Principled Technologies®

TEST REPORT
OCTOBER 2009

M610 vs. HP BL460c: Full enclosure SPECpower_ssj2008 testing

Executive summary

Dell Inc. (Dell) commissioned Principled Technologies (PT) to use the SPECpower_ssj2008 test tool to compare the performance per watt per dollar of two blade enclosures, fully populated with similarly configured blade servers:

- 16 Dell™ PowerEdge™ M610 blade servers inside a Dell PowerEdge M1000e Modular Blade Enclosure (Dell blade solution)
- 16 HP ProLiant BL460c G6 servers inside an HP BladeSystem c7000 Enclosure (HP blade solution)

Each blade server had two Intel® Xeon® Processor E5540s, 24GB DDR3 memory, and two 72GB 15K RPM SAS drives.

SPECpower_ssj2008 is an industry-standard benchmark created by the Standard Performance Evaluation Corp. (SPEC) to measure a server's power and performance. SPECpower_ssj2008 consists of a Server Side Java (SSJ) workload along with data collection and control services. SPECpower_ssj2008 results portray the server's performance in ssj_ops divided by the power used in watts (ssj_ops/watt). For more information about SPECpower_ssj2008, see the Workload section below.

The Dell blade solution delivered a SPECpower_ssj2008 result of 1,352 overall ssj_ops/watt compared to the HP blade solution, which yielded 1,295 overall ssj_ops/watt. Higher ssj_ops/watt results are better. The Dell blade solution retailed for $89,562.36 and the HP blade solution retailed for $104,289.00. The Dell blade solution delivered better results on both SPECpower_ssj2008 and cost. We combined ssj_ops and the price into an overall (ssj_ops/watt)/dollar measure by dividing by the cost in dollars. We normalized these values to the HP blade solution, assigning it a value of 100. The Dell blade solution provided 21.6 percent better performance/watt/dollar than the HP blade solution. Higher scores indicate more cost-effective servers and so are

KEY FINDINGS

- Sixteen Dell™ PowerEdge™ M610 blade servers inside a Dell PowerEdge M1000e Modular Blade Enclosure provided up to 21.6% better ssj_ops/watt/dollar than sixteen HP ProLiant BL460c G6 servers inside an HP BladeSystem c7000 enclosure*. (See Figure 1.)
- Sixteen Dell™ PowerEdge™ M610 blade servers inside a Dell PowerEdge M1000e Modular Blade Enclosure used up to 19% less overall power while idle than sixteen HP ProLiant BL460c G6 servers inside an HP BladeSystem c7000 enclosure: 1,552 watts vs. 1,916 watts, respectively*. (See Figure 2.)
- Sixteen Dell™ PowerEdge™ M610 blade servers inside a Dell PowerEdge M1000e Modular Blade Enclosure used less power than sixteen HP ProLiant BL460c G6 servers inside an HP BladeSystem c7000 enclosure across all SPECpower load levels*. (See Figure 3.)
- Sixteen Dell™ PowerEdge™ M610 blade servers inside a Dell PowerEdge M1000e Modular Blade Enclosure achieved a higher performance to power ratio across all SPECpower load levels than sixteen HP ProLiant BL460c G6 servers inside an HP BladeSystem c7000 enclosure*. (See Figure 4.)
- Sixteen Dell™ PowerEdge™ M610 blade servers inside a Dell PowerEdge M1000e Modular Blade Enclosure achieved higher ssj_ops results across all SPECpower load levels than sixteen HP ProLiant BL460c G6 servers inside an HP BladeSystem c7000 enclosure*. (See Figures 5 and 6.)
- The enclosures and blades for the Dell™ PowerEdge™ M610 blade servers inside a Dell PowerEdge M1000e Modular Blade Enclosure cost approximately 14 percent less than sixteen HP ProLiant BL460c G6 servers inside an HP BladeSystem c7000 enclosure*. (See Figure 10.)

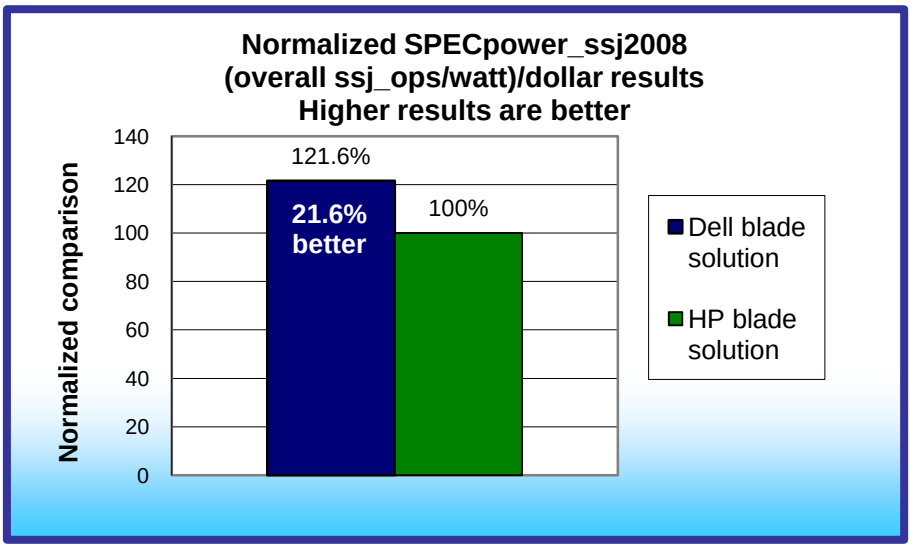


Figure 1: Normalized performance/watt/ results of the blade server solutions using the SPECpower_ssj2008 workload. Higher numbers are better.

* Source: Principled Technologies, "M610 vs. HP BL460c: Full enclosure SPECpower_ssj2008 testing" an October 2009 report commissioned by Dell.

better. Figure 1 shows that normalized result. For detailed data on SPECpower_ssj2008 results as well as submeasurements from all target loads during our testing, see Figures 6 and 7.

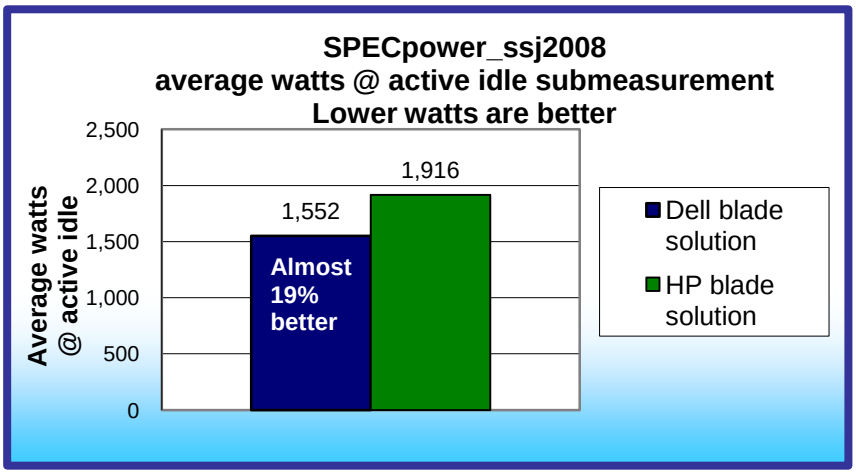


Figure 2: Idle power results of the blade server solutions using the SPECpower_ssj2008 benchmark. During the idle test, the blades run without any transactions scheduled by the workload software. Lower idle power is better.

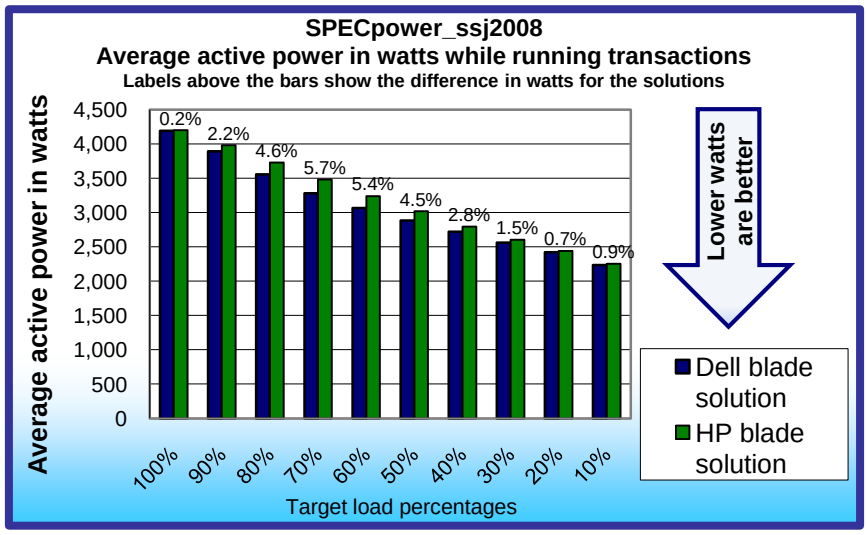


Figure 3: Average active power watts while running transactions at the 10 percent to 100 percent target load percentages as reported by SPECpower_ssj2008. Lower watts are better.

SPECpower_ ssj2008 includes a measurement of power while the blades are idle. As Figure 2 shows, the full enclosure of 16 Dell PowerEdge M610 blade servers used 19 percent less overall power while idle in our testing, compared to the 16 HP ProLiant BL460c G6 servers. The 16-blade Dell PowerEdge M610 solution used 1,552 watts, while the 16-blade HP ProLiant BL460c G6 solution used 1,916 watts. Lower idle power is better.

Figure 3 shows the average active power in watts while running transactions at the 10 percent to 100 percent target load percentages as reported by SPECpower_ssj2008. Lower watts are better. A full enclosure of 16 Dell PowerEdge M610 blade servers used less power than 16 HP ProLiant BL460c G6 servers across all of the SPECpower target load levels. The Dell blade solution shows greater than 2 percent and as much as 5.7 percent lower power on the mid-level target loads (load percentages between 40 percent and 80 percent). The average of these ten results was 3,080 watts for the Dell blade solution and 3,174 watts for the HP blade solution; a 3 percent lower average for the Dell solution. Lower watts are better.

Figure 4 shows the performance-to-watt ratio results for the target load percentages. Results are the average throughput divided by the average power consumption for each of these measurement intervals. A full enclosure of 16 Dell PowerEdge M610 blade servers achieved higher throughput and used less power than 16 HP ProLiant BL460c G6 servers at all SPECpower_ssj2008 target load levels. As a result, a full enclosure of 16 Dell PowerEdge M610 blade servers achieved a higher performance-to-watt ratio (ssj_ops/watt) than 16 HP ProLiant BL460c G6 servers across all target loads.

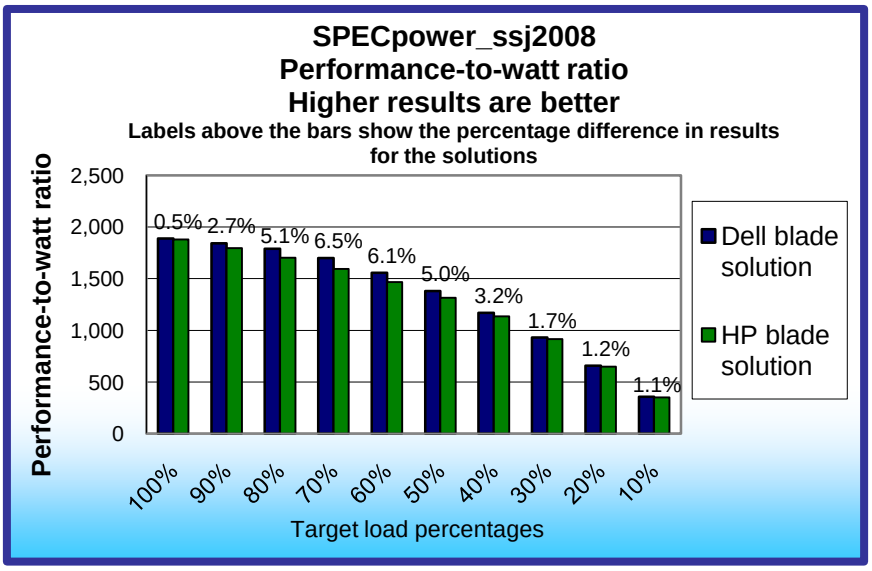


Figure 4: Performance-to-power ratios (ssj_ops/watt) reported by SPECpower_ssj2008. Results include the Overall ssj_ops/watt result and the ssj_ops/watt results for each of the measurement intervals. Higher results are better.

The final SPECpower_ssj2008 result is the sum of the ssj_ops score at all measurement intervals divided by the sum of the power readings (including the idle power reading). The Dell blade solution had a better performance-to-watt ratio than the HP blade solution at all measurement intervals, and delivered a 1,352 overall ssj_ops/watts score, 4.4 percent better than the HP blade solution score of 1,295.

Workload

SPECpower_ssj2008 is an industry-standard benchmark created by the Standard Performance Evaluation Corp. (SPEC) to measure a server's power and performance. (Note: SPEC and the SPECpower_ssj2008 are trademarks of the Standard Performance Evaluation Corporation.) SPEC has created SPECpower_ssj2008 for those who want to accurately measure the power consumption of their server in relation to their server's performance.

SPECpower_ssj2008 consists of three main software components: Server Side Java (SSJ), Power and Temperature Deamon (PTDaemon), and Control and Collect System (CCS). The SSJ is a Java program that stresses a server's hardware, such as the processor and memory, as well as aspects of the operating system and Java program. The PTDaemon is the program that controls the power analyzer and temperature sensor. Finally, the CCS is a Java program that coordinates the collection of all the data. For more information on how SPECpower_ssj2008 works, see http://www.spec.org/power_ssj2008/docs/SPECpower_ssj2008-User_Guide.pdf.

During a SPECpower_ssj2008 run, the system under test starts at full load, so the server is running at 100 percent of its capabilities and records the performance and power. Then, the benchmark scales the workload back by 10 percent, so the next data point is 90 percent of the server's total performance. The workload continues by scaling back by 10 percent and recording performance and power at each increment until the server under test reaches zero activity. When the server is at zero activity, SPECpower_ssj2008 considers the server idle and records the power consumption.

SPECpower_ssj2008 results portray the server's performance in ssj ops divided by the power used in watts. It displays the results as overall ssj_ops/watt. A higher number of SPECpower_ssj2008 ssj_ops/watt is better. For more information on SPECpower_ssj2008, go to www.spec.org.

Test results

Figure 5 shows the SPECpower_ssj2008 results for the Dell blade solution and HP blade solution. SPECpower_ssj2008 shows the final results in overall ssj_ops/watts. A higher overall ssj_ops/watts score is better and indicates the server is able to handle more overall requests per unit of power. In our tests, the Dell blade solution achieved a 4.4 percent better overall ssj_ops/watt than the HP blade solution.

	Overall ssj_ops/watt
Dell blade solution	1,352
HP blade solution	1,295

Figure 5: SPECpower_ssj2008 overall ssj_ops/watt results for the blade server solutions. Higher numbers are better.

Figure 6 shows the SPECpower_ssj2008 results for the Dell blade solution for each target load.

Dell blade solution (16 total blades)				
Performance			**Power**	**Performance-to-power ratio**
Target load	**Actual load**	**ssj_ops**	**Average active power (W)**	
100%	99.5%	7,917,079	4,189	1,890
90%	90.2%	7,173,757	3,890	1,844
80%	80.0%	6,368,019	3,557	1,790
70%	70.0%	5,572,858	3,280	1,699
60%	60.0%	4,773,632	3,066	1,557
50%	50.0%	3,980,293	2,884	1,380
40%	40.0%	3,182,915	2,718	1,171
30%	30.0%	2,386,956	2,562	932
20%	20.0%	1,591,436	2,422	657
10%	10.0%	795,729	2,233	356
Active idle		0	1,552	0
∑ssj_ops / ∑power =				**1,352**

Figure 6: SPECpower_ssj2008 results for the 16-blade Dell solution. Lower active power (W) results are better. Higher ssj_ops and performance-to-power ratios are better.

Figure 7 shows the SPECpower_ssj2008 results for the HP blade solution for each target load.

HP blade solution (16 total blades)				
Performance			**Power**	**Performance-to-power ratio**
Target load	**Actual load**	**ssj_ops**	**Average active power (W)**	
100%	99.5%	7,896,155	4,199	1,880
90%	90.0%	7,139,564	3,978	1,795
80%	80.1%	6,351,417	3,730	1,703
70%	70.0%	5,550,454	3,479	1,595
60%	59.9%	4,754,898	3,240	1,467
50%	50.0%	3,967,024	3,019	1,314
40%	40.0%	3,172,077	2,795	1,135
30%	30.0%	2,382,221	2,602	916
20%	20.0%	1,583,827	2,440	649
10%	10.0%	793,148	2,253	352
Active idle		0	1,916	0
∑ssj_ops / ∑power =				**1,295**

Figure 7: SPECpower_ssj2008 results for the 16-blade HP solution. Lower active power (W) results are better. Higher ssj_ops and performance-to-power ratios are better.

Test methodology

In SPEC's terms, our results were from "compliant" runs, which means we can disclose them publicly though we are not posting them on the SPEC Web site with all the files SPEC requires. In this section and appendices, we do present all the data necessary to reproduce these results and include copies of the results files.

We began our testing by installing a fresh copy of Microsoft Windows Server® 2008 R2 Enterprise on each server. We followed this process for each installation:

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 R2 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. Ensure you select the proper drive, and click New.
9. Click Apply.
10. Click Next.
11. At the User's password must be changed before logging on warning screen, click OK.
12. Type `Password1` as the new password in both fields, and click the arrow to continue.
13. At the Your password has been changed screen, click OK.

We used the default BIOS settings, with the exception of disabling HW Prefetcher, Adjacent Cache Line Prefetcher, and Turbo mode on all blade servers. We set Power Efficiency Mode to Active Power Controller on all Dell PowerEdge M610 blade servers. We set Power Efficiency Mode to Balanced Power and Performance on all HP ProLiant BL460c G6 blade servers.

To improve Java performance, we enabled large pages in memory on all blade servers. To enable this service, the administrator must first assign additional privileges to the user who will be running the application. We assigned this privilege to only the administrator, because we used that account for our tests. To enable large pages, we selected the following:

- Control Panel→Administrative Tools→Local Security Policy
- Local Policies→User Rights Assignment
- Lock pages in memory, add users and/or groups

SPECpower_ssj2008 configuration

We used SPECpower_ssj2008 version 1.10, dated April 15, 2009. We followed SPEC's run rules. (For more information about SPECpower_ssj2008 and its run rules, see http://www.spec.org/power_ssj2008/docs/SPECpower_ssj2008-Run_Reporting_Rules.html).

SPECpower_ssj2008 requires a Java Virtual Machine (JVM) on the system under test. We used the Oracle JRockit (build P28.0.0-29-114096-1.6.0_11-20090427-1759-windows-x86_64, compiled mode) JVM for this testing and left the default installation settings.

We modified the SPECpower_ssj2008 configuration files so each blade server ran four JVM instances during testing. We set processor affinity of F, F0, F00, and F000 across the four JVM instances. We used the following Java options string to provide the best performance (-Xms3700m -Xmx3700m -Xns3100m -XXaggressive -XlargePages -XXthroughputCompaction -XXcallprofiling -XXlazyUnlocking -Xgc:genpar -XXgcthreads:4 -XXtlasize:min=4k,preferred=1024k).

SPECpower_ssj2008 requires a power meter and temperature sensor for testing. We used two Yokogawa WT210 power analyzers and one Digi Watchport/H temperature sensor for testing. We configured the two Yokogawa WT210 meters with splitter cable so the cable from each meter powered three of the six power supplies in the blade chassis.

Appendix A – Enclosure configuration information

This appendix provides detailed configuration information about the enclosures, which we list in alphabetical order in Figure 8.

Enclosure	Dell PowerEdge M1000e	HP BladeSystem c7000
General dimension information		
Height (inches)	17.3	17.5
Width (inches)	17.6	17.5
Depth (inches)	29.7	32.0
U size in server rack	10	10
Number of blades	16	16
Power supplies		
Total number	6	6
Wattage of each	2,360	2,450
Cooling fans		
Total number	9	10
Dimensions (H x W) of each	3.1” x 3.5”	2.75” x 2.25”
Voltage	12	12
Amps	7.0	16.5

Figure 8: Detailed configuration information for the blade enclosures.

Appendix B – Blade system configuration information

This appendix provides detailed configuration information about each of the test server systems, which we list in alphabetical order in Figure 9.

Servers	Dell PowerEdge M610	HP ProLiant BL460C 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	Xeon E5540	Xeon E5540
Stepping	D0	D0
Socket type	LGA1366	LGA1366
Core frequency (GHz)	2.53	2.53
L1 cache	4 x 32 KB + 32 KB	4 x 32 KB + 32 KB
L2 cache	4 x 256 KB	4 x 256 KB
L3 cache (MB)	8	8
Platform		
Vendor and model number	Dell PowerEdge M610	HP ProLiant BL460C G6
Motherboard model number	0N582M	531221-001
BIOS name and version	Dell 1.2.7 (07/22/2009)	Hewlett-Packard I24 (07/25/2009)
BIOS settings	Disabled HW Prefetcher, Adjacent Cache Line Prefetcher, and Turbo mode Power Efficiency Mode to Active Power	Disabled HW Prefetcher, Adjacent Cache Line Prefetcher, and Turbo mode Power Efficiency Mode to Balanced Power
Memory modules		
Total RAM in system (GB)	24	24
Vendor and model number	6 x Samsung M393B5170EH1-CH9 (9 blades); 6 x Hynix HMT151R7BFR4C-H9 (7 blades)	Micron MT36JSZF51272PY-1G4D1AB
Type	PC3-10600R	PC3-10600R
Speed (MHz)	1,333	1,333
Speed in the system currently running @ (MHz)	1,066	1,066
Timing/latency (tCL-tRCD-iRP-tRASmin)	7-7-7-20	7-7-7-20
Size (GB)	24	24
Number of RAM modules	6 x 4 GB	6 x 4 GB
Chip organization	Double-sided	Double-sided
Hard disk		
Vendor and model number	Seagate ST973452SS	HP DH0072FAQRD

Servers	Dell PowerEdge M610	HP ProLiant BL460C G6
Number of disks in system	2	2
Size (GB)	72	72
Buffer size (MB)	16	16
RPM	15,000	15,000
Type	SAS	SAS
Controller	Dell PERC 6/I	HP Smart Array P410i
Operating system		
Name	Microsoft Windows Server 2008 R2 Enterprise	Microsoft Windows Server 2008 R2 Enterprise
Build number	7600	7600
File system	NTFS	NTFS
Language	English	English
Network card/subsystem		
Vendor and model number	Broadcom BCM5709S NetXtreme II	Broadcom NetXtreme II 5709C
Type	Integrated	Integrated

Figure 9: Detailed system configuration information for the two test servers.

Appendix C – Pricing

Figure 10 provides the pricing breakdown for each blade solution. Prices include the enclosure and blade parts we used in the test but exclude tax and shipping.

Server	Dell blade solution	HP blade solution
Individual blade (includes processor, memory, and hard drives)	$5,083.00	$5,961.00
Sixteen blades	$81,328.00	$95,376.00
Blade enclosure	$8,234.36	$8,913.00
Total	$89,562.36	$104,289.00
Date of price	October 19, 2009	October 19, 2009

Figure 10: Detailed pricing for the blade solutions.

Appendix D – SPECpower_ssj2008 output

Figures in this appendix provide the SPECpower_ssj2008 output files from the two blade solutions.

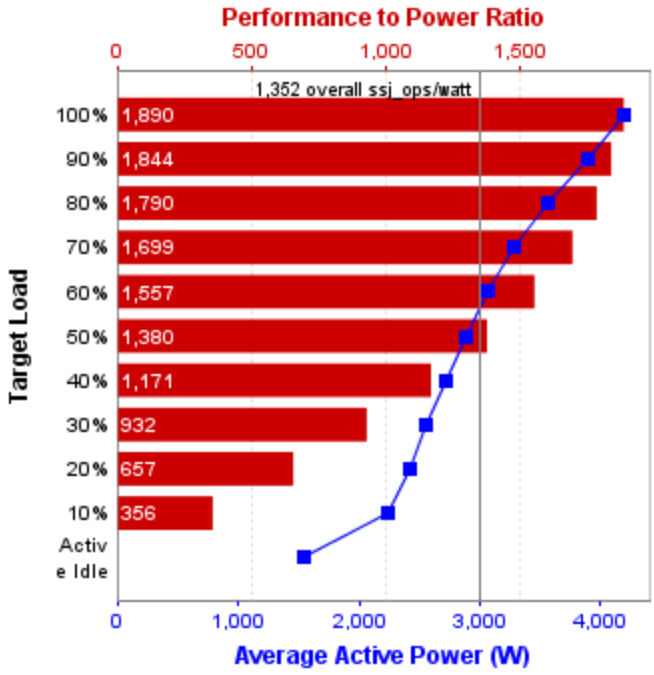
Dell PowerEdge M610 blade server

SPECpower_ssj2008

Dell PowerEdge M610			SPECpower_ssj2008 = 1,352 overall ssj_ops/watt		
Test Sponsor:	Principled Technologies	SPEC License #:	3184	Test Method:	Multi Node
Tested By:	Principled Technologies	Test Location:	Raleigh, NC, USA	Test Date:	Oct 14, 2009
Hardware Availability:	Aug-2009	Software Availability:	Sep-2009	Publication:	Unpublished
System Source:	Single Supplier	System Designation:	Server	Power Provisioning:	Line-powered

Benchmark Results Summary

Performance			Power	Performance to Power Ratio
Target Load	Actual Load	ssj_ops	Average Active Power (W)	
100%	99.5%	7,917,079	4,189	1,890
90%	90.2%	7,173,757	3,890	1,844
80%	80.0%	6,368,019	3,557	1,790
70%	70.0%	5,572,858	3,280	1,699
60%	60.0%	4,773,632	3,066	1,557
50%	50.0%	3,980,293	2,884	1,380
40%	40.0%	3,182,915	2,718	1,171
30%	30.0%	2,386,956	2,562	932
20%	20.0%	1,591,436	2,422	657
10%	10.0%	795,729	2,233	356
	Active Idle	0	1,552	0
			∑ssj_ops / ∑power =	**1,352**



Aggregate SUT Data

# of Nodes	# of Chips	# of Cores	# of Threads	Total RAM (GB)	# of OS Images	# of JVM Instances
16	32	128	256	384	16	64

System Under Test
Shared Hardware

Shared Hardware	
Enclosure:	Dell PowerEdge M1000e Modular Blade Enclosure
Form Factor:	10U
Power Supply Quantity and Rating (W):	6 x 2360
Power Supply Details:	Dell ATSN 7001333-J100
Network Switch:	1
Network Switch Details:	Dell PowerConnect 5448
KVM Switch:	None
KVM Switch Details:	N/A
Other Hardware:	None
Comment:	None

Set: 'sut'

Set Identifier:	sut
Set Description:	System Under Test
# of Identical Nodes:	16
Comment:	None
Hardware per Node	
Hardware Vendor:	Dell
Model:	PowerEdge M610
Form Factor:	Blade

CPU Name:	Intel Xeon E5540
CPU Characteristics:	Quad-Core, 2.53GHz, 8MB L3 Cache, 1066 system bus
CPU Frequency (MHz):	2533
CPU(s) Enabled:	8 cores, 2 chips, 4 cores/chip
Hardware Threads:	16 (2 / core)
CPU(s) Orderable:	1,2 chips
Primary Cache:	32 KB I + 32 KB D on chip per core
Secondary Cache:	256 KB I+D on chip per core
Tertiary Cache:	8 MB I+D on chip per chip
Other Cache:	None
Memory Amount (GB):	24
# and size of DIMM:	6 x 4096 MB
Memory Details:	PC3-10600R; slots A1, A2 and A3 populated on node one; and slots B1, B2, and B3 populated on node two.
Power Supply Quantity and Rating (W):	None
Power Supply Details:	N/A
Disk Drive:	2 x 72GB 15K RPM SAS; Dell part #9FT066-050
Disk Controller:	Dell PERC 6/i Integrated SAS RAID Controller Card
# and type of Network Interface Cards (NICs) Installed:	2 x Broadcom BCM5709S NetXtreme II GigE
NICs Enabled in Firmware / OS / Connected:	2/2/1
Network Speed (Mbit):	1000
Keyboard:	None
Mouse:	None
Monitor:	None
Optical Drives:	None
Other Hardware:	None

Software per Node	
Power Management:	Enabled (see SUT Notes)
Operating System (OS):	Microsoft Windows Server 2008 R2 x64 Enterprise Edition
OS Version:	Service Pack 2
Filesystem:	NTFS
JVM Vendor:	Oracle Corporation
JVM Version:	Oracle JRockit(R)(build P28.0.0-29-114096-1.6.0_11-20090427-1759-windows-x86_64, compiled mode)
JVM Command-line Options:	Xms3700m -Xmx3700m -Xns3100m -XXaggressive -XlargePages -XXthroughputCompaction -XXcallprofiling -XXlazyUnlocking -Xgc:genpar -XXgcthreads:4 -XXtlasize:min=4k,preferred=1024k
JVM Affinity:	start /affinity [F,F0,F00,F000]
JVM Instances:	64
JVM Initial Heap (MB):	3700

Software per Node	
JVM Maximum Heap (MB):	3700
JVM Address Bits:	64
Boot Firmware Version:	I24 07/25/2009
Boot Firmware Settings:	See SUT Notes
Management Firmware Version:	2.10, A00 09/01/2009
Management Firmware Settings:	None
Benchmark Version:	SPECpower_ssj2008 1.2.7
Director Location:	Controller
Other Software:	None

System Under Test Notes

- We affinitized each JVM instance to 2 cores per socket.
- Using the local security settings console, we enabled "lock pages in memory" for the user running the benchmark.
- We set the hard disk to turn off after 1 minute.
- We set Power Efficiency Mode to Active Power Controller in BIOS.
- We disabled Hardware Prefetcher in BIOS.
- We disabled Adjacent Cache Line Prefetch in BIOS.
- We disabled Turbo Mode in BIOS.

Controller System

Hardware	
Hardware Vendor:	Dell
Model:	PowerEdge 2950 III
CPU Description:	Intel Xeon E5405
Memory amount (GB):	16
Software	
Operating System (OS):	Microsoft Windows Server 2003 x86 Enterprise Edition Service Pack 2
JVM Vendor:	Oracle Corporation
JVM Version:	Oracle JRockit(R) (build R27.6.3-40_o-112056-1.6.0_11-20090318-2104-windows-ia32, compiled mode)
CCS Version:	1.2.4

Measurement Devices

Power Analyzer pwr1	
Hardware Vendor:	Yokogawa Electric International Pte. Ltd.
Model:	WT210
Serial Number:	91GB51135

Power Analyzer pwr1	
Connectivity:	RS232, SABRENT SBT-USC6M USB to Serial adapter
Input Connection:	Default
Calibration Institute:	NIST
Accredited by:	Davis Calibration
Calibration Label:	07-1684
Date of Calibration:	4-Aug-2009
PTDaemon Host System:	same as CCS
PTDaemon Host OS:	same as CCS
PTDaemon Version:	1.3.9-49c8760c
Setup Description:	SUT Power Supplies 1, 2 and 3

Power Analyzer pwr2	
Hardware Vendor:	Yokogawa Electric International Pte. Ltd.
Model:	WT210
Serial Number:	91GB45373
Connectivity:	RS232, SABRENT SBT-USC6M USB to Serial adapter
Input Connection:	Default
Calibration Institute:	NIST
Accredited by:	Davis Calibration
Calibration Label:	07-1673
Date of Calibration:	4-Aug-2009
PTDaemon Host System:	same as CCS
PTDaemon Host OS:	same as CCS
PTDaemon Version:	1.3.9-49c8760c
Setup Description:	SUT Power Supplies 4, 5 and 6

Temperature Sensor temp1	
Hardware Vendor:	Digi International Inc.
Model:	Watchport/H
Driver Version:	5.10.26.0
Connectivity:	USB
PTDaemon Host System:	same as CCS
PTDaemon Host OS:	same as CCS
Setup Description:	50 mm in front of SUT main airflow intake

Notes

None

Aggregate Electrical and Environmental Data

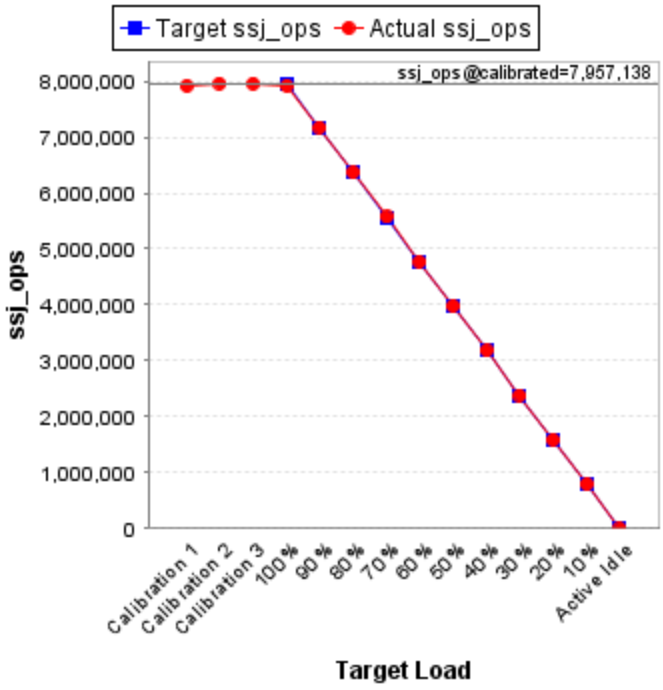
Target Load	Average Active Power (W)	Minimum Ambient Temperature (°C)
100%	4,189	23.6
90%	3,890	23.4
80%	3,557	23.1
70%	3,280	23.0
60%	3,066	22.9
50%	2,884	23.0

Target Load	Average Active Power (W)	Minimum Ambient Temperature (°C)
40%	2,718	23.1
30%	2,562	22.2
20%	2,422	21.9
10%	2,233	22.9
Active Idle	1,552	22.8
Line Standard	**Minimum Temperature (°C)**	**Elevation (m)**
208V / 60 Hz / 1 phase / 2 wires	21.9	434

See the Power/Temperature Details Report for additional details.

Aggregate Performance Data

Target Load	Actual Load	ssj_ops	
		Target	Actual
Calibration 1			7,918,514
Calibration 2			7,958,605
Calibration 3			7,955,671
			ssj_ops@calibrated=7,957,138
100%	99.5%	7,957,138	7,917,079
90%	90.2%	7,161,424	7,173,757
80%	80.0%	6,365,710	6,368,019
70%	70.0%	5,569,996	5,572,858
60%	60.0%	4,774,283	4,773,632
50%	50.0%	3,978,569	3,980,293
40%	40.0%	3,182,855	3,182,915
30%	30.0%	2,387,141	2,386,956
20%	20.0%	1,591,428	1,591,436
10%	10.0%	795,714	795,729
Active Idle		0	0



See the Aggregate Performance Report for additional details.

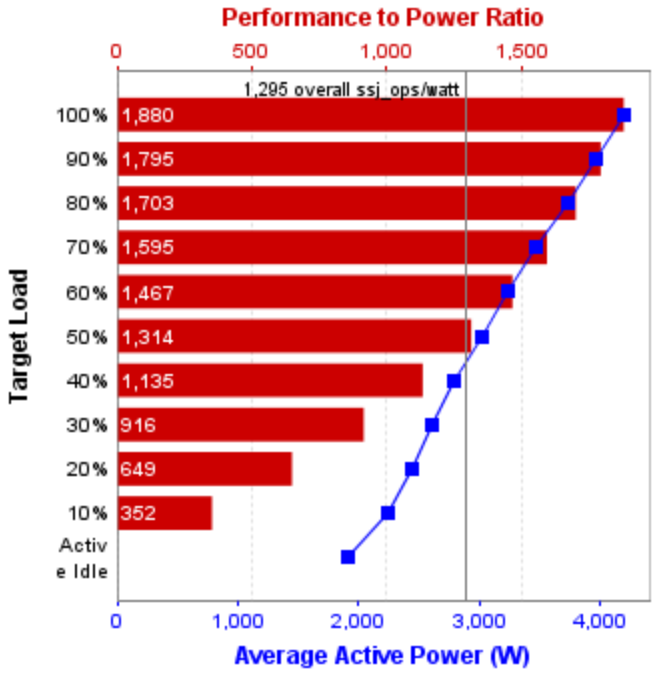
HP ProLiant BL460c G6 server

SPECpower_ssj2008

Hewlett-Packard Company ProLiant BL460c G6			SPECpower_ssj2008 = 1,295 overall ssj_ops/watt		
Test Sponsor:	Principled Technologies	SPEC License #:	3184	Test Method:	Multi Node
Tested By:	Principled Technologies	Test Location:	Raleigh, NC, USA	Test Date:	Oct 8, 2009
Hardware Availability:	Aug-2009	Software Availability:	Sep-2009	Publication:	Unpublished
System Source:	Single Supplier	System Designation:	Server	Power Provisioning:	Line-powered

Benchmark Results Summary

Performance			Power	Performance to Power Ratio
Target Load	Actual Load	ssj_ops	Average Active Power (W)	
100%	99.5%	7,896,155	4,199	1,880
90%	90.0%	7,139,564	3,978	1,795
80%	80.1%	6,351,417	3,730	1,703
70%	70.0%	5,550,454	3,479	1,595
60%	59.9%	4,754,898	3,240	1,467
50%	50.0%	3,967,024	3,019	1,314
40%	40.0%	3,172,077	2,795	1,135
30%	30.0%	2,382,221	2,602	916
20%	20.0%	1,583,827	2,440	649
10%	10.0%	793,148	2,253	352
	Active Idle	0	1,916	0
			∑ssj_ops / ∑power =	**1,295**



Aggregate SUT Data

# of Nodes	# of Chips	# of Cores	# of Threads	Total RAM (GB)	# of OS Images	# of JVM Instances
16	32	128	256	384	16	64

System Under Test
Shared Hardware

Shared Hardware	
Enclosure:	HP BladeSystem c7000 Enclosure
Form Factor:	10U
Power Supply Quantity and Rating (W):	6 x 2450
Power Supply Details:	HP HSTNS-PR16
Network Switch:	1
Network Switch Details:	Dell PowerConnect 5448
KVM Switch:	None
KVM Switch Details:	N/A
Other Hardware:	None
Comment:	None

Set: 'sut'

Set Identifier:	sut
Set Description:	System Under Test
# of Identical Nodes:	16
Comment:	None
Hardware per Node	
Hardware Vendor:	Hewlett-Packard Company
Model:	ProLiant BL460c G6
Form Factor:	Blade

CPU Name:	Intel Xeon E5540
CPU Characteristics:	Quad-Core, 2.53GHz, 8MB L3 Cache, 1066 system bus
CPU Frequency (MHz):	2533
CPU(s) Enabled:	8 cores, 2 chips, 4 cores/chip
Hardware Threads:	16 (2 / core)
CPU(s) Orderable:	1,2 chips
Primary Cache:	32 KB I + 32 KB D on chip per core
Secondary Cache:	256 KB I+D on chip per core
Tertiary Cache:	8 MB I+D on chip per chip
Other Cache:	None
Memory Amount (GB):	24
# and size of DIMM:	6 x 4096 MB
Memory Details:	PC3-10600R; slots 2A, 4B and 6C populated on each node
Power Supply Quantity and Rating (W):	None
Power Supply Details:	N/A
Disk Drive:	2 x 72GB 15K RPM SAS; HP part #459889-002
Disk Controller:	HP Smart Array P410i Integrated RAID Controller
# and type of Network Interface Cards (NICs) Installed:	2 x NC532i
NICs Enabled in Firmware / OS / Connected:	2/2/1
Network Speed (Mbit):	1000
Keyboard:	None
Mouse:	None
Monitor:	None
Optical Drives:	None
Other Hardware:	None

Software per Node	
Power Management:	Enabled (see SUT Notes)
Operating System (OS):	Microsoft Windows Server 2008 R2 x64 Enterprise Edition
OS Version:	Service Pack 2
Filesystem:	NTFS
JVM Vendor:	Oracle Corporation
JVM Version:	Oracle JRockit(R)(build P28.0.0-29-114096-1.6.0_11-20090427-1759-windows-x86_64, compiled mode)
JVM Command-line Options:	Xms3700m -Xmx3700m -Xns3100m -XXaggressive -XlargePages -XXthroughputCompaction -XXcallprofiling -XXlazyUnlocking -Xgc:genpar -XXgcthreads:4 -XXtlasize:min=4k,preferred=1024k
JVM Affinity:	start /affinity [F,F0,F00,F000]
JVM Instances:	64
JVM Initial Heap (MB):	3700

Software per Node	
JVM Maximum Heap (MB):	3700
JVM Address Bits:	64
Boot Firmware Version:	I24 07/25/2009
Boot Firmware Settings:	See SUT Notes
Management Firmware Version:	1.79 08/28/2009
Management Firmware Settings:	None
Benchmark Version:	SPECpower_ssj2008 1.2.7
Director Location:	Controller
Other Software:	None

System Under Test Notes

- We affinitized each JVM instance to 2 cores per socket.
- Using the local security settings console, we enabled "lock pages in memory" for the user running the benchmark.
- We set the hard disk to turn off after 1 minute.
- We set Power Efficiency Mode to Active Power Controller in BIOS.
- We disabled Hardware Prefetcher in BIOS.
- We disabled Adjacent Cache Line Prefetch in BIOS.
- We disabled Turbo Mode in BIOS.

Controller System

Hardware	
Hardware Vendor:	Dell
Model:	PowerEdge 2950 III
CPU Description:	Intel Xeon E5405
Memory amount (GB):	16
Software	
Operating System (OS):	Microsoft Windows Server 2003 x86 Enterprise Edition Service Pack 2
JVM Vendor:	Oracle Corporation
JVM Version:	Oracle JRockit(R) (build R27.6.3-40_o-112056-1.6.0_11-20090318-2104-windows-ia32, compiled mode)
CCS Version:	1.2.4

Measurement Devices

Power Analyzer pwr1	
Hardware Vendor:	Yokogawa Electric International Pte. Ltd.
Model:	WT210

Power Analyzer pwr1	
Serial Number:	91GB51135
Connectivity:	RS232, SABRENT SBT-USC6M USB to Serial adapter
Input Connection:	Default
Calibration Institute:	NIST
Accredited by:	Davis Calibration
Calibration Label:	07-1684
Date of Calibration:	4-Aug-2009
PTDaemon Host System:	same as CCS
PTDaemon Host OS:	same as CCS
PTDaemon Version:	1.3.9-49c8760c
Setup Description:	SUT Power Supplies 1, 2 and 3

Power Analyzer pwr2	
Hardware Vendor:	Yokogawa Electric International Pte. Ltd.
Model:	WT210
Serial Number:	91GB45373
Connectivity:	RS232, SABRENT SBT-USC6M USB to Serial adapter
Input Connection:	Default
Calibration Institute:	NIST
Accredited by:	Davis Calibration
Calibration Label:	07-1673
Date of Calibration:	4-Aug-2009
PTDaemon Host System:	same as CCS
PTDaemon Host OS:	same as CCS
PTDaemon Version:	1.3.9-49c8760c
Setup Description:	SUT Power Supplies 4, 5 and 6

Temperature Sensor temp1	
Hardware Vendor:	Digi International Inc.
Model:	Watchport/H
Driver Version:	5.10.26.0
Connectivity:	USB
PTDaemon Host System:	same as CCS
PTDaemon Host OS:	same as CCS
Setup Description:	50 mm in front of SUT main airflow intake

Notes

None

Aggregate Electrical and Environmental Data

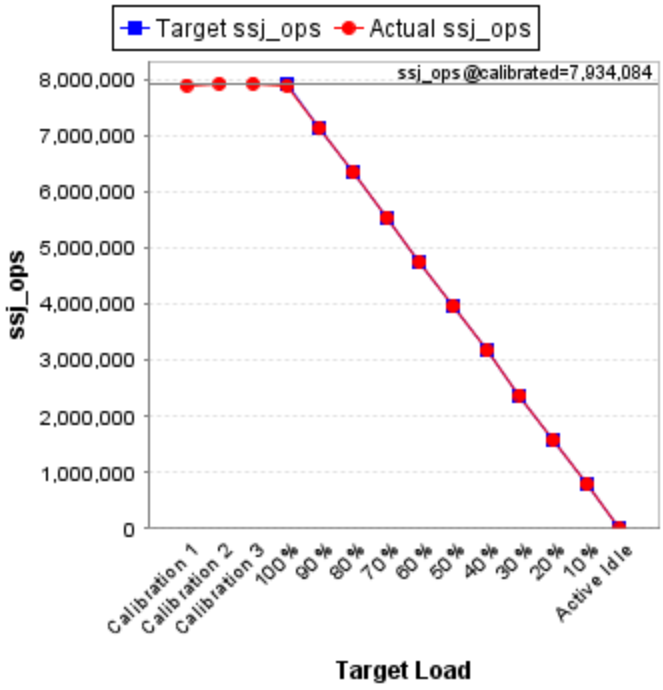
Target Load	Average Active Power (W)	Minimum Ambient Temperature (°C)
100%	4,199	20.5
90%	3,978	20.6
80%	3,730	21.1
70%	3,479	20.5
60%	3,240	20.8

Target Load	Average Active Power (W)	Minimum Ambient Temperature (°C)
50%	3,019	21.4
40%	2,795	21.4
30%	2,602	21.2
20%	2,440	21.3
10%	2,253	21.5
Active Idle	1,916	21.9
Line Standard	**Minimum Temperature (°C)**	**Elevation (m)**
208V / 60 Hz / 1 phase / 2 wires	20.5	434

See the Power/Temperature Details Report for additional details.

Aggregate Performance Data

Target Load	Actual Load	ssj_ops	
		Target	Actual
Calibration 1			7,901,911
Calibration 2			7,932,370
Calibration 3			7,935,798
			ssj_ops@calibrated=7,934,084
100%	99.5%	7,934,084	7,896,155
90%	90.0%	7,140,676	7,139,564
80%	80.1%	6,347,267	6,351,417
70%	70.0%	5,553,859	5,550,454
60%	59.9%	4,760,450	4,754,898
50%	50.0%	3,967,042	3,967,024
40%	40.0%	3,173,634	3,172,077
30%	30.0%	2,380,225	2,382,221
20%	20.0%	1,586,817	1,583,827
10%	10.0%	793,408	793,148
Active Idle		0	0



See the Aggregate Performance Report for additional details.

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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