Performance and power efficiency of Dell PowerEdge servers with E5-2600 v2

This white paper shows the performance and power efficiency improvements of Dell™ PowerEdge™ and PowerEdge C servers with the Intel® Xeon® processor E5-2600 v2 product family.

Solutions Performance Analysis

Dell | Enterprise Solutions Group

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Introduction

Dell PowerEdge and PowerEdge C servers are now available with the Intel Xeon processor E5-2600 v2 product family, code named "Ivy Bridge-EP". These new Xeon processors feature up to 12 cores and are fabricated on a 22-nanometer process for improved power efficiency.

In order to show customers the performance and power efficiency improvements that E5-2600 v2 processors bring to PowerEdge servers, Dell's Solutions Performance Analysis team performed a series of benchmarks using the new processors then compared the results to those obtained using the Intel Xeon processor E5-2600 product family, code named "Sandy Bridge-EP".

Based on the results of performed testing, PowerEdge servers with E5-2600 v2 processors perform 23% to 50% better and have as much as 52% better power efficiency, compared to the same servers running E5-2600 processors.

Key findings

Power efficiency with E5-2600 v2

- **The PowerEdge R720 is the world's most power-efficient server**, achieving a 54% higher overall score in the industry standard SPECpower_ssj2008 benchmark with two E5-2660 v2 processors.
- **The PowerEdge M620 is once again the world's most power-efficient blade server**, achieving a 51% higher overall score in the industry standard SPECpower_ssj2008 benchmark with two E5-2660 v2 processors.

Performance with E5-2600 v2

- **The PowerEdge R720 server with two E5-2697 v2 processors supported 50% more virtual desktops** using the industry standard Login VSI benchmark.
- **The PowerEdge R620 server with two E5-2697 v2 processors achieved 48% higher gigaFLOPS** running the Linpack scientific-computing benchmark.

Methodology

To highlight the performance improvements gained by PowerEdge servers running E5-2600 v2 processors, few configuration changes were made between those runs and the runs with E5-2600 processors that were used for comparison. However, as PowerEdge servers with E5-2600 v2 processors support up to 16 DIMMs running at 1866MT/s, that speed memory was used in most benchmarks, except as noted in Appendix A.

Integer performance

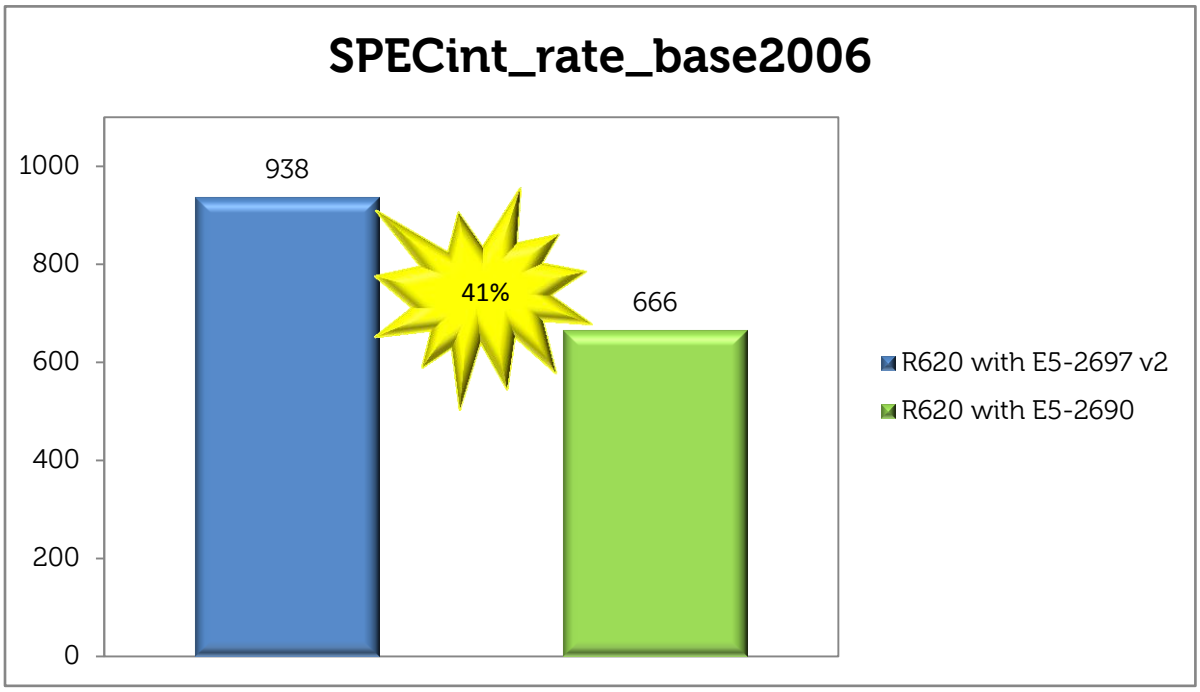
SPEC CPU2006 integer tests

The industry standard SPEC CPU2006 benchmark is [described on SPEC.org](#) as:

> CPU2006 is SPEC's next-generation, industry-standardized, CPU-intensive benchmark suite, stressing a system's processor, memory subsystem and compiler. SPEC designed CPU2006 to provide a comparative measure of compute-intensive performance across the widest practical range of hardware using workloads developed from real user applications.

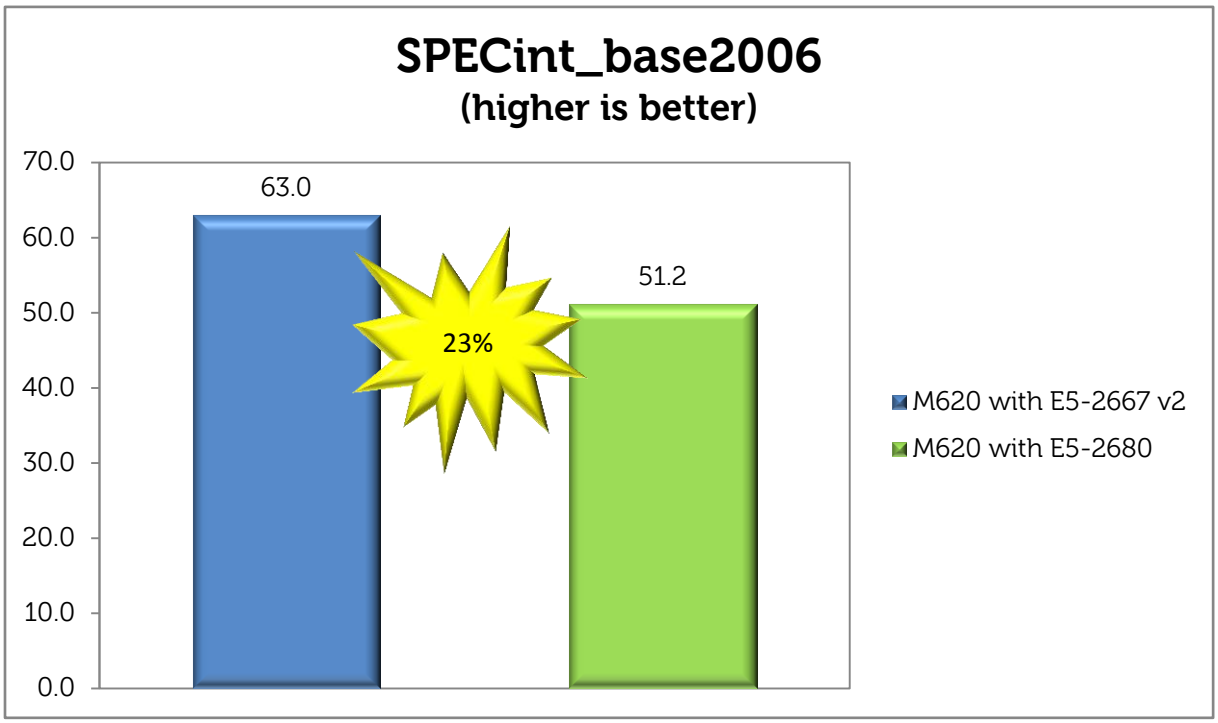
The integer portion of the benchmark is particularly good at measuring a server's ability to run general business applications. In Figure 1, we see a 41% improvement in the SPECint_rate benchmark with E5-2600 v2 processors.

Figure 1: Performance improvement running SPECint_rate_base2006



Even the SPECint_base_2006 benchmark, which only runs a single copy of each benchmark, benefits with the upgrade to E5-2667 v2, as seen in Figure 2.

Figure 2: Performance improvement running SPECint_base2006



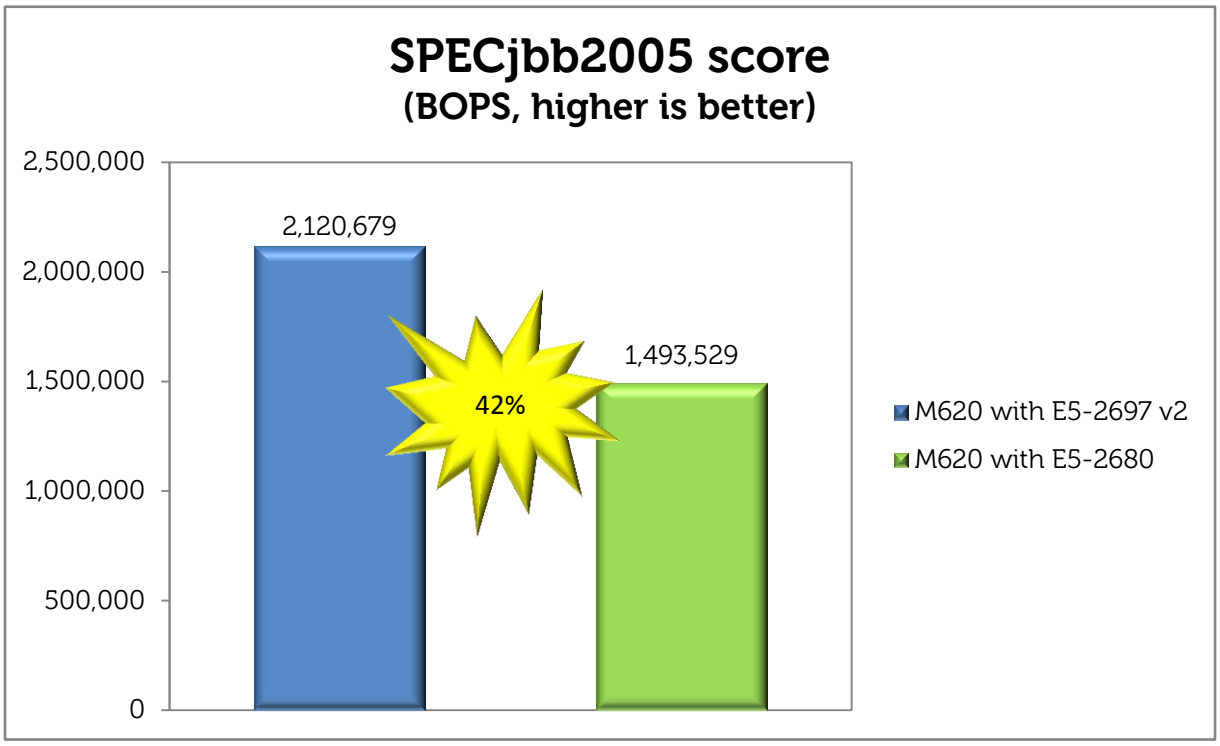
Java server tests

The SPECjbb2005 and SPECjbb2013 are also useful for measuring a server's ability to run general business apps. As described on SPEC.org:

> **SPECjbb2005 (Java Server Benchmark)** is SPEC's benchmark for evaluating the performance of server side Java. ...SPECjbb2005 evaluates the performance of server side Java by emulating a three-tier client/server system (with emphasis on the middle tier).

SPECjbb2005 is a multithreaded benchmark, and as Figure 3 shows, scores 42% higher with E5-2697 v2.

Figure 3: Performance improvement running SPECjbb2005

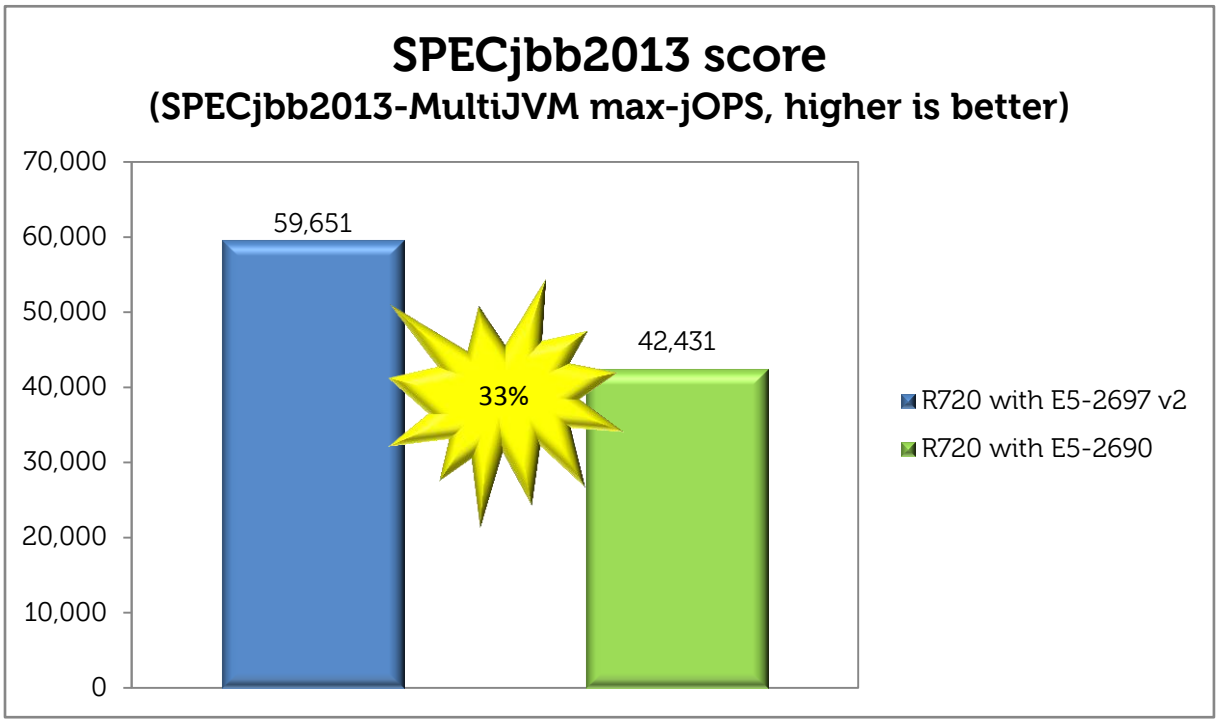


SPECjbb2005 was retired on October 1, 2013, for the newer SPECjbb2013 benchmark, which is described as follows:

> A usage model based on a worldwide supermarket company with an IT infrastructure that handles a mix of point-of-sale requests, online purchases and data-mining operations.

As Figure 4 shows, the performance improvement with SPECjbb2013 is 33%.

Figure 4: Performance improvement running SPECjbb2013

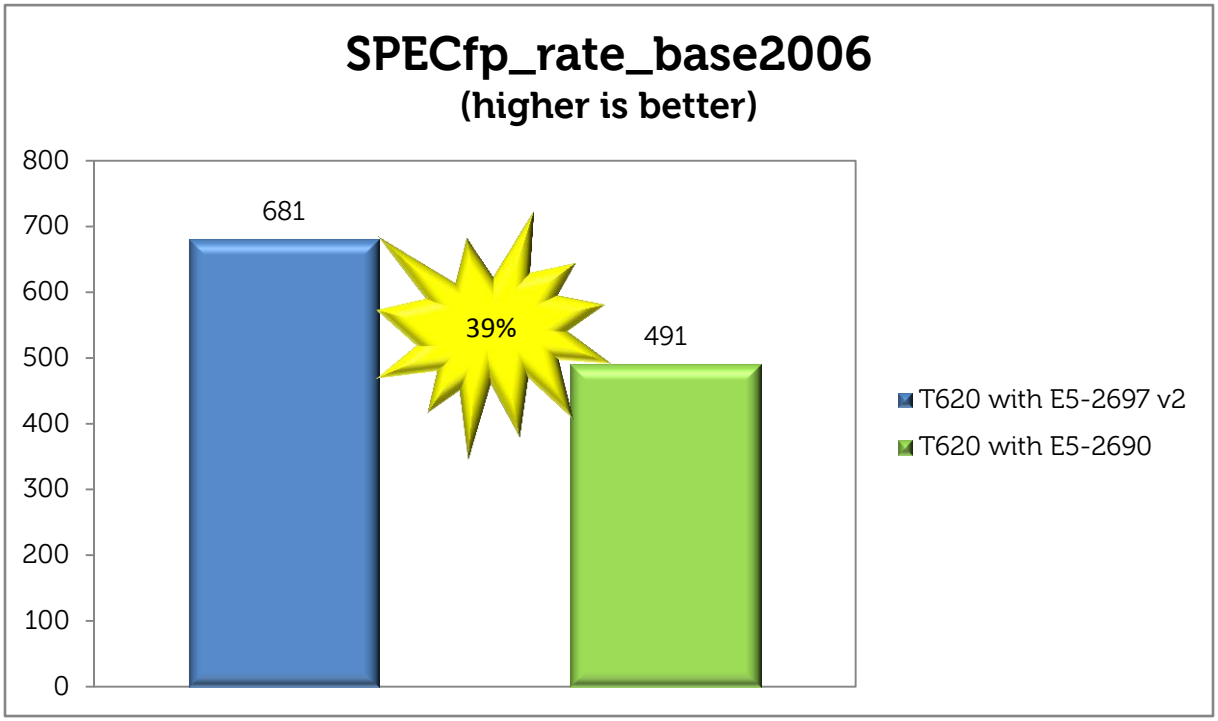


Floating point performance

SPEC CPU2006 floating point tests

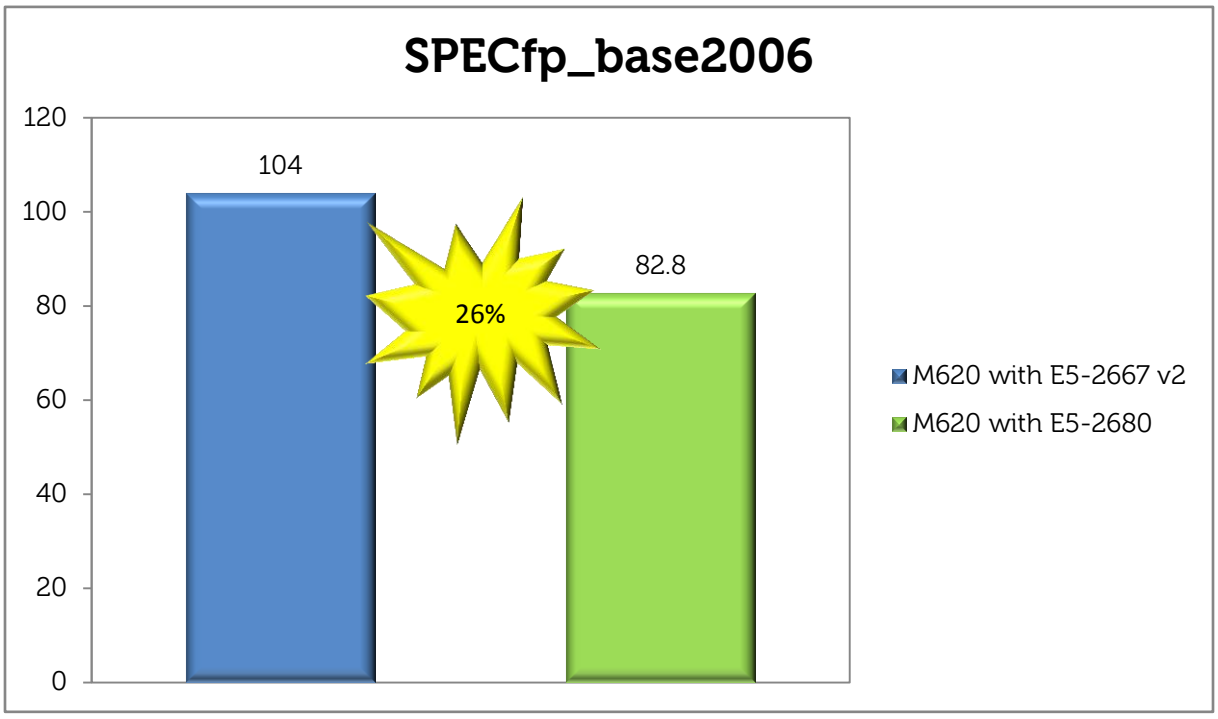
Floating point performance is important to those running science, simulations and HPC workloads. SPEC CPU2006 contains a suite of floating point tests which when in "rate" (multithreaded) mode, show a 39% performance improvement with E5-2697 v2, as seen in Figure 5.

Figure 5: Performance improvement running SPECfp_rate_base2006



SPECfp_base2006 runs a single copy of each benchmark. In Figure 6 we see a 26% performance improvement with the E5-2667 v2 processor.

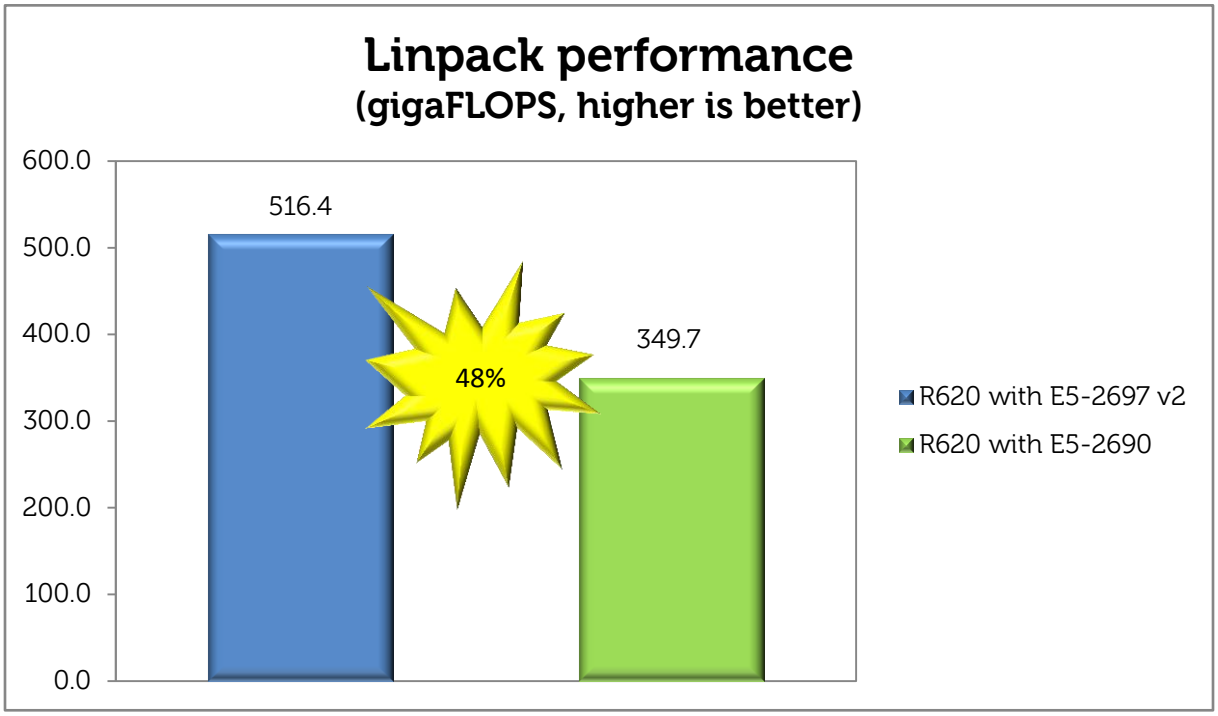
Figure 6: Performance improvement running SPECfp_base2006



HPC performance tests

The Linpack benchmark is used to measure a system's floating point processing power by solving linear equations. We ran the Intel Optimized Linpack Benchmark against a single node using both generations of processors. The E5-2697 v2 shows a 48% performance improvement, as seen in Figure 7.

Figure 7: Performance improvement running Linpack

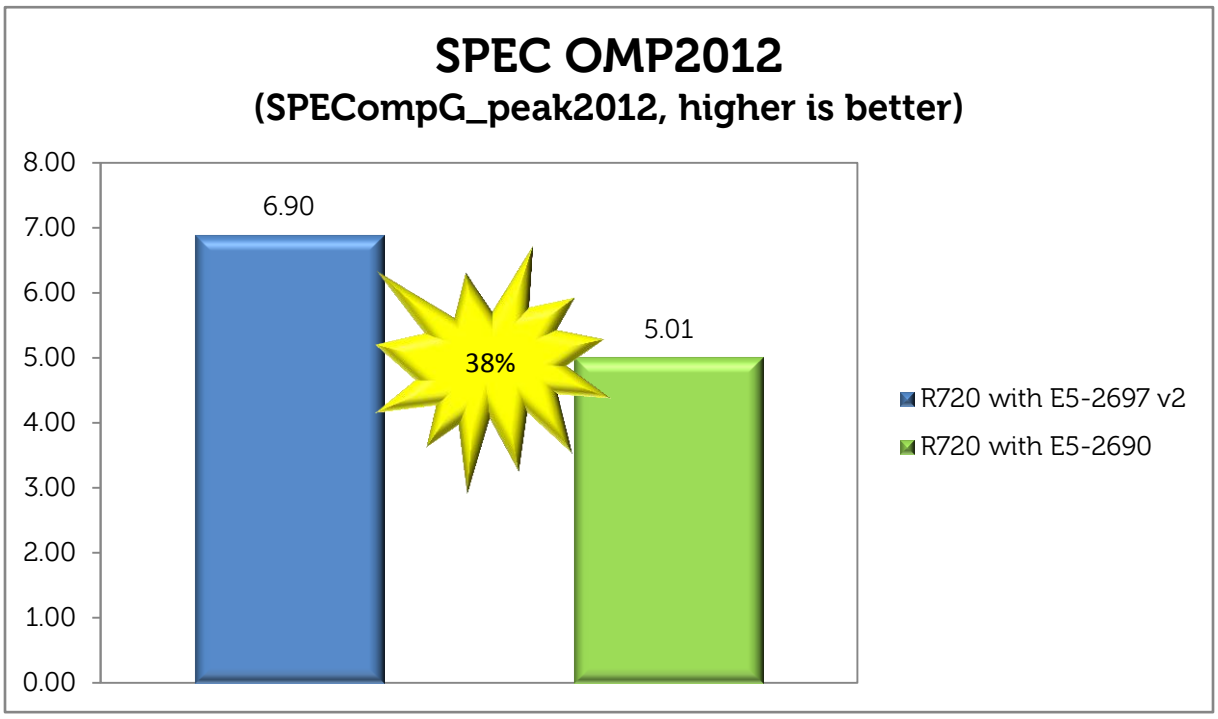


SPEC OMP2012 is another scientific computing benchmark, described on SPEC.org as:

> SPEC OMP2012 is designed for measuring performance using applications based on the OpenMP 3.1 standard for shared-memory parallel processing. The benchmark suite includes 14 scientific and engineering application codes, covering everything from computational fluid dynamics (CFD) to molecular modeling to image manipulation.

Figure 8 shows that running E5-2697 v2 processors on the PowerEdge R720 provides a 38% uplift compared to the E5-2690.

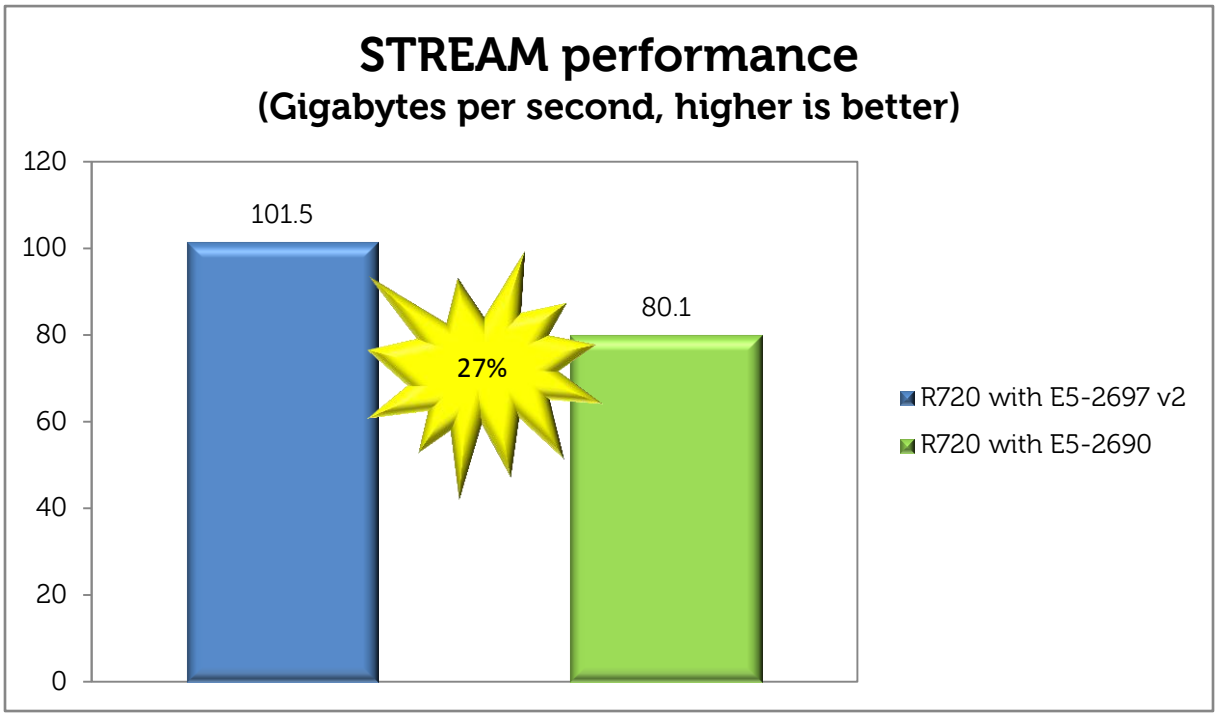
Figure 8: Performance improvement running SPEC OMP2012



Memory subsystem performance

Many workloads benefit from greater memory bandwidth. Dell PowerEdge servers running E5-2600 v2 processors support up to 16 DIMMs running at 1866MT/s. In Figure 9, the STREAM memory bandwidth benchmark shows a 27% improvement thanks to the faster memory and additional cores of the E5-2697 v2.

Figure 9: Performance improvement running STREAM



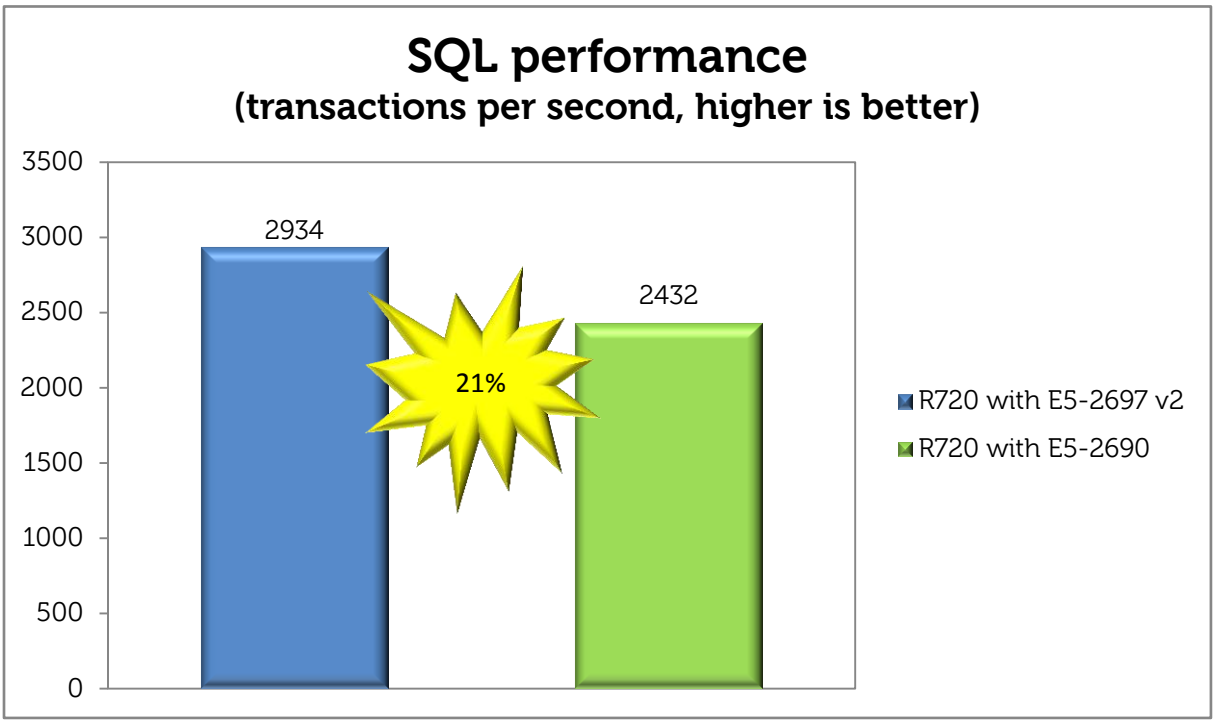
Workloads performance

Database performance

To measure the performance improvements brought by E5-2600 v2 processors to database workloads, we connected a PowerEdge R720 server to a Dell PowerVault™ MD1220 storage enclosure using a PERC H810 RAID controller. Four 400GB solid state drives were installed in the MD1220 and configured in RAID 10 to host a Microsoft® SQL Server® 2012 SP1 database.

We installed the 64-bit version of Quest Benchmark Factory® for Databases v6.9.1 and used it to create a 230GB test database. We then ran the Benchmark Factory Online Transaction Processing (OLTP) workload. Figure 10 shows the peak transactions per second (TPS) achieved by the R720 with both sets of processors. For this workload, the E5-2697 v2 processors provide 21% improved performance.

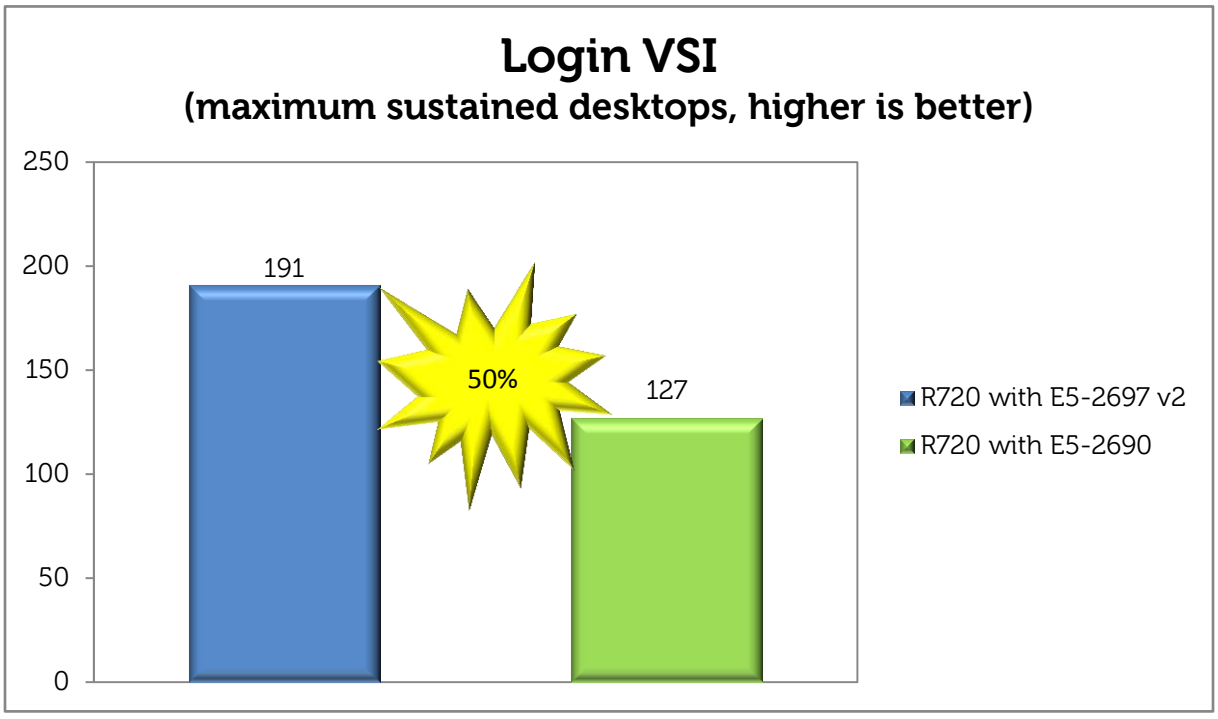
Figure 10: Performance improvement running a database workload



VDI

Administrators looking to maximize their investment in Virtual Desktop Infrastructure (VDI) often use the Login VSI load testing tool to see how many virtual desktops a server can support while maintaining acceptable response time. Using Login VSI set to the medium workload, the following results were generated.

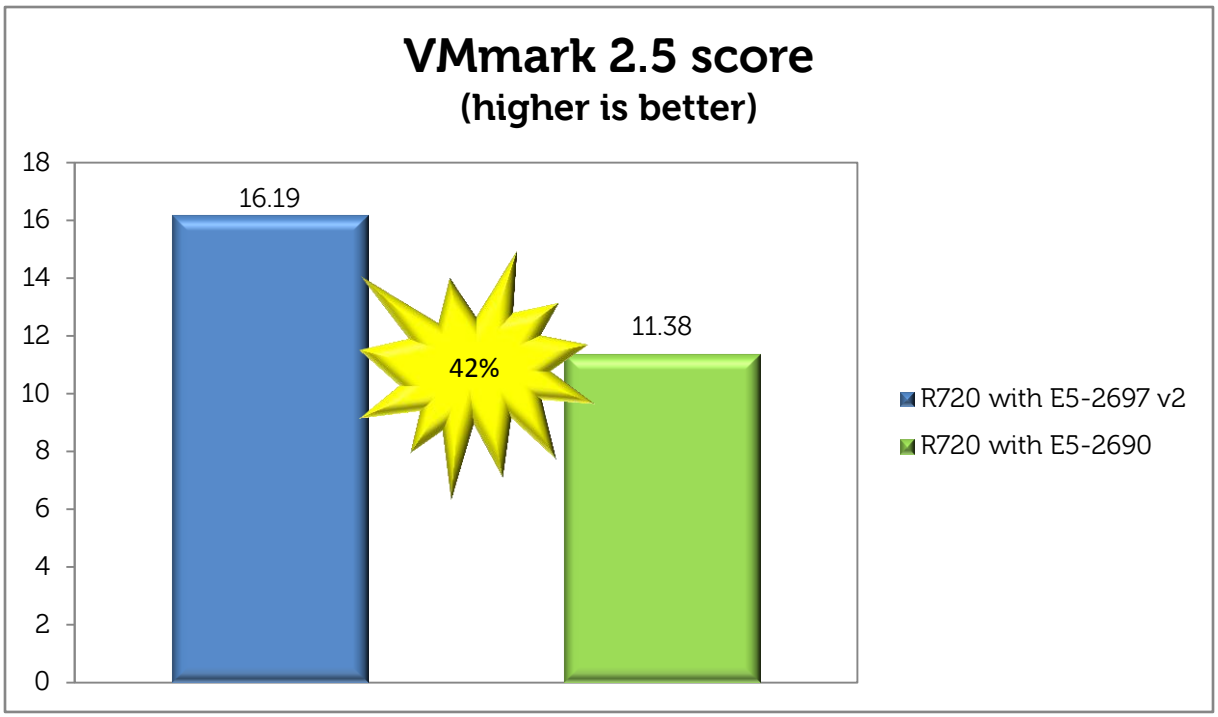
Figure 11: Performance improvement running Login VSI



Virtualization

Administrators running in virtualized environments can see in Figure 12 that virtualization performance on the PowerEdge R720 is up to 42% greater when running VMware® VMmark® 2.5 with the E5-2697 v2 processor.

Figure 12: Performance improvement running VMmark 2.5



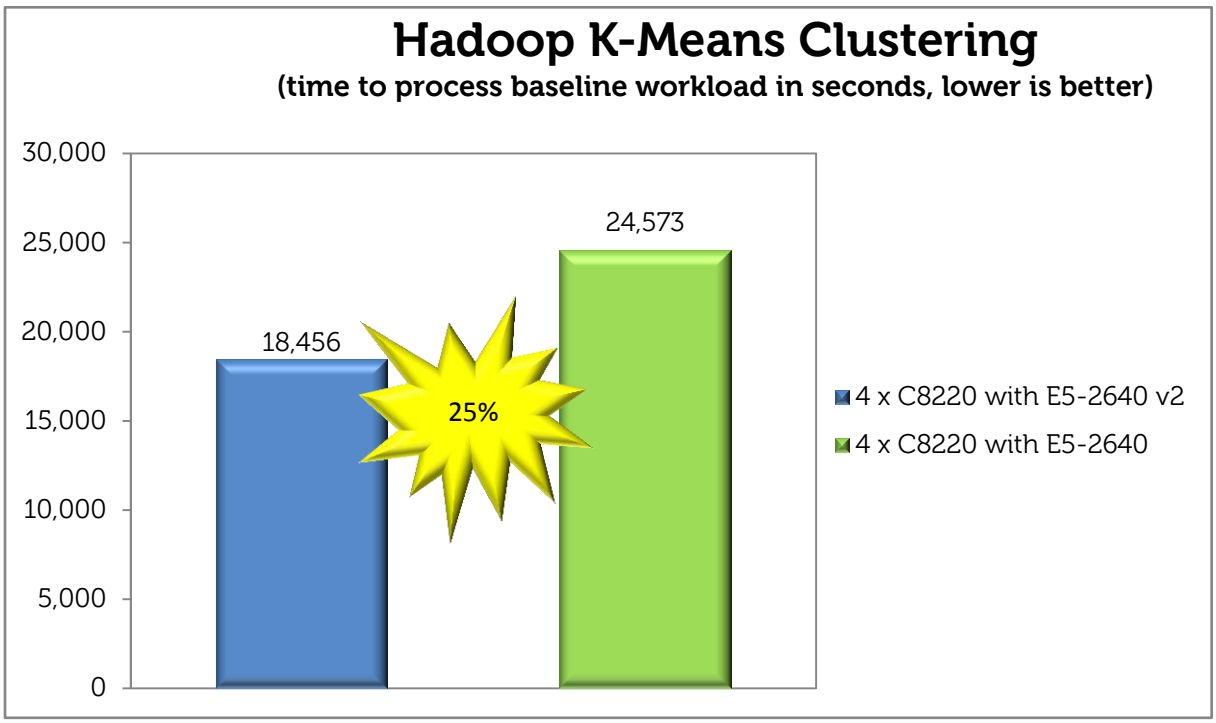
Big data

The Apache™ Hadoop® software library is described by the Apache Hadoop Project Team as:

> ...a framework that allows for the distributed processing of large data sets across clusters of computers using simple programming models.

Dell tests the performance of our servers using HiBench 2.2. While many of the sub-benchmarks of HiBench are bound by storage performance thus seeing minimal improvement from processor upgrades, the K-Means Clustering sub-benchmark was completed in 25% less time when the processors in our four-node C8220 cluster were upgraded to E5-2640 v2 processors and 1866MT/s DIMMs.

Figure 13: Performance improvement running HiBench K-Means Clustering benchmark

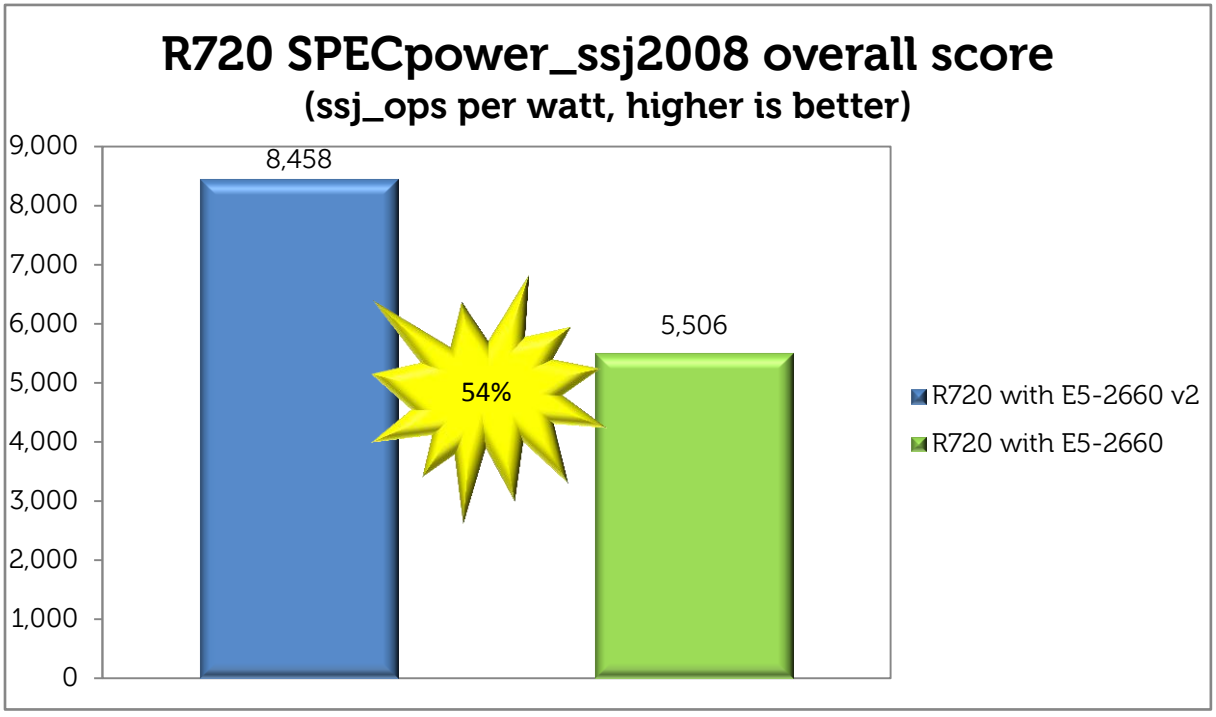


Power efficiency

The SPECpower_ssj2008 benchmark measures the performance of a server or servers running a server-side Java workload, and measures the power consumed during the workload to produce a performance-per-watt metric.

The greater power efficiency and improved performance of E5-2600 v2 processors leads to a 54% increase in the PowerEdge R720's overall score on the SPECpower_ssj2008 benchmark. The score of 8,458 SPECpower_ssj2008 overall ssj_ops/watt makes **the PowerEdge R720 the world's most power-efficient server**.

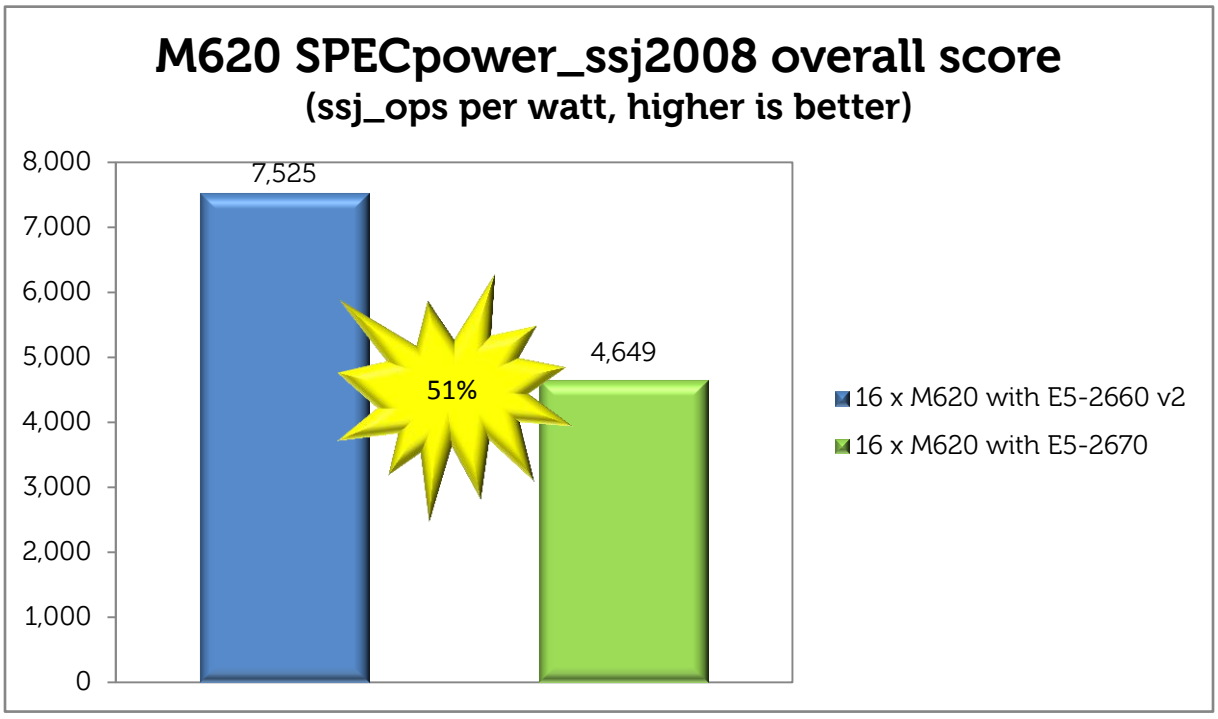
Figure 14: Power efficiency improvement of the R720 running the SPECpower_ssj2008 benchmark



The Dell PowerEdge M610 was the most power efficient blade server of the previous generation, with its score of 3,348 SPECpower_ssj2008 overall ssj_ops/watt being the best among all blade servers running Intel Xeon X5600 processors. Similarly, the PowerEdge M620 scored the highest among all blade servers using E5-2600 processors (4,982 SPECpower_ssj2008 overall ssj_ops/watt) and the PowerEdge M520 scored the highest among all blade servers using E5-2400 processors (5,521 SPECpower_ssj2008 overall ssj_ops/watt).

Based on all blade SPECpower scores submitted to spec.org at the time of this whitepaper's writing, **the PowerEdge M620 is once again the world's most power-efficient blade server**, with a score of 7,525 SPECpower_ssj2008 overall ssj_ops/watt with E5-2660 v2 processors.

Figure 15: Power efficiency improvement of the M620 running the SPECpower_ssj2008 benchmark



Summary

Performance benefits with E5-2600 v2 processors will depend on the workload being run. Scientific workloads that scale linearly with additional cores, such as Linpack, can see performance improvements of as much as 48%. Likewise, the VDI benchmark Login VSI saw a 50% increase in the number of virtual desktops supported.

Workloads with a heavy storage component benefit somewhat less from the additional processing power brought by the upgrade of E5-2600 v2 processors. Even so, the IO bound Quest Benchmark Factory with SQL, saw a 21% improvement in transactions per second running an OLTP workload.

Power-efficiency improvements gained from a move to E5-2600 v2 processors will likewise depend on the workload being run. However, in the industry-standard SPECpower_ssj2008 benchmark, the gains were impressive. The performance per watt of the R720 improved by 52%, making it the most power-efficient server in the world. And, the performance per watt of the M620 improved by 51% compared to E5-2600, making it the world's most power-efficient blade server.

The E5-2600 v2 product family is available for purchase on all PowerEdge 12G servers that supported E5-2600 processors. The enhanced performance and world record power efficiency make the new processors a worthy enhancement to the already formidable 12G server lineup.

Appendix A — Test configurations

Table 1: Benchmark configurations

Benchmark	PowerEdge Platform	E5-2600 v2 product family	E5-2600 v2 product family score	E5-2600 product family	E5-2600 product family score	Improvements with v2
SPECint_rate_base2006	R620	E5-2697 v2	938	E5-2690	666	41%
SPECint_base2006	M620	E5-2667 v2	63	E5-2680	51.2	23%
SPECfp_rate_base2006	T620	E5-2697 v2	681	E5-2690	491	39%
SPECfp_base2006	M620	E5-2667 v2	104	E5-2680	82.8	26%
STREAM	R720	E5-2697 v2	101.5	E5-2690	80.1	27%
Linpack	R620	E5-2697 v2	516.4	E5-2690	349.7	48%
SPECpower_ssj2008 (modular)	M620	E5-2660 v2	7,525	E5-2670	4,982	51%
SPECpower_ssj2008 (rack)	R720	E5-2660 v2	8,458	E5-2660	5,506	52%
SPECjbb2005 (modular)	M620	E5-2697 v2	2,120,679	E5-2680	1,493,529	42%
SPECjbb2013 max-jOPS	R720	E5-2697 v2	59,651	E5-2690	42,431	33%
Login VSI	R720	E5-2697 v2	191	E5-2690	127	50%
SPEC OMP 2012 (peak)	R720	E5-2697 v2	6.90	E5-2690	5.01	38%
VMmark 2.5	R720	E5-2697 v2	16.19	E5-2690	11.38	42%
SAP	M620	E5-2697 v2	9,695	E5-2690	6,500	49%
SQL (Benchmark Factory)	R720XD	E5-2697 v2	2,934	E5-2690	2,432	21%
Hadoop	C8220	E5-2640 v2	18,456	E5-2640	24,573	33%

- For SPECpower_ssj2008, we used 1600MT/s UDIMMs with E5-2600 v2 and 1333MT/s UDIMMs with E5-2600

- For all other benchmarks, we used 1866MT/s RDIMMs with E5-2600 v2 and 1600MT/s RDIMMs with E5-2600
- For SQL workload testing with Quest Benchmark Factory, we used a PERC H710 mini with 2 x 200GB SAS SSD RAID 1 for the operating system, and a PERC H810 connected to a PowerVault MD1220 with 4 x 400GB SAS SSD in RAID 10 for the database, and 4 x 300GB 10k SAS in RAID 10 for database logs
- For the Hadoop K-Means Clustering test, we used the LSI 2008 controller and 12, 1TB SATA HDDs