

DRIVE PERFORMANCE COMPARISON: DELL POWEREDGE R710 VS. HP PROLIANT DL380 G7

up to **183%**
more I/O from 6 SSDs

Dell™ PowerEdge™ R710 server with Dell PERC H700 controller



Dell PowerEdge R710 server

VS.

HP ProLiant DL380 G7 server

OUR FINDINGS

Advances in controller and drive technologies allow today's servers to handle an ever more demanding workload. There are, however, differences among the latest offerings from major vendors. In Principled Technologies' tests in our labs, the Dell PowerEdge R710 server with the PowerEdge RAID Controller (PERC) H700 and six SATA solid state drives (SSDs) delivered up to 182.9 percent greater performance than the current HP ProLiant DL380 G7 server with the HP Smart Array P410i controller and six SATA SSDs.

OUR PROCESS

We used the Iometer benchmark to gauge how well each server and storage solution would handle a variety of common storage tasks. We ran nine Iometer access specifications, which included OLTP database, Microsoft® Exchange Server, file server, and typical operating system workloads. We ran these tests against five common RAID levels: RAID 0, 5, 6, 10, and 50.



PROJECT OVERVIEW

We tested the following server and storage solutions:

- Dell PowerEdge R710 server using the PowerEdge RAID Controller (PERC) H700 with six SATA solid state drives and two SAS hard disk drives (Dell SATA SSD solution)
- HP ProLiant DL380 G7 server using the HP Smart Array P410i controller with six SATA solid state drives and two SAS hard disk drives (HP SATA SSD solution)

For testing, the servers ran Microsoft Windows Server® 2008 R2 Enterprise Edition. The goal of this report is to show the performance increase one can expect from the Dell SATA SSD solution over the HP SATA SSD solution.

As Figure 1 shows, across all RAID levels, the Dell SATA SSD solution delivered from 104.5 percent to 182.9 percent average greater performance in IOPS than the HP SATA SSD solution.

We present additional results in the What we found section of this report.

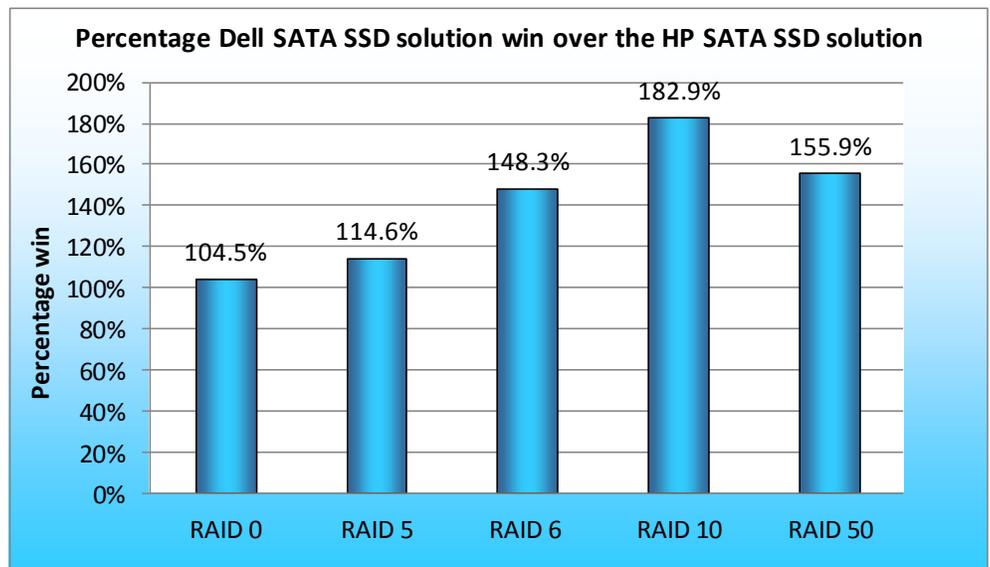


Figure 1: Average percentage wins of the Dell SATA SSD solution over the HP SATA SSD solution.

WHAT WE TESTED

Iometer measures input/output per second (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 servers to simulate various typical server workloads on the RAID controllers 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 input/output operations per second (IOPS) for each controller and each RAID level tested.

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.

First, we ran the Iometer workload, consisting of nine access specifications, at RAID levels 0, 5, 6, 10, and 50 on both servers. We then compared the median runs of each server at each RAID level by calculating the percentage win of each access specification for the Dell SATA SSD solution over the HP SATA SSD solution. To obtain an overall percentage for each RAID level, we then averaged the percentage wins of all access specifications for each RAID level.

Figure 2 details the Iometer access specifications we used. We present the number of outstanding I/Os and other specific settings we used during testing in Figures 5 and 6 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 32K	50%	50%	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 2: Description of Iometer access specification settings.

SYSTEM COMPARISON

Figure 3 shows a side-by-side comparison of the key hardware features of the two solutions. Appendix A presents the detailed system information of the Dell SATA SSD solution and the HP SATA SSD solution, and Appendix B presents the detailed system information about the internal storage.

Hardware specifications	Dell SATA SSD solution	HP SATA SSD solution
Server platform	Dell PowerEdge R710	HP ProLiant DL380 G7
Processor	Intel® Xeon® Processor E5620	Intel Xeon Processor E5620
RAID controller	Dell PERC H700	HP Smart Array P410i
RAID controller firmware	12.3.0-0032	3.00
Memory	24GB memory (6 x 4 GB)	24GB memory (6 x 4 GB)
Drive layout	2 x HDD OS, 6 x SSD as lometer target volume	2 x HDD OS, 6 x SSD as lometer target volume

Figure 3: Key hardware features of the two solutions.

WHAT WE FOUND

We report the average percentage results of our custom lometer tests, based on the IOPS scores of each test. 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 win for each access specification for each RAID level tested, in this case RAID 0, 5, 6, 10, and 50.

Figure 4 shows the percentage wins of the Dell SATA SSD solution over the HP SATA SSD solution across the nine access specifications we tested. See Appendix C for detailed test results.

Access specification	RAID level				
	RAID 0	RAID 5	RAID 6	RAID 10	RAID 50
DB OLTP 8K, 70/30, 100/0	117.6%	102.0%	163.6%	237.3%	182.2%
Exchange email 4K, 67/33, 100/0	138.7%	163.7%	176.6%	267.4%	195.9%
Exchange email 8K, 67/33, 100/0	123.0%	148.2%	167.8%	253.8%	192.7%
Exchange email 32K, 50/50, 100/0	111.7%	146.5%	159.7%	227.8%	211.1%
Exchange email 64K, 50/50, 100/0	100.4%	122.1%	193.6%	194.0%	212.3%
OS drive 8K, 70/30, 100/0	111.9%	138.8%	165.2%	238.1%	182.7%
Web file server 4K, 95/5, 75/25	116.0%	103.0%	123.6%	108.6%	97.7%
Web file server 8K, 95/5, 75/25	86.6%	76.7%	101.4%	78.1%	84.8%
Web file server 64K, 95/5, 75/25	34.3%	30.3%	83.5%	40.8%	43.8%
Average of all access specifications	104.5%	114.6%	148.3%	182.9%	155.9%

Figure 4: Percentage wins of the Dell SATA SSD solution over the HP SATA SSD solution.

TEST CONFIGURATIONS

Host servers

- For Dell SATA SSD solution testing: Dell PowerEdge R710, Intel Xeon Processor E5620, 24GB memory (6 x 4 GB)
- For HP SATA SSD solution testing: HP ProLiant DL380 G7, Intel Xeon Processor E5620, 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 per drive set, per RAID level.

Figure 5 shows the outstanding I/O settings we tested on the Dell PowerEdge R710.

Access specification	Dell SATA SSD solution testing outstanding I/Os				
	RAID 0	RAID 5	RAID 6	RAID 10	RAID 50
DB OLTP 8K, 70/30, 100/0	256	256	256	256	256
Exchange email 4K, 67/33, 100/0	256	256	256	256	256
Exchange email 8K, 67/33, 100/0	256	256	256	256	256
Exchange email 32K	256	256	256	256	256
Exchange email 64K	256	256	256	256	256
OS drive 8K	256	256	256	256	256
Web file server 4K	256	256	256	256	256
Web file server 8K, 95/5, 75/25	256	256	256	256	256
Web file server 64K, 95/5, 75/25	256	256	256	256	256

Figure 5: Outstanding I/O settings for each access specification we tested on the Dell PowerEdge R710.

Figure 6 shows the outstanding I/O settings we tested on the HP ProLiant DL380 G7.

Access specification	HP SATA SSD solution testing outstanding I/Os				
	RAID 0	RAID 5	RAID 6	RAID 10	RAID 50
DB OLTP 8K, 70/30, 100/0	256	128	64	32	128
Exchange email 4K, 67/33, 100/0	256	128	64	32	64
Exchange email 8K, 67/33, 100/0	256	32	64	16	64
Exchange email 32K	128	16	32	64	64
Exchange email 64K	128	32	16	32	256
OS drive 8K	256	128	256	64	256
Web file server 4K	256	256	64	256	256
Web file server 8K, 95/5, 75/25	256	256	256	256	256
Web file server 64K, 95/5, 75/25	256	256	256	256	256

Figure 6: Outstanding I/O settings for each access specification we tested on the HP ProLiant DL380 G7.

Internal storage test configurations

Figure 7 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
Dell SATA SSD solution	2 x 73GB HDDs in RAID 1	6 x 50GB SSDs	0, 5, 6, 10, 50
HP SATA SSD solution	2 x 73GB HDDs in RAID 1	6 x 60GB SSDs	0, 5, 6, 10, 50

Figure 7: Hardware configurations for each drive set RAID level during testing.

HOW WE TESTED

We used the servers' respective RAID BIOS configuration utilities to create the virtual drives as we outline in Figure 7 and allowed time for any disk initialization operations to complete. 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. In the AutoPlay window, click Run autorun.exe.
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.

Installing HP ProLiant DL380 G7 software and preparing the target drives

Installing HP Array Configuration Utility

1. Download the ProLiant Support Pack for Microsoft Windows Server 2008 R2 from <http://h20000.www2.hp.com/bizsupport/TechSupport/SoftwareDescription.jsp?lang=en&cc=us&prodTypeId=15351&prodSeriesId=4091412&prodNameId=4091432&swEnvOID=4064&swLang=13&mode=2&taskId=135&swItem=MTX-358b3bcb8b5241ceb740ccdd6d> and follow HP's instructions on how to prepare the installer.
2. Open the installer (hpsum.exe).
3. In the Source Selections window, accept the defaults, and click Start Inventory.
4. In the Select Installation Host(s) window, select Local Host, and click Next.
5. In the Select Bundle Filter window, check the box next to ProLiant Support Pack for Microsoft Windows Server 2008 R2, and click OK.
6. In the Select Items to be Installed window, accept the defaults, and click Install.

Setting up a test volume

1. Boot the server.
2. When the window prompts you to do so, to Press any key to view Option ROM messages, press any key.
3. When the HP Smart Array P410i Controller posts, press F8 when prompted to enter the Option ROM Configuration.
4. On the Main Menu, select Create Logical Drive, and press Enter.
5. All drives will be selected by default, but if they are not, select each one by highlighting it and pressing the Space Bar.
6. Press Tab to navigate to the RAID Configuration pane, select the appropriate RAID level, and press Enter.
7. At the notification screen, press F8 to save the configuration.
8. At the Configuration saved screen, press Enter to continue.
9. Press Esc to exit.

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 1.
 - 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 Figures 5 and 6.
 - 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 8 provides detailed configuration information about the test servers.

System	Dell PowerEdge R710	HP ProLiant DL380 G7
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 E5620	Intel Xeon Processor E5620
Stepping	B1	B1
Socket type	LGA 1366	LGA 1366
Core frequency (GHz)	2.40	2.40
Bus frequency	5.8 GT/s	5.8 GT/s
L1 cache	32 KB + 32KB (per core)	32 KB + 32KB (per core)
L2 cache	256 KB (per core)	256 KB (per core)
L3 cache	12 MB (shared)	12 MB (shared)
Platform		
Vendor and model number	Dell PowerEdge R710	HP ProLiant DL380 G7
Motherboard model number	00NH4P	ProLiant DL380 G7
Motherboard chipset	Intel 5520	Intel 5520
BIOS name and version	Dell 2.1.9 (5/21/2010)	HP P67 (05/14/2010)
BIOS settings	Default	Default
Memory module(s)		
Vendor and model number	Samsung M393B5170FHD-CH9	Samsung M393B5270CH0-CH9Q4
Type	PC3-10600R	PC3-10600R
Speed (MHz)	1,333	1,333
Speed in the system currently running @ (MHz)	1,067	1,067
Timing/Latency (tCL-tRCD-iRP-tRASmin)	7-7-7-20	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	HP ProLiant DL380 G7
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	HP NC382i DP Multifunction Gigabit Server Adapter
Type	Integrated	Integrated
Driver version	Broadcom 5.2.14.0 (12/17/2009)	HP 5.2.14.0 (12/17/2009)
Optical drive		
Vendor and model number	TEAC DV-28SW	N/A
USB ports		
Number	4	4
Type	2.0	2.0
Power supplies		
Total number	2	2
Wattage of each (W)	870	750
Cooling fans		
Total number	5	6
Dimensions (inches)	2-3/8 x 2-3/8	2-5/8 x 2-3/8
Voltage (V)	12	12
Amps (A)	1.68	2.45

Figure 8: Detailed information for the test servers.

APPENDIX B – TEST STORAGE INFORMATION

Figure 9 provides detailed information for the test storage.

RAID controller	Dell PERC H700	HP Smart Array P410i
Firmware version	12.3.0-0032	3.00
Driver version	Dell 4.23.0.64 (11/16/2009)	HP 6.20.0.64 (02/22/2010)
Cache size (MB)	512	512
ROC (Raid-on-Chip)	LSI 2108	PM8011
Internal storage		
Operating system drives		
Vendor and model number	Dell ST973452SS	HP DH0072FACRD
Number of drives	2	2
Speed (Gbps)	6	6
Size (GB)	73	73
RPM	15,000	15,000
Type	SAS	SAS
iometer target drives		
Vendor and model number	Dell MCB4E50G5MXP-0VB	HP MK0060EAVDR
Number of drives	6	6
Speed (Gbps)	3	3
Size (GB)	50	60
Type	SATA	SATA

Figure 9: Primary internal storage hardware.

APPENDIX C – DETAILED TEST RESULTS

Figure 10 shows results, in IOPS, from the Dell SATA SSD testing.

Access specification name and block size	RAID 0 IOPS	RAID 5 IOPS	RAID 6 IOPS	RAID 10 IOPS	RAID 50 IOPS
DB OLTP 8K, 70/30, 100/0	30,830.24	11,273.07	9,290.47	21,272.02	14,713.86
Exchange email 4K, 67/33, 100/0	36,276.58	15,948.73	10,592.03	24,495.85	16,856.87
Exchange email 8K, 67/33, 100/0	29,725.49	12,452.60	8,586.18	19,863.57	13,807.90
Exchange email 32K, 50/50, 100/0	12,492.16	4,215.76	3,219.09	7,112.16	5,247.83
Exchange email 64K, 50/50, 100/0	7,937.26	2,981.30	2,629.25	4,513.95	3,825.36
OS drive 8K, 70/30, 100/0	30,738.63	13,321.01	9,205.84	21,152.69	14,737.41
Web file server 4K, 95/5, 75/25	86,529.19	56,582.18	41,553.36	77,828.98	54,966.01
Web file server 8K, 95/5, 75/25	61,571.91	40,601.09	31,499.84	55,433.98	42,119.65
Web file server 64K, 95/5, 75/25	15,358.44	11,273.07	10,248.57	13,695.63	12,113.39

Figure 10: IOPS results from the Dell SATA SSD testing. Higher numbers are better.

Figure 11 shows results, in IOPS, from the HP SATA SSD testing.

Access specification name and block size	RAID 0 IOPS	RAID 5 IOPS	RAID 6 IOPS	RAID 10 IOPS	RAID 50 IOPS
DB OLTP 8K, 70/30, 100/0	14,169.92	5,580.81	3,524.82	6,305.85	5,213.49
Exchange email 4K, 67/33, 100/0	15,198.31	6,049.11	3,829.38	6,667.87	5,697.25
Exchange email 8K, 67/33, 100/0	13,331.10	5,017.86	3,205.90	5,614.01	4,717.93
Exchange email 32K, 50/50, 100/0	5,899.76	1,710.44	1,239.47	2,169.57	1,686.70
Exchange email 64K, 50/50, 100/0	3,960.88	1,342.15	895.47	1,535.32	1,224.79
OS drive 8K, 70/30, 100/0	14,509.53	5,578.52	3,471.93	6,256.52	5,213.79
Web file server 4K, 95/5, 75/25	40,051.99	27,876.07	18,580.37	37,312.66	27,801.14
Web file server 8K, 95/5, 75/25	32,997.50	22,975.42	15,642.34	31,116.49	22,787.92
Web file server 64K, 95/5, 75/25	11,439.02	8,650.17	5,585.19	9,729.22	8,421.67

Figure 11: IOPS results from the HP SATA SSD testing. Higher numbers are better.

ABOUT PRINCIPLED TECHNOLOGIES



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