

Dell™ PowerVault™ MD3220i

Twice the performance of the PowerVault MD3000i



*on a mixed workload:
email, database, and file service*

OUR FINDINGS

The responsiveness and capacity of much of a company's server infrastructure—and particularly email, database, and file service—rely heavily on the underlying storage subsystem. In Principled Technologies' tests in our labs, the new Dell PowerVault MD3220i iSCSI SAN array exceeded the total mixed workload performance of the older Dell PowerVault MD3000i iSCSI SAN array by 110.7 percent. Our results show that upgrading to the Dell PowerVault MD3220i can boost a company's server performance in many key areas—and let it support significantly more users.

OUR PROCESS

To gauge how well each storage array would handle email, database, and file server requests, we configured two Dell PowerEdge™ R710 servers in a Microsoft Windows Server 2008 R2 high-availability cluster. We used the Iometer benchmarking tool to run simultaneously simulated Microsoft® Exchange Server 2007, Microsoft SQL Server® 2008 OLTP, and Microsoft Windows®-based file service workloads. We used the maximum numbers of drives each system supported—96 for the Dell PowerVault MD3220i and 45 for the Dell PowerVault MD3000i—and we configured multiple I/O paths to each array.

PROJECT OVERVIEW

We tested the mixed workload performance of the following storage devices:

- Dell PowerVault MD3220i (1Gb iSCSI host interfaces with 6Gb SAS back end)
- Dell PowerVault MD3000i (1Gb iSCSI host interfaces with 3Gb SAS back end)

The goal was to determine which storage array provides better performance for a workload of multiple I/O intensive business activities running simultaneously, such as Microsoft Exchange Server 2007, Microsoft SQL Server 2008 OLTP, and a Microsoft Windows-based file server. We represent performance in terms of total I/O operations per second (IOPS).

We created identical test beds for both devices with two Dell PowerEdge R710 rack servers, both running Microsoft Windows Server® 2008 R2 with Hyper-V as the underlying hypervisor, using cluster shared volumes with failover enabled. Each Dell PowerEdge R710 ran eight Windows Server 2008 R2 virtual machines (VMs). The first Dell PowerEdge R710 ran a Microsoft Exchange Server 2007 VM (which we ran using an Exchange Server 2007 Iometer workload), a file service VM (which we ran a file server Iometer workload against), and six other background VMs that were active but not under load. The second Dell PowerEdge R710 ran a Microsoft SQL Server 2008 VM (which we ran using a Microsoft SQL Server 2008 OLTP Iometer workload), an additional file service VM (which we ran a file server Iometer workload against), and six other background VMs that were active but not under load. In the event that one server went offline, all workloads would continue to operate on the online server without user intervention. Both arrays use iSCSI technology for their connection to the servers. We ran all the workloads simultaneously on each Dell PowerEdge R710 server. The Dell PowerVault MD3220i supports 6Gbps drive technology, while the Dell PowerVault MD3000i supports 3Gbps drive technology.

We installed a combination of commonly used Microsoft applications on our background virtual machines (those VMs that were active but not under load), including Microsoft SharePoint®, Microsoft Internet Information Server, Microsoft DHCP server, and Microsoft Active Directory®. We list all of the specific applications we used in Appendix A.

WORKLOAD

Iometer performs I/O operations on a server in order to stress the disk-subsystem, and then records the performance of and stress created by these I/O operations. Iometer can create and measure workloads on a single system or on networked systems. We used Iometer version 2006.07.27 on two Dell PowerEdge R710

servers to simulate a Microsoft Exchange Server 2007 workload, a Microsoft SQL Server 2008 OLTP workload, and a file server workload on the storage arrays. We present the number of outstanding I/Os and other specific settings we used during testing in Appendix A.

We ran the tests three times to ensure repeatability, and report the results from the run that produced the median total IOPS.

SYSTEM COMPARISON

Figure 1 shows a side-by-side comparison of the key hardware differences between the storage arrays. Appendix A presents detailed system information.



	Dell PowerVault MD3220i	Dell PowerVault MD3000i
		
Arrays	Dell PowerVault MD3220i	Dell PowerVault MD3000i
Disks	24x 146GB SAS 15k 2.5", 72x 73GB SAS 15k 2.5" (96 total)	13x 146GB SAS 15k 3.5", 24x 73GB SAS 15k 3.5", 8x 300GB SAS 15k 3.5" (45 total)
Disk layout	We created one 20-disk RAID 10 group for the SQL database volume, one 20-disk RAID 10 group for the Exchange database volume, one 8-disk RAID 5 group for the SQL logging volume, one 8-disk RAID 10 group for the Exchange logging volume, one 12-disk RAID 10 group for the file server 1 volume, one 12-disk RAID 10 group for the file server 2 volume, one 8-disk RAID 5 group for the OS VHDs on the first Dell PowerEdge R710, and one 8-disk RAID 5 group for the OS VHDs on the second Dell PowerEdge R710. We also created a small 20GB volume on the OS VHD-1 disk group to act as a witness disk so that if one of the Dell PowerEdge R710s failed, a quorum would still exist and the cluster would remain active.	We created one 8-disk RAID 10 group for the SQL database volume, one 8-disk RAID 10 group for the Exchange database volume, one 4-disk RAID 10 group for the SQL logging volume, one 4-disk RAID 5 group for the Exchange logging volume, one 6-disk RAID 10 group for the file server 1 volume, one 6-disk RAID 10 group for the file server 2 volume, one 4-disk RAID 5 group for the OS VHDs on the first Dell PowerEdge R710, and one 4-disk RAID 5 group for the OS VHDs on the second Dell PowerEdge R710. We also created a small 20GB volume on the OS VHD-1 disk group to act as a witness disk so that if one of the Dell PowerEdge R710s failed, a quorum would still exist and the cluster would remain active.
Formatted storage capacity	5,099 GB	3,373 GB
Connection	iSCSI	iSCSI
Multi-pathing	Yes	Yes
RAID technology	RAID 10 and RAID 5	RAID 10 and RAID 5

Figure 1: Storage system configuration information.

WHAT WE FOUND

Figure 2 shows the total IOPS the two storage arrays achieved on the Exchange Server 2007, SQL Server 2008 OLTP, and file server mixed workload. As Figure 2 shows, the Dell PowerVault MD3220i achieved 17,523 total IOPS, while the Dell PowerVault MD3000i achieved only 8,318 total IOPS. The Dell PowerVault MD3220i achieved 110.7 percent greater total IOPS than the Dell PowerVault MD3000i when running the mixed workload.

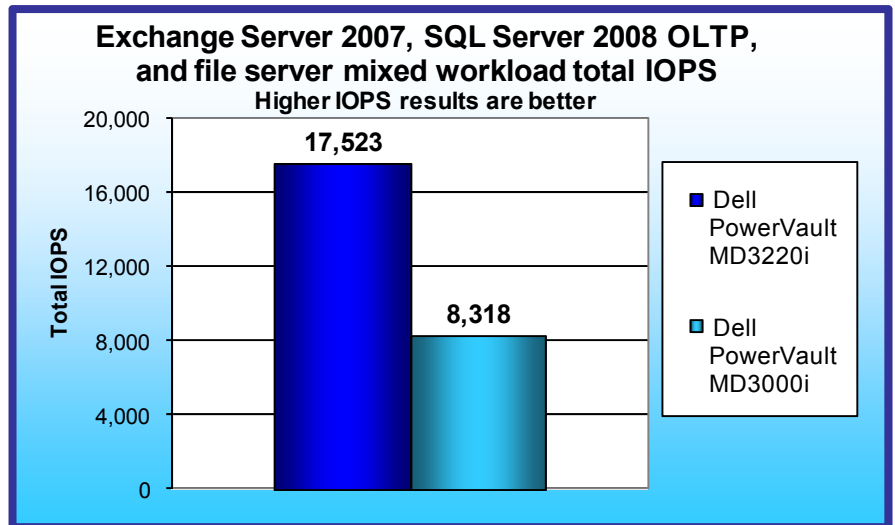


Figure 2: Exchange Server 2007, SQL Server 2008 OLTP, and file server mixed workload total IOPS results for the storage arrays during the mixed workload test.

Figure 3 shows the Exchange Server 2007 total IOPS the two storage arrays achieved during the mixed workload test. Total IOPS is the sum of database and logging IOPS. The Dell PowerVault MD3220i achieved 5,729 total IOPS, while the Dell PowerVault MD3000i achieved only 2,203 total IOPS. The Dell PowerVault MD3220i achieved 160.0 percent greater Exchange Server 2007 total IOPS than the Dell PowerVault MD3000i.

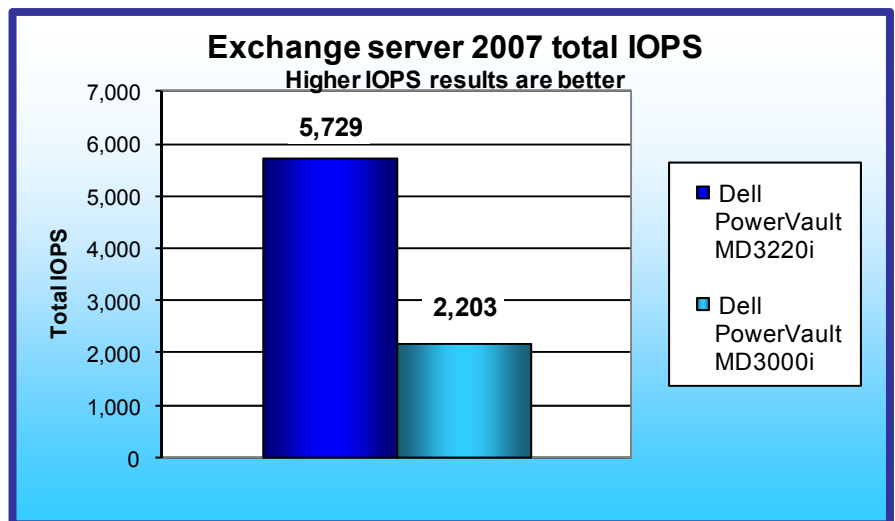


Figure 3: Exchange Server 2007 total IOPS results for the storage arrays during the mixed workload test.

Figure 4 shows the SQL Server 2008 OLTP total IOPS the two storage arrays achieved during the mixed workload test. Total IOPS is the sum of database and logging IOPS. As Figure 4 shows, the Dell PowerVault MD3220i achieved 4,935 total IOPS, while the Dell PowerVault MD3000i achieved only 2,364 total IOPS. The Dell PowerVault MD3220i achieved 108.7 percent greater total IOPS than the Dell PowerVault MD3000i.

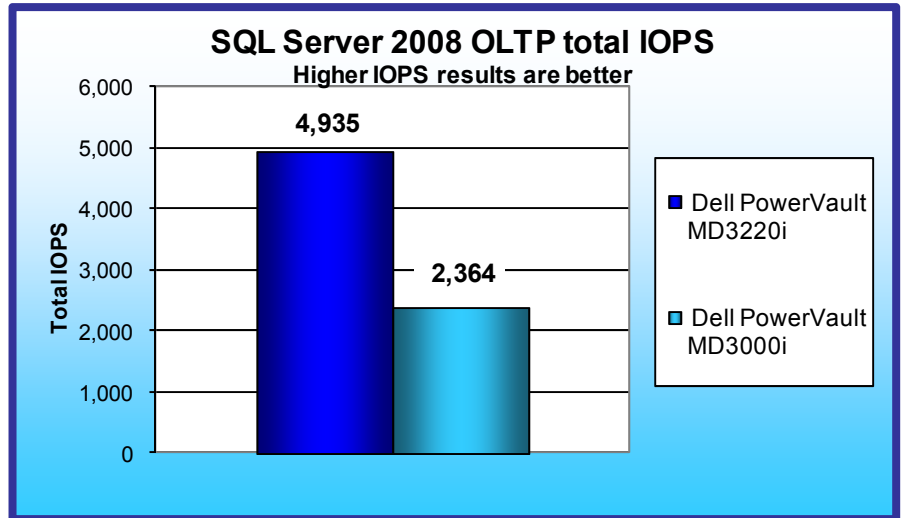


Figure 4: SQL Server 2008 OLTP total IOPS results for the storage arrays during the mixed workload test.

Figure 5 shows the file server total IOPS the two storage arrays achieved during the mixed workload test. The file server total IOPS is the sum of file server 1 IOPS and file server 2 IOPS. As Figure 5 shows, the Dell PowerVault MD3220i achieved 6,859 total IOPS, while the Dell PowerVault MD3000i achieved only 3,749 total IOPS. The Dell PowerVault MD3220i achieved 82.9 percent greater total IOPS than the Dell PowerVault MD3000i.

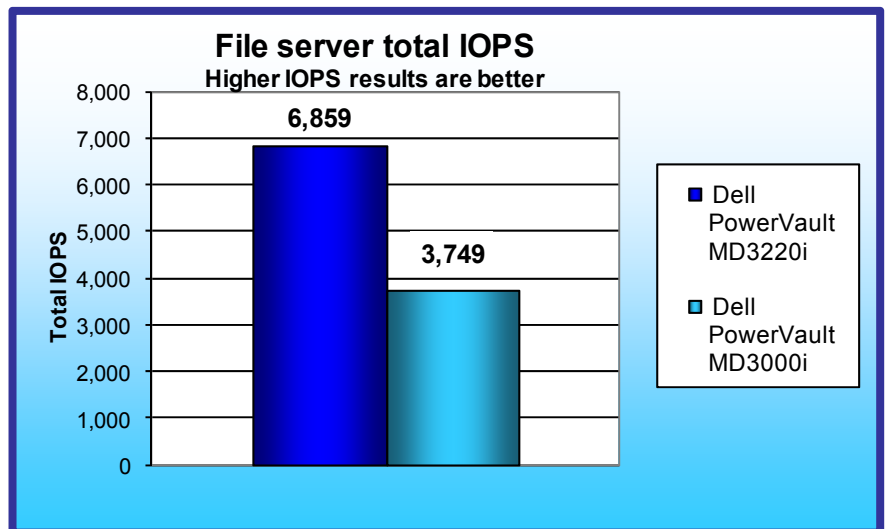


Figure 5: File server total IOPS results for the storage arrays during the mixed workload test.

HOW WE TESTED

We created an Iometer workload that closely mirrors the disk activity of a server running Microsoft Exchange Server 2007, another Iometer workload that simulates the disk activity of a server running Microsoft SQL Server 2008 with an OLTP-type database, and another Iometer workload that simulates the disk activity of a Windows-based file server. We ran all three workloads simultaneously.

We configured the Iometer Dynamo to run on four separate virtual machines distributed between the two Dell PowerEdge R710 servers for each storage array, and used one of these servers to run the Iometer application. We set Iometer to run for a total of 5 minutes with a 60-second ramp-up time for each run. We chose an amount of outstanding I/Os for each access specification to ensure that the storage arrays queued a sufficient amount of I/Os to provide the maximum IOPS possible.

We gathered the following results from the Iometer result files:

- Exchange Server 2007 Database IOPS
- Exchange Server 2007 Logging IOPS
- SQL Server 2008 OLTP Database IOPS
- SQL Server 2008 Logging IOPS
- File server 1 IOPS
- File server 2 IOPS

The results we report in Figures 2 through 5 are from the run that produced the median total IOPS.

Appendix B provides complete Iometer mixed-workload performance test results for the storage arrays. Appendix C provides details of our test environment. Appendix D provides configuration details of our test server. Appendix E details the testing procedures we followed.

APPENDIX A – STORAGE CONFIGURATION AND SETUP

This appendix includes the Iometer parameters we used to simulate the Microsoft Exchange Server 2007, Microsoft SQL Server 2008 OLTP, and file server workloads, and the steps we took to configure the arrays.

Virtual machines

We installed the following applications on the virtual machines:

Dell PowerEdge R710 #1

- Microsoft Exchange Server 2007 (active and under Iometer load)
- File server (active and under Iometer load)
- Microsoft SharePoint (active but not under load)
- Secondary Microsoft Active Directory Service (active but not under load)
- Microsoft IIS (active but not under load)
- Microsoft DHCP Server (active but not under load)
- Microsoft SQL Server 2008 (active but not under load)
- File server (active but not under load)

Dell PowerEdge R710 #2

- Microsoft SQL Server 2008 (active and under Iometer load)
- File server (active and under Iometer load)
- Microsoft SharePoint (active but not under load)
- File server (active but not under load)
- Microsoft IIS (active but not under load)
- Microsoft Systems Management Server (active but not under load)
- Secondary Microsoft DHCP Server—different scope (active but not under load)
- Secondary Microsoft SQL Server 2008 (active but not under load)

We configured the virtual machines under load with the following settings:

- 8,192MB memory
- 4 virtual processors
- Windows Server 2008 R2
- One 40GB fixed VHD for OS
- One 50GB fixed VHD for the workload
- Additional 50GB fixed VHD for logging on the Exchange and SQL Server VMs

We configured the virtual machines not under load with the following settings:

- 1,204MB memory
- 1 virtual processor
- Windows Server 2008 R2
- One 40GB fixed VHD for OS

Simulated Exchange Server 2007 configuration

We defined the simulated Exchange Server 2007 workload using the following parameters:

- 8K transfer request size
- 67% reads, 33% writes
- 100% random, 0% sequential
- 8K sector boundaries
- 100% seek range
- 60 outstanding I/Os per target
- 1 worker per target

We defined the logging component of the Exchange Server 2007 workload using the following parameters:

- 8K transfer request size
- 0% reads, 100% writes
- 0% random, 100% sequential
- 8K sector boundaries
- 100% seek range
- 4 outstanding I/Os per target
- 1 worker per target

Simulated SQL Server 2008 OLTP configuration

We defined the simulated SQL Server 2008 OLTP workload using the following parameters:

- 8K transfer request size
- 70% reads, 30% writes
- 100% random, 0% sequential
- 8K sector boundaries
- 100% seek range
- 60 outstanding I/Os per target
- 1 worker per target

We defined the logging component of the simulated SQL Server 2008 OLTP workload using the following parameters:

- 64K transfer request size
- 0% reads, 10% writes
- 0% random, 100% sequential
- 64K sector boundaries
- 100% seek range
- 4 outstanding I/Os per target

- 1 worker per target

Simulated file server configuration

We defined the simulated file server workload using the following parameters:

- 10% 512 byte, 5% 1K, 5% 2K, 60% 4K, 2% 8K, 4% 16K, 4% 32K, and 10% 64K transfer request size
- 80% reads, 0% writes
- 100% random, 0% sequential
- I/Os aligned on sector boundaries
- 100% seek range
- 60 outstanding I/Os per target
- 1 worker per target

Figure 6 shows the primary storage hardware for the two storage arrays, Figure 7 shows the primary storage software on the host server, and Figure 8 shows the primary storage disk configuration.

Primary storage hardware

System	Dell PowerVault MD3220i	Dell PowerVault MD3000i
Total number of disks tested in solution	96	45 (44 active)
Storage connectivity (Fibre Channel, SAS, SATA, iSCSI)	iSCSI	iSCSI
Storage model and OS/firmware revision	Dell PowerVault MD3220i Firmware 97.70.03.62	Dell PowerVault MD3000i Firmware 07.35.31.60
Storage memory	4 GB (2 GB per controller)	1 GB (512 MB per controller)
Number of storage controllers	2	2
Number of storage ports	8	4

Figure 6: Primary storage hardware.

Primary storage software on the host server

System	Dell PowerVault MD3220i	Dell PowerVault MD3000i
Server HBA/NIC driver	Broadcom BCM5709C NetXtreme II 5.0.15.0	Broadcom BCM5709C NetXtreme II 5.0.15.0
TCP chimney	Automatic	Automatic
Multi-pathing	Yes	Yes
Host OS	Windows Server 2008 R2 x64	Windows Server 2008 R2 x64
Max transfer length	1,024K	1,024K

Figure 7: Primary storage software on host server.

Primary storage disk configuration

System	Dell PowerVault MD3220i	Dell PowerVault MD3000i
Disk type and speed	24x 146GB SAS 15k 2.5", 72x 73GB SAS 15k 2.5" (96 total)	13x 146GB SAS 15k 3.5", 24x 73GB SAS 15k 3.5", 8x 300GB SAS 15k 3.5" (45 total)
Raw capacity per disk (GB)	73 and 146	73, 146, and 300
Number of physical disks in test	96	44
Total raw storage capacity (GB)	8,760	5,750
Raid level	RAID 10	RAID 10
Total formatted capacity (GB) (1GB=2 ³⁰ bytes)	5,099	3,373
Segment size	Default	Default
Cache settings	Cache Disabled on all volumes (except write caching on SQL logging and Exchange logging)	Read Cache Enabled, Write Cache Enabled (Default)

Figure 8: Primary storage disk configuration.

APPENDIX B – TEST RESULTS

Figure 9 provides complete Iometer mixed-workload performance test results for the storage arrays.

We ran the Iometer test three times for each storage array, and then determined the median.

System	Dell PowerVault MD3220i	Dell PowerVault MD3000i
Run 1		
Exchange DB IOPS	4,814.801	1,951.732
Exchange Log IOPS	914.907	251.726
File server 1 IOPS	3,430.933	1,831.046
File server 2 IOPS	3,428.451	1,918.664
SQL DB IOPS	4,458.525	2,023.702
SQL Log IOPS	475.793	341.197
Total IOPS - Run 1	17,523.410	8,318.067
Run 2		
Exchange DB IOPS	4,736.282	1,910.382
Exchange Log IOPS	924.502	239.666
File server 1 IOPS	3,452.448	1,884.225
File server 2 IOPS	3,488.286	1,817.661
SQL DB IOPS	4,243.931	2,002.541
SQL Log IOPS	602.431	329.628
Total IOPS - Run 2	17,447.880	8,184.102
Run 3		
Exchange Log IOPS	910.255	253.905
File server 1 IOPS	3,426.519	1,914.799
File server 2 IOPS	3,449.751	1,839.417
SQL DB IOPS	4,457.861	2,023.955
SQL Log IOPS	477.575	340.683
Total IOPS - Run 3	17,529.055	8,332.936

Figure 9: Iometer mixed-workload performance test results for the storage arrays.

APPENDIX C – TEST ENVIRONMENT

We created a test bed in a climate-controlled room for each storage system. Each test bed included the following components:

- Microsoft Windows Server 2008 R2 High Availability cluster
 - Two Dell PowerEdge R710 servers installed with the following software:
 - Microsoft Windows Server 2008 R2 x64
 - Iometer 2006.07.27
 - One Dell PowerEdge 2950 server for domain controller
 - Microsoft Windows Server 2008 R2 x64
 - Microsoft Active Directory Service
- Switch
 - Two Dell PowerConnect™ 5448 switches
 - One switch for storage network
 - One switch for cluster network
 - Cat6e cables used
- Storage systems under test
 - One Dell PowerVault MD3220i array
 - Three Dell PowerVault MD1220 disk enclosures attached
 - One Dell PowerVault MD3000i array
 - Two Dell PowerVault MD1000 disk enclosures attached

Figure 10 provides highlights of the Dell PowerEdge R710 server configuration. Figure 13 in Appendix D provides complete configuration details.

Dell PowerEdge R710 rack server	
Processors	Two quad-core Intel® Xeon® Processor X5570s at 2.93 GHz
Memory	48 GB, 6 x 8 GB, 1,333 MHz
Internal disk	One 146GB, 15K RPM Seagate ST9146852SS SATA drive
Network	Integrated Quad Port Broadcom BCM5709C
Operating system	Microsoft Windows Server 2008 R2 x64
Test software	Iometer 2006.07.27

Figure 10: Dell PowerEdge R710 server configuration highlights.

Windows Server 2008 R2 high availability failover cluster configuration

Figure 11 shows the VM distribution of the Dell PowerVault MD3220i and two Dell PowerEdge R710 servers in an optimized state, and Figure 12 shows the VM distribution of the Dell PowerVault MD3220i and the single Dell PowerEdge R710 server in a degraded state. If one of the Dell PowerEdge R710 servers fails or

must go offline, the remaining Dell PowerEdge R710 can automatically take over the workload and virtual machines of the offline Dell PowerEdge R710 to prevent unplanned downtime.

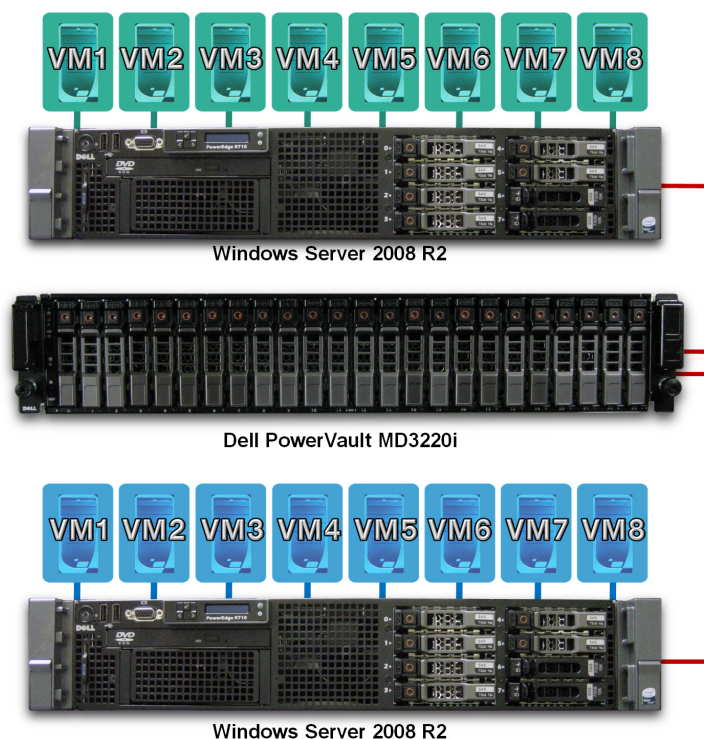


Figure 11: VM distribution on the Dell PowerVault MD3220i storage array and two Dell PowerEdge R710 servers running Windows Server 2008 R2 in an optimized system state.

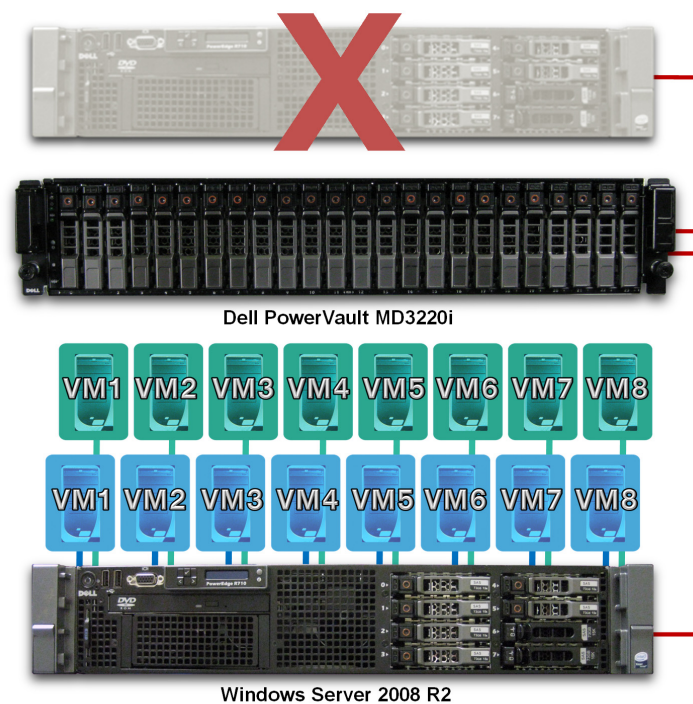


Figure 12: VM distribution on the Dell PowerVault MD3220i storage array and a single Dell PowerEdge R710 server running Windows Server 2008 R2 in a degraded system state.

APPENDIX D – SERVER CONFIGURATION INFORMATION

Figure 13 provides detailed configuration information about the test server.

Server	Dell PowerEdge R710
General dimension information	
Height (inches)	3.50
Width (inches)	17.50
Depth (inches)	27.00
U size in server rack (U)	2
Power supplies	
Total number	1
Wattage of each (W)	570
Cooling fans	
Total number	5
Dimensions (h x w) of each	2.50" x 2.50"
Voltage (V)	12
Amps (A)	1.60
General processor setup	
Number of processor packages	2
Number of cores per processor package	4
Number of hardware threads per core	2
CPU	
Vendor	Intel
Name	Xeon X5570
Stepping	D0
Socket type	LGA1366
Core frequency (GHz)	2.93
L1 cache	4 x 32 KB + 32 KB
L2 cache	4 x 256 KB
L3 cache (MB)	8
Platform	
Vendor and model number	Dell PowerEdge R710
Motherboard model number	0M233H
Motherboard revision number	13
BIOS name and version	Dell 1.3.6 (12/14/2009)
BIOS settings	Default
Memory modules	
Total RAM in system (GB)	48
Vendor and model number	Samsung M393B1K70BH1-CH9
Type	PC3-10600R
Speed (MHz)	1,333
Speed in the system currently running @ (MHz)	1,333

Server		Dell PowerEdge R710
Timing/latency (tCL-tRCD-iRP-tRASmin)		9-9-9-9
Size (GB)		8
Number of RAM modules		6
Chip organization		Double-sided
Hard disk		
Vendor and model number		Seagate ST9146852SS
Number of disks in system		1
Size (GB)		146
Buffer size (MB)		16
RPM		15,000
Type		SAS
Network card/subsystem		
Vendor and model number		Broadcom BCM5709C
Type		Integrated

Figure 13: Detailed system configuration information for the server we used for testing.

APPENDIX E – TEST PROCEDURES

We set up our test environment and installed Microsoft Windows Server 2008 R2 x64 Enterprise Edition on the test server. We used the Dell and Microsoft best practices for configuring Hyper-V on Windows Server 2008 R2 with Hyper-V, including the following:

1. Use virtual hard disks (VHDs) to allow the ability to use cluster-shared volumes (CSVs) and failover features in Windows Server 2008 R2. We recommend fixed-size VHDs for best performance.
2. Enable Jumbo Frames on the storage, NIC, and network switch for best performance and to reduce TCP/IP overhead (Dell tuning recommendation).
3. Install the Dell PowerVault Management software on every system that you will connect to the storage so that the Dell PowerVault MPIO driver is active.
4. Dedicate at least two NICs per server for server-storage iSCSI communication.
5. Dedicate at least one NIC for client-server communication.
6. Dedicate at least one NIC for the cluster heartbeat.

Note: We provide a description of our test bed in Appendix C.

Installing and configuring the domain controller (Dell PowerEdge 2950)

1. Install Windows Server 2008 R2 x64 with default settings.
2. Reboot the computer.
3. Click Start.
4. Right-click Network, and select Properties.
5. Click Change adapter settings.
6. Right-click the first NIC, and select Properties.
7. Select Internet Protocol Version 4 (TCP/IPv4), and click Properties.
8. Select Use the following IP address, and type 192 . 168 . 1 . 250 for the IP address and 255 . 255 . 255 . 0 for the subnet mask.
9. Type 127 . 0 . 0 . 1 for the preferred DNS server address.
10. Click OK.
11. Click OK.
12. Click Start→Run.
13. Type `dcpromo` and press Enter.
14. Click Next.
15. Click Next.
16. Select Create a new domain in a new forest.
17. Type `domain.company.com` and click Next.
18. Select Windows Server 2008 R2 for the Forest Functional level, and click Next.
19. Click Next.
20. Click Yes.
21. Click Next.
22. Enter a password and confirm the password.
23. Click Next.
24. Click Next.

25. Click Finish.
26. Click Restart Now.

Installing and configuring the hypervisors

1. Install Windows Server 2008 R2 Enterprise with the default settings on the Dell PowerEdge R710-1.
2. As the system restarts, press F2 to access the BIOS.
3. Select Processor Settings, and press Enter.
4. Change Virtualization Technology from Disabled to Enabled.
5. Press Escape.
6. Select Save Changes and Exit, and press Enter.
7. In the Server Manager, click Roles.
8. Click Add Roles.
9. Click Next.
10. Check the Hyper-V checkbox.
11. Click Next.
12. Click Next.
13. Check the Local Area Connection 4 checkbox, and click Next.
14. Click Install.
15. Click Close.
16. Click Yes
17. Click Close.
18. In the Server Manager, click Features.
19. Click Add Features.
20. Check the Failover Clustering checkbox, and click Next.
21. Click Install.
22. Click Close.
23. Repeat steps 1 through 22 for the Dell PowerEdge R710-2.

Configuring the cluster

1. On one of the servers, in the Server Manager, expand the Features.
2. Click Failover Cluster Manager.
3. Click Create a Cluster.
4. Click Next.
5. Type R710-1 and click Add.
6. Type R710-2 and click Add.
7. Click Next.
8. Click Next.
9. Click Next.
10. Click Next.
11. Click Next.
12. Click Finish.
13. Type MD3000-Cluster and uncheck the 192.168.131.1/24 and 192.168.130.0/24 checkboxes.
14. Type 192.168.1.102 for the Address.
15. Click Next.

16. Click Next.
17. Click Finish.
18. Click Enable Cluster Shared Volumes.
19. Check the I have read the notice above checkbox, and click OK.
20. Click on the Storage menu option under MD3000-Cluster.
21. Click Add a disk.
22. Select all five disks, and click OK.
23. Right-click the MD3000-Cluster and select More Actions→Configure Cluster Quorum Settings.
24. Click Next.
25. Select Node and Disk Majority.
26. Select the first disk, and click Next.
27. Click Finish.
28. Click Cluster Shared Volumes.
29. Click Add storage.
30. Select all the disks remaining, and click OK.

Setting up and configuring the virtual machines

Configuring the virtual machines

1. In the Server Manager, expand the Roles menu item.
2. Expand Hyper-V.
3. Expand Hyper-V Manager.
4. Click R710-1.
5. Click Hyper-V Settings.
6. Click Browse.
7. Change the location to C:\ClusterStorage\Volume1, and click Select Folder.
8. Click Virtual Machines.
9. Click Browse.
10. Change the location to C:\ClusterStorage\Volume1, and click Select Folder.
11. Click OK.
12. Right Click R710-1, and select New→Virtual Machine.
13. Click Next.
14. Type `Windows Server 2008 R2` as the name, and click Next.
15. Set the memory to 2048, and click Next.
16. Select Local Area Connection 4 – Virtual Network.
17. Set the virtual hard disk size to 40 GB, and the type to fixed size.
18. Click Next.
19. Select Install an operating system from a boot CD/DVD-ROM.
20. Insert the Windows Server 2008 R2 DVD into the server disk drive.
21. Click Next.
22. Click Finish.
23. Right-click the Windows Server 2008 R2 Virtual Machine, and select Start.
24. Right-click the VM, and select Connect.
25. Click Next.

26. Click Install Now.
27. Select Windows Server 2008 R2 Enterprise (Full Installation), and click Next.
28. Check the I accept the license terms checkbox, and click Next.
29. Click Custom (advanced).
30. Click Next.
31. Click OK.
32. Enter your Administrator password, and confirm it.
33. Shut down the virtual machine.

Setting up the virtual machines

1. Make 15 copies of the Windows Server 2008 R2 VHD.
2. Create seven new VMs on R710-1 with those VHDs as the OS drive.
3. Create eight new VMs on R710-2 with the remaining eight VHDs as the OS drive.
4. In the Server Manager, Click Services and applications.
5. Click Configure Service or Application.
6. Click Next.
7. Select Virtual Machine, and click Next.
8. Check every checkbox, and click Next.
9. Click Next.
10. Click Finish.

Installing and configuring Iometer

1. Download the Iometer package from www.iometer.org.
2. Uncompress the files, and copy Iometer.exe, Dynamo.exe, and Iometer.icf to c:\Iometer.
3. Open Iometer.exe.
4. Verify that for Disk Targets, the # of Outstanding I/Os is set to the appropriate value.
5. Under Results Display, make sure that Iometer has selected Start of Test, and set the update frequency to ∞ .
6. Under Test Setup, set the Run Time to 4 minutes and the Ramp Up Time to 60 seconds.
7. Exit Iometer.

Disabling Windows Firewall

1. Click Start, and click Control Panel.
2. Double-click Windows Firewall.
3. Click Turn Windows Firewall on or off.
4. Select Off.
5. Click OK.



Principled Technologies, Inc.
1007 Slater Road, Suite 300
Durham, NC, 27703
www.principledtechnologies.com

We provide industry-leading technology assessment and fact-based marketing services. We bring to every assignment extensive experience with and expertise in all aspects of technology testing and analysis, from researching new technologies, to developing new methodologies, to testing with existing and new tools.

When the assessment is complete, we know how to present the results to a broad range of target audiences. We provide our clients with the materials they need, from market-focused data to use in their own collateral to custom sales aids, such as test reports, performance assessments, and white papers. Every document reflects the results of our trusted independent analysis.

We provide customized services that focus on our clients' individual requirements. Whether the technology involves hardware, software, Web sites, or services, we offer the experience, expertise, and tools to help our clients assess how it will fare against its competition, its performance, its market readiness, and its quality and reliability.

Our founders, Mark L. Van Name and Bill Catchings, have worked together in technology assessment for over 20 years. As journalists, they published over a thousand articles on a wide array of technology subjects. They created and led the Ziff-Davis Benchmark Operation, which developed such industry-standard benchmarks as Ziff Davis Media's Winstone and WebBench. They founded and led eTesting Labs, and after the acquisition of that company by Lionbridge Technologies were the head and CTO of VeriTest.

Principled Technologies is a registered trademark of Principled Technologies, Inc.
All other product names are the trademarks of their respective owners.

Disclaimer of Warranties; Limitation of Liability:

PRINCIPLED TECHNOLOGIES, INC. HAS MADE REASONABLE EFFORTS TO ENSURE THE ACCURACY AND VALIDITY OF ITS TESTING, HOWEVER, PRINCIPLED TECHNOLOGIES, INC. SPECIFICALLY DISCLAIMS ANY WARRANTY, EXPRESSED OR IMPLIED, RELATING TO THE TEST RESULTS AND ANALYSIS, THEIR ACCURACY, COMPLETENESS OR QUALITY, INCLUDING ANY IMPLIED WARRANTY OF FITNESS FOR ANY PARTICULAR PURPOSE. ALL PERSONS OR ENTITIES RELYING ON THE RESULTS OF ANY TESTING DO SO AT THEIR OWN RISK, AND AGREE THAT PRINCIPLED TECHNOLOGIES, INC., ITS EMPLOYEES AND ITS SUBCONTRACTORS SHALL HAVE NO LIABILITY WHATSOEVER FROM ANY CLAIM OF LOSS OR DAMAGE ON ACCOUNT OF ANY ALLEGED ERROR OR DEFECT IN ANY TESTING PROCEDURE OR RESULT.

IN NO EVENT SHALL PRINCIPLED TECHNOLOGIES, INC. BE LIABLE FOR INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH ITS TESTING, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. IN NO EVENT SHALL PRINCIPLED TECHNOLOGIES, INC.'S LIABILITY, INCLUDING FOR DIRECT DAMAGES, EXCEED THE AMOUNTS PAID IN CONNECTION WITH PRINCIPLED TECHNOLOGIES, INC.'S TESTING. CUSTOMER'S SOLE AND EXCLUSIVE REMEDIES ARE AS SET FORTH HEREIN.
