Power Efficiency Comparison: Cisco UCS 5108 Blade Server Chassis and Dell PowerEdge M1000e Blade Enclosure

White Paper

March 2014

Contents

Executive Summary

Rising energy prices and a drastic increase in computing solution density have made energy management a critical component of efficient data center operations. In addition to availability and scalability, data center managers must address power utilization to deliver cost-effective solutions for their businesses. Cisco is dedicated to the advancement of energy efficiency in the data center ecosystem. This document compares the power efficiency of similarly configured Cisco UCS® 5108 Blade Server Chassis and Dell PowerEdge M1000e Blade Enclosure solutions.

Cisco compared power and performance characteristics of equivalently configured Cisco UCS 5108 Blade Server Chassis and Dell PowerEdge M1000e Blade Enclosure. The Cisco® solution was configured with Cisco UCS B200 M3 blade servers, and the Dell solution was configured with equivalent Dell PowerEdge M620 G12 blade servers. Both solutions are based on the Intel Xeon processor E5-2600 product family. An industry-standard benchmark, SPECpower_ssj2008 which measures the performance-to-power ratio, was run on both solutions to evaluate performance, power consumption, and power efficiency.

The results demonstrate that the Cisco Unified Computing System™ (Cisco UCS) configured with Cisco UCS B200 M3 blade servers, consumes less power and is more efficient than a Dell solution configured with Dell PowerEdge M620 G12 blade servers.

Main Findings

- Performance
  - Cisco UCS and Dell PowerEdge solutions achieved equivalent performance as expected when configured with comparable hardware, firmware, and OS settings and running the same workload.
  - Average performance across all target loads varied less than 0.2 percent.
- Power
  - At maximum target load, the Cisco UCS chassis consumed 294 watts (W) less power than the equivalently configured Dell PowerEdge enclosure: a difference of 11.3 percent less power.
  - In the active-idle state, the Cisco UCS chassis consumed 43W less power than the equivalently configured Dell PowerEdge enclosure: a difference of 5.1 percent less power.
- Efficiency
  - The Cisco UCS chassis achieved a 9.3 percent higher performance-to-power ratio than the Dell PowerEdge enclosure using similarly configured hardware, BIOS, OS, and benchmark settings.
  - At 70 percent target load, the Cisco UCS chassis consumed 12.5 percent less power while providing equivalent performance to the Dell PowerEdge enclosure.
  - Cisco Fabric Extender Technology (FEX Technology) scales to 20 chassis within a single unified system, eliminating the power incurred from dedicated chassis management and blade switch modules as the solution expands beyond a single blade enclosure.

SPEC Fair Use Rule disclosure condition:

At 100 percent target load, the Cisco UCS 5108 blade chassis with eight Cisco UCS B200 M3 servers installed achieved 11,252,295 ssj_ops using 2,311W (Figure 8), and the Dell PowerEdge M1000e blade enclosure with eight Dell PowerEdge M620 G12 servers installed achieved 11,269,813 ssj_ops using 2,605W (Figure 14).

At 70 percent target load, the Cisco UCS 5108 blade chassis with eight Cisco UCS B200 M3 servers installed achieved 7,947,925 ssj_ops using 1,665W (Figure 8), and the Dell PowerEdge M1000e blade enclosure with eight Dell PowerEdge M620 G12 servers installed achieved 7,964,801 ssj_ops using 1,902W (Figure 14).

Test Method Overview

To make relevant power efficiency comparisons, all solution variables that affect performance and power consumption must be equivalent. The Cisco UCS 5108 and Dell PowerEdge solutions were equivalently configured. The BIOS parameters affecting performance and power consumption were set consistently across each blade solution (see Appendix B for BIOS parameter configuration details). The same workload was run on each solution while operating in the same environmental conditions.

The workload provides a basis for comparing equivalent computing solutions. SPECpower_ssj2008 is a benchmark developed by the Standard Performance Evaluation Corporation (SPEC), a nonprofit group of computer vendors, system integrators, universities, research organizations, publishers, and consultants. The benchmark is designed to provide a view of server system power consumption while the system runs Java server applications. The results from each SPECpower_ssj2008 benchmark are listed in Appendix C. The analysis contained in this document is based on the data obtained from these results.

Hardware Configuration 1

The first solution evaluated was a single blade chassis configured with eight blades. The Cisco and Dell blade enclosures were configured similarly (Table 1). Individual power analyzers measured the power consumption of the blade enclosures and the redundant pair of Cisco UCS 6248UP 48-Port Fabric Interconnects.

Table 1. Solution Details (Configuration 1)

Enclosure	1 Cisco UCS 5108	1 Dell PowerEdge M1000e
Blade slots available and installed per chassis	Available: 8 Installed: 8	Available: 16 Installed: 8
Enclosure management modules	Cisco UCS 6248UP 48-Port Fabric Interconnect (2)[1]	Dell Chassis Management Controller (2)
Internal I/O modules per chassis	Cisco UCS 2204XP Fabric Extender (2)	Dell Force10 MXL 10/40 GbE switch module (2)
Power supplies per chassis	2500W Platinum rated (4)	2700W Platinum rated (4)[2]
Fan slots available and installed per chassis	Available: 8 Installed: 8	Available: 9 Installed: 9
Blade Model	**Cisco UCS B200 M3**	**Dell PowerEdge M620 G12**
Form factor	Half width	Half height
Processor	Intel Xeon E5-2660 (2)	Intel Xeon E5-2660 (2)
Physical and logical cores	Physical: 16 Logical: 32	Physical: 16 Logical: 32
Memory	32 GB (4X 8-GB DDR3 RDIMM PC3L-12800)	32 GB (4X 8-GB DDR3 RDIMM PC3L-12800)
Hard disk drive	300 GB 10K RPM 6 Gbps with RAID 0 (1)	300 GB 10K RPM 6 Gbps with RAID 0 (1)
Network	Cisco UCS VIC 1240 10-Gbps 4-port adapter (1)	Broadcom 57810-k 10-Gbps 2-port adapter (1)
Storage controller	LSI Logic SAS 2004 (1)	PERC H310 Mini (1)

[1] The Cisco UCS 6248UP 48-Port Fabric Interconnect provides the management and communication backbone for the Cisco UCS B-Series Blade Servers and C-Series Rack Servers. A single redundant pair of fabric interconnects supports up to 20 blade enclosures in a single highly available management domain. The benchmark was run with and without the power consumed by the redundant pair of fabric interconnects included in the measurement (Figures 8 through 10).

[2] Dynamic Power Supply Engagement and Max Power Conservation Mode were enabled, which turns power supplies on or off based on power consumption, optimizing energy consumption for the entire chassis.

The available system firmware at the time of testing was installed; see Appendix A for additional details.

Microsoft Windows Server 2008 R2 Enterprise with Service Pack 1 (SP1) was installed on each server. The same OS power management settings were used for each solution; see the OS section of the test procedure in Appendix B for additional details.

A Cisco UCS service profile was used to update all Cisco UCS blades simultaneously using a common BIOS policy. Each BIOS parameter was manually duplicated on Dell blades; see the BIOS section in Appendix B.

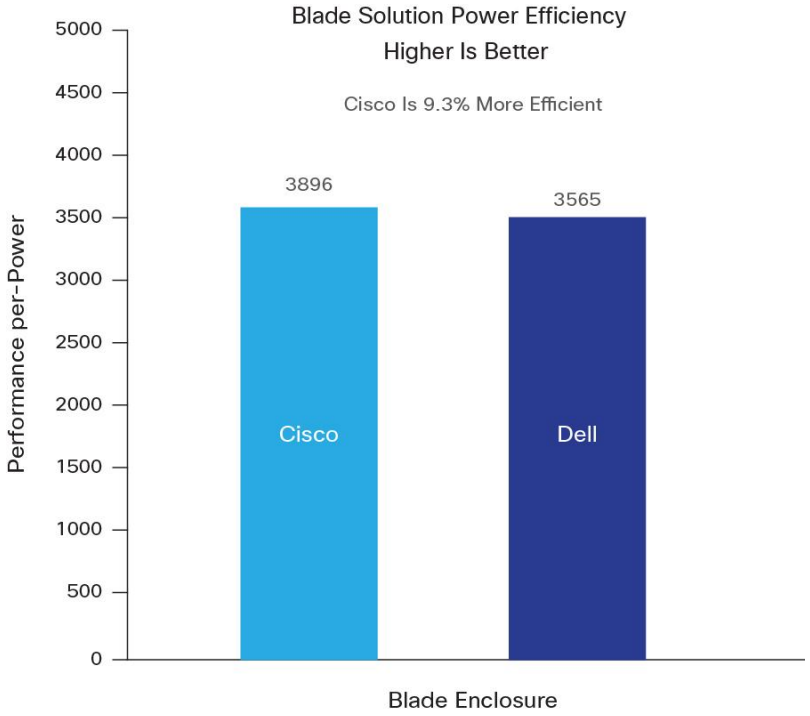
The blade enclosure power supply management policy was set to grid redundant or AC redundant for each solution. The additional power management features Dynamic Power Supply Engagement and Max Power Conservation Mode were enabled on the Dell solution. External networking components were not included in the power measurements.

Results: Hardware Configuration 1

At maximum target load conditions, the Cisco UCS chassis consumed 294W less power than the equivalently configured Dell PowerEdge enclosure: a difference of 11.3 percent less power consumption. In the active-idle state, the Cisco UCS chassis consumed 43W less power than the equivalently configured Dell PowerEdge enclosure: a difference of 5.1 percent less power consumption.

The Cisco UCS chassis consumed less power while providing equivalent performance compared to the Dell solution. The Cisco UCS chassis achieved a 9.3 percent higher performance-to-power ratio than the Dell PowerEdge enclosure (Figure 1).

Figure 1. Power Efficiency Comparison (Configuration 1)



SPEC Fair Use Rule disclosure condition:

At 100 percent target load, the Cisco UCS 5108 blade chassis with eight Cisco UCS B200 M3 servers installed achieved 11,252,295 ssj_ops using 2,311W (Figure 8), and the Dell PowerEdge M1000e blade enclosure with eight Dell PowerEdge M620 G12 servers installed achieved 11,269,813 ssj_ops using 2,605W (Figure 14).

Power efficiency is computed by dividing the number of operations performed by the average power consumption. The performance-per-watt ratio for each target is shown in Figure 2. The Cisco UCS chassis has greater power efficiency than the Dell enclosure: an advantage of 2.9 to 14.0 percent across all target loads.

Figure 2. Target Load Power Efficiency Comparison (Configuration 1)

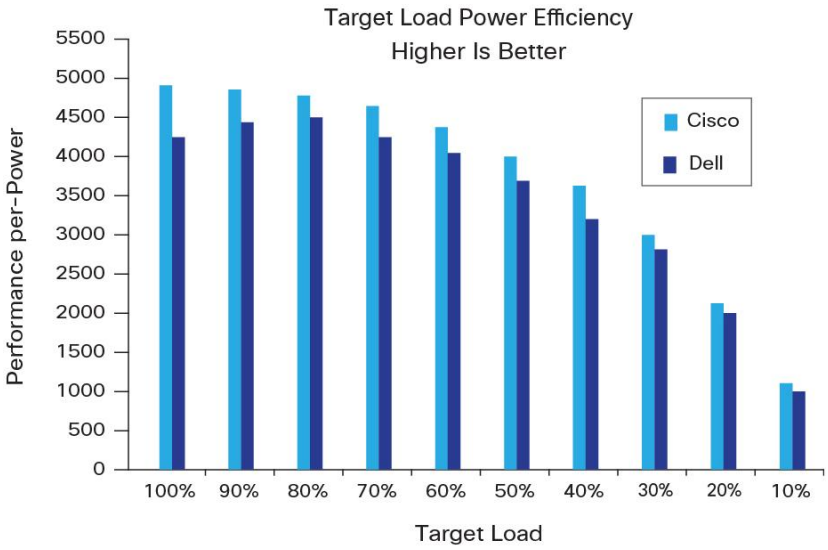
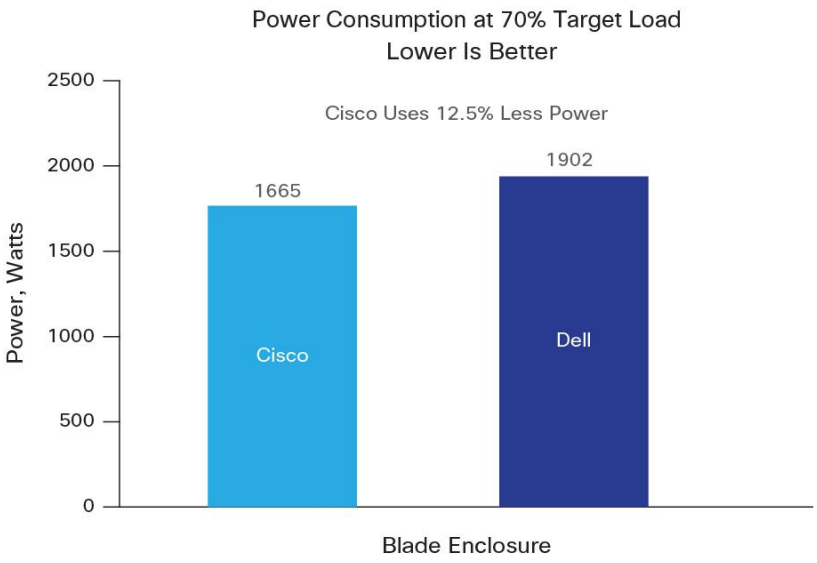


Figure 3. Average Power Comparison at 70% Target Load



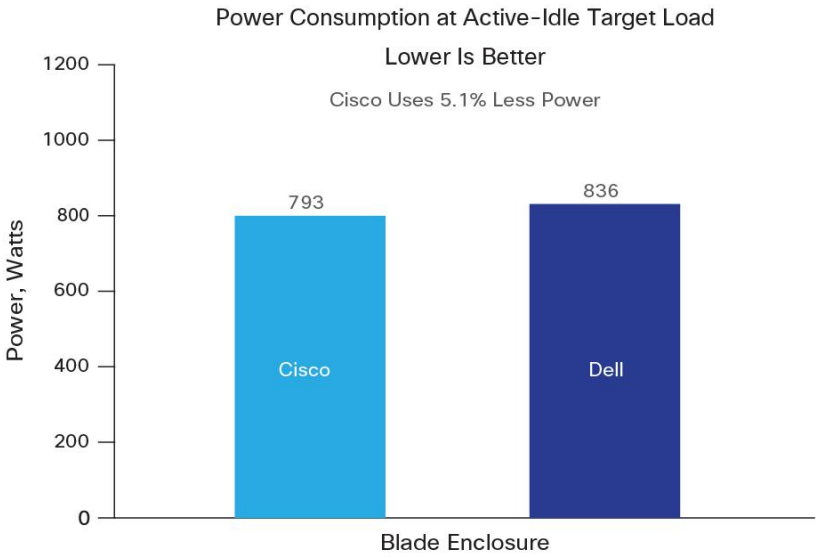
SPEC Fair Use Rule disclosure condition:

At 70 percent target load, the Cisco UCS 5108 blade chassis with eight Cisco UCS B200 M3 servers installed achieved 7,947,925 ssj_ops using 1,665W (Figure 8), and the Dell PowerEdge M1000e blade enclosure with eight Dell PowerEdge M620 G12 servers installed achieved 7,964,801 ssj_ops using 1,902W (Figure 14).

A general rule used by many industry professionals is to compare solution power consumption at a specific utilization rate. The typical values range from 50 to 70 percent utilization. For this comparison, the average power consumption at 70 percent target load is shown in Figure 3. At this target load, the Cisco UCS chassis consumed 12.5 percent less power while providing equivalent performance to the Dell PowerEdge enclosure.

Another method used by many industry professionals is to compare solution power consumption in the idle state. The average power consumed by the Cisco UCS chassis in the idle state was 43W less than the equivalently configured Dell PowerEdge enclosure: a difference of 5.1 percent less power consumption, as shown in Figure 4.

Figure 4. Average Power Comparison in Active-Idle State



SPEC Fair Use Rule disclosure condition:

At 100 percent target load, the Cisco UCS 5108 blade chassis with eight Cisco UCS B200 M3 servers installed achieved 11,252,295 ssj_ops using 2,311W (Figure 8), and the Dell PowerEdge M1000e blade enclosure with eight Dell PowerEdge M620 G12 servers installed achieved 11,269,813 ssj_ops using 2,605W (Figure 14).

Hardware Configuration 2

Enterprise customers generally deploy multiple blade enclosures to maximize the power density and management advantages of a typical blade solution. Compared to traditional blade architectures, Cisco UCS extends these advantages using Cisco FEX Technology. This architecture supports up to 20 chassis in a single unified system without additional complexity, providing uniform access to both networks and storage and eliminating the additional power overhead incurred from dedicated chassis management and blade switch modules for each blade chassis.

Configuring multiple large-scale solutions, consisting of hundreds of blade servers, to measure power efficiency is not practical. A simple example in which the Cisco UCS solution is scaled from one to two chassis demonstrates Cisco's power efficiency advantage over traditional blade architectures such as the Dell PowerEdge solution.

An identical Cisco UCS chassis with eight blades, from Configuration 1 (Table 1), was added to the Cisco solution. Eight blades were added to the Dell solution (Table 2). The same test methodology was used to measure performance and power usage. Individual power analyzers measured power consumption of the blade chassis and redundant pair of Cisco UCS 6248UP fabric interconnects.

Table 2. Solution Details (Configuration 2)

Enclosure	2 Cisco UCS 5108	1 Dell PowerEdge M1000e
Blade slots available and installed per chassis	Available: 8 Installed: 8	Available: 16 Installed: 16
Enclosure management modules	Cisco UCS 6248UP 48-Port Fabric Interconnect (2)[1]	Dell Chassis Management Controller (2)
Internal I/O modules per chassis	Cisco UCS 2204XP Fabric Extender (2)	Dell Force10 MXL 10/40 GbE switch module (2)
Power supplies per chassis	2500W Platinum rated (4)	2700W Platinum rated (6)[2]
Fan slots available and installed per chassis	Available: 8 Installed: 8	Available: 9 Installed: 9
Blade Model	**Cisco UCS B200 M3**	**Dell PowerEdge M620 G12**
Form factor	Half width	Half height
Processor	Intel Xeon E5-2660 (2)	Intel Xeon E5-2660 (2)
Physical and logical cores	Physical: 16 Logical: 32	Physical: 16 Logical: 32
Memory	32 GB (4X 8-GB DDR3 RDIMM PC3L-12800)	32 GB (4X 8-GB DDR3 RDIMM PC3L-12800)
Hard disk drive	300 GB 10K RPM 6 Gbps with RAID 0 (1)	300 GB 10K RPM 6 Gbps with RAID 0 (1)
Network	Cisco UCS VIC 1240 10-Gbps 4-port adapter (1)	Broadcom 57810-k 10-Gbps 2-port adapter (1)
Storage controller	LSI Logic SAS 2004 (1)	PERC H310 Mini (1)

[1] The Cisco UCS 6248UP 48-Port Fabric Interconnect is a core part of Cisco UCS. Typically deployed in redundant pairs, the Cisco UCS 6248UP provides uniform access to both network and storage. The Cisco UCS fabric extender architecture provides management for 20 blade enclosures in a single unified system without additional complexity, thus eliminating dedicated chassis management and blade switches and reducing the number of cables required.

[2] Dynamic Power Supply Engagement and Max Power Conservation Mode were enabled on the Dell solution, which turns power supplies on or off based on power consumption, optimizing energy consumption for the entire chassis.

Results: Hardware Configuration 2

As seen with the first configuration, performance for the Cisco and Dell solutions varied less than one percent.

As expected, the power consumed by the redundant pair of fabric interconnects did not increase with the addition of a second Cisco UCS chassis (Figure 5). The power consumed by the redundant pair of fabric interconnects remained constant at 521W for each Cisco configuration (see Figures 10 and 13 for detailed power measurement data). The fabric interconnects power per chassis for the first configuration was 521W. The fabric interconnects power per chassis for the second configuration was 261W. The fabric interconnects have more capacity remaining to support another 18 blade chassis, or 160 total blades. As the number of blades in the domain increases, the fabric interconnects power is amortized across more Cisco UCS chassis.

The additional chassis did not require another set of dedicated chassis management or blade switch modules. At 70 percent target load, the two Cisco UCS chassis consumed 3,348W, and the Dell PowerEdge enclosure consumed 3,729W (Figure 6). The Cisco UCS chassis used 381W less power. The detailed power measurement data for the Cisco and Dell solutions is shown in Figures 13 and 15.

SPEC Fair Use Rule disclosure condition:

At 70 percent target load, the two Cisco UCS 5108 blade chassis with 16 Cisco UCS B200 M3 servers installed and two Cisco UCS 6248UP fabric interconnects achieved 15,936,381 ssj_ops using 3869W (1,669W for chassis 1, 1,679W for chassis 2, and 521W for two fabric interconnects; see Figures 12 and 13), and the Dell PowerEdge M1000e blade enclosure with 16 Dell PowerEdge M620 G12 servers installed achieved 15,944,659 ssj_ops using 3,729W (Figure 15).

Using power consumption data for the chassis and fabric interconnects; reasonable power estimates for solutions expanding beyond 16 blades can be generated. Although tempting, the SPEC Fair Use Rule considers estimates to be non-compliant, and non-compliant results cannot be published publicly for any SPECpower_ssj2008 metric.

Figure 5. Fabric Interconnect Power Consumption Comparison: Configuration 1 and Configuration 2

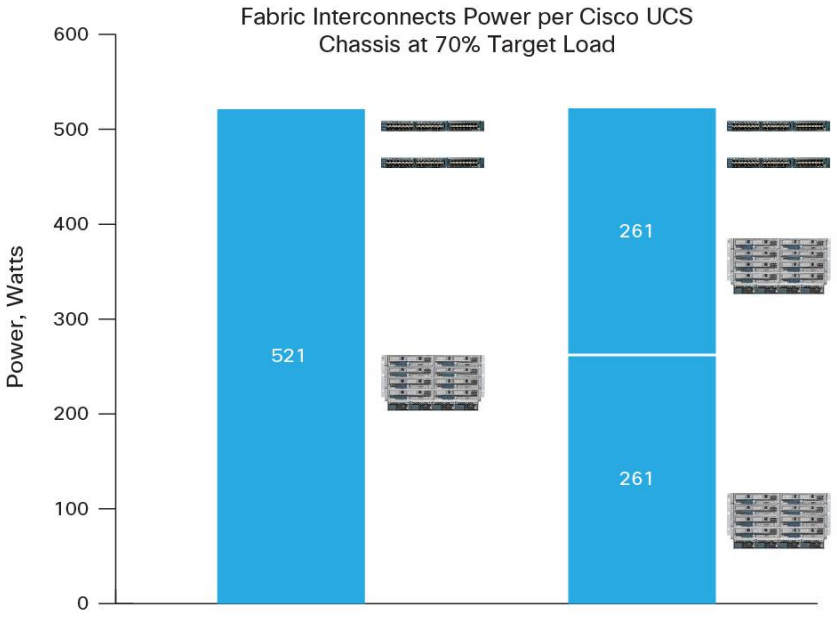
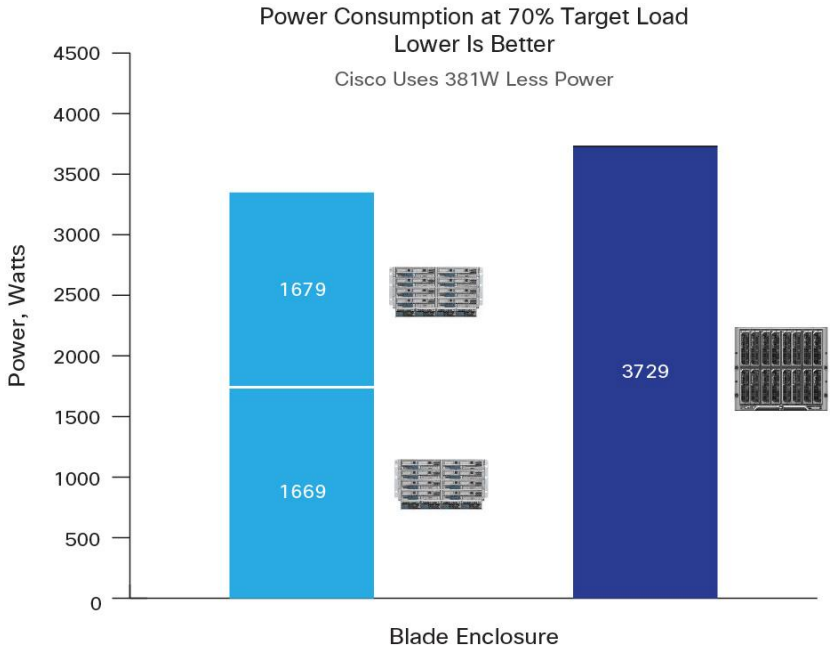


Figure 6. Average Power Comparison at 70% Target Load



SPEC Fair Use Rule disclosure condition:

At 70 percent target load, the two Cisco UCS 5108 blade chassis with 16 Cisco UCS B200 M3 servers installed and two Cisco UCS 6248UP fabric interconnects achieved 15,936,381 ssj_ops using 3,869W (1,669W for chassis 1, 1,679W for chassis 2, and 521W for two fabric interconnects; see Figures 12 and 13), and the Dell PowerEdge M1000e blade enclosure with 16 Dell PowerEdge M620 G12 servers installed achieved 15,944,659 ssj_ops using 3,729W (Figure 15).

Conclusions

Both blade solutions were configured with similar hardware and firmware running an identical workload. The results yielded comparable performance across each blade. Performance for the Cisco and Dell solutions varied less than one percent.

The first configuration measured the power efficiency of the blade enclosure. The Cisco UCS chassis was 9.3 percent more power efficient than the Dell PowerEdge enclosure. At 70 percent target load, the Cisco UCS chassis consumed 12.5 percent less power than the Dell PowerEdge enclosure. In the active-idle state, Cisco UCS consumed 5.1 percent less power than the equivalent Dell PowerEdge enclosure.

The second configuration showed that the power consumption for the fabric interconnects did not increase when a second Cisco UCS blade chassis was added to the solution. At 70 percent target load, the two Cisco UCS chassis consumed 381W less power than the Dell PowerEdge enclosure. As the number of blades in the domain increases, the fabric interconnects power is amortized across more and more Cisco UCS chassis.

Over the years, computing solutions have become less expensive to purchase and maintain, delivering more computing capacity at lower equipment costs. At the same time, the cost of energy has continued to rise. In some cases, operating expenses for data center solutions can exceed capital expenses. Cisco UCS is a more efficient architecture that scales to 20 chassis in a single unified system, eliminating the additional power incurred from dedicated chassis management and blade switch modules for each blade enclosure.

SPEC Fair Use Rule disclosure condition:

At 100 percent target load, the Cisco UCS 5108 blade chassis with eight Cisco UCS B200 M3 servers installed achieved 11,252,295 ssj_ops using 2,311W (Figure 8), and the Dell PowerEdge M1000e blade enclosure with eight Dell PowerEdge M620 G12 servers installed achieved 11,269,813 ssj_ops using 2,605W (Figure 14).

At 70 percent target load, the Cisco UCS 5108 blade chassis with eight Cisco UCS B200 M3 servers installed achieved 7,947,925 ssj_ops using 1,665W (Figure 8), and the Dell PowerEdge M1000e blade enclosure with eight Dell PowerEdge M620 G12 servers installed achieved 7,964,801 ssj_ops using 1,902W (Figure 14).

At 70 percent target load, the two Cisco UCS 5108 blade chassis with 16 Cisco UCS B200 M3 servers installed and two Cisco UCS 6248UP fabric interconnects achieved 15,936,381 ssj_ops using 3,869W (1,669W for chassis 1, 1,679W for chassis 2, and 521W for two fabric interconnects; see Figures 12 and 13), and the Dell PowerEdge M1000e blade enclosure with 16 Dell PowerEdge M620 G12 servers installed achieved 15,944,659 ssj_ops using 3,729W (Figure 15).

For More Information About Cisco UCS

Cisco UCS: http://www.cisco.com/en/US/products/ps10265/index.html

Cisco UCS Case Studies: http://www.cisco.com/en/US/solutions/ns340/ns517/ns224/dc_case_studies.html

Cisco UCS White Papers: http://www.cisco.com/en/US/prod/ps10265/ucs_white_paper.html

Appendix A: Solution Firmware and Driver Details

Table 3 provides firmware and driver details for the Cisco UCS 5108 and Dell PowerEdge M1000e solutions.

Table 3. Installed Firmware and Driver Revisions

Component	Cisco	Dell
Enclosure model	Cisco UCS 5108	Dell PowerEdge M1000e
Enclosure management firmware	5.0(3)N2(2.11f)	4.31
Internal I/O module firmware	2.1(1f)	8.3.16.2
Blade model	Cisco UCS B200 M3	Dell PowerEdge M620 G12
System BIOS	B200M3.2.1.1a.0.121720121447	1.7.6
Management controller firmware	2.1(1f)	iDRAC7 1.40.40 (Build 17)
Integrated KVM switch firmware	-	01.00.01.01
Network adapter firmware	2.1(1f)	4.1.450.5
Storage controller firmware	20.10.1-0100	20.10.1-0084
Network adapter driver	2.20.13	7.6.51.0
Storage controller driver	5.1.112.64	5.1.112.64
Display adapter driver	6.1.7600.16385	6.1.7600.16385

Appendix B: Test Procedure

This appendix describes the test procedure used to collect performance and power consumption data.

Hardware and System Firmware

Each solution was configured with comparable hardware components; see Tables 1 and 2 for specific hardware details. The available system firmware at the time of testing was installed; see Appendix A for details.

BIOS

The available BIOS parameters differ between the Cisco and Dell blade solutions. The BIOS parameters were set as equivalently as possible to ensure comparable performance and power management; see Table 4 for the BIOS settings for each blade solution.

Table 4. BIOS Settings

Component	Cisco UCS B200 M3	Dell PowerEdge M620 G12
Processor Configuration		
Intel Hyper-Threading Technology	Enabled	Enabled
Number of Enabled Cores	All	All
Execute Disable	Disabled	Disabled
Intel Virtualization Technology	Enabled	Enabled
Processor Performance Configuration		
Hardware Prefetcher	Disabled	Disabled
Adjacent Sector Prefetcher	Disabled	Disabled
DCU Streamer Prefetcher	Disabled	Disabled
Processor Power Management Configuration		
Enhanced SpeedStep Technology	Enabled	-
Intel Turbo Boost Technology	Enabled	Enabled

Component	Cisco UCS B200 M3	Dell PowerEdge M620 G12
Processor Power State C1 Enhanced	Enabled	Enabled
Processor Power State C6	Enabled	Enabled
Energy Performance Policy[1]	OS Controlled	System DBPM (DAPC)
Memory Configuration		
Select Memory RAS Configuration[2]	Maximum Performance	Optimizer Mode
Low Voltage DDR Mode[3]	Performance Mode	Auto
DRAM Refresh Rate	1X	1X
DDR Speed[4]	Auto	Maximum Performance
Patrol Scrub	Disabled	Disabled
QPI Configuration		
QPI Link Frequency Select	6.4 GT/s	6.4 GT/s
USB Configuration		
All USB Devices	Enabled	All Ports On

[1] Dell Advanced Power Control (DAPC) mode allows the BIOS to manage the processor power states for the best performance-per-watt ratio for all utilization levels and workload types while still meeting performance requirements. The equivalent Cisco BIOS parameter allows the OS to manage processor power states for best performance.

[2] Dell Memory Operating Mode set to Optimized (or Independent Channel) allows memory channels to run independently of each other without lockstep or mirroring. The equivalent Cisco BIOS parameter is Cisco RAS Configuration set to Maximum performance.

[3] Dell Memory Frequency set to Auto directs the BIOS to configure the system to operate at the lowest voltage supported for the given memory configuration and memory frequency. Cisco Low Voltage DDR Mode set to Performance Mode prioritizes high-frequency operations over low-voltage operations.

[4] Dell Memory Frequency set to Maximum Performance sets the memory frequency to the highest supported frequency. The equivalent Cisco BIOS parameter DDR Speed set to Auto in combination with LV DDR Mode set to Maximum Performance helps ensure that memory is operating equivalently in the Cisco and Dell solutions.

For a complete list of available BIOS settings for the Cisco UCS B200 M3 and Dell PowerEdge M620 G12, see the following links:

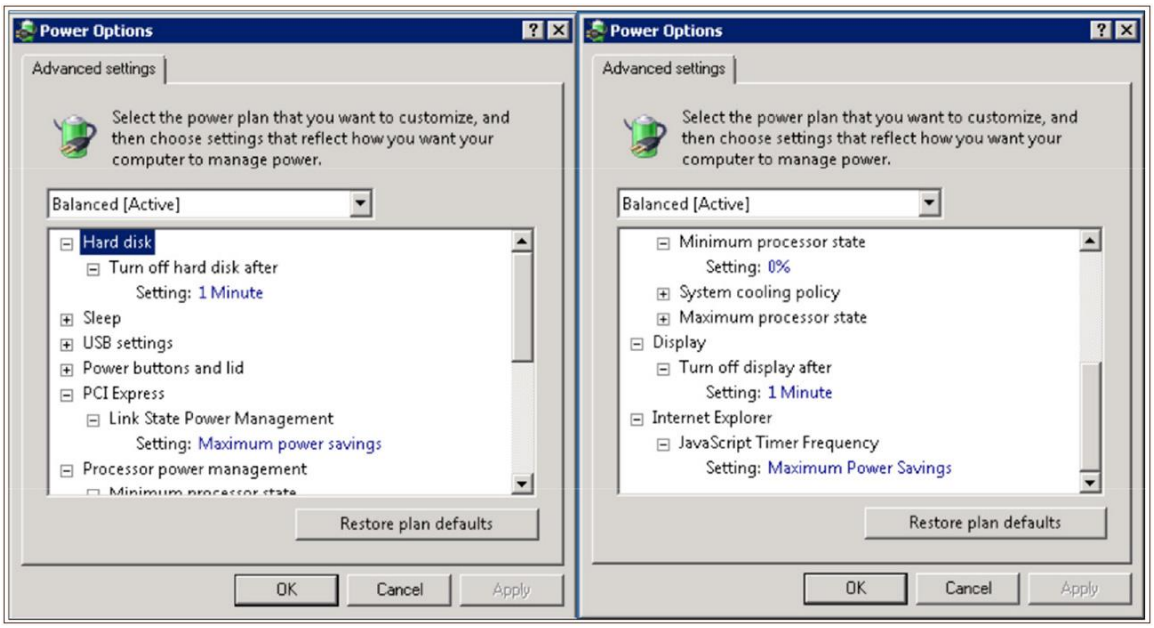
- Cisco UCS Manager GUI Configuration Guide, Release 2.0: Configuring BIOS Settings
- Dell PowerEdge 12th-Generation Server BIOS Configuration Tech Brief

Operating System

The same Microsoft Windows Server 2008 R2 Enterprise with Service Pack 1 (SP1) image was installed on each blade server.

The same operating system power management settings were used for each solution. The power management plan was set to Balanced. The specific settings are shown in Figure 7.

Figure 7. Operating System Power Management Settings



To improve Java performance, the local security policy was modified to enable the Administrator account to lock pages in memory. The security setting determines which accounts can use a process to keep data in physical memory, which prevents the system from paging data to virtual memory on disk.

Benchmark

The latest SPECpower_ssj2008 version (1.12) was installed on each blade and the control system. The Standard Performance Evaluation Corporation (SPEC), a nonprofit group of computer vendors, system integrators, universities, research organizations, publishers, and consultants, developed the SPECpower_ssj2008 benchmark. It was designed to provide a view of a server system's power consumption running Java server applications.

SPECpower_ssj2008 consists of three main software components:

- Server-Side Java (SSJ)-Workload
  - SSJ-Workload is a Java program designed to exercise the CPUs, caches, memory, scalability of shared-memory processors, Java Virtual Machine (JVM) implementations, just-in-time (JIT) compilers, garbage collection, and other aspects of the operating system of the system under test (SUT).
  - For more information, see http://www.spec.org/power/docs/SPECpower_ssj2008-Design_ssj.pdf.
- Power and Temperature Daemon (PTDaemon)
  - PTDaemon offloads the work of controlling a power analyzer or temperature sensor during measurement intervals to a system other than the SUT.
  - For more information, see http://www.spec.org/power/docs/SPEC-PTDaemon_Design.pdf.
- Control and Collect System (CCS)
  - CCS is a multithreaded Java application that controls and enables the coordinated collection of data from multiple data sources such as a workload running on a separate SUT, a power analyzer, and a temperature sensor.
  - For more information, see http://www.spec.org/power/docs/SPECpower_ssj2008-Design_ccs.pdf.

All results discussed in this document are from compliant runs. Although the tests have not been submitted to SPEC for review, Cisco can disclose the results for the purpose of this study. The comparisons comply with the required conditions outlined in the SPEC Fair Use Rules and SPECpower_ssj2008 Run Rules. All details required to reproduce these results are listed in the appendixes. The sections from each complaint run referenced in this document are included in Appendix C.

Java Virtual Machine (JVM)

The same JVM version was installed on each server and control system. The JVM version installed was IBM J9 Virtual Machine (VM): Build 2.6, Java Run Environment (JRE) 1.7.0, Microsoft Windows Server 2008 R2 amd64-64 20120322_106209, JIT enabled, and ahead-of-time (AOT) compilation enabled.

The same JVM command-line options were used on all blades:

```
-Xaggressive -Xcompressedrefs -Xmx1024m -Xms1024m –Xmn800m –XlockReservation
-Xnoloa –Xlp –XtlhPrefetch –Xthr:minimizeusercpu –Xgcthreads2
```

A complete list of JVM command-line options and their functions can be found in the IBM user guides for Java V7 on Microsoft Windows.

Each blade server was configured with two Intel Xeon processor E5-2660 CPUs, with eight cores per socket and two threads (logical processors) per core. Sixteen JVM instances were started on each server. Each JVM instance was bound to two logical processors. The following CPU affinity commands were used:

```
start /affinity (3,C,30,C0,300,C00,3000,C000,30000,C0000,300000,C00000 …
30000000,C0000000)
```

Power and Temperature Measurements

Yokogawa WT210 and WT500 Digital Power Meters were used to collect power measurements. The Yokogawa WT210 and WT500 units used were within calibration limits.

The enclosures were mounted in adjacent racks. The inlet temperature was measured at the front of each blade enclosure during testing. A Digi International Watchport/H probe was used to collect temperature and humidity data.

Appendix C: SPECpower_ssj2008 Results

Figures 8 through 15 show SPECpower_ssj2008 full disclosure report (FDR) for the Cisco and Dell solutions.

Figure 8. SPECpower_ssj2008 FDR: 1 Cisco UCS 5108 Chassis with 8 Cisco UCS B200 M3 Servers (Configuration 1)

SPECpower_ssj2008

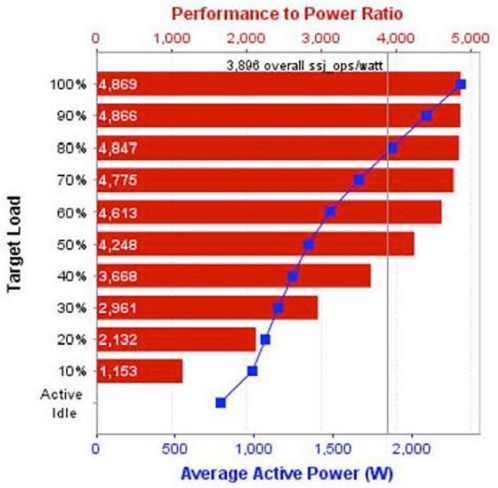
Copyright © 2007-2013 Standard Performance Evaluation Corporation

Cisco Systems, Inc. UCS B200 M3				SPECpower_ssj2008 = 3,896 overall ssj_ops/watt	
Test Sponsor:	Cisco Systems, Inc.	**SPEC License #:**	9019	**Test Method:**	Multi Node
Tested By:	Cisco Systems, Inc.	**Test Location:**	San Jose, CA, USA	**Test Date:**	Dec 24, 2013
Hardware Availability:	Mar-2012	**Software Availability:**	Jun-2013	**Publication:**	Unpublished
System Source:	Single Supplier	**System Designation:**	Server	**Power Provisioning:**	Line-powered

Set B200M3 WARNING: For point 0, elapsed nanoTime=241338656331 ns, elapsed currentTimeMillis=240022 ms

Benchmark Results Summary

Performance			Power	
Target Load	Actual Load	ssj_ops	Average Active Power (W)	Performance to Power Ratio
100%	98.6%	11,252,295	2,311	4,869
90%	89.3%	10,184,249	2,093	4,866
80%	79.6%	9,076,315	1,872	4,847
70%	69.7%	7,947,925	1,665	4,775
60%	59.9%	6,833,366	1,481	4,613
50%	50.0%	5,707,916	1,344	4,248
40%	40.0%	4,569,305	1,246	3,668
30%	30.0%	3,423,329	1,156	2,961
20%	20.0%	2,285,510	1,072	2,132
10%	10.0%	1,139,300	988	1,153
Active Idle		0	793	0
			∑ssj_ops / ∑power =	3,896



Aggregate SUT Data

# of Nodes	# of Chips	# of Cores	# of Threads	Total RAM (GB)	# of OS Images	# of JVM Instances
8	16	128	256	256	8	128

System Under Test

Shared Hardware

Shared Hardware	
Enclosure:	UCS 5108 Server Chassis
Form Factor:	6U
Power Supply Quantity and Rating (W):	4 x 2500
Power Supply Details:	Cisco P/N UCSB-PSU-2500ACPL
Network Switch:	2X UCS 6248UP
Network Switch Details:	20-Port 10Gb Fabric Interconnect
KVM Switch:	None
KVM Switch Details:	N/A
Other Hardware:	2X UCS 2204XP Fabric Extender
Comment:	2X UCS 6248UP power not included in measurement

Set: 'B200M3'

Set Identifier:	B200M3
Set Description:	System Under Test
# of Identical Nodes:	8

Figure 9. SPECpower_ssj2008 FDR: 1 Cisco UCS 5108 Chassis with 8 Cisco UCS B200 M3 Servers Including 2 Cisco UCS 6248UP Fabric Interconnects (Configuration 1)

SPECpower_ssj2008

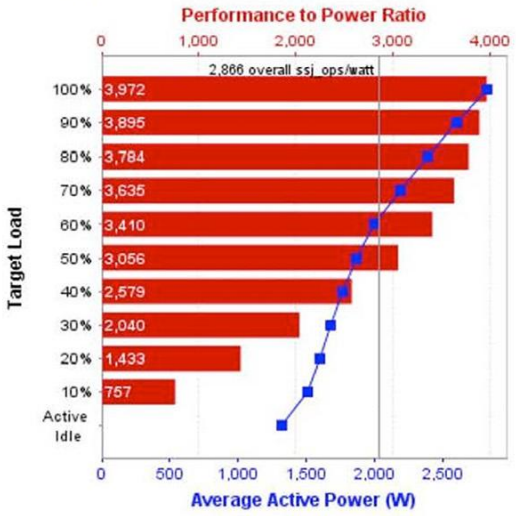
Copyright © 2007-2014 Standard Performance Evaluation Corporation

Cisco Systems, Inc. UCS B200 M3				SPECpower_ssj2008 = 2,866 overall ssj_ops/watt	
Test Sponsor:	Cisco Systems, Inc.	**SPEC License #:**	9019	**Test Method:**	Multi Node
Tested By:	Cisco Systems, Inc.	**Test Location:**	San Jose, CA, USA	**Test Date:**	Jan 26, 2014
Hardware Availability:	Mar-2012	**Software Availability:**	Jun-2013	**Publication:**	Unpublished
System Source:	Single Supplier	**System Designation:**	Server	**Power Provisioning:**	Line-powered

Set B200M3 WARNING: For point 0, elapsed nanoTime=241126514452 ns, elapsed currentTimeMillis=240085 ms

Benchmark Results Summary

Performance			Power	
Target Load	Actual Load	ssj_ops	Average Active Power (W)	Performance to Power Ratio
100%	98.3%	11,224,776	2,826	3,972
90%	89.0%	10,161,929	2,609	3,895
80%	79.4%	9,065,792	2,396	3,784
70%	69.7%	7,959,406	2,190	3,635
60%	59.9%	6,841,819	2,006	3,410
50%	50.0%	5,705,929	1,867	3,056
40%	40.0%	4,562,592	1,769	2,579
30%	30.0%	3,427,304	1,680	2,040
20%	20.0%	2,285,984	1,596	1,433
10%	10.0%	1,143,883	1,511	757
Active Idle		0	1,318	0
			∑ssj_ops / ∑power =	2,866



Aggregate SUT Data

# of Nodes	# of Chips	# of Cores	# of Threads	Total RAM (GB)	# of OS Images	# of JVM Instances
8	16	128	256	256	8	128

System Under Test

Shared Hardware

Shared Hardware	
Enclosure:	UCS 5108 Server Chassis
Form Factor:	6U
Power Supply Quantity and Rating (W):	4 x 2500
Power Supply Details:	Cisco P/N UCSB-PSU-2500ACPL
Network Switch:	2X UCS 6248UP
Network Switch Details:	20-Port 10Gb Fabric Interconnect
KVM Switch:	None
KVM Switch Details:	N/A
Other Hardware:	2X UCS 2204XP Fabric Extender
Comment:	2X UCS 6248UP power included in measurement

Set: 'B200M3'

Set Identifier:	B200M3
Set Description:	System Under Test
# of Identical Nodes:	8

Figure 10. Power and Temperature Detailed Report SPECpower_ssj2008 FDR: 1 Cisco UCS 5108 Chassis with 8 Cisco UCS B200 M3 Servers Including 2 Cisco UCS 6248UP Fabric Interconnects (Configuration 1)

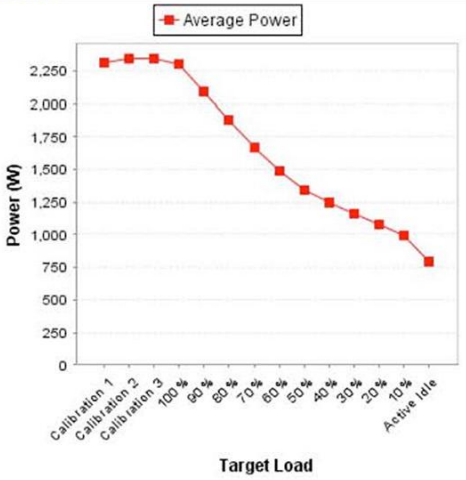
Temperature Sensor temp1	
Hardware Vendor:	Digi International
Model:	Watchport/H
Driver Version:	Watchport Virtual Port 5.10.26.0
Connectivity:	USB
PTDaemon Host System:	same as CCS
PTDaemon Host OS:	same as CCS
Setup Description:	25 mm in front of SUT main airflow intake

Notes

None

Power Details for Device pwr1

Target Load	Voltage (V)		Current (A)		Avg Power Factor	Avg Active Power (W)	Power Measurement Uncertainty (%)
	Avg	Range	Avg	Range			
Calibration 1	206	300.0	11.4	20.0	0.983	2,314	0.4%
Calibration 2	206	300.0	11.6	20.0	0.983	2,339	0.4%
Calibration 3	205	300.0	11.6	20.0	0.983	2,346	0.4%
100%	206	300.0	11.4	20.0	0.982	2,305	0.4%
90%	206	300.0	10.4	20.0	0.979	2,088	0.5%
80%	207	300.0	9.32	20.0	0.974	1,875	0.5%
70%	207	300.0	8.33	10.0	0.968	1,669	0.4%
60%	207	300.0	7.46	10.0	0.962	1,485	0.4%
50%	207	300.0	6.79	10.0	0.956	1,346	0.4%
40%	207	300.0	6.34	10.0	0.951	1,249	0.5%
30%	207	300.0	5.92	10.0	0.945	1,159	0.5%
20%	208	300.0	5.53	10.0	0.937	1,075	0.5%
10%	207	300.0	5.14	10.0	0.928	990	0.5%
Active Idle	208	300.0	4.27	5.0	0.899	797	0.4%



Power Details for Device pwr2

Target Load	Voltage (V)		Current (A)		Avg Power Factor	Avg Active Power (W)	Power Measurement Uncertainty (%)
	Avg	Range	Avg	Range			
Calibration 1	207	300.0	2.61	5.0	0.965	520	0.5%
Calibration 2	206	300.0	2.61	5.0	0.965	521	0.5%
Calibration 3	206	300.0	2.61	5.0	0.965	521	0.5%
100%	207	300.0	2.61	5.0	0.965	521	0.5%
90%	207	300.0	2.61	5.0	0.965	521	0.5%
80%	207	300.0	2.61	5.0	0.965	521	0.5%
70%	207	300.0	2.61	5.0	0.965	521	0.5%
60%	207	300.0	2.61	5.0	0.965	521	0.5%
50%	207	300.0	2.60	5.0	0.965	521	0.5%
40%	207	300.0	2.61	5.0	0.965	521	0.5%
30%	207	300.0	2.60	5.0	0.965	521	0.5%
20%	207	300.0	2.60	5.0	0.965	521	0.5%
10%	207	300.0	2.61	5.0	0.965	521	0.5%
Active Idle	207	300.0	2.60	5.0	0.965	521	0.5%

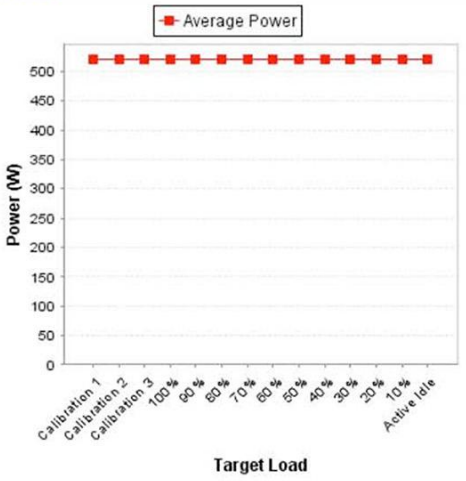


Figure 11. SPECpower_ssj2008 FDR: 2 Cisco UCS 5108 Chassis with 16 Cisco UCS B200 M3 Servers (Configuration 2)

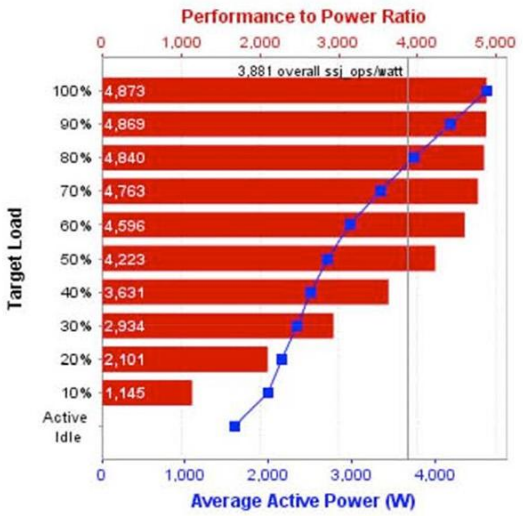
SPECpower_ssj2008

Cisco Systems, Inc. UCS B200 M3				SPECpower_ssj2008 = 3,881 overall ssj_ops/watt	
Test Sponsor:	Cisco Systems, Inc.	**SPEC License #:**	9019	**Test Method:**	Multi Node
Tested By:	Cisco Systems, Inc.	**Test Location:**	San Jose, CA, USA	**Test Date:**	Feb 1, 2014
Hardware Availability:	Mar-2012	**Software Availability:**	Jun-2013	**Publication:**	Unpublished
System Source:	Single Supplier	**System Designation:**	Server	**Power Provisioning:**	Line-powered

Set B200M3 WARNING: For point 0, elapsed nanoTime=241423012423 ns, elapsed currentTimeMillis=240022 ms
Set B200M3 WARNING: For point 0, elapsed nanoTime=242137998216 ns, elapsed currentTimeMillis=240053 ms
Set B200M3 WARNING: For point 0, elapsed nanoTime=241504341485 ns, elapsed currentTimeMillis=240053 ms
Set B200M3 WARNING: For point 0, elapsed nanoTime=241925361193 ns, elapsed currentTimeMillis=240225 ms
Set B200M3 WARNING: For point 0, elapsed nanoTime=242135114305 ns, elapsed currentTimeMillis=240037 ms

Benchmark Results Summary

Performance			Power	
Target Load	Actual Load	ssj_ops	Average Active Power (W)	Performance to Power Ratio
100%	98.6%	22,543,503	4,626	4,873
90%	89.2%	20,401,345	4,190	4,869
80%	79.5%	18,179,748	3,756	4,840
70%	69.7%	15,931,909	3,345	4,763
60%	59.9%	13,706,824	2,983	4,596
50%	50.0%	11,443,892	2,710	4,223
40%	40.0%	9,140,519	2,517	3,631
30%	30.0%	6,866,922	2,340	2,934
20%	19.9%	4,557,115	2,169	2,101
10%	10.0%	2,282,723	1,994	1,145
Active Idle		0	1,593	0
			∑ssj_ops / ∑power =	3,881



Aggregate SUT Data

# of Nodes	# of Chips	# of Cores	# of Threads	Total RAM (GB)	# of OS Images	# of JVM Instances
16	32	256	512	512	16	256

System Under Test

Shared Hardware

Shared Hardware	
Enclosure:	2X UCS 5108 Server Chassis
Form Factor:	6U
Power Supply Quantity and Rating (W):	8 x 2500
Power Supply Details:	Cisco P/N UCSB-PSU-2500ACPL
Network Switch:	2X UCS 6248UP
Network Switch Details:	20-Port 10Gb Fabric Interconnect
KVM Switch:	None
KVM Switch Details:	N/A
Other Hardware:	2X UCS 2204XP Fabric Extender per UCS 5108 Chassis
Comment:	2X UCS 6248UP power not included in measurement

Set: 'B200M3'

Figure 12. SPECpower_ssj2008 FDR: 2 Cisco UCS 5108 Chassis with 16 Cisco UCS B200 M3 Servers Including 2 Cisco UCS 6248UP Fabric Interconnects (Configuration 2)

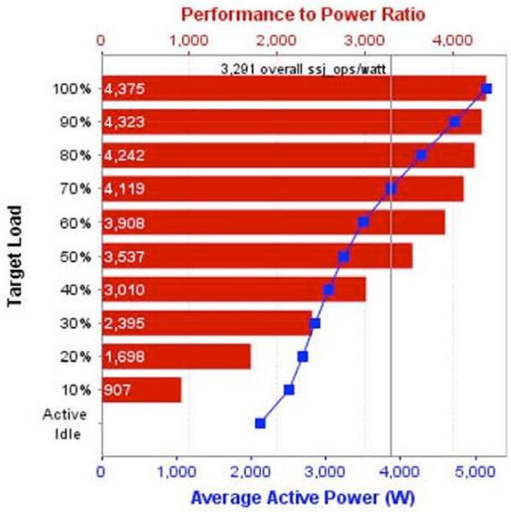
SPECpower_ssj2008

Cisco Systems, Inc. UCS B200 M3				SPECpower_ssj2008 = 3,291 overall ssj_ops/watt	
Test Sponsor:	Cisco Systems, Inc.	**SPEC License #:**	9019	**Test Method:**	Multi Node
Tested By:	Cisco Systems, Inc.	**Test Location:**	San Jose, CA, USA	**Test Date:**	Jan 28, 2014
Hardware Availability:	Mar-2012	**Software Availability:**	Jun-2013	**Publication:**	Unpublished
System Source:	Single Supplier	**System Designation:**	Server	**Power Provisioning:**	Line-powered

Set B200M3 WARNING: For point 0, elapsed nanoTime=241610597746 ns, elapsed currentTimeMillis=240115 ms
Set B200M3 WARNING: For point 0, elapsed nanoTime=241123066089 ns, elapsed currentTimeMillis=240022 ms
Set B200M3 WARNING: For point 0, elapsed nanoTime=241742741100 ns, elapsed currentTimeMillis=240007 ms
Set B200M3 WARNING: For point 0, elapsed nanoTime=241980618264 ns, elapsed currentTimeMillis=240007 ms
Set B200M3 WARNING: For point 0, elapsed nanoTime=241768520462 ns, elapsed currentTimeMillis=240038 ms

Benchmark Results Summary

Performance			Power	
Target Load	Actual Load	ssj_ops	Average Active Power (W)	Performance to Power Ratio
100%	98.5%	22,516,767	5,146	4,375
90%	89.2%	20,382,619	4,715	4,323
80%	79.3%	18,137,325	4,275	4,242
70%	69.7%	15,936,381	3,869	4,119
60%	59.9%	13,698,588	3,506	3,908
50%	50.0%	11,430,441	3,232	3,537
40%	40.0%	9,149,387	3,040	3,010
30%	30.0%	6,857,971	2,863	2,395
20%	20.0%	4,569,769	2,692	1,698
10%	10.0%	2,279,816	2,515	907
	Active Idle	0	2,114	0
			∑ssj_ops / ∑power =	3,291



Aggregate SUT Data

# of Nodes	# of Chips	# of Cores	# of Threads	Total RAM (GB)	# of OS Images	# of JVM Instances
16	32	256	512	512	16	256

System Under Test

Shared Hardware

Shared Hardware	
Enclosure:	2X UCS 5108 Server Chassis
Form Factor:	6U
Power Supply Quantity and Rating (W):	8 x 2500
Power Supply Details:	Cisco P/N UCSB-PSU-2500ACPL
Network Switch:	2X UCS 6248UP
Network Switch Details:	20-Port 10Gb Fabric Interconnect
KVM Switch:	None
KVM Switch Details:	N/A
Other Hardware:	2X UCS 2204XP Fabric Extender per UCS 5108 Chassis
Comment:	2X UCS 6248UP power included in measurement

Set: 'B200M3'

Figure 13. Power and Temperature Detailed Report SPECpower_ssj2008 FDR: 2 Cisco UCS 5108 Chassis with 16 Cisco UCS B200 M3 Servers Including 2 Cisco UCS 6248UP Fabric Interconnects (Configuration 2)

Power Analyzer pwr3

Setup Description:	Connected SUT UCS 5108 PSU 1-4

Temperature Sensor temp1

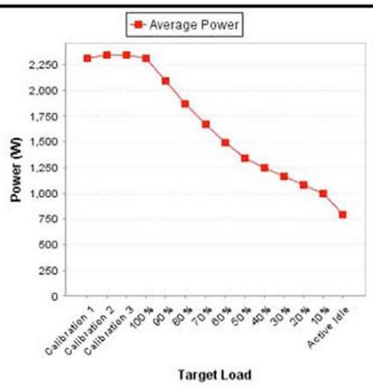
Hardware Vendor:	Digi International
Model:	Watchport/H
Driver Version:	Watchport Virtual Port 5.10.26.0
Connectivity:	USB
PTDaemon Host System:	same as CCS
PTDaemon Host OS:	same as CCS
Setup Description:	25 mm in front of SUT main airflow intake

Notes

None

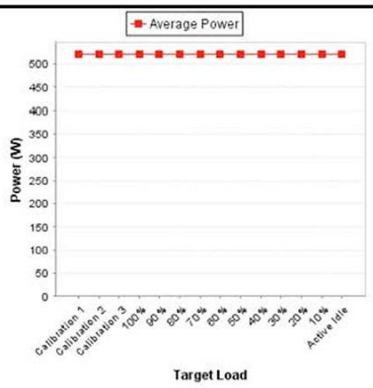
Power Details for Device pwr1

Target Load	Voltage (V) Avg	Voltage (V) Range	Current (A) Avg	Current (A) Range	Avg Power Factor	Avg Active Power (W)	Power Measurement Uncertainty (%)
Calibration 1	206	300.0	11.5	20.0	0.983	2,316	0.4%
Calibration 2	205	300.0	11.6	20.0	0.983	2,340	0.4%
Calibration 3	205	300.0	11.6	20.0	0.983	2,347	0.4%
100%	205	300.0	11.4	20.0	0.983	2,307	0.4%
90%	205	300.0	10.4	20.0	0.979	2,094	0.5%
80%	205	300.0	9.36	20.0	0.974	1,874	0.5%
70%	206	300.0	8.38	10.0	0.969	1,669	0.4%
60%	206	300.0	7.49	10.0	0.963	1,486	0.4%
50%	206	300.0	6.83	10.0	0.957	1,348	0.4%
40%	206	300.0	6.37	10.0	0.952	1,250	0.5%
30%	206	300.0	5.95	10.0	0.945	1,161	0.5%
20%	206	300.0	5.56	10.0	0.939	1,076	0.5%
10%	206	300.0	5.16	10.0	0.930	990	0.5%
Active Idle	206	300.0	4.29	5.0	0.901	797	0.4%



Power Details for Device pwr2

Target Load	Voltage (V) Avg	Voltage (V) Range	Current (A) Avg	Current (A) Range	Avg Power Factor	Avg Active Power (W)	Power Measurement Uncertainty (%)
Calibration 1	207	300.0	2.61	5.0	0.965	521	0.5%
Calibration 2	207	300.0	2.61	5.0	0.965	521	0.5%
Calibration 3	206	300.0	2.62	5.0	0.965	521	0.5%
100%	206	300.0	2.62	5.0	0.965	521	0.5%
90%	206	300.0	2.62	5.0	0.965	521	0.5%
80%	206	300.0	2.62	5.0	0.965	521	0.5%
70%	207	300.0	2.61	5.0	0.965	521	0.5%
60%	207	300.0	2.61	5.0	0.965	521	0.5%
50%	207	300.0	2.61	5.0	0.965	521	0.5%
40%	207	300.0	2.61	5.0	0.965	521	0.5%
30%	207	300.0	2.61	5.0	0.965	521	0.5%
20%	207	300.0	2.62	5.0	0.965	522	0.5%
10%	206	300.0	2.62	5.0	0.965	521	0.5%
Active Idle	206	300.0	2.62	5.0	0.965	521	0.5%



Power Details for Device pwr3

Target Load	Voltage (V) Avg	Voltage (V) Range	Current (A) Avg	Current (A) Range	Avg Power Factor	Avg Active Power (W)	Power Measurement Uncertainty (%)
Calibration 1	204	300.0	11.5	20.0	0.983	2,313	0.4%
Calibration 2	204	300.0	11.7	20.0	0.983	2,345	0.4%
Calibration 3	204	300.0	11.7	20.0	0.983	2,353	0.4%
100%	204	300.0	11.6	20.0	0.983	2,318	0.4%
90%	204	300.0	10.5	20.0	0.979	2,100	0.5%
80%	204	300.0	9.45	20.0	0.974	1,880	0.5%
70%	205	300.0	8.47	10.0	0.968	1,679	0.4%
60%	205	300.0	7.62	10.0	0.960	1,499	0.4%
50%	205	300.0	6.97	10.0	0.953	1,363	0.4%
40%	205	300.0	6.53	10.0	0.947	1,268	0.5%
30%	205	300.0	6.12	10.0	0.940	1,181	0.5%
20%	205	300.0	5.72	10.0	0.933	1,095	0.5%
10%	205	300.0	5.30	10.0	0.923	1,003	0.5%
Active Idle	205	300.0	4.38	5.0	0.886	797	0.4%

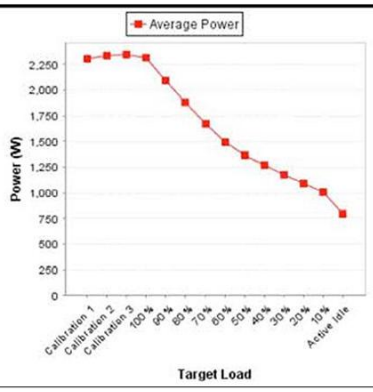


Figure 14. SPECpower_ssj2008 FDR: 1 Dell PowerEdge M1000e Enclosure with 8 Dell PowerEdge M620 G12 Servers (Configuration 1)

SPECpower_ssj2008

Copyright © 2007-2013 Standard Performance Evaluation Corporation

Dell, Inc. Dell PowerEdge M620				SPECpower_ssj2008 = 3,565 overall ssj_ops/watt	
Test Sponsor:	Cisco Systems, Inc.	**SPEC License #:**	9019	**Test Method:**	Multi Node
Tested By:	Cisco Systems, Inc.	**Test Location:**	San Jose, CA, USA	**Test Date:**	Dec 23, 2013
Hardware Availability:	Mar-2012	**Software Availability:**	Jul-2013	**Publication:**	Unpublished
System Source:	Single Supplier	**System Designation:**	Server	**Power Provisioning:**	Line-powered

Set M620 WARNING: For point 0, elapsed nanoTime=242030632682 ns, elapsed currentTimeMillis=240022 ms
Set M620 WARNING: For point 0, elapsed nanoTime=241152903689 ns, elapsed currentTimeMillis=240131 ms
Set M620 WARNING: For point 0, elapsed nanoTime=241043026693 ns, elapsed currentTimeMillis=240022 ms
Set M620 WARNING: For point 0, elapsed nanoTime=241766040049 ns, elapsed currentTimeMillis=240022 ms

Benchmark Results Summary

Performance			Power	
Target Load	Actual Load	ssj_ops	Average Active Power (W)	Performance to Power Ratio
100%	99.0%	11,269,813	2,605	4,327
90%	89.8%	10,222,863	2,256	4,532
80%	80.0%	9,107,799	1,962	4,642
70%	70.0%	7,964,801	1,902	4,188
60%	60.0%	6,826,596	1,650	4,138
50%	50.1%	5,699,576	1,507	3,783
40%	40.0%	4,558,883	1,413	3,225
30%	30.0%	3,413,237	1,263	2,703
20%	19.9%	2,270,838	1,114	2,039
10%	10.0%	1,140,253	1,018	1,120
Active Idle		0	836	0
			∑ssj_ops / ∑power =	3,565

Aggregate SUT Data

# of Nodes	# of Chips	# of Cores	# of Threads	Total RAM (GB)	# of OS Images	# of JVM Instances
8	16	128	256	256	8	128

System Under Test

Shared Hardware

Shared Hardware	
Enclosure:	Dell PowerEdge M1000e
Form Factor:	10U
Power Supply Quantity and Rating (W):	4 x 2700
Power Supply Details:	(Dell P/N K569M)
Network Switch:	Nexus 2232PP
Network Switch Details:	10GE Fabric Extender 32 Ports
KVM Switch:	Avocent iKVM Switch (Dell P/N: 0K036D)
KVM Switch Details:	N/A
Other Hardware:	2x Dell M1000e Chasis Management Controller (Dell P/N: JV95D), 2x Force10 MXL 10/40GbE Blade Switch
Comment:	Network switch power not included in measurement

Figure 15. SPECpower_ssj2008 FDR: 1 Dell PowerEdge M1000e Enclosure with 16 Dell PowerEdge M620 G12 Servers (Configuration 2)

SPECpower_ssj2008

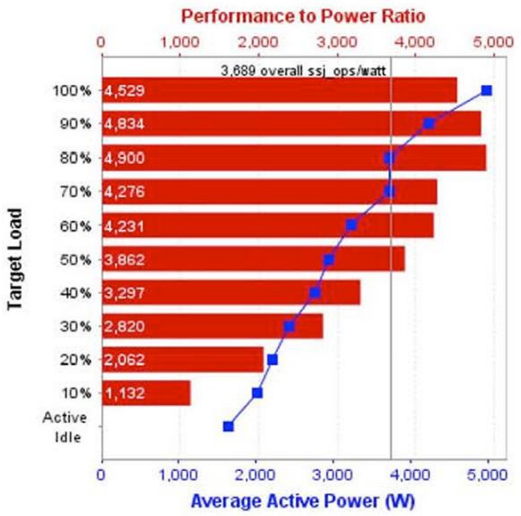
Copyright © 2007-2013 Standard Performance Evaluation Corporation

Dell, Inc. Dell PowerEdge M620				SPECpower_ssj2008 = 3,689 overall ssj_ops/watt	
Test Sponsor:	Cisco Systems, Inc.	**SPEC License #:**	9019	**Test Method:**	Multi Node
Tested By:	Cisco Systems, Inc.	**Test Location:**	San Jose, CA, USA	**Test Date:**	Dec 30, 2013
Hardware Availability:	Mar-2012	**Software Availability:**	Jul-2013	**Publication:**	Unpublished
System Source:	Single Supplier	**System Designation:**	Server	**Power Provisioning:**	Line-powered

Set M620 WARNING: For point 0, elapsed nanoTime=241513031158 ns, elapsed currentTimeMillis=240100 ms
Set M620 WARNING: For point 0, elapsed nanoTime=241343707353 ns, elapsed currentTimeMillis=240006 ms
Set M620 WARNING: For point 0, elapsed nanoTime=241598584758 ns, elapsed currentTimeMillis=240178 ms

Benchmark Results Summary

Performance			Power	
Target Load	Actual Load	ssj_ops	Average Active Power (W)	Performance to Power Ratio
100%	99.0%	22,566,700	4,982	4,529
90%	89.9%	20,473,912	4,235	4,834
80%	80.0%	18,235,248	3,721	4,900
70%	70.0%	15,944,659	3,729	4,276
60%	60.0%	13,659,931	3,229	4,231
50%	50.0%	11,389,941	2,949	3,862
40%	40.0%	9,109,267	2,763	3,297
30%	30.0%	6,838,218	2,425	2,820
20%	19.9%	4,544,314	2,204	2,062
10%	10.0%	2,278,119	2,012	1,132
Active Idle		0	1,641	0
			∑ssj_ops / ∑power =	3,689



Aggregate SUT Data

# of Nodes	# of Chips	# of Cores	# of Threads	Total RAM (GB)	# of OS Images	# of JVM Instances
16	32	256	512	512	16	256

System Under Test

Shared Hardware

Shared Hardware	
Enclosure:	Dell PowerEdge M1000e
Form Factor:	10U
Power Supply Quantity and Rating (W):	6 x 2700
Power Supply Details:	(Dell P/N K569M)
Network Switch:	Nexus 2232PP
Network Switch Details:	10GE Fabric Extender 32 Ports
KVM Switch:	Avocent iKVM Switch (Dell P/N: 0K036D)
KVM Switch Details:	N/A
Other Hardware:	2x Dell M1000e Chasis Management Controller (Dell P/N: JV95D), 2x Force10 MXL 10/40GbE Blade Switch
Comment:	Network switch power not included in measurement

Set: 'M620'

Americas Headquarters
Cisco Systems, Inc.
San Jose, CA

Asia Pacific Headquarters
Cisco Systems (USA) Pte. Ltd.
Singapore

Europe Headquarters
Cisco Systems International BV Amsterdam,
The Netherlands

Cisco has more than 200 offices worldwide. Addresses, phone numbers, and fax numbers are listed on the Cisco Website at www.cisco.com/go/offices.

Printed in USA C11-731237-00 03/14