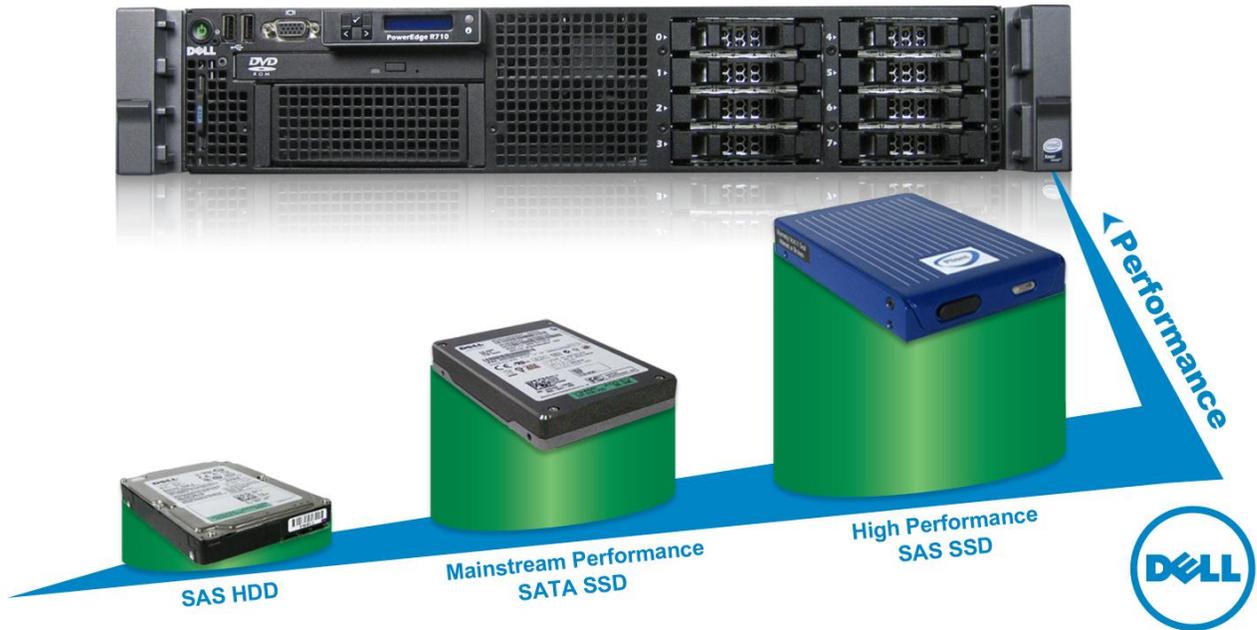


DRIVE PERFORMANCE COMPARISON: DELL POWEREDGE R710 DRIVE OPTIONS

Dell™ PowerEdge™ R710 server

with Dell PERC H700 gives you many ways to meet your performance needs



OUR FINDINGS

Advances in storage controller and drive technologies allow today's servers to handle increasingly more demanding workloads. In Principled Technologies' tests in our labs, we found that a company using the Dell PowerEdge R710 server with the PowerEdge RAID Controller (PERC) H700 can improve upon the performance of its six 6Gb SAS HDDs two ways: upgrading to six Mainstream Performance SATA SSDs yields up to 15.8 times better performance, and investing in four High Performance SAS SSDs boosts performance by an additional 13.0 times (28.8 times greater than the six SAS HDDs).

OUR PROCESS

We used the Iometer benchmark to gauge how well each storage solution would handle a variety of common storage tasks. We ran eight Iometer access specifications, which included OLTP database, Microsoft® Exchange Server, file server, and typical operating system workloads, against two standard RAID levels: RAID 5 and RAID 10.



PROJECT OVERVIEW

We tested the performance of the Dell PowerEdge R710 server using the Dell PERC H700 and the following storage solutions:

- six SAS hard disk drives as target drives and two SAS hard disk drives for the OS partition (SAS HDD solution)¹
- six mainstream performance SATA solid state drives and two SAS hard disk drives (Mainstream Performance SATA SSD solution)
- four high performance SAS solid state drives and two SAS hard disk drives (High Performance SAS SSD solution)

For testing, the server ran Microsoft Windows Server® 2008 R2 Enterprise Edition. The goal of this report is to show the performance increase one can expect when upgrading from the SAS HDD solution to the Mainstream Performance SATA SSD solution, and the additional performance increase one can expect upgrading to the High Performance SAS SSD solution.

The Dell PERC H700 features Cut-Through IO (based on LSI’s FastPath™ Technology). According to Dell and LSI, this is a high-performance I/O accelerator for SSD arrays configured as a virtual disk (or volume) behind a Dell PERC

controller. This feature is designed to substantially boost transactional application throughput and can dramatically boost storage subsystem bandwidth – nearly doubling input/output per second (IOPS) in certain I/O profiles – when compared to the previous-generation product.

Figure 1 demonstrates the performance difference for RAID

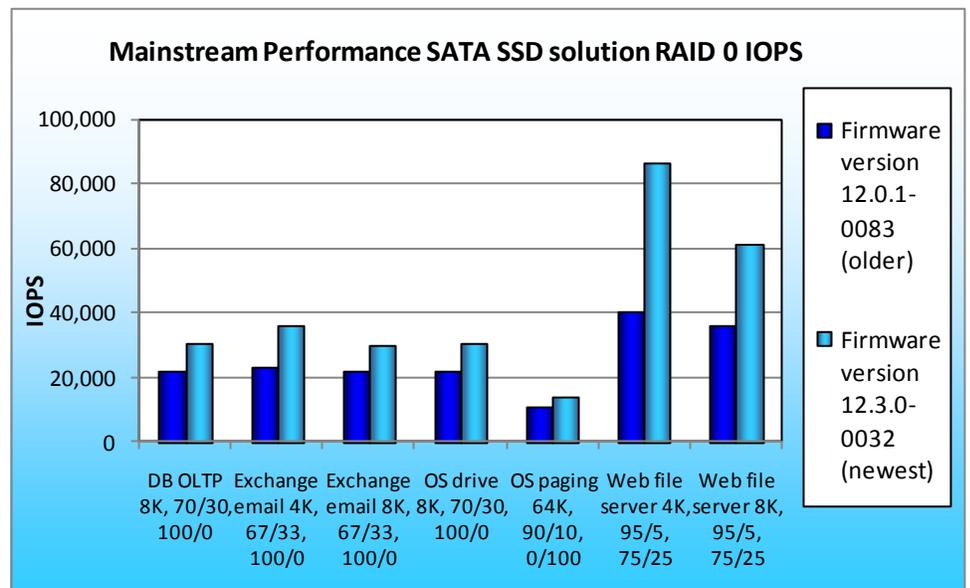


Figure 1: IOPS results across RAID 0 for the Mainstream Performance SATA SSD solution for an older firmware version and the most recent firmware release. Higher numbers are better.

¹ The data we use for the SAS HDD solution is from a prior Principled Technologies test report available at http://www.principledtechnologies.com/clients/reports/Dell/6Gbps_v_3Gbps_RAID.pdf. Figure 2 shows the differences in server configuration and firmware between the old and new tests.

0, in IOPS, of the Mainstream Performance SATA SSD solution using the previous firmware version (12.0.1-0083) vs. the most recent firmware release (12.3.0-0032).

We report the normalized results of our custom Iometer tests, based on the IOPS scores of each test, with results for the

Mainstream Performance SATA SSD solution and the High Performance SAS SSD solution normalized to the results of the SAS HDD solution. For all tests, higher IOPS numbers are better.

As Figure 2 shows, across RAID 5 for the small block access specifications, the Mainstream Performance SATA SSD solution delivered up to 13.4 times greater performance in IOPS over the SAS HDD solution, while the High Performance SAS SSD solution delivered up to 21.5 times greater performance in IOPS over the SAS HDD solution.

As Figure 3 shows, for the large block access specifications across RAID 5, the Mainstream Performance SATA SSD solution delivered up to 6.4 times greater performance in IOPS over the SAS HDD solution, while the

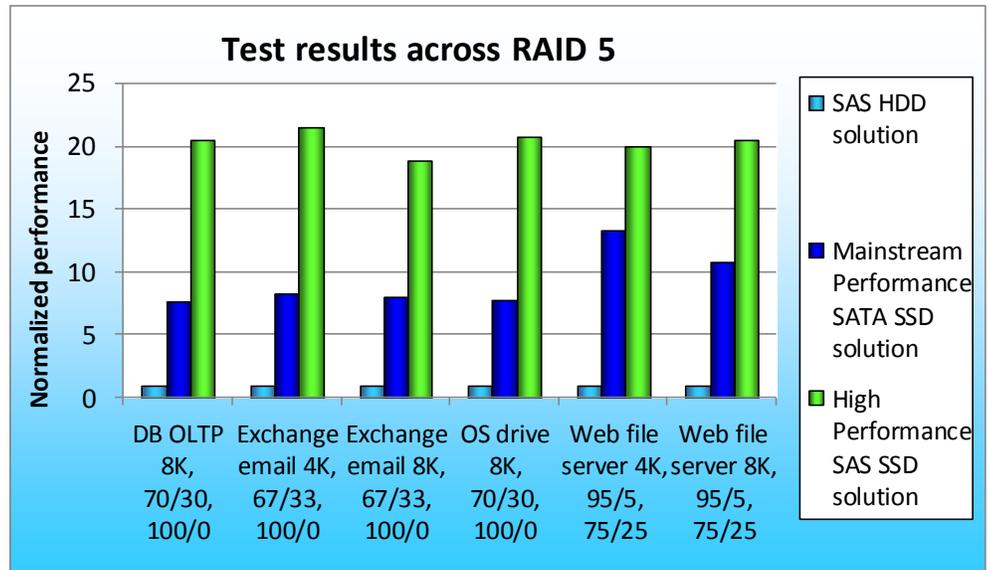


Figure 2: Normalized performance results of the solutions across RAID 5 for the small block access specifications. We normalized Mainstream Performance SATA SSD and High Performance SAS SSD solution results to those of the SAS HDD solution.

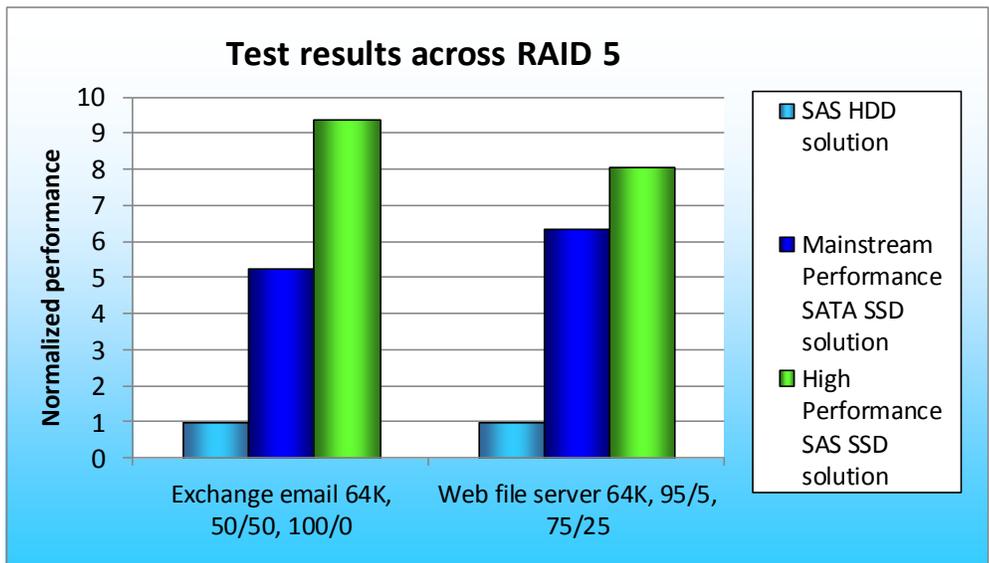


Figure 3: Normalized performance results of the solutions across RAID 5 for the large block access specifications. We normalized Mainstream Performance SATA SSD and High Performance SAS SSD solution results to those of the SAS HDD solution.

High Performance SAS SSD solution delivered up to 9.4 times greater performance in IOPS over the SAS HDD solution.

As Figure 4 shows, across RAID 10 for the small block access specifications, the Mainstream Performance SATA SSD solution delivered up to 15.8 times greater performance in IOPS over the

SAS HDD solution, while the High Performance SAS SSD solution delivered up to 28.8 times greater performance in IOPS over the SAS HDD solution, an increase of 13.0 normalized IOPS performance, or 82.2 percent more, over the Mainstream Performance SATA SSD solution.

As Figure 5 shows, on the large block access specifications across RAID 10, the Mainstream Performance SATA SSD solution delivered up to 7.1 times greater performance in IOPS over the SAS HDD solution, while the High Performance SAS SSD solution delivered up to 8.0 times greater performance in IOPS over the SAS HDD solution.

We present our test results in detail in the What we found section.

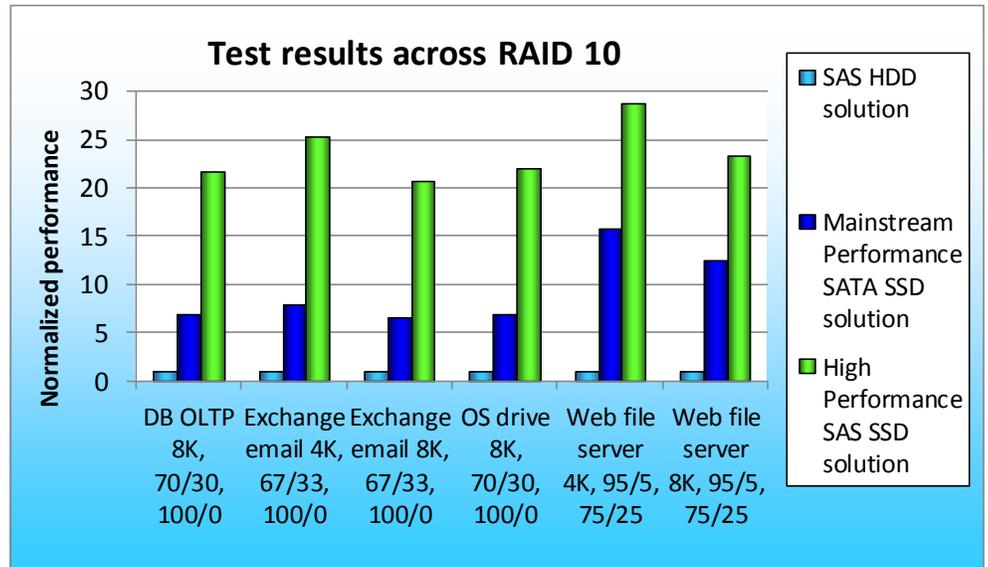


Figure 4: Normalized performance results of the solutions across RAID 10 for the small block access specifications. We normalized Mainstream Performance SATA SSD and High Performance SAS SSD solution results to those of the SAS HDD solution.

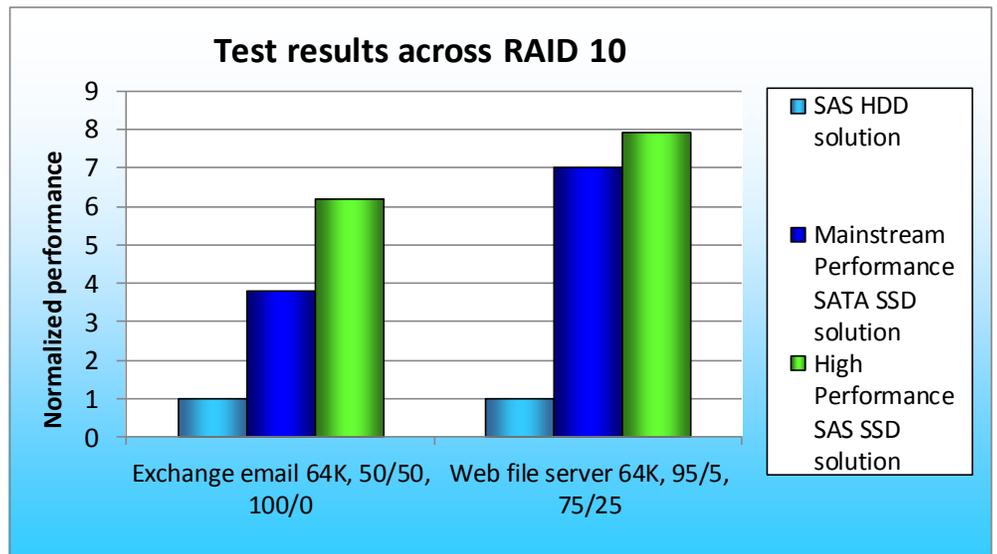


Figure 5: Normalized performance results of the solutions across RAID 10 for the large block access specifications. We normalized Mainstream Performance SATA SSD and High Performance SAS SSD solution results to those of the SAS HDD solution.

WHAT WE TESTED

Iometer measures IOPS on single and clustered systems. Iometer performs input/output (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 the Dell PowerEdge R710 to simulate various typical server workloads on the Dell PERC H700 and corresponding storage. We used the same Iometer workload across both SSD storage solutions, but tuned the number of outstanding I/Os to obtain the maximum possible IOPS for each controller and each RAID level tested.

First, at RAID levels 5 and 10, we compared the performance of the Mainstream Performance SATA SSD solution to that of the SAS HDD solution. Next, at RAID levels 5 and 10, we compared the performance of the High Performance SAS SSD solution to that of the SAS HDD solution. We normalize the Mainstream Performance SATA SSD and High Performance SAS SSD solution scores to the SAS HDD solution score.

Figure 6 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 11, in 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%
Exchange email 4K	67%	33%	100%	0%
Exchange email 8K	67%	33%	100%	0%
Exchange email 64K	50%	50%	100%	0%
OS drive 8K	70%	30%	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%

Figure 6: Description of Iometer access specification settings.

SYSTEM COMPARISON

Figure 7 shows a side-by-side comparison of the key hardware features of the three solutions. Appendix A presents detailed system information, and Appendix B presents detailed internal storage information.

Hardware specifications	SAS HDD solution	Mainstream Performance SATA SSD solution	High Performance SAS SSD solution
Server platform	Dell PowerEdge R710	Dell PowerEdge R710	Dell PowerEdge R710
Processor	Intel® Xeon® Processor X5570	Intel Xeon Processor E5620	Intel Xeon Processor E5620
RAID controller	Dell PERC H700	Dell PERC H700	Dell PERC H700
RAID controller firmware	12.0.1-0083	12.3.0-0032	12.3.0-0032
Memory	24GB memory (6 x 4 GB)	24GB memory (6 x 4 GB)	24GB memory (6 x 4 GB)
Drive layout	2 x HDD OS, 6 x HDD as lometer target volume	2 x HDD OS, 6 x SSD as lometer target volume	2 x HDD OS, 4 x SSD as lometer target volume

Figure 7: Key hardware features of the three solutions.

WHAT WE FOUND

We ran each test three times and report results from the run that produced the median of the three IOPS results. We calculated the normalized performance for each access specification for each RAID level tested, in this case RAID 5 and RAID 10.

Figure 8 displays the Mainstream Performance SATA SSD solution and High Performance SAS SSD solution specific normalized IOPS improvement in performance across RAID 5 over the SAS HDD solution.

Test access specifications and block size across RAID 5	SAS HDD solution	Mainstream Performance SATA SSD solution	High Performance SAS SSD solution
DB OLTP 8K, 70/30, 100/0	1.00	7.67	20.51
Exchange email 4K, 67/33, 100/0	1.00	8.26	18.85
Exchange email 8K, 67/33, 100/0	1.00	8.01	21.52
Exchange email 64K, 50/50, 100/0	1.00	5.28	9.38
OS drive 8K, 70/30, 100/0	1.00	7.76	20.83
Web file server 4K, 95/5, 75/25	1.00	13.38	19.99
Web file server 8K, 95/5, 75/25	1.00	10.77	20.54
Web file server 64K, 95/5, 75/25	1.00	6.35	8.06

Figure 8: The Mainstream Performance SATA SSD solution and High Performance SAS SSD solution normalized IOPS improvement in performance across RAID 5 over the SAS HDD solution. Higher numbers are better.

Figure 9 displays the Mainstream Performance SATA SSD solution and High Performance SAS SSD solution specific normalized IOPS improvement in performance across RAID 10 over the SAS HDD solution. See Appendix C for detailed test results.

Test access specifications and block size across RAID 10	SAS HDD solution	Mainstream Performance SATA SSD solution	High Performance SAS SSD solution
DB OLTP 8K, 70/30, 100/0	1.00	6.98	21.72
Exchange email 4K, 67/33, 100/0	1.00	7.94	25.36
Exchange email 8K, 67/33, 100/0	1.00	6.59	20.81
Exchange email 64K, 50/50, 100/0	1.00	3.84	6.21
OS drive 8K, 70/30, 100/0	1.00	7.00	22.05
Web file server 4K, 95/5, 75/25	1.00	15.82	28.83
Web file server 8K, 95/5, 75/25	1.00	12.54	23.39
Web file server 64K, 95/5, 75/25	1.00	7.06	7.95

Figure 9: The Mainstream Performance SATA SSD solution and High Performance SAS SSD solution normalized IOPS improvement in performance across RAID 10 over the SAS HDD solution. Higher numbers are better.

As we mentioned earlier, Dell’s newest RAID controller with LSI technology and SSD firmware release enables new features to optimize SSD performance. Figure 10 provides details of the performance improvement for RAID 0, in IOPS, of the Mainstream Performance SATA SSD solution using the previous firmware version (12.0.1-0083) vs. the most recent firmware release (12.3.0-0032).

Access specification name and block size	Mainstream Performance SATA SSD solution with firmware version 12.0.1-0083	Mainstream Performance SATA SSD solution with firmware version 12.3.0-0032
DB OLTP 8K, 70/30, 100/0	22,200.32	30,830.24
Exchange email 4K, 67/33, 100/0	23,465.58	36,276.58
Exchange email 8K, 67/33, 100/0	21,709.14	29,725.49
OS drive 8K, 70/30, 100/0	22,097.98	30,738.63
Web file server 4K, 95/5, 75/25	40,653.37	86,529.19
Web file server 8K, 95/5, 75/25	36,085.57	61,571.91
Web file server 64K, 95/5, 75/25	22,200.32	30,830.24

Figure 10: IOPS results across RAID 0 for the Mainstream Performance SATA SSD solution for an older firmware version and the most recent firmware release. Higher numbers are better.

TEST CONFIGURATIONS

Host servers

- For SAS HDD testing: Dell PowerEdge R710, Intel Xeon Processor X5570, 24GB memory (6 x 4 GB)
- For mainstream and high-performance SSD testing: Dell PowerEdge R710, Intel Xeon Processor E5620, 24GB memory (6 x 4 GB)

For complete information on the SAS HDD solution, see

http://www.principledtechnologies.com/clients/reports/Dell/6Gbps_v_3Gbps_RAID.pdf.

Iometer settings

- 1 worker per target (1 total)
- 4GB dataset per target (4 GB total)
- Outstanding I/Os tuned for each access specification per drive set, per RAID level.

Figure 11 displays the outstanding I/O settings for each access specification we tested.

Access specification	SAS HDD testing outstanding I/Os		Mainstream Performance SATA SSD testing outstanding I/Os		High Performance SAS SSD testing outstanding I/Os	
	RAID 5	RAID 10	RAID 5	RAID 10	RAID 5	RAID 10
DB OLTP 8K, 70/30, 100/0	64	64	256	256	128	256
Exchange email 4K, 67/33, 100/0	64	64	256	256	128	128
Exchange email 8K, 67/33, 100/0	64	64	256	256	128	256
Exchange email 64K, 50/50, 100/0	16	16	256	256	32	32
OS drive 8K, 70/30, 100/0	64	64	256	256	128	256
Web file server 4K, 95/5, 75/25	128	128	256	256	256	256
Web file server 8K, 95/5, 75/25	128	128	256	256	256	256
Web file server 64K, 95/5, 75/25	96	96	256	256	256	128

Figure 11: Outstanding I/O settings for each access specification we tested.

Internal storage test configurations

Figure 12 shows the specific hardware configurations for each drive set and RAID level during testing.

Drives under test	OS partition	Target drives	RAID level target drives
SAS HDD solution	2 x 73GB HDDs in RAID 1	6 x 73GB HDDs	5, 10
Mainstream Performance SATA SSD solution	2 x 73GB HDDs in RAID 1	6 x 50GB SSDs	5, 10
High Performance SAS SSD solution	2 x 73GB HDDs in RAID 1	4 x 150GB SSDs	5, 10

Figure 12: Hardware configurations for each drive set RAID level during testing.

HOW WE TESTED

We used the PERC BIOS configuration utility to create and initialize the virtual drives as we outline in Figure 12. We then proceeded to install the operating system as follows.

Installing the operating system

Installing Windows Server 2008 R2 Enterprise Edition

1. Boot the server, and insert the Windows Server 2008 R2 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), 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 R2 settings

We installed all recommended and critical Windows® updates through 8/26/2010. In addition, we downloaded and installed the latest drivers.

Disabling Windows Firewall

1. Click Start → Administrative Tools → Windows Firewall with 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.

Disabling Display Sleep

1. Click Start→Control Panel.
2. Click System and Security.
3. Click Power Options.
4. Next to the selected power plan (Balanced), click Change plan settings.
5. Under the dropdown menu next to Turn off display sleep, select Never.
6. Click Save Changes, and close the Edit Plan Settings window.

Installing Dell PowerEdge R710 software and preparing the target drives

Installing Dell OpenManage™ Server Administrator

1. Insert the Dell OpenManage Install DVD.
2. Click Run autorun.exe in the AutoPlay window.
3. Select Dell OpenManage Server Administrator, and click Install.
4. At the installer dialogue box, click Install, Modify, Repair, or Remove Server Administrator.
5. At the Welcome screen, click Next.
6. Select I accept the terms in the license agreement, and click Next.
7. At the Setup Type window, select Typical, and click Next.
8. Click Install.
9. Click Finish.

Setting up a test volume

1. Reboot the system.
2. During boot, press CTRL+R when prompted in order to enter the PERC BIOS Configuration Utility.
3. Highlight the RAID controller card, press F2, and select Create New VD.
4. Under RAID Level, Press Enter, select the appropriate RAID level, and press Enter.
5. In the Physical Disks box, select all available drives.
6. In Basic Settings, enter a VD Name.
7. Highlight Advanced settings, and press Enter.
 - a. Under Read Policy, select No Read Ahead.
 - b. Under Write Policy, select Write Through.
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. When the dialogue box asks if you want to continue, Select Yes.
12. When the dialogue box notifies you that the initialization is complete, select OK.
13. After initialization is complete, press ESC, and select OK to exit.
14. When the application prompts you to do so, press Ctrl+Alt+Delete to reboot.

Formatting and mounting the test volume

1. Click Start→Administrative Tools→Computer Management.
2. Under Storage, click Disk Management.
3. Right-click Unallocated space, and click New Simple Volume.

4. Leave the default maximum volume size, and click Next.
5. Set the default drive letter to E, and click Next.
6. Check the Perform a quick format box.
7. Click Next.
8. Click Finish.

Setting up Iometer

Installing and configuring Iometer

1. Download the Iometer 2006.07.27 package for Windows from <http://www.iometer.org/doc/downloads.html>.
2. Double-click the installer, and click Run.
3. At the Welcome window, click Next.
4. At the License Agreement window, click I Agree.
5. At the Choose Components window, leave the defaults selected, and click Next.
6. At the Choose Install Location window, change the Destination Folder to C:\Iometer 2006.07.27, and click Install.
7. When the installation is complete, click Finish.

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 6.
 - 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 11.
 - 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 10 minutes.
5. Press Enter.
6. After all access specifications are finished running, copy and remove the result files from the server.
7. Repeat steps 1 through 6 two more times for a total of three runs.

APPENDIX A – SERVER CONFIGURATION INFORMATION

Figure 13 provides detailed configuration information about the test servers.

System	Dell PowerEdge R710 – SAS HDD tests	Dell PowerEdge R710 – Mainstream and high performance SSD tests
General		
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 E5620
Stepping	D0	B1
Socket type	LGA 1366	LGA 1366
Core frequency (GHz)	2.93	2.40
Front-side bus frequency	6.4 GT/s	5.8 GT/s
L1 cache	32 KB + 32 KB (per core)	32 KB + 32KB (per core)
L2 cache	256 KB (per core)	256 KB (per core)
L3 cache (MB)	8 MB (shared)	12 MB (shared)
Platform		
Vendor and model number	Dell PowerEdge R710	Dell PowerEdge R710
Motherboard model number	0M233H	00NH4P
Motherboard chipset	Intel 5520	Intel 5520
BIOS name and version	Dell 1.3.6 (10/30/2009)	Dell 2.1.9 (5/21/2010)
BIOS settings	Default	Default
Memory module(s)		
Vendor and model number	Crucial CT51272BB1339	Samsung M393B5170FHD-CH9
Type	PC3-10600R	PC3-10600R
Speed (MHz)	1,333	1,333
Speed in the system currently running @ (MHz)	1,333	1,067
Timing/Latency (tCL-tRCD-iRP-tRASmin)	9-9-9-24	7-7-7-20
RAM module size (GB)	4	4
Number of RAM modules	6	6
Chip organization	Double-sided	Double-sided
Total system memory (GB)	24	24

System	Dell PowerEdge R710 – SAS HDD tests	Dell PowerEdge R710 – Mainstream and high performance SSD tests
Operating system		
Name	Windows Server 2008 R2 Enterprise Edition	Windows Server 2008 R2 Enterprise Edition
Build number	7600	7600
Service pack	N/A	N/A
File system	NTFS	NTFS
Kernel	ACPI x64-based PC	ACPI x64-based PC
Language	English	English
Microsoft DirectX version	11	11
Network card/subsystem		
Vendor and model number	Broadcom® BCM5709C NetXtreme® II GigE (NDIS VBD Client) x 2	Broadcom BCM5709C NetXtreme II GigE (NDIS VBD Client) x 2
Type	Integrated	Integrated
Driver version	Broadcom 5.0.15.0 (10/02/2009)	Broadcom 5.2.14.0 (12/17/2009)
Optical drive		
Vendor and model number	TSSTCorp DVD-ROM TS-L333A	TEAC DV-28SW
USB ports		
Number	4	4
Type	2.0	2.0
Power supplies		
Total number	2	2
Wattage of each (W)	870	870
Cooling fans		
Total number	5	5
Dimensions (inches)	2-3/8 x 2-3/8	2-3/8 x 2-3/8
Voltage (V)	12	12
Amps (A)	1.68	1.68

Figure 13: Detailed information for the test servers.

APPENDIX B – TEST STORAGE INFORMATION

Figure 14 provides detailed information for the test storage.

RAID controller	Dell PERC H700
Firmware version	12.0.1-0083 for HDDs, 12.3.0-0032 for mainstream and high-performance SSDs
Driver version	Dell 4.23.0.64 (11/16/2009)
Cache size (MB)	512
ROC (Raid-on-Chip)	LSI 2108
Internal storage	
SAS HDD testing	
Vendor and model number	Dell ST973452SS
Number of drives	8
Speed (Gbps)	6
Size (GB)	73
RPM	15K
Type	SAS
Mainstream Performance SATA SSD testing	
Vendor and model number	Dell MCB4E50G5MXP-0VB
Number of drives	8
Speed (Gbps)	3
Size (GB)	50
Type	SATA
High Performance SAS SSD testing	
Vendor and model number	Pliant LB0150S
Number of drives	4
Speed (Gbps)	3
Size (GB)	150
Type	SAS

Figure 14: Primary internal storage hardware.

APPENDIX C – DETAILED TEST RESULTS

Figure 15 shows results, in IOPS, from the SAS HDD testing.

Access specification name and block size	SAS HDD - RAID 5 IOPS	SAS HDD - RAID 10 IOPS
DB OLTP 8K, 70/30, 100/0	1,730.63	3,047.16
Exchange email 4K, 67/33, 100/0	1,930.64	3,086.86
Exchange email 8K, 67/33, 100/0	1,555.09	3,012.07
Exchange email 64K, 50/50, 100/0	564.99	1,176.45
OS drive 8K, 70/30, 100/0	1,717.03	3,021.09
Web file server 4K, 95/5, 75/25	4,229.71	4,919.90
Web file server 8K, 95/5, 75/25	3,771.30	4,421.75
Web file server 64K, 95/5, 75/25	1,775.00	1,940.63

Figure 15: IOPS results from the SAS HDD testing. Higher numbers are better.

Figure 16 shows results, in IOPS, from the Mainstream Performance SATA SSD testing.

Access specification name and block size	Mainstream Performance SATA SSD - RAID 5 IOPS	Mainstream Performance SATA SSD - RAID 10 IOPS
DB OLTP 8K, 70/30, 100/0	13,273.04	21,272.02
Exchange email 4K, 67/33, 100/0	15,948.73	24,495.85
Exchange email 8K, 67/33, 100/0	12,452.60	19,863.57
Exchange email 64K, 50/50, 100/0	2,981.30	4,513.95
OS drive 8K, 70/30, 100/0	13,321.01	21,152.69
Web file server 4K, 95/5, 75/25	56,582.18	77,828.98
Web file server 8K, 95/5, 75/25	40,601.09	55,433.98
Web file server 64K, 95/5, 75/25	11,273.07	13,695.63

Figure 16: IOPS results from the Mainstream Performance SATA SSD testing. Higher numbers are better.

Figure 17 shows results, in IOPS, from the High Performance SAS SSD testing.

Access specification name and block size	High Performance SAS SSD - RAID 5 IOPS	High Performance SAS SSD - RAID 10 IOPS
DB OLTP 8K, 70/30, 100/0	35,500.48	66,185.33
Exchange email 4K, 67/33, 100/0	36,398.65	78,276.56
Exchange email 8K, 67/33, 100/0	33,469.50	62,686.49
Exchange email 64K, 50/50, 100/0	5,301.16	7,308.22
OS drive 8K, 70/30, 100/0	35,763.57	66,610.38
Web file server 4K, 95/5, 75/25	84,541.99	141,852.34
Web file server 8K, 95/5, 75/25	77,466.64	103,446.12
Web file server 64K, 95/5, 75/25	14,307.29	15,420.56

Figure 17: IOPS results from the High Performance SAS SSD testing. Higher numbers are better.

ABOUT PRINCIPLED TECHNOLOGIES



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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.

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