Power Efficiency Comparison of the Dell PowerEdge M630 and HPE ProLiant BL460c Gen 9 Blade Servers

This white paper compares the power efficiency of Intel Xeon E5-2600v4 based blade server solutions

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Introduction

With power and cooling costs accounting for increasingly large portions of IT budgets, IT departments looking to minimize total cost of ownership (TCO) are making power efficiency a priority when choosing server hardware. On top of their density and management advantages, blade servers can be extremely power-efficient, and are an increasingly popular choice in the data centers. In this white paper, we examine the power efficiency of two-socket blade servers using the Intel® Xeon® processor E5-2600 product family.

The Dell™ Solutions Performance Analysis (SPA) team compared a blade server solution based on the Dell PowerEdge™ M630 to the HPE® ProLiant™ BL460c Gen9, both of which use the Intel® Xeon® processor E5-2600v4 product family. Using the industry standard SPECpower_ssj2008® benchmark, the solution from each vendor was tested for performance, power draw, and performance per watt. The hardware for each solution was configured as similarly as possible to ensure an apples-to-apples comparison.

The results showed the **Dell PowerEdge™ M1000e blade chassis and M630 blades** delivered **better power efficiency,** provided **higher performance,** and **drew less power** than the **HPE BladeSystem c7000 with BL460c Gen9 blades.**

Key findings

Performance per watt

Overall, the **Dell PowerEdge M630 blade solution** achieved a **16% higher performance-to-power ratio than the HPE** ProLiant BL460c Gen9 blade solution.

Performance

At the same input power, the **PowerEdge M630 provided higher raw performance** than the ProLiant BL360p Gen9 at all load levels.

Power

When comparing power efficiency of the blades and enclosure, the **Dell blade solution drew 28% less power at idle** and **14% less power at 100% load than the HPE solution drew.**

Test methodology and detailed results are documented in this paper.

Methodology

SPECpower_ssj2008 is an industry standard benchmark created by the Standard Performance Evaluation Corporation (SPEC®) to measure a server's power and performance across multiple utilization levels. Appendix A — Test methodology details the test methodology used by Dell; Appendix B — Blade enclosure hardware configuration information; Appendix C — Blade server firmware and drivers; and Appendix D — SPECpower_ssj2008 results provide detailed report data that supports the results in this paper.

Configuration 1

Blades, chassis, and internal chassis components

Each blade solution measured for power efficiency was configured with eight blades, the blade enclosure, a Gigabit pass through module, and three power supplies.

Table 1: Blade solution configurations

	Dell blade solution	HPE blade solution
Enclosure	PowerEdge M1000e	BladeSystem c7000
Blade slots occupied / total	8 / 16	8 / 16
Blades	8 x PowerEdge M630	8 x ProLiant BL460c Gen9
Internal I/O Module	1 x Dell 16 Port 1Gb Ethernet Pass-Through Module	1 x HPE 16 Port 1Gb Ethernet Pass-Thru Module
Management	1 x Dell CMC Module	1 x HPE Onboard Administrator Module
Power supply quantity/rating	3 x 3000W	3 x 2400W

The blades in the solutions were configured as similarly as possible. To eliminate any possible power efficiency variations between processors and memory samples, the Dell SPA team ran tests on both solutions using the exact same Intel Xeon E5-2660v4 processors and DIMMs. Storage Controllers and Network Interface Cards were matched as close as possible between the two vendors.

The configurations of the blade servers used are summarized in Table 2.

Table 2: Detailed configuration for blades used in the power efficiency comparisons

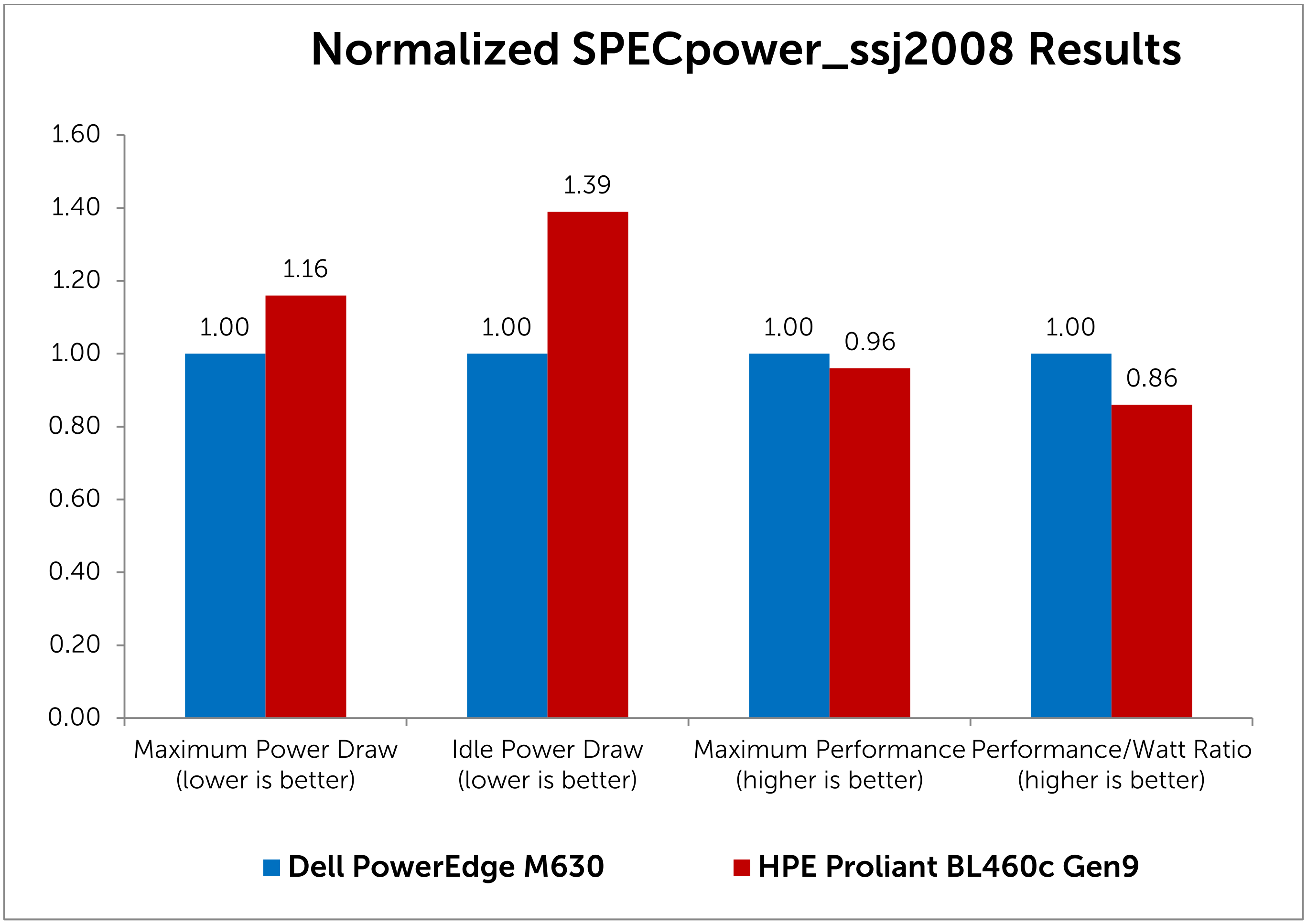
Per blade	Dell PowerEdge M630	HPE ProLiant BL460c Gen9
Sockets/form factor	2 / half height	2 / half height
Processors	2 x Intel Xeon E5-2660v4	2 x Intel Xeon E5-2660v4
Physical/logical cores	14/28	14/28
Memory	8 x 16GB Dual Ranked PC4-2400T RDIMMs	8 x 16GB Dual Ranked PC4-2400T RDIMMs
Hard drives	2 x 300GB SAS 10k, RAID 1	2 x 300GB SAS 10k, RAID 1
Network	1 x Onboard 2 port Broadcom BCM57810 10GbE	1 x Onboard 2 port FlexFabric 5536FLB 10GbE
Storage controller	PERC H730 Mini	Smart HBA H244br Controller

Rather than employing power efficiency-specific BIOS tunings, the blade servers were set to their BIOS default settings for all tests, thus simulating a typical initial deployment. All blade servers ran Microsoft® Windows Server® 2012 R2, with all Windows settings left at their defaults except for enabling the “Lock pages in memory” setting for the Administrator user, which is recommended in order for the SPECpower_ssj2008 benchmark to run optimally.

Results

In this like-for-like comparison, the HPE ProLiant BL460c Gen 9 drew 16% more power than the Dell PowerEdge M630 at 100% load, and the HPE solution drew 39% more power than the Dell solution at active idle. The ProLiant Bl460c Gen9 also provided 4% lower raw performance than the PowerEdge M630, which led to a 14% lower overall performance/watt ratio for the HPE solution.

Figure 1: Normalized SPECpower_ssj2008 Results for PowerEdge M630 and ProLiant BL460c Gen9



The SPECpower_ssj2008 benchmark includes a measurement of power while the servers are at varying levels of target utilization. The performance-to-watt ratio at each target load level is total operations (ssj_ops) divided by average power consumption of the server at that load level. Figure 2 shows power efficiency at each interval.

Figure 2: Performance per watt ratios for all target loads[1]

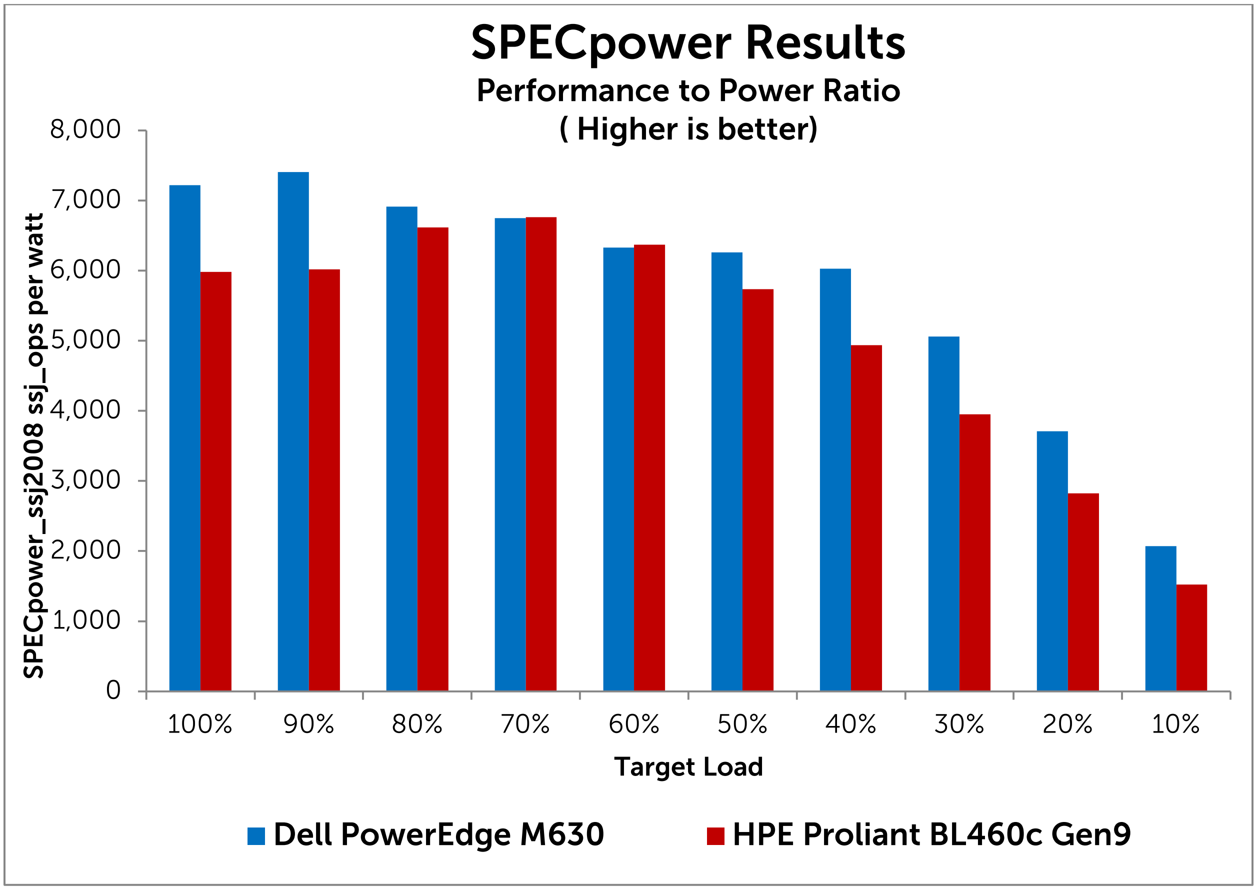
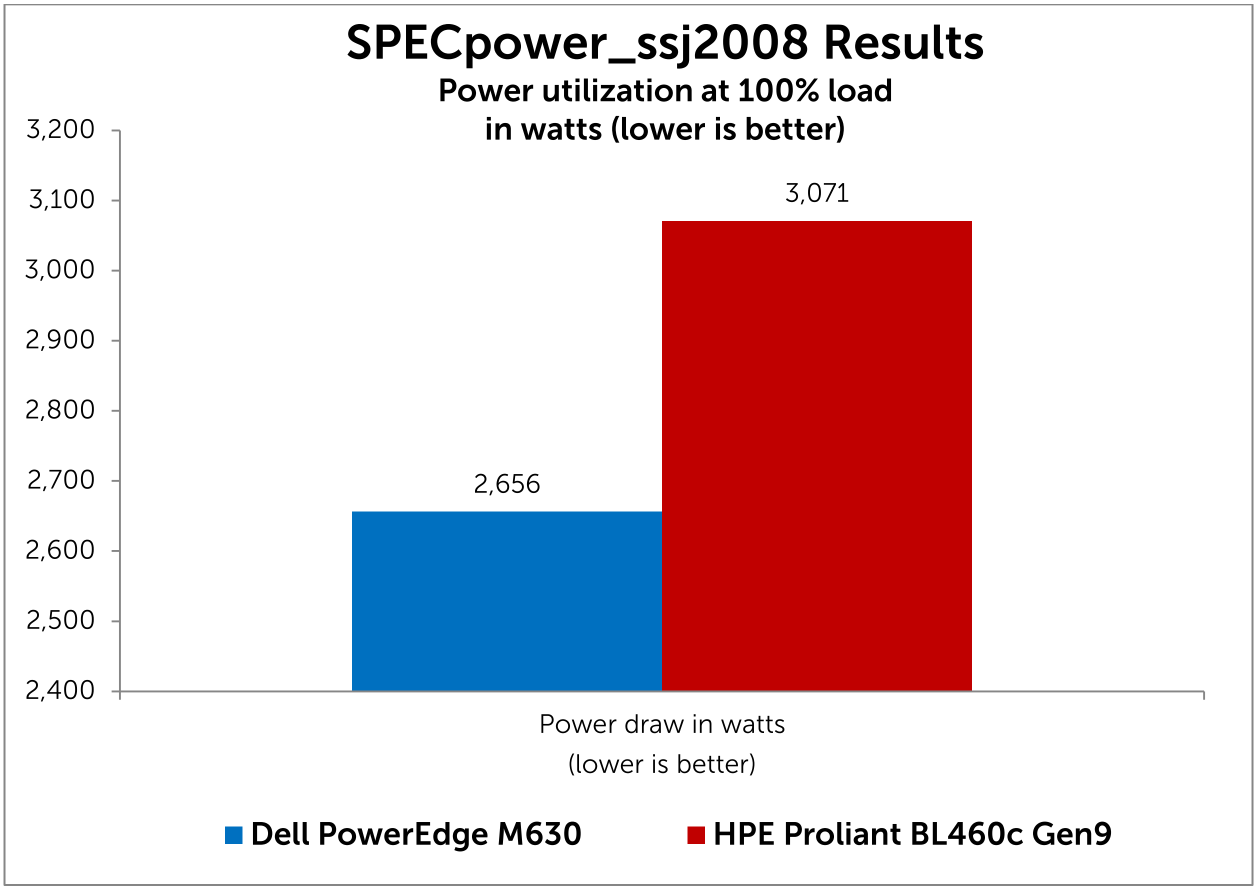


Figure 2 shows that the Dell PowerEdge blade solution has a significant power efficiency advantage over the HPE ProLiant blade solution at most target loads, including a 21% percent advantage at 100% target load and a 36% advantage at 10% load.

[1] Required SPEC disclosure information: PowerEdge M630 blade solution scores: (19,178,162 ssj_ops and 2,656 W) @ 100% target load and 6,013 overall ssj_ops/watt vs. ProLiant BL460c Gen9 blade solution scores: (18,372,379 ssj_ops and 3,071 W) @ 100% and 5,172 overall ssj_ops/watt. Comparison based on results by Dell Labs May 2016. SPEC® and the benchmark name SPECpower_ssj® are registered trademarks of the Standard Performance Evaluation Corporation. For more information about SPECpower, see www.spec.org/power_ssj2008/.

When IT professionals are calculating their data center needs, the maximum power draw of a solution is a critical component of the decision. This makes the power draw at the 100% load interval particularly important. At 100% target load, the Dell PowerEdge M630 blade solution drew only 2,656 Watts compared to HPE's ProLiant BL460c Gen9 blade solution which drew 3,071 Watts (16% more) under the same workload. Figure 3 shows the power draw of the solutions at the 100% load level.

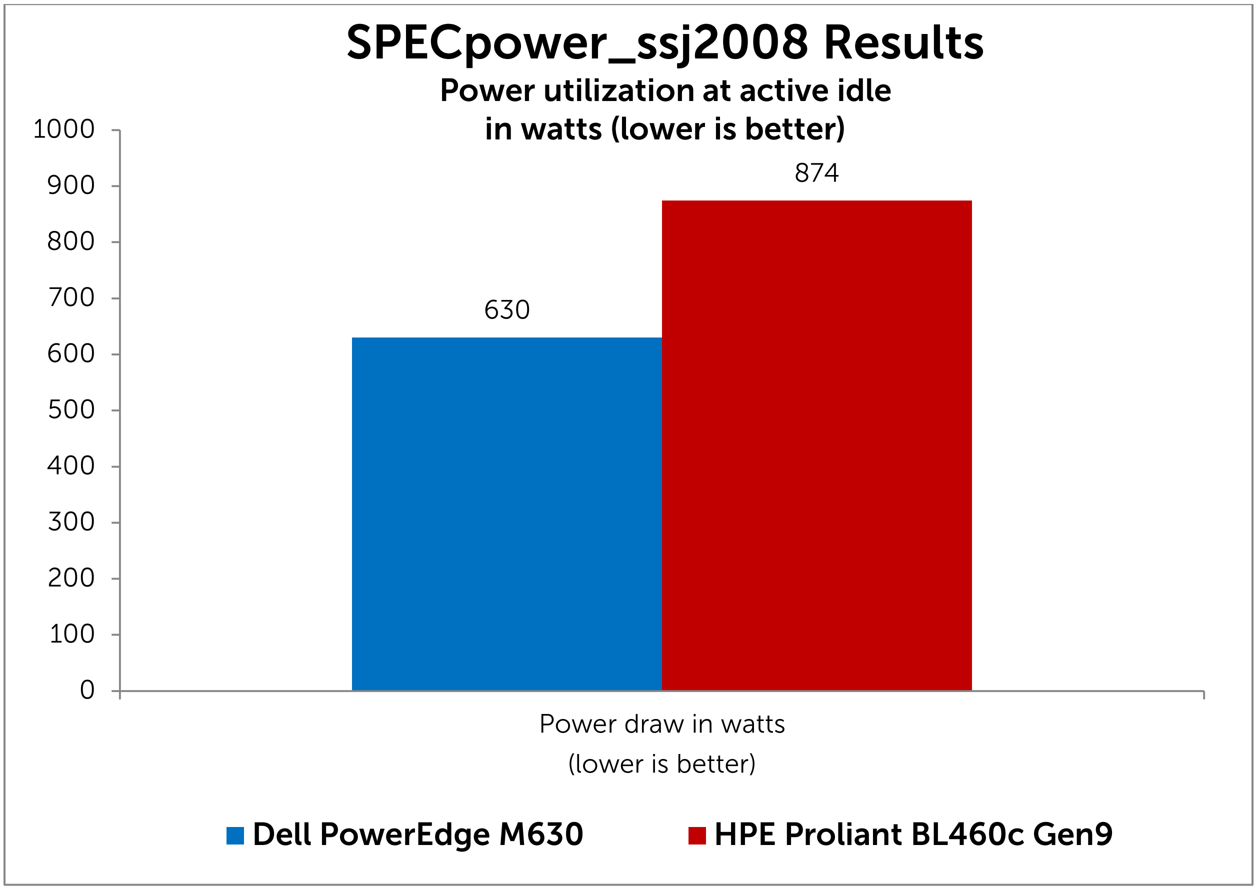
Figure 3: Power utilization at 100% target load[2]



[2] Required SPEC disclosure information: PowerEdge M630 blade solution scores: (19,178,162 ssj_ops and 2,656 W) @ 100% target load and 6,013 overall ssj_ops/watt vs. ProLiant BL460c Gen9 blade solution scores: (18,372,379 ssj_ops and 3,071 W) @ 100% and 5,172 overall ssj_ops/watt. Comparison based on results by Dell Labs May 2016. SPEC® and the benchmark name SPECpower_ssj® are registered trademarks of the Standard Performance Evaluation Corporation. For more information about SPECpower, see www.spec.org/power_ssj2008/.

SPECpower_ssj2008 also includes a measurement of power while the servers are at 0% target utilization (Active Idle). Average power utilization of the blade solutions at idle is shown in Figure 4. Compared to the Dell PowerEdge blade solution, the HPE ProLiant blade solution consumed 244 watts more (39% higher.)

Figure 4: Power utilization at active idle[3]



[3] Required SPEC disclosure information: PowerEdge M630 blade solution scores: (19,178,162 ssj_ops and 2,656 W) @ 100% target load and 6,013 overall ssj_ops/watt vs. ProLiant BL460c Gen9 blade solution scores: (18,372,379 ssj_ops and 3,071 W) @ 100% and 5,172 overall ssj_ops/watt. Comparison based on results by Dell Labs May 2016. SPEC® and the benchmark name SPECpower_ssj® are registered trademarks of the Standard Performance Evaluation Corporation. For more information about SPECpower, see www.spec.org/power_ssj2008/.

Summary

The results of the SPECpower_ssj2008 testing show that the Dell PowerEdge M630 blades have a 4% advantage in raw performance over the HPE blade solution based on BL460c Gen 9 blades. The Dell solution drew less power in most intervals, from 14% less at 100% load down to 28% lower at active idle. This led the Dell solution to have 16% higher overall power efficiency than the similarly configured HPE solution.

As energy costs rise, power efficiency becomes an increasingly important factor in the decision to purchase these important data center components. The higher performance per watt ratio of the blade solution based on Dell PowerEdge M630 blades makes it a compelling addition to the datacenter compared to the solution from HPE.

Appendix A — Test methodology

SPECpower_ssj2008 standard

SPECpower_ssj2008 is an industry standard benchmark created by the Standard Performance Evaluation Corporation (SPEC) to measure a server's power and performance across multiple utilization levels. 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 (server side Java operations per second) divided by the power used in watts (ssj_ops per watt). SPEC created SPEcpower_ssj2008 for those who want to accurately measure the power consumption of their server in relation to the performance that the server is capable of achieving with ssj2008 workload.

SPECpower_ssj2008 consists of three main software components:

- **Server Side Java (SSJ) Workload**—Java database that stresses the processors, caches and memory of the system, as well as software elements, such as operating system elements and the Java implementation chosen to run the benchmark.
- **Power and Temperature Daemon (PTDaemon)**—Program that controls and reports the power analyzer and temperature sensor data.
- **Control and Collect System (CCS)**—Java program that coordinates the collection of all the data.

For more information on how SPECpower_ssj008 works, see http://www.spec.org/power_ssj2008/.

All results discussed in this whitepaper are from *compliant runs* in SPEC terminology, which means that although they have not been submitted to SPEC for review, Dell can disclose them for the purpose of this study. All configuration details required to reproduce these results are listed in Appendices A, B, and C; all result files from the runs compared are included in Appendix D — SPECpower_ssj2008 results.

All servers were configured by installing a fresh copy of Microsoft Windows Server 2008 Enterprise R2 (Service Pack 1) and the operating system install with a single drive RAID 0, choosing the *full installation* option for each.

The latest driver and firmware update packages available were installed to all servers at the beginning of this study. Refer to Appendix B — Blade enclosure hardware configuration information for details.

BIOS settings

Available BIOS settings differed between the two manufacturers. Rather than experiment with each setting to evaluate its effect on performance per watt, each blade was tested as it was shipped from the factory, with default settings. This configuration more closely mimics a typical customer deployment in most situations.

For both servers, Snoop mode was set to Opportunistic Snoop Broadcast, Intel Turbo Boost was enabled by default, and memory speed was left at the default value of 2400 MHz. Prefetchers built into the Intel Xeon E5-2660 processors were left on for all three blade models. Both systems defaulted to handling their own power management rather than leaving that function to the operating system.

For the Dell PowerEdge M630 blades, the following default settings were used:

- Adjacent Cache Line Prefetch enabled
- Hardware Prefetcher enabled
- DCU Streamer Prefetcher enabled
- DCU IP Prefetcher enabled

- System Profile set to Performance Per Watt (DAPC)
- Turbo Boost enabled
- C1E Enabled
- C States enabled
- Memory Patrol Scrub set to Standard
- Memory Refresh Rate set to 1x

For the HP ProLiant BL460c Gen8 blades, the following default settings were used:

- HP Power Regulator set to HP Dynamic Power Savings Mode
- Energy/Performance Bias set to Balanced Performance
- Minimum Processor Idle Power Core State set to C6 State
- Minimum Processor Idle Power Package State set to Package C6 (retention) State
- HW Prefetch Enabled in BIOS
- Adjacent Sector Prefetch Enabled in BIOS
- DCU Stream Prefetcher Enabled in BIOS
- DCU IP Prefetcher Enabled in BIOS
- Dynamic Power Savings Mode Response set to Fast in BIOS
- Collaborative Power Control Enabled in BIOS
- Intel Turbo Boost enabled

Operating system tuning

To improve Java performance, large pages were enabled by entering **Control Panel>Administrative Tools>Local Security Policy>Local Policies>User Rights Assignment>Lock Pages in Memory**. An option was changed to add Administrator. Operating System Power Management mode for all blades was left at the default **Balanced Mode.**

All servers were configured with separate IP addresses on the same subnet as the SPECpower_ssj2008 controller system where the Director, CCS, and PTDaemon components were located, and connected all servers at 1GbE network speed through their onboard I/O module and into their external top-of-rack switch.

SPECpower_ssj2008 configuration

The Oracle Hotspot Java Virtual Machine (JVM)[4] was used for all solutions.

The following JVM options were used on all blade servers.

```
-server -Xmx13g -Xms13g -Xmn11g -XX:SurvivorRatio=1 -XX:TargetSurvivorRatio=99 -
XX:ParallelGCThreads=28 -XX:AllocatePrefetchDistance=256 -
XX:AllocatePrefetchLines=4 -XX:LoopUnrollLimit=45 -XX:InitialTenuringThreshold=12 -
XX:MaxTenuringThreshold=15 -XX:InlineSmallCode=9000 -XX:MaxInlineSize=270 -
XX:FreqInlineSize=6000 -XX:+UseLargePages -XX:+UseParallelOldGC -XX:+AggressiveOpts
```

The following binding was used to ensure that each of the 2 JVMs ran on 28 logical processors:

```
start /affinity [FFFFFFF]
```

[4] Oracle Java HotSpot 64-Bit Server VM (build 24.80-b11, mixed mode), version 1.7.0_80

Power and temperature configuration

Yokogawa WT210 Digital Power Meters were used for the actual power measurements of the servers, as this is the most commonly used analyzer for SPECpower_ssj2008 publications at the time that this study was conducted. The WT210 units used were each calibrated less than a year prior to the test date to ensure accurate power consumption measurements.

To ensure a fair comparison, the systems were mounted near each other in the test racks, and inlet temperature was measured at the front of each system during their runs using a Digi International Watchport/H temperature probe. As the attached Power Temperature Details reports show, the three solutions were run in environments with a temperature difference of less than 1 degree Celsius.

Appendix B — Blade enclosure hardware configuration information

Table 4: Blade enclosure hardware configuration information

	Dell blade solution	HPE blade solution
Enclosure	PowerEdge M1000e	BladeSystem c7000
Enclosure management module	1 x Dell CMC Module	1 x HP Onboard Administrator module
Enclosure management firmware	CMC 5.01	Onboard Administrator 4.50
Internal I/O module	1 x Dell 16 Port 1Gb Ethernet Pass-Through Module	1 x HPE 16 Port 1Gb Ethernet Pass-Thru Module
Internal IOM firmware	11.0.0.0	3.03
Power supply quantity/rating	3 x 3000W	3 x 2400W

Appendix C — Blade server firmware and drivers

Table 5: Blade server firmware and drivers

Driver/firmware versions	PowerEdge M630	ProLiant BL460c Gen9
System BIOS	2.0.1	2.0.0
Network drivers	7.4.23.2	7.4.14.0
Network firmware	7.12.19	7.12.83
HBA firmware	25.2.1.0037	3.56
HBA drivers	6.600.21.8	6.46.0.64
Video driver	6.3.9600.16384	4.1.2.2
Integrated management controller firmware	iDRAC8 2.30.30.30	2.40
Management controller driver	N/A	3.9.0.0

Appendix D – SPECpower_ssj2008 results

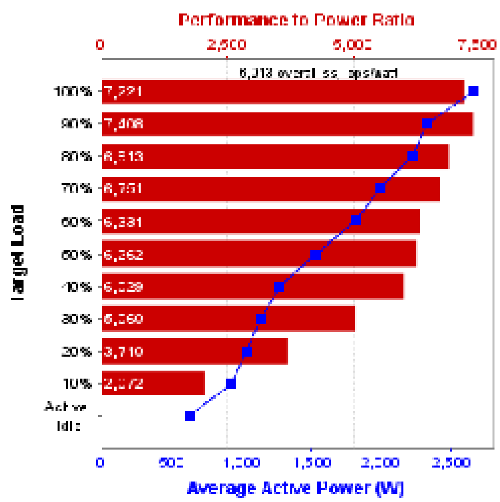
Figure 5: SPECpower_ssj2008 results for Dell PowerEdge M630 blade solution

SPECpower_ssj2008

Dell Inc. PowerEdge M630 (Intel Xeon E5-2660 v4, 2.00 GHz)				SPECpower_ssj2008 = 6,013 overall ssj_ops/watt	
Test Sponsor:	Dell Inc.	SPEC License #:	55	Test Method:	Multi Node
Tested By:	Dell Inc.	Test Location:	Round Rock, TX, USA	Test Date:	May 20, 2016
Hardware Availability:	Mar-2016	Software Availability:	Apr-2015	Publication:	Unpublished
System Source:	Single Supplier	System Designation:	Server	Power Provisioning:	Line-powered

Benchmark Results Summary

Performance			Power	
Target Load	Actual Load	ssj_ops	Average Active Power (W)	Performance to Power Ratio
100%	100.1%	19,178,162	2,656	7,221
90%	90.0%	17,233,268	2,326	7,408
80%	79.9%	15,309,479	2,215	6,913
70%	70.1%	13,421,003	1,988	6,751
60%	60.0%	11,494,640	1,816	6,331
50%	50.0%	9,569,349	1,528	6,262
40%	40.0%	7,666,215	1,271	6,029
30%	30.0%	5,739,772	1,134	5,060
20%	20.0%	3,830,355	1,033	3,710
10%	10.0%	1,920,523	927	2,072
Active Idle		0	630	0
			∑ssj_ops / ∑power =	6,013



Aggregate SUT Data

# of Nodes	# of Chips	# of Cores	# of Threads	Total RAM (GB)	# of OS Images	# of JVM Instances
8	16	224	448	1,024	8	16

System Under Test

Shared Hardware

Shared Hardware	
Enclosure:	Dell PowerEdge M1000e
Form Factor:	10U
Power Supply Quantity and Rating (W):	3 x 3000
Power Supply Details:	Dell P/N: 8V4DK
Network Switch:	Dell PowerConnect 6248
Network Switch Details:	48 Port 1Gb Ethernet Switch
KVM Switch:	None
KVM Switch Details:	N/A
Other Hardware:	Dell M1000e Chassis Management Controller, Dell P/N: JV95D; Dell 16-Port Gigabit Ethernet Pass-Through Module
Comment:	Network switch not measured for power

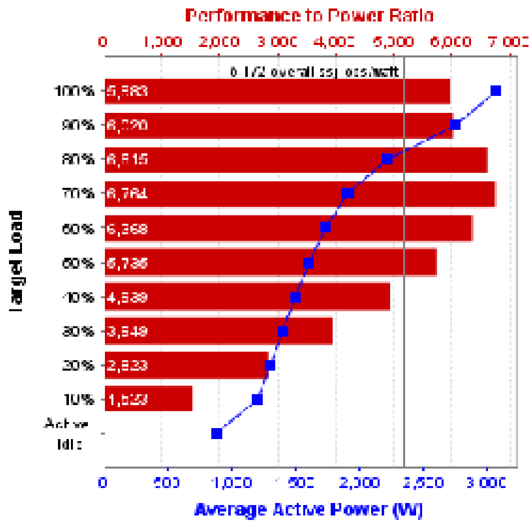
Figure 6: SPECpower_ssj2008 results for HPE ProLiant BL460c Gen9 blade solution

SPECpower_ssj2008

Hewlett Packard Enterprise Proliant BL460c Gen9 (Intel Xeon E5-2660 v4, 2.00 GHz)				SPECpower_ssj2008 = 5,172 overall ssj_ops/watt	
Test Sponsor:	Dell Inc.	SPEC License #:	55	Test Method:	Multi Node
Tested By:	Dell Inc.	Test Location:	Round Rock, TX, USA	Test Date:	May 16, 2016
Hardware Availability:	Mar-2016	Software Availability:	Apr-2015	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%	99.8%	18,372,379	3,071	5,983
90%	90.0%	16,576,309	2,753	6,020
80%	80.0%	14,722,874	2,226	6,615
70%	70.0%	12,885,499	1,905	6,764
60%	60.0%	11,057,875	1,736	6,368
50%	50.0%	9,211,622	1,606	5,735
40%	40.0%	7,368,876	1,492	4,939
30%	30.0%	5,517,084	1,397	3,949
20%	20.0%	3,684,952	1,305	2,823
10%	10.0%	1,841,922	1,209	1,523
Active Idle		0	874	0
			∑ssj_ops / ∑power =	5,172



Aggregate SUT Data

# of Nodes	# of Chips	# of Cores	# of Threads	Total RAM (GB)	# of OS Images	# of JVM Instances
8	16	224	448	1,024	8	16

System Under Test

Shared Hardware

Shared Hardware	
Enclosure:	HPE Bladesystem c7000 Enclosure
Form Factor:	10U
Power Supply Quantity and Rating (W):	3 x 2400
Power Supply Details:	HPE P/N:570493-101
Network Switch:	Dell PowerConnect 6248
Network Switch Details:	48 Port 1Gb Ethernet Switch
KVM Switch:	None
KVM Switch Details:	N/A
Other Hardware:	BladeSystem c7000 DDR2 Onboard Administrator with KVM, HP P/N: 456204-B21; HPE 16 Port 1Gb Ethernet Pass-Thru Module
Comment:	Network switch not measured for power