SPECpower_ssj2008 - Driving Server Energy Efficiency

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ABSTRACT
SPECpower_ssj2008 [1] is the first industry-standard SPEC [2] benchmark that evaluates the power and performance characteristics of volume server-class and multi-node class computers. This poster-paper gives an overview of the benchmark that defines the server power measurement standards [8] in the same way SPEC have done for performance.

Categories and Subject Descriptors
H.3.4 [**Systems and Software**]: Performance evaluation (efficiency and effectiveness)

General Terms
Design, Experimentation, Measurement, Performance, Reliability, Standardization

Keywords
SPEC, SPECpower, Rating Tool, Benchmark, Energy Efficiency, Power, Server, Storage, Datacenter, ENERGY STAR, Environmental Protection Agency, EPA

1. SPECPOWER_SSJ2008
The general approach [3] is to compare measured performance with measured power consumption. An initial requirement was to include power measurement data of a system running at different target load levels to reflect the fact that data center server systems run at different target loads relative to maximum throughput.

2. CONFIGURATION OVERVIEW
The simplest SPECpower_ssj2008 hardware measurement configuration [7] requires four main hardware components: one **Power Analyzer**, one **Temperature sensor,** a **SUT** and the **Controller**. SPECpower_ssj2008 is composed of several elements; with the first is the test Control and Collect System (**CCS**) [4]**,** which handles the logistical side of measuring and recording the power consumption and inlet temperature of the SUT. It also controls the software installed on both the SUT and Controller, communicating via the TCP/IP transport protocol.

CCS communicates with the **Director**, which instructs the SUT to execute the **workload** [5] while CCS collects the power and temperature data.

The temperature sensor must be placed no more than 50mm in front of (upwind of) the main airflow inlet of the SUT. SPECpower_ssj2008 will measure the inlet temperature of the SUT and marks the results "valid" only if the temperature measured is 20°C or higher, in order to discourage the "gaming" of the test environment. A stable temperature value is not required during warm-up or measurement phases.

The power analyzer must be located between the AC Line Voltage Source and the SUT. Both are connected to the Controller via their device specific interfaces, as shown in Figure 1. Each analyzer and sensor interacts with its dedicated instance of the **SPEC PTDaemon** [6]**,** which gathers their readings while the worklets are executed.

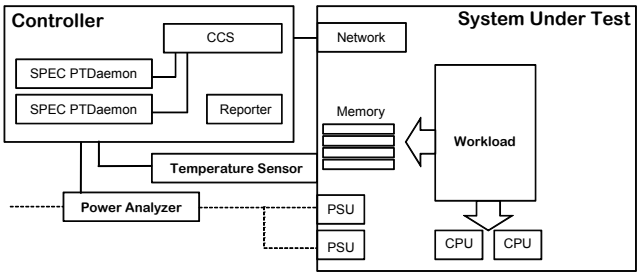

Figure 1. SPECpower_ssj2008 Overview

The **Reporter**, executed after all measurements phases are completed, compiles all of the environmental, power, and performance data for a complete test run into an easy to read report. The output format will be HTML and plain text. The HTML report includes a graphical visualization of the results.

3. WORKLOAD
SPEC recognized that many servers include technologies to reduce the power consumption when the system is running at low utilizations. Since most systems spend much of their time running at less than full capacity, SPEC developed a methodology which advocated measuring performance and power consumption at a variety of system loads.

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3.1 Load Levels

An SSJ run consists of two main phases: Calibration and running at a series of Target Loads. The calibration phase is used to determine the maximum throughput that a system is capable of sustaining. Once this calibrated throughput is established, the system runs at a series of target loads. Each load runs at some percentage of the calibrated throughput. For compliant runs, the sequence of load levels decreases from 100% to 0% in increments of 10% (Figure 2). Measuring the points in decreasing order limits the change in load to 10% at each level, resulting in a more stable power measurement. Using increasing order would have resulted in a jump from 100% to 10% moving from the final calibration interval to the first target load and another jump from 100% to Active Idle at the end of the run.

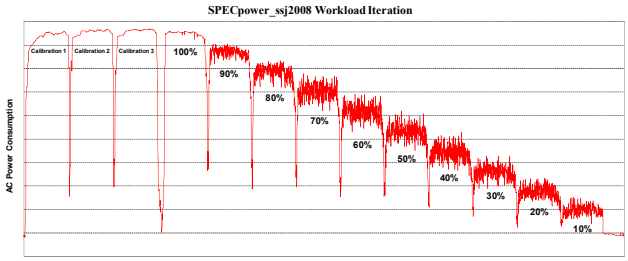

Figure 2. Load Levels

4. Driving Server Energy Efficiency

The game changing innovations, flexible design, cross-platform implementation, and automatic power measurement harness made SPECpower_ssj2008 the first industry standard benchmark to measure the power and performance characteristics of volume server-class compute-equipment.

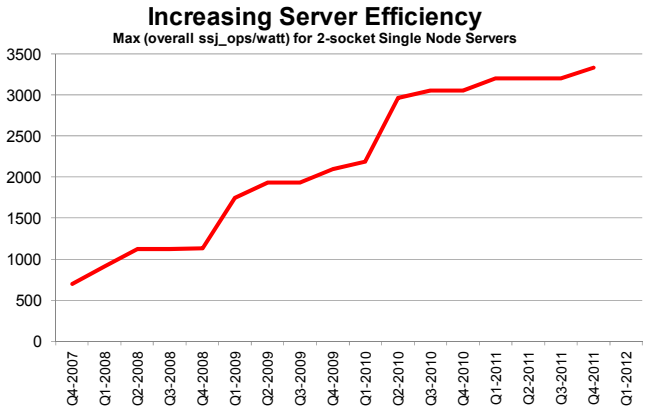

Figure 3. Dual Server Efficiency Trend

SPECpower_ssj2008 was first released in December 2007, most recently updated in 2011, and continues to drive innovations in server efficiency (Figure 3). Rather than trying to approximate all the typical workloads used across organizations SPECpower_ssj2008 is focused on transactional server-side Java workloads that simulate a warehouse-based customer ordering, supply and replenishment model. This synthetic workload exercises many aspects of commercially-available Java implementations, together with the underlying server hardware including processors (with support for multiple cores per processor), memory hierarchies (including caches) and the system Symmetric Multiprocessing (SMP) scalability.

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6. REFERENCES

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