An evaluation of blade server power efficiency for the HP ProLiant BL260c G5, Dell PowerEdge M600, and IBM BladeCenter HS21 using the SPECjbb2005 Benchmark

HP

The HP Difference

The ProLiant BL260c G5 is a new class of server blade designed to meet the needs of the small to mid-market businesses that value simplicity and flexibility at an entry level price.

The low wattage Intel Xeon processor enables greater density, providing excellent performance/watt efficiencies for power-constrained IT environments.

HP 2P, Quad-Core ProLiant BL260c G5 server blade

The ProLiant BL260c G5, when fully optimized, defeated Dell and IBM two-processor competitors for performance and performance/watt[1]

More information about the SPECjbb2005 benchmark can be found at the following Web page:

http://www.spec.org/benchmarks.html#java

Key results at a glance:

n With a fully optimized configuration, the ProLiant BL260c G5 server blade scored an impressive 64.3% better performance/watt than the Dell PowerEdge M600.[1]

n The performance results display how the HP BladeSystem c-Class two-processor server blades optimize the latest Quad-Core Intel® Xeon® technology utilizing the E5400 series.

n In a direct comparison, the HP ProLiant BL260c G5 server blade with HP Thermal Logic Technology achieved 11.7% and 43.7% better performance/watt than Dell and IBM competitors, respectively.[1]

Summary

HP evaluated the performance and energy efficiency of the HP ProLiant BladeSystem c-Class with the ProLiant BL260c G5 and compared results to those from the December 2007 Principled Technologies report on the Dell PowerEdge M600 and the IBM BladeCenter HS21 server blades utilizing the SPECjbb2005 benchmark.[1] HP's comparison of HP's server blade result and the Principled Technologies report showed that the HP ProLiant BL260c G5 server blade attained the highest performance/watt in all configurations run.

The first test configuration that HP ran on the ProLiant BL260c G5 demonstrated the greater performance and efficiency that is realized with the use of HP Thermal Logic Technologies including CPU, memory, and enclosure-level power and thermal optimizations. Competitor comparison configurations for the first test were obtained from the Principled Technologies December 2007 report. This test configuration was a baseline comparison with the ProLiant BL260c G5 using the same CPU, the same amount of memory, and the same software-level tuning parameters as the configurations used for Dell and IBM in the Principled Technologies December 2007 report.

The second test case, run on the ProLiant BL260c G5, used an optimized configuration and showed a 64% greater energy efficiency when compared to the Dell and IBM results as referenced in the Principled Technologies December 2007 report.

Table 1 provides information on the both HP tests, highlighting the ProLiant BL260c G5's leading performance/watt comparison with Dell and IBM. Higher results show better system performance/watt.

Table 2 shows the second test results for the HP ProLiant BL260c G5, with the optimized configurations, achieving higher performance/watt scores than the Dell M600 score from the Principled Technologies report.

Table 3 shows detailed information on the first test results with the ProLiant BL260c having higher performance/watt when compared to Dell and IBM's results from the Principled Technologies December 2007 report. All HP ProLiant BL260c servers tested were configured with HP Thermal Logic technology.

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[1] Results for Dell and IBM comparison are from the Principled Technologies Dec. 27 Report, "SPECjbb2005 performance and power consumption on Dell, HP, and IBM Blade Servers"
http://www.principledtechnologies.com/Clients/Reports/Dell/DellHPIBMbladeserverPwrPerf1207.pdf

Figure 1. Comparison of performance/watt results of the HP ProLiant BL260c G5 two-processor Quad-Core server with a fully populated blade enclosure and using Thermal Logic technology vs. competitors on the SPECjbb2005 benchmark using E5345 processors. Dell and IBM results are taken from the Principled Technologies December 2007 report. (See full configuration in Appendices A and B sections. All results as of 03-31-08).
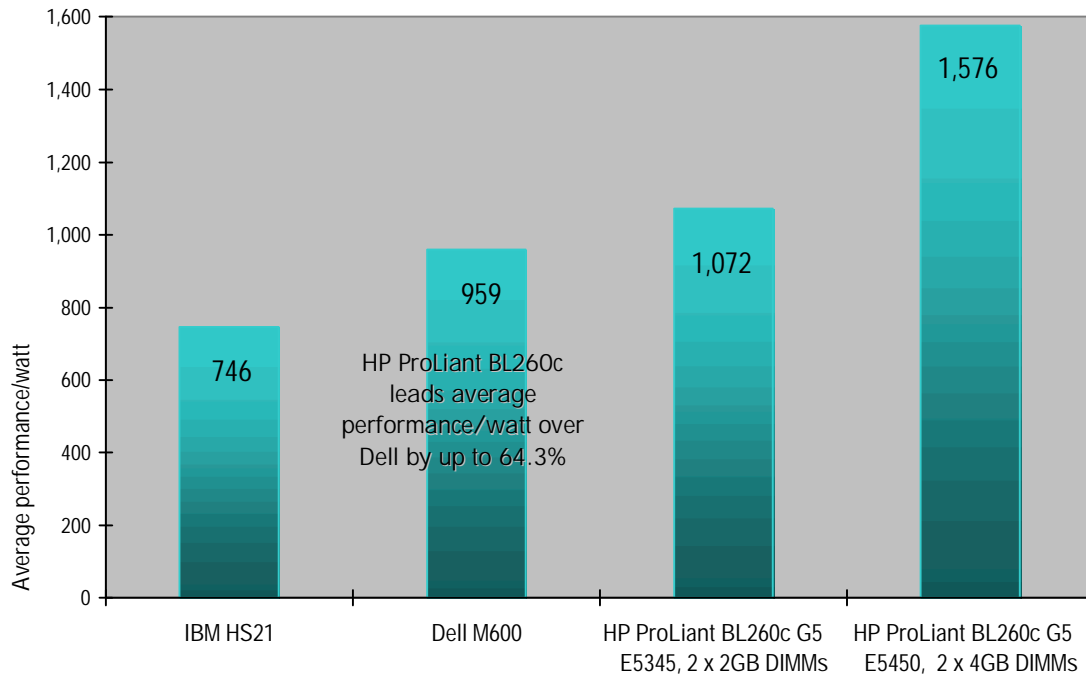

Table 1. Average performance /watt results for the HP ProLiant BL260c G5 server blade utilizing two different configurations and fully populated blade enclosures compared to the Dell PowerEdge M600 and the IBM BladeCenter HS21. Dell and IBM results are taken from the Principled Technologies December 2007 report.

	HP ProLiant BL260c G5 server blade (baseline configuration)	HP ProLiant BL260c G5 server blade	Dell PowerEdge M600 (baseline configuration)[2]	IBM BladeCenter HS21 (baseline configuration)[2]
Average performance/watt	1,071.8	1,575.7	958.9	745.7

HP Thermal Logic Technology

With built-in instrumentation, accurate monitoring and control, and the ability to pool, share and allocate the right amount of power and cooling to match demand, HP Thermal Logic ensures blade solutions do not waste a watt of power or a gram of air. Its benefits include:

- Less hot air in the datacenter: Less heat from less power, plus less air pushed into the datacenter

- Extending the life of the datacenter. Powers more servers for less energy and cooling

- Supporting full-featured server blades: Efficient design with capacity to support features equal to enterprise class 2

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[2] Information gathered from Principled Technologies December 2007 report.
http://www.principledtechnologies.com/Clients/Reports/Dell/DellHPIBMbladeserverPwrPerf1207.pdf

Workload

SPECjbb2005

SPECjbb2005 is an industry-standard benchmark created by the Standard Performance Evaluation Corp. (SPEC) to measure a server's Java performance. SPEC modeled SPECjbb2005 on the three-tier client/server architecture, with the middle layer as the primary focus. SPECjbb2005 utilizes multiple special data groups and multiple threads as it runs. Each data unit is a "warehouse", which is roughly a 25MB collection of data objects. Each thread represents an active user posting transaction requests within a warehouse. The benchmark run begins with one warehouse, and then increases the number of warehouses; its goal is to saturate the server's processor capacity. As the number of warehouses increases, so does the number of threads. The benchmark's results portray the server's throughput in business operations per second or SPECjbb2005 bops. A higher number of SPECjbb2005 bops is better.

For more information on SPECjbb2005, please visit www.spec.org.

Description of the test results

Test measurements

The testing on the HP ProLiant BL260c G5 was performed by HP engineers in Houston, TX on March 14, 2008. The Dell PowerEdge M600 and IBM BladeCenter HS21 test results were taken from the Principled Technologies December 2007 report, "SPECjbb2005 performance and power consumption on Dell, HP, and IBM Blade Servers".

For the ProLiant BL260c G5 test, HP installed 16 blade servers into the HP BladeSystem c7000 Enclosure and ran SPECjbb2005 on all servers. For the baseline test configuration, two JVM instances were run at the same time, each instance affinitized to one socket, a common practice on servers with many processors. To compute the overall score for the system, SPECjbb2005 sums the scores of all the JVMs. SPECjbb2005 computes the score of each JVM by taking the average of the results during mixes when the server is running at peak performance. Utilizing SPEC's terms, these results are from "compliant" runs, meaning that they can be disclosed publicly without posting them on the SPEC website with all the files SPEC usually requires. However, all the data necessary to reproduce these results are given. The following JVM flags were used for the first test configuration: -Xms1600m -Xns1300m -Xmx1600m -XXaggressive -XXlargepages -XXcallprofiling -Xgc:genpar -XXthroughputCompaction -XXlazyunlocking -XXtlasize:min=4k,preferred=256k.

In the fully optimized test configuration, four JVM instances were run at the same time, each instance affinitized to a pair of cores. The Windows swap file was disabled, and the following JVM flags were used for the fully optimized test configuration: -Xms1600m -Xns1300m -Xmx1600m -XXaggressive -XXlargepages -XXcallprofiling -Xgc:genpar -XXgcthreads:2 -XXthroughputCompaction -XXlazyunlocking -XXtlasize:min=12k,preferred=256k.

HP used the following formula to calculate the performance/watt: Performance/watt = the benchmark's score divided by the average power consumption in watts during the period the system achieved peak performance.

Test methodology

HP used the SPECjbb2005 benchmark for this test. This is the same benchmark used on the Principled Technologies, Inc. December 2007 report, "SPECjbb2005 performance and power consumption on Dell, HP, and IBM blade servers". For a copy of this report, please link to
http://www.principledtechnologies.com/Clients/Reports/Dell/DellHPIBMbladeserverPwrPerf1207.pdf

The test methodology operations performed by Principled Technologies during their evaluation of the Dell PowerEdge M600 and the IBM BladeCenter HS21 are the same as those utilized by HP during the ProLiant BL260c testing. Any exceptions to the Principled Technologies report operations are noted below:

- HP used HP ProLiant Essentials Rapid Deployment Pack to propagate the OS image to all blade servers
- Power measurements were taken with a Voltech PM3000 Power Analyzer (www.voltech.com). The Voltech PM3000 Power Analyzer is equipped with three power measurement channels. HP connected two of the HP BladeSystem c7000 Enclosure power supplies to channel 1, one power supply to channel 2, and the remaining power supply to channel 3. The PM3000 was configured to return the sum of the power consumed on each channel.

HP then ran SPECjbb2005 on two system configurations for the ProLiant BL260c G5 and recorded the performance/watt during these runs. The results are shown in the tables below:

Table 2. Results: Performance/watt, SPECjbb2005 bops, average peak watts, and average idle watts. The Dell server utilized Quad-Core Intel Xeon E5345 processors. The ProLiant BL260c G5 was fully optimized with HP Thermal Logic Technology harnessing 2 Quad-Core Intel Xeon E5450 processors, 4 PSUs, 2 4GB low power DIMMs, and Static Low Power State. All Dell numbers listed below were obtained from the Principled Technologies December 2007 report.

	Dell M600	HP BL260c G5	%• (HP over Dell)
Perf/watt	958.86	1,575.66	64.33%
Average SPECjbb2005 BOPS	211,054	232,232	10.03%
Average Peak Watts	3,524.19	2,358.20	-33.09%
Average Idle Watts	2,416.18	1,412.16	-41.55%

Table 3. Results: Performance/watt, SPECjbb2005 bops, average peak watts, and average idle watts. The servers utilized Quad-Core Intel Xeon E5345 processors. The ProLiant BL260c G5 harnessed HP Thermal Logic Technologies with a configuration of 4 PSUs, 2 2GB low power DIMMs, and Static Low Power State. All Dell and IBM numbers listed below were obtained from the Principled Technologies December 2007 report.

	HP BL260c G5	Dell M600	%• (HP over Dell)	IBM HS21	%• (HP over IBM)
Perf/watt	1,071.78	958.86	11.78%	745.7	43.73%
Average SPECjbb2005 BOPS	187,968	211,054	-10.94%	186,121	1.00%
Average Peak Watts	2,806.06	3,524.19	-20.38%	3,494.45	-19.7%
Average Idle Watts	1,869.52	2,416.18	-22.62%	2,409.92	-22.42%

Disclaimer

The measured results shown reflect numbers as of the release date of this document. Due to the nature of system performance and the test harness used, the benchmark used for this investigation may not yield the same results as other benchmarks with different workloads. Further development of hardware or software used could potentially change these measurement results.

Appendix A – Enclosure configuration information

Detailed enclosure information for blade servers. Enclosure information for Dell and IBM were obtained from the Principled Technologies December 2007 report.

Enclosure	HP ProLiant BL260c G5	Dell PowerEdge M600	IBM BladeCenter HS21
General information			
U size	10	10	9
Number of server blades	16	16	14
Power supplies			
Total	4	6	2
Wattage rating per power supply	2,250	2,360	2.900
Cooling fans			
Total	10	9	2 blowers
Voltage/Amps	12 volts/16.5 amps	12 volts/7 amps	200-240 volts/5.5 amps

Appendix B – Blade system configuration information

Detailed system configurations for blade servers. Configuration information for Dell and IBM were obtained from the Principled Technologies report.

Servers	HP ProLiant BL260c G5 E5345 processors	HP ProLiant BL260c G5 E5450 processors	Dell PowerEdge M600	IBM BladeCenter HS21
General processor setup				
Number of processors	2	2	2	2
Number of cores per processor	4	4	4	4
Number of threads per core	1	1	1	1
System Power Management	Always on	Always on	Always on	Always on
CPU				
Processor	Quad-Core Intel Xeon processor 5345	Quad-Core Intel Xeon processor 5450	Quad-Core Intel Xeon processor 5345	Quad-Core Intel Xeon processor 5345
CPU stepping	7	7	B	7
Core frequency	2.33GHz	3.00GHz	2.33GHz	2.33GHz
Front-side bus frequency	1,333MHz	1,333MHz	1,333MHz	1,333MHz
L1 cache per core	32KB + 32KB	32KB + 32KB	32KB + 32KB	32KB + 32KB
L2 cache	2 x 4MB (each 4MB shared by 2 cores)	2 x 6MB (each 6MB shared by 2 cores)	2 x 4MB (each 4MB shared by 2 cores)	2 x 4MB (each 4MB shared by 2 cores)
Platform				
Server blade and model number	HP ProLiant BL260c G5	HP ProLiant BL260c G5	Dell PowerEdge M600	IBM BladeCenter HS21
Motherboard model	HP P/N 466623-001	HP P/N 466623-001	DellOMY736	IBM 8853C2U
Chipset	Intel 5100	Intel 5100	Intel 5000P	Intel 5000P
Motherboard rev. number	X05	X05	X31	B1
BIOS version	HP I20 1/30/2008	HP I20 1/30/2008	Dell 0.2.11	IBM 1.07 (10/26/2007)
Advanced BIOS settings	Disabled Hardware Prefetcher and Adjacent Cache Line Prefetcher	Disabled Hardware Prefetcher and Adjacent Cache Line Prefetcher	Disabled Hardware Prefetcher and Adjacent Cache Line Prefetcher	Disabled Hardware Prefetcher and Adjacent Cache Line Prefetcher
Chipset driver version	Microsoft 5.2.3790.1830	Microsoft 5.2.3790.1830	Intel 7.4.1005	Intel 7.4.1005

Servers	HP ProLiant BL260c G5 E5345 processors	HP ProLiant BL260c G5 E5450 processors	Dell PowerEdge M600	IBM BladeCenter HS21
Memory module(s)				
Memory vendor and model number	Hynix HYMP125P72CP4-Y5	Hynix HYMP151P72CP4-Y5	Samsung M395T2953EZ4-CE65	Hynix HYMP512F72CP8D2-Y5
Memory type	PC2-5300P	PC2-5300P	PC2-5300F	PC2-5300F
Speed	667MHz	667MHz	667MHz	667 MHz
Timing/Latency	5-5-5-12	5-5-5-12	5-5-5-15	5-5-5-15
DIMM size	4GB (2 x 2GB)	8GB (2 x 4GB)	4GB (4 x 1GB)	4GB (4 x 1GB)
Number of memory modules	2	2	4	4
Chip ranking	Dual side	Dual side	Dual side	Dual side
Hard disk				
Hard disk vendor and model number	Fujitsu MHT2060BS	Fujitsu MHT2060BS	Fujitsu may2073rc	IBM 26K5777
Number of disks	2	1	2	2
Disk capacity	60GB	60GB	73GB	73.4GB
Disk buffer size	8MB	8MB	16MB	8MB
Disk RPM	5400	5400	10,000	10,000
Disk type	SATA	SATA	SAS	SAS
Disk controller	Intel ICH9R	Intel ICH9R	Dell SAS 6i/R Integrated Blades Controller	LSI Adapter, SAS 3000 series
Disk controller driver	HP 1.4.17015	Microsoft 5.2.3790.1830	Dell 1.24.4.0	LSI 1.21.28.0
Operating system				
OS name	Microsoft Windows Server 2003, Enterprise x64 Edition	Microsoft Windows Server 2003, Enterprise x64 Edition	Microsoft Windows Server 2003, Enterprise x64 Edition	Microsoft Windows Server 2003, Enterprise x64 Edition
OS build number	3790	3790	3790	3790
OS Service Pack	SP2	SP2	SP2	SP2
Microsoft Windows updates	SP2 plus updates through 11/29/07	SP2 plus updates through 11/29/07	SP2 plus updates through 11/29/07	SP2 plus updates through 11/29/07
OS file system	NTFS	NTFS	NTFS	NTFS
OS kernel	ACPI Multiprocessor x64-based PC	ACPI Multiprocessor x64-based PC	ACPI Multiprocessor x64-based PC	ACPI Multiprocessor x64-based PC
Graphics				
Graphics vendor and model number	ATI ES1000	ATI ES1000	ATI ES1000	ATI ES1000
Graphics chipset	ATI ES1000	ATI ES1000	ATI ES1000	ATI ES1000
Graphics BIOS version	BK-ATI VER008.005.031.000	BK-ATI VER008.005.031.000	BK-ATI VER008.005.031.000	BK-ATI VER008.005.031.000
Graphics type	Integrated	Integrated	Integrated	Integrated
Graphics memory size	32MB	32MB	32MB	16MB
Graphics resolution	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768
Graphics driver	Microsoft 5.2.3790.1830	Microsoft 5.2.3790.1830	ATI 8.240.50.1000	ATI 8.24.3.0

Servers	HP ProLiant BL260c G5 E5345 processors	HP ProLiant BL260c G5 E5450 processors	Dell PowerEdge M600	IBM BladeCenter HS21
Network card/subsystem				
NIC vendor and model number	Broadcom 5715S	Broadcom 5715S	Broadcom BCM5708S NetXtreme II GigE	Broadcom BCM5708S NetXtreme II GigE
NIC type	Integrated	Integrated	Integrated	Integrated
NIC driver	Broadcom 10.62.0.0	Broadcom 10.62.0.0	Broadcom 3.5.8.0	Broadcom 3.5.8.0
Optical drive				
Optical drive vendor and model number	None installed	None installed	None installed	None installed
USB ports				
Number of ports	2	2	2	2
USB type	USB 2.0	USB 2.0	USB 2.0	USB 2.0

For more information

HP ProLiant BL260c G5 server blade: www.hp.com/servers/bl260c

HP ProLiant BladeSystem c-Class: www.hp.com/servers/BladeSystemc-class

HP ProLiant storage solutions: www.hp.com/go/serial and
http://h18004.www1.hp.com/products/servers/platforms/storage.html

HP Thermal Logic technology: www.hp.com/thermallogic

SPECjbb2005 details: http://www.spec.org/benchmarks.html