

# Fujitsu Server PRIMERGY Performance Report PRIMERGY RX2530 M6



This document provides an overview of benchmarks executed on the Fujitsu Server PRIMERGY RX2530 M6.

Explains PRIMERGY RX2530 M6 performance data in comparison to other PRIMERGY models. In addition to the benchmark results, the explanation for each benchmark and benchmark environment are also included.

## Version

1.4

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Technical data

PRIMERGY RX2530 M6



Decimal prefixes according to the SI standard are used for measurement units in this white paper (e.g. 1 GB = 10<sup>9</sup> bytes). In contrast, these prefixes should be interpreted as binary prefixes (e.g. 1 GB = 2<sup>30</sup> bytes) for the capacities of caches and memory modules. Separate reference will be made to any further exceptions where applicable.

Model	PRIMERGY RX2530 M6
Form factor	Rack server
Chipset	Intel C621A
Number of sockets	2
Number of configurable processors	1 or 2
Processor type	3rd Generation Intel Xeon Scalable Processors Family
Number of memory slots	32 (16 per processor)
Maximum memory configuration	10,240 GB
Onboard HDD controller	Controller with RAID (0, 1, 10) function (supports up to 8 SATA HDD/SSD)
PCI slots	PCI-Express 4.0 (x16 lane): 3 (Low Profile) PCI-Express 4.0 (x8 lane) : 1 (Low Profile)
Maximum number of internal hard disks	12 x 2.5 inches or 4 x 3.5 inches or 32 x EDSFF

Processor								
Processor model	Number of cores	Number of threads	Cache [MB]	UPI speed [GT/s]	Rated frequency [GHz]	Maximum turbo frequency [GHz]	Maximum memory frequency [MHz]	TDP [W]
Xeon Platinum 8380	40	80	60	11.2	2.3	3.4	3,200	270
Xeon Platinum 8368Q	38	76	57	11.2	2.6	3.7	3200	270
Xeon Platinum 8368	38	76	57	11.2	2.4	3.4	3,200	270
Xeon Platinum 8362*1	32	64	48	11.2	2.8	3.6	3,200	265
Xeon Platinum 8360Y	36	72	54	11.2	2.4	3.5	3,200	250
Xeon Platinum 8358P	32	64	48	11.2	2.6	3.4	3,200	240
Xeon Platinum 8358	32	64	48	11.2	2.6	3.4	3,200	250
Xeon Platinum 8352Y	32	64	48	11.2	2.2	3.4	3,200	205
Xeon Platinum 8352V	36	72	54	11.2	2.1	3.5	2,933	195
Xeon Platinum 8352M*1	32	64	48	11.2	2.3	3.5	3,200	185
Xeon Gold 6354	18	36	39	11.2	3.0	3.6	3,200	205
Xeon Gold 6348	28	56	42	11.2	2.6	3.5	3,200	235
Xeon Gold 6346	16	32	36	11.2	3.1	3.6	3,200	205
Xeon Gold 6342*1	24	48	36	11.2	2.8	3.5	3,200	230
Xeon Gold 6338T*1	24	48	36	11.2	2.1	3.4	2,933	165
Xeon Gold 6338	32	64	48	11.2	2.0	3.2	3,200	205
Xeon Gold 6336Y*1	24	48	36	11.2	2.4	3.6	3,200	185
Xeon Gold 6334*1	8	16	18	11.2	3.6	3.7	3,200	165
Xeon Gold 6330N	28	56	42	11.2	2.2	3.4	2,667	165
Xeon Gold 6330	28	56	42	11.2	2.0	3.1	2,933	205
Xeon Gold 6326*1	16	32	24	11.2	2.9	3.5	3,200	185
Xeon Gold 6314U	32	64	48	-	2.3	3.4	3,200	205
Xeon Gold 6312U*1	24	48	36	-	2.4	3.6	3,200	185
Xeon Gold 5320*1	26	52	39	11.2	2.2	3.4	2,933	185
Xeon Gold 5318Y*1	24	48	36	11.2	2.1	3.4	2,933	165
Xeon Gold 5318S*1	24	48	36	11.2	2.1	3.4	2,933	165
Xeon Gold 5317*1	12	24	18	11.2	3.0	3.6	2,933	150
Xeon Gold 5315Y*1	8	16	12	11.2	3.2	3.6	2,933	140
Xeon Silver 4316*1	20	40	30	10.4	2.3	3.4	2,666	150
Xeon Silver 4314*1	16	32	24	10.4	2.4	3.4	2,666	135
Xeon Silver 4310*1	12	24	18	10.4	2.1	3.3	2,666	120
Xeon Silver 4309Y*1	8	16	12	10.4	2.8	3.6	2,666	105

\*1: To be supported in July 2021 or later

All processors that can be ordered with PRIMERGY RX2530 M6 support Intel Turbo Boost Technology 2.0.

This technology allows you to operate the processor with higher frequencies than the rated frequency. The "maximum turbo frequency" listed in the processor list above is the theoretical maximum frequency when there is only one active core per processor. The maximum frequency that can actually be achieved depends on the number of active cores, current consumption, power consumption, and processor temperature.

As a general rule, Intel does not guarantee that maximum turbo frequencies will be achieved. This is related to manufacturing tolerances, and the performance of each individual processor model varies from each other.

The range of difference covers the range including all of the rated frequency and the maximum turbo frequency.

The turbo function can be set in the BIOS option. Generally, Fujitsu always recommends leaving the [Turbo Mode] option set at the standard setting [Enabled], as performance is substantially increased by the higher frequencies. However, the Turbo Mode frequency depends on the operating conditions mentioned above and is not always guaranteed. The turbo frequency fluctuates in applications where AVX instructions are used intensively and the number of instructions per clock is large. If you need stable performance or want to reduce power consumption, it may be beneficial to set the [Turbo Mode] option to [Disabled] to disable the turbo function.

The processor with the suffix means it is optimized for the following feature.

Suffix	Additional feature
M	Processor which is optimized for media, AI, and HPC
N	Processor which is optimized for NFV usage
P	Processor which is optimized for IaaS (orchestration efficiency targeting higher frequency for VM Market)
Q	Processor which requires liquid cooling
S	Processor which supports max SGX enclave size of 512GB
T	Processor with higher Tcase, which is designed for Network Environment-Building system environments and supports for up to 10-year reliability
U	Processor which is optimized for single socket
V	Processor which is optimized for SaaS (orchestration efficiency targeting high density, lower power VM environment)
Y	Processor which supports Speed Select Technology

Memory modules								
Type	Capacity [GB]	Number of ranks	Bit width of the memory chips	Frequency [MHz]	Load Reduced	Registered	NVDIMM	ECC
8 GB (1x8 GB) 1Rx8 DDR4-3200 R ECC	8	1	8	3,200		✓		✓
16 GB (1x16 GB) 2Rx8 DDR4-3200 R ECC	16	2	8	3,200		✓		✓
16 GB (1x16 GB) 1Rx4 DDR4-3200 R ECC	16	1	4	3,200		✓		✓
32 GB (1x32 GB) 2Rx4 DDR4-3200 R ECC	32	2	4	3,200		✓		✓
64 GB (1x64 GB) 2Rx4 DDR4-3200 R ECC	64	2	4	3,200		✓		✓
64 GB (1x64 GB) 2Rx4 DDR4-3200 LR ECC	64	2	4	3,200	✓	✓		✓
128 GB (1x128 GB) 4Rx4 DDR4-3200 LR ECC	128	4	4	3,200	✓	✓		✓
128 GB (1x128GB) Optane PMem- 3200	128			3,200			✓	✓
256 GB (1x256GB) Optane PMem- 3200	256			3,200			✓	✓
512 GB (1x512GB) Optane PMem- 3200	512			3,200			✓	✓

Power supplies		Maximum number
Modular redundant PSU	500W platinum PSU	2
	900W platinum PSU	2
	1,600W platinum PSU	2
	2,200W platinum PSU	2
	900W titanium PSU	2

Includes components that will be supported after the system release. Also, some components may not be available in all countries or sales regions.

Detailed technical information is available in the data sheet of PRIMERGY RX2530 M6.

# SPEC CPU2017

## Benchmark description

SPEC CPU2017 is a benchmark which measures the system efficiency with integer and floating-point operations. It consists of an integer test suite (SPECrate 2017 Integer, SPECSpeed 2017 Integer) containing 10 applications and a floating-point test suite (SPECrate 2017 Floating Point, SPECSpeed 2017 Floating Point) containing 14 applications. Both test suites are extremely computing-intensive and concentrate on the CPU and the memory. Other components, such as Disk I/O and network, are not measured by this benchmark.

SPEC CPU2017 is not tied to a special operating system. The benchmark is available as source code and is compiled before the actual measurement. The used compiler version and their optimization settings also affect the measurement result.

SPEC CPU2017 contains two different performance measurement methods. The first method (SPECSpeed 2017 Integer or SPECSpeed 2017 Floating Point) determines the time which is required to process a single task. The second method (SPECrate 2017 Integer or SPECrate 2017 Floating Point) determines the throughput, i.e. the number of tasks that can be handled in parallel. Both methods are also divided into two measurement runs, "base" and "peak." They differ in the use of compiler optimization. When publishing the results, the base values are always used and the peak values are optional.

Benchmark	Number of single benchmarks	Arithmetics	Type	Compiler optimization	Measurement result
SPECSpeed2017_int_peak	10	integer	peak	aggressive	Speed
SPECSpeed2017_int_base	10	integer	base	conservative	
SPECrate2017_int_peak	10	integer	peak	aggressive	Throughput
SPECrate2017_int_base	10	integer	base	conservative	
SPECSpeed2017_fp_peak	10	floating point	peak	aggressive	Speed
SPECSpeed2017_fp_base	10	floating point	base	conservative	
SPECrate2017_fp_peak	13	floating point	peak	aggressive	Throughput
SPECrate2017_fp_base	13	floating point	base	conservative	

The measurement results are the geometric average from normalized ratio values which have been determined for individual benchmarks. The geometric average - in contrast to the arithmetic average - means that there is a weighting in favor of the lower individual results. "Normalized" means that the measurement is how fast is the test system compared to a reference system. For example, value "1" was defined for the SPECSpeed2017\_int\_base, SPECrate2017\_int\_base, SPECSpeed2017\_fp\_base, and SPECrate2017\_fp\_base results of the reference system. A SPECSpeed2017\_int\_base value of 2 means that the measuring system has handled this benchmark twice as fast as the reference system. A SPECrate2017\_fp\_base value of 4 means that the measuring system has handled this benchmark about 4/[# base copies] times faster than the reference system. "# base copies" specifies how many parallel instances of the benchmark have been executed.

Not every SPEC CPU2017 measurement is submitted by Fujitsu for publication at SPEC. This is why the SPEC web pages do not have every result. As Fujitsu archives the log files for all measurements, it is possible to prove the correct implementation of the measurements at any time.

## Benchmark environment

### System Under Test (SUT)

#### Hardware

• Model	PRIMERGY RX2530 M6
• Processor	2 x 3rd Generation Intel Xeon Scalable Processors Family
• Memory	32 x 32 GB 2Rx4 PC4-3200AA-R

#### Software

• BIOS settings	<p>SPECspeed2017_int_base:</p> <ul style="list-style-type: none"> <li>• CPU C1E Support = Disabled</li> <li>• UPI Link Frequency Select = 10.4GT/s</li> </ul> <p>SPECSpeed2017_fp_base:</p> <ul style="list-style-type: none"> <li>• Hyper Threading = Disabled</li> <li>• DCU Streamer Prefetcher = Disabled</li> <li>• Override OS energy Performance = Enabled</li> <li>• Energy Performance = Performance</li> <li>• FAN Control = Full</li> </ul> <p>SPECrate2017_int_base:</p> <ul style="list-style-type: none"> <li>• DCU Streamer Prefetcher = Disabled</li> <li>• CPU C1E Support = Disabled</li> <li>• Package C State Limit = C2</li> <li>• UPI Link Frequency Select = 10.4GT/s</li> <li>• XPT Prefetch = Enable</li> <li>• LLC Prefetch = Enabled</li> <li>• UPI Prefetch = Disabled</li> <li>• Sub NUMA (SNC) =Enable SNC2</li> <li>• Fan Control = Ful</li> </ul> <p>SPECrate2017_fp_base:</p> <ul style="list-style-type: none"> <li>• Hyper Threading = Disabled</li> <li>• Adjacent Cache Line Prefetch = Disabled</li> <li>• DCU Streamer Prefetcher = Disabled</li> <li>• Intel Virtualization Technology = Disabled</li> <li>• Override OS energy Performance = Enabled</li> <li>• Energy Performance = Performance</li> <li>• CPU C1E Support = Disabled</li> <li>• Patrol Scrub = Enabled</li> <li>• Sub NUMA (SNC) = Enable SNC2</li> </ul>
• Operating system	<p>SPECrate2017_fp:</p> <p>SUSE Linux Enterprise Server 15 SP2 5.3.18-22-default</p> <p>SPECrate2017_int , SPECspeed2017_int, SPECspeed2017_fp:</p> <p>Red Hat Enterprise Linux Server release 8.2 4.18.0-193.el8.x86_64</p>
• Operating system settings	<p>Stack size set to unlimited using "ulimit -s unlimited"</p> <p>SPECspeed2017_int</p> <p>Sched_migration_cost_ns = 1000</p> <p>SPECspeed2017_fp</p> <p>Sched_latency_ns = 16000000</p>



	<p>SPECrate2017_int:</p> <p>Kernel Boot Parameter set with : nohz_full=1-X (X: logical core number -1)</p>
• Compiler	<p>SPECspeed2017, SPECrate2017_int</p> <p>C/C++: Version 19.1.2.275 of Intel C/C++ Compiler for Linux</p> <p>Fortran: Version 19.1.2.275 of Intel Fortran Compiler for Linux</p> <p>SPECrate2017_fp</p> <p>C/C++: Version 2021.1 of Intel C/C++ Compiler for Linux</p> <p>Fortran: Version 2021.1 of Intel Fortran Compiler for Linux</p>

## Benchmark results

In terms of processors, the benchmark result depends primarily on the size of the processor cache, the support for Hyper-Threading, the number of processor cores, and the processor frequency. In the case of processors with Turbo mode, the number of cores, which are loaded by the benchmark, determines the maximum processor frequency that can be achieved. In the case of single-threaded benchmarks, which largely load one core only, the maximum processor frequency that can be achieved is higher than with multi-threaded benchmarks.

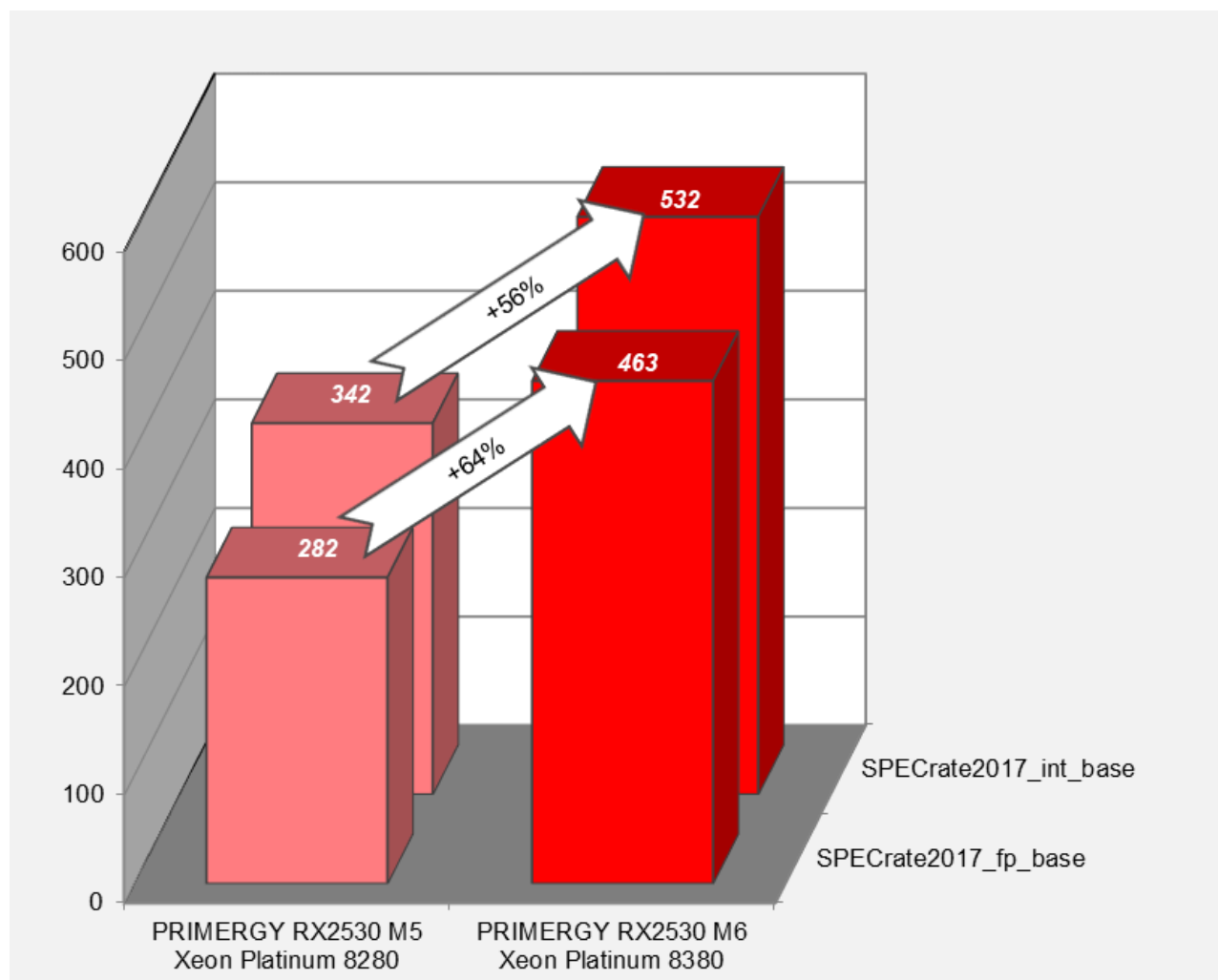
The results with "est." are the estimated values.

Processor	Number of cores	Number of processors	SPECrate2017 int_base	SPECrate2017 fp_base
Xeon Platinum 8380	40	2	<b>532</b>	<b>463</b>
Xeon Platinum 8368Q	38	2	517 est.	458 est.
Xeon Platinum 8368	38	2	506 est.	449 est.
Xeon Platinum 8362* <sup>1</sup>	32	2	464 est.	428 est.
Xeon Platinum 8360Y	36	2	483 est.	437 est.
Xeon Platinum 8358P	32	2	438 est.	413 est.
Xeon Platinum 8358	32	2	454 est.	424 est.
Xeon Platinum 8352Y	32	2	413 est.	395 est.
Xeon Platinum 8352V	36	2	424 est.	390 est.
Xeon Platinum 8352M* <sup>1</sup>	32	2	388 est.	378 est.
Xeon Gold 6354	18	2	297 est.	314 est.
Xeon Gold 6348	28	2	<b>407</b>	<b>391</b>
Xeon Gold 6346	16	2	274 est.	294 est.
Xeon Gold 6342* <sup>1</sup>	24	2	373 est.	367 est.
Xeon Gold 6338T* <sup>1</sup>	24	2	309 est.	322 est.
Xeon Gold 6338	32	2	397 est.	386 est.
Xeon Gold 6336Y* <sup>1</sup>	24	2	337 est.	343 est.
Xeon Gold 6334* <sup>1</sup>	8	2	145 est.	172 est.
Xeon Gold 6330N	28	2	332 est.	325 est.
Xeon Gold 6330	28	2	359 est.	349 est.
Xeon Gold 6326* <sup>1</sup>	16	2	259 est.	277 est.
Xeon Gold 6314U	32	1	213 est.	204 est.
Xeon Gold 6312U* <sup>1</sup>	24	1	175 est.	178 est.
Xeon Gold 5320* <sup>1</sup>	26	2	350 est.	344 est.
Xeon Gold 5318Y* <sup>1</sup>	24	2	311 est.	316 est.
Xeon Gold 5318S* <sup>1</sup>	24	2	310 est.	313 est.
Xeon Gold 5317* <sup>1</sup>	12	2	195 est.	212 est.
Xeon Gold 5315Y* <sup>1</sup>	8	2	137 est.	155 est.
Xeon Silver 4316* <sup>1</sup>	20	2	269 est.	277 est.
Xeon Silver 4314* <sup>1</sup>	16	2	222 est.	238 est.
Xeon Silver 4310* <sup>1</sup>	12	2	166 est.	188 est.
Xeon Silver 4309Y* <sup>1</sup>	8	2	125 est.	138 est.

Processor	Number of cores	Number of processors	SPECspeed2017 int_base	SPECspeed2017 fp_base
Xeon Platinum 8380	40	2		233 est.
Xeon Platinum 8368Q	38	2	12.5 est.	

The following graph compares the throughput of PRIMERGY RX2530 M6 and its older model, PRIMERGY PRIMERGY RX2530 M5, with maximum performance configurations.

#### SPECrate2017: Comparison of PRIMERGY RX2530 M6 and PRIMERGY RX2530 M5



# STREAM

## Benchmark description

STREAM is a synthetic benchmark that has been used for many years to determine memory throughput and was developed by John McCalpin during his professorship at the University of Delaware. Today STREAM is supported at the University of Virginia, where the source code can be downloaded in either Fortran or C. STREAM continues to play an important role in the HPC environment in particular. It is for example an integral part of the HPC Challenge benchmark suite.

The benchmark is designed in such a way that it can be used both on PCs and on server systems. The unit of measurement of the benchmark is GB/s, i.e. the number of gigabytes that can be read and written per second.

STREAM measures the memory throughput for sequential accesses. These can generally be performed more efficiently than accesses that are randomly distributed on the memory, because the processor caches are used for sequential access.

Before execution the source code is adapted to the environment to be measured. Therefore, the size of the data area must be at least 12 times larger than the total of all last-level processor caches so that these have as little influence as possible on the result. The OpenMP program library is used to enable selected parts of the program to be executed in parallel during the runtime of the benchmark. This provides optimal load distribution for the available processor cores.

In the STREAM benchmark, a data area consisting of 8-byte elements is continuously copied to four operation types. Arithmetic operations are also performed on operation types other than COPY.

Arithmetics type	Arithmetics	Bytes per step	Floating-point calculation per step
COPY	$a(i) = b(i)$	16	0
SCALE	$a(i) = q \times b(i)$	16	1
SUM	$a(i) = b(i) + c(i)$	24	1
TRIAD	$a(i) = b(i) + q \times c(i)$	24	2

The throughput is output in GB/s for each type of calculation. The differences between the various values are usually only minor on modern systems. In general, only the determined TRIAD value is used as a comparison.

The measured results primarily depend on the clock frequency of the memory modules. The processors influence the arithmetic calculations.

In this chapter, throughputs are indicated as a power of 10. (1 GB/s =  $10^9$  Byte/s)

## Benchmark environment

### System Under Test (SUT)

#### Hardware

• Model	PRIMERGY RX2530 M6
• Processor	2 x 3rd Generation Intel Xeon Scalable Processors Family
• Memory	32 x 32 GB 2Rx4 PC4-3200AA-R

#### Software

• BIOS settings	<ul style="list-style-type: none"><li>• Override OS Energy Performance = Enabled</li><li>• Energy Performance = Performance</li><li>• HWPM Support = Disabled</li><li>• Intel Virtualization Technology = Disabled</li><li>• LLC Dead Line Alloc = Disabled</li><li>• Stale AtoS = Enabled</li><li>• Sub NUMA (SNC) = Enable SNC2</li></ul>
• Operating system	Red Hat Enterprise Linux Server release 8.2 4.18.0-193.el8.x86_64
• Operating system settings	Kernel Boot Parameter set with : nohz_full=1-X (X: logical core number -1) Transparent Huge Pages inactivated ulimit -s unlimited
• Compiler	C/C++: Version 19.1.2.254 of Intel C/C++ Compiler for Linux
• Benchmark	STREAM Version 5.10

Some components may not be available in all countries or sales regions.

## Benchmark results

The results with "est." are the estimated values.

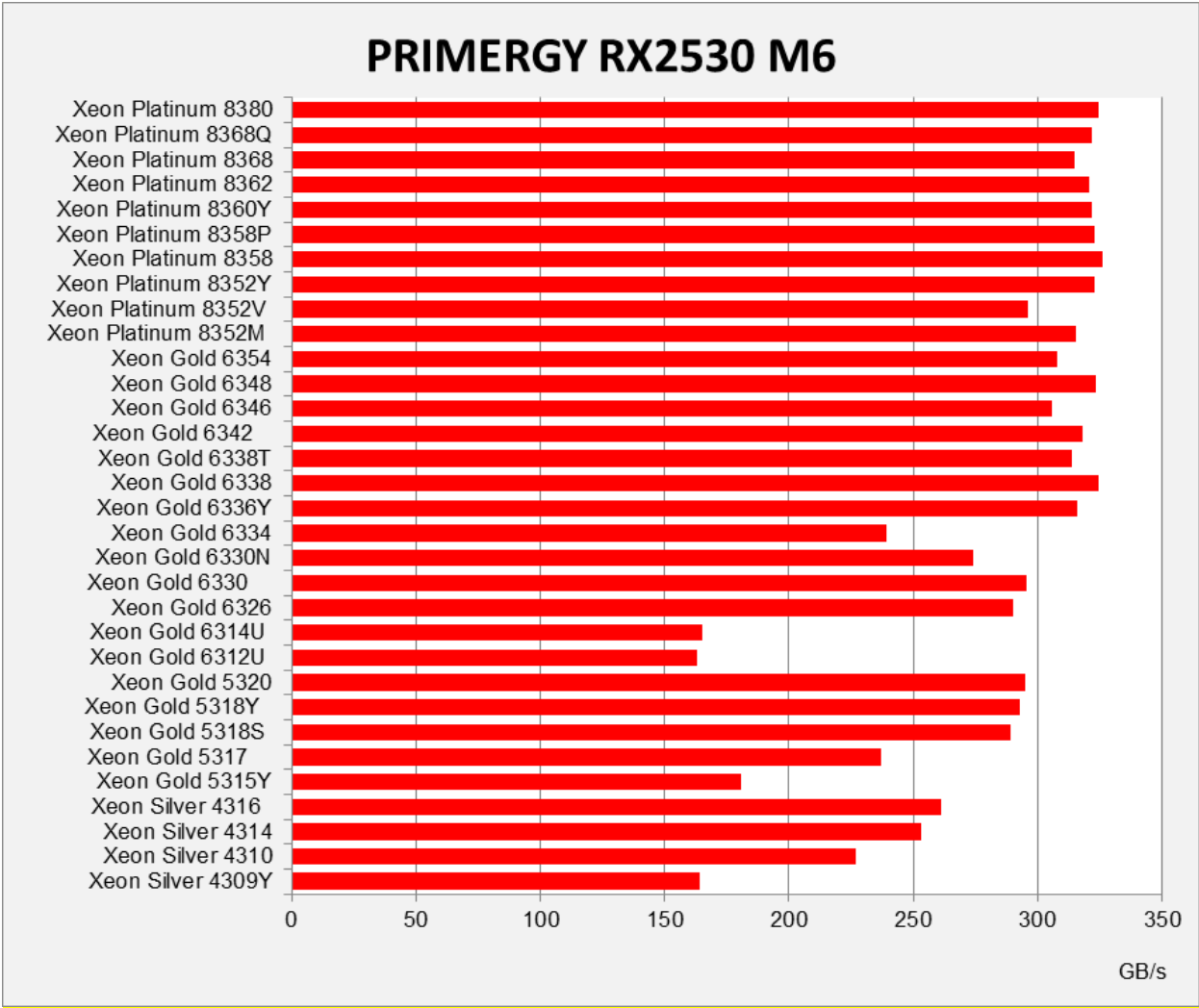
Processor	Memory frequency	Maximum memory bandwidth* 1	Number of cores	Rated frequency	Number of processors	TRIAD
	[MHz]	[GB/s]		[GHz]		[GB/s]
Xeon Platinum 8380	3,200	205	40	2.3	2	<b>324</b>
Xeon Platinum 8368Q	3,200	205	38	2.6	2	322 est.
Xeon Platinum 8368	3,200	205	38	2.4	2	315 est.
Xeon Platinum 8362*2	3,200	205	32	2.8	2	321 est.
Xeon Platinum 8360Y	3,200	205	36	2.4	2	322 est.
Xeon Platinum 8358P	3,200	205	32	2.6	2	323 est.
Xeon Platinum 8358	3,200	205	32	2.6	2	326 est.
Xeon Platinum 8352Y	3,200	205	32	2.2	2	323 est.
Xeon Platinum 8352V	2,933	188	36	2.1	2	296 est.
Xeon Platinum 8352M*2	3,200	205	32	2.3	2	315 est.
Xeon Gold 6354	3,200	205	18	3.0	2	308 est.
Xeon Gold 6348	3,200	205	28	2.6	2	323 est.
Xeon Gold 6346	3,200	205	16	3.1	2	306 est.
Xeon Gold 6342*2	3,200	205	24	2.8	2	318 est.
Xeon Gold 6338T*2	2,933	188	24	2.1	2	314 est.
Xeon Gold 6338	3,200	205	32	2.0	2	325 est.
Xeon Gold 6336Y*2	3,200	205	24	2.4	2	316 est.
Xeon Gold 6334*2	3,200	205	8	3.6	2	239 est.
Xeon Gold 6330N	2,666	171	28	2.2	2	274 est.
Xeon Gold 6330	2,933	188	28	2.0	2	296 est.
Xeon Gold 6326*2	3,200	205	16	2.9	2	290 est.
Xeon Gold 6314U	3,200	205	32	2.3	1	165 est.
Xeon Gold 6312U*2	3,200	205	24	2.4	1	163 est.
Xeon Gold 5320*2	2,933	188	26	2.2	2	295 est.
Xeon Gold 5318Y*2	2,933	188	24	2.1	2	293 est.
Xeon Gold 5318S*2	2,933	188	24	2.1	2	289 est.
Xeon Gold 5317*2	2,933	188	12	3.0	2	237 est.
Xeon Gold 5315Y*2	2,933	188	8	3.2	2	181 est.
Xeon Silver 4316*2	2,666	171	20	2.3	2	261 est.
Xeon Silver 4314*2	2,666	171	16	2.4	2	253 est.
Xeon Silver 4310*2	2,666	171	12	2.1	2	227 est.
Xeon Silver 4309Y*2	2,666	171	8	2.8	2	164 est.

\*1: Value per Processor

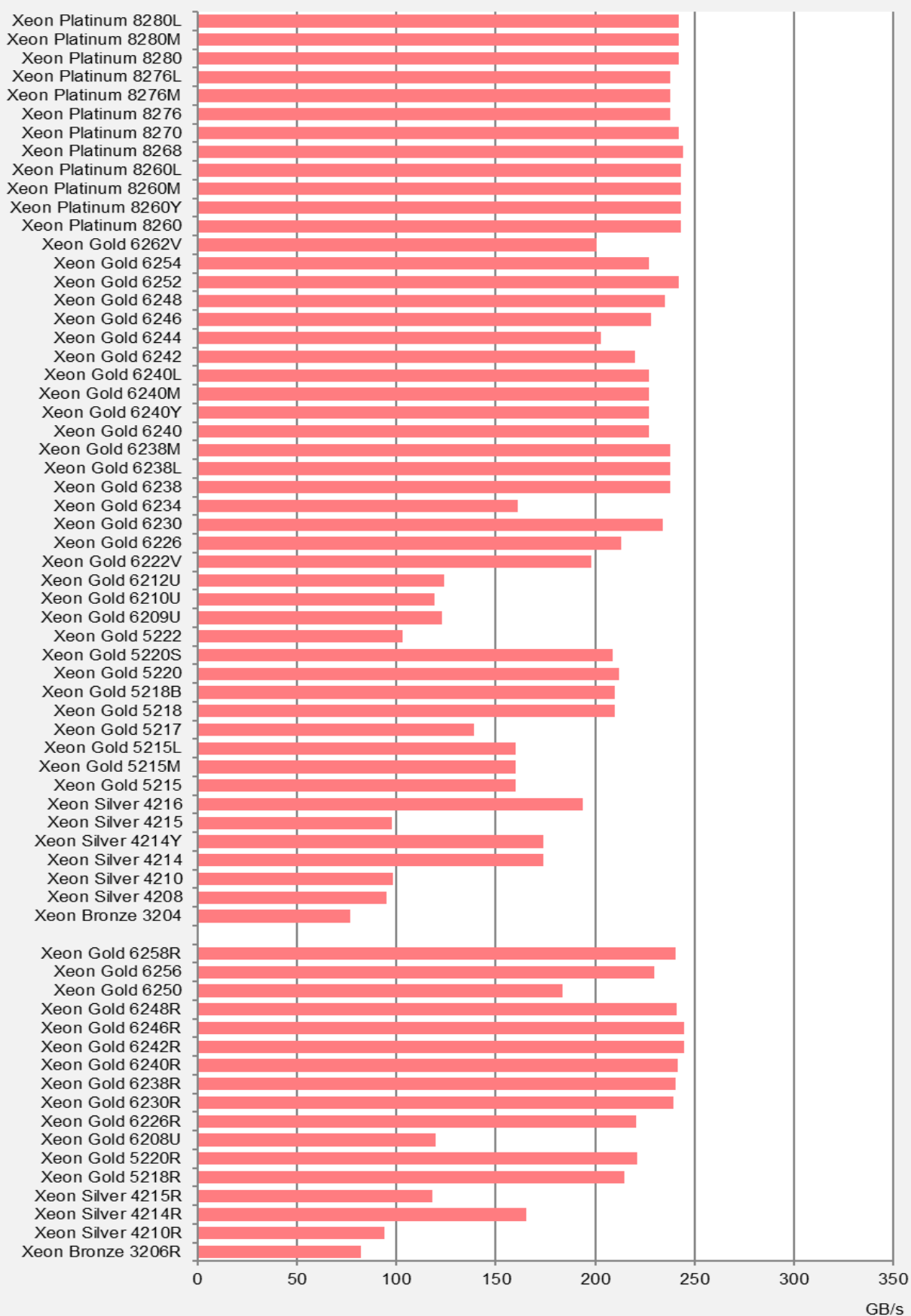
\*2: To be supported in July 2021 or later

The following diagram illustrates the throughput of the PRIMERGY RX2530 M6 in comparison to its predecessor, the PRIMERGY RX2530 M5..

**STREAM TRIAD: Comparison of PRIMERGY RX2530 M6 and PRIMERGY RX2530 M5**



## PRIMERGY RX2530 M5





# LINPACK

## Benchmark description

LINPACK was developed in the 1970s by Jack Dongarra and some other people to show the performance of supercomputers. The benchmark consists of a collection of library functions for the analysis and solution of linear system of equations. The description can be found in the following document.

<http://www.netlib.org/utk/people/JackDongarra/PAPERS/hplpaper.pdf>

LINPACK can be used to measure the speed of computers when solving a linear equation system. For this purpose, an  $n \times n$  matrix is set up and filled with random numbers between -2 and +2. The calculation is then performed via LU decomposition with partial pivoting.

A memory of  $8n^2$  bytes is required for the matrix. In case of an  $n \times n$  matrix the number of arithmetic operations required for the solution is  $\frac{2}{3}n^3 + 2n^2$ . Thus, the choice of  $n$  determines the duration of the measurement. In other words, if  $n$  is doubled, the measurement time will be approximately eight times longer. The size of  $n$  also has an influence on the measurement result itself. As  $n$  increases, the measured value asymptotically approaches its limit. The size of the matrix is therefore usually adapted to the amount of memory available. Furthermore, the memory bandwidth of the system only plays a minor role for the measurement result, but a role that cannot be fully ignored. The processor performance is the decisive factor for the measurement result. Since the algorithm used permits parallel processing, in particular the number of processors used and their processor cores are - in addition to the clock rate - of outstanding significance.

LINPACK is used to measure how many floating point operations were carried out per second. The result is referred to as **Rmax** and specified in GFlops (Giga Floating Point Operations per Second: 1 billion floating point operations/second).

An upper limit, referred to as **Rpeak**, for the speed of a computer can be calculated from the maximum number of floating point operations that its processor cores could theoretically carry out in one clock cycle.

$$\text{Rpeak} = \begin{aligned} &\text{Maximum number of floating point operations per clock cycle} \\ &\times \text{Number of processor cores of the computer} \\ &\times \text{Rated processor frequency [GHz]} \end{aligned}$$

LINPACK is classed as one of the leading benchmarks in the field of high performance computing (HPC). LINPACK is one of the seven benchmarks currently included in the HPC Challenge benchmark suite, which takes other performance aspects in the HPC environment into account.

Manufacturer-independent publication of LINPACK results is possible at <http://www.top500.org/>. This requires using an HPL-based LINPACK version (see <http://www.netlib.org/benchmark/hpl/>).

Intel offers a highly optimized LINPACK version (shared memory version) for individual systems with Intel processors. Parallel processes communicate here via "shared memory," i.e. jointly used memory. Another version provided by Intel is based on HPL (High Performance Linpack). Intercommunication of the LINPACK processes here takes place via OpenMP and MPI (Message Passing Interface). This enables communication between the parallel processes - also from one computer to another. Both versions can be downloaded from <http://software.intel.com/en-us/articles/intel-math-kernel-library-linpack-download/>.

Manufacturer-specific LINPACK versions also come into play when graphics cards for General Purpose Computation on Graphics Processing Unit (GPGPU) are used. These are based on HPL and include extensions which are needed for communication with the graphics cards. Benchmark environment

## Benchmark environment

### System Under Test (SUT)

#### Hardware

• Model	PRIMERGY RX2530 M6
• Processor	2 x 3rd Generation Intel Xeon Scalable Processors Family
• Memory	32 x 32 GB 2Rx4 PC4-3200AA-R

#### Software

• BIOS settings	HyperThreading = Disabled Link Frequency Select = 10.4 GT/s HWPM Support = Disabled Intel Virtualization Technology = Disabled LLC Dead Line Alloc = Disabled Stale AtoS = Enabled Fan Control = Full
• Operating system	Red Hat Enterprise Linux Server release 8.2 4.18.0-193.el8.x86_64
• Operating system settings	Kernel Boot Parameter set with : nohz_full=1-X (X: logical core number -1) cpupower -c all frequency-set -g performance echo 50000 > /proc/sys/kernel/sched_cfs_bandwidth_slice_us echo 240000000 > /proc/sys/kernel/sched_latency_ns echo 5000000 > /proc/sys/kernel/sched_migration_cost_ns echo 100000000 > /proc/sys/kernel/sched_min_granularity_ns echo 150000000 > /proc/sys/kernel/sched_wakeup_granularity_ns echo always > /sys/kernel/mm/transparent_hugepage/enabled echo 1048576 > /proc/sys/fs/aio-max-nr run with avx512
• Compiler	C/C++: Version 19.1.2.254 of Intel C/C++ Compiler for Linux
• Benchmark	Intel Optimized MP LINPACK Benchmark for Clusters

Some components may not be available in all countries or sales regions.

## Benchmark results

The results with "est." are the estimated values.

Processor	Number of cores	Rated frequency [GHz]	Number of processors	Rpeak [GFlops]	Rmax [GFlops]	Efficiency
Xeon Platinum 8380	40	2.3	2	5,888	<b>4,433</b>	75%
Xeon Platinum 8368Q	38	2.6	2	6,323	4,408 est.	70%
Xeon Platinum 8368	38	2.4	2	5,837	4,250 est.	73%
Xeon Platinum 8362 <sup>*1</sup>	32	2.8	2	5,734	4,041 est.	70%
Xeon Platinum 8360Y	36	2.4	2	5,530	3,939 est.	71%
Xeon Platinum 8358P	32	2.6	2	5,325	3,561 est.	67%
Xeon Platinum 8358	32	2.6	2	5,325	3,787 est.	71%
Xeon Platinum 8352Y	32	2.2	2	4,506	3,167 est.	70%
Xeon Platinum 8352V	36	2.1	2	4,838	3,328 est.	69%
Xeon Platinum 8352M <sup>*1</sup>	32	2.3	2	4,710	2,940 est.	62%
Xeon Gold 6354	18	3.0	2	3,456	2,447 est.	71%
Xeon Gold 6348	28	2.6	2	4,659	3,351 est.	72%
Xeon Gold 6346	16	3.1	2	3,174	2,327 est.	73%
Xeon Gold 6342 <sup>*1</sup>	24	2.8	2	4,301	3,175 est.	74%
Xeon Gold 6338T <sup>*1</sup>	24	2.1	2	3,226	2,364 est.	73%
Xeon Gold 6338	32	2.0	2	4,096	3,157 est.	77%
Xeon Gold 6336Y <sup>*1</sup>	24	2.4	2	3,686	2,658 est.	72%
Xeon Gold 6334 <sup>*1</sup>	8	3.6	2	1,843	1,316 est.	71%
Xeon Gold 6330N	28	2.2	2	3,942	2,507 est.	64%
Xeon Gold 6330	28	2.0	2	3,584	2,996 est.	84%
Xeon Gold 6326 <sup>*1</sup>	16	2.9	2	2,970	2,205 est.	74%
Xeon Gold 6314U	32	2.3	1	2,355	1,593 est.	68%
Xeon Gold 6312U <sup>*1</sup>	24	2.4	1	1,843	1,341 est.	73%
Xeon Gold 5320 <sup>*1</sup>	26	2.2	2	3,661	2,817 est.	77%
Xeon Gold 5318Y <sup>*1</sup>	24	2.1	2	3,226	2,457 est.	76%
Xeon Gold 5318S <sup>*1</sup>	24	2.1	2	3,226	2,458 est.	76%
Xeon Gold 5317 <sup>*1</sup>	12	3.0	2	2,304	1,615 est.	70%
Xeon Gold 5315Y <sup>*1</sup>	8	3.2	2	1,638	1,212 est.	74%
Xeon Silver 4316 <sup>*1</sup>	20	2.3	2	2,944	2,086 est.	71%
Xeon Silver 4314 <sup>*1</sup>	16	2.4	2	2,458	1,703 est.	69%
Xeon Silver 4310 <sup>*1</sup>	12	2.1	2	1,613	1,480 est.	92%
Xeon Silver 4309Y <sup>*1</sup>	8	2.8	2	1,434	1,026 est.	72%

Rpeak values in the table above were calculated by the base frequency of each processor. Since we enabled Turbo mode in the measurements, the average Turbo frequency exceeded the base frequency for some processors.

As explained in the section "Technical Data," Intel generally does not guarantee that the maximum turbo frequency can be reached in the processor models due to manufacturing tolerances. A further restriction applies for workloads, such as those generated by LINPACK, with intensive use of AVX instructions and a high number of instructions per clock unit. Here the frequency of a core can also be limited if the upper limits of the processor for power consumption and temperature are reached before the upper limit for the current consumption. This can result in the achievement of a lower performance with turbo mode than without turbo mode. In such a case, disable the turbo function in the BIOS option.

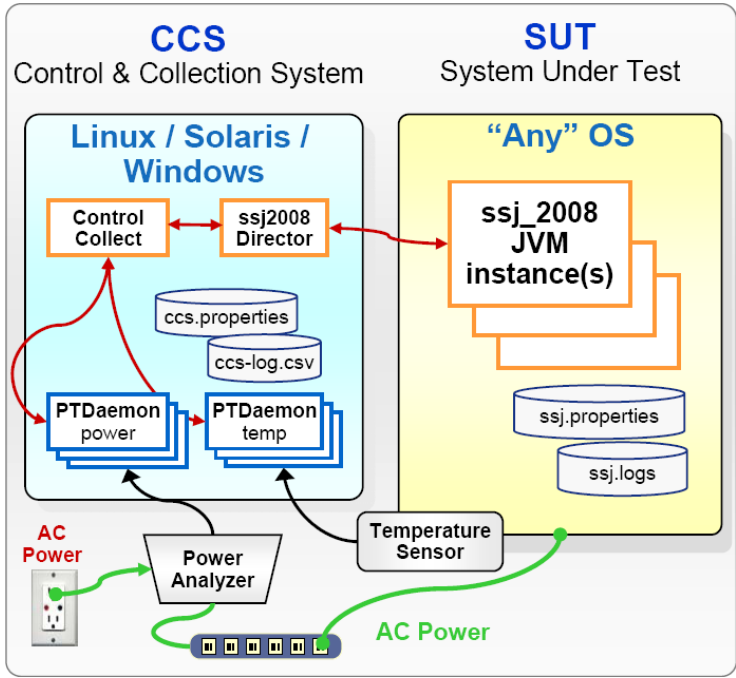
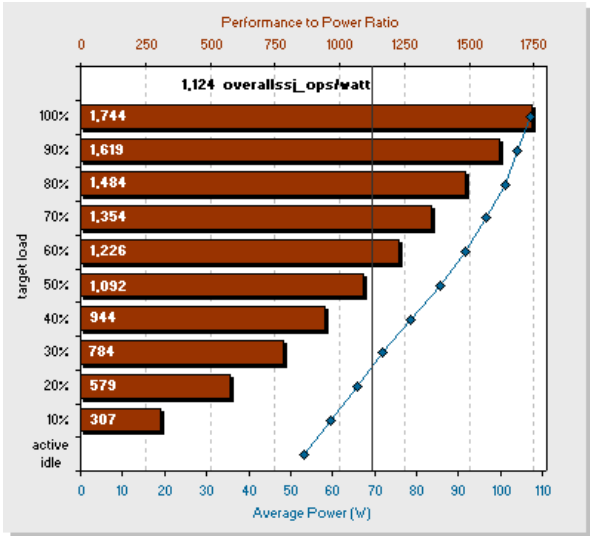
# SPECpower\_ssj2008

## Benchmark description

SPECpower\_ssj2008 is the first industry-standard SPEC benchmark that evaluates the power and performance characteristics of a server. With SPECpower\_ssj2008 SPEC has defined standards for server power measurements in the same way they have done for performance.

The benchmark workload represents typical server-side Java business applications. The workload is scalable, multi-threaded, portable across a wide range of platforms, and easy to run. The benchmark tests CPUs, caches, the memory hierarchy, and scalability of symmetric multiprocessor systems (SMPs), as well as the implementation of Java Virtual Machine (JVM), Just In Time (JIT) compilers, garbage collection, threads, and some aspects of the operating system.

SPECpower\_ssj2008 reports power consumption for servers at different performance levels — from 100% to “active idle” in 10% segments — over a set period of time. The graduated workload recognizes the fact that processing loads and power consumption on servers vary substantially over the course of days or weeks. To compute a power-performance metric across all levels, measured transaction throughputs for each segment are added together and then divided by the sum of the average power consumed for each segment. The result is a figure of merit called “overall ssj\_ops/watt”. This ratio provides information about the energy efficiency of the measured server. The defined measurement standard enables customers to compare it with other configurations and servers measured with SPECpower\_ssj2008. The diagram shows a typical graph of a SPECpower\_ssj2008 result.



The benchmark runs on a wide variety of operating systems and hardware architectures, and does not require extensive client or storage infrastructure. The minimum equipment for SPEC-compliant testing is two networked computers, plus a power analyzer and a temperature sensor. One computer is the System Under Test (SUT) which runs one of the supported operating systems and the JVM. The JVM provides the environment required to run the SPECpower\_ssj2008 workload which is implemented in Java. The other computer is a “Control & Collection System” (CCS) which controls the operation of the benchmark and captures the power, performance, and temperature readings for reporting. The diagram provides an overview of the basic structure of the benchmark configuration and the various components.

## Benchmark environment

### System Under Test (SUT)

#### For Linux OS measurement

#### Hardware

• Model	PRIMERGY RX2530 M6
• Processor	2 x Intel Xeon Platinum 8380
• Memory	16 x 16 GB 2Rx8 PC4-3200Y-R
• Network interface	1 x PLAN CP I350-T4 4X 1000BASE-T OCPv3, PYBLA274U
• Disk subsystem	1 x SSD M.2 240GB, S26361-F5787-E240
• Power Supply Unit	1 x 900 W, S26113-E629-V50-1

#### Software

• BIOS	R1.3.0
• BIOS settings	<ul style="list-style-type: none"> <li>• Hardware Prefetcher = Disabled</li> <li>• Adjacent Cache Line Prefetch = Disabled</li> <li>• DCU Streamer Prefetcher = Disabled</li> <li>• Intel Virtualization Technology = Disabled</li> <li>• Energy Performance = Energy Efficient</li> <li>• Package C State limit = C6</li> <li>• UPI Link Frequency Select = 9.6GT/s</li> <li>• Uncore Frequency Scaling = Power Balanced</li> <li>• DDR Performance = Power balanced</li> <li>• SNC(Sub NUMA) = Enable SNC2</li> <li>• ASPM Support = L1 only</li> <li>• SATA Controller = Disabled</li> <li>• Serial Port = Disabled</li> <li>• USB Port Control = Disable all ports</li> <li>• Network Stack = Disabled</li> </ul>
• iRMC Firmware	3.20m
• Operating system	SUSE Linux Enterprise Server 15 SP2, 5.3.18-24.43-default
• Operating system settings	kernel parameter: pcie_aspm=force pcie_aspm.policy=powersave intel_pstate=passive Benchmark started via ssh. modprobe cpufreq_conservative cpupower frequency-set -g conservative echo 3000000 > /sys/devices/system/cpu/cpufreq/conservative/sampling_rate echo 94 > /sys/devices/system/cpu/cpufreq/conservative/up_threshold echo 1 > /sys/devices/system/cpu/cpufreq/conservative/freq_step echo 93 > /sys/devices/system/cpu/cpufreq/conservative/down_threshold echo always > /sys/kernel/mm/transparent_hugepage/enabled cpupower frequency-set -u 2400MHz sysctl -w kernel.nmi_watchdog=0
• JVM	Oracle Java HotSpot 64-Bit Server VM 18.9 (build 11.0.9+7-LTS, mixed mode)
• JVM settings	-server -Xmn16000m -Xms18000m -Xmx18000m -XX:+UseHugeTLBFS -XX:+UseLargePages -XX:+UseTransparentHugePages - XX:AllocatePrefetchDistance=256 -XX:AllocatePrefetchInstr=0 -XX:AllocatePrefetchLines=4 - XX:InlineSmallCode=3900 -XX:MaxInlineSize=270 -XX:ParallelGCThreads=8 -XX:SurvivorRatio=1 -XX:TargetSurvivorRatio=99 -XX:+UseParallelOldGC -XX:FreqInlineSize=2500 -XX:MinJumpTableSize=18 -XX:UseAVX=0 -XX:+UseBiasedLocking

**For Windows OS measurement****Hardware**

• Model	PRIMERGY RX2530 M6
• Processor	2 x Intel Xeon Platinum 8380
• Memory	16 x 16 GB 2Rx8 PC4-3200Y-R
• Network interface	1 x PLAN CP I350-T4 4X 1000BASE-T OCPv3, PYBLA274U
• Disk subsystem	1 x SSD M.2 240GB, S26361-F5787-E240
• Power Supply Unit	1 x 900 W, S26113-E629-V50-1

**Software**

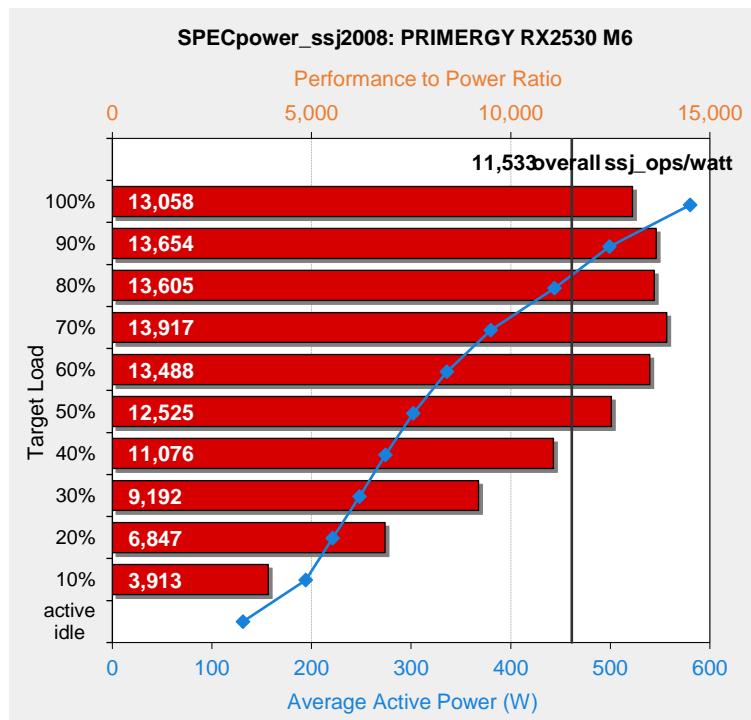
• BIOS	R1.3.0
• BIOS settings	<ul style="list-style-type: none"> <li>• Hardware Prefetcher = Disabled</li> <li>• Adjacent Cache Line Prefetch = Disabled</li> <li>• DCU Streamer Prefetcher = Disabled</li> <li>• Intel Virtualization Technology = Disabled</li> <li>• Turbo Mode = Disabled</li> <li>• Energy Performance = Energy Efficient</li> <li>• Package C State limit = C6</li> <li>• UPI Link Frequency Select = 9.6GT/s</li> <li>• Uncore Frequency Scaling = Power Balanced</li> <li>• DDR Performance = Power balanced</li> <li>• SNC(Sub NUMA) = Enable SNC2</li> <li>• ASPM Support = L1 only</li> <li>• SATA Controller = Disabled</li> <li>• Serial Port = Disabled</li> <li>• USB Port Control = Disable all ports</li> <li>• Network Stack = Disabled</li> </ul>
• iRMC Firmware	3.20m
• Operating system	Microsoft Windows Server 2019 Standard
• Operating system settings	Turn off hard disk after = 1 Minute Turn off display after = 1 Minute Minimum processor state = 0% Maximum processor state = 100% Using the local security settings console, "lock pages in memory" was enabled for the user running the benchmark. Benchmark was started via Windows Remote Desktop Connection.
• JVM	Oracle Java HotSpot 64-Bit Server VM 18.9 (build 11.0.9+7-LTS, mixed mode)
• JVM settings	-server -Xmn1700m -Xms1950m -Xmx1950m -XX:SurvivorRatio=1 -XX:TargetSurvivorRatio=99 -XX:ParallelGCThreads=2 - XX:AllocatePrefetchDistance=256 -XX:AllocatePrefetchLines=4 -XX:LoopUnrollLimit=45 - XX:InitialTenuringThreshold=12 -XX:MaxTenuringThreshold=15 -XX:InlineSmallCode=3900 -XX:MaxInlineSize=270 -XX:FreqInlineSize=2500 -XX:+UseLargePages -XX:+UseParallelOldGC - XX:UseAVX=0 -XX:-UseAdaptiveSizePolicy -XX:-ThreadLocalHandshakes

Some components may not be available in all countries or sales regions.

## Benchmark results (Linux)

The PRIMERGY RX2530 M6 in SUSE Linux Enterprise Server 15 SP2 achieved the following result:

**SPECpower\_ssj2008 = 11,533 overall ssj\_ops/watt**



The adjoining diagram shows the result of the configuration described above. The red horizontal bars show the performance to power ratio in ssj\_ops/watt (upper x-axis) for each target load level tagged on the y-axis of the diagram. The blue line shows the run of the curve for the average power consumption (bottom x-axis) at each target load level marked with a small rhomb. The black vertical line shows the benchmark result of 11,533 overall ssj\_ops/watt for the PRIMERGYPRIMERGY RX2530 M6. This is the quotient of the sum of the transaction throughputs for each load level and the sum of the average power consumed for each measurement interval.

The following table shows the benchmark results for the throughput in ssj\_ops, the power consumption in watts and the resulting energy efficiency for each load level.

Performance		Power	Energy Efficiency
Target Load	ssj_ops	Average Power (W)	ssj_ops/watt
100%	7,573,884	580	13,058
90%	6,814,856	499	13,654
80%	6,047,198	444	13,605
70%	5,292,424	380	13,917
60%	4,535,904	336	13,488
50%	3,781,094	302	12,525
40%	3,031,768	274	11,076
30%	2,279,204	248	9,192
20%	1,516,364	221	6,847
10%	758,504	194	3,913
Active Idle	0	131	0
Σssj_ops / Σpower = 11,533			

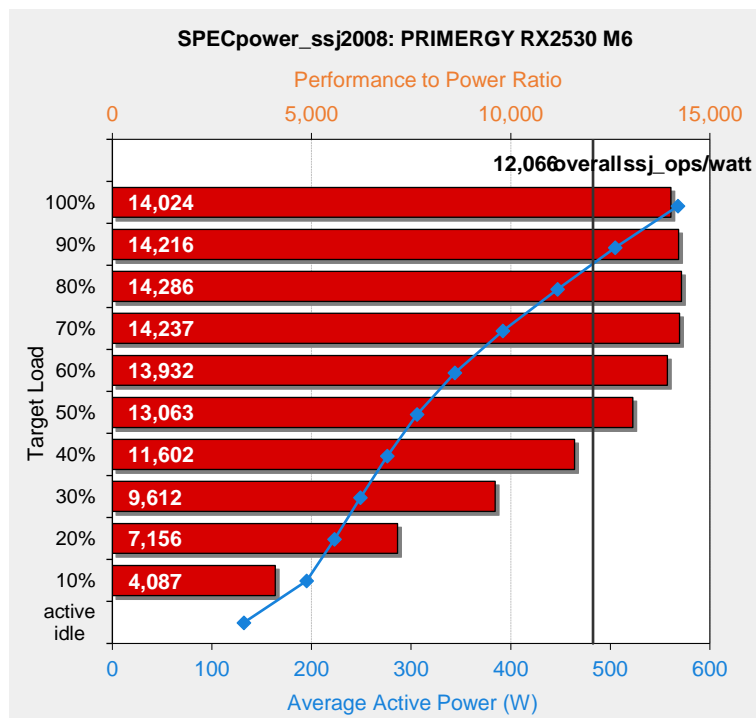


## Benchmark results (Windows)

The PRIMERGY RX2530 M6 in Microsoft Windows Server 2019 Standard achieved the following result:

**SPECpower\_ssj2008 = 12,066 overall ssj\_ops/watt**

performance to power ratio in ssj\_ops/watt (upper x-axis) for each target load level tagged on the y-axis of the diagram. The blue line shows the run of the curve for the average power consumption (bottom x-axis) at each target load level marked with a small rhomb. The black vertical line shows the benchmark result of 1



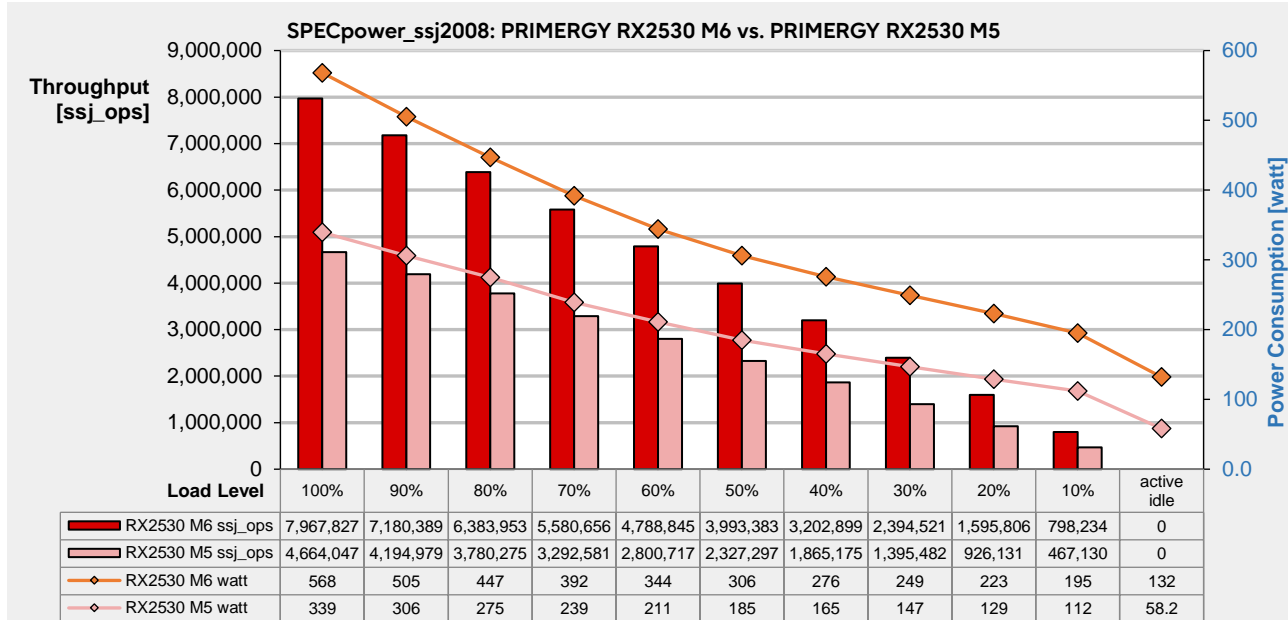
The adjoining diagram shows the result of the configuration described above. The red horizontal bars show the 2,066 overall ssj\_ops/watt for the PRIMERGYPRIMERGY RX2530 M6. This is the quotient of the sum of the transaction throughputs for each load level and the sum of the average power consumed for each measurement interval.

The following table shows the benchmark results for the throughput in ssj\_ops, the power consumption in watts and the resulting energy efficiency for each load level.

Performance		Power	Energy Efficiency
Target Load	ssj_ops	Average Power (W)	ssj_ops/watt
100%	7,967,827	568	14,024
90%	7,180,389	505	14,216
80%	6,383,953	447	14,286
70%	5,580,656	392	14,237
60%	4,788,845	344	13,932
50%	3,993,383	306	13,063
40%	3,202,899	276	11,602
30%	2,394,521	249	9,612
20%	1,595,806	223	7,156
10%	798,234	195	4,087
Active Idle	0	132	0
$\Sigma \text{ssj\_ops} / \Sigma \text{power} = 12,066$			

## Comparison with the predecessor

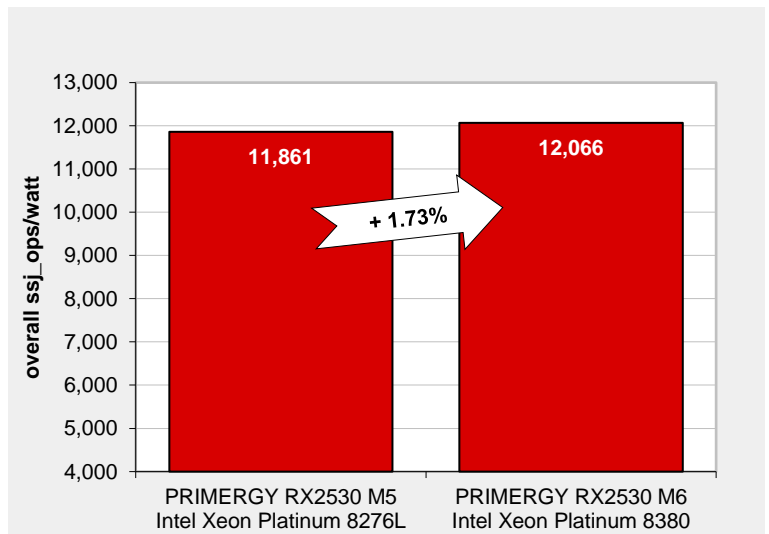
The following diagram shows for each load level (on the x-axis) the throughput (on the left y-axis) and the power consumption (on the right y-axis) of the PRIMERGY RX2530 M6 compared to the predecessor PRIMERGY RX2530 M5 with the JVM versions that affect the SPECpower\_ssj2008 benchmark.



The total average throughput of the PRIMERGY RX2530 M6 is 43,886,513 ssj\_ops, an improvement of 70.7% over the 25,713,812 ssj\_ops of the PRIMERGY RX2530 M5.

On the other hand, the total average power consumption of the PRIMERGY RX2530 M6 is 3,637 W, which is 67.9% higher than the 2,167 W of the PRIMERGY RX2530 M5. One of the reasons for the increased power consumption is the increased power consumption of the CPU used for the measurement. The TDP of the Intel Xeon Platinum 8276L used in the PRIMERGY RX2530 M5 was 165W, while the TDP of the Intel Xeon Platinum 8380 used in the PRIMERGY RX2530 M6 was 270W, an increase of 63.6%. Another reason is the increased power consumption when idle. It was 58.2W on the PRIMERGY RX2530 M5, but it increased 2.27 times to 132W on the PRIMERGY RX2530 M6.

The overall energy efficiency of the PRIMERGY RX2530 M6 has improved by 1.73% due to a 67.9% increase in power consumption but a 70.7% improvement in performance.



## Disk I/O: Performance of storage media

### Benchmark description

Performance measurements of disk subsystems for PRIMERGY servers are used to assess their performance and enable a comparison of the different storage connections for PRIMERGY servers. As standard, these performance measurements are carried out with a defined measurement method, which models the accesses of real application scenarios on the basis of specifications.

The essential specifications are:

- Share of random accesses / sequential accesses
- Share of read / write access types
- Block size (kiB)
- Number of parallel accesses (# of outstanding I/Os)

A given value combination of these specifications is known as "load profile". The following five standard load profiles can be allocated to typical application scenarios:

Standard load profile	Access	Type of access		Block size [kiB]	Application
		read	write		
Filecopy	Random	50%	50%	64	Copying files
Fileserver	Random	67%	33%	64	Fileserver
Database	Random	67%	33%	8	Database (data transfer) Mail server
Streaming	Sequential	100%	0%	64	Database (log file), Data backup, Video streaming (partial)
Restore	Sequential	0%	100%	64	Restoring files

In order to model applications that access in parallel with a different load intensity the "# of Outstanding I/Os" is increased from 1 to 512 (in steps to the power of two).

The measurements of this document are based on these standard load profiles.

The main results of a measurement are:

- Throughput [MiB/s] Throughput in megabytes per second
- Transactions [I/O/s] Transaction rate in I/O operations per second
- Latency [ms] Average response time in ms

The data throughput has established itself as the normal measurement variable for sequential load profiles, whereas the measurement variable "transaction rate" is mostly used for random load profiles with their small block sizes. Data throughput and transaction rate are directly proportional to each other and can be transferred to each other according to the formula.

Data throughput [MiB/s]	= Transaction rate [I/O/s] × Block size [MiB]
Transaction rate [I/O/s]	= Data throughput [MiB/s] / Block size [MiB]

This section specifies capacities of storage media on a basis of 10 (1 TB = 10<sup>12</sup> bytes) while all other capacities, file sizes, block sizes and throughputs are specified on a basis of 2 (1 MiB/s = 2<sup>20</sup> bytes/s).

All the details of the measurement method and the basics of disk I/O performance are described in the white paper "[Basics of Disk I/O Performance](#)".

## Benchmark environment

All the measurement results discussed in this section apply for the hardware and software components listed below.

### System Under Test (SUT)

#### Hardware

#### 3.5 inch model

Controller: PRAID EP540i

Storage media	Category	Drive name
HDD	SAS HDD (SAS 12Gbps, 15k rpm) [512n]	ST300MP0006 ST600MP0006
	SAS HDD (SAS 12Gbps, 10k rpm) [512e]	AL15SEB18EQ AL15SEB24EQ
	SAS HDD (SAS 12Gbps, 10k rpm) [512n]	AL15SEB060N AL15SEB120N
	NL-SAS HDD (SAS 12Gbps, 7.2k rpm) [512e]	ST6000NM029A ST8000NM001A
	NL-SAS HDD (SAS 12Gbps, 7.2k rpm) [512n]	ST2000NM003A ST4000NM003A
	BC-SATA HDD (SATA 6Gbps, 7.2k rpm) [512e]	ST6000NM021A ST8000NM000A
	BC-SATA HDD (SATA 6Gbps, 7.2k rpm) [512n]	ST2000NM000A ST4000NM000A
SSD	SAS SSD (SAS 12Gbps, Write Intensive)	XS400ME70084 XS800ME70084 XS1600ME70084
	SAS SSD (SAS 12Gbps, Mixed Use)	XS800LE70084 XS1600LE70084 XS3200LE70084
	SAS SSD (SAS 12Gbps, Read Intensive)	XS960SE70084 XS1920SE70084 XS3840SE70084 XS7680SE70084
	SATA SSD (SATA 6Gbps, Mixed Use)	MTFDDAK240TDT MTFDDAK480TDT MTFDDAK960TDT MTFDDAK1T9TDT MTFDDAK3T8TDT
	SATA SSD (SATA 6Gbps, Read Intensive)	MTFDDAK240TDS MTFDDAK480TDS MTFDDAK960TDS MTFDDAK1T9TDS MTFDDAK3T8TDS MTFDDAK7T6TDS

Controller: Intel C620 Standard SATA AHCI controller		
Storage media	Category	Drive name
SSD	M.2 Flash module	MTFDDAV240TDS
		MTFDDAV480TDS

## 2.5 inch model

Controller: PRAID EP540i		
Storage media	Category	Drive name
HDD	SAS HDD (SAS 12Gbps, 15k rpm) [512n]	ST300MP0006
		ST600MP0006
	SAS HDD (SAS 12Gbps, 10k rpm) [512e]	AL15SEB18EQ
		AL15SEB24EQ
SSD	SAS HDD (SAS 12Gbps, 10k rpm) [512n]	AL15SEB060N
		AL15SEB120N
	SAS SSD (SAS 12Gbps, Write Intensive)	XS400ME70084
		XS800ME70084
		XS1600ME70084
	SAS SSD (SAS 12Gbps, Mixed Use)	XS800LE70084
		XS1600LE70084
		XS3200LE70084
	SAS SSD (SAS 12Gbps, Read Intensive)	XS960SE70084
		XS1920SE70084
		XS3840SE70084
		XS7680SE70084
	SATA SSD (SATA 6Gbps, Mixed Use)	MTFDDAK240TDT
		MTFDDAK480TDT
		MTFDDAK960TDT
		MTFDDAK1T9TDT
		MTFDDAK3T8TDT
	SATA SSD (SATA 6Gbps, Read Intensive)	MTFDDAK240TDS
		MTFDDAK480TDS
		MTFDDAK960TDS
		MTFDDAK1T9TDS
		MTFDDAK3T8TDS
		MTFDDAK7T6TDS
	PCIe SSD (Write intensive)	SSDPE21K750GA
	PCIe SSD (Mixed Use)	SSDPE2KE016T8
		SSDPE2KE032T8
		SSDPE2KE064T8
	PCIe SSD (Read intensive)	SSDPE2KX010T8
		SSDPE2KX020T8
		SSDPE2KX040T8

Controller: Intel C620 Standard SATA AHCI controller		
Storage media	Category	Drive name
SSD	M.2 Flash module	MTFDDAV240TDS
		MTFDDAV480TDS

### EDSFF NVMe model

Controller: Integrated PCI Express controller CPU: 2x Xeon Gold 6330 processor (2GHz, 28core, 42MB)		
Storage media	Category	Drive name
SSD	E1.S form factor PCIe SSD (Read Intensive)	SSDPEYKX040T8C

Controller: Intel C620 Standard SATA AHCI controller		
Storage media	Category	Drive name
SSD	M.2 Flash module	MTFDDAV240TDS
		MTFDDAV480TDS

### Software

Operating system		Microsoft Windows Server 2016 Standard
Benchmark version		3.0
RAID type		Type RAID 0 logical drive consisting of 1 hard disk
Stripe size		HDD: 256KiB, SSD: 64 KiB
Measuring tool		lometer 1.1.0
Measurement area	HDD,SSD (other than M.2, E1.S)	RAW file system is used. The first 32GiB of available LBA space is used for sequential access. The following 64GiB is used for random access.
	SSD (M.2, E1.S)	NTFS file system is used. The first 32GiB of available LBA space is used for sequential access. The following 64GiB is used for random access.
Total number of lometer worker		1
Alignment of lometer accesses		Aligned to access block size

Some components may not be available in all countries or sales regions.

## Benchmark results

The results shown here are intended to help you select the appropriate storage media under the aspect of disk-I/O performance. For this purpose, a single storage medium was measured in the configuration specified in the subsection Benchmark environment.

### Controller

The measurements were made using controllers in the table below.

Storage medium	Storage medium	Cache	Supported interfaces		RAID levels
			host	drive	
SSD/HDD PCIe SSD 2.5"	PRAID EP540i	-	8x PCIe 3.0	SATA 6G SAS 12G PCIe x16	0, 1, 1E, 10, 5, 50
PCIe SSD E1.S	Integrated PCI Express controller	-	4x PCIe 4.0	4x PCIe 3.0	-
M.2 Flash	C620 Standard SATA AHCI controller	-	4x DMI 3.0	SATA 6G	-

### Storage media

When selecting the type and number of storage media you can move the weighting in the direction of storage capacity, performance, security or price. The following types of HDD and SSD storage media can be used for PRIMERGY servers.

model	Storage media type	Interface	Form factor
3.5 inch model	HDD	SAS 12G	3.5 inch or 2.5 inch <sup>1)</sup>
		SATA 6G	3.5 inch
	SSD	SAS 12G	2.5 inch <sup>1)</sup>
		SATA 6G	2.5 inch <sup>1)</sup> or M.2
2.5 inch model	HDD	SAS 12G	2.5 inch
		SATA 6G	2.5 inch
	SSD	SAS 12G	2.5 inch
		SATA 6G	2.5 inch or M.2
		PCIe 3.0	2.5 inch
EDSFF NVMe model	SSD	PCIe 3.0	E1.S
		SATA 6G	M.2

1) It is available with a 3.5 inch cage.

HDDs and SSDs are operated via host bus adapters, usually RAID controllers, with a SATA or SAS interface. The interface of the RAID controller to the chipset of the systemboard is typically PCIe or, in the case of the integrated onboard controllers, an internal bus interface of the systemboard.

Of all the storage medium types SSDs offer by far the highest transaction rates for random load profiles as well as the shortest access times. In return, however, the price per gigabyte of storage capacity is substantially higher.

## Cache settings

In most cases, the cache of HDDs has a great influence on disk-I/O performance. It is frequently regarded as a security problem in case of power failure and is thus switched off. On the other hand, it was integrated by hard disk manufacturers for the good reason of increasing the write performance. For performance reasons it is therefore advisable to enable the hard disk cache. To prevent data loss in case of power failure you are recommended to equip the system with a UPS.

For the purpose of easy and reliable handling of the settings for RAID controllers and hard disks it is advisable to use the RAID-Manager software "ServerView RAID" that is supplied for PRIMERGY servers. All the cache settings for controllers and hard disks can usually be made en bloc - specifically for the application - by using the pre-defined mode "Performance" or "Data Protection." The "Performance" mode ensures the best possible performance settings for the majority of the application scenarios.

## Performance values

The performance values are summarized in the following tables. In each case specifically for a single storage medium and with various access types and block sizes. The established measurement variables, as already mentioned in the subsection "Benchmark description" are used here. Thus, transaction rate is specified for random accesses and data throughput for sequential accesses. To avoid any confusion among the measurement units the tables have been separated for the two access types.

The table cells contain the maximum achievable values. This means that each value is the maximum achievable value of the whole range of load intensities (number of Outstanding I/Os). In order to also visualize the numerical values each table cell is highlighted with a horizontal bar, the length of which is proportional to the numerical value in the table cell. All bars shown in the same scale of length have the same color. In other words, a visual comparison only makes sense for table cells with the same colored bars. Since the horizontal bars in the table cells depict the maximum achievable performance values, they are shown by the color getting lighter as you move from left to right. The light shade of color at the right end of the bar tells you that the value is a maximum value and can only be achieved under optimal prerequisites. The darker the shade becomes as you move to the left, the more frequently it will be possible to achieve the corresponding value in practice.



## 3.5 inch Storage media

### HDDs

Capacity [GB]	Storage device	Inter face	Transactions [IO/s]			Throughput [MiB/s]	
			Database	Fileserver	Filecopy	Streaming	Restore
300	ST300MP0006	SAS 12G	790	696	666	304	304
600	ST600MP0006	SAS 12G	736	651	601	301	300
1,800	AL15SEB18EQ	SAS 12G	767	631	624	255	249
2,400	AL15SEB24EQ	SAS 12G	754	620	617	264	260
600	AL15SEB060N	SAS 12G	698	586	600	232	232
1,200	AL15SEB120N	SAS 12G	732	604	615	230	226
6,000	ST6000NM029A	SAS 12G	369	333	323	252	252
8,000	ST8000NM001A	SAS 12G	354	310	310	255	255
2,000	ST2000NM003A	SAS 12G	378	343	336	237	237
4,000	ST4000NM003A	SAS 12G	369	333	330	214	215
6,000	ST6000NM021A	SATA 6G	326	293	302	253	253
8,000	ST8000NM000A	SATA 6G	325	290	301	249	248
2,000	ST2000NM000A	SATA 6G	331	304	313	230	207
4,000	ST4000NM000A	SATA 6G	313	290	297	211	210

### SSDs

Capacity [GB]	Storage device	Inter face	Transactions [IO/s]			Throughput [MiB/s]	
			Database	Fileserver	Filecopy	Streaming	Restore
400	XS400ME70084	SAS 12G	122,956	22,969	19,438	1,052	872
800	XS800ME70084	SAS 12G	123,848	23,784	19,435	1,052	874
1,600	XS1600ME70084	SAS 12G	123,277	23,725	19,270	1,051	884
800	XS800LE70084	SAS 12G	121,914	23,707	19,257	1,052	871
1,600	XS1600LE70084	SAS 12G	122,949	23,771	19,455	1,052	874
3,200	XS3200LE70084	SAS 12G	123,090	22,816	19,418	1,051	872
960	XS960SE70084	SAS 12G	123,014	23,678	19,424	1,052	870
1,920	XS1920SE70084	SAS 12G	123,093	23,760	19,423	1,052	874
3,840	XS3840SE70084	SAS 12G	122,810	22,949	19,406	1,051	871
7,680	XS7680SE70084	SAS 12G	123,461	22,899	19,516	1,051	880
240	MTFDDAK240TDT	SATA 6G	46,406	5,989	6,121	508	370
480	MTFDDAK480TDT	SATA 6G	49,138	6,383	6,600	508	437
960	MTFDDAK960TDT	SATA 6G	50,488	6,970	7,136	508	486
1,920	MTFDDAK1T9TDT	SATA 6G	50,669	7,183	7,336	508	487
3,840	MTFDDAK3T8TDT	SATA 6G	49,490	7,115	7,208	493	474
240	MTFDDAK240TDS	SATA 6G	42,594	5,435	5,510	508	301
480	MTFDDAK480TDS	SATA 6G	47,577	6,109	6,310	508	401
960	MTFDDAK960TDS	SATA 6G	50,134	6,633	6,852	506	480
1,920	MTFDDAK1T9TDS	SATA 6G	50,638	7,078	7,286	508	488
3,840	MTFDDAK3T8TDS	SATA 6G	49,542	7,097	7,196	495	477
7,680	MTFDDAK7T6TDS	SATA 6G	47,200	7,134	7,563	508	487
240	MTFDDAV240TDS	SATA 6G	32,805	5,482	5,518	504	300
480	MTFDDAV480TDS	SATA 6G	39,927	6,384	6,575	497	397

## 2.5 inch Storage media

### HDDs

Capacity [GB]	Storage device	Inter face	Transactions [IO/s]			Throughput [MiB/s]	
			Database	Fileserver	Filecopy	Streaming	Restore
300	ST300MP0006	SAS 12G	790	696	666	304	304
600	ST600MP0006	SAS 12G	736	651	601	301	300
1,800	AL15SEB18EQ	SAS 12G	767	631	624	255	249
2,400	AL15SEB24EQ	SAS 12G	754	620	617	264	260
600	AL15SEB060N	SAS 12G	698	586	600	232	232
1,200	AL15SEB120N	SAS 12G	732	604	615	230	226

### SSDs

Capacity [GB]	Storage device	Inter face	Transactions [IO/s]			Throughput [MiB/s]	
			Database	Fileserver	Filecopy	Streaming	Restore
400	XS400ME70084	SAS 12G	122,956	22,969	19,438	1,052	872
800	XS800ME70084	SAS 12G	123,848	23,784	19,435	1,052	874
1,600	XS1600ME70084	SAS 12G	123,277	23,725	19,270	1,051	884
800	XS800LE70084	SAS 12G	121,914	23,707	19,257	1,052	871
1,600	XS1600LE70084	SAS 12G	122,949	23,771	19,455	1,052	874
3,200	XS3200LE70084	SAS 12G	123,090	22,816	19,418	1,051	872
960	XS960SE70084	SAS 12G	123,014	23,678	19,424	1,052	870
1,920	XS1920SE70084	SAS 12G	123,093	23,760	19,423	1,052	874
3,840	XS3840SE70084	SAS 12G	122,810	22,949	19,406	1,051	871
7,680	XS7680SE70084	SAS 12G	123,461	22,899	19,516	1,051	880
240	MTFDDAK240TDT	SATA 6G	46,406	5,989	6,121	508	370
480	MTFDDAK480TDT	SATA 6G	49,138	6,383	6,600	508	437
960	MTFDDAK960TDT	SATA 6G	50,488	6,970	7,136	508	486
1,920	MTFDDAK1T9TDT	SATA 6G	50,669	7,183	7,336	508	487
3,840	MTFDDAK3T8TDT	SATA 6G	49,490	7,115	7,208	493	474
240	MTFDDAK240TDS	SATA 6G	42,594	5,435	5,510	508	301
480	MTFDDAK480TDS	SATA 6G	47,577	6,109	6,310	508	401
960	MTFDDAK960TDS	SATA 6G	50,134	6,633	6,852	506	480
1,920	MTFDDAK1T9TDS	SATA 6G	50,638	7,078	7,286	508	488
3,840	MTFDDAK3T8TDS	SATA 6G	49,542	7,097	7,196	495	477
7,680	MTFDDAK7T6TDS	SATA 6G	47,200	7,134	7,563	508	487
750	SSDPE21K750GA	PCIe3 x4	194,085	37,392	36,626	2,561	2,334
1,600	SSDPE2KE016T8	PCIe3 x4	276,785	45,739	40,923	3,214	1,972
3,200	SSDPE2KE032T8	PCIe3 x4	306,446	53,059	50,093	3,220	2,461
6,400	SSDPE2KE064T8	PCIe3 x4	297,505	56,338	56,632	3,219	2,499
1,000	SSDPE2KX01	PCIe3 x4	153,263	25,891	21,942	2,799	1,109
2,000	SSDPE2KX02	PCIe3 x4	237,530	38,336	34,740	3,181	1,979
4,000	SSDPE2KX04	PCIe3 x4	242,546	39,242	38,151	2,905	2,417
240	MTFDDAV240TDS	SATA 6G	32,805	5,482	5,518	504	300
480	MTFDDAV480TDS	SATA 6G	39,927	6,384	6,575	497	397

EDSFF NVMe media  
SSDs

Capacity [GB]	Storage device	Inter face	Transactions [IO/s]			Throughput [MiB/s]	
			Database	Fileserver	Filecopy	Streaming	Restore
4,000	SSDPEYKX040T8C	PCIe3 x4	170,015	33,691	32,143	2,589	2,202
240	MTFDDAV240TDS	SATA 6G	<div></div> 32,805	<div></div> 5,482	<div></div> 5,518	<div></div> 504	<div></div> 300
480	MTFDDAV480TDS	SATA 6G	<div></div> 39,927	<div></div> 6,384	<div></div> 6,575	<div></div> 497	<div></div> 397

## OLTP-2

### Benchmark description

OLTP stands for Online Transaction Processing. The OLTP-2 benchmark is based on the typical application scenario of a database solution. In OLTP-2 database access is simulated and the number of transactions achieved per second (tps) determined as the unit of measurement for the system.

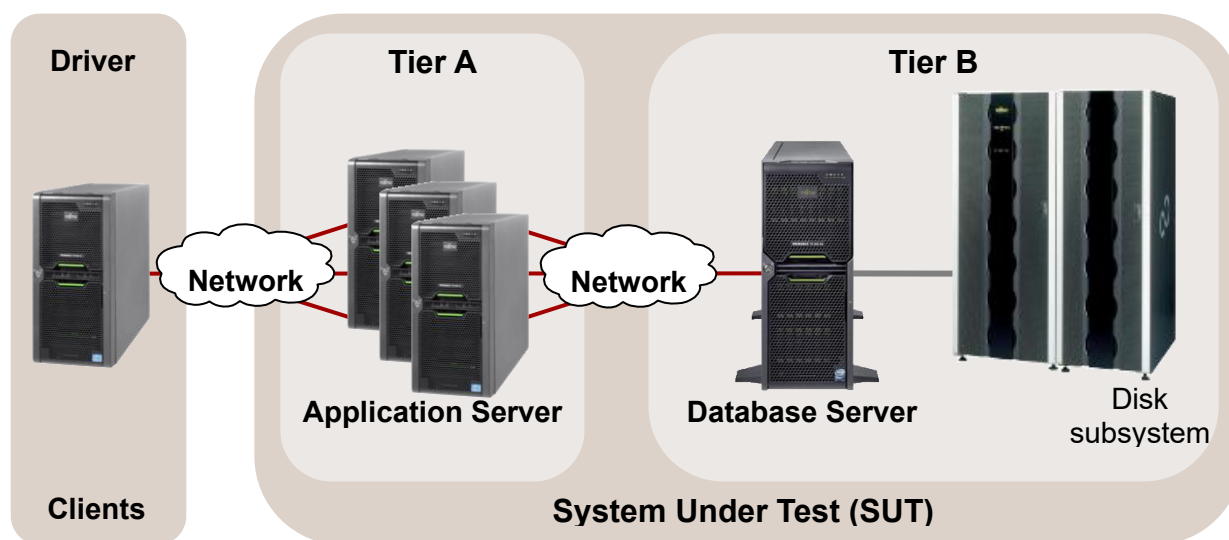
In contrast to benchmarks such as SPEC CPU and TPC-E, which were standardized by independent bodies and for which adherence to the respective rules and regulations are monitored, OLTP-2 is an internal benchmark of Fujitsu. OLTP-2 is based on the well-known database benchmark TPC-E. OLTP-2 was designed in such a way that a wide range of configurations can be measured to present the scaling of a system with regard to the CPU and memory configuration.

Even if the two benchmarks OLTP-2 and TPC-E simulate similar application scenarios using the same load profiles, the results cannot be compared or even treated as equal, as the two benchmarks use different methods to simulate user load. OLTP-2 values are typically similar to TPC-E values. A direct comparison, or even referring to the OLTP-2 result as TPC-E, is not permitted, especially because there is no price-performance calculation.

Further information can be found in the document [Benchmark Overview OLTP-2](#).

### Benchmark environment

The typical measurement set-up is illustrated below:



All OLTP-2 results were calculated based on the configuration of the next following pages of PRIMERGY RX2540 M6

**Database Server (Tier B)****Hardware**

• Model	PRIMERGY RX2540 M6
• Processor	3rd Generation Intel Xeon Processor Scalable Family
• Memory	1 processors:16 x 64 GB (1x64 GB) 2Rx4 DDR4-3200 ECC 2 processors:32 x 64 GB (1x64 GB) 2Rx4 DDR4-3200 ECC
• Network interface	1 x Dual port LAN 10 Gbps 1 x Quad port OCPv3 LAN 1 Gbps
• Disk subsystem	PRIMERGY RX2530 M6: RAID controller PRAID EP540i 6 x 1.6 TB SSD drive, RAID10 (LOG), 5 x RAID controller PRAID EP540e 10 x JX40 S2: 4 x 1.6 TB SSD drive, RAID10 (temp), 68 x 1.6 TB SSD drive, RAID5 (data)

**Software**

• BIOS	Version R1.6.0
• Operating system	Microsoft Windows Server 2016 Standard
• Database	Microsoft SQL Server 2017 Enterprise + KB4341265

**Application Server (Tier A)****Hardware**

• Model	1 x PRIMERGY RX2530 M4
• Processor	2 x Xeon Platinum 8180
• Memory	192 GB, 2666 MHz Registered ECC DDR4
• Network interface	1 x Dual port LAN 10 Gbps 1 x Dual port onboard LAN 1 Gbps
• Disk subsystem	2 x 300 GB 10k rpm SAS drive

**Software**

• Operating system	Microsoft Windows Server 2016 Standard
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**Client****Hardware**

• Model	1 x PRIMERGY RX2530 M2
• Processor	2 x Xeon E5-2667 v4
• Memory	128 GB, 2400 MHz Registered ECC DDR4
• Network interface	1 x Quad port onboard LAN 1 Gbps
• Disk subsystem	1 x 300 GB 10k rpm SAS drive

**Software**

• Operating system	Microsoft Windows Server 2012 R2 Standard
• Benchmark	OLTP-2 Software EGen version 1.14.0

Some components may not be available in all countries / sales regions.

## Benchmark results

Database performance greatly depends on the configuration options with CPU, memory and on the connectivity of an adequate disk subsystem for the database. In the following scaling considerations for the processors we assume that both the memory and the disk subsystem has been adequately chosen and is not a bottleneck.

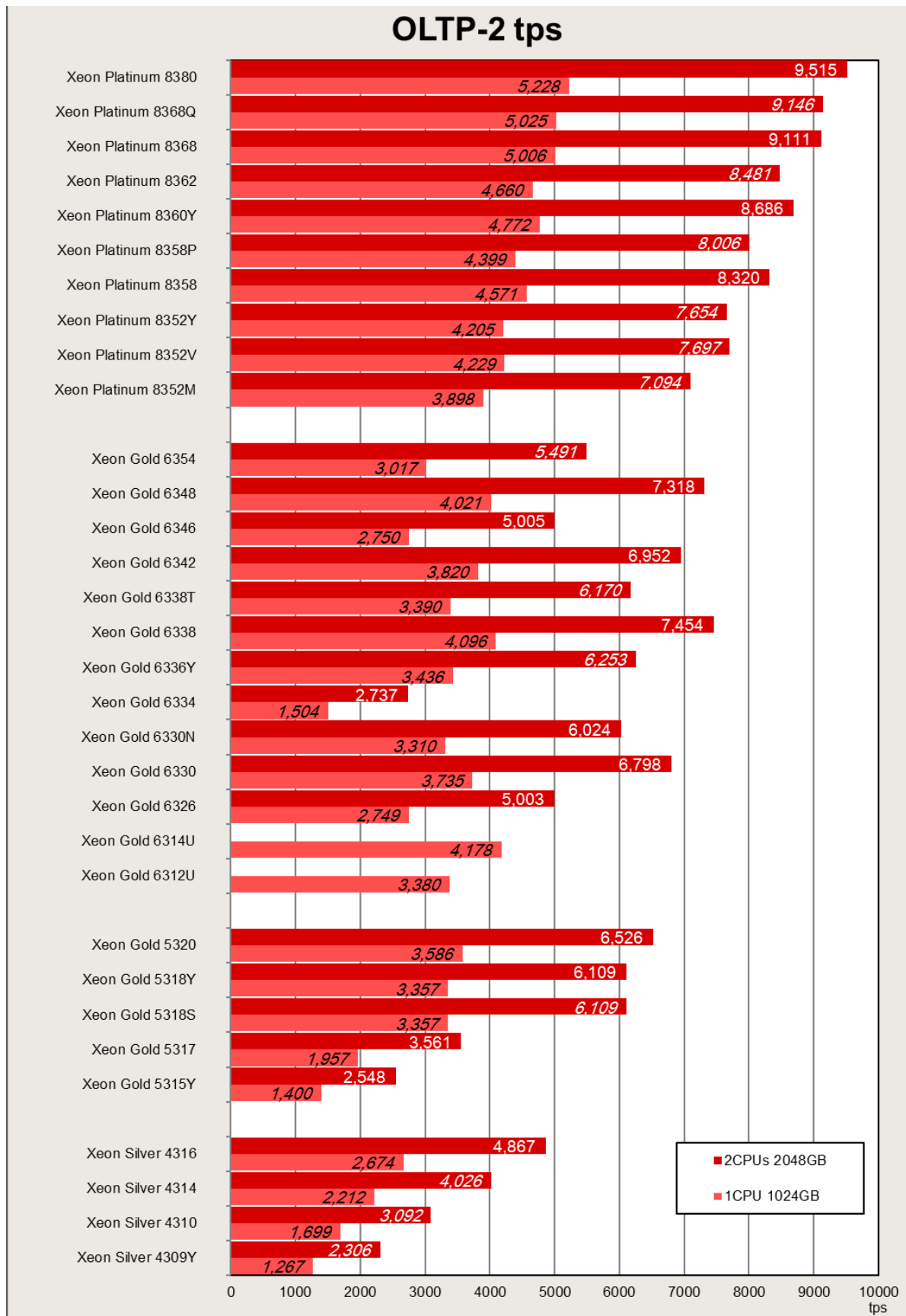
A guideline in the database environment for selecting main memory is that sufficient quantity is more important than the speed of the memory accesses. This why a configuration with a total memory of 2048 GB was considered for the measurements with two processors and a configuration with a total memory of 1024 GB for the measurements with one processor. Both memory configurations have memory access of 3200 MHz.

The result with "est." are the estimated values.

Processor	Cores	Threads	2CPU Score	1CPU Score
Xeon Platinum 8380	40	80	<b>9,515</b>	5,228 est.
Xeon Platinum 8368Q	38	76	9,146 est.	5,025 est.
Xeon Platinum 8368	38	76	<b>9,111</b>	5,006 est.
Xeon Platinum 8362	32	64	8,481 est.	4,660 est.
Xeon Platinum 8360Y	36	72	<b>8,686</b>	4,772 est.
Xeon Platinum 8358P	32	64	8,006 est.	4,399 est.
Xeon Platinum 8358	32	64	<b>8,320</b>	4,571 est.
Xeon Platinum 8352Y	32	64	7,654 est.	4,205 est.
Xeon Platinum 8352V	36	72	7,697 est.	4,229 est.
Xeon Platinum 8352M	32	64	7,094 est.	3,898 est.
Xeon Gold 6354	18	36	5,491 est.	3,017 est.
Xeon Gold 6348	28	56	<b>7,318</b>	4,021 est.
Xeon Gold 6346	16	32	<b>5,005</b>	2,750 est.
Xeon Gold 6342	24	48	<b>6,952</b>	3,820 est.
Xeon Gold 6338T	24	48	6,170 est.	3,390 est.
Xeon Gold 6338	32	64	<b>7,454</b>	4,096 est.
Xeon Gold 6336Y	24	48	6,253 est.	3,436 est.
Xeon Gold 6334	8	16	<b>2,737</b>	1,504 est.
Xeon Gold 6330N	28	56	<b>6,024</b>	3,310 est.
Xeon Gold 6330	28	56	<b>6,798</b>	3,735 est.
Xeon Gold 6326	16	32	<b>5,003</b>	2,749 est.
Xeon Gold 6314U	32	64	-	4,178 est.
Xeon Gold 6312U	24	48	-	3,380 est.
Xeon Gold 5320	26	52	<b>6,526</b>	3,586 est.
Xeon Gold 5318Y	24	48	<b>6,109</b>	3,357 est.
Xeon Gold 5318S	24	48	6,109 est.	3,357 est.

Xeon Gold 5317	12	24	<b>3,561</b>		1,957	est.
Xeon Gold 5315Y	8	16	<b>2,548</b>		1,400	est.
Xeon Silver 4316	20	40	<b>4,867</b>		2,674	est.
Xeon Silver 4314	16	32	4,026	est.	2,212	est.
Xeon Silver 4310	12	24	3,092	est.	1,699	est.
Xeon Silver 4309Y	8	16	2,306	est.	1,267	est.

The following graph shows the OLTP-2 transaction rates obtained with the 3rd Generation Intel Xeon Processor Scalable Family (one or two processors).





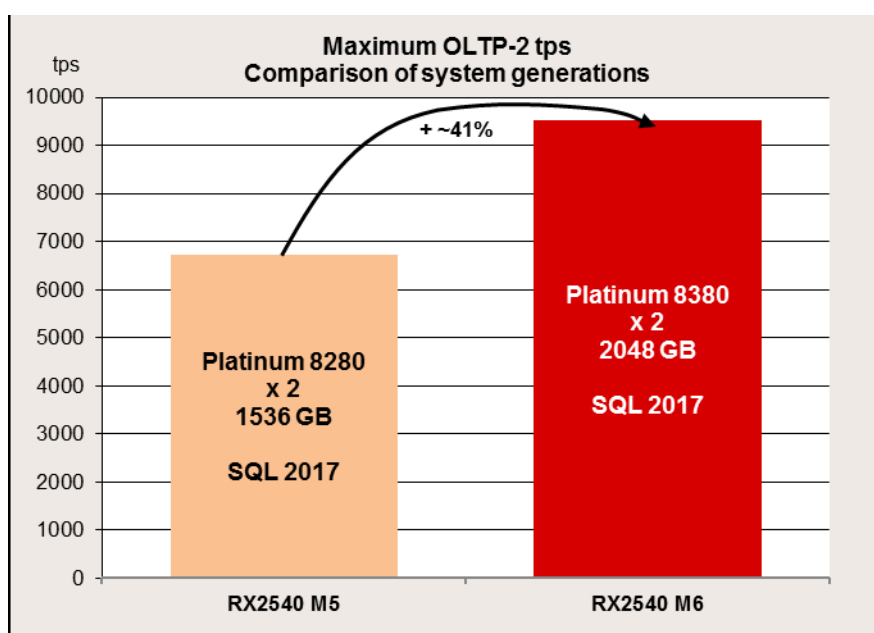
It is evident that a wide performance range is covered by the variety of released processors. If you compare the OLTP-2 value of the processor with the lowest performance (Xeon Platinum 8380) with the value of the processor with the highest performance (Xeon Sliver 4309Y) the OLTP-2 value increased by a factor of 4.

The features of the processors are summarized in the section "Technical data."

The relatively large performance differences between the processors can be explained by their features. The values scale on the basis of the number of cores, the size of the L3 cache and the CPU clock frequency and as a result of the features of Hyper-Threading and turbo mode, which are available in most processor types. Furthermore, the data transfer rate between processors ("UPI Speed") also determines the performance.

Within a group of processors with the same number of cores, scaling can be seen via the CPU clock frequency.

The highest value for OLTP-2 on the current PRIMERGY model is about 40% higher than the highest value on the previous model.



# Literature

## PRIMERGY Servers

<https://www.fujitsu.com/global/products/computing/servers/primergy/>

## PRIMERGY RX2530 M6

This Whitepaper

 <https://docs.ts.fujitsu.com/dl.aspx?id=47baf8e6-c94f-481c-bd4b-93047fc98dbf>

 <https://docs.ts.fujitsu.com/dl.aspx?id=6ea0c606-9733-4eb7-a5c9-1a8e44108e77>

Data sheet

<https://docs.ts.fujitsu.com/dl.aspx?id=da5d07ce-b4f5-4add-a1eb-1904b5277863>

## PRIMERGY Performance

<https://www.fujitsu.com/global/products/computing/servers/primergy/benchmarks/>

## SPEC CPU2017

<https://www.spec.org/osg/cpu2017>

Benchmark Overview SPECcpu2017

<https://docs.ts.fujitsu.com/dl.aspx?id=20f1f4e2-5b3c-454a-947f-c169fca51eb1>

## STREAM

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

## LINPACK

The LINPACK Benchmark: Past, Present, and Future

<https://www.netlib.org/utk/people/JackDongarra/PAPERS/hplpaper.pdf>

TOP500

<https://www.top500.org/>

HPL - A Portable Implementation of the High-Performance Linpack Benchmark for Distributed-Memory Computers

<https://www.netlib.org/benchmark/hpl/>

Intel Math Kernel Library – LINPACK Download

<https://www.intel.com/content/www/us/en/developer/articles/technical/onemkl-benchmarks-suite.html>

## SPECpower\_ssj2008

[https://www.spec.org/power\\_ssj2008](https://www.spec.org/power_ssj2008)

Benchmark Overview SPECpower\_ssj2008

<https://docs.ts.fujitsu.com/dl.aspx?id=166f8497-4bf0-4190-91a1-884b90850ee0>

## OLTP-2

Benchmark Overview OLTP-2

<https://docs.ts.fujitsu.com/dl.aspx?id=e6f7a4c9-aff6-4598-b199-836053214d3f>

## Document change history

Version	Date	Description
1.4	2023-11-14	Update <ul style="list-style-type: none"> <li>• Minor Correction</li> </ul>
1.3	2023-10-03	Update <ul style="list-style-type: none"> <li>• New Visual Identity format</li> </ul>
1.2	2022-07-05	Update <ul style="list-style-type: none"> <li>• Minor Correction</li> </ul>
1.1	2021-07-21	Update <ul style="list-style-type: none"> <li>• SPECcpu2017, OLTP-2, STREAM, LINPACK Measured and calculated with 3rd Generation Intel Xeon Processor Scalable Family</li> </ul>
1.0	2021-05-17	New: <ul style="list-style-type: none"> <li>• Technical data</li> <li>• SPECcpu2017, OLTP-2, STREAM, LINPACK Measured and calculated with 3rd Generation Intel Xeon Processor Scalable Family</li> <li>• SPECpower_ssj2008 Measured with Intel Xeon Platinum 8380</li> <li>• Disk I/O Measured with 2.5", 3.5", and EDSSD storage media</li> </ul>

**Contact****Fujitsu**Web site: <https://www.fujitsu.com>**PRIMERGY Performance and Benchmarks**

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