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# Refreshed PowerEdge Server Performance and Energy Efficiency

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*This white paper details the performance improvements of Dell™ PowerEdge™ servers with the 2<sup>nd</sup> Gen “Cascade Lake” Intel® Xeon® Scalable Processor Family.*

**R640**



**R940**



**R740/XD**

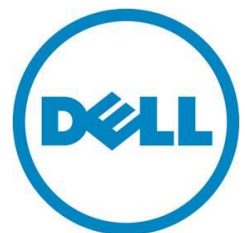


**C6420/C6400**



**Solutions Performance Analysis**

**Dell | Global Solutions Engineering**



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## Executive summary

### Introduction

Dell's refreshed PowerEdge servers are now available with Intel's second-generation Xeon Processor Scalable family, code named "Cascade Lake-SP". This new CPU family features up to 28 cores, 38.5 MB of last level caching and (6) 2933 MT/s DDR4 memory channels.

In order to show customers, the performance and energy efficiency uplifts possible from the new PowerEdge products, Dell's Solutions Performance Analysis team performed a series of benchmarks and compared the results to those previously obtained from PowerEdge servers equipped with the previous generation "Skylake-SP" Xeon family.

Based on these results, PowerEdge servers with new Cascade Lake-SP family processors performed up to 63% better as compared to their direct predecessors equipped with Skylake-SP family processors.<sup>1</sup>

### Key findings

#### Performance with Cascade Lake-SP

- Refreshed PowerEdge servers with two Xeon Platinum 8280 processors delivered 19% higher throughput using the comprehensive SPECcpu2017 integer workload suite.
- Refreshed PowerEdge servers with two Xeon Platinum 8280 processors delivered 4.5% higher throughput using the comprehensive SPECcpu2017 floating point workload suite.
- Refreshed PowerEdge servers with two Xeon Platinum 8280 processors produced 3.3 trillion double precision floating point operations per second according to the popular LINPACK high performance computing metric.
- Refreshed PowerEdge servers with two Xeon Platinum 8280 processors and a 2933 MT/s DDR4 memory configuration exhibited 4% higher sustained memory bandwidth according to the STREAM benchmark.
- Refreshed PowerEdge servers with two Xeon Platinum 8280 processors demonstrated a 9% improved overall energy efficiency over its Xeon Platinum 8180 processor predecessor.
- Refreshed PowerEdge servers with two Xeon Platinum 8280 processors demonstrated a 14% higher Java transactional throughput than its Xeon Platinum 8180 processor predecessor.
- Refreshed PowerEdge servers with two Xeon Platinum 8280 processors achieved another SAP-SD two-tier business transaction benchmark world record with its 11% higher score than with two Xeon Platinum 8180 processors.

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<sup>1</sup> Comparing the SPECcpu2017 integer rate score for the 2 x 4216 CPU configuration to the 2 x 4116 one (179 vs 110).

## Arithmetic performance

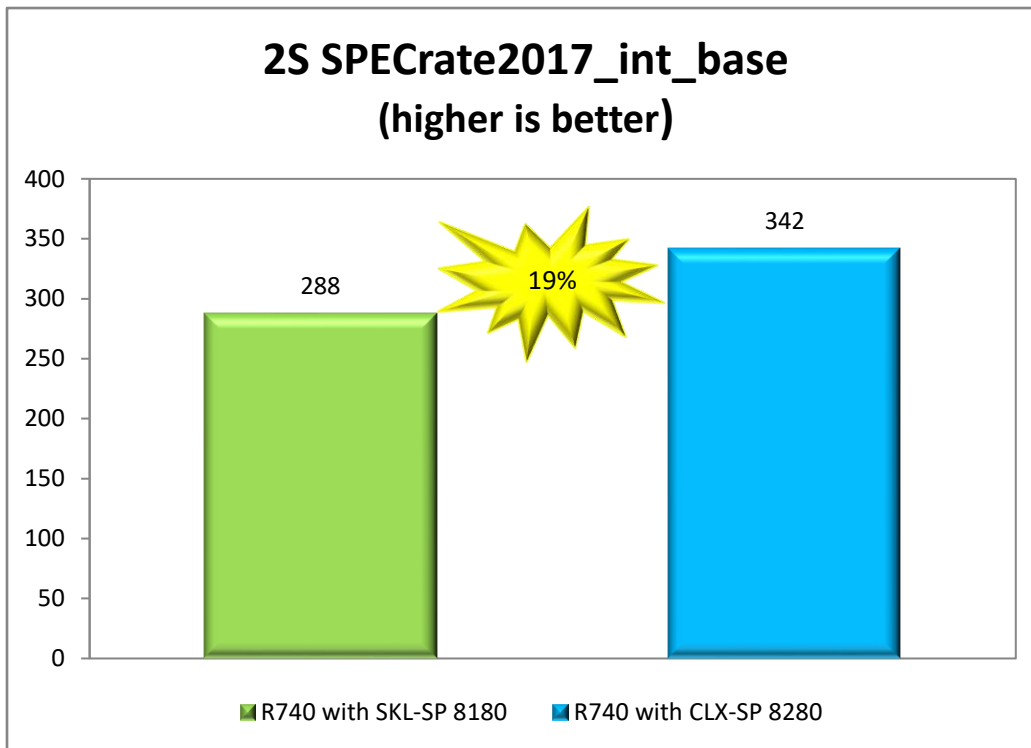
### SPEC CPU2017 integer tests

The widely referenced SPEC CPU2017 benchmark is [described on SPEC.org](https://www.spec.org) as:

The **SPEC CPU® 2017** benchmark package contains SPEC's next-generation, industry-standardized, CPU intensive suites for measuring and comparing compute intensive performance, stressing a system's processor, memory subsystem and compiler. SPEC designed CPU2017 to provide a comparative measure of compute-intensive performance across the widest practical range of hardware based upon the aggregate score of 10 integer and 13 floating point real-world 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 the Xeon Platinum 8280 achieve a 19% improvement<sup>2</sup> in integer throughput over the Platinum 8180 with its need for OS-based Spectre/Meltdown security vulnerability mitigations.

[Figure 1 Two socket Platform Performance improvement running SPECint\\_rate\\_base2017](#)



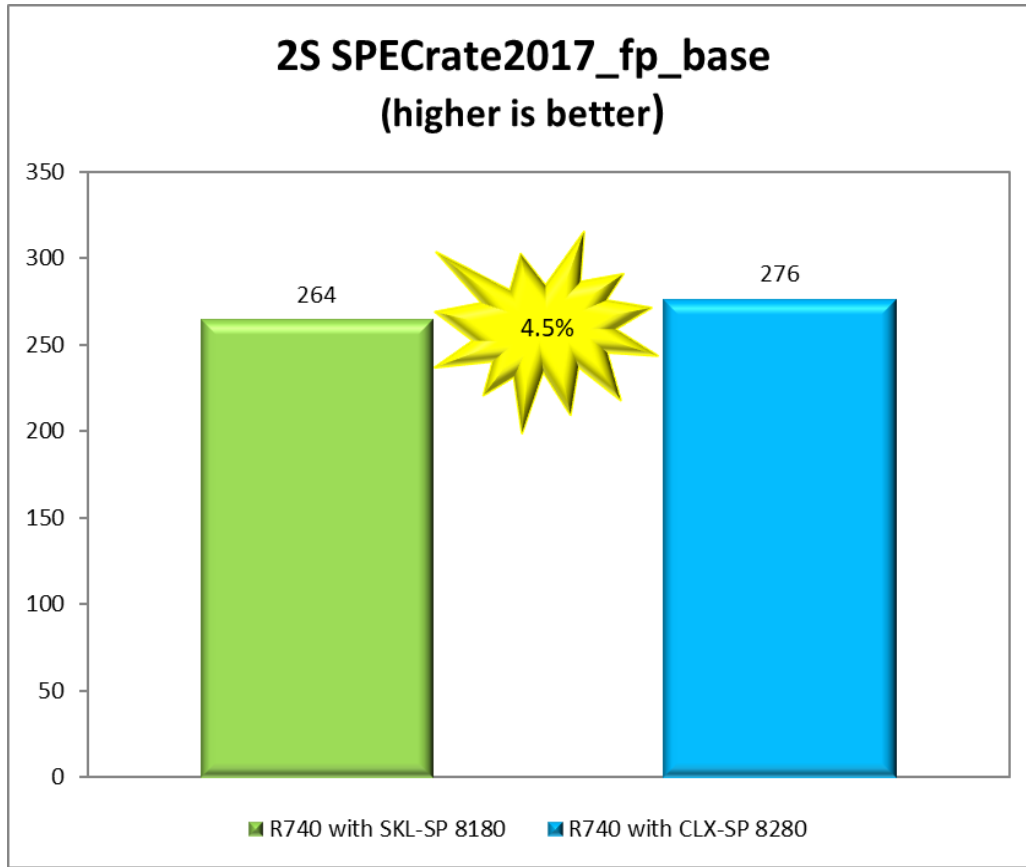
See the Appendix D for comparative CascadeLake-SP and SkyLake-SP model integer rate results.

<sup>2</sup> SPEC and SPECcpu are registered trademarks of Standard Performance Evaluation Corporation. The performance described is based upon results posted at <http://www.spec.org> in Apr-2017.

### SPEC CPU2017 floating-point tests

The throughput or rate of a machine carrying out floating-point arithmetic is important to those working today's biggest problems in science and engineering. In figure 2, we see Xeon Platinum 8280 achieve a 4.5% improvement<sup>3</sup> in floating point throughput over the Platinum 8180 with its need for OS-based Spectre/Meltdown security vulnerability mitigations.

[Figure 2 Two socket Platform Performance improvement running SPECfp\\_rate\\_base2017](#)



See the Appendix D for comparative CascadeLake-SP and SkyLake-SP model floating point rate results.

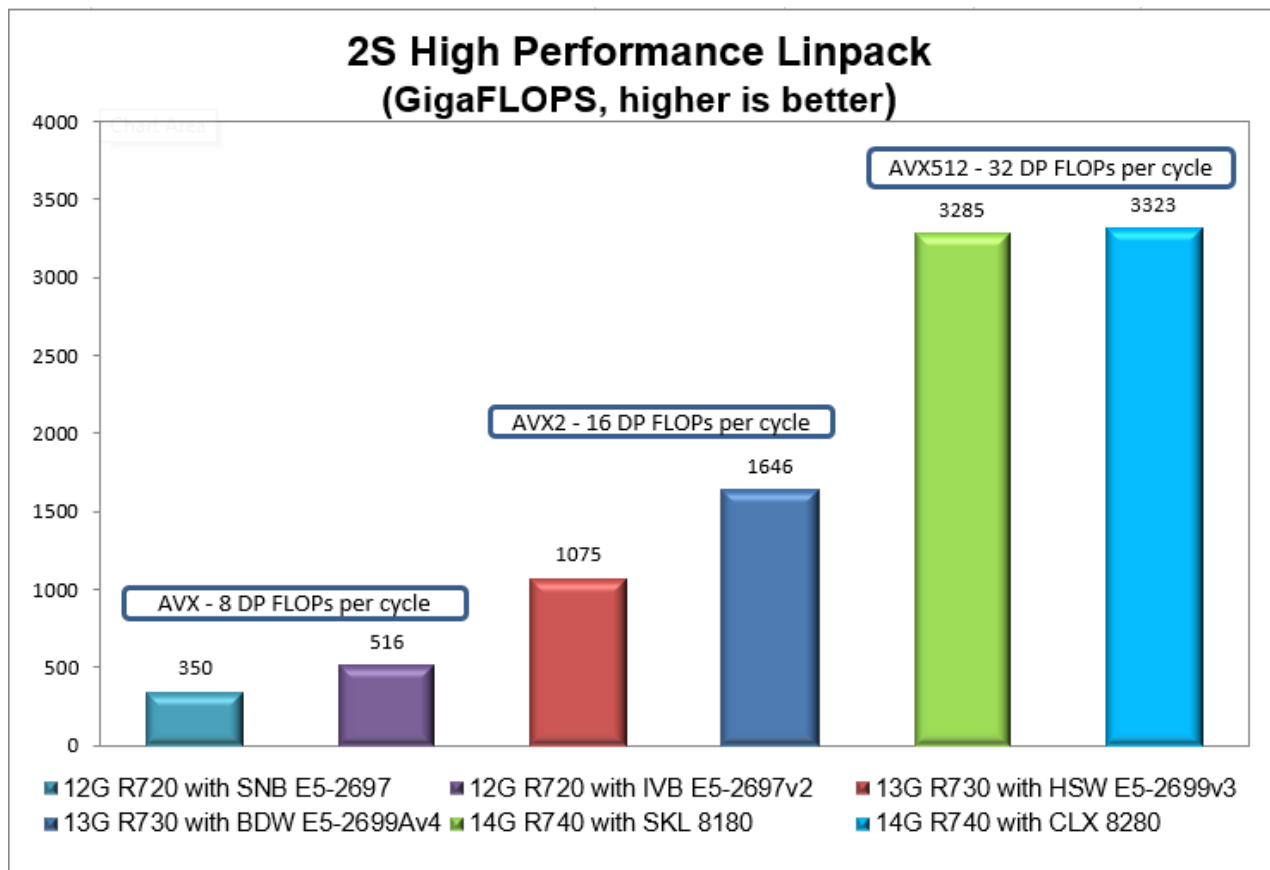
<sup>3</sup> SPEC and SPECcpu are registered trademarks of Standard Performance Evaluation Corporation. The performance described is based upon results posted at <http://www.spec.org> in Apr-2019.

### High Performance Computing (HPC) performance tests

The widely-available LINPACK<sup>4</sup> benchmark is the standard for illustrating a system's "heavy math" floating point processing power needed for simulating natural phenomena, analyzing structures and machine learning.

Cascade Lake-SP's incrementally improved Turbo Boost levels, IPC and support for 2933M DDR4 provide a nominal uplift over Skylake-SP. Figure 3 illustrates how each new AVX SIMD instruction set extension effectively doubles the CPU's floating-point operations per second over the previous rendition. As a result, today's new PowerEdge servers produce 10x the FLOPs of those based upon the E5-2600 series Xeon CPUs from 2012.

[Figure 3 Performance improvement running High-Performance Linpack](#)



See the Appendix B for LINPACK results from more Cascade Lake-SP CPU models

<sup>4</sup> [https://en.wikipedia.org/wiki/LINPACK\\_benchmarks](https://en.wikipedia.org/wiki/LINPACK_benchmarks),

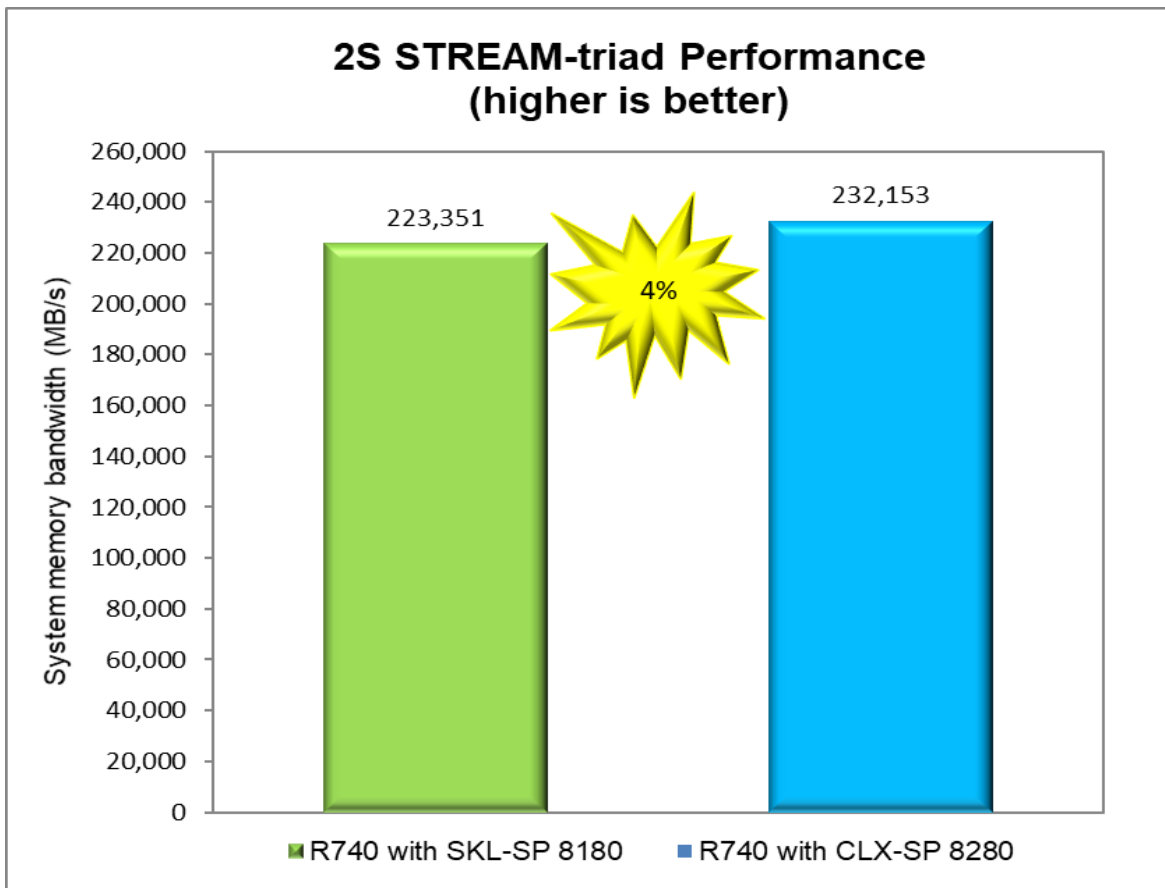


## Memory subsystem performance

### STREAM-triad

As CPU throughput performance grows so does the need for the main memory configurations that will maximize aggregate data transfer rate. This is especially true for Cloud and in-memory database applications. Dell new PowerEdge servers with select Cascade Lake-SP processor models support 2933 MT/s DDR4 system memory configurations up from the 2666 MT/s of Skylake-SP. In figure 4, the server industry-standard STREAM-triad<sup>5</sup> metric illustrates the CLX + 2933M solution provides a 4% uplift in total system memory read bandwidth over the previous SKL + 2666M one.

[Figure 4 Performance improvement running STREAM](#)



See the Appendix C for STREAM results from more Cascade Lake-SP CPU models

<sup>5</sup> <https://www.cs.virginia.edu/stream/>

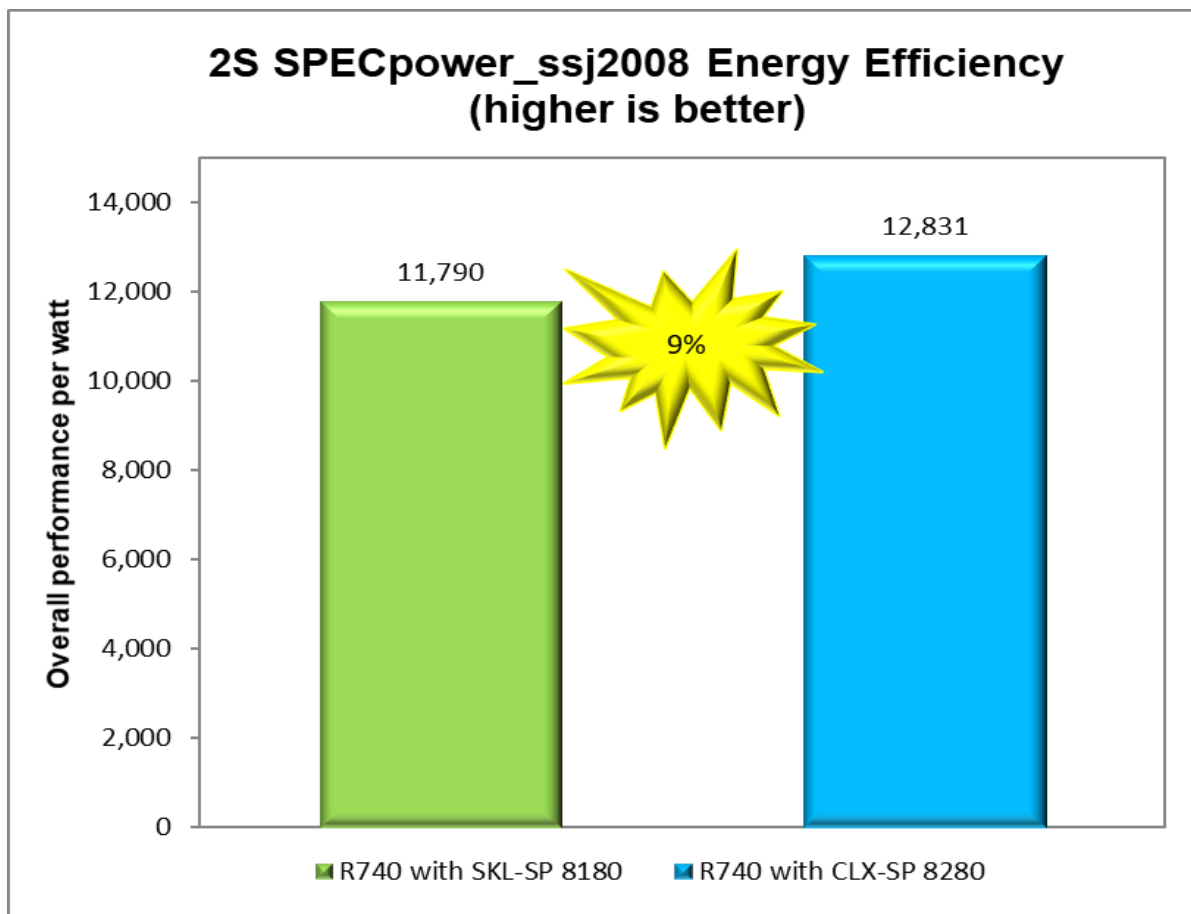
## Energy Efficiency

### SPECpower\_ssj2008

SPECpower\_ssj2008 is an industry standard benchmark created by the Standard Performance Evaluation Corporation (SPEC®) to measure a server’s power and performance across its full range of utilization levels from 100% to idle.

As figure 5 shows, the Dell PowerEdge R740 with two of the new Cascade Lake-SP 8280 processors is capable of 9% higher performance per watt than was possible with the Skylake-SP Platinum 8180<sup>6</sup>.

[Figure 5 Two Socket Platform Energy Efficiency improvement running SPECpower\\_ssj2008](#)



<sup>6</sup> Required SPEC disclosure information: R740/8280 scores: (5,811,114 ssj\_ops and 432W) @ 100% target load and 12,831 overall ssj\_ops/watt vs. R740/8180: (5,727,798 ssj\_ops and 457W) @ 100% and 11,790 overall ssj\_ops/watt. Both results published at [https://spec.org/power\\_ssj2008/results/](https://spec.org/power_ssj2008/results/). SPEC® and the benchmark name SPECpower\_ssj® are registered trademarks

## Business Transaction Performance

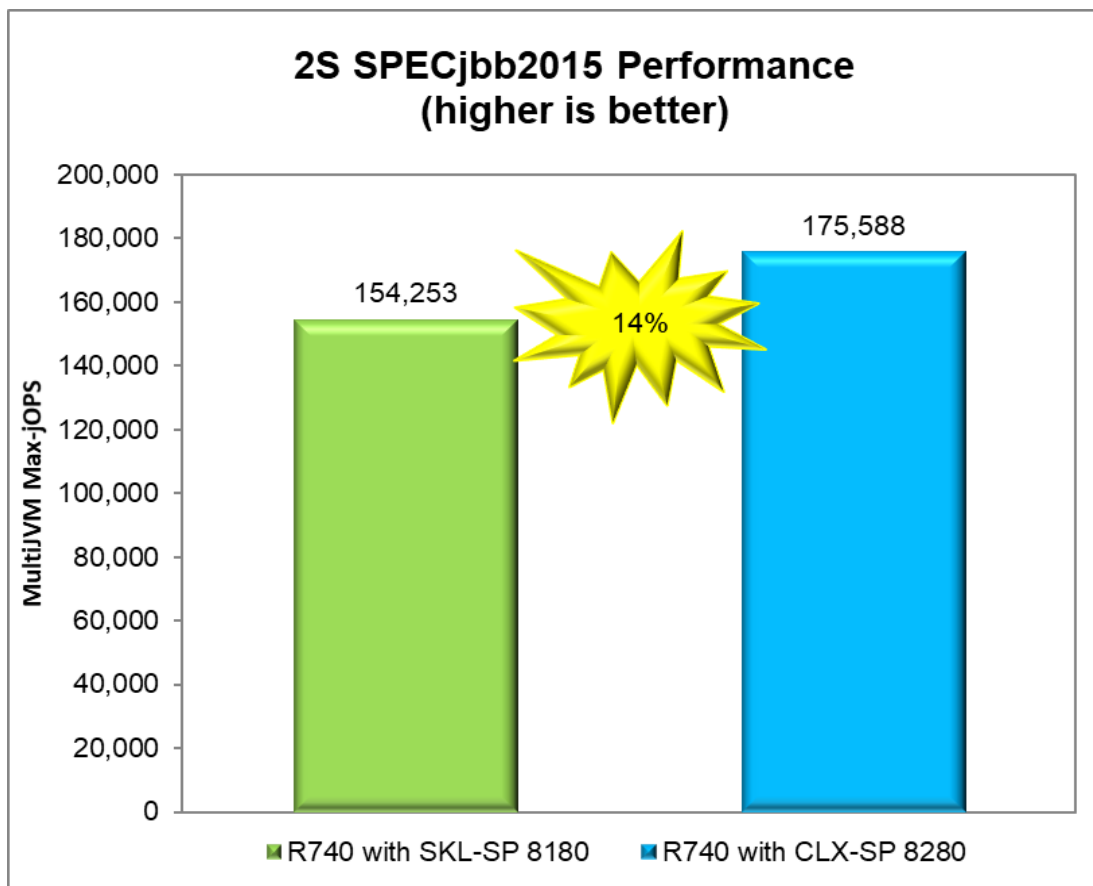
### SPECjbb2015

According to the [SPEC website](#):

This benchmark models a Java-based business application for a worldwide supermarket company with an IT infrastructure that handles a mix of point-of-sale requests, online purchases and data-mining operations. It exercises the latest data formats (XML), communication using compression and messaging with security in a virtualized cloud computing environment.

As figure 6 shows, a Dell PowerEdge R740 with a pair of the new Cascade Lake-SP 8280 processors and accompanying 2933M memory provides 14% more Java operations per second than the R740 with Skylake-SP Platinum 8180<sup>7</sup>

[Figure 6 Two Socket Platform Performance improvement running SPECjbb2015](#)



<sup>7</sup> SPEC and SPECjbb are registered trademarks of Standard Performance Evaluation Corporation. SKL-SP result from Dell lab Spectre/Meltdown security vulnerability mitigation regression. CLX-SP result published at <https://spec.org/jbb2015/results/> in Mar-2019.

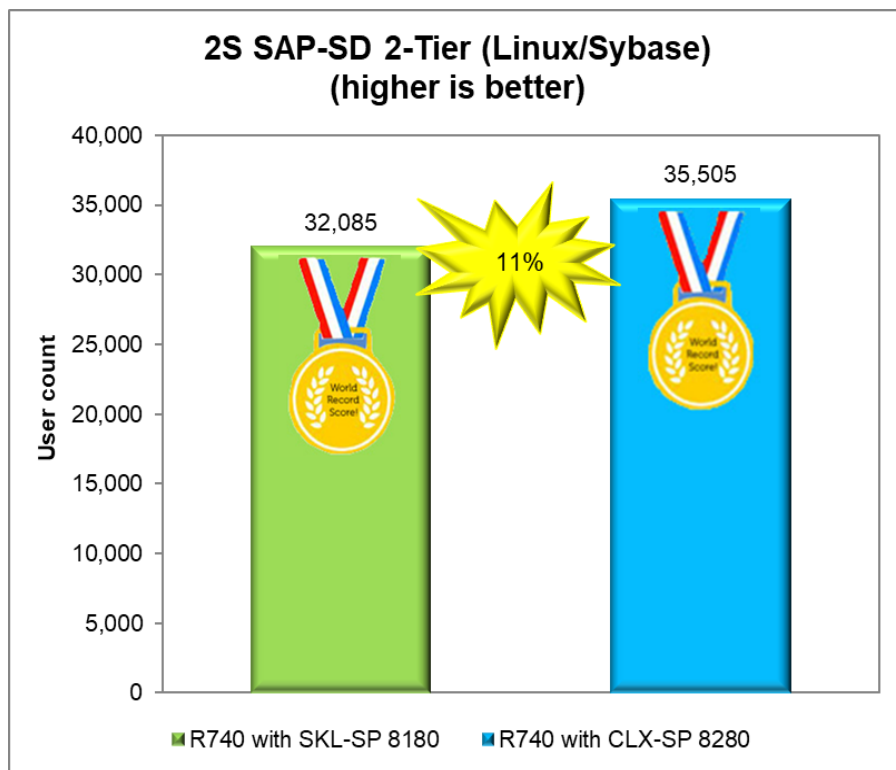
## SAP-SD 2-Tier, Linux / Sybase

The (Sales and Distribution) benchmark is described on the [SAP web site](#) as:

The Sales and Distribution (SD) Benchmark covers a sell-from-stock scenario, which includes the creation of a customer order with five-line items and the corresponding delivery with subsequent goods movement and invoicing.

The SAP-SD Two-Tier benchmark's primary metric is the Number of Benchmark Users. As figure 7 shows, the PowerEdge R740 with Xeon Platinum 8280 achieved an acknowledged world record result being 11% higher<sup>8</sup> than from the PowerEdge R740 with Xeon Platinum 8180 which itself was a world record<sup>9</sup>

[Figure 7 Performance improvement running SAP SD 2-Tier, Linux / Sybase](#)



<sup>8</sup> Results of the Dell PowerEdge R740 on the two-tier SAP SD standard application benchmark: 35,505 SAP SD benchmark users with the SAP enhancement package 5 for SAP ERP 6.0, SUSE Linux Enterprise Server 15, and Sybase ASE 16.0.03.03, 2 x Intel Xeon Platinum 8280 processors (56 cores, 112 threads), 768 GB main memory. Certification number 2019026. <http://www.sap.com/benchmark>

<sup>9</sup> Results of the Dell PowerEdge R740 on the two-tier SAP SD standard application benchmark: 32,085 SAP SD benchmark users with the SAP enhancement package 5 for SAP ERP 6.0, Red Hat Enterprise Linux 7.3, and Sybase ASE 16.0, 2 x Intel Xeon Platinum 8180 processors (56 cores, 112 threads), 768 GB main memory. Certification number 2017017.

## Summary

Dell's refreshed PowerEdge servers with the new Cascade Lake-SP processor models, can provide even more performance from all scientific analysis and business transaction workloads. Thanks to both the CPU family's better computing value and Dell's Energy Smart implementation; this additional performance comes with reduced power/cooling requirements over the life of the product making possible capacity growth, infrastructure reduction and lower total cost of ownership.

Xeon Cascade Lake-SP and Cascade Lake Refresh processor models are available for purchase on select PowerEdge servers. The enhanced performance of the refreshed PowerEdge server lineup continues Dell's tradition for delivering the maximum performance value that today's datacenter administrators' demand.

## Appendix A — Test configurations

Table 1 Benchmark configurations

Benchmark	Processor quantity	Skylake-SP4 family processor	DIMM quantity	DIMM specifications
<b>SPECint_rate_base2017</b>	2	Xeon Platinum 8280	12	32 GB dual rank 2933 MT/s registered DIMMs
<b>SPECfp_rate_base2006</b>	2	Xeon Platinum 8280	12	32 GB dual rank 2933 MT/s registered DIMMs
<b>High Performance LINPAC</b>	2	Xeon Platinum 8280	12	32 GB dual rank 2933 MT/s registered DIMMs
<b>STREAM</b>	2	Xeon Platinum 8280	12	32 GB dual rank 2933 MT/s registered DIMMs
<b>SPECpower_ssj2008</b>	2	Xeon Platinum 8280	12	16 GB dual rank 2933 MT/s registered DIMMs
<b>SPECjbb2015</b>	2	Xeon Platinum 8280	12	16 GB dual rank 2933 MT/s registered DIMMs
<b>SAP SD Two-Tier, Linux</b>	2	Xeon Platinum 8280	24	32 GB dual rank 2666 MT/s registered DIMMs

## Appendix B —PowerEdge Server Floating Point Operations per Second

Figure 8 Linpack results for the Cascade Lake SP family in a 2-socket platform

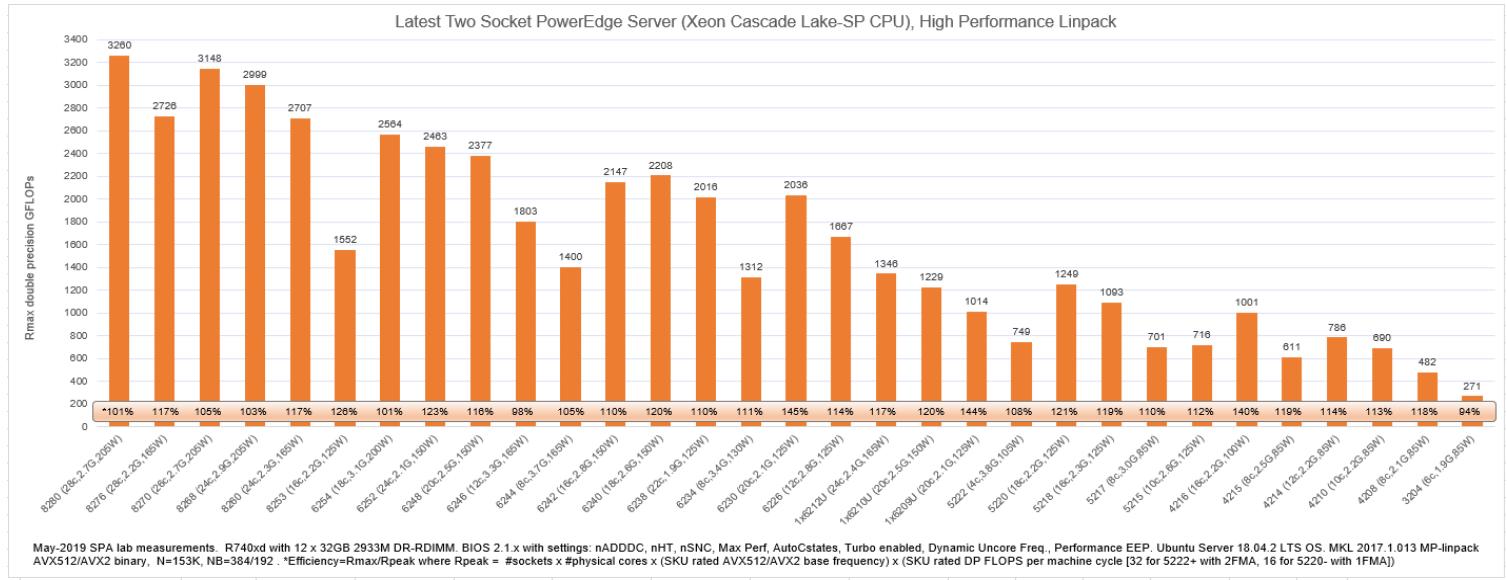
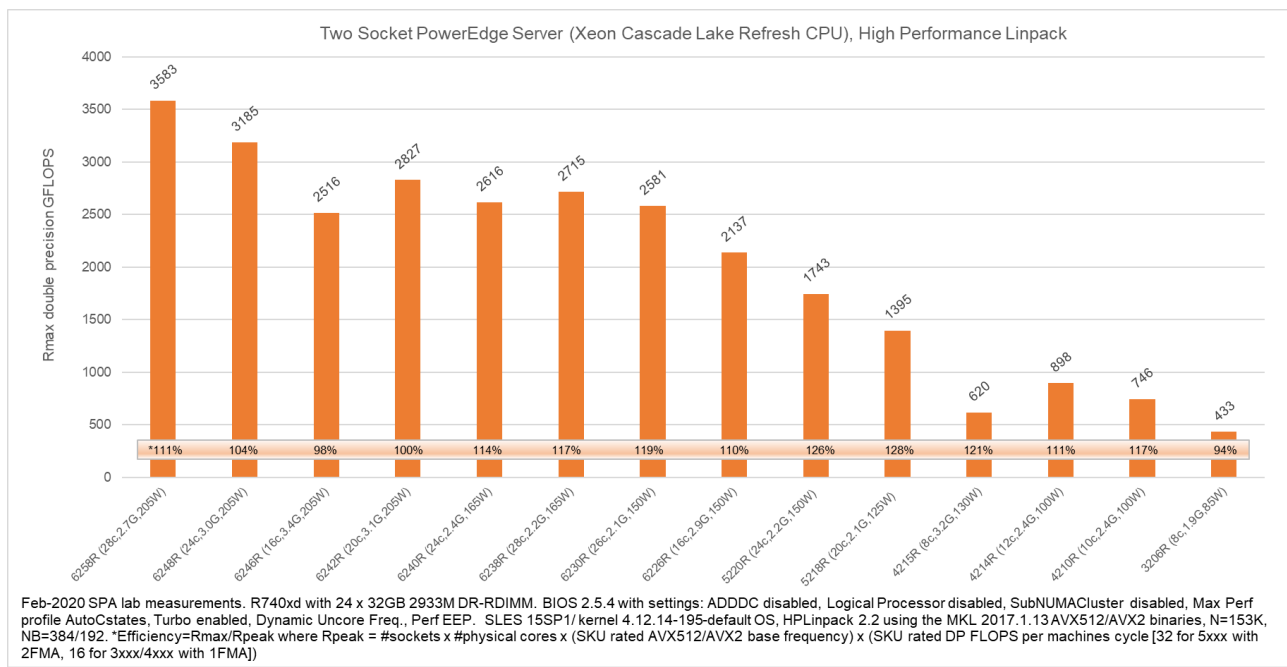


Figure 9 Linpack results for the Cascade Lake Refresh family in a 2-socket platform



<https://software.intel.com/en-us/articles/intel-mkl-benchmarks-suite>

## Appendix C — PowerEdge Server Total Memory Bandwidth

Figure 10 Stream results for the Cascade Lake SP family in a 2-socket platform

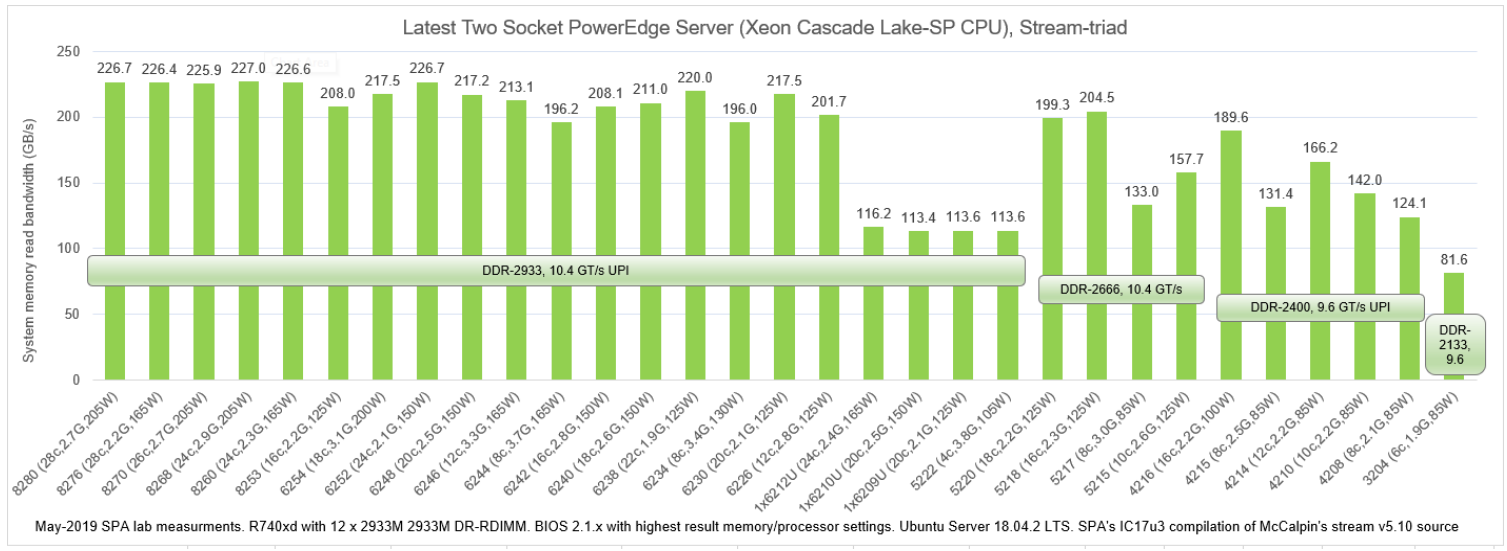
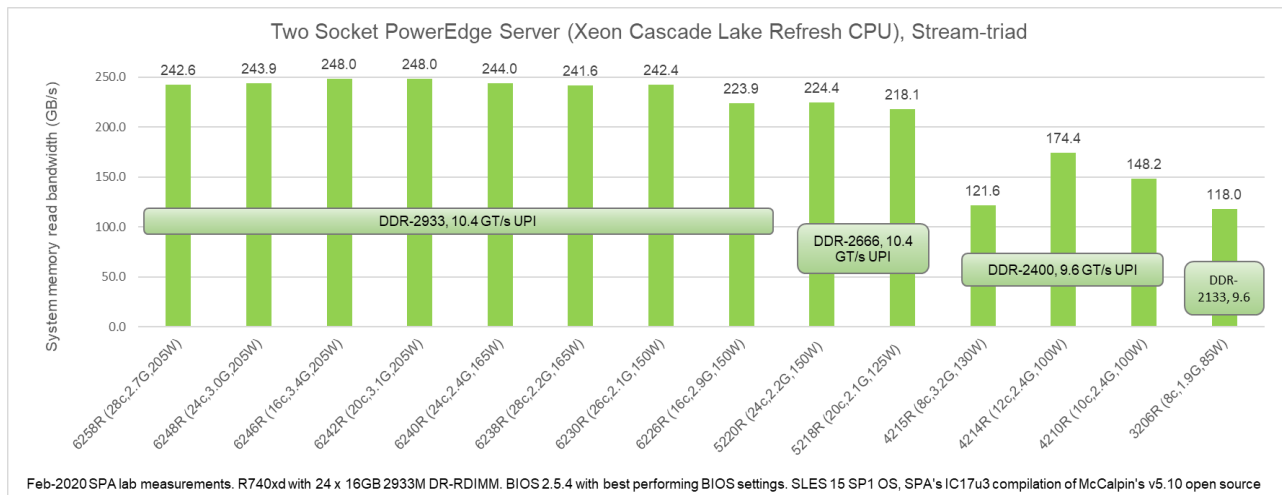


Figure 11 Stream results for the Cascade Lake Refresh family in a 2-socket platform



<https://www.cs.virginia.edu/stream/>



## Appendix D- 2S SPECcpu2017 RATE throughput metric results across the Xeon Cascade Lake-SP, Skylake-SP and Cascade Lake Refresh processor families<sup>10</sup>

Figure 12 Integer Workloads on Cascade Lake-SP and Skylake-SP

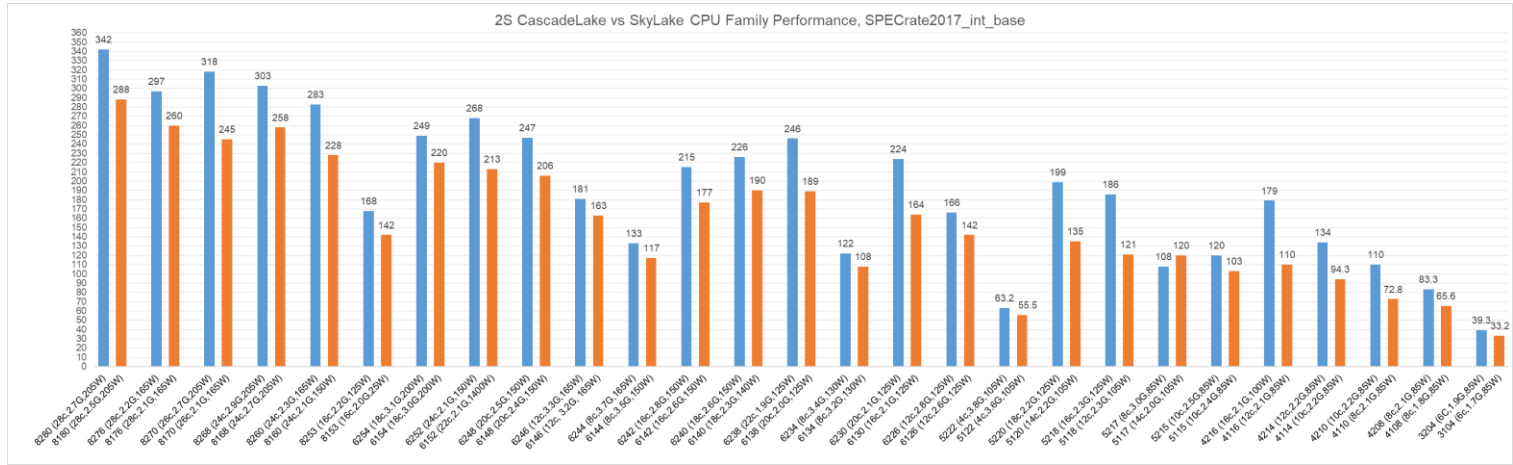
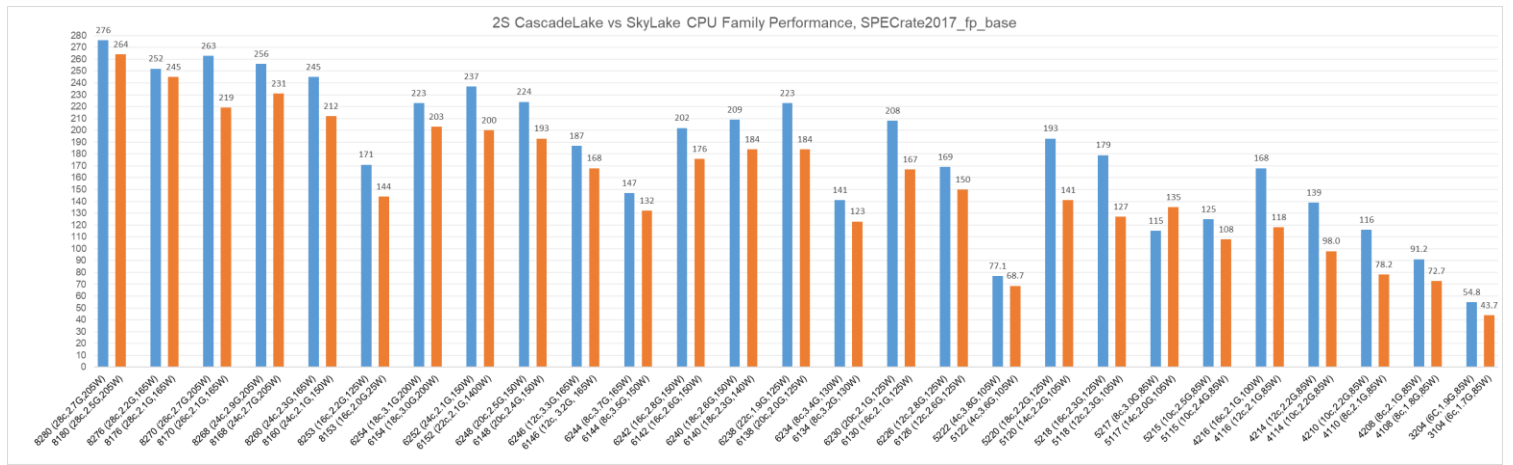


Figure 13 Floating Point Workloads on Cascade Lake-SP and Skylake-SP



<sup>10</sup> SPEC and SPECcpu are registered trademarks of Standard Performance Evaluation Corporation. The performance described is based upon SKL-SP, CLX-SP and CLX-R results published at <http://www.spec.org> as of June 4, 2020.

Figure 14 Integer Workloads on Cascade Lake-SP and Cascade Lake Refresh

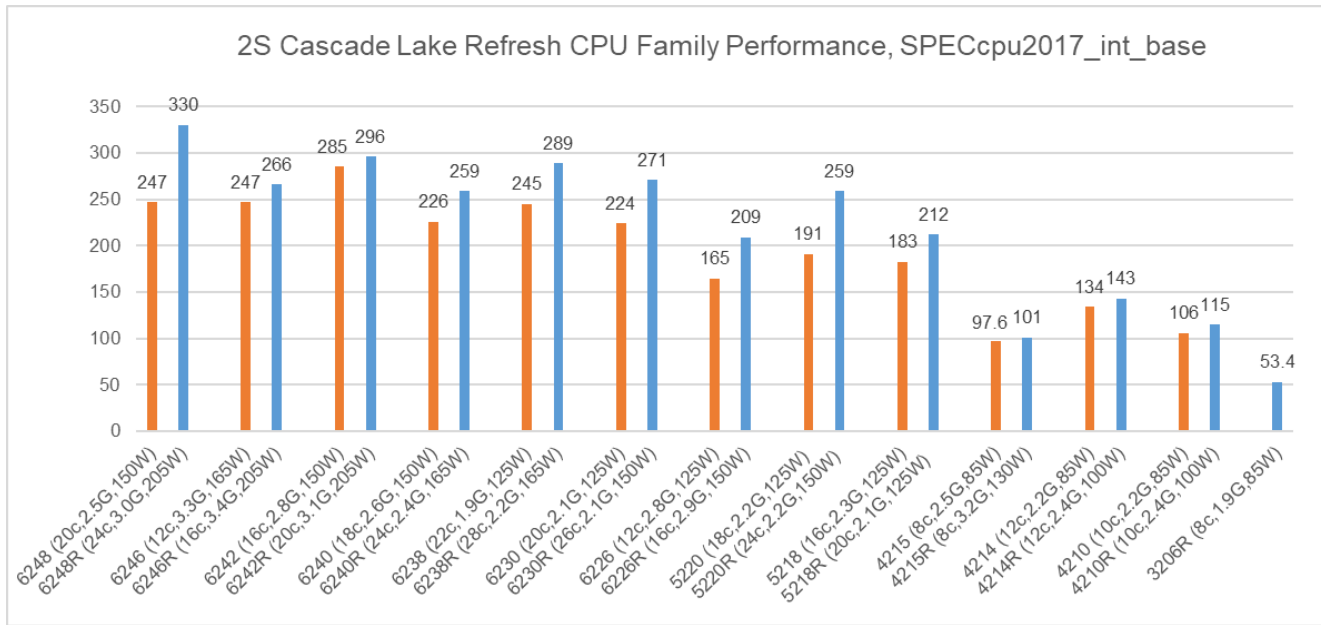


Figure 15 Floating Point Workloads on Cascade Lake-SP and Cascade Lake Refresh

