Evaluating Blade Server Power Consumption: An Independent Analysis of Dell’s Power Efficiency Comparison Study

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Executive Summary
Driven by the significant operation costs savings that can be achieved by reducing data center power consumption, businesses are looking to invest in energy efficient IT platforms, such as those found in several of today’s advanced blade server architectures. The challenge for many organizations is identifying which solution provides the optimal performance and energy savings to support their particular business goals. In a recently published study, Dell provided details of its comparative analysis of power efficiency for its own enterprise-class blade server platform and comparable solutions offered by HP and IBM. ENTERPRISE MANAGEMENT ASSOCIATES® (EMA™) analysts have reviewed both the methodology and results of this study to assess their validity and relevance.

Blade Server Energy Efficiency
The fundamental objective for achieving data center efficiency is to provide more IT services with less managed resources. Clearly, this concept has been embraced by the business community as enterprises have increasingly focused on introducing greater data center efficiencies. In particular, the reduction of energy consumption in the data center has been recognized as a key enabler for reducing operational costs without compromising IT productivity. The U.S. Environmental Protection Agency (EPA) has projected data center power consumption in the commercial sector alone to account for roughly 2.5% of all the nation’s energy consumption in 2011, resulting in a whopping 7.4 billion in annual electric costs.

To curb the rapidly growing expenses, as well as to meet regulatory compliance and environmental impact reduction goals, businesses have employed a number of energy reduction programs, the two most popular being server consolidation and hardware efficiency improvements. In fact, in an EMA survey of 250 IT professionals, 79% of organizations that have introduced power reduction initiatives indicated server consolidation as an essential part of their program, and 73% reported upgrading to more energy efficient platforms. Central to both these top two energy reduction initiatives is the introduction of power efficient blade servers that facilitate the consolidation of IT services while minimizing energy consumption.

Naturally, being a critical component in the purchase decision process for many organizations, energy efficiency has been marketed heavily by the leading blade server manufacturers, promoting a variety of power reduction features. For many businesses, the evaluation process has been complicated by the introduction of software and firmware level applications designed to reduce resource utilization in several different ways to conserve power consumption. Unfortunately, these diverse approaches to energy reduction have left many IT managers bewildered on how to achieve a true apples-to-apples product comparison to identify the best solutions to meet their unique requirements.

Recently, Dell released the results of an extensive blade server power consumption evaluation. The goal of the project was to utilize industry testing standards to establish as close to identical operating conditions across the evaluated systems. Included in the study were three of today’s most popular blade platforms:
The Dell PowerEdge M1000e fully populated with 16 PowerEdge M610 blade servers
The HP BladeSystem C7000 fully populated with 16 ProLiant BL460C G6 blade servers
The IBM BladeCenter H fully populated with 14 BladeCenter HS22 blade servers

EMA has taken the opportunity to review this testing process and analyze the results with an objective eye toward ensuring the reliability of the published data.

**Reviewing the Methodology**

When selecting an industry standard benchmark for evaluating the power and performance characteristics of volume server class computers, there is really only one choice that has been widely accepted and adopted. The SPECpower_ssj2008 benchmark was developed by the Standard Performance Evaluation Corporation (SPEC) with the support of sponsor members including Dell, HP, IBM, Intel, and Sun Microsystems. Dell wisely chose this benchmark not only for its broad acceptance, but also because it was developed to be both hardware and operating system agnostic, so it can provide comparable results regardless of the platforms being evaluated. It is important to recognize that different architectures will perform differently under certain unique conditions. However, for the purpose of a general test, EMA believes the SPECpower_ssj2008 benchmark provides as close to a common and fair evaluation environment as can currently be achieved.

**Blade Server Configurations**

The fully populated Dell M1000e, HP C7000, and IBM BladeCenter H enclosures were commonly configured and installed with Windows Server 2008 Enterprise R2 on each blade. EMA has confirmed that the driver and firmware updates Dell reported installed on the systems were the most recent available from each manufacturer at the time of testing. Identical CPU types (2 x Intel Xeon X5670 2.933 GHz), memory (6 x 4GB 1333MHz DDR3 RDIMM), and disk drives (2 x 73GB 15K SAS) were utilized in each blade configuration. Although BIOS setting options differ on each of the architectures, EMA has evaluated the BIOS configurations that were used in the testing as reported by Dell and found them to be consistent with the optimal settings recommended by each of the manufacturers.

The operating system power settings were identically tuned with one notable exception. Dell and HP provide BIOS Power Management algorithms (respectively, the Dell Active Power Controller and the HP Dynamic Power Saver) that automatically reduce aggregate processor energy consumption during low-use periods. The IBM blade solution does not have a BIOS Power Management algorithm, so to similarly configure how processors are regulated on all three platforms, the minimum processor state was set to 0% and the maximum was set to 100% within the operating system on the IBM system, allowing Windows to vary the processing speed (and related power draw) as required. EMA believes this is as accurate a method as possible for standardizing the processor speed.

Ensuring consistent thermal conditions on the test systems is essential for a fair comparison test as overheating can cause a significant increase in energy consumption. To guarantee appropriate cooling,
Dell placed two floor vents in front of the area used in each blade chassis measurement. Also, when one chassis was measured, the others were powered off, so the heat generated by one test system did not interfere with the others. A Digi Watchport/H temperature sensor was placed in front of each blade chassis and the results were reviewed to be certain the ambient temperature did not vary by more than 1-2 degrees Celsius.

Testing Configurations

The SPECpower_ssj2008 benchmark involves the testing of three primary software components, all of which were utilized in the testing process:

- **Server Side Java (SSJ) Workload** – Selected by SPEC for its scalability and portability to a variety of architectures, this Java database stresses the processors, caches, and memory of the systems being tested. The IBM J9 Java Virtual Machine (JVM) has been independently recognized as currently providing the best performance for SPECpower_ssj2008 testing. Dell adopted this platform for the analysis and tuned it identically on all test systems for optimal performance on systems with large memory configurations.

- **Power and Temperature Daemon (PTDaemon)** – A process that delivers the power analyzer and temperature sensor measurements to an independent data repository.

- **Control and Collect System (CCS)** – A multi-threaded Java application that manages the collection of data from multiple sources.

The Yokogawa WT210 Digital Power Meter was utilized for the actual power measurement of the blade enclosures. This meter is included in the SPECpower list of accepted power analyzers and EMA has identified it as a commonly utilized resource in a number of independent SPECpower_ssj2008 evaluations. Two meters were attached identically to the Dell and HP platforms. Due to architectural differences, three meters had to be used to monitor power on the IBM systems in a slightly different configuration, although EMA is satisfied that this alteration would not skew the results.

Evaluating the Results

Following the SPECpower_ssj2008 benchmark process, power consumption was measured on all three platforms while they were idle. The workload was introduced and measured at utilization increments of 10%. In the published test results, the Dell solution was consistently identified as the lowest power consumer at each interval. Dell performed particularly well when the systems were idle – 24.1% less power than the HP blade solution and a whopping 63.6% less than the IBM blade solution. For the IBM solution, C-states are disabled by default, which is not ideal for power efficiency at low utilizations, so C-states were enabled for this testing. Interestingly, as workloads are introduced and increased, the IBM solution significantly improves in its power efficiency, overtaking the HP solution to achieve by much as 10% better power efficiency when the systems were fully engaged at 100% utilization. Dell appears to edge out the IBM solution by only 1 or 2 percent at every workload interval, although it should be noted that the fully populated IBM chassis does so while supporting two less blade servers. Factoring a reasonable margin of error, this indicates comparable results between the two solutions in active operation, but clearly indicates the advantage to Dell when the systems are running idle.
Since it’s critical to understand how much processing is actually being performed at each load interval, the next SPECpower_ssj2008 measurement identifies performance-to-watt ratios – that is, how much processing occurs for every watt of power consumed. The HP and IBM solutions displayed comparable results in this analysis, but both lagged by as much as 14% behind Dell when operating at 100% utilization. Although the HP solution was noted to have similar throughput to the Dell system, it appears to draw significantly more power to achieve the same performance, diminishing its results in this particular test.

After all data is collected, an overall SPECpower_ssj2008 score was calculated by adding each server’s performance results across all test intervals and then dividing by its total power consumed across all test intervals. The final scores reported by Dell are as follows (in ssj_ops/watt):

<table>
<thead>
<tr>
<th>Solution</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dell Blade Solution</td>
<td>2,530</td>
</tr>
<tr>
<td>HP Blade Solution</td>
<td>2,197</td>
</tr>
<tr>
<td>IBM Blade Solution</td>
<td>2,068</td>
</tr>
</tbody>
</table>

**EMA Perspective**

Although EMA was not present during the actual testing, after careful assessment of the documented process, EMA was unable to identify any notable errors in the evaluation process and concludes that the testing methodology employed by Dell was sound and consistent with processes outlined in the SPECpower_ssj2008 benchmark. It follows, then, that the results can be expected to be accurate and reproducible. Certainly, that’s great news for Dell, having scored as much as 15% better than its nearest competition in the study.

It should be noted that all three solutions performed exceptionally well in this testing and any of these leading solutions can be expected to achieve significant reduction in energy consumption when compared to solutions that are not focused on power efficiency in their design or, worse, distributed environments consisting of independent servers. Only when the leading blade solutions are compared side-by-side do real performance differences become evident. For instance, organizations with IT services that experience a good deal of idle time – such as during evenings and weekends – would be better served with the Dell or HP solutions than with the IBM platform.

Although the SPECpower_ssj2008 benchmark provides as close as currently possible to a true apples-to-apples power efficiency evaluation, it cannot account for every possible use case. Radically different workloads may generate alternative results than presented in the Dell analysis. Without a doubt, reducing energy consumption in a data center infrastructure provides real, measurable, and appreciable operational cost savings to a business, but it is not the only factor to be considered in determining which platforms or vendors to invest in. EMA advises all businesses take into consideration their own unique service requirements before making any final purchase decisions.