Power Efficiency Comparison of Dell™ and Cisco High Memory Capacity Blade Servers

This Dell test report analyzes the performance and performance per watt of high memory capacity blade solutions from Dell using the Dell PowerEdge™ M620 and M710HD compared to the Cisco UCS B250 M2.

Brian Bassett

Solutions Performance Analysis

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Executive summary

In March 2012, Dell Inc. commissioned its Solutions Performance Analysis team to compare the performance and power efficiency of four-blade solutions using three choices of blades: the Cisco UCS B250 M2, Dell PowerEdge M710HD, and the recently announced PowerEdge M620. To represent configurations common for applications such as virtualization with heavy system memory requirements, each blade in all three solutions had 192 GB of system memory installed.

Each solution had four blade servers, one blade enclosure with one I/O module and the maximum installable power supplies, and one 10Gb top-of-rack switch.

Key findings

Performance / watt

The higher performance and lower power draw of the four-blade Dell solutions compared to the UCS B250 M2 blade solution led to the **PowerEdge M710HD solution's 76% higher performance per watt score** and the **PowerEdge M620 solution's 108% higher performance per watt score**.

Power at Idle

Even with all blades configured with the same amount of system memory, the four-blade **PowerEdge M710HD** solution consumed **58% as much power at idle** as the four-blade **UCS B250 M2** solution with its extra DIMMs and supporting circuitry. Similarly, the four-blade **PowerEdge M620 blade solution drew just 55% as much power at idle** as the Cisco blade solution.

Power at 100% Load

Both of the four-blade PowerEdge solutions, again with the same amount of system memory installed per blade, **drew 64% to 67% as much power as the four-blade Cisco UCS B250 M2 blade solution** with all blades running at 100% load.

Performance

With the same processor models and the same memory capacity installed in each blade, the four-blade solution based on **PowerEdge M710HD blades provided up to 11% higher performance** than the four-blade solution based on UCS B250 M2 blades, and the four-blade solution based on **PowerEdge M620 blades provided up to 25% higher performance** than the UCS blade solution.

Rack density

When the 10U M1000e Modular Blade Enclosure is equipped with its maximum of sixteen M710HD or M620 servers, the solution can fit 1.6 servers per rack unit of space, 2.4 times as dense as the solution with Cisco UCS B250 M2 blades.

Cost

In the configuration tested, the Cisco UCS B250 M2 blade solution costs $112,591.02[1], while the similarly configured **Dell PowerEdge M710HD solution costs 34% less** at $73,820.00 [2], and the **PowerEdge M620 solution costs 33% less** at $75,372.00[3].

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[1] Source: Quote from Cisco authorized reseller, February 22, 2012. Price is in U.S. dollars.
[2] Source: Quote from www.dell.com, February 21, 2012. Price is in U.S. dollars.
[3] Source: Quote from www.dell.com, February 21, 2012. Price is in U.S. dollars.

Introduction

In order to compare the power efficiency of blade servers with high memory capacities installed, a Cisco blade solution was assembled using four UCS B250 M2 blades (each with 192 GB of system memory installed) and associated blade infrastructure. This solution was then measured for performance and performance / watt using the industry-standard SPECpower_ssj2008 benchmark. For comparison purposes, a similar Dell blade infrastructure was assembled and tested, first using four PowerEdge M710HD blades, and then using four PowerEdge M620 blades. Each blade in the PowerEdge solutions also had 192 GB of system memory installed. In all three cases, the entire blade infrastructure including the external network switch was included in the power measurements.

The Cisco UCS 5108 Blade Server Chassis has eight blade slots, all of which are full with the four double-width UCS B250 M2 blades installed. The Dell PowerEdge M1000e blade enclosure has sixteen blade slots, so with four blade servers installed in the tested configurations, both Dell blade solutions have twelve slots open for future expansion.

Table 1. Blade enclosure configuration details

Chassis	Cisco UCS 5108 Blade Server Chassis	Dell PowerEdge M1000e Modular Blade Enclosure
Blade slots per chassis	8	16
Power supply quantity and rating	4 x 2500W	6 x 2700W
I/O	1 x UCS 2104XP Fabric Extender	1 x M8024-k 10GbE Switch Module
External network switch	UCS 6120XP 20-Port Fabric Interconnect	PowerConnect 8024F Switch
Management	Cisco UCS Manager	Dell CMC Module

As Table 1 shows, the infrastructure needed for the blade solutions was configured as similarly as possible given the differences between the two blade enclosures. In the UCS setup, the external network switch hosts the Cisco UCS Manager and is a required part of the solution, so in all three solutions, the external network switch was included in power measurements.

Table 2. Blade server details

Blade Component	Cisco UCS B250 M2	Dell PowerEdge M710HD	Dell PowerEdge M620
Blade server form factor	Double-width (consumes two chassis slots per blade)	Single-height (consumes one chassis slot per blade)	Single-height (consumes one chassis slot per blade)
Blades per solution	4	4	4
Empty chassis slots for expansion	0	12	12
Processor sockets / blade	2	2	2
Processors / blade	2 x Intel Xeon X5675 (3.06 GHz)	2 x Intel Xeon X5675 (3.06 GHz)	2 x Intel E5-2660 (2.2 GHz)
Processor power (TDP)	95W	95W	95W
Physical / logical processor cores / solution	48 / 96	48 / 96	64 / 128
Memory configuration / blade	48 x 4GB Dual Ranked PC3L-10600R LV RDIMMs	12 x 16GB Dual Ranked PC3-12800R LV RDIMMs	12 x 16GB Dual Ranked PC3-12800R RDIMMs
Memory capacity / blade	192 GB	192 GB	192 GB
Installed memory / solution	768 GB	768 GB	768 GB
Hard Drives Per Blade	2 x 73GB 15k 6Gb RAID 1	2 x 73GB 15k 6Gb RAID 1	2 x 73GB 15k 6Gb RAID 1
Storage Controller	LSI SAS30813E-R	Dell PERC H200	Dell PERC H310

Table 2 shows the configuration information for the four blades used in each blade solution. As with the blade enclosures detailed in Table 1, the blades themselves were configured as closely as possible to each other given the architectural differences.

The four blades ("nodes" in SPECpower_ssj2008 terminology) in each solution were each configured with two 95W processors, two 73GB hard drives, and dual 10Gb network ports installed. The Cisco B250 M2 blades with Extended Memory Technology achieved their 192GB of system memory using forty-eight 4GB DIMMs each, while the PowerEdge M710HD and M620 blades achieved the same memory capacity per blade using twelve 16GB DIMMs each.

PowerEdge M620 blades used for the comparisons were equipped with 16GB standard voltage 1600 MHz DIMMs, which are only available on systems with Intel Xeon E5-series processors. If the extra memory bandwidth provided by 1600 MHz DIMMs is not needed, the M620 can be configured with 16 GB 1333 MHz low voltage DIMMs like those used in the M710HD blades in the comparisons.

In Comparison 1, which is detailed below, the memory in each blade was configured to run at 1333 MHz to make the configurations as comparable as possible. For Comparison 2, each blade was configured with its memory set to 1067 MHz and the test was run again to examine what differences this setting made to relative performance and power efficiency of the three blade solutions.

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. It should be noted that Dell has published many results using this benchmark[4], while Cisco, at the time of writing, has published none.[5]

Appendix A details the test methodology, Appendices B and C provide detailed configuration for the tests, and Appendix D provides detailed report data that supports the results in this paper.

Comparison 1: Blade solution power efficiency with 1333 MHz memory

In Comparison 1, the blades in all three solutions were configured with 192 GB of memory running at 1333 MHz. The Cisco UCS B250 M2 was configured with all 48 DIMM slots occupied with 4GB low-voltage DIMMs. The PowerEdge M710HD and M620 blades were configured with 12 DIMM slots occupied by 16GB DIMMs, so all blades in the comparison had 192GB of memory installed.

In this comparison, the memory in the Cisco UCS C25 M2 blades was set to Performance Mode. This mode sets the UCS B250 M2's memory to run at 1333 MHz, but also disables Low Voltage memory operation and forces system memory to run at 1.5 volts.

The memory in the PowerEdge M710HD blades was also set to 1333 MHz, but LV-DIMMs installed in the M710HD can operate in low-voltage mode at that speed, so its memory was left at the default 1.35 volts. Finally, the standard voltage memory in the PowerEdge M620 blades was set to run at 1333 MHz and 1.5 volts.

Memory configurations for Comparison 1 are summarized in Table 3 below.

Table 3. Comparison 1 memory configuration

Comparison 1 memory config	Cisco UCS B250 M2	Dell PowerEdge M710HD	Dell PowerEdge M620
Memory configuration per blade	48 x 4GB Dual Ranked PC3L-10600R LV RDIMMs	12 x 16GB Dual Ranked PC3-12800R LV RDIMMs	12 x 16GB Dual Ranked PC3-12800R RDIMMs
Installed memory capacity per blade	192 GB	192 GB	192 GB
Memory speed (Actual / Max)	1333 / 1333 MHz	1333 / 1333 MHz	1333 / 1600 MHz
Memory voltage	1.5 V[6]	1.35 V	1.5 V

[4] Dell SPECpower results at www.spec.org.
[5] Cisco SPECpower results at www.spec.org.
[6] When the memory subsystem in the B250 M2 blades is configured for Performance (1333 MHz) mode, the low voltage DIMMs are forced to standard voltage mode (1.5 volts).

Figure 1. As seen in Comparison 1 Normalized Results

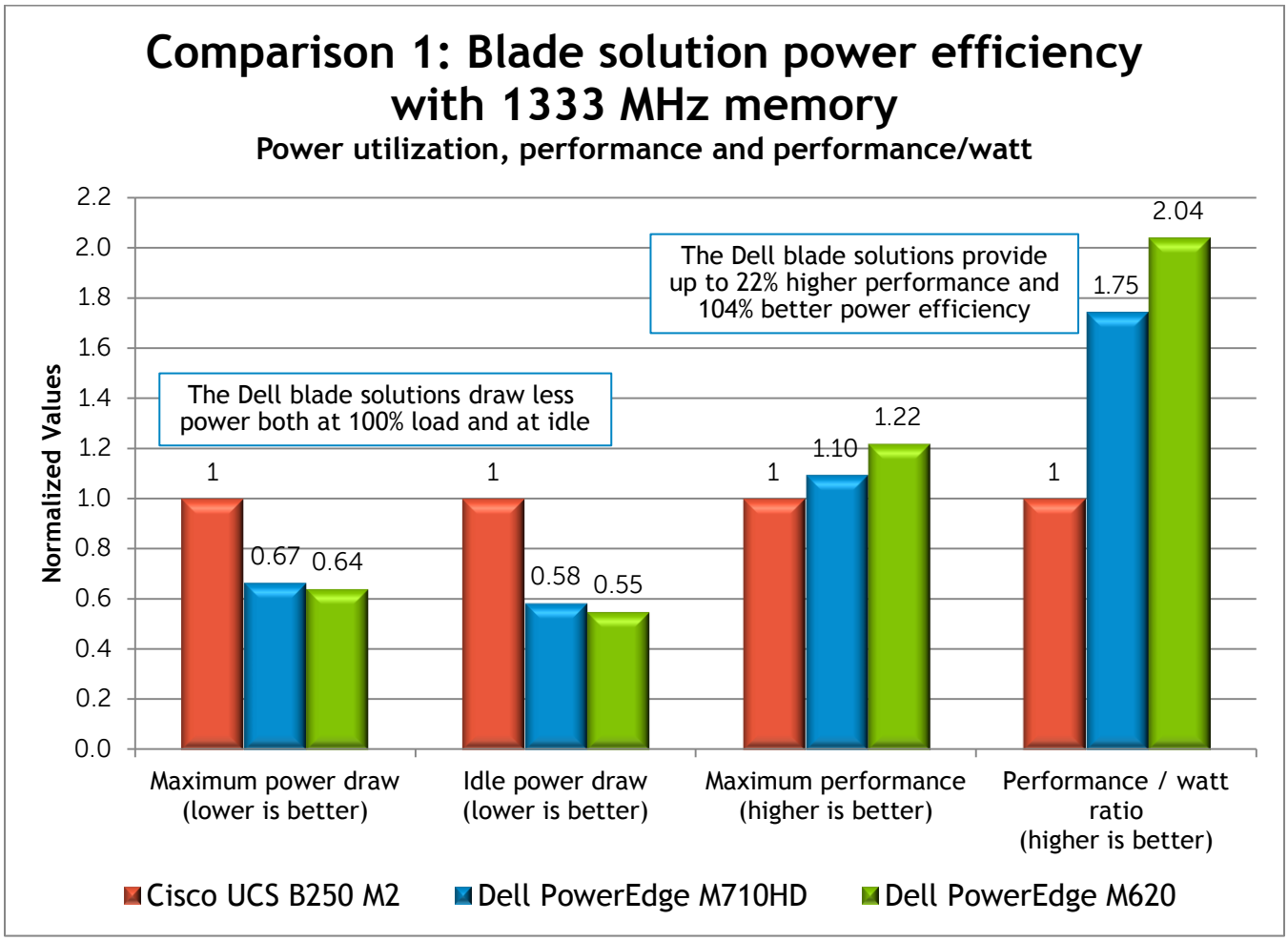
below, the Dell blade solutions have a distinct advantage over the Cisco blade solution in power draw both at idle and at 100% target load, with the PowerEdge M620 solution drawing only 55% as much power as the Cisco B250 M2 when both blade solutions were idle.

Compared to the four-blade UCS B250 M2 solution, aggregate performance at 100% target load was 10% higher with the four-blade PowerEdge M710HD solution. The Cisco solution's proprietary Extended Memory Technology can have a negative impact on performance, as also seen with the UCS C250 M2 rack server[7].

The performance of the PowerEdge M620 blade solution with 95-watt E5-series processors is even higher, with an aggregate score 22% higher than of that of the UCS B250 M2 blade solution.

The higher performance of the PowerEdge M710HD and M620 solutions combined to give them a 75% and 104% advantage, respectively, in overall performance per watt ratio compared to the UCS B250 M2 blade solution.

Figure 2. Comparison 1 Normalized Results

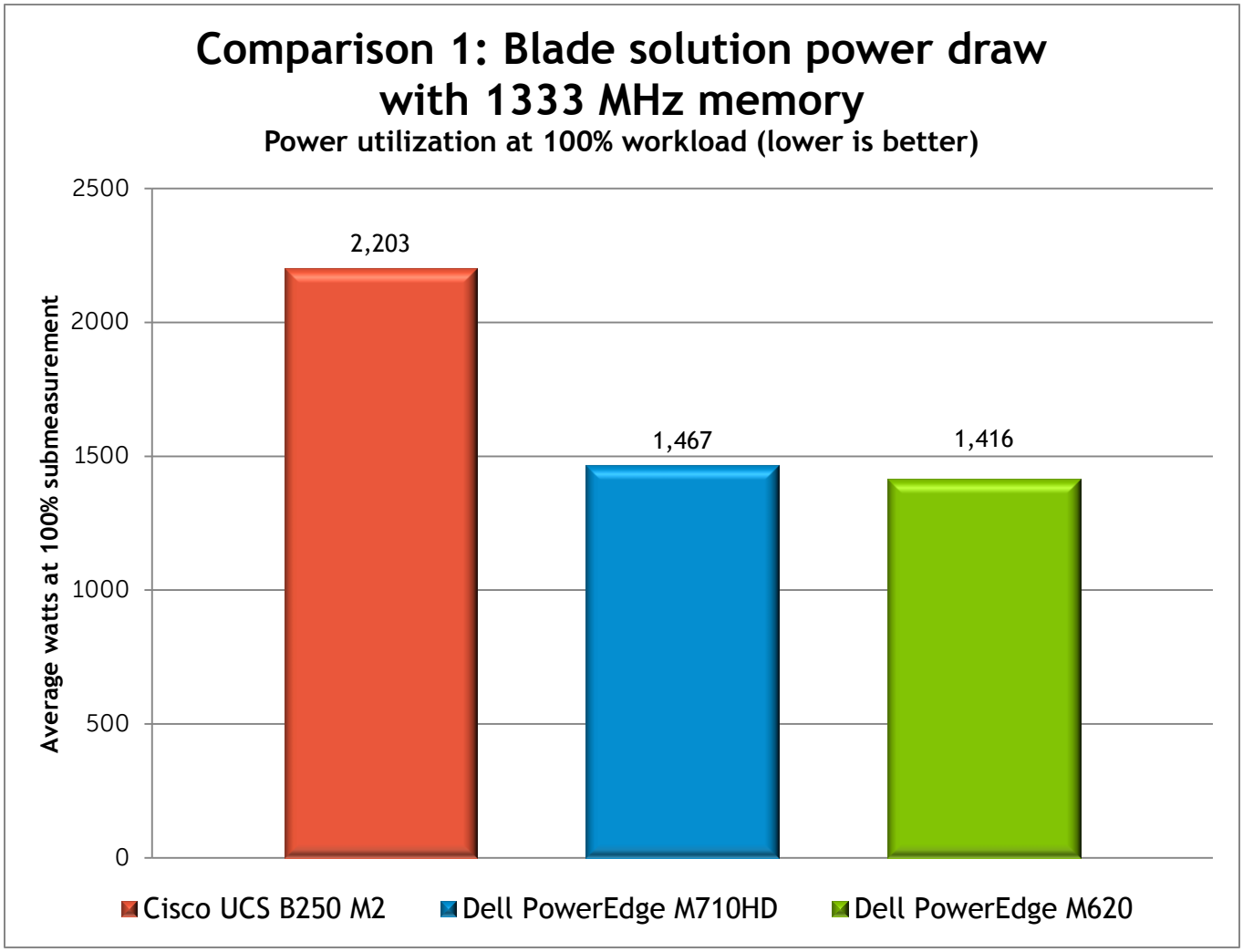


[7] Comparison of UCS C250 M2 and PowerEdge R710 rack servers.

Figure 3 below shows the power utilization of each four-blade solution when running at 100% target load. The Cisco solution draws 736 watts more than the M710HD solution, and 787 more watts than the M620 blade solution, even though each of the three solutions have four similarly configured servers[8].

The UCS B250 M2 blade solution had higher power draw than both PowerEdge solutions at the 100% load level, at idle, and all measured points between.

Figure 3. Comparison 1 power utilization at 100% load

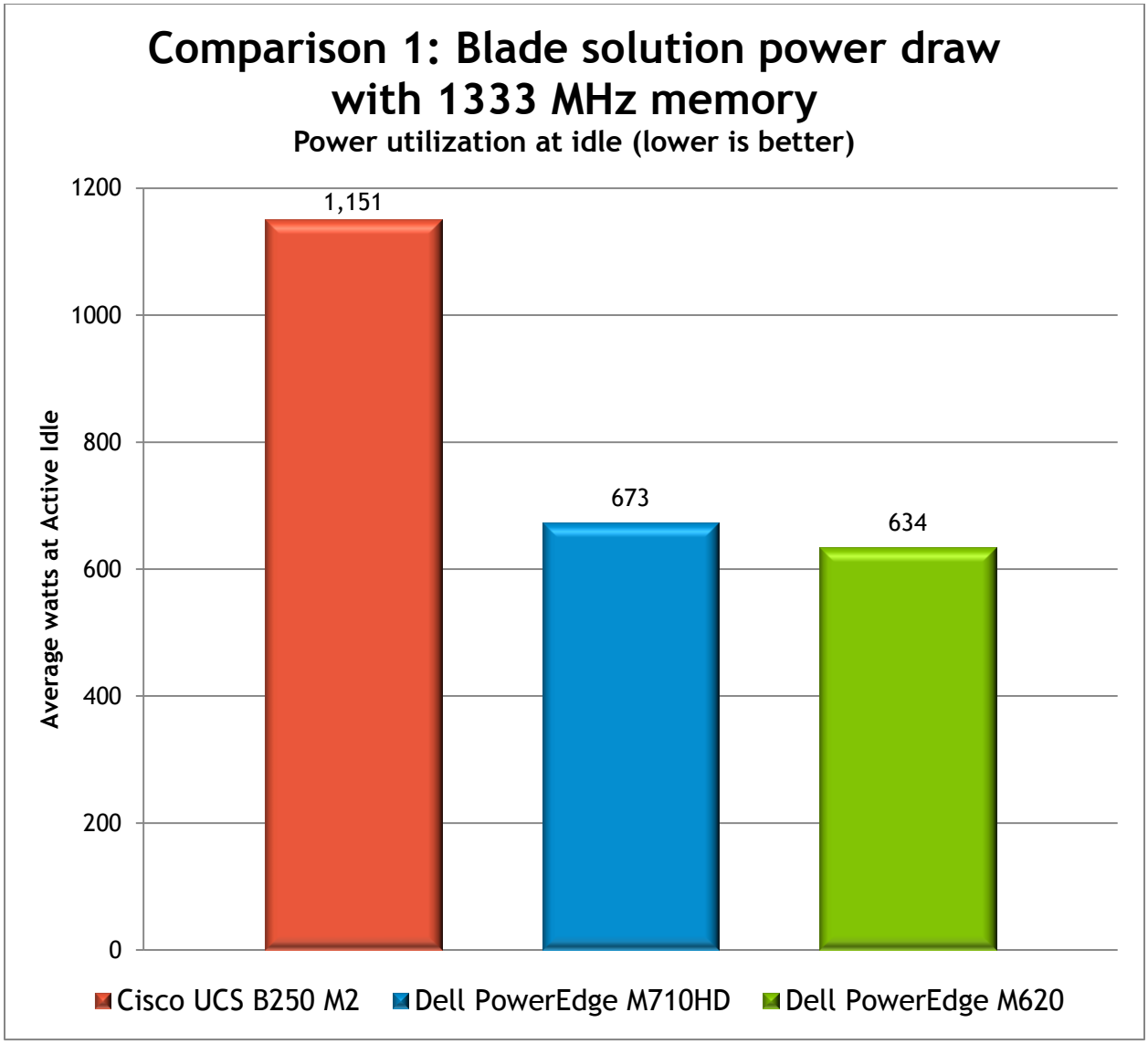


[8] Required SPEC.org disclosure for Comparison 1:

- The 4-node UCS B250 M2 solution scores (3,419,587 ssj_ops and 2,203 W) @ 100% target load for a SPECpower_ssj2008 overall ssj_ops / watt of 1,006.
- The 4-node PowerEdge M710HD achieved (3,749,443 ssj_ops and 1,467 W) @ 100% target load for a SPECpower_ssj2008 overall ssj_ops / watt of 1,756.
- The 4-node PowerEdge M620 achieved (4,175,133 ssj_ops and 1,416 W) @ 100% target load for a SPECpower_ssj2008 overall ssj_ops / watt of 2,054.

Figure 4 below shows each of the four-blade solutions' power draw during the Active Idle phase of the SPECpower_ssj2008 benchmark. The four-blade B250 M2 solution draws 478W more than the four-blade M710HD solution and 517W more than the four-blade M620 solution.[9]

Figure 4. Comparison 1 power utilization at idle



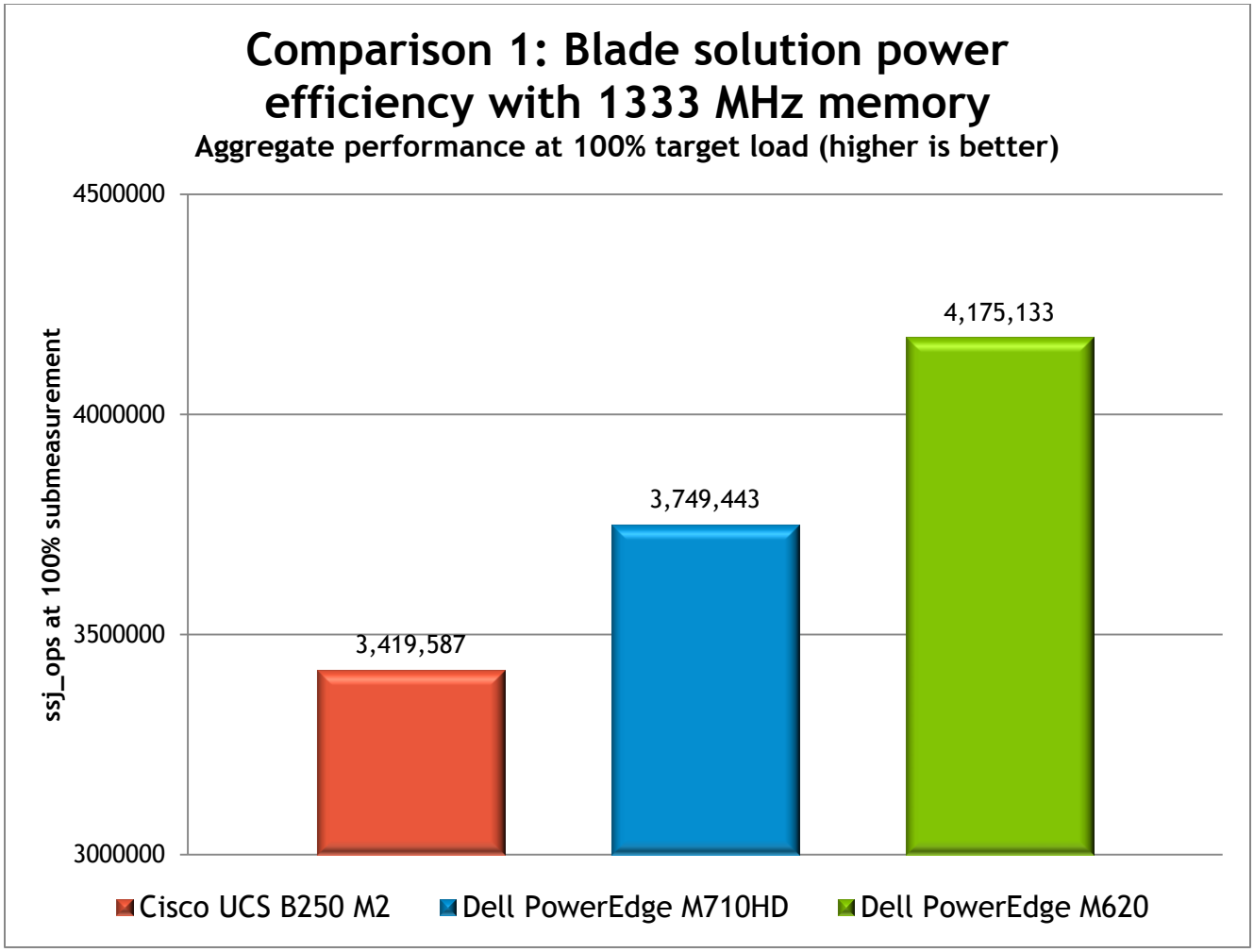
[9] Required SPEC.org disclosure for Comparison 1:

- The 4-node UCS B250 M2 solution scores (3,419,587 ssj_ops and 2,203 W) @ 100% target load for a SPECpower_ssj2008 overall ssj_ops / watt of 1,006.
- The 4-node PowerEdge M710HD achieved (3,749,443 ssj_ops and 1,467 W) @ 100% target load for a SPECpower_ssj2008 overall ssj_ops / watt of 1,756.
- The 4-node PowerEdge M620 achieved (4,175,133 ssj_ops and 1,416 W) @ 100% target load for a SPECpower_ssj2008 overall ssj_ops / watt of 2,054.

Figure 5 below shows each solution's aggregate performance, computed by totaling the ssj_ops of each of that solution's four blades at the 100% target load level. The blade servers in the UCS B250 M2 and PowerEdge M710HD solutions both use Intel Xeon model X5675 processors, and each blade of both solutions has 192GB of system memory installed, but the M710HD solution's aggregate performance is 10% higher in this comparison. The UCS B250 M2 solution's lower performance has also been measured on the Cisco UCS C250 M2 rack server, and is further compounded by the inability through the UCS Manager to manually change a certain BIOS parameter on the B250 M2 blades (see Appendix A).

The additional cores and greater per core efficiency of the E5-2660 processors used in the four-blade PowerEdge M620 solution lead to its 22% higher aggregate performance than the four-blade UCS B250 M2 solution.[10]

Figure 5. Comparison 1 aggregate performance at 100% target load



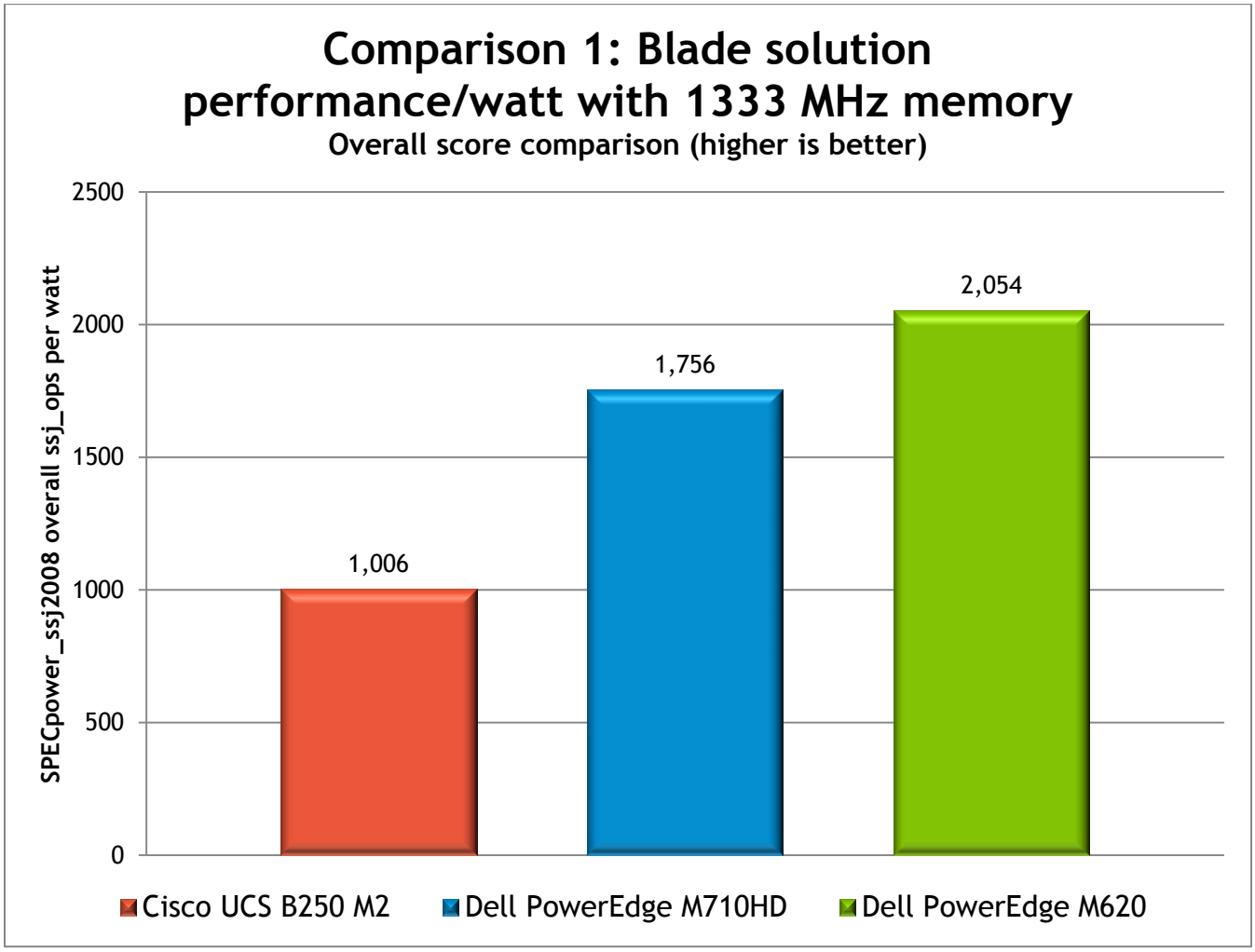
[10] Required SPEC.org disclosure for Comparison 1:

- The 4-node UCS B250 M2 solution scores (3,419,587 ssj_ops and 2,203 W) @ 100% target load for a SPECpower_ssj2008 overall ssj_ops / watt of 1,006.
- The 4-node PowerEdge M710HD achieved (3,749,443 ssj_ops and 1,467 W) @ 100% target load for a SPECpower_ssj2008 overall ssj_ops / watt of 1,756.
- The 4-node PowerEdge M620 achieved (4,175,133 ssj_ops and 1,416 W) @ 100% target load for a SPECpower_ssj2008 overall ssj_ops / watt of 2,054.

Figure 6 below shows the overall SPECpower_ssj2008 performance / watt scores of the three four-blade solutions. The higher power draw of the Cisco solution with four B250 M2 blades, combined with that solution's lower aggregate performance, lead to an overall score of 1,006 ssj_ops / watt, compared to 1,756 ssj_ops / watt for the solution with four M710HD blade servers.

The difference is even greater when compared to the solution with four M620 blades with the higher performing and more power efficient E5-2600 series processors. That solution achieved a score of 2054 ssj_ops / watt, or more than twice the score of the Cisco solution.

Figure 6. Comparison 1 overall performance / watt scores



Comparison 1 Summary

Cisco's Extended Memory Technology is claimed to provide improvements to performance and power efficiency. As shown with results of the SPECpower_ssj2008 benchmark, however, the solution with four UCS B250 M2 blade servers provides lower aggregate performance and significantly higher power draw at all tested load levels compared to the solution with four similarly-configured PowerEdge M710HD blade servers. These factors combine to give the four-blade M710HD solution a 75% lower performance / watt ratio than the Cisco solution in this comparison.

The solution based on four of the recently introduced M620 blades achieves an even greater performance and power efficiency advantage, giving it more than twice the power efficiency score of the Cisco solution.

Comparison 2: Blade solution power efficiency at 1067 MHz memory speed

The Cisco UCS B250 M2 blades are able to run LV-DIMMs at the low voltage 1.35 volt setting only when memory is set to Power Saving Mode, which also runs all system memory at 1067 MHz. For Comparison 2 this mode was selected for the UCS B250 M2 blades.

The PowerEdge M710HD can run low voltage DIMMs at 1.35 volts while keeping its system memory at 1333 MHz, but in the interest of configuring the three solutions as closely as possible, for Comparison 2 the PowerEdge M710HD also had its system memory set to 1067 MHz. The 1600 MHz DIMMs used in the PowerEdge M620 blade solution run at 1.5 volts, and were also clocked down to 1067 MHz for Comparison 2.

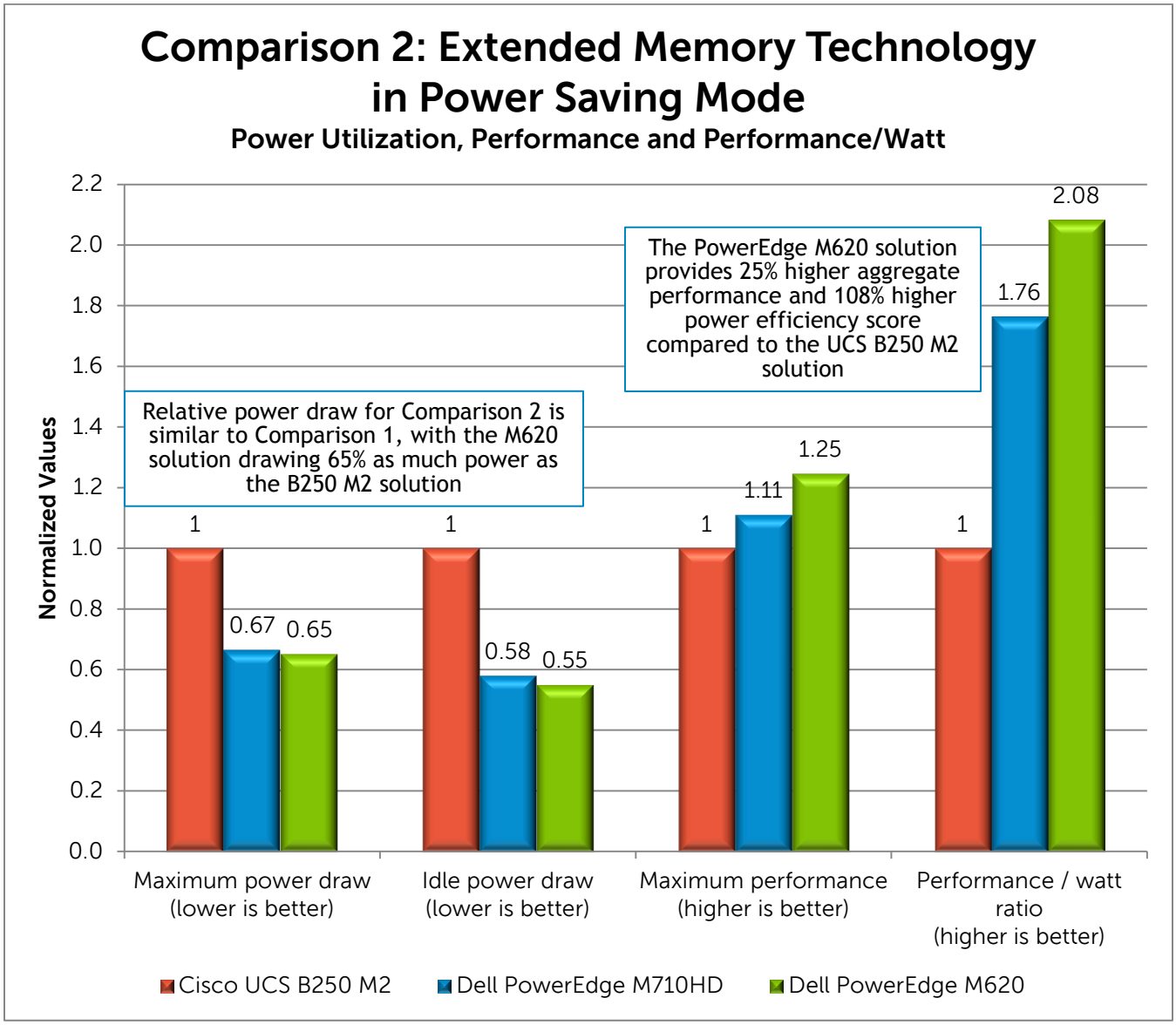
Table 4. Comparison 2 memory configuration

Comparison 2 memory config	Cisco UCS B250 M2	Dell PowerEdge M710HD	Dell PowerEdge M620
Memory configuration per blade	48 x 4GB Dual Ranked PC3L-10600R LV RDIMMs	12 x 16GB Dual Ranked PC3-12800R LV RDIMMs	12 x 16GB Dual Ranked PC3-12800R RDIMMs
Installed memory capacity per blade	192 GB	192 GB	192 GB
Memory speed (Actual / Max)	1067 / 1333 MHz	1067 / 1333 MHz	1067 / 1600 MHz
Tested memory voltage	1.35 V	1.35 V	1.5 V

As Figure 7 shows, lowering all blades' memory speed to 1067 MHz had a slightly negative impact to the aggregate performance of all three blade solutions, and less than 2% impact to overall performance / watt score. Running the blades in the UCS B250 M2 with their memory set to Power-saving mode does little to improve their performance and power efficiency in this benchmark. When compared to the four-blade UCS B250 M2 solution, the solution with four PowerEdge M710HD blades drew 67% as much power at 100% load and 58% as much power when both solutions were idle.

Similarly, the four-blade PowerEdge M620 solution had an even greater advantage, drawing 65% as much power at 100% load and 55% as much power at idle compared to the UCS B250 M2 solution.

Figure 7. Comparison 2 normalized results



Comparison 2 Summary

Even with its system memory configured for Power Saving Mode, the four-blade UCS B250 M2 solution's combination of higher power draw and lower performance led to the four-blade PowerEdge M710HD solution having a performance / watt ratio 76% higher, and the four-blade PowerEdge M620 solution having a performance / watt ratio 108% higher.

Cost as tested

Cisco's Extended Memory Technology is claimed to allow "large memory footprints … at a lower cost."

However, in the configuration tested, the four-blade UCS B250 M2 solution with 192 GB of system memory per blade costs $112,591.02[11], while the comparably configured four-blade Dell PowerEdge M710HD with the 192GB of system memory per blade costs over 34% less at $73,820.00[12]. Similarly, the four-blade PowerEdge M620 solution costs 33% less at $75,372.00[13].

Table 5. Blade solution cost details

Blade solution cost details	UCS B250 M2	PowerEdge M710HD	PowerEdge M620
Blade Infrastructure Cost (Enclosure, PSUs, Internal and External Network Switches)	$29,079.58	$25,444.00	$25,444.00
Cost per blade	$20,877.86	$12,094.00	$12,482.00
Cost for four blades	$83,511.44	$48,376.00	$49,928.00
Total Cost of four-blade solution (Infrastructure + blades)	$112,591.02	$73,820.00	$75,372.00
PowerEdge Solution % Less	--	34%	33%

Expandability

As noted earlier, the four B250 M2 servers used in the Cisco solution consume all eight slots in the UCS 5108 Blade Sever Chassis, leaving no room for future expansion without purchasing additional UCS blade chassis, additional infrastructure like fabric extender modules and power distribution units, and consuming additional ports in the top-of-rack switch.

As configured, each of the four-blade PowerEdge solutions used only four of the available sixteen slots in the M1000e Modular Blade Enclosure, leaving twelve slots available for adding additional servers, without incurring additional infrastructure costs.

[11] Source: Quote from Cisco authorized reseller, February 21, 2012. Price is in U.S. Dollars.
[12] Source: Quote from www.dell.com, February 21, 2012. Price is in U.S. Dollars.
[13] Source: Quote from www.dell.com, February 21, 2012. Price is in U.S. Dollars.

Rack density

The solution based on the UCS B250 M2 blade server can fit just four servers into the UCS 5108 Blade Server Chassis, which consumes 6U (rack units) of rack space, or 0.67 servers per U. Thus, an admin could fit just 28 UCS B250 M2 servers in a standard 42U rack, assuming no space in that rack was consumed by infrastructure like the UCS 6120XP Fabric Interconnect.

In contrast, when the 10U M1000e Modular Blade Enclosure is equipped with its maximum of sixteen M710HD or M620 servers, the solution is 2.4 times as dense, able to fit 1.6 servers per U. With four M1000e enclosures consuming 40U of rack space (leaving 2U for top-of-rack switches such as the PowerConnect 8024F used in this test report), an admin could fit 64 M710HD or M620 servers in a single rack, with each server having the same memory capacity, higher performance, and as much as 108% greater power efficiency compared to the UCS B250 M2 blades.

Summary

The results of the testing contradict the claimed advantages of Cisco UCS Extended Memory Technology, namely increased performance, reduced power, and lower cost. The four-blade Cisco UCS B250 M2 solution has lower aggregate performance and worse power efficiency compared to the four-blade PowerEdge M710HD solution with the same memory capacity per blade and the same model processors. In the tested configurations, the PowerEdge M710HD blade solution costs 34% less than the comparably configured UCS B250 M2 solution.

The four-blade solution based on the recently introduced PowerEdge M620 blade is even better performing and more power-efficient than both solutions, due in large part to Intel Xeon E5-2600 series processors. These generational improvements lead to an even greater advantage for the M620 solution in aggregate performance and power efficiency over the solution based on the UCS B250 M2. The PowerEdge M620 also has a 33% price advantage over the comparable four-blade UCS solution, and both PowerEdge solutions are 2.4 times as rack-dense as the UCS solution.

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/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 OS 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 test report are from "compliant runs" in SPEC terminology, which means that although they have not been submitted to SPEC for review, Dell is allowed to disclose them for the purpose of this study. All configuration details required to reproduce these results are listed in Appendices A, B, and C and the first page of the result files from the runs compared are included in Appendix D. Full result files from the runs compared are attached to this document for reference.

All servers were configured by installing a fresh copy of Microsoft® Windows Server® 2008 Enterprise R2 (Service Pack 1) with the operating system installed on a two-hard drive RAID 1 choosing the "full installation" option for each.

The latest driver and firmware update packages available to both servers were installed at the beginning of this study. Refer to Appendix B for details.

The Dell Solutions Performance Analysis Team ran SPECpower_ssj2008 three times per configuration and chose the run with the highest overall ssj_ops/watt for each configuration to compare for this study.

BIOS settings

BIOS settings differed between the two manufacturers, so we tuned for best-known SPECpower_ssj2008 performance results.

For the Dell PowerEdge M710HD blade servers:

- Turbo Mode Disabled in BIOS.
- Adjacent Cache Line Prefetch Disabled in BIOS.
- Hardware Prefetcher Disabled in BIOS.
- DCU Streamer Prefetcher Disabled in BIOS.
- Data Reuse Disabled in BIOS.

- DAPC Mode Enabled.

For the Dell PowerEdge M620 blade servers:

- Turbo Boost Disabled in BIOS
- Adjacent Cache Line Prefetch Disabled in BIOS.
- Hardware Prefetcher Disabled in BIOS.
- DCU Streamer Prefetcher Disabled in BIOS.
- DCU IP Prefetcher Disabled in BIOS.
- DAPC Mode Enabled.
- Memory Patrol Scrub Disabled in BIOS.

For the Cisco UCS B250 M2 blade servers:

When managed through UCS Manager, the Cisco UCS B250 M2 blades do not allow directly changing values for BIOS settings through the blades' F2 setup; rather, the settings are controlled through profiles in the UCS Manager interface.

- Turbo Boost Disabled in profile.
- Processor C3 Report set to enabled in profile.
- Processor C6 Report set to enabled in profile.
- CPU Performance set to the "Enterprise" template, which sets the following values on the blade BIOS:
    - Data Reuse Disabled
    - DCU Streamer Prefetcher Disabled
    - DCU IP Prefetcher Enabled
    - Hardware Prefetcher Disabled
    - Adjacent Line Prefetch Disabled

Most published results for SPECpower_ssj2008 from Dell and other vendors set the value of "DCU IP Prefetcher" to "Disabled" when using Intel Xeon 5600-series processors. The lack of ability to set this value to Disabled through UCS Manager likely hurt the aggregate performance scores of the UCS B250 M2 blades in this test report.

For Comparison 1, the memory speed of all systems was set to 1333 MHz; for Comparison 2, the memory speed of all systems was set to 1067 MHz.

OS 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**. The option was changed to add Administrator.

Operating System Power Management mode for all solutions was changed to Power saver edited to turn off the Hard Drive after 1 minute. On the Cisco UCS B250 M2 blades, which lack an integrated active power controller, the setting "Minimum processor state" was changed to 0% from the default 5%, and the setting for "Maximum processor state" was left at its default 100%. The PowerEdge M620 and M710HD blades did not need these settings due to the integrated Dell Active Power Controller on those systems.

We configured each server with a separate IP address on the same subnet as our SPECpower_ssj2008 controller system where the Director, CCS, and PTDaemon components were located, and connected all servers to the external network switch through NIC 1 for their respective runs.

SPECpower_ssj2008 configuration

IBM J9 Java Virtual Machine (JVM)[14] was used for all solutions.

The following JVM options were used on both servers, as they are the best-known JVM tunings for SPECpower_ssj2008 for the IBM J9 JVM when running with larger memory configurations:

```
-Xms1875m -Xmx1875m -Xmn1400m -Xaggressive -Xcompressedrefs -Xgcpolicy:gencon -
XlockReservation -Xnloa -XtlhPrefetch -Xlp
```

On each UCS B250 M2 and PowerEdge M710HD, with 24 logical processors per server, the following bindings were used to ensure that each of the six JVMs ran on four logical processors:

```
start /affinity [F,F0,F00,F000,F0000,F0000]
```

On each PowerEdge M620, with 32 logical processors per server, the following bindings were used to ensure that each of the eight JVMs ran on four logical processors:

```
start /affinity [F,F0,F00,F000,F0000,F0000,F00000,F000000]
```

Power meter configuration

We used the Yokogawa WT210 Digital Power Meter for the actual power measurement of the servers, as this is the most commonly used analyzer for SPECpower_ssj2008 publications at the time that this study was undertaken.

[14] JVM build 2.4, J2RE 1.6.0 IBM J9 2.4 Windows Server® 2008 amd64-64 jvmwa64 60sr5-20090519_35743

Appendix B—Server hardware configuration details

Table 6. Server hardware configuration details

	Dell PowerEdge M710HD	Dell PowerEdge M620	Cisco UCS B250 M2
Memory Modules			
Total RAM in system (GB)	192	192	192
Vendor and model number	Samsung M393B2G0AH0-YH9	Samsung M393B2G70BH0-CK0	Samsung M393B517FH0-YH9
Type	PC3L-10600R	PC3-12800R	PC3L-10600R
Number of RAM modules	12 x 16 GB	12 x 16 GB	48 x 4 GB
Rank organization	Dual Rank	Dual Rank	Dual Rank
Hard Disk			
Vendor and model number	Seagate	Seagate	Seagate
Number of disks in system	2	2	2
Size (GB)	73	73	73
RPM	15,000	15,000	15,000
Type	SAS 6 Gbps	SAS 6 Gbps	SAS 6 Gbps
RAID Type	RAID 1	RAID 1	RAID 1
Controller	Dell PERC H200	Dell PERC H310	LSI SAS30813E-R
Operating System			
Name	Microsoft® Windows Server® 2008 R2 Enterprise SP1	Microsoft® Windows Server® 2008 R2 Enterprise SP1	Microsoft® Windows Server® 2008 R2 Enterprise SP1
Build number	7601	7601	7601
File system	NTFS	NTFS	NTFS
Network Adapter			
Vendor and model number	Broadcom® 57712-k 10GbE 2P	Intel X520-k 10GbE 2P	Cisco UCS M81KR 10GbE 2P
Type	Integrated	Integrated	Mezzanine card

Appendix C—Server firmware and driver details

Table 7. Server firmware and driver details

Driver/Firmware Versions	Dell PowerEdge M710HD	Dell PowerEdge M620	Cisco UCS B250 M2
System BIOS	4.1.0	1.0.2	S5500.2.0.1d.081220111423
Network Drivers	16.4.0	2.9.67.0	2.1.0.9
HBA Firmware	07.03.05.00	20.10.1-0049	1.32.04.00
HBA Drivers	2.0.35.10	5.1.112.64	1.34.2.0
Video Driver	1.1.3.0	2.4.1.0	OS Native
Integrated Management Controller Firmware	3.33 Build 2	iDRAC7 1.00 build 70	2.0(1s)

Appendix D—Comparison results

The first page of the SPECpower_ssj2008 results files which were generated for each server for convenience. Full SPECpower_ssj2008 results files are attached to this document for reference.

Figure 8. Comparison 1 results for UCS B250 M2

SPECpower_ssj2008

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Cisco Inc. Cisco UCS B250 M2				SPECpower_ssj2008 = 1,006 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:	Nov 30, 2011
Hardware Availability:	Apr-2011	Software Availability:	Feb-2011	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%	3,419,587	2,203	1,552
90%	90.2%	3,097,943	2,085	1,486
80%	80.1%	2,752,281	1,981	1,389
70%	70.1%	2,408,536	1,881	1,281
60%	59.9%	2,060,050	1,781	1,157
50%	49.9%	1,713,549	1,692	1,013
40%	40.0%	1,375,485	1,614	852
30%	30.1%	1,033,523	1,539	671
20%	20.0%	687,318	1,467	468
10%	10.0%	342,943	1,388	247
	Active Idle	0	1,151	0
			∑ssj_ops / ∑power =	1,006

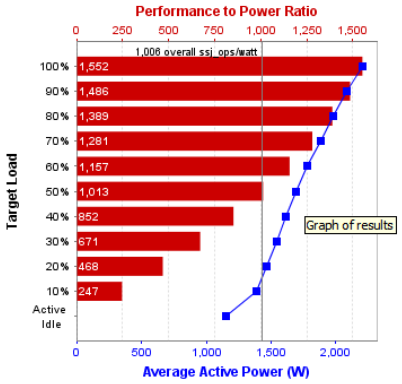

Figure 9. Comparison 1 results for PowerEdge M710HD

SPECpower_ssj2008

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Dell Inc. PowerEdge M710HD				SPECpower_ssj2008 = 1,756 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:	Jan 25, 2012
Hardware Availability:	Oct-2011	Software Availability:	Apr-2011	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%	99.6%	3,749,443	1,467	2,556
90%	89.9%	3,385,167	1,363	2,484
80%	80.1%	3,016,723	1,267	2,381
70%	70.0%	2,636,180	1,189	2,217
60%	60.1%	2,260,906	1,112	2,032
50%	50.2%	1,888,515	1,052	1,795
40%	40.0%	1,507,082	996	1,513
30%	30.0%	1,129,437	944	1,196
20%	20.0%	754,350	893	845
10%	10.0%	377,485	833	453
	Active Idle	0	673	0
			∑ssj_ops / ∑power =	1,756

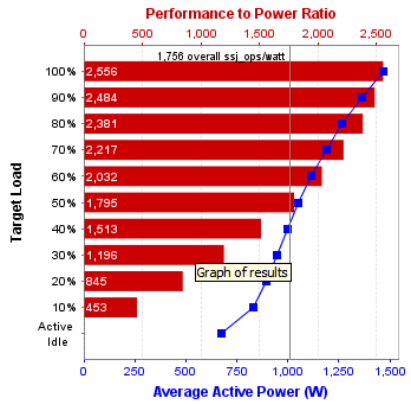

Figure 10. Comparison 1 results for PowerEdge M620

SPECpower_ssj2008

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Dell Inc. PowerEdge M620				SPECpower_ssj2008 = 2,054 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:	Feb 3, 2012
Hardware Availability:	Mar-2012	Software Availability:	Feb-2011	Publication:	Unpublished
System Source:	Single Supplier	System Designation:	Server	Power Provisioning:	Line-powered

WARNING: PTDaemon 1.4.1-1271fb18-20110728 is over 6 months old. Check http://www.spec.org/power/docs/SPECpower-Device_List.html to determine if a newer version is available. (see Run Rules Section 1.1)
WARNING: PTDaemon 1.4.1-1271fb18-20110728 is over 6 months old. Check http://www.spec.org/power/docs/SPECpower-Device_List.html to determine if a newer version is available. (see Run Rules Section 1.1)
WARNING: PTDaemon 1.4.1-1271fb18-20110728 is over 6 months old. Check http://www.spec.org/power/docs/SPECpower-Device_List.html to determine if a newer version is available. (see Run Rules Section 1.1)
Set sut WARNING: The highest calibrated throughput in this set (M620-02=1,060,589) is 2.5% more than the lowest calibrated throughput (M620-04=1,034,355)

Benchmark Results Summary

Performance			Power	Performance to Power Ratio
Target Load	Actual Load	ssj_ops	Average Active Power (W)	
100%	99.6%	4,175,133	1,416	2,948
90%	89.9%	3,767,952	1,331	2,831
80%	80.1%	3,359,332	1,253	2,681
70%	69.9%	2,931,354	1,139	2,573
60%	60.0%	2,516,088	1,058	2,377
50%	50.0%	2,094,981	997	2,102
40%	40.0%	1,677,376	934	1,796
30%	30.1%	1,260,863	870	1,449
20%	20.1%	841,699	819	1,028
10%	10.0%	419,172	766	547
	Active Idle	0	634	0
			∑ssj_ops / ∑power =	**2,054**

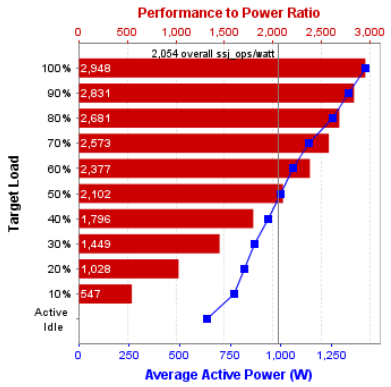

Figure 11. Comparison 2 results for UCS B250 M2

SPECpower_ssj2008

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Cisco Inc. Cisco UCS B250 M2				SPECpower_ssj2008 = 993 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:	Dec 1, 2011
Hardware Availability:	Apr-2011	Software Availability:	Feb-2011	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%	99.7%	3,331,116	2,186	1,524
90%	90.0%	3,008,324	2,059	1,461
80%	80.0%	2,674,096	1,955	1,368
70%	69.9%	2,335,698	1,850	1,262
60%	60.0%	2,004,908	1,752	1,144
50%	50.1%	1,674,062	1,665	1,005
40%	39.9%	1,335,199	1,585	843
30%	30.0%	1,003,714	1,510	665
20%	20.0%	668,717	1,439	465
10%	10.0%	333,904	1,364	245
	Active Idle	0	1,133	0
			∑ssj_ops / ∑power =	**993**

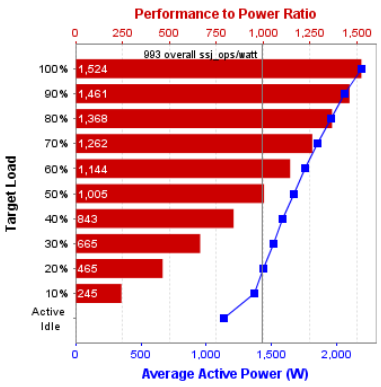

Figure 12. Comparison 2 results for PowerEdge M710HD

SPECpower_ssj2008

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Dell Inc. PowerEdge M710HD				SPECpower_ssj2008 = 1,752 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:	Jan 24, 2012
Hardware Availability:	Oct-2011	Software Availability:	Apr-2011	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%	99.7%	3,704,687	1,458	2,541
90%	90.1%	3,348,742	1,353	2,475
80%	79.9%	2,970,563	1,257	2,363
70%	70.0%	2,600,493	1,178	2,207
60%	59.9%	2,224,961	1,101	2,021
50%	49.9%	1,856,004	1,039	1,786
40%	40.1%	1,489,962	985	1,513
30%	30.0%	1,116,118	932	1,197
20%	20.1%	745,179	879	847
10%	10.0%	371,079	820	452
	Active Idle	0	660	0
			∑ssj_ops / ∑power =	1,752

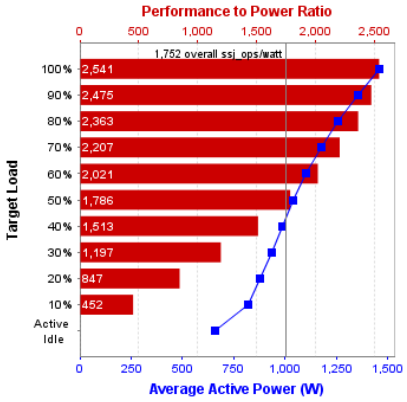

Figure 13. Comparison 2 results for PowerEdge M620

SPECpower_ssj2008

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Dell Inc. PowerEdge M620				SPECpower_ssj2008 = 2,070 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:	Feb 3, 2012
Hardware Availability:	Mar-2012	Software Availability:	Feb-2011	Publication:	Unpublished
System Source:	Single Supplier	System Designation:	Server	Power Provisioning:	Line-powered

WARNING: PTDaemon 1.4.1-1271fb18-20110728 is over 6 months old. Check http://www.spec.org/power/docs/SPECpower-Device_List.html to determine if a newer version is available. (see Run Rules Section 1.1)
WARNING: PTDaemon 1.4.1-1271fb18-20110728 is over 6 months old. Check http://www.spec.org/power/docs/SPECpower-Device_List.html to determine if a newer version is available. (see Run Rules Section 1.1)
WARNING: PTDaemon 1.4.1-1271fb18-20110728 is over 6 months old. Check http://www.spec.org/power/docs/SPECpower-Device_List.html to determine if a newer version is available. (see Run Rules Section 1.1)

Benchmark Results Summary

Performance			Power	Performance to Power Ratio
Target Load	Actual Load	ssj_ops	Average Active Power (W)	
100%	99.6%	4,160,173	1,430	2,909
90%	90.1%	3,761,834	1,332	2,825
80%	79.9%	3,336,002	1,229	2,714
70%	70.0%	2,924,924	1,126	2,597
60%	60.0%	2,505,882	1,045	2,399
50%	50.1%	2,091,374	982	2,130
40%	40.0%	1,671,883	917	1,823
30%	30.0%	1,254,139	853	1,470
20%	20.0%	835,222	803	1,040
10%	10.0%	417,582	750	557
	Active Idle	0	626	0
			∑ssj_ops / ∑power =	2,070