlan 20
```

```
exit
!
interface port-channel 5
switchport access vlan 20
exit
!
interface port-channel 11
switchport access vlan 20
exit
!
interface port-channel 12
switchport access vlan 20
exit
!
interface port-channel 13
switchport access vlan 20
exit
!
interface port-channel 14
switchport access vlan 20
exit
!
interface port-channel 15
switchport access vlan 20
exit
!
interface port-channel 16
switchport access vlan 20
exit
!
interface port-channel 17
switchport access vlan 20
exit
!
!
! Define the stacking ports
!
!
interface ethernet 1/xg1
switchport mode general
switchport general allowed vlan add 20,40 tagged
exit
```

```
interface ethernet 2/xg1
switchport mode general
switchport general allowed vlan add 20,40 tagged
exit
!
interface ethernet 1/xg2
switchport mode general
switchport general allowed vlan add 20,40 tagged
exit
interface ethernet 2/xg2
switchport mode general
switchport general allowed vlan add 20,40 tagged
exit
!
!
! Define the Up-Link ports
!
!
interface ethernet 1/xg3
switchport mode general
switchport general allowed vlan add 20,40 tagged
exit
interface ethernet 2/xg3
switchport mode general
switchport general allowed vlan add 20,40 tagged
exit
!
interface ethernet 1/xg4
switchport mode general
switchport general allowed vlan add 20,40 tagged
exit
interface ethernet 2/xg4
switchport mode general
switchport general allowed vlan add 20,40 tagged
exit
!
exit
exit
```

14 Appendix B: Network Connection Layout - Hyper-V Server

Connection	Device Network Port	Switch	Switch Port	Function
1	Hyper-V Server #1 LOM #1	G1	26	Parent Partition Management Traffic (Teamed)
2	Hyper-V Server #1 LOM #2	G2	17	Cluster Private Traffic used for Cluster Shared Volume
3	Hyper-V Server #1 LOM #3	G1	17	Cluster Private Traffic used for Live Migration
4	Hyper-V Server #1 LOM #4	G2	26	Parent Partition Management Traffic (Teamed)
5	Hyper-V Server #1 PCIe Bus #2 Port #1	G1	3	iSCSI Traffic
6	Hyper-V Server #1 PCIe Bus #2 Port #2	G1	39	Virtual Machine traffice (Teamed)
7	Hyper-V Server #1 PCIe Bus #2 Port #3	G2	3	iSCSI Traffic
8	Hyper-V Server #1 PCIe Bus #2 Port #4	G1	40	Virtual Machine traffic (Teamed)
9	Hyper-V Server #1 PCIe Bus #2 Port #1	G1	4	iSCSI Traffic
10	Hyper-V Server #1 PCIe Bus #2 Port #2	G2	39	Virtual Machine traffice (Teamed)
11	Hyper-V Server #1 PCIe Bus #2 Port #3	G2	4	iSCSI Traffic
12	Hyper-V Server #1 PCIe Bus #2 Port #4	G2	40	Virtual Machine traffic (Teamed)
13	Hyper-V Server #1 iDRAC Port	G1	31	iDRAC managment traffic