Dell PowerEdge R630 Energy Efficiency

A Dell Technical White Paper

This white paper compares the energy efficiency of the 13th generation PowerEdge 1U rack server, based on the Intel Xeon processor E5-2600 v3 product family, to that of its direct PowerEdge predecessor.

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Introduction

With power and cooling costs accounting for an increasingly large portion of IT budgets, IT departments looking to minimize total cost of ownership (TCO) are finding it advisable to make power efficiency a priority when choosing server hardware. In this white paper, we examine power efficiency improvements in the 13th generation Dell PowerEdge server family focusing on the two-processor, 1U rack form factor platform, configured as it might be ordered for use in a typical data center.

The Dell Solutions Performance Analysis (SPA) team compared the Dell PowerEdge R630 to its immediate predecessor, the PowerEdge R620. Using the industry-standard SPECpower_ssj2008® benchmark, the two servers were typically configured and tested for performance/watt, performance, and input power consumption.

The results showed **the Dell PowerEdge R630 delivered substantially better performance and greater power efficiency.**

Key findings

Performance/watt

The PowerEdge R630 achieved a **19% higher performance-to-power ratio** overall than the R620 in each typical configuration. At the key **70% target load, the R630 had an 18% higher** performance-to-power ratio.

Performance

The **PowerEdge R630 provided as much as 9.5% better raw performance** than the R620.

Power

The PowerEdge R630 consumed 9% less power when running at the data center ideal 70% utilization level. It also consumed 14% less power at idle **saving 88KWh of electricity annually**.

Test methodology and detailed result reports are documented in this paper.

Methodology

SPECpower_ssj2008 is an industry-standard benchmark created by Standard Performance Evaluation Corporation (SPEC) to measure a server's power and performance across multiple utilization levels. Appendix A—Test details the test methodology used by Dell and Appendix B SPECpower_ssj2008 provides the detailed report data that supports the results in this paper.

Typical configuration

The two systems were configured as they might be by enterprise data center customers. The differences between the two generations are due to the natural advancement in technology, commodity component price/availability and the support requirements of contemporary customer applications.

The configuration used is summarized in Table 1.

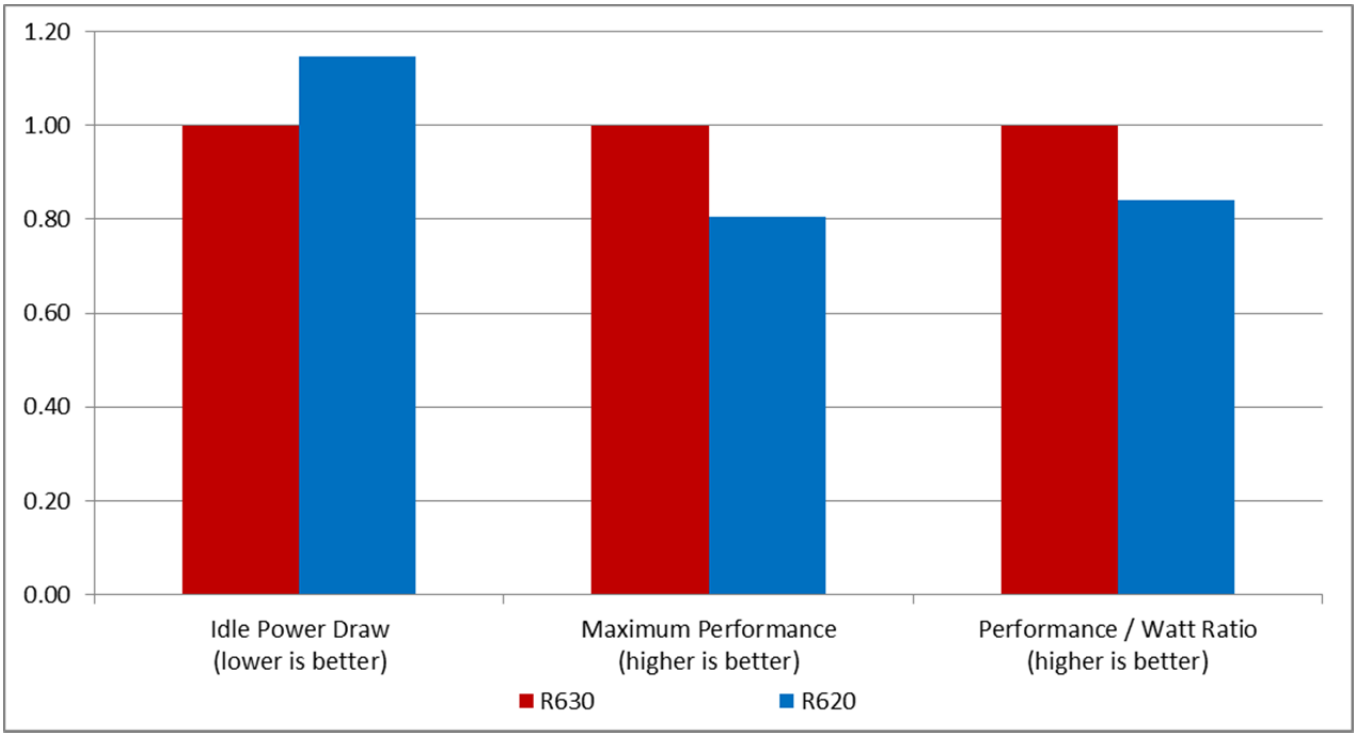
Table 1. Detailed configuration for power efficiency comparison

Configuration	PowerEdge R630	PowerEdge R620
Sockets/form factor	2S/1U	2S/1U
Processors	2 x Intel® Xeon® E5-2620 v3, 6 physical/12 logical cores, 2.40GHz	2 x Intel Xeon E5-2620 v2, 6 physical/12 logical cores, 2.20GHz
Memory	64GB, 8 x 8GB dual-ranked PC4-2133P ULV RDIMMs	32GB, 8 x 4GB dual-ranked PC3L-10600R LV RDIMMs
Hard drives	2 x 300GB 10K RPM 6Gb SAS RAID 1 (DP/N MTV7G)	2 x 300GB 10K RPM 6Gb SAS RAID 1 (DP/N 74Y07)
Storage controller	Dell PERC H730 1GB cache (DP/N KMCCD)	Dell PERC H710 512MB cache (DP/N FRH64)
Power supply quantity/rating	2 χ 495W (DP/N 2FR04)	2 x 495W (DP/N 13MD5)
Network adapter	2x Broadcom® 5720 dual-port GbE	2x Broadcom 5720 dual-port GbE
Operating system	Microsoft® Windows Server® 2012 R2 Datacenter, Build 9600	Microsoft Windows Server 2012 R2 Datacenter, Build 9600
System BIOS FW	1.0.2	1.45.45
Board management FW	2.0.00	2.0.19

Results

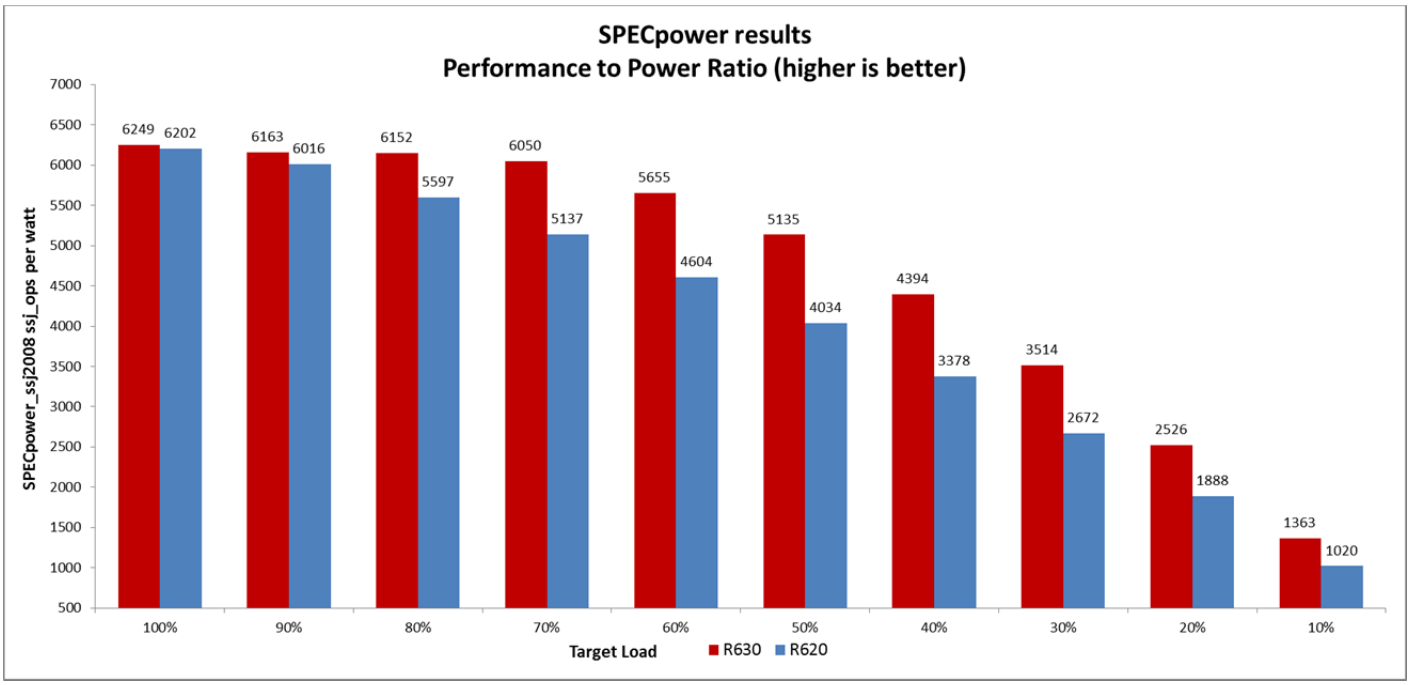
In the like-for-like comparison detailed in Figure 1, the PowerEdge R630 demonstrated 10W less power consumption when idle, 24% higher throughput and 19% better overall efficiency than the previous-generation R620.

Figure 1. Normalized SPECpower_ssj2008 results for PowerEdge R630 and PowerEdge R620



SPECpower_ssj2008 includes a measurement of power at each 10% load increment. The performance to watt ratio at each target load level is calculated by dividing the total operations for that load level by the average power consumption of the server at that load level (ssj_ops/watts). Figure 2 shows the PowerEdge R630 has a higher power efficiency ratio at all workload levels.

Figure 2. Performance per watt ratios for all target loads[1]



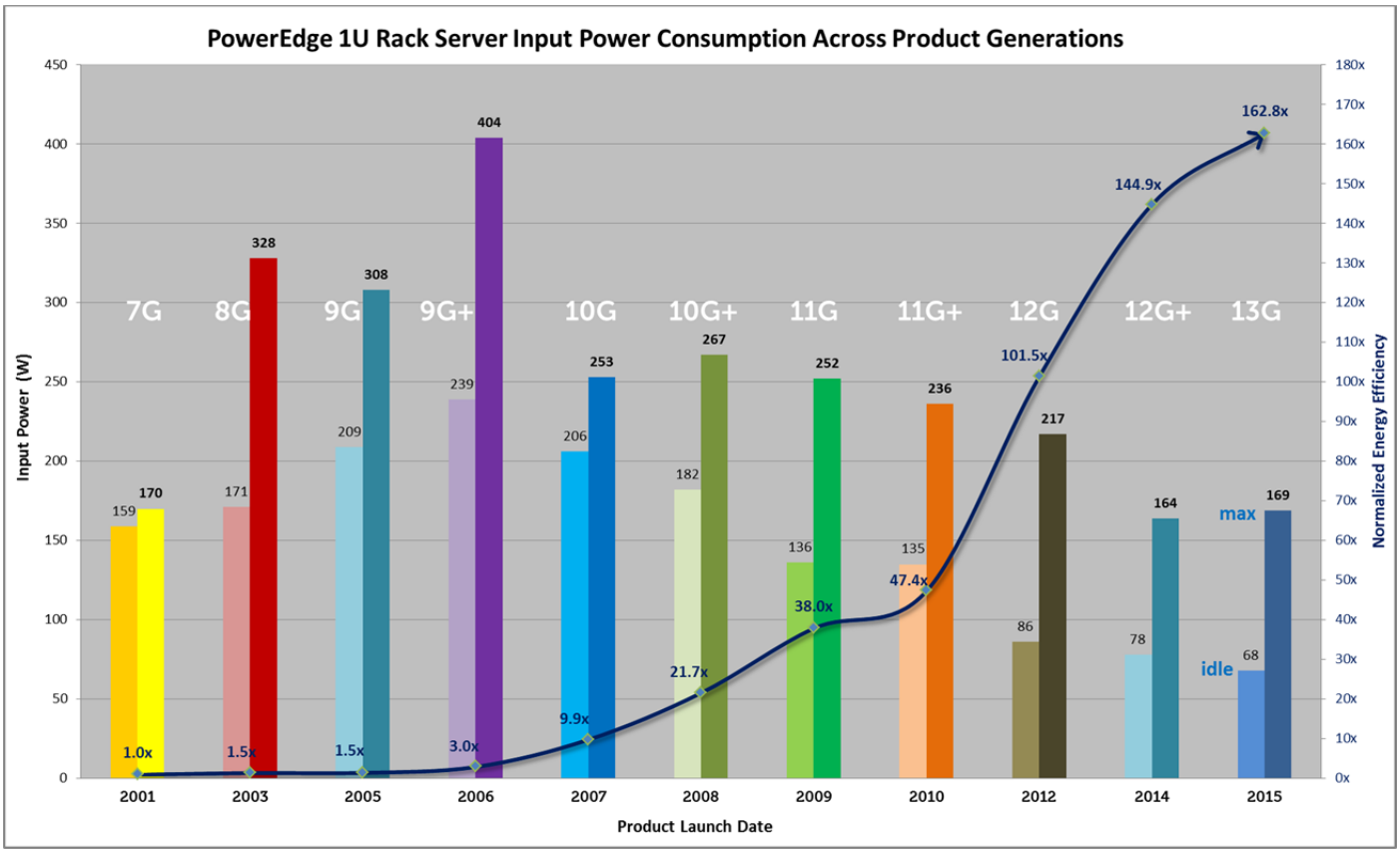
[1] Required SPEC disclosure information: R630 scores: (1,017,125 ssj_ops and 164W) at 100% target load and 4053 overall ssj_ops/watt vs. R620: (1,262,314 ssj_ops and 202W) at 100% and 4825 overall ssj_ops/watt. Comparison based on results by Dell Labs, August 2014. For more information about SPECpower, see spec.org/power_ssj2008/.

Summary

The PowerEdge R630 1U rack server proves capable of producing 9.5% more work and 19% better overall energy efficiency than a like-configuration of its two-year-old predecessor the PowerEdge R620.

As outlined in Figure 3, the energy efficiency of Dell PowerEdge servers has improved in a whopping 163 fold over the past ten years. Given IT customers' demand for servers that can perform more work while at the same time reducing a data center footprint, electricity use and TCO, Dell makes the engineering investment to provide just that.

Figure 3. PowerEdge energy efficiency progress



Appendix A—Test methodology

SPECpower_ssj2008 standard

SPECpower_ssj2008 consists of a server-side Java™ (SSJ) workload along with data collection and control services. SPECpower_ssj2008 results portray the server's performance in ssj_ops (server-side Java operations per second) divided by the power used in watts (ssj_ops/watt). SPEC created SPEcpower_ssj2008 to accurately measure the power consumption of servers in relation to the performance that the server is capable of achieving with ssj2008 workload.

SPECpower_ssj2008 consists of three main software components:

- **Server-Side Java (SSJ) Workload** — Java database that stresses the processors, caches and memory of the system, as well as software elements such as OS elements, and the Java implementation chosen to run the benchmark.
- **Power and Temperature Daemon (PTDaemon)** — Program that controls and reports the power analyzer and temperature sensor data.
- **Control and Collect System (CCS)** — Java program that coordinates the collection of all the data.

For more information on how SPECpower_ssj008 works, see spec.org/power_ssj2008/

All results discussed in this white paper are from "compliant runs" in SPEC terminology, which means that although they have not been submitted to SPEC for review, Dell is allowed to disclose them for the purpose of this study. All configuration details required to reproduce these results are listed in the appendices and all result files from the runs compared are included in Appendix B SPECpower_ssj2008 results.

Both servers were configured by installing a fresh copy of Microsoft Windows Server 2012 Enterprise R2 (Service Pack 1) with the operating system installed on a two-drive RAID 1 configuration, choosing the "full installation" option for each.

BIOS settings

The BIOS settings were those that the SPA team identified as being the best efficiency practices for the select PowerEdge server model. All fields are clearly listed in the shipping BIOS setup menus and those common to both HSW-EP and IVB-EP CPU family architectures are listed on the same row of this table.

Table 2. BIOS settings

PowerEdge R630	PowerEdge R620
Memory Snoop mode set to Early Snoop	
QPI speed set to 6.4GT/s Data Rate	QPI speed set to 6.4 GT/s Data Rate
Adjacent Cache Line Prefetch disabled	Adjacent Cache Line Prefetch disabled
Hardware Prefetcher disabled	Hardware Prefetcher disabled
DCU Streamer Prefetcher disabled	DCU Streamer Prefetcher disabled
DCU IP Prefetcher enabled	DCU IP Prefetcher enabled
CPU Power Management set to System DBPM (DAPC)	CPU Power Management set to System DBPM (DAPC)
Turbo Boost enabled	Turbo Boost enabled
Energy Efficiency Turbo enabled	
Collaborative CPU Performance Control enabled	Collaborative CPU Performance Control enabled
Energy Efficiency Policy set to Balanced Performance	

OS tuning

To improve Java performance, large pages were enabled by entering **Control Panel > Administrative Tools > Local Security Policy > Local Policies > User Rights Assignment > Lock Pages in Memory**. An option was changed to add Administrator.

The Operating System Power Management Plan was left set to Balanced, as that is the Microsoft-recommended default.

Both servers were configured with a separate IP address on the same subnet as the SPECpower_ssj2008 controller system where the Director, CCS, and PTDaemon components were located, and both servers were connected directly to the controller system through NIC 1 for their respective runs.

SPECpower_ssj2008 configuration

The IBM® J9 Java Virtual Machine (JVM)[2] was used for both solutions.

The following JVM options were used on both servers, as they are the best-known JVM tunings for SPECpower_ssj2008 for the IBM J9 JVM:

-Xaggressive -Xcompressedrefs -Xmn1400m -Xms1875m -Xmx1875m -XlockReservation

-Xnoloa -XtlhPrefetch -Xlp -Xconcurrentlevel0 -Xthr:minimizeusercpu -Xgcthreads4 -

Xgc:preferredHeapBase=0x80000000

The following bindings were used to associate logical processor to JVM in order to consume all 24 available in a two- socket, six core/socket, two threads/core (hyper-threading) CPU system.

R630: start /AFFINITY [0x3,0xC,0x30,0xC0,0x300,0xC00,0x3000,0xC000,0x30000,0xC0000,0x300000,0xC00000]

R620: start /AFFINITY [F,F0,F00,F000,F0000,F00000]

Power and temperature configuration

The Yokogawa WT210 Digital Power Meter was used for the actual power measurement of the servers, as this was the most commonly used analyzer for SPECpower_ssj2008 publications at the time that this study was conducted. The WT210 unit used was within its one-year calibration window to ensure accurate power consumption measurements. Input line voltage supplying both systems varied by less than 1V.

To ensure a fair comparison, the systems were mounted in the same rack, and inlet temperatures were measured at the front of both systems using a Digi® International Watchport®/H temperature probe. As the attached Power_Temperature reports show, the temperatures were maintained to less than 0.5 °C.

[2] Build 2.6, JRE 1.7.0 Windows Server 2008 R2 amd64-64 20120322_106209 (JIT enabled, AOT enabled)

Appendix B—SPECpower_ssj2008 results

Figure 4. SPECpower_ssj2008 results for Dell PowerEdge R630

SPECpower_ssj2008

Dell Inc. PowerEdge R630 (Intel Xeon E5-2620 v3 2.40 GHz)			SPECpower_ssj2008 = 4,825 overall ssj_ops/watt		
Test Sponsor:	Dell Inc.	**SPEC License #:**	55	**Test Method:**	Single Node
Tested By:	Dell Inc.	**Test Location:**	Round Rock, TX, USA	**Test Date:**	Aug 8, 2014
Hardware Availability:	Sep-2014	**Software Availability:**	Sep-2012	**Publication:**	Unpublished
System Source:	Single Supplier	**System Designation:**	Server	**Power Provisioning:**	Line-powered

Set sut WARNING: For point 0, elapsed nanoTime=242138988492 ns, elapsed currentTimeMillis=240188 ms

Benchmark Results Summary

Performance			Power	
Target Load	**Actual Load**	**ssj_ops**	**Average Active Power (W)**	**Performance to Power Ratio**
100%	99.7%	1,262,314	202	6,241
90%	90.0%	1,140,152	185	6,165
80%	80.2%	1,015,066	165	6,164
70%	70.2%	889,334	147	6,030
60%	59.8%	757,764	134	5,659
50%	49.9%	631,587	123	5,124
40%	39.9%	505,336	115	4,389
30%	30.0%	379,512	108	3,510
20%	20.2%	255,138	101	2,517
10%	10.1%	127,321	93.4	1,363
Active Idle		0	68.5	0
			∑ssj_ops / ∑power =	**4,825**

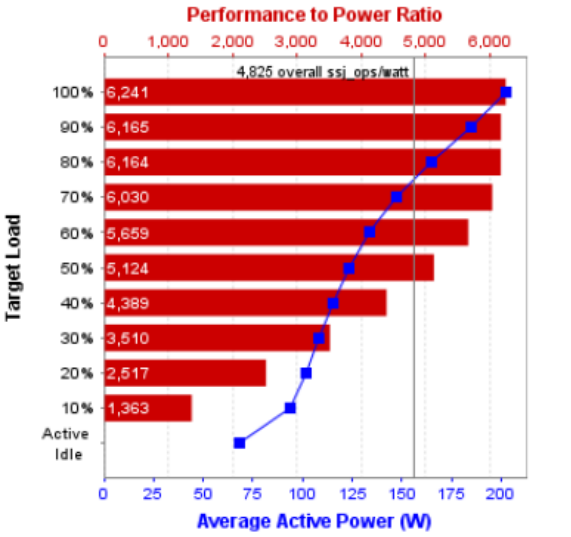


Figure 5. SPECpower_ssj2008 results for the Dell PowerEdge R620

SPECpower_ssj2008

Dell Inc. PowerEdge R620 (Intel Xeon E5-2660, 2.20 GHz)			SPECpower_ssj2008 = 4,053 overall ssj_ops/watt		
Test Sponsor:	Dell Inc.	SPEC License #:	55	Test Method:	Single Node
Tested By:	Dell Inc.	Test Location:	Round Rock, TX, USA	Test Date:	Jul 22, 2014
Hardware Availability:	Oct-2012	Software Availability:	Sep-2012	Publication:	Unpublished
System Source:	Single Supplier	System Designation:	Server	Power Provisioning:	Line-powered

Benchmark Results Summary

Performance			Power	
Target Load	Actual Load	ssj_ops	Average Active Power (W)	Performance to Power Ratio
100%	99.0%	1,017,125	164	6,192
90%	90.2%	926,497	154	6,019
80%	80.1%	822,704	147	5,590
70%	70.0%	719,235	140	5,121
60%	60.0%	616,905	134	4,609
50%	50.3%	516,317	128	4,047
40%	39.8%	408,752	121	3,367
30%	29.9%	307,319	115	2,666
20%	20.0%	205,786	109	1,890
10%	10.0%	103,069	101	1,018
Active Idle		0	78.3	0
			∑ssj_ops / ∑power =	4,053