Principled Technologies®

Dell 6Gbps vs. 3Gbps RAID controller performance comparison

Test report commissioned by Dell Inc. January 2010

Executive summary

We compared the performance of the 6Gbps Dell™ PowerEdge™ RAID Controller (PERC) H800 and H700 against the 3Gbps Dell PERC 6/E and 6/i using internal hard disk drives (HDDs), internal solid state drives (SSDs), and Dell™ PowerVault™ MD1120 and MD1220 external drive arrays.

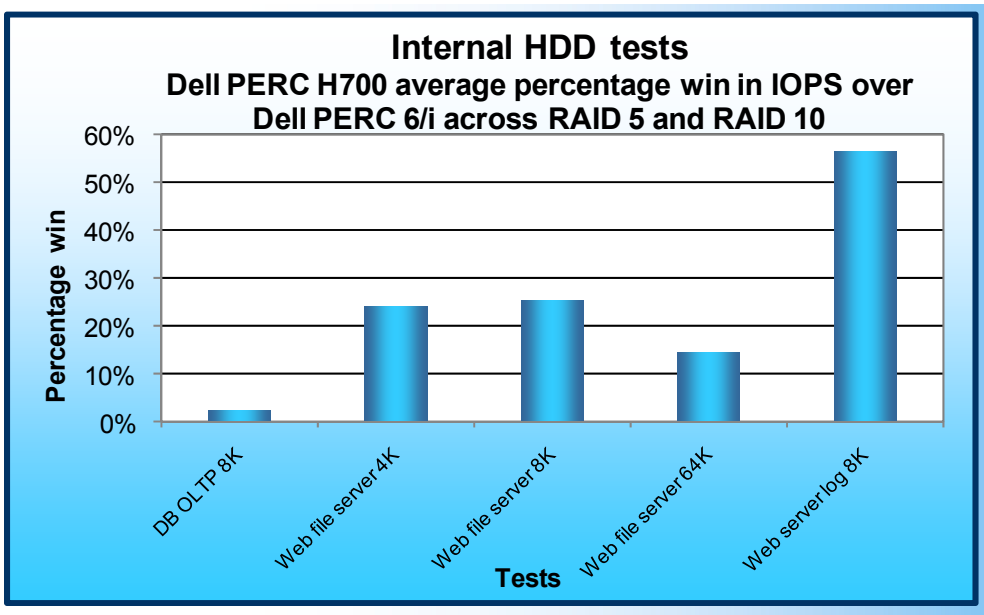

Figure 1: Percentage wins of the Dell PERC H700 over the Dell PERC 6/i using internal HDDs.

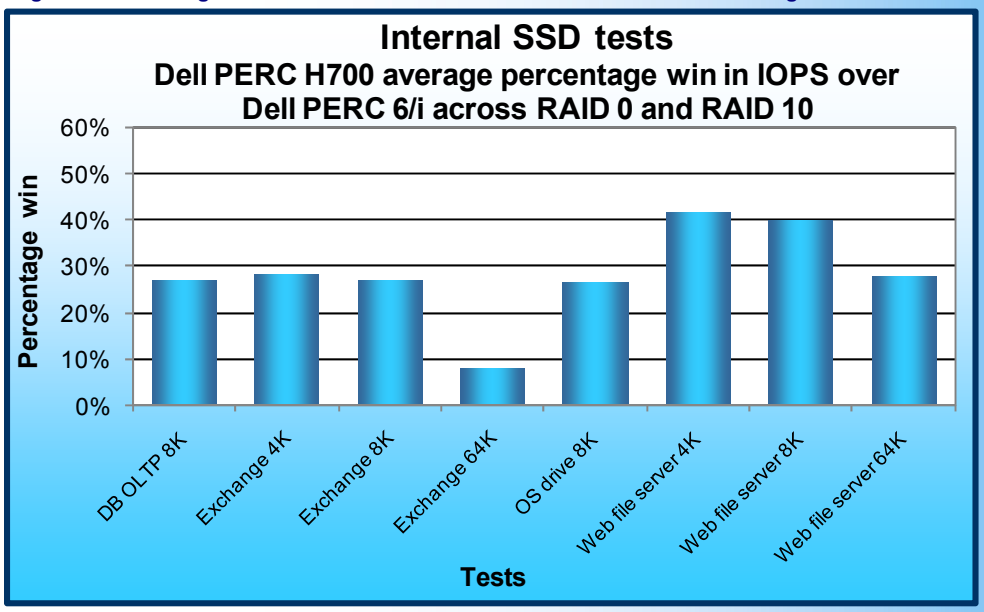

Figure 2: Percentage wins of the Dell PERC H700 over the Dell PERC 6/i using internal SSDs.

KEY FINDINGS

The Dell PERC H700 delivered up to an average of 56% better IOPS performance with internal HDDs than the Dell PERC 6/i.

The Dell PERC H700 delivered up to an average of 41% better IOPS performance with internal SSDs than the Dell PERC 6/i.

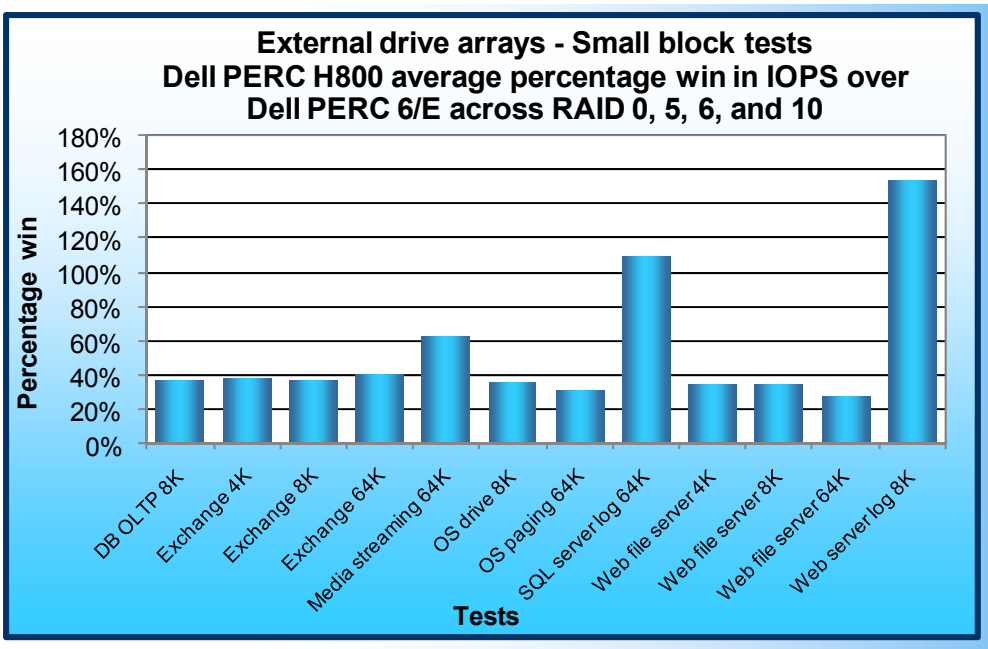

Figure 3: Percentage wins in the small block tests of the 6Gbps Dell PERC H800 with the Dell PowerVault MD1220 array over the 3Gbps Dell PERC 6/E with the Dell PowerVault MD1120 array.

KEY FINDINGS

The Dell PERC H800 delivered up to an average of 153% better IOPS performance with external drive arrays in our small block tests than the Dell PERC 6/E.

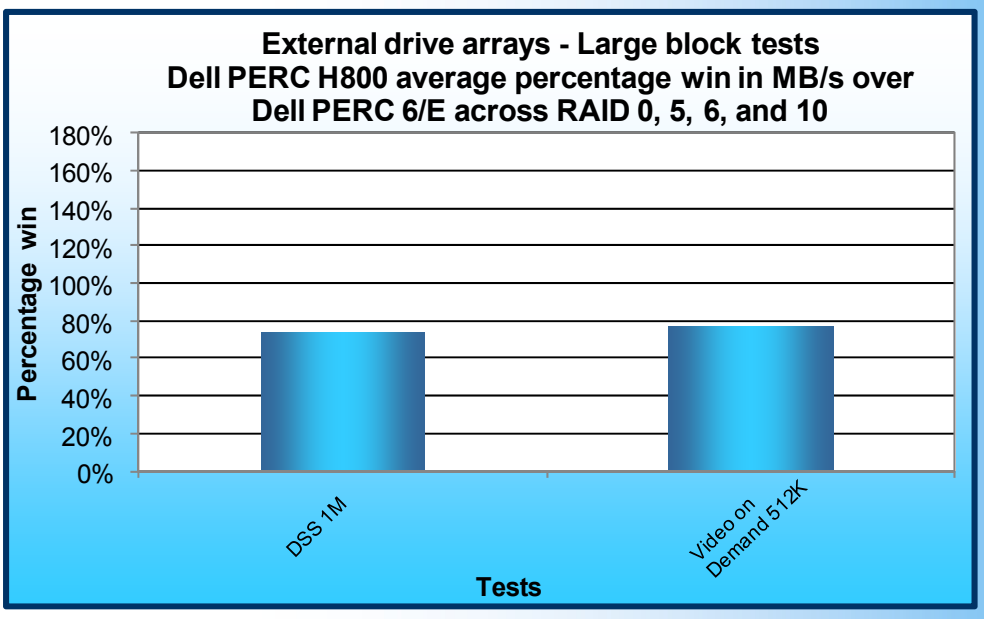

Figure 4: Percentage wins in the large block tests of the 6Gbps Dell PERC H800 with the Dell PowerVault MD1220 array over the 3Gbps Dell PERC 6/E with the Dell PowerVault MD1120 array.

The Dell PERC H800 delivered up to an average of 77% more MB/s with external drive arrays in our large block tests than the Dell PERC 6/E.

We present the details of the test access specifications we used in the What we tested section of this report. Additionally, specific results for individual tests are located in the What we found section and Appendix C.

What we tested

Iometer

Iometer measures input/output (I/O) on single and clustered systems. Iometer performs I/O operations on a system in order to stress the system, and then records the performance of and system 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 a Dell PowerEdge R710 to simulate a file server workload on the RAID controllers and corresponding storage. We used the same Iometer workload across all hardware configurations but tuned the number of outstanding I/Os to obtain the maximum possible Input/Output Operations Per Second (IOPS) on the controller with the best performance for each of the three sets of hardware comparisons being made: the 6Gbps vs. 3Gbps internal RAID controllers with hard disk drives, the 6Gbps vs. 3Gbps internal RAID controllers with solid state drives, and the 6Gbps vs. 3Gbps external RAID controllers with storage arrays. Figure 5 displays the details on the Iometer access specifications we used. We present the number of outstanding I/Os and other specific settings we used during testing in Figure 10 of the Test configurations section.

Access specification name and block size	Percentage read	Percentage write	Percentage random	Percentage sequential
DB OLTP 8K	70%	30%	100%	0%
DSS 1M	100%	0%	100%	0%
Exchange email 4K	67%	33%	100%	0%
Exchange email 8K	67%	33%	100%	0%
Exchange email 64K	50%	50%	100%	0%
Media streaming 64K	98%	2%	0%	100%
OS drive 8K	70%	30%	100%	0%
OS paging 64K	90%	10%	0%	100%
SQL server log 64K	0%	100%	0%	100%
Video on Demand 512K	100%	0%	100%	0%
Web file server 4K	95%	5%	75%	25%
Web file server 8K	95%	5%	75%	25%
Web file server 64K	95%	5%	75%	25%
Web server log 8K	0%	100%	0%	100%

Figure 5: Description of access specification settings.

For more information about Iometer, see http://www.iometer.org/.

Testing overview

We used a Dell PowerEdge R710 server to test the Iometer workload on all RAID controllers paired with corresponding storage.

First, we compared the performance of an internal Dell PERC 6/i 3Gbps RAID controller against an internal Dell PERC H700 6Gbps RAID controller at RAID levels 5 and 10 for HDD tests, and RAID levels 0 and 10 for SSD tests. The corresponding storage for testing the internal RAID controllers were six 6Gbps 73GB 15K SAS HDDs or, for SSD testing, six 3Gbps 50GB SSDs.

We then compared the performance of an external Dell PERC 6/E 3Gbps RAID controller against an external Dell PERC H800 6Gbps RAID controller at RAID levels 0, 5, 6, and 10. We used three Dell PowerVault MD1120 drive arrays with a total of 72 6Gbps 15K SAS HDDs (24 73GB drives and 48 146GB drives) to test the Dell PERC 6/E, and three Dell PowerVault MD1220 drive arrays, also with a total of 72 6Gbps 15K SAS HDDs (24 73GB drives and 48 146GB drives), to test the Dell PERC H800. We present the details on the 16 hardware configurations we used for testing in the Test configuration section below.

What we found

We report the IOPS results of our custom Iometer tests. For the large block access specifications in the external RAID controller testing, we report the MB/s results. For all tests, higher IOPS and MB-per-second numbers are better. We ran each test three times and report results from the run that produced the median of the three I/O-per-second results.

We calculated the average percentage wins for each access specification by averaging the performance gain percentage of all of the RAID levels we tested.

Internal HDD tests

Figure 6 displays the Dell PERC H700 percentage improvement in IOPS performance over the Dell PERC 6/i. The Dell PERC H700 delivered an average performance increase ranging from 2.2 percent to 56.3 percent.

Internal HDD test access specifications and block size	Dell PERC H700 percentage win in IOPS over Dell PERC 6/i RAID 5	Dell PERC H700 percentage win in IOPS over Dell PERC 6/i RAID 10	Dell PERC H700 average percentage win in IOPS over Dell PERC 6/i across both RAID 5 and RAID 10
DB OLTP 8K	0.1%	4.3%	**2.2%**
Web file server 4K	18.9%	28.6%	**23.8%**
Web file server 8K	20.8%	29.8%	**25.3%**
Web file server 64K	13.9%	15.1%	**14.5%**
Web server log 8K	77.1%	35.4%	**56.3%**

Figure 6: The Dell PERC H700 percentage improvement in IOPS performance over the Dell PERC 6/i. Higher numbers are better.

Internal SSD tests

For the internal SSD tests, we focused on performance gains from access specifications that contain random as well as write activity. Compared to the Dell PERC 6/i, the Dell PERC H700 RAID controller had significant performance improvements in all of the specifications we tested. The Dell PERC H700 yielded average performance gains across RAID levels 0 and 10 ranging from 8.1 percent to 41.8 percent.

Figure 7 displays the results from our internal SSD tests.

Internal SSD test access specifications and block size	Dell PERC H700 percentage win in IOPS over Dell PERC 6/i RAID 0	Dell PERC H700 percentage win in IOPS over Dell PERC 6/i RAID 10	Dell PERC H700 average percentage win in IOPS over Dell PERC 6/i across both RAID 0 and RAID 10
DB OLTP 8K	28.4%	25.5%	**26.9%**
Exchange 4K	30.3%	26.1%	**28.2%**
Exchange 8K	28.4%	25.2%	**26.8%**
Exchange 64K	11.2%	5.0%	**8.1%**
OS drive 8K	27.8%	25.5%	**26.6%**
Web file server 4K	42.8%	40.8%	**41.8%**
Web file server 8K	40.2%	39.3%	**39.8%**
Web file server 64K	33.4%	22.5%	**27.9%**

Figure 7: Access specification results from our internal SSD tests showing Dell PERC H700 improvement over the Dell PERC 6/i. Higher numbers are better.

External drive arrays – Small block tests

For our external drive arrays small block tests, the Dell PERC H800 RAID controller in conjunction with the Dell PowerVault MD1220 arrays delivered significantly better performance than the Dell PERC 6/E RAID controller in conjunction with the Dell PowerVault MD1120 arrays on all access specifications we tested across all RAID levels. The Dell PERC H800 controller delivered the greatest percentage increase in IOPS small block test results in the following three access specifications: Web server log 8K, with a 153.9 percent average performance increase; SQL server log 64K, with a 109.8 percent average performance increase; and Media Streaming 64K, with a 62.6 percent average performance increase. All other small block access specifications yielded significant average performance increases ranging from 27.5 percent to 40.1 percent.

Figure 8 displays the results from our external drive arrays small block tests.

External drive arrays – small block test access specifications and block size	Dell PERC H800 percentage win in IOPS over Dell PERC 6/E RAID 0	Dell PERC H800 percentage win in IOPS over Dell PERC 6/E RAID 5	Dell PERC H800 percentage win in IOPS over Dell PERC 6/E RAID 6	Dell PERC H800 percentage win in IOPS over Dell PERC 6/E RAID 10	Dell PERC H800 average percentage win in IOPS over Dell PERC 6/E across all RAID levels (RAID 0, 5, 6, and 10)
DB OLTP 8K	53.5%	32.8%	28.6%	30.5%	**36.4%**
Exchange 4K	55.7%	33.9%	29.5%	31.3%	**37.6%**
Exchange 8K	55.6%	33.0%	28.7%	31.7%	**37.2%**
Exchange 64K	56.8%	33.9%	37.3%	32.6%	**40.1%**
Media streaming 64K	58.1%	66.9%	68.3%	56.9%	**62.6%**
OS drive 8K	53.2%	32.7%	28.9%	30.5%	**36.3%**
OS paging 64K	31.9%	36.2%	50.2%	4.2%	**30.6%**
SQL server log 64K	118.9%	114.5%	156.4%	49.6%	**109.8%**
Web file server 4K	42.1%	33.9%	31.6%	33.0%	**35.2%**
Web file server 8K	41.1%	32.5%	30.7%	32.2%	**34.1%**
Web file server 64K	30.4%	27.1%	26.5%	25.9%	**27.5%**
Web server log 8K	198.4%	153.1%	167.5%	96.4%	**153.9%**

Figure 8: Access specifications results in our external drive arrays small block tests showing Dell PERC H800 improvements over the Dell PERC 6/E. Higher numbers are better.

External drive arrays – Large block tests

For our external drive arrays large block tests, the Dell PERC H800 in conjunction with the Dell PowerVault MD1220 outperformed the Dell PERC 6/E in conjunction with the Dell PowerVault MD1120 on both access specifications across all four RAID levels. The greatest average performance increase for the Dell PERC H800 was for the Video on Demand access specification with 77.2 percent more MB/s than the Dell PERC 6/E, followed closely by the DSS access specification, with 74.2 percent more MB/s than the Dell PERC 6/E.

Figure 9 displays the results from our external drive arrays large block tests.

External drive arrays – large block test access specifications and block size	Dell PERC H800 percentage win in MB/s over Dell PERC 6/E RAID 0	Dell PERC H800 percentage win in MB/s over Dell PERC 6/E RAID 5	Dell PERC H800 percentage win in MB/s over Dell PERC 6/E RAID 6	Dell PERC H800 percentage win in MB/s over Dell PERC 6/E RAID 10	Dell PERC H800 average percentage win in MB/s over Dell PERC 6/E across all RAID levels (RAID 0, 5, 6, and 10)
DSS 1M	72.1%	76.6%	74.7%	73.4%	**74.2%**
Video on Demand 512K	78.4%	79.3%	78.9%	72.3%	**77.2%**

Figure 9: Access specification results in our external drive arrays large block tests showing Dell PERC H800 improvements over the Dell PERC 6/E. Higher numbers are better.

Test configurations

Host server

- Dell PowerEdge R710, Intel® Xeon® 5540 processor, 24GB memory (6 x 4 GB)

Iometer settings

- **Internal HDD testing**
  - 1 Worker per target (1 total)
  - 4GB Dataset per target (4 GB total)
  - Outstanding I/Os tuned for each access specification, as we show in Figure 10.
- **Internal SSD testing**
  - 1 Worker per target (1 total)
  - 4GB Dataset per target (4 GB total)
  - Outstanding I/Os tuned for each access specification, as we show in Figure 10.
- **External HDD testing**
  - 1 Worker per target (3 total)
  - 4GB Dataset per target (12 GB total)
  - Outstanding I/Os tuned for each access specification, as we show in Figure 10.

Figure 10 displays the outstanding I/O settings for each access specification we tested.

Access specification	Internal HDD testing outstanding I/Os	Internal SSD testing outstanding I/Os	External HDD testing outstanding I/Os
DB OLTP 8K	64	256	64
DSS 1M	8	4	32
Exchange 4K	64	256	64
Exchange 8K	64	256	64
Exchange 64K	16	256	32
Media streaming 64K	16	96	128
OS drive 8K	64	256	64
OS paging 64K	16	64	16
SQL server log 64K	16	32	32
Video on Demand 512K	8	16	64
Web file server 4K	128	256	128
Web file server 8K	128	256	128
Web file server 64K	96	256	96
Web server log 8K	64	512	256

Figure 10: Outstanding I/O settings for each access specification we tested.

Dell PERC H700 vs. Dell PERC 6/i

Internal HDD testing

Figure 11 shows the specific hardware configurations for each RAID controller and RAID level during internal HDD testing.

Controller	OS partition HDDs (RAID 1)	Target HDDs	RAID level target HDDs
Dell PERC 6/i	2 x 73GB 6Gbps 15K RPM SAS	6 x 73GB 6Gbps 15K RPM SAS	5
Dell PERC 6/i	2 x 73GB 6Gbps 15K RPM SAS	6 x 73GB 6Gbps 15K RPM SAS	10
Dell PERC H700	2 x 73GB 6Gbps 15K RPM SAS	6 x 73GB 6Gbps 15K RPM SAS	5
Dell PERC H700	2 x 73GB 6Gbps 15K RPM SAS	6 x 73GB 6Gbps 15K RPM SAS	10

Figure 11: Hardware configurations for each RAID controller and RAID level during internal HDD testing.

Internal SSD testing

Figure 12 shows the specific hardware configurations for each RAID controller and RAID level during internal SSD testing.

Controller	OS partition SSDs (RAID 1)	Target SSDs	RAID level target SSDs
Dell PERC 6/i	2 x 50GB 3Gbps	6 x 50GB 3Gbps	0
Dell PERC 6/i	2 x 50GB 3Gbps	6 x 50GB 3Gbps	10
Dell PERC H700	2 x 50GB 3Gbps	6 x 50GB 3Gbps	0
Dell PERC H700	2 x 50GB 3Gbps	6 x 50GB 3Gbps	10

Figure 12: Hardware configurations for each RAID controller and RAID level during internal SSD testing.

Dell PERC H800 vs. Dell PERC 6/E

External HDD testing

For external testing with the Dell PERC 6/E, we configured the Dell PowerEdge R710 with the Dell PERC 6/i internal RAID controller with two 73GB 6Gbps 15K RPM SAS drives in a RAID 1 volume for the operating system. In the case of the Dell PERC H800 external testing, we configured the Dell PowerEdge R710 with the Dell PERC H700 internal RAID controller with two of the same 73GB 6Gbps 15K RPM SAS drives again in a RAID 1 volume for the operating system.

Note: We used the Dell recommended Redundant Path configuration to connect the storage arrays to the controllers. This configuration provides better performance and adds fault tolerance to the configuration; even if a single path fails, you continue to have access to your data through the alternate port. In addition, the Dell PERC H800 controller has automatic I/O load balancing capabilities to detect when a single path starts to become saturated. The controller then automatically balances the I/O traffic across both paths.

Figure 13 shows the specific hardware configurations for each RAID controller and RAID level during external HDD testing.

External RAID controller	Enclosure/Connectivity	Target HDDs per enclosure	Target HDDs	RAID level target HDDs
Dell PERC 6/E	3 x Dell PowerVault MD1120 Unified Redundant Path	24	24 x 73GB, 48 x 146GB 6Gbps 15K RPM SAS	0
Dell PERC 6/E	3 x Dell PowerVault MD1120 Unified Redundant Path	24	24 x 73GB, 48 x 146GB 6Gbps 15K RPM SAS	5
Dell PERC 6/E	3 x Dell PowerVault MD1120 Unified Redundant Path	24	24 x 73GB, 48 x 146GB 6Gbps 15K RPM SAS	6
Dell PERC 6/E	3 x Dell PowerVault MD1120 Unified Redundant Path	24	24 x 73GB, 48 x 146GB 6Gbps 15K RPM SAS	10
Dell PERC H800	3 x Dell PowerVault MD1220 Unified Redundant Path	24	24 x 73GB, 48 x 146GB 6Gbps 15K RPM SAS	0
Dell PERC H800	3 x Dell PowerVault MD1220 Unified Redundant Path	24	24 x 73GB, 48 x 146GB 6Gbps 15K RPM SAS	5
Dell PERC H800	3 x Dell PowerVault MD1220 Unified Redundant Path	24	24 x 73GB, 48 x 146GB 6Gbps 15K RPM SAS	6
Dell PERC H800	3 x Dell PowerVault MD1220 Unified Redundant Path	24	24 x 73GB, 48 x 146GB 6Gbps 15K RPM SAS	10

Figure 13: Hardware configurations for each RAID controller and RAID level during external HDD testing.

How we tested

Installing Windows Server 2008 Enterprise R2 x64

1. Boot the server, and insert the Windows Server 2008 R2 x64 installation DVD in the DVD-ROM drive.
2. At the Language Selection Screen, click Next.
3. Click Install Now.
4. Select Windows Server 2008 Enterprise (Full Installation) x64, and click Next.
5. Click the I accept the license terms check box, and click Next.
6. Click Custom.
7. Click Drive options (advanced).
8. Delete any existing partitions.
9. Ensure the first drive is selected, and click New.
10. Click Apply.
11. Click OK.
12. Click Next.
13. At the User's password must be changed before logging on warning screen, click OK.
14. Type your new password into both fields, and click the arrow to continue.
15. At the Your password has been changed screen, click OK.

Windows Server 2008 settings

We installed all recommended and critical Windows updates through 12/7/2009.

Disable Windows Firewall:

1. Click Start→Administrative Tools→Windows Firewall and Advanced Security.
2. Under the Overview heading, click Windows Firewall Properties.
3. Click the dropdown menu beside Firewall state, and select Off.
4. Click the Private Profile tab.
5. Click the dropdown menu beside Firewall state, and select Off.
6. Click the Public Profile tab.
7. Click the dropdown menu beside Firewall state, and select Off.
8. Click OK to close the Properties window.
9. Close the Windows Firewall with Advanced Security window.

Installing Dell OpenManage Server Administrator 6.2

1. Insert the Dell OpenManage Install DVD.
2. Select Dell OpenManage Server Administrator, and click Install.
3. At the installer dialogue box, click Install again.
4. At the Welcome screen, click Next.
5. Select Install, and click Next.
6. At the Custom Setup window, leave default components selected, and click Next.
7. Click Install.

Setting up a test volume

1. Reboot the system.
2. When the application prompts you to do so, enter CTRL+R to enter the PERC BIOS Configuration Utility.
3. Highlight the appropriate RAID controller, and press Enter.
4. Highlight the RAID controller card, press F2, and select Create New VD.
5. Select the appropriate RAID level, and press Enter.
6. Select all 6 drives if testing an internal RAID controller, or 24 drives in a single storage array if testing an external RAID controller.
7. In Basic Settings, enter a VD Name.
8. Select OK, and select OK again at the warning dialogue box.
9. At the main screen, highlight the newly created Virtual Disk, and press F2.
10. Select Initialization, and in the sub-menu, select Start Init.
11. Select OK when the dialogue box notifies you that the initialization is complete.
12. If testing an external RAID controller, repeat steps 4 through 11 twice to add and initialize the remaining volumes.
13. After initialization is complete, press ESC twice, and select OK to exit.
14. Press Ctrl+Alt+Delete to reboot as prompted.

Formatting and mounting each test volume

1. Click Start→Administrative Tools→Computer Management.
2. Under Storage, click Disk Management.
3. When prompted to initialize the drive(s), select the GPT partition style, and click OK.
4. For each partition:
    a. Right-click Unallocated space, and click New Simple Volume.
    b. Leave the default maximum volume size, and click Next.
    c. Leave the default drive letter, and click Next.
    d. Check the Perform a quick format box.
    e. Click Next.
    f. Click Finish.

Installing and configuring Iometer

1. Download the Iometer package from www.iometer.org.
2. Double-click the installer, and click Next at the welcome window.
3. At the License Agreement window, click I Agree.
4. At the Choose Components window, leave the defaults selected, and click Next.
5. At the Choose Install Location window, change the Destination Folder to C:\Iometer 2006.07.27, and click Install.

Setting up the individual Iometer workloads

We used the following settings for each test:

1. Open Iometer.exe.
2. For each access specification:
    a. Create the access specification to match the configurations in Figure 5.
    b. Verify that the access specification has the following additional settings:
        i. Under Burstiness, set Transfer Delay to 0ms and set Burst Length to 1 I/O.
        ii. Under Align I/Os, select Sector Boundaries.

iii. Under Reply Size, select No Reply.

c. Under Topology, select the computer name, and click the Start a New Disk Worker on Selected Manager button until you have one worker assigned to each target volume.
d. Under Disk Targets, set the # of Outstanding I/Os according to the corresponding value shown in Figure 10.
e. Set the disk size to 8388608 sectors (4GB).
f. Under Results Display, make sure that Iometer has selected Start of Test.
g. Under Test Setup, set the Run Time to 4 minutes and the Ramp Up Time to 60 seconds.

3. Exit Iometer.

Running the test

1. Reboot the system.
2. After logging in, open a command prompt.
3. Type `cd c:\Iometer 2006.07.27` and press Enter.
4. Type `run.bat`
5. Wait 5 minutes.
6. Press Enter.
7. After all access specifications are finished running, copy the result files from the server.
8. Repeat steps 1 through 7 two more times, for a total of three runs.

Appendix A –Test server information

Figure 14 provides detailed information for the test servers.

Test server	Dell PowerEdge R710
General processor setup	
Number of processor packages	2
Number of cores per processor package	4
Number of hardware threads per core	2
System power management policy	Balanced
CPU	
Vendor	Intel
Name	Intel Xeon Processor X5570
Stepping	D0
Socket type	LGA 1366
Core frequency (GHz)	2.93
Front-side bus frequency	6.4 GT/s
L1 cache	32 KB + 32 KB (per core)
L2 cache	1 MB (4 x 256 KB)
L3 cache (MB)	8
Platform	
Vendor and model number	Dell PowerEdge R710
Motherboard model number	0M233H
Motherboard chipset	Intel 5520
Motherboard revision number	13
BIOS name and version	Dell 1.3.6 (10-30-2009)
BIOS settings	Default
Memory module(s)	
Vendor and model number	Crucial CT51272BB1339
Type	PC3-10600R
Speed (MHz)	1,333
Speed in the system currently running @ (MHz)	1,333
Timing/Latency (tCL-tRCD-iRP-tRASmin)	9-9-9-24
RAM module size (GB)	4
Number of RAM modules	6
Chip organization	Double-sided
Total system memory (GB)	24
Operating system	
Name	Windows Server 2008 R2 Enterprise x64 Edition
Build number	7600
Service Pack	NA
File system	NTFS
Kernel	ACPI x64-based PC

Test server	Dell PowerEdge R710
Language	English
Microsoft DirectX version	11
Graphics	
Vendor and model number	Matrox G200
Chipset	G2+
BIOS version	00
Type	Integrated
Memory size (MB)	8
Resolution	1,024 x 768
Network card/subsystem	
Vendor and model number	Broadcom BCM5709C NetXtreme II GigE (NDIS VBD Client) x 2
Type	Integrated
Driver version	Broadcom 5.0.15.0 (10/02/2009)
Optical drive	
Vendor and model number	TSSTCorp DVD-ROM TS-L333A
USB ports	
Number	4
Type	USB 2.0
Power supplies	
Total number	2
Wattage of each (W)	870
Cooling fans	
Total number	5
Dimensions (mm)	80
Voltage (V)	12
Amps (A)	1.60

Figure 14: Detailed test server information.

Appendix B –Test storage information

Figures 15 and 16 provide detailed information for the test storage.

Internal testing hardware

RAID controller	Dell PERC 6/i	Dell PERC H700
Firmware version	6.2.0-0013	12.0.1-0083
Driver version	4.5.0.64	4.17.2.64
Cache size (MB)	256	512
ROC (Raid-on-Chip)	LSI 1078	LSI 2108
Internal storage		
HDD testing		
Vendor and model number	Dell ST973452SS	Dell ST973452SS
Number of drives	8	8
Speed (Gbps)	6	6
Size (GB)	73	73
RPM	15K	15K
Type	SAS	SAS
SSD testing		
Vendor and model number	Dell MCB4E50G5MXP-0VB	Dell MCB4E50G5MXP-0VB
Number of drives	8	8
Speed (Gbps)	3	3
Size (GB)	50	50
Type	SATA	SATA

Figure 15: Primary internal storage hardware.

External testing hardware

RAID controller	Dell PERC 6/E	Dell PERC H800
Firmware version	6.2.0-0013	12.0.1-0083
Driver version	4.5.0.64	4.17.2.64
Cache size (MB)	512	512
ROC (Raid-on-Chip)	LSI 1078	LSI 2108
Storage arrays		
Vendor and model	Dell PowerVault MD1120	Dell PowerVault MD1220
Connection type	SAS SFF 8470	SAS SFF 8088
Connectivity mode	Unified mode (redundant path)	Unified mode (redundant path)
Total number of drives	72	72
Hard drives		
Hard drive 1		
Vendor and model number	Dell ST973452SS	Dell ST973452SS
Number of drives	24	24
Speed (Gbps)	6	6
Size (GB)	73	73
RPM	15K	15K
Type	SAS	SAS
Hard drive 2		
Vendor and model number	ST9146852SS	ST9146852SS
Number of drives	48	48
Speed (Gbps)	6	6
Size (GB)	146	146
RPM	15K	15K
Type	SAS	SAS

Figure 16: Primary external storage hardware.

Appendix C – Detailed test results

Figure 17 shows results in IOPS from the Dell PERC 6/i and the Dell PERC H700 RAID controllers during the internal HDD testing.

Access specification name and block size	Dell PERC 6/i RAID 5 IOPS	Dell PERC H700 RAID 5 IOPS	Dell PERC 6/i RAID 10 IOPS	Dell PERC H700 RAID 10 IOPS
DB OLTP 8K	1,729.66	1,730.63	2,921.35	3,047.16
Web file server 4K	3,556.62	4,229.71	3,826.13	4,919.90
Web file server 8K	3,120.67	3,771.30	3,406.67	4,421.75
Web file server 64K	1,558.98	1,775.00	1,686.66	1,940.63
Web server log 8K	38,520.36	68,228.92	40,295.86	54,572.70

Figure 17: IOPS results from the Dell PERC 6/i during internal HDD testing. Higher numbers are better.

Figure 18 below shows results in IOPS from the Dell PERC 6/i and the Dell PERC H700 RAID controllers during the internal SSD testing.

Access specification name and block size	Dell PERC 6/i RAID 0 IOPS	Dell PERC H700 RAID 0 IOPS	Dell PERC 6/i RAID 10 IOPS	Dell PERC H700 RAID 10 IOPS
DB OLTP	17,292.73	22,200.32	15,691.25	19,693.82
Exchange email 4K	18,009.07	23,465.58	16,379.77	20,658.06
Exchange email 8K	16,910.89	21,709.14	15,209.36	19,046.42
Exchange email 64K	8,088.94	8,993.83	4,684.52	4,919.04
OS drive 8K	17,289.46	22,097.98	15,694.62	19,692.68
Web file server 4K	28,463.39	40,653.37	27,169.92	38,249.78
Web file server 8K	25,742.32	36,085.57	24,910.36	34,706.44
Web file server 64K	12,033.80	16,047.51	11,532.13	14,125.25

Figure 18: IOPS results from the Dell PERC 6/i and the Dell PERC H700 during internal SSD testing. Higher numbers are better.

Figure 19 shows results in IOPS for RAID levels 0 and 10 from the Dell PERC 6/E in conjunction with the Dell PowerVault MD1120 and the Dell PERC H800 in conjunction with the Dell PowerVault MD1220 during the external HDD small block testing.

Access specification name and block size	Dell PERC 6/E Dell PowerVault MD1120 RAID 0 IOPS	Dell PERC H800 Dell PowerVault MD1220 RAID 0 IOPS	Dell PERC 6/E Dell PowerVault MD1120 RAID 10 IOPS	Dell PERC H800 Dell PowerVault MD1220 RAID 10 IOPS
DB OLTP 8K	13,416.65	20,594.40	14,871.51	19,412.68
Exchange email 4K	13,405.64	20,878.13	15,139.82	19,872.05
Exchange email 8K	12,853.65	19,997.95	14,279.73	18,799.59
Exchange email 64K	6,999.13	10,976.31	7,203.16	9,550.81
Media streaming 64K	20,058.84	31,714.52	20,979.67	32,924.99
OS drive 8K	13,422.88	20,569.39	14,874.98	19,411.04
OS paging 64K	10,799.67	14,245.53	14,462.62	15,069.07
SQL server log 64K	9,716.22	21,265.15	7,809.24	11,681.52
Web file server 4K	25,977.16	36,912.93	26,058.00	34,662.08
Web file server 8K	24,623.87	34,751.93	24,632.07	32,571.00
Web file server 64K	14,844.71	19,360.50	14,234.49	17,914.37
Web server log 8K	57,369.98	171,190.07	48,245.40	94,773.71

Figure 19: IOPS results from the Dell PERC 6/E and Dell PERC H800 during external HDD small block testing, RAID 0 and 10. Higher numbers are better.

Figure 20 shows results in IOPS for RAID levels 5 and 6 from the Dell PERC 6/E in conjunction with the Dell PowerVault MD1120 and the Dell PERC H800 in conjunction with the Dell PowerVault MD1220 during the external HDD small block testing.

Access specification name and block size	Dell PERC 6/E Dell PowerVault MD1120 RAID 5 IOPS	Dell PERC H800 Dell PowerVault MD1220 RAID 5 IOPS	Dell PERC 6/E Dell PowerVault MD1120 RAID 6 IOPS	Dell PERC H800 Dell PowerVault MD1220 RAID 6 IOPS
DB OLTP 8K	10,773.03	14,307.67	9,702.83	12,474.36
Exchange email 4K	10,741.64	14,378.02	9,644.43	12,489.63
Exchange email 8K	10,208.22	13,577.40	9,164.07	11,790.45
Exchange email 64K	4,767.99	6,384.66	3,955.03	5,428.98
Media streaming 64K	19,232.19	32,094.21	18,577.61	31,272.27
OS drive 8K	10,774.41	14,297.12	9,695.26	12,494.15
OS paging 64K	9,694.27	13,207.10	8,425.08	12,656.29
SQL server log 64K	7,805.41	16,739.41	6,361.07	16,309.97
Web file server 4K	24,422.64	32,696.79	23,529.41	30,975.97
Web file server 8K	23,187.66	30,729.83	22,275.78	29,107.53
Web file server 64K	13,583.09	17,264.34	13,018.11	16,465.85
Web server log 8K	52,650.14	133,279.05	48,321.84	129,243.67

Figure 20: IOPS results from the Dell PERC 6/E and Dell PERC H800 during external HDD small block testing, RAID 5 and 6. Higher numbers are better.

Figure 21 shows results in MB/s for RAID levels 0 and 10 from the Dell PERC 6/E in conjunction with the Dell PowerVault MD1120 and Dell PERC H800 in conjunction with the Dell PowerVault MD1220 during the external HDD large block testing.

Access specification name and block size	Dell PERC 6/E Dell PowerVault MD1120 RAID 0 MB/s	Dell PERC H800 Dell PowerVault MD1220 RAID 0 MB/s	Dell PERC 6/E Dell PowerVault MD1120 RAID 10 MB/s	Dell PERC H800 Dell PowerVault MD1220 RAID 10 MB/s
DSS 1M	1,192.33	2,052.50	1,158.76	2,009.23
Video on Demand 512K	1,168.02	2,083.61	1,112.67	1,917.41

Figure 21: MB/s results from the Dell PERC 6/E and Dell PERC H800 during external HDD large block testing, RAID 0 and 10. Higher numbers are better.

Figure 22 shows results in MB/s for RAID levels 5 and 6 from the Dell PERC 6/E in conjunction with the Dell PowerVault MD1120 and Dell PERC H800 in conjunction with the Dell PowerVault MD1220 during the external HDD large block testing.

Access specification name and block size	Dell PERC 6/E Dell PowerVault MD1120 RAID 5 MB/s	Dell PERC H800 Dell PowerVault MD1220 RAID 5 MB/s	Dell PERC 6/E Dell PowerVault MD1120 RAID 6 MB/s	Dell PERC H800 Dell PowerVault MD1220 RAID 6 MB/s
DSS 1M	1,192.33	2,105.65	1,185.89	2,071.69
Video on Demand 512K	1,167.54	2,093.17	1,160.50	2,076.58

Figure 22: MB/s results from the Dell PERC 6/E and Dell PERC H800 during external HDD large block testing, RAID 5 and 6. Higher numbers are better.

About Principled Technologies

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 you assess how it will fare against its competition, its performance, whether it's ready to go to market, 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.

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