Principled Technologies®

Dell 6Gbps vs. HP 6Gbps RAID controller performance comparison
Test report commissioned by Dell Inc. February 2010

Executive summary

We compared the performance of the 6Gbps Dell PowerEdge RAID controller (PERC) H700 against that of the 6Gbps HP Smart Array P410i controller with both systems using internal hard disk drives (HDDs). We also compared the performance of the 6Gbps Dell PERC H800 against that of the 6Gbps HP Smart Array P411 controller using the Dell PowerVault MD1220 and HP StorageWorks D2700 external drive arrays, respectively.

Figure 1: Percentage wins of the Dell PERC H700 over the HP Smart Array P410i using internal HDDs.

KEY FINDINGS

The Dell PERC H700 delivered up to an average of 130.5% better IOPS performance with internal HDDs than the HP Smart Array P410i.

Figure 2: Percentage wins of the Dell PERC H800 with the Dell PowerVault MD1220 array in a single-path configuration over the HP Smart Array P411 with the HP StorageWorks D2700 array in a single-path configuration.

The Dell PERC H800 in a single-path configuration delivered up to an average of 117.2% better IOPS performance with external drive arrays in our tests than the HP Smart Array P411 in a single-path configuration.
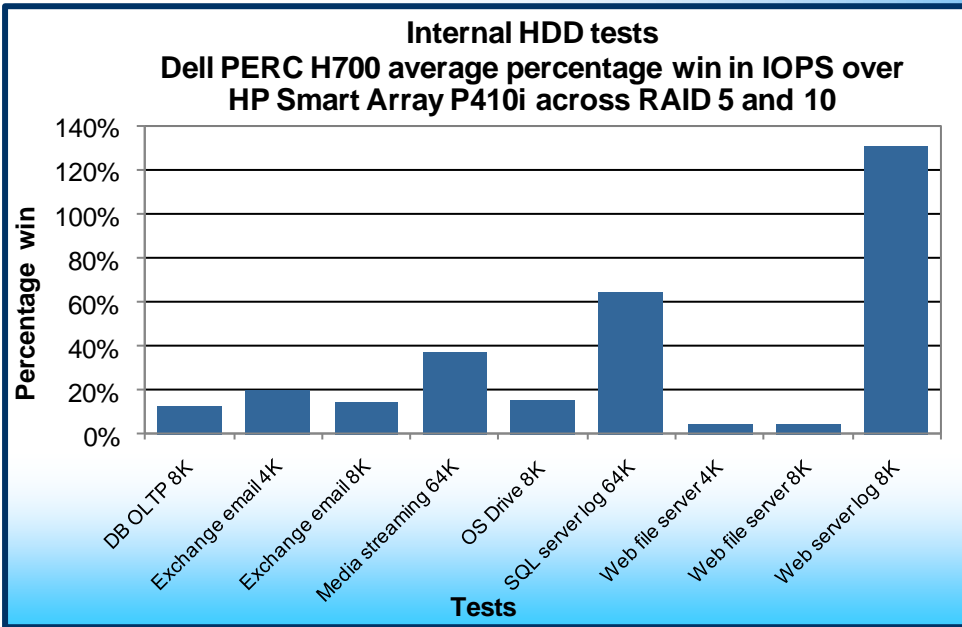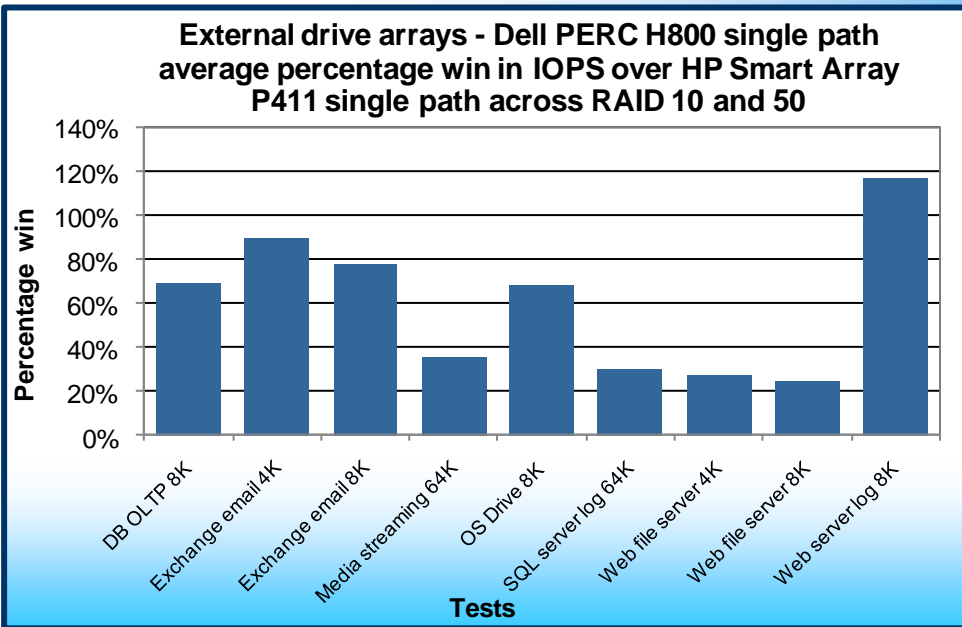
External drive arrays - Dell PERC H800 redundant path average percentage win in IOPS over HP Smart Array P411 single path across RAID 10 and 50
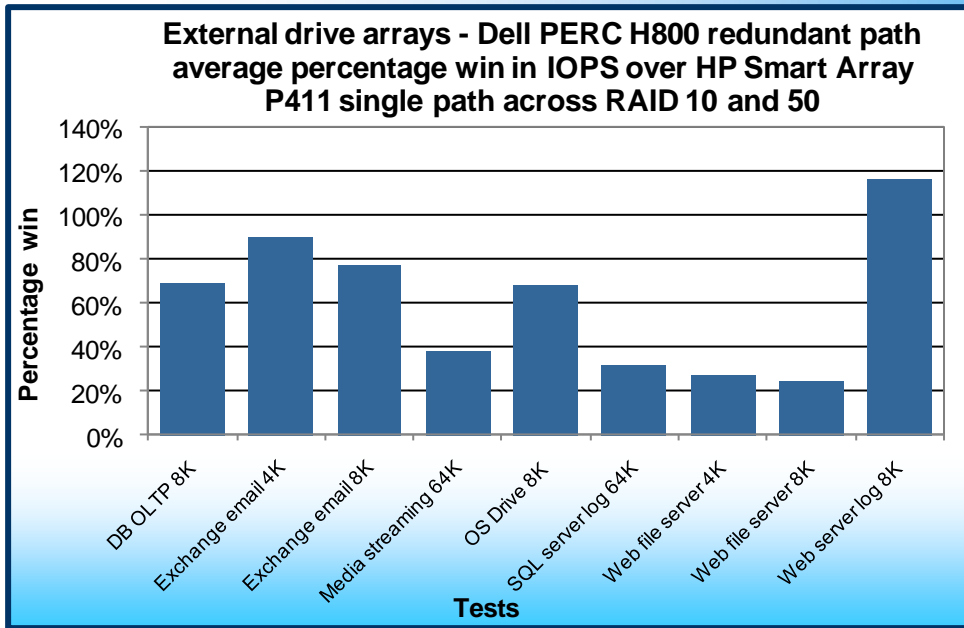
Figure 3: Percentage wins of the Dell PERC H800 with the Dell PowerVault MD1220 array in a redundant-path configuration over the HP Smart Array P411 with the HP StorageWorks D2700 array in a single-path configuration.

We present the details of the test access specifications we used in the What we tested section of this report. Additionally, we present the specific results for individual tests in the What we found section and in 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 both the Dell PowerEdge R710 and the HP ProLiant DL380 G6 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 on all three sets of hardware comparisons being made: the Dell 6Gbps vs. HP 6Gbps internal RAID controllers with hard disk drives, the single-path configuration Dell 6Gbps vs. single-path configuration HP 6Gbps external RAID controllers with storage arrays, and the redundant-path configuration Dell 6Gbps vs. single-path configuration HP 6Gbps external RAID controllers with storage arrays.

Figure 4 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 8 of the Test configurations section.

Note: We tested the Dell hardware in both single-path and redundant-path configurations to demonstrate that the redundant-path configuration provides a significant performance increase over the HP solution while also adding fault tolerance to the configuration; even if a single path fails, the server continues to have access to the storage through the alternate port.

Access specification name and block size	Percentage read	Percentage write	Percentage random	Percentage sequential
DB OLTP 8K	70%	30%	100%	0%
Exchange email 4K	67%	33%	100%	0%
Exchange email 8K	67%	33%	100%	0%
Media streaming 64K	98%	2%	0%	100%
OS Drive 8K	70%	30%	100%	0%
SQL server log 64K	0%	100%	0%	100%
Web file server 4K	95%	5%	75%	25%
Web file server 8K	95%	5%	75%	25%
Web server log 8K	0%	100%	0%	100%

Figure 4: Description of access specification settings.

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

Testing overview
We used a Dell PowerEdge R710 server for the Dell controllers and an HP ProLiant DL380 G6 server for the HP controllers, each paired with its corresponding storage, to test the Iometer workload on all RAID levels. First, at RAID levels 5 and 10, we compared the performance of an internal Dell PERC H700 6Gbps RAID controller against an internal HP Smart Array P410i 6Gbps RAID controller. The corresponding storage for testing the internal RAID controllers were six 6Gbps 73GB 15K SAS HDDs.

Then, at RAID levels 10 and 50, we compared the performance of an external Dell PERC H800 6Gbps RAID controller against that of an external HP Smart Array P411 6Gbps RAID controller, both connected in a single-path configuration. We used one Dell PowerVault MD1220 drive array with a total of 24 73GB drives to test the Dell PERC H800, and one HP StorageWorks D2700 drive array with a total of 24 6Gbps 73GB 15K SAS HDDs to test the HP Smart Array P411.

We then repeated the RAID levels 10 and 50 external HDD tests, but this time with the Dell PERC H800 6Gbps RAID controller in a redundant-path configuration against that of the HP Smart Array P411 6Gbps RAID controller in a single-path configuration with external storage. We present the details on the 13 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 all tests, higher IOPS numbers are better. We ran each test three times and report results from the run that produced the median of the three IOPS 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 5 displays the Dell PERC H700 percentage improvement in IOPS performance over the HP Smart Array P410i. The Dell PERC H700 delivered an average performance increase ranging from 4.3 percent to 130.5 percent.

Internal HDD test access specifications and block size	Dell PERC H700 percentage win in IOPS over HP Smart Array P410i RAID 5	Dell PERC H700 percentage win in IOPS over HP Smart Array P410i RAID 10	Dell PERC H700 average percentage win in IOPS over HP Smart Array P410i across both RAID 5 and RAID 10
DB OLTP 8K	10.8%	14.6%	**12.7%**
Exchange email 4K	23.6%	15.7%	**19.6%**
Exchange email 8K	7.6%	21.2%	**14.4%**
Media streaming 64K	51.1%	22.2%	**36.6%**
OS Drive 8K	11.3%	18.3%	**14.8%**
SQL server log 64K	5.5%	123.8%	**64.6%**
Web file server 4K	2.3%	6.8%	**4.5%**
Web file server 8K	3.8%	4.7%	**4.3%**
Web server log 8K	26.7%	234.3%	**130.5%**

Figure 5: The Dell PERC H700 percentage improvement in IOPS performance over the HP Smart Array P410i. Higher numbers are better.

External drive arrays – Single-path configuration

For our external drive array single-path configuration tests, the Dell PERC H800 RAID controller in conjunction with the Dell PowerVault MD1220 array delivered significantly better performance than the HP Smart Array P411 controller in conjunction with the HP StorageWorks D2700 array on all access specifications we tested across both RAID levels. The Dell PERC H800 controller delivered the greatest percentage increase in IOPS in Web server log 8K, with a 117.2 percent average performance increase. The remaining access specifications also yielded significant average performance increases ranging from 24.4 percent to 89.7 percent.

Figure 6 displays the results from our external drive arrays single-path configuration.

External drive array test access specifications and block size	Dell PERC H800 percentage win in IOPS over HP Smart Array P411 RAID 10	Dell PERC H800 percentage win in IOPS over HP Smart Array P411 RAID 50	Dell PERC H800 average percentage win in IOPS over HP Smart Array P411 across both RAID 10 and RAID 50
DB OLTP 8K	0.8%	137.3%	**69.1%**
Exchange email 4K	2.2%	177.3%	**89.7%**
Exchange email 8K	2.3%	153.4%	**77.9%**
Media streaming 64K	31.4%	38.8%	**35.1%**
OS Drive 8K	1.6%	134.3%	**68.0%**
SQL server log 64K	52.1%	6.3%	**29.2%**
Web file server 4K	20.3%	32.7%	**26.5%**
Web file server 8K	17.0%	31.8%	**24.4%**
Web server log 8K	116.2%	118.1%	**117.2%**

Figure 6: Access specifications results in our external drive arrays single path-configuration tests showing Dell PERC H800 improvements over the HP Smart Array P411. Higher numbers are better.

External drive arrays – Redundant-path configuration vs. single-path configuration

For our external drive array redundant-path configuration tests, the Dell PERC H800 in conjunction with the Dell PowerVault MD1220 configured in redundant path mode outperformed the HP Smart Array P411 controller in conjunction with the HP StorageWorks D2700 array configured in single-path mode on all access specifications across both RAID levels. The greatest average performance increase for the Dell PERC H800 was for the Web server log 8K access specification with 115.6 percent more IOPS than the HP Smart Array P411. The remaining

access specifications also yielded significant average performance increases ranging from 24.5 percent to 89.9 percent.

Figure 7 displays the results from our external drive array redundant-path configuration tests.

External drive array test access specifications and block size	Dell PERC H800 percentage win in IOPS over HP Smart Array P411 RAID 10	Dell PERC H800 percentage win in IOPS over HP Smart Array P411 RAID 50	Dell PERC H800 average percentage win in IOPS over HP Smart Array P411 across both RAID 10 and RAID 50
DB OLTP 8K	0.6%	137.2%	**68.9%**
Exchange email 4K	1.8%	178.0%	**89.9%**
Exchange email 8K	1.9%	151.4%	**76.6%**
Media streaming 64K	36.9%	38.4%	**37.7%**
OS Drive 8K	1.7%	134.0%	**67.8%**
SQL server log 64K	58.4%	5.3%	**31.9%**
Web file server 4K	21.2%	32.0%	**26.6%**
Web file server 8K	17.7%	31.2%	**24.5%**
Web server log 8K	113.9%	117.4%	**115.6%**

Figure 7: Access specification results in our external drive arrays redundant-path configuration tests showing Dell PERC H800 improvements over the HP Smart Array P411. Higher numbers are better.

Test configurations

Host servers
- Dell PowerEdge R710, Intel® Xeon® Processor X5570, 24GB memory (6 x 4 GB)
- HP ProLiant DL380 G6, Intel Xeon Processor X5570, 24GB memory (6 x 4 GB)

Iometer settings
- 1 worker per target (1 total)
- 4GB Dataset per target (4 GB total)
- Outstanding I/Os tuned for each access specification

Figure 8 displays the outstanding I/O settings for each access specification we tested.

Access specification	Internal HDD testing outstanding I/Os	External HDD testing outstanding I/Os
DB OLTP 8K	64	64
Exchange 4K	64	64
Exchange 8K	64	64
Media streaming 64K	16	128
OS Drive 8K	64	64
SQL server log 64K	16	32
Web file server 4K	128	128
Web file server 8K	128	128
Web server log 8K	64	256

Figure 8: Outstanding I/O settings for each access specification we tested.

Dell PERC H700 vs. HP Smart Array P410i
Internal HDD testing
Figure 9 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
HP Smart Array P410i	2 x 73GB 6Gbps 15K RPM SAS	6 x 73GB 6Gbps 15K RPM SAS	5
HP Smart Array P410i	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 9: Hardware configurations for each RAID controller and RAID level during internal HDD testing.

Dell PERC H800 vs. HP Smart Array P411
External HDD testing
For external testing with the Dell PERC H800, we configured the Dell PowerEdge R710 with the Dell PERC H700 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 HP Smart Array P411 external testing, we configured the HP ProLiant DL380 G6 with the HP Smart Array P410i internal RAID controller with two of the same 73GB 6Gbps 15K RPM SAS drives, again in a RAID 1 volume for the operating system.

We tested the Dell hardware in both single-path and redundant-path configurations to connect the storage arrays to the controllers. This was to demonstrate that the redundant-path configuration provides a significant performance increase over the HP solution while also adding fault tolerance to the configuration; even if a single path fails, the server continues to have access to the storage through the alternate port. Additionally, 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 10 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
HP Smart Array P411	1 x HP Storage Works D2700 single path	24	24 x 73GB 6Gbps 15K RPM SAS	10
HP Smart Array P411	1 x HP Storage Works D2700 single path	24	24 x 73GB 6Gbps 15K RPM SAS	50
Dell PERC H800	1 x Dell PowerVault MD1220 single path	24	24 x 73GB 6Gbps 15K RPM SAS	10
Dell PERC H800	1 x Dell PowerVault MD1220 single path	24	24 x 73GB 6Gbps 15K RPM SAS	50
Dell PERC H800	1 x Dell PowerVault MD1220 redundant path	24	24 x 73GB 6Gbps 15K RPM SAS	10
Dell PERC H800	1 x Dell PowerVault MD1220 redundant path	24	24 x 73GB 6Gbps 15K RPM SAS	50

Figure 10: Hardware configurations for each RAID controller and RAID level during external HDD testing.

How we tested

Installing the operating system

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 drop-down menu beside Firewall state, and select Off.
4. Click the Private Profile tab.
5. Click the drop-down menu beside Firewall state, and select Off.
6. Click the Public Profile tab.
7. Click the drop-down 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 PowerEdge R710 software and preparing the target drives

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, press 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.

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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 when the application prompts you to do so.

Formatting and mounting each test volume
1. Click Start→Administrative Tools→Computer Management.
2. Under Storage, click Disk Management.
3. When the application prompts you 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 HP ProLiant DL380 G6 software and preparing the target drives
Installing the HP Array Configuration Utility
1. Double click the installer package.
2. Click Install.

Setting up a test volume
1. Open the HP Array Configuration Utility.
2. Under the Configuration tab, select the appropriate RAID controller from the drop-down menu.
3. Under Systems and Devices, highlight the RAID controller, and click Create Array in the right pane.
4. Under Select Physical Drives for the New Array, select either 6 physical drives if doing the internal testing, or 24 physical drives if doing the external testing, and click OK.
5. Highlight the newly created Logical Drive, and click Create Logical Drive in the right pane.
6. Under Fault Tolerance, select the appropriate RAID level.
7. Leave all other settings at their default value, and click Save.
8. If creating a RAID 50 Logical Drive, allow the Array Configuration Utility to complete initialization once the volume has been formatted in Windows.

Formatting and mounting each test volume
1. Click Start→Administrative Tools→Computer Management.
2. Under Storage, click Disk Management.
3. When the application prompts you 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.

Setting up Iometer
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 4.
   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 8.
   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` and wait 5 minutes.
5. Press Enter.
6. After all access specifications are finished running, copy the result files from the server.
7. Repeat steps 1 through 6 two more times, for a total of three runs.

Appendix A – Test server information

Figure 11 provides detailed information for the test servers.

Test server	Dell PowerEdge R710	HP ProLiant DL380 G6
General processor setup		
Number of processor packages	2	2
Number of cores per processor package	4	4
Number of hardware threads per core	2	2
System power management policy	Balanced	Balanced
CPU		
Vendor	Intel	Intel
Name	Intel Xeon Processor X5570	Intel Xeon processor X5570
Stepping	D0	D0
Socket type	LGA 1366	LGA 1366
Core frequency (GHz)	2.93	2.93
Front-side bus frequency	6.4 GT/s	6.4 GT/s
L1 cache	32 KB + 32 KB (per core)	32 KB + 32 KB (per core)
L2 cache	1 MB (4 x 256 KB)	1 MB (4 x 256 KB)
L3 cache (MB)	8	8
Platform		
Vendor and model number	Dell PowerEdge R710	HP ProLiant DL380 G6
Motherboard model number	0M233H	PADAB0G9VXC1CQ
Motherboard chipset	Intel 5520	Intel 5520
BIOS name and version	Dell 1.3.6 (10/30/2009)	HP P62 (10/01/2009)
BIOS settings	Default	Default
Memory module(s)		
Vendor and model number	Crucial CT51272BB1339	Crucial CT51272BB1339
Type	PC3-10600R	PC3-10600R
Speed (MHz)	1,333	1,333
Speed in the system currently running @ (MHz)	1,333	1,066
Timing/Latency (tCL-tRCD-iRP-tRASmin)	9-9-9-24	9-9-9-24
RAM module size (GB)	4	4
Number of RAM modules	6	6
Chip organization	Double-sided	Double-sided
Total system memory (GB)	24	24
Operating system		
Name	Windows Server 2008 R2 Enterprise x64 Edition	Windows Server 2008 R2 Enterprise x64 Edition
Build number	7600	7600
Service pack	NA	NA
File system	NTFS	NTFS

Test server	Dell PowerEdge R710	HP ProLiant DL380 G6
Kernel	ACPI x64-based PC	ACPI x64-based PC
Language	English	English
Microsoft DirectX version	11	11
Graphics		
Vendor and model number	Matrox G200	ATI ES1000
Chipset	G2+	ES1000
Type	Integrated	Integrated
Memory size (MB)	8	64
Resolution	1,024 x 768	1,024 x 768
Network card/subsystem		
Vendor and model number	Broadcom BCM5709C NetXtreme II GigE (NDIS VBD Client) x 2	HP NC382i DP Multifunction Gigabit
Type	Integrated	Integrated
Driver version	Broadcom 5.0.15.0 (10/02/2009)	Hewlett-Packard 5.0.13.0 (7/30/2009)
Optical drive		
Vendor and model number	TSSTCorp DVD-ROM TS-L333A	LG GDR-D20N DVD-ROM
USB ports		
Number	4	4
Type	USB 2.0	USB 2.0
Power supplies		
Total number	2	2
Wattage of each (W)	870	460
Cooling fans		
Total number	5	6
Dimensions (mm)	80	80
Voltage (V)	12	12
Amps (A)	1.60	2.45

Figure 11: Detailed test server information.

Appendix B —Test storage information

Figures 12 and 13 provide detailed information for the test storage.

Internal testing hardware

RAID controller	Dell PERC H700	HP Smart Array P410i
Firmware version	12.0.1-0083	2.50
Driver version	4.17.2.64	6.18.0.64
Cache size (MB)	512	512
ROC (Raid-on-Chip)	LSI 2108	PM8011
Internal storage		
Vendor and model number	Dell ST973452SS	HP DH0072FACRD
Number of drives	8	8
Speed (Gbps)	6	6
Size (GB)	73	73
RPM	15K	15K
Type	SAS	SAS

Figure 12: Primary internal storage hardware.

External testing hardware

RAID controller	Dell PERC H800	HP Smart Array P411
Firmware version	12.0.1-0083	1.58
Driver version	4.17.2.64	6.18.0.64
Cache size (MB)	512	512
ROC (Raid-on-Chip)	LSI 2108	PM8011
Storage arrays		
Vendor and model	Dell PowerVault MD1220	HP StorageWorks D2700
Connection type	SAS SFF 8088	SAS SFF 8088
Total number of drives	24	24
Hard drives		
Vendor and model number	Dell ST973452SS	HP DH0072FACRD
Number of drives	24	24
Speed (Gbps)	6	6
Size (GB)	73	73
RPM	15K	15K
Type	SAS	SAS

Figure 13: Primary external storage hardware.

Appendix C – Detailed test results

Figure 14 shows results in IOPS from the HP Smart Array P410i and the Dell PERC H700 RAID controllers during the internal HDD testing.

Access specification name and block size	HP Smart Array P410i RAID 5 IOPS	Dell PERC H700 RAID 5 IOPS	HP Smart Array P410i RAID 10 IOPS	Dell PERC H700 RAID 10 IOPS
DB OLTP 8K	1,561.39	1,730.63	2,659.65	3,047.16
Exchange email 4K	1,561.58	1,930.64	2,668.94	3,086.86
Exchange email 8K	1,445.91	1,555.09	2,484.86	3,012.07
Media streaming 64K	3,635.63	5,493.46	4,711.34	5,756.03
OS Drive 8K	1,542.84	1,717.03	2,553.91	3,021.09
SQL server log 64K	10,740.85	11,331.78	3,057.44	6,842.36
Web file server 4K	4,133.71	4,229.71	4,607.96	4,919.90
Web file server 8K	3,631.64	3,771.30	4,222.92	4,421.75
Web server log 8K	53,838.51	68,228.92	16,322.35	54,572.70

Figure 14: IOPS results from the HP Smart Array P410i and Dell PERC H700 during internal HDD testing. Higher numbers are better.

Figure 15 shows results in IOPS for RAID levels 10 and 50 from the HP Smart Array P411 in conjunction with the HP StorageWorks D2700 in single-path configuration and the Dell PERC H800 in conjunction with the Dell PowerVault MD1220 in single-path configuration during the external HDD testing.

Access specification name and block size	HP Smart Array P411 HP StorageWorks D2700 RAID 10 IOPS	Dell PERC H800 Dell PowerVault MD1220 RAID 10 IOPS	HP Smart Array P411 HP StorageWorks D2700 RAID 50 IOPS	Dell PERC H800 Dell PowerVault MD1220 RAID 50 IOPS
DB OLTP 8K	9,939.40	10,019.46	3,579.15	8,493.44
Exchange email 4K	10,260.39	10,484.08	3,180.96	8,819.78
Exchange email 8K	9,671.60	9,898.73	3,241.36	8,212.52
Media streaming 64K	15,041.57	19,759.23	14,737.77	20,458.96
OS Drive 8K	9,771.01	9,928.24	3,600.35	8,436.32
SQL server log 64K	8,361.55	12,719.04	10,303.59	10,948.88
Web file server 4K	13,828.38	16,631.20	12,071.03	16,019.46
Web file server 8K	13,129.37	15,365.89	11,142.05	14,686.48
Web server log 8K	42,856.22	92,667.27	38,311.67	83,568.91

Figure 15: IOPS results from the HP Smart Array P411 and Dell PERC H800 during external HDD single-path configuration testing, RAID 10 and 50. Higher numbers are better.

Figure 16 shows results in IOPS for RAID levels 10 and 50 from the HP Smart Array P411 in conjunction with the HP StorageWorks D2700 in single-path configuration and Dell PERC H800 in conjunction with the Dell PowerVault MD1220 in redundant-path configuration during the external HDD testing.

Access specification name and block size	HP Smart Array P411 HP StorageWorks D2700 RAID 10 IOPS	Dell PERC H800 Dell PowerVault MD1220 RAID 10 IOPS	HP Smart Array P411 HP StorageWorks D2700 RAID 50 IOPS	Dell PERC H800 Dell PowerVault MD1220 RAID 50 IOPS
DB OLTP 8K	9,939.40	9,999.57	3,579.15	8,491.14
Exchange email 4K	10,260.39	10,441.34	3,180.96	8,841.78
Exchange email 8K	9,671.60	9,856.91	3,241.36	8,148.10
Media streaming 64K	15,041.57	20,597.45	14,737.77	20,395.60
OS Drive 8K	9,771.01	9,934.76	3,600.35	8,424.26
SQL server log 64K	8,361.55	13,245.92	10,303.59	10,853.01
Web file server 4K	13,828.38	16,758.50	12,071.03	15,929.53
Web file server 8K	13,129.37	15,458.34	11,142.05	14,614.18
Web server log 8K	42,856.22	91,649.68	38,311.67	83,288.55

Figure 16: IOPS results from the HP Smart Array P411 and Dell PERC H800 during external HDD redundant-path configuration testing, RAID 10 and 50. 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.