Fujitsu Server PRIMERGY
Performance Report
PRIMERGY RX2530 M7 / RX2540 M7

This document provides an overview of benchmarks executed on the Fujitsu Server PRIMERGY RX2530 M7 / RX2540 M7.

Explaines PRIMERGY RX2530 M7 / RX2540 M7 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
1.5 2024-11-12

Contents

Technical data

PRIMERGY RX2530 M7

PRIMERGY RX2540 M7

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

Model	PRIMERGY RX2530 M7	PRIMERGY RX2540 M7
Form factor	Rack server	
Chipset	Intel C741	
Number of sockets	2	
Number of configurable processors	1 or 2	
Processor type	4th Generation Intel Xeon Scalable Processors Family 5th Generation Intel Xeon Scalable Processors Family	
Number of memory slots	32 (16 per processor)	
Maximum memory configuration	8,192 GB	
Maximum number of internal storage disks	10	30
Maximum number of PCI slots	PCI Express 5.0 : 3	PCI Express 5.0 : 8

Processor									
Processor model	Type	Number of cores	Number of threads	L3 Cache	UPI speed	Rated frequency	Maximum turbo frequency	Maximum memory transfer rate	TDP
				[MB]	[GT/s]	[GHz]	[GHz]	[MT/s]	[W]
4th Generation Xeon Scalable Processors (1CPU and 2CPU supported processor)									
Xeon Max 9468	HBM	48	96	105	16	2.10	3.50	4,800	350
Xeon Max 9462	HBM	32	64	75	16	2.70	3.50	4,800	350
Xeon Max 9460	HBM	40	80	97.5	16	2.20	3.50	4,800	350
Xeon Platinum 8490H	XCC	60	120	112.5	16	1.90	3.50	4,800	350
Xeon Platinum 8480+	XCC	56	112	105	16	2.00	3.80	4,800	350
Xeon Platinum 8470N	XCC	52	104	97.5	16	1.70	3.60	4,800	300
Xeon Platinum 8470	XCC	52	104	105	16	2.00	3.80	4,800	350
Xeon Platinum 8468V	XCC	48	96	97.5	16	2.40	3.80	4,800	330
Xeon Platinum 8468	XCC	48	96	105	16	2.10	3.80	4,800	350
Xeon Platinum 8462Y+	MCC	32	64	60	16	2.80	4.10	4,800	300
Xeon Platinum 8460Y+	XCC	40	80	105	16	2.00	3.70	4,800	300
Xeon Platinum 8458P	XCC	44	88	82.5	16	2.70	3.80	4,800	350
Xeon Platinum 8452Y	XCC	36	72	67.5	16	2.00	3.20	4,800	300
Xeon Gold 6454S	XCC	32	64	60	16	2.20	3.40	4,800	270
Xeon Gold 6448Y	MCC	32	64	60	16	2.10	4.10	4,800	225
Xeon Gold 6444Y	MCC	16	32	45	16	3.60	4.00	4,800	270
Xeon Gold 6442Y	MCC	24	48	60	16	2.60	4.00	4,800	225
Xeon Gold 6438Y+	MCC	32	64	60	16	2.00	4.00	4,800	205
Xeon Gold 6438N	MCC	32	64	60	16	2.00	3.60	4,800	205
Xeon Gold 6438M	MCC	32	64	60	16	2.20	3.90	4,800	205
Xeon Gold 6434	MCC	8	16	22.5	16	3.70	4.10	4,800	195
Xeon Gold 6430	XCC	32	64	60	16	2.10	3.40	4,400	270
Xeon Gold 6428N	MCC	32	64	60	16	1.80	3.80	4,000	185
Xeon Gold 6426Y	MCC	16	32	37.5	16	2.50	4.10	4,800	185
Xeon Gold 5420+	MCC	28	56	52.5	16	2.00	4.10	4,400	205
Xeon Gold 5418Y	MCC	24	48	45	16	2.00	3.80	4,400	185
Xeon Gold 5418N	MCC	24	48	45	16	1.80	3.80	4,000	165
Xeon Gold 5416S	MCC	16	32	30	16	2.00	4.00	4,400	150
Xeon Gold 5415+	MCC	8	16	22.5	16	2.90	4.10	4,400	150
Xeon Silver 4416+	MCC	20	40	37.5	16	2.00	3.90	4,000	165
Xeon Silver 4410Y	MCC	12	24	30	16	2.00	3.90	4,000	150
Xeon Silver 4410T	MCC	10	20	26.25	16	2.70	4.00	4,000	150

Processor									
Processor model	Type	Number of cores	Number of threads	L3 Cache	UPI speed	Rated frequency	Maximum turbo frequency	Maximum memory transfer rate	TDP
				[MB]	[GT/s]	[GHz]	[GHz]	[MT/s]	[W]
4th Generation Xeon Scalable Processors (1CPU supported processor)									
Xeon Gold 6414U	XCC	32	64	60	-	2.00	3.40	4,800	250
Xeon Gold 5412U	MCC	24	48	45	-	2.10	3.90	4,400	185
Xeon Bronze 3408U	MCC	8	8	22.5	-	1.80	1.90	4,000	125
5th Generation Xeon Scalable Processors (1CPU and 2CPU supported processor)									
Xeon Platinum 8592V	XCC	64	128	320	16	2.00	3.90	4,800	330
Xeon Platinum 8592+	XCC	64	128	320	20	1.90	3.90	5,600	350
Xeon Platinum 8580	XCC	60	120	300	20	2.00	4.00	5,600	350
Xeon Platinum 8570	XCC	56	112	300	20	2.10	4.00	5,600	350
Xeon Platinum 8568Y+	XCC	48	96	300	20	2.30	4.00	5,600	350
Xeon Platinum 8562Y+	MCC	32	64	60	20	2.80	4.10	5,600	300
Xeon Platinum 8558P	XCC	48	96	260	20	2.70	4.00	5,600	350
Xeon Platinum 8558	XCC	48	96	260	20	2.10	4.00	5,200	330
Xeon Gold 6554S	XCC	36	72	180	20	2.20	4.00	5,200	270
Xeon Gold 6548Y+	MCC	32	64	60	20	2.50	4.10	5,200	250
Xeon Gold 6548N	MCC	32	64	60	20	2.80	4.10	5,200	250
Xeon Gold 6544Y	MCC	16	32	45	20	3.60	4.10	5,200	270
Xeon Gold 6542Y	MCC	24	48	60	20	2.90	4.10	5,200	250
Xeon Gold 6538Y+	MCC	32	64	60	20	2.20	4.00	5,200	225
Xeon Gold 6538N	MCC	32	64	60	20	2.10	4.10	5,200	205
Xeon Gold 6534	MCC	8	16	22.5	20	3.90	4.20	4,800	195
Xeon Gold 6530	XCC	32	64	160	20	2.10	4.00	4,800	270
Xeon Gold 6526Y	MCC	16	32	37.5	20	2.80	3.90	5,200	195
Xeon Gold 5520+	MCC	28	56	52.5	20	2.20	4.00	4,800	205
Xeon Gold 5515+	MCC	8	16	22.5	20	3.20	4.10	4,800	165
Xeon Silver 4516Y+	MCC	24	48	45	16	2.20	3.70	4,400	185
Xeon Silver 4514Y	MCC	16	32	30	16	2.00	3.40	4,400	150
Xeon Silver 4510T	LCC	12	24	30	16	2.00	3.70	4,400	115
Xeon Silver 4510	LCC	12	24	30	16	2.40	4.10	4,400	150
Xeon Silver 4509Y	LCC	8	16	22.5	16	2.60	4.10	4,400	125

Processor									
Processor model	Type	Number of cores	Number of threads	L3 Cache	UPI speed	Rated frequency	Maximum turbo frequency	Maximum memory transfer rate	TDP
				[MB]	[GT/s]	[GHz]	[GHz]	[MT/s]	[W]
5th Generation Xeon Scalable Processors (1CPU supported processor)									
Xeon Platinum 8581V	XCC	60	120	300	-	2.00	3.90	4,800	270
Xeon Platinum 8558U	XCC	48	96	260	-	2.00	4.00	4,800	300
Xeon Gold 5512U	MCC	28	56	52.5	-	2.10	3.70	4,800	185
Xeon Bronze 3508U	LCC	8	8	22.5	-	2.10	2.20	4,400	125

All processors that can be ordered with PRIMERGY RX2530 M7 / RX2540 M7 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	Workload
H	**DB/Analytics** Data analytics and big data usages
M	**Media Transcode** Media, AI, and HPC workloads
N	**Networking** Network and 5G workload environments from edge to the data center
P	**Cloud IaaS** VM environments which require higher frequency
Q	**Liquid Cooled** Environments that require higher core count and higher frequency such as HPC
S	**Storage & HCI** Storage provider and HCI
T	**Long-life Use (IOT)** High reliability and long-life availability usage
U	**1-Socket** Edge server, router, storage and security appliances composed of cost effective 1 socket configuration
V	**Cloud SaaS** VM environments which require power efficiency, higher frequency, and higher core counts
Y	**IaaS, networking, virtualized environments** Environments which require more granular control of CPU performance using Speed Select Technology

Please refer to the below URL for details.

https://www.intel.com/content/www/us/en/support/articles/000059657/processors/intel-xeon-processors.html

Memory modules									
Type	Capacity [GB]	Number of ranks	Bit width of the memory chips	Memory transfer rate [MT/s]	3DS	Load Reduced	Registered	NVDIMM	ECC
16GB (1x16GB) 1Rx8 DDR5-4800 R ECC	16	1	8	4,800			✓		✓
32GB (1x32GB) 2Rx8 DDR5-4800 R ECC	32	2	8	4,800			✓		✓
32GB (1x32GB) 1Rx4 DDR5-4800 R ECC	32	1	4	4,800			✓		✓
64GB (1x64GB) 2Rx4 DDR5-4800 R ECC	64	2	4	4,800			✓		✓
128GB (1x128GB) 4Rx4 DDR5-4800 R 3DS ECC	128	4	4	4,800	✓		✓		✓
256GB (1x256GB) 8Rx4 DDR5-4800 R 3DS ECC	256	8	4	4,800	✓		✓		✓
16GB (1x16GB) 1Rx8 DDR5-5600 R ECC	16	1	8	5,600			✓		✓
32GB (1x32GB) 2Rx8 DDR5-5600 R ECC	32	2	8	5,600			✓		✓
32GB (1x32GB) 1Rx4 DDR5-5600 R ECC	32	1	4	5,600			✓		✓
64GB (1x64GB) 2Rx4 DDR5-5600 R ECC	64	2	4	5,600			✓		✓
96GB (1x96GB) 2Rx4 DDR5-5600 R ECC	96	2	4	5,600			✓		✓
128GB (1x128GB) 4Rx4 DDR5-5600 R 3DS ECC	128	4	4	5,600	✓		✓		✓
256GB (1x256GB) 8Rx4 DDR5-5600 R 3DS ECC	256	8	4	5,600	✓		✓		✓

Power supplies		Maximum number
Modular redundant PSU	500W platinum PSU	2
	500W titanium PSU	2
	900W platinum PSU	2
	900W titanium PSU	2
	1,600W platinum PSU	2
	1,600W titanium PSU	2
	2,200W platinum PSU	2
	2,400W titanium PSU	2
DC PSU	1,300W PSU DC	2
	1,600W PSU HVDC	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 M7 / RX2540 M7.

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 M7 / RX2540 M7
• Processor	2 x 4th Generation Intel Xeon Scalable Processors Family or 1 x 4th Generation Intel Xeon Scalable Processors Family or 2 x 5th Generation Intel Xeon Scalable Processors Family or 1 x 5th Generation Intel Xeon Scalable Processors Family
• Memory	16 x 64GB (1x64GB) 2Rx4 DDR5-4800 R ECC (2CPU configuration) *1 or 8 x 64GB (1x64GB) 2Rx4 DDR5-4800 R ECC (1CPU configuration) *1 or 16 x 64GB (1x64GB) 2Rx4 DDR5-5600 R ECC (2CPU configuration) *2 or 8 x 64GB (1x64GB) 2Rx4 DDR5-5600 R ECC (1CPU configuration) *2 *1 CPU models which maximum memory transfer rate is 4,800 MT/s or less *2 CPU models which maximum memory transfer rate is 5,200 MT/s or more

Software

• BIOS settings	**4th Generation Intel Xeon Scalable Processors Family** SPECspeed2017_int_base: • RdCur for XPT Prefetch = Enable • Adjacent Cache Line Prefetch = Disabled • Package C State limit = C0 • SNC(Sub NUMA) = Enable SNC2 (Disabled when MCC are installed) • HWPM Support = Disabled • AVX P1 = Level2 • CPU Performance Boost = Aggressive • FAN Control = Full SPECspeed2017_fp_base: • Hyper Threading = Disabled • DCU IP Prefetcher = Disabled • Package C State limit = C0 • LLC Prefetch = Enabled • DBP-F = Enabled • CPU Performance Boost = Aggressive • FAN Control = Full SPECrate2017_int_base: • DCU Streamer Prefetcher = Disabled • Package C State limit = C0 • CPU Performance Boost = Aggressive • SNC(Sub NUMA) =Enable SNC4 • FAN Control = Full SPECrate2017_fp_base: • Hyper Threading = Disabled (Enabled when MCC are installed) • Package C State limit = C0 • CPU Performance Boost = Aggressive • SNC(Sub NUMA) =Enable SNC4 (Enable SNC2 when MCC are installed) • FAN Control = Full

System Under Test (SUT)

Software (Continued)

• BIOS settings	**5th Generation Intel Xeon Scalable Processors Family** SPECspeed2017_int_base: • LLC Prefetch = Enabled • XPT Prefetch = Enabled • FAN Control = Full SPECspeed2017_fp_base: • ASPM Support = Auto • Adjacent Cache Line Prefetch = Disabled • Override OS Energy Performance = Enabled • Energy Performance = Balanced Energy • LLC Prefetch = Enabled • CPU Performance Boost = Aggressive • DBP-F = Enabled • CPU C1 auto demotion = Enabled • CPU C1 auto undemotion = Enabled • IODC Configuration = Enable for Remote InvItoM and Remote WciLF • FAN Control = Full SPECrate2017_int_base: • DCU Streamer Prefetcher = Disabled • UPI Link Frequency Select = 14.4GT/s • CPU Performance Boost = Aggressive • SNC(Sub NUMA) =Enable SNC2 • HWPM Support = Disabled • FAN Control = Full SPECrate2017_fp_base: • Intel Virtualization Technology = Disabled • Utilization Profile = Unbalanced • CPU Performance Boost = Aggressive • SNC (Sub NUMA) =Enable SNC2 • FAN Control = Full
• Operating system	**4th Generation Intel Xeon Scalable Processors Family** SUSE Linux Enterprise Server 15 SP4 5.14.21-150400.22-default **5th Generation Intel Xeon Scalable Processors Family** SPECspeed2017_fp_base: Red Hat Enterprise Linux 9.2 (Plow) 5.14.0-284.11.1.el9_2.x86_64 Others: SUSE Linux Enterprise Server 15 SP5 5.14.21-150500.53-default
• Operating system settings	Stack size set to unlimited using “ulimit -s unlimited”

System Under Test (SUT)

Software (Continued)

• Compiler	**4th Generation Intel Xeon Scalable Processors Family** C/C++: Version 2023.0 of Intel C/C++ Compiler for Linux Fortran: Version 2023.0 of Intel Fortran Compiler for Linux **5th Generation Intel Xeon Scalable Processors Family** SPECspeed2017_fp_base: C/C++: Version 2023.2.3 of Intel C/C++ Compiler for Linux Fortran: Version 2023.2.3 of Intel Fortran Compiler for Linux Others: C/C++: Version 2024.0.2 of Intel C/C++ Compiler for Linux Fortran: Version 2024.0.2 of Intel Fortran Compiler for Linux

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 model	Number of cores	Number of processors	SPECrate2017_int_base		SPECrate2017_fp_base	
			RX2530 M7	RX2540 M7	RX2530 M7	RX2540 M7
4th Generation Intel Xeon Scalable Processors Family (2CPU configuration)						
Xeon Max 9468	48	2	756 est.	**773**	1,020 est.	**1,020**
Xeon Max 9462	32	2	591 est.	**604**	853 est.	**852**
Xeon Max 9460	40	2	664 est.	**679**	940 est.	**938**
Xeon Platinum 8490H	60	2	**943**	**964**	**976**	**974**
Xeon Platinum 8480+	56	2	**923**	**934**	**956**	**953**
Xeon Platinum 8470N	52	2	781 est.	**807**	843 est.	**857**
Xeon Platinum 8470	52	2	865 est.	**884**	924 est.	**923**
Xeon Platinum 8468V	48	2	792 est.	**809**	878 est.	**877**
Xeon Platinum 8468	48	2	826 est.	**844**	903 est.	**901**
Xeon Platinum 8462Y+	32	2	649 est.	**663**	766 est.	**765**
Xeon Platinum 8460Y+	40	2	675 est.	**690**	801 est.	**800**
Xeon Platinum 8458P	44	2	786 est.	**803**	869 est.	**868**
Xeon Platinum 8452Y	36	2	609 est.	**623**	720 est.	**719**
Xeon Gold 6454S	32	2	541 est.	**553**	669 est.	**668**
Xeon Gold 6448Y	32	2	563 est.	**576**	690 est.	**689**
Xeon Gold 6444Y	16	2	377 est.	**386**	521 est.	**520**
Xeon Gold 6442Y	24	2	480 est.	**490**	626 est.	**625**
Xeon Gold 6438Y+	32	2	535 est.	**547**	646 est.	**645**
Xeon Gold 6438N	32	2	532 est.	**544**	651 est.	**650**
Xeon Gold 6438M	32	2	543 est.	**555**	654 est.	**653**
Xeon Gold 6434	8	2	194 est.	**198**	285 est.	**285**
Xeon Gold 6430	32	2	515 est.	**526**	632 est.	**631**
Xeon Gold 6428N	32	2	488 est.	**499**	586 est.	**585**
Xeon Gold 6426Y	16	2	324 est.	**332**	444 est.	**443**
Xeon Gold 5420+	28	2	467 est.	**478**	590 est.	**589**
Xeon Gold 5418Y	24	2	409 est.	**418**	520 est.	**520**
Xeon Gold 5418N	24	2	386 est.	**395**	479 est.	**478**
Xeon Gold 5416S	16	2	275 est.	**282**	369 est.	**368**
Xeon Gold 5415+	8	2	174 est.	**178**	253 est.	**252**

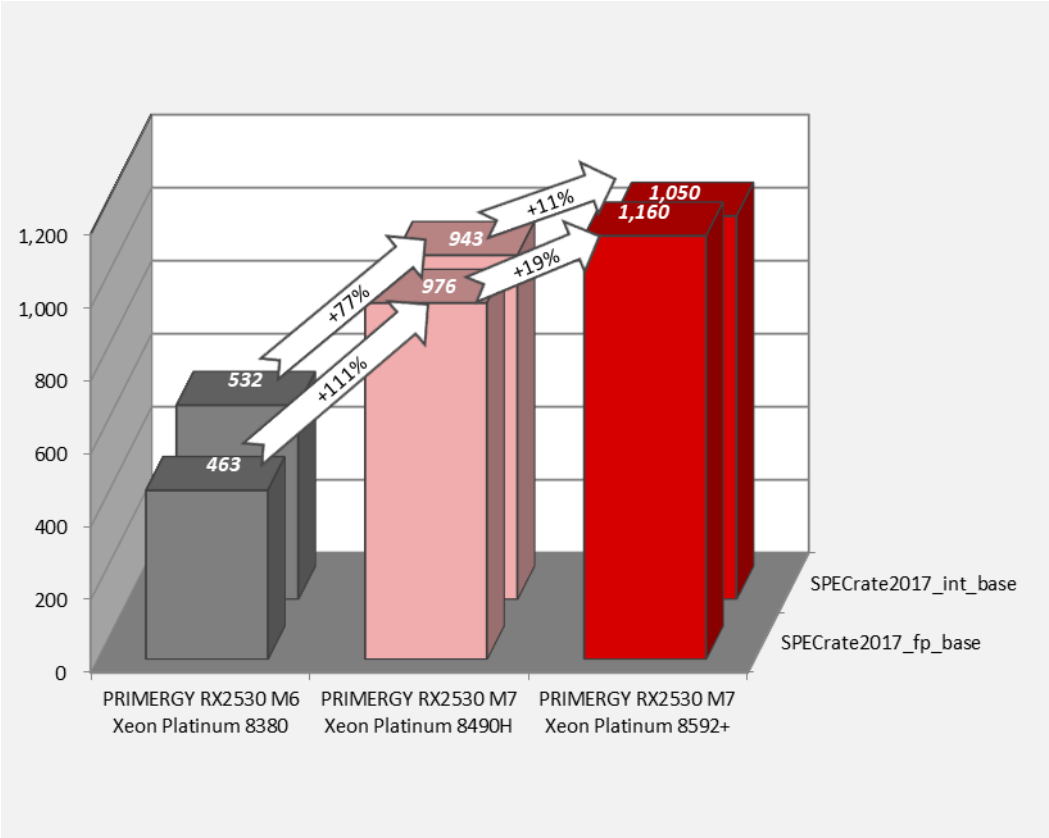
Processor model	Number of cores	Number of processors	SPECrate2017_int_base		SPECrate2017_fp_base	
			RX2530 M7	RX2540 M7	RX2530 M7	RX2540 M7
4th Generation Intel Xeon Scalable Processors Family (2CPU configuration, continued)						
Xeon Silver 4416+	20	2	355 est.	**363**	454 est.	**453**
Xeon Silver 4410Y	12	2	213 est.	**218**	320 est.	**320**
Xeon Silver 4410T	10	2	207 est.	**211**	292 est.	**291**
4th Generation Intel Xeon Scalable Processors Family (1CPU configuration)						
Xeon Gold 6414U	32	1	261 est.	**267**	335 est.	**334**
Xeon Gold 5412U	24	1	216 est.	**221**	282 est.	**282**
Xeon Bronze 3408U	8	1	42.0 est.	**42.9**	75.2 est.	**75.1**
5th Generation Intel Xeon Scalable Processors Family (2CPU configuration)						
Xeon Platinum 8592V	64	2	1,010 est.	**1,020**	1,080 est.	**1,110**
Xeon Platinum 8592+	64	2	**1,050**	**1,060**	**1,160**	**1,190**
Xeon Platinum 8580	60	2	1,010 est.	**1,010**	1,130 est.	**1,160**
Xeon Platinum 8570	56	2	973 est.	**978**	1,100 est.	**1,120**
Xeon Platinum 8568Y+	48	2	894 est.	**899**	1,060 est.	**1,080**
Xeon Platinum 8562Y+	32	2	672 est.	**676**	822 est.	**840**
Xeon Platinum 8558P	48	2	891 est.	**895**	1,040 est.	**1,060**
Xeon Platinum 8558	48	2	834 est.	**838**	982 est.	**1,000**
Xeon Gold 6554S	36	2	639 est.	**642**	805 est.	**824**
Xeon Gold 6548Y+	32	2	622 est.	**625**	760 est.	**777**
Xeon Gold 6548N	32	2	625 est.	**629**	764 est.	**781**
Xeon Gold 6544Y	16	2	379 est.	**381**	539 est.	**551**
Xeon Gold 6542Y	24	2	505 est.	**507**	672 est.	**687**
Xeon Gold 6538Y+	32	2	589 est.	**592**	728 est.	**744**
Xeon Gold 6538N	32	2	548 est.	**551**	697 est.	**713**
Xeon Gold 6534	8	2	195 est.	**196**	297 est.	**303**
Xeon Gold 6530	32	2	539 est.	**542**	723 est.	**739**
Xeon Gold 6526Y	16	2	336 est.	**338**	476 est.	**486**
Xeon Gold 5520+	28	2	498 est.	**501**	638 est.	**653**
Xeon Gold 5515+	8	2	175 est.	**176**	277 est.	**283**
Xeon Silver 4516Y+	24	2	423 est.	**426**	564 est.	**576**
Xeon Silver 4514Y	16	2	263 est.	**265**	388 est.	**397**
Xeon Silver 4510T	12	2	209 est.	**210**	306 est.	**312**
Xeon Silver 4510	12	2	239 est.	**240**	353 est.	**361**
Xeon Silver 4509Y	8	2	170 est.	**171**	252 est.	**258**

Processor model	Number of cores	Number of processors	SPECrate2017_int_base		SPECrate2017_fp_base	
			RX2530 M7	RX2540 M7	RX2530 M7	RX2540 M7
5th Generation Intel Xeon Scalable Processors Family (1CPU configuration)						
Xeon Platinum 8581V	60	1	456 est.	**458**	510 est.	**521**
Xeon Platinum 8558U	48	1	417 est.	**419**	489 est.	**500**
Xeon Gold 5512U	28	1	255 est.	**256**	330 est.	**338**
Xeon Bronze 3508U	8	1	45.7 est.	**46.0**	80.8 est.	**82.7**

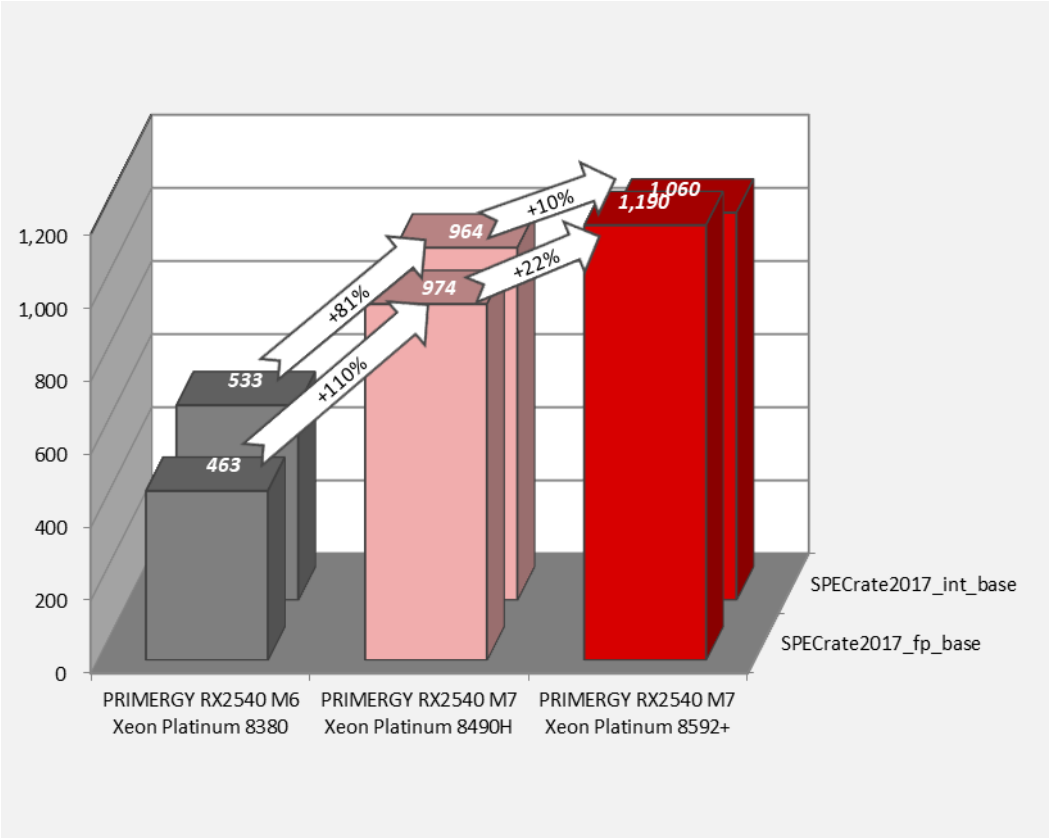
Processor model	Number of cores	Number of processors	SPECspeed2017_int_base		SPECspeed2017_fp_base	
			RX2530 M7	RX2540 M7	RX2530 M7	RX2540 M7
4th Generation Intel Xeon Scalable Processors Family						
Xeon Platinum 8490H	60	2	-	-	**354**	**355**
Xeon Platinum 8462Y+	32	2	**16.0**	**15.9**	-	-
5th Generation Intel Xeon Scalable Processors Family						
Xeon Platinum 8592+	64	2	-	-	**411**	**413**
Xeon Platinum 8562Y+	32	2	**14.9**	**14.9**	-	-

The following graphs compare the throughputs of PRIMERGY RX2530 M7 / RX2540 M7 and their older models, PRIMERGY RX2530 M6 / RX2540 M6, with maximum performance configurations.

Compared to the Xeon Platinum 8380 (3rd Generation Xeon Scalable Processor), both models with the Xeon Platinum 8490H (4th Generation Xeon Scalable Processor) showed significant performance improvements of +77% to +111% over the previous generation. In addition, compared to the Xeon Platinum 8490H, the Xeon Platinum 8592+ (5th Generation Xeon Scalable Processor) showed performance improvements of +10% to +22%.



SPECrate2017: Comparison of PRIMERGY RX2530 M6 and PRIMERGY RX2530 M7



SPECrate2017: Comparison of PRIMERGY RX2540 M6 and PRIMERGY RX2540 M7

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 × b(i)	16	1
SUM	a(i) = b(i) + c(i)	24	1
TRIAD	a(i) = b(i) + q × 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 M7 / RX2540 M7
• Processor	2 x 4th Generation Intel Xeon Scalable Processors Family or 1 x 4th Generation Intel Xeon Scalable Processors Family or 2 x 5th Generation Intel Xeon Scalable Processors Family or 1 x 5th Generation Intel Xeon Scalable Processors Family
• Memory	16 x 64GB (1x64GB) 2Rx4 DDR5-4800 R ECC (2CPU configuration) *1 or 8 x 64GB (1x64GB) 2Rx4 DDR5-4800 R ECC (1CPU configuration) *1 16 x 64GB (1x64GB) 2Rx4 DDR5-5600 R ECC (2CPU configuration) *2 or 8 x 64GB (1x64GB) 2Rx4 DDR5-5600 R ECC (1CPU configuration) *2 *1 CPU models which maximum memory transfer rate is 4,800 MT/s or less *2 CPU models which maximum memory transfer rate is 5,200 MT/s or more
Software	
• BIOS settings	**Common** • DCU Streamer Prefetcher = Disabled • Intel Virtualization Technology = Disabled • LLC Dead Line Alloc = Disabled • Stale Atos = Enabled **4th Generation Intel Xeon Scalable Processors Family** • SNC(Sub NUMA) = Enable SNC4 (Enable SNC2 when MCC type installed) **5th Generation Intel Xeon Scalable Processors Family** • SNC(Sub NUMA) = Enable SNC2
• Operating system	**4th Generation Intel Xeon Scalable Processors Family** SUSE Linux Enterprise Server 15 SP4 5.14.21-150400.22-default **5th Generation Intel Xeon Scalable Processors Family** SUSE Linux Enterprise Server 15 SP5 5.14.21-150500.53-default
• Operating system settings	Default
• Compiler	C/C++: Version 2023.0 of Intel C/C++ Compiler for Linux
• Benchmark	STREAM Version 5.10

Benchmark results

The results with “est.” are the estimated values.

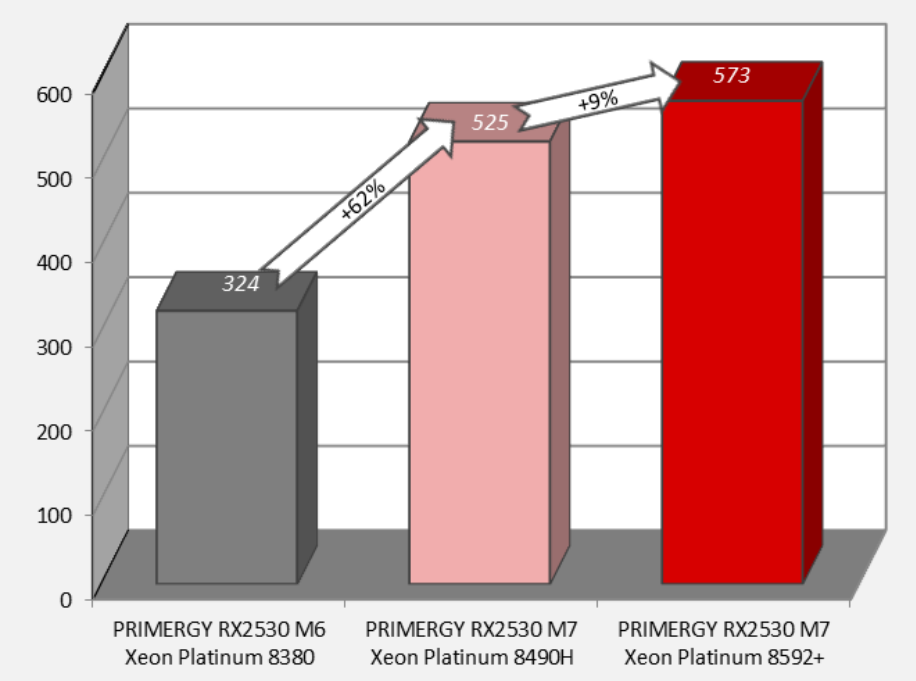
Processor	Memory transfer rate [MT/s]	Maximum memory bandwidth [GB/s]	Number of cores	Rated frequency [GHz]	Number of processors	TRIAD [GB/s] RX2530 M7	TRIAD [GB/s] RX2540 M7
4th Generation Intel Xeon Scalable Processors Family (2CPU configuration)							
Xeon Max 9468	4,800	282	48	2.10	2	514 est.	**511**
Xeon Max 9462	4,800	282	32	2.70	2	491 est.	**488**
Xeon Max 9460	4,800	282	40	2.20	2	514 est.	**512**
Xeon Platinum 8490H	4,800	307	60	1.90	2	**525**	**522**
Xeon Platinum 8480+	4,800	307	56	2.00	2	524 est.	**521**
Xeon Platinum 8470N	4,800	307	52	1.70	2	514 est.	**511**
Xeon Platinum 8470	4,800	307	52	2.00	2	513 est.	**511**
Xeon Platinum 8468V	4,800	307	48	2.40	2	508 est.	**505**
Xeon Platinum 8468	4,800	307	48	2.10	2	490 est.	**488**
Xeon Platinum 8462Y+	4,800	307	32	2.80	2	477 est.	**474**
Xeon Platinum 8460Y+	4,800	307	40	2.00	2	480 est.	**478**
Xeon Platinum 8458P	4,800	307	44	2.70	2	500 est.	**498**
Xeon Platinum 8452Y	4,800	307	36	2.00	2	455 est.	**452**
Xeon Gold 6454S	4,800	307	32	2.20	2	447 est.	**444**
Xeon Gold 6448Y	4,800	307	32	2.10	2	469 est.	**467**
Xeon Gold 6444Y	4,800	307	16	3.60	2	385 est.	**383**
Xeon Gold 6442Y	4,800	307	24	2.60	2	443 est.	**441**
Xeon Gold 6438Y+	4,800	307	32	2.00	2	465 est.	**463**
Xeon Gold 6438N	4,800	307	32	2.00	2	467 est.	**464**
Xeon Gold 6438M	4,800	307	32	2.20	2	466 est.	**464**
Xeon Gold 6434	4,800	307	8	3.70	2	228 est.	**227**
Xeon Gold 6430	4,400	282	32	2.10	2	421 est.	**419**
Xeon Gold 6428N	4,000	256	32	1.80	2	410 est.	**407**
Xeon Gold 6426Y	4,800	307	16	2.50	2	350 est.	**348**
Xeon Gold 5420+	4,400	282	28	2.00	2	420 est.	**418**
Xeon Gold 5418Y	4,400	282	24	2.00	2	388 est.	**386**
Xeon Gold 5418N	4,000	256	24	1.80	2	363 est.	**362**
Xeon Gold 5416S	4,400	282	16	2.00	2	285 est.	**284**
Xeon Gold 5415+	4,400	282	8	2.90	2	215 est.	**214**
Xeon Silver 4416+	4,000	256	20	2.00	2	331 est.	**330**
Xeon Silver 4410Y	4,000	256	12	2.00	2	265 est.	**264**

Processor	Memory transfer rate [MT/s]	Maximum memory bandwidth [GB/s]	Number of cores	Rated frequency [GHz]	Number of processors	TRIAD [GB/s] RX2530 M7	TRIAD [GB/s] RX2540 M7
4th Generation Intel Xeon Scalable Processors Family (2CPU configuration, Continued)							
Xeon Silver 4410T	4,000	256	10	2.70	2	240 est.	**239**
4th Generation Intel Xeon Scalable Processors Family (1CPU configuration)							
Xeon Gold 6414U	4,800	307	32	2.0	1	240 est.	**239**
Xeon Gold 5412U	4,400	282	24	2.1	1	210 est.	**209**
Xeon Bronze 3408U	4,000	256	8	1.8	1	124 est.	**123**
5th Generation Intel Xeon Scalable Processors Family (2CPU configuration)							
Xeon Platinum 8592V	4,800	307	64	2.00	2	520 est.	**520**
Xeon Platinum 8592+	5,600	358	64	1.90	2	**573**	**574**
Xeon Platinum 8580	5,600	358	60	2.00	2	570 est.	**571**
Xeon Platinum 8570	5,600	358	56	2.10	2	573 est.	**574**
Xeon Platinum 8568Y+	5,600	358	48	2.30	2	564 est.	**565**
Xeon Platinum 8562Y+	5,600	358	32	2.80	2	491 est.	**492**
Xeon Platinum 8558P	5,600	358	48	2.70	2	562 est.	**563**
Xeon Platinum 8558	5,200	333	48	2.10	2	536 est.	**537**
Xeon Gold 6554S	5,200	333	36	2.20	2	490 est.	**490**
Xeon Gold 6548Y+	5,200	333	32	2.50	2	467 est.	**468**
Xeon Gold 6548N	5,200	333	32	2.80	2	470 est.	**471**
Xeon Gold 6544Y	5,200	333	16	3.60	2	390 est.	**391**
Xeon Gold 6542Y	5,200	333	24	2.90	2	460 est.	**461**
Xeon Gold 6538Y+	5,200	333	32	2.20	2	464 est.	**465**
Xeon Gold 6538N	5,200	333	32	2.10	2	462 est.	**463**
Xeon Gold 6534	4,800	307	8	3.90	2	237 est.	**238**
Xeon Gold 6530	4,800	307	32	2.10	2	460 est.	**461**
Xeon Gold 6526Y	5,200	333	16	2.80	2	357 est.	**357**
Xeon Gold 5520+	4,800	307	28	2.20	2	430 est.	**430**
Xeon Gold 5515+	4,800	307	8	3.20	2	234 est.	**235**
Xeon Silver 4516Y+	4,400	282	24	2.20	2	381 est.	**381**
Xeon Silver 4514Y	4,400	282	16	2.00	2	291 est.	**292**
Xeon Silver 4510T	4,400	282	12	2.00	2	272 est.	**272**
Xeon Silver 4510	4,400	282	12	2.40	2	283 est.	**283**
Xeon Silver 4509Y	4,400	282	8	2.60	2	210 est.	**210**

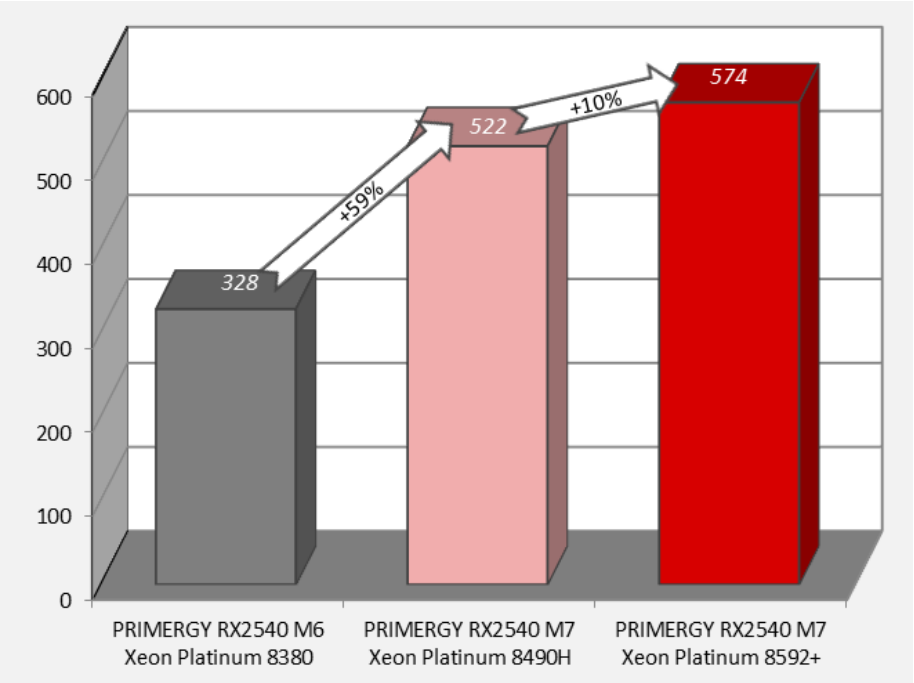
Processor	Memory transfer rate [MT/s]	Maximum memory bandwidth [GB/s]	Number of cores	Rated frequency [GHz]	Number of processors	TRIAD [GB/s] RX2530 M7		TRIAD [GB/s] RX2540 M7	
5th Generation Intel Xeon Scalable Processors Family (1CPU configuration)									
Xeon Platinum 8581V	4,800	307	60	2.00	1	248	est.	**249**	
Xeon Platinum 8558U	4,800	307	48	2.00	1	248	est.	**248**	
Xeon Gold 5512U	4,800	307	28	2.10	1	229	est.	**229**	
Xeon Bronze 3508U	4,400	282	8	2.10	1	126	est.	**126**	

The following graphs compare the throughputs of PRIMERGY RX2530 M7 / RX2540 M7 and their older models, PRIMERGY RX2530 M6 / RX2540 M6, with maximum performance configurations.

Compared to the Xeon Platinum 8380 (3rd Generation Xeon Scalable Processor), both models with the Xeon Platinum 8490H (4th Generation Xeon Scalable Processor) showed significant performance improvements of +59% to +62% over the previous generation. In addition, compared to the Xeon Platinum 8490H, the Xeon Platinum 8592+ (5th Generation Xeon Scalable Processor) showed performance improvements of +9% to +10%.



STREAM: Comparison of PRIMERGY RX2530 M6 and PRIMERGY RX2530 M7



STREAM: Comparison of PRIMERGY RX2540 M6 and PRIMERGY RX2540 M7

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.

https://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 x 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 x n matrix the number of arithmetic operations required for the solution is $2/3n^3 + 2n^2$. 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. he 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.

Rpeak = Maximum number of floating point operations per clock cycle
x Number of processor cores of the computer
x Rated processor frequency [GHz]

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 https://www.top500.org/. This requires using an HPL-based LINPACK version (see https://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 https://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 M7 / RX2540 M7
• Processor	2 x 4th Generation Intel Xeon Scalable Processors Family or 1 x 4th Generation Intel Xeon Scalable Processors Family or 2 x 5th Generation Intel Xeon Scalable Processors Family or 1 x 5th Generation Intel Xeon Scalable Processors Family
• Memory	16 x 64GB (1x64GB) 2Rx4 DDR5-4800 R ECC (2CPU configuration) *1 or 8 x 64GB (1x64GB) 2Rx4 DDR5-4800 R ECC (1CPU configuration) *1 16 x 64GB (1x64GB) 2Rx4 DDR5-5600 R ECC (2CPU configuration) *2 or 8 x 64GB (1x64GB) 2Rx4 DDR5-5600 R ECC (1CPU configuration) *2 *1 CPU models which maximum memory transfer rate is 4,800 MT/s or less *2 CPU models which maximum memory transfer rate is 5,200 MT/s or more

Software

• BIOS settings	• HyperThreading = Disabled • CPU Performance Boost = Agressive • Fan Control = Full
• Operating system	**4th Generation Intel Xeon Scalable Processors Family** SUSE Linux Enterprise Server 15 SP4 5.14.21-150400.22-default **5th Generation Intel Xeon Scalable Processors Family** SUSE Linux Enterprise Server 15 SP5 5.14.21-150500.53-default
• Operating system settings	Kernel Boot Parameter set with : nohz_full=1-X (X: logical core number -1)
• Compiler	C/C++: Version 2023.0 of Intel C/C++ Compiler for Linux
• Benchmark	Intel Optimized MP LINPACK Benchmark for Clusters

Benchmark results

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

Processor	Number of cores	Rated frequency [GHz]	Number of processors	Rpeak [GFlops]	RX2530 M7		RX2540 M7	
					Rmax [GFlops]	Effic.	Rmax [GFlops]	Effic.
4th Generation Intel Xeon Scalable Processors Family (2CPU configuration)								
Xeon Max 9468	48	2.10	2	6,451	5,950 est.	92%	**6,037**	94%
Xeon Max 9462	32	2.70	2	5,530	4,986 est.	90%	**5,059**	91%
Xeon Max 9460	40	2.20	2	5,632	5,479 est.	97%	**5,559**	99%
Xeon Platinum 8490H	60	1.90	2	7,296	**7,279**	100%	**7,386**	101%
Xeon Platinum 8480+	56	2.00	2	7,168	7,281 est.	102%	**7,388**	103%
Xeon Platinum 8470N	52	1.70	2	5,658	6,017 est.	106%	**6,105**	108%
Xeon Platinum 8470	52	2.00	2	6,656	6,830 est.	103%	**6,930**	104%
Xeon Platinum 8468V	48	2.40	2	7,373	6,230 est.	84%	**6,321**	86%
Xeon Platinum 8468	48	2.10	2	6,451	6,450 est.	100%	**6,544**	101%
Xeon Platinum 8462Y+	32	2.80	2	5,734	5,442 est.	95%	**5,522**	96%
Xeon Platinum 8460Y+	40	2.00	2	5,120	5,343 est.	104%	**5,421**	106%
Xeon Platinum 8458P	44	2.70	2	7,603	6,073 est.	80%	**6,162**	81%
Xeon Platinum 8452Y	36	2.00	2	4,608	5,100 est.	111%	**5,175**	112%
Xeon Gold 6454S	32	2.20	2	4,301	4,354 est.	101%	**4,418**	103%
Xeon Gold 6448Y	32	2.10	2	4,301	4,425 est.	103%	**4,490**	104%
Xeon Gold 6444Y	16	3.60	2	3,686	3,446 est.	93%	**3,497**	95%
Xeon Gold 6442Y	24	2.60	2	3,994	3,975 est.	100%	**4,034**	101%
Xeon Gold 6438Y+	32	2.00	2	4,096	4,147 est.	101%	**4,207**	103%
Xeon Gold 6438N	32	2.00	2	4,096	4,249 est.	104%	**4,311**	105%
Xeon Gold 6438M	32	2.20	2	4,506	4,309 est.	96%	**4,373**	97%
Xeon Gold 6434	8	3.70	2	1,894	1,811 est.	96%	**1,838**	97%
Xeon Gold 6430	32	2.10	2	3,891	4,257 est.	109%	**4,320**	111%
Xeon Gold 6428N	32	1.80	2	3,686	3,771 est.	102%	**3,826**	104%
Xeon Gold 6426Y	16	2.50	2	2,560	2,816 est.	110%	**2,857**	112%
Xeon Gold 5420+	28	2.00	2	3,584	3,864 est.	108%	**3,920**	109%
Xeon Gold 5418Y	24	2.00	2	3,072	3,241 est.	105%	**3,288**	107%
Xeon Gold 5418N	24	1.80	2	2,765	2,975 est.	108%	**3,019**	109%
Xeon Gold 5416S	16	2.00	2	2,048	2,194 est.	107%	**2,226**	109%
Xeon Gold 5415+	8	2.90	2	1,485	1,495 est.	101%	**1,517**	102%
Xeon Silver 4416+	20	2.00	2	2,560	2,880 est.	113%	**2,923**	114%
Xeon Silver 4410Y	12	2.00	2	1,536	1,852 est.	121%	**1,879**	122%
Xeon Silver 4410T	10	2.70	2	1,728	1,840 est.	106%	**1,867**	108%

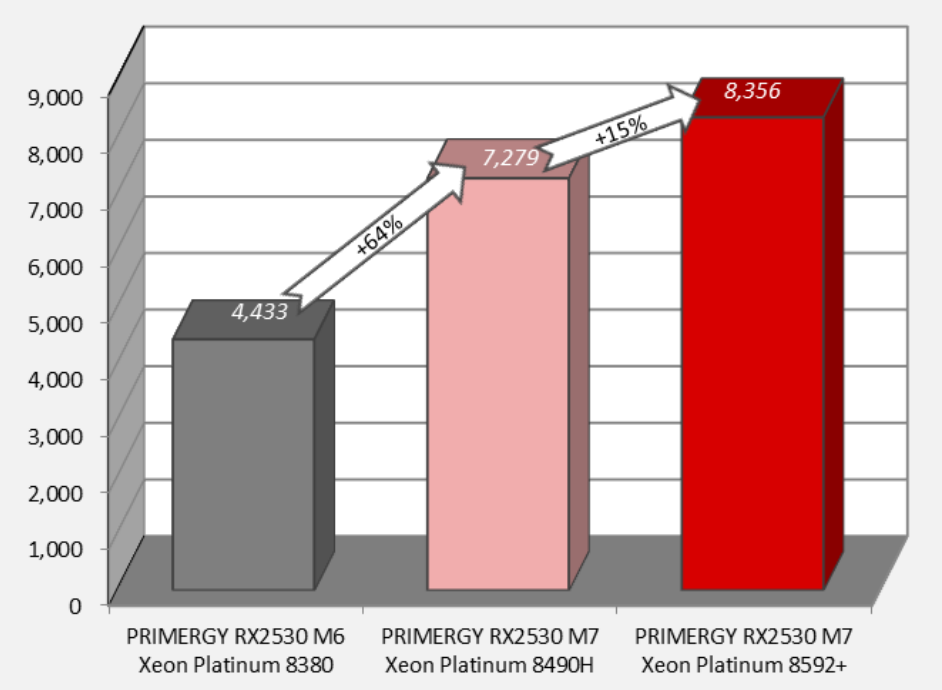
Processor	Number of cores	Rated frequency [GHz]	Number of processors	Rpeak [GFlops]	RX2530 M7		RX2540 M7	
					Rmax [GFlops]	Effic.	Rmax [GFlops]	Effic.
4th Generation Intel Xeon Scalable Processors Family (1CPU configuration)								
Xeon Gold 6414U	32	2.00	1	2,048	2,198 est.	107%	**2,230**	109%
Xeon Gold 5412U	24	2.10	1	1,613	1,844 est.	114%	**1,871**	116%
Xeon Bronze 3408U	8	1.80	1	230	239 est.	104%	**242**	105%
5th Generation Intel Xeon Scalable Processors Family (2CPU configuration)								
Xeon Platinum 8592V	64	2.00	2	8,192	7,981 est.	97%	8,038 est.	98%
Xeon Platinum 8592+	64	1.90	2	7,782	**8,356**	107%	**8,416**	108%
Xeon Platinum 8580	60	2.00	2	7,680	8,073 est.	105%	8,131 est.	106%
Xeon Platinum 8570	56	2.10	2	7,526	7,743 est.	103%	7,799 est.	104%
Xeon Platinum 8568Y+	48	2.30	2	7,066	7,302 est.	103%	7,354 est.	104%
Xeon Platinum 8562Y+	32	2.80	2	5,734	6,229 est.	109%	6,273 est.	109%
Xeon Platinum 8558P	48	2.70	2	8,294	7,226 est.	87%	7,278 est.	88%
Xeon Platinum 8558	48	2.10	2	6,451	6,886 est.	107%	6,936 est.	108%
Xeon Gold 6554S	36	2.20	2	5,069	5,225 est.	103%	5,262 est.	104%
Xeon Gold 6548Y+	32	2.50	2	5,120	5,601 est.	109%	5,640 est.	110%
Xeon Gold 6548N	32	2.80	2	5,734	5,481 est.	96%	5,520 est.	96%
Xeon Gold 6544Y	16	3.60	2	3,686	3,899 est.	106%	3,927 est.	107%
Xeon Gold 6542Y	24	2.90	2	4,454	4,774 est.	107%	4,808 est.	108%
Xeon Gold 6538Y+	32	2.20	2	4,506	5,093 est.	113%	5,129 est.	114%
Xeon Gold 6538N	32	2.10	2	4,301	4,704 est.	109%	4,737 est.	110%
Xeon Gold 6534	8	3.90	2	1,997	2,023 est.	101%	2,038 est.	102%
Xeon Gold 6530	32	2.10	2	4,301	4,953 est.	115%	4,988 est.	116%
Xeon Gold 6526Y	16	2.80	2	2,867	3,171 est.	111%	3,194 est.	111%
Xeon Gold 5520+	28	2.20	2	3,942	4,426 est.	112%	4,457 est.	113%
Xeon Gold 5515+	8	3.20	2	1,638	1,803 est.	110%	1,816 est.	111%
Xeon Silver 4516Y+	24	2.20	2	3,379	3,838 est.	114%	3,866 est.	114%
Xeon Silver 4514Y	16	2.00	2	2,048	2,569 est.	125%	2,588 est.	126%
Xeon Silver 4510T	12	2.00	2	1,536	1,737 est.	113%	**1,750**	114%
Xeon Silver 4510	12	2.40	2	1,843	2,017 est.	109%	**2,032**	110%
Xeon Silver 4509Y	8	2.60	2	1,331	1,352 est.	102%	**1,362**	102%
5th Generation Intel Xeon Scalable Processors Family (1CPU configuration)								
Xeon Platinum 8581V	60	2.00	1	3,840	3,517 est.	92%	3,542 est.	92%
Xeon Platinum 8558U	48	2.00	1	3,072	3,473 est.	113%	3,498 est.	114%
Xeon Gold 5512U	28	2.10	1	1,882	2,161 est.	115%	2,176 est.	116%
Xeon Bronze 3508U	8	2.10	1	269	256 est.	95%	**258**	96%

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.

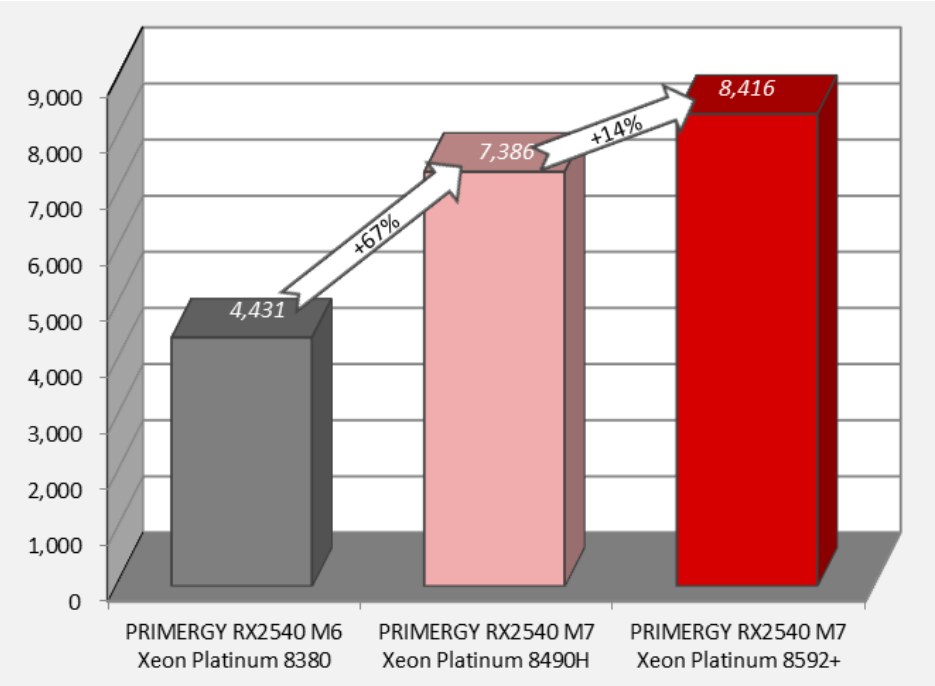
As explained in the section "Technical Data," Intel generally does not guarantee that the maximum turbo frequency can be reached in the processor models due to manufacturing tolerances. A further restriction applies for workloads, such as those generated by LINPACK, with intensive use of AVX instructions 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.

The following graphs compare the throughputs of PRIMERGY RX2530 M7 / RX2540 M7 and their older models, PRIMERGY RX2530 M6 / RX2540 M6, with maximum performance configurations.

Compared to the Xeon Platinum 8380 (3rd Generation Xeon Scalable Processor), both models with the Xeon Platinum 8490H (4th Generation Xeon Scalable Processor) showed significant performance improvements of +64% to +67% over the previous generation. In addition, compared to the Xeon Platinum 8490H, the Xeon Platinum 8592+ (5th Generation Xeon Scalable Processor) showed performance improvements of +14% to +15%.



LINPACK: Comparison of PRIMERGY RX2530 M6 and PRIMERGY RX2530 M7



LINPACK: Comparison of PRIMERGY RX2540 M6 and PRIMERGY RX2540 M7

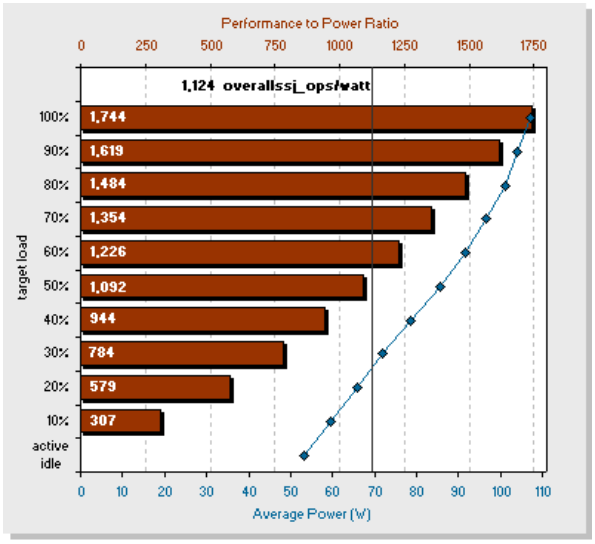
SPECpower_ssj2008

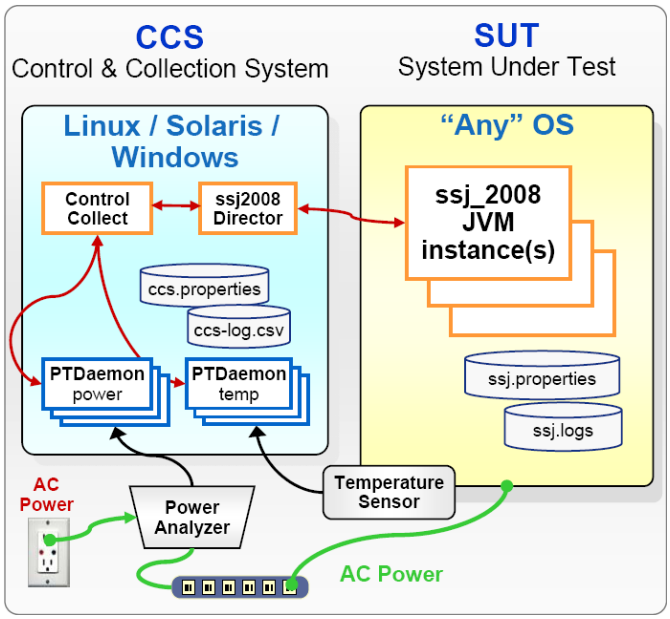
Benchmark description

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)

Hardware

• Model	PRIMERGY RX2530 M7 / RX2540 M7
• Processor	2 x Xeon Platinum 8490H 2 x Xeon Platinum 8592+
• Memory	16 x 32GB (1x32GB) 2Rx8 DDR5-4800 R ECC
• Network interface	1Gbit/s (RJ45) on Motherboard
• Disk subsystem	1 x SSD SATA M.2 drive for booting, non hot-plug 240GB
• Power Supply Unit	**When using Xeon Platinum 8490H processors** 2 x 900W titanium PSU **When using Xeon Platinum 8592+ processors** 1 x 1,600W titanium PSU

System Under Test (SUT)

Software

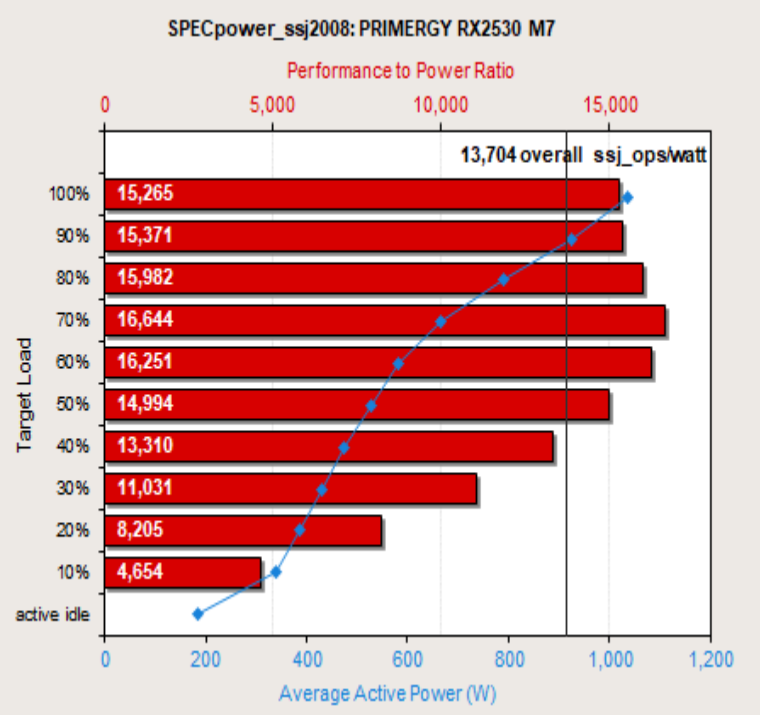
• BIOS settings	**When using Xeon Platinum 8490H processors** ASPM Support = Auto Hardware Prefetcher = Disabled Adjacent Cache Line Prefetch = Disabled DCU Streamer Prefetcher = Disabled Intel(R) VT-d = Disabled Package C State limit = No limit Uncore Frequency Scaling = Power balanced CPU Performance Boost = Aggressive SNC(Sub NUMA) = Enable SNC4 SATA Controller = Disabled USB Port Control = Disable all ports Serial Port = Disabled Network Stack = Disabled **When using Xeon Platinum 8592+ processors** DCU Streamer Prefetcher = Disabled Optimized Power Mode = Enabled Uncore Frequency Scaling = Power balanced SNC(Sub NUMA) = Enable SNC2 Serial Port = Disabled
• Operating system	Windows Server 2022 Standard
• Operating system settings	Turn off hard disk after = 1 Minute PCI Express Link State Power Management = Maximum power savings Minimum processor state = 0% Maximum processor state = 100% (When using Xeon Platinum 8490H processors) Turn off display after = 1 Minute POWERCFG /SETACVALUEINDEX SCHEME_CURRENT SUB_PROCESSOR PERFBOOSTMODE 4 POWERCFG /SETACVALUEINDEX SCHEME_CURRENT SUB_PROCESSOR PERFINCTHRESHOLD 90 POWERCFG /SETACVALUEINDEX SCHEME_CURRENT SUB_PROCESSOR PERFDECTHRESHOLD 80 POWERCFG /SETACVALUEINDEX SCHEME_CURRENT SUB_PROCESSOR PERFDECTIME 1 POWERCFG /SETACVALUEINDEX SCHEME_CURRENT SUB_PROCESSOR IDLESCALING 1 POWERCFG /S SCHEME_CURRENT 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	**When using Xeon Platinum 8490H processors** Oracle Java HotSpot(TM) 64-Bit Server VM 18.9 (build 11.0.16.1+1-LTS, mixed mode) **When using Xeon Platinum 8592+ processors** OpenJDK 64-Bit Server VM Temurin-17.0.9+9 (build 17.0.9+9, mixed mode, sharing)
• JVM settings	**When using Xeon Platinum 8490H processors** -server -Xmn1500m -Xms1625m -Xmx1625m -XX:+UseLargePages -XX:AllocatePrefetchDistance=256 -XX:AllocatePrefetchLines=4 -XX:InlineSmallCode=3900 -XX:MaxInlineSize=270 -XX:MaxTenuringThreshold=15 -XX:ParallelGCThreads=2 -XX:SurvivorRatio=1 -XX:TargetSurvivorRatio=99 -XX:-UseAdaptiveSizePolicy -XX:+UseParallelOldGC -XX:FreqInlineSize=2500 -XX:LoopUnrollLimit=45 -XX:InitialTenuringThreshold=12 -XX:-ThreadLocalHandshakes -XX:UseAVX=0 **When using Xeon Platinum 8592+ processors** -server -Xmn1900m -Xms2048m -Xmx2048m -XX:LargePageSizeInBytes=2m -XX:+UseLargePages -XX:InlineSmallCode=1500 -XX:UseAVX=1 -XX:+AggressiveHeap -XX:ParallelGCThreads=2 -XX:+UseParallelGC -XX:+UseBiasedLocking -XX:AutoBoxCacheMax=20000 -XX:+OptimizeFill

PRIMERGY RX2530 M7

Benchmark results (Xeon Platinum 8490H)

The PRIMERGY RX2530 M7 in Microsoft Windows Server 2022 Standard achieved the following result:

SPECpower_ssj2008 = 13,704 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 13,704 overall ssj_ops/watt for the PRIMERGY RX2530 M7. 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.

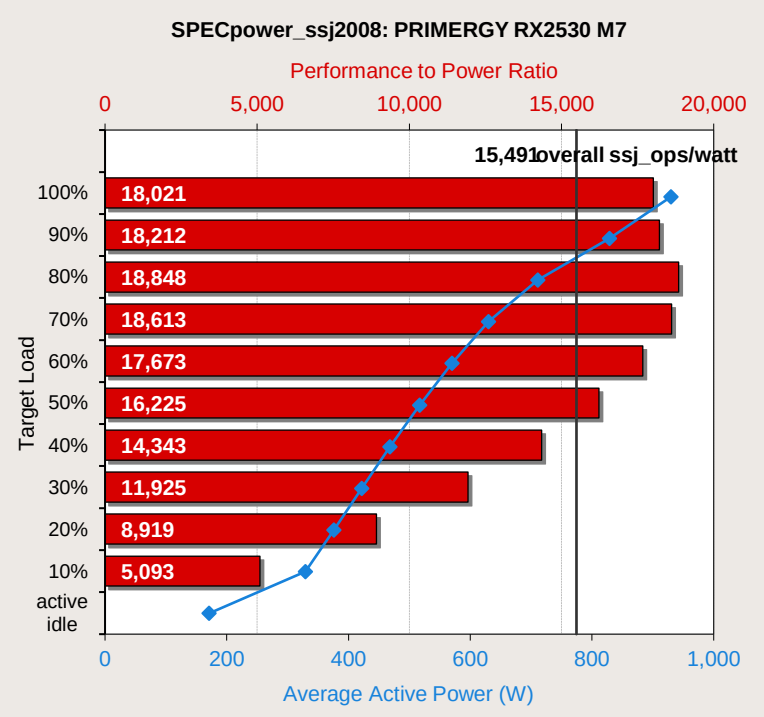
The following table shows the benchmark results for the throughput in ssj_ops, the power consumption in watts and the resulting energy efficiency for each load level.

Performance		Power	Energy Efficiency
Target Load	ssj_ops	Average Power (W)	ssj_ops/watt
100%	15,820,662	1,036	15,265
90%	14,236,661	926	15,371
80%	12,635,148	791	15,982
70%	11,066,053	665	16,644
60%	9,478,897	583	16,251
50%	7,900,421	527	14,994
40%	6,324,823	475	13,310
30%	4,735,725	429	11,031
20%	3,166,440	386	8,205
10%	1,583,224	340	4,654
Active Idle	0	186	0
			Σ ssj_ops / Σ power = 13,704

Benchmark results (Xeon Platinum 8592+)

The PRIMERGY RX2530 M7 in Microsoft Windows Server 2022 Standard achieved the following result:

SPECpower_ssj2008 = 15,491 overall ssj_ops/watt



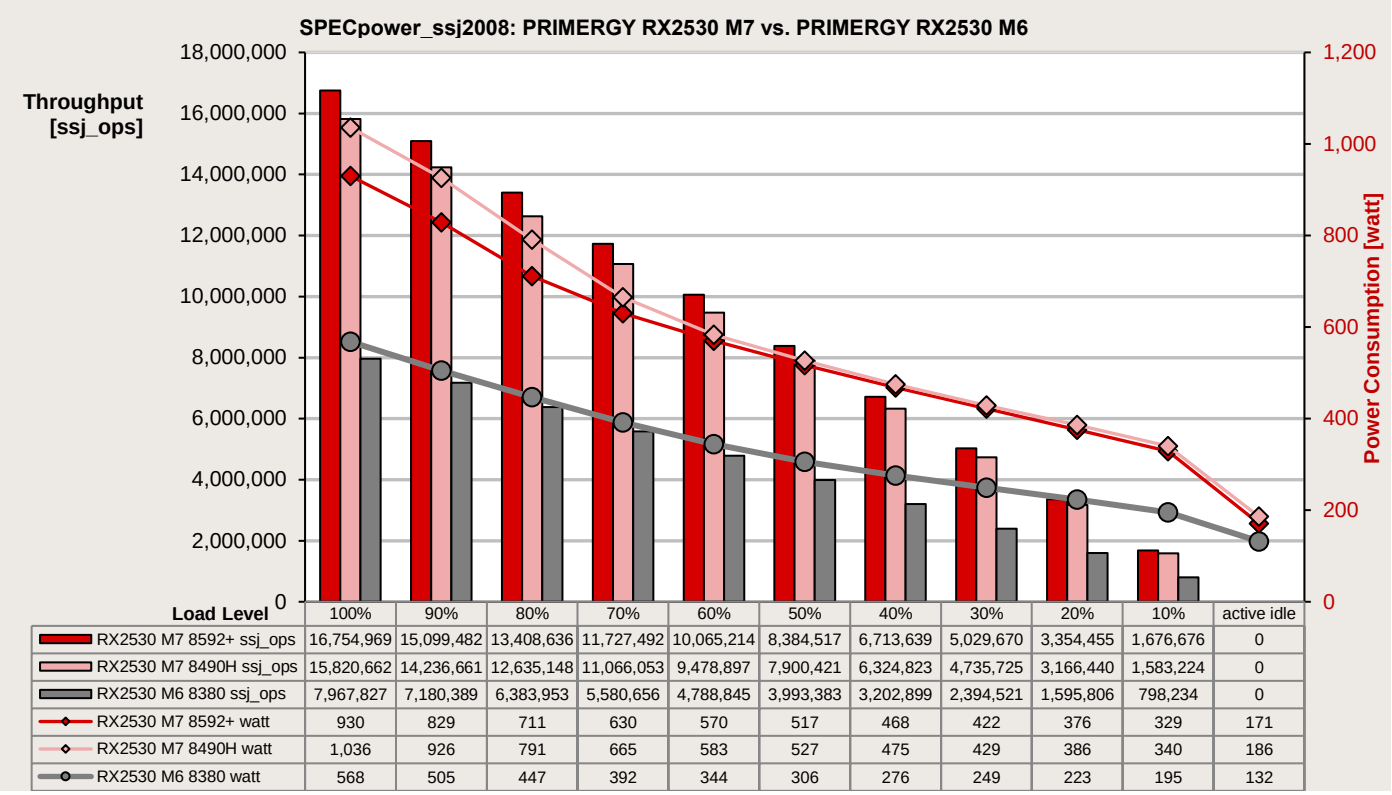
The adjoining diagram shows the result of the configuration described above. The red horizontal bars show the performance to power ratio in ssj_ops/watt (upper x-axis) for each target load level tagged on the y-axis of the diagram. The blue line shows the run of the curve for the average power consumption (bottom x-axis) at each target load level marked with a small rhomb. The black vertical line shows the benchmark result of 15,491 overall ssj_ops/watt for the PRIMERGY RX2530 M7. 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%	16,754,969	930	18,021
90%	15,099,482	829	18,212
80%	13,408,636	711	18,848
70%	11,727,492	630	18,613
60%	10,065,214	570	17,673
50%	8,384,517	517	16,225
40%	6,713,639	468	14,343
30%	5,029,670	422	11,925
20%	3,354,455	376	8,919
10%	1,676,676	329	5,093
Active Idle	0	171	0
			Σ ssj_ops / Σ power = 15,491

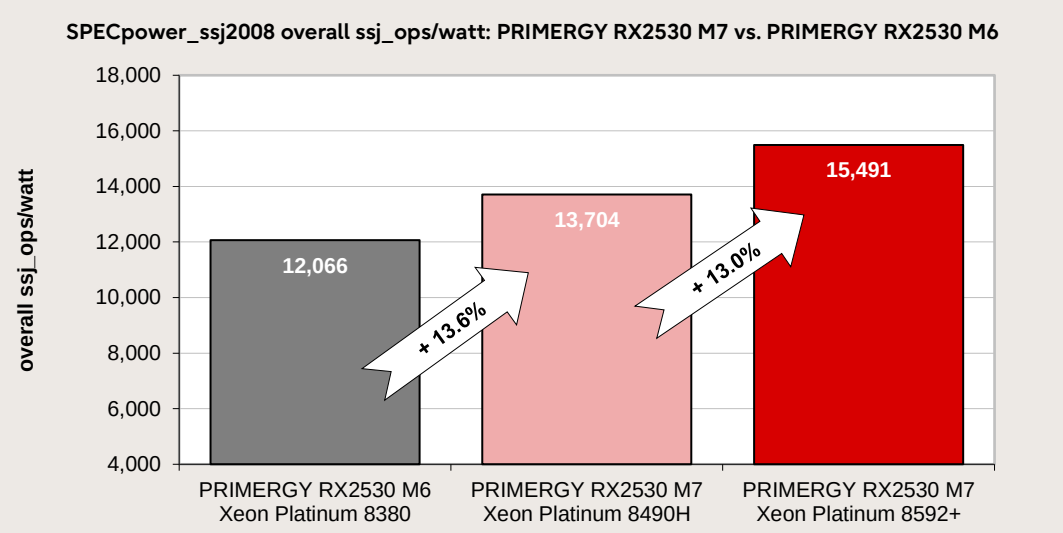
Comparison with the predecessor

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 M7 compared to the predecessor PRIMERGY RX2530 M6.



Load Level	100%	90%	80%	70%	60%	50%	40%	30%	20%	10%	active idle
RX2530 M7 8592+ ssj_ops	16,754,969	15,099,482	13,408,636	11,727,492	10,065,214	8,384,517	6,713,639	5,029,670	3,354,455	1,676,676	0
RX2530 M7 8490H ssj_ops	15,820,662	14,236,661	12,635,148	11,066,053	9,478,897	7,900,421	6,324,823	4,735,725	3,166,440	1,583,224	0
RX2530 M6 8380 ssj_ops	7,967,827	7,180,389	6,383,953	5,580,656	4,788,845	3,993,383	3,202,899	2,394,521	1,595,806	798,234	0
RX2530 M7 8592+ watt	930	829	711	630	570	517	468	422	376	329	171
RX2530 M7 8490H watt	1,036	926	791	665	583	527	475	429	386	340	186
RX2530 M6 8380 watt	568	505	447	392	344	306	276	249	223	195	132

The energy efficiency of the PRIMERGY RX2530 M7 with the Xeon Platinum 8490H is improved by 13.6% compared to the PRIMERGY RX2530 M6. Furthermore, the energy efficiency of the PRIMERGY RX2530 M7 with the Xeon Platinum 8592+ is improved by 13.0% compared to the Xeon Platinum 8490H.

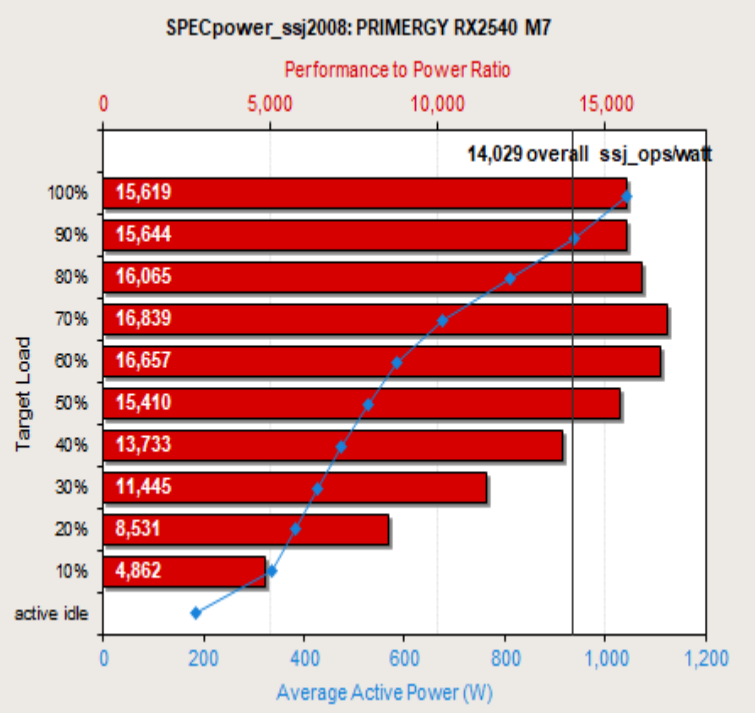


PRIMERGY RX2540 M7

Benchmark results (Xeon Platinum 8490H)

The PRIMERGY RX2540 M7 in Microsoft Windows Server 2022 Standard achieved the following result:

SPECpower_ssj2008 = 14,029 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 14,029 overall ssj_ops/watt for the PRIMERGY RX2540 M7. 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.

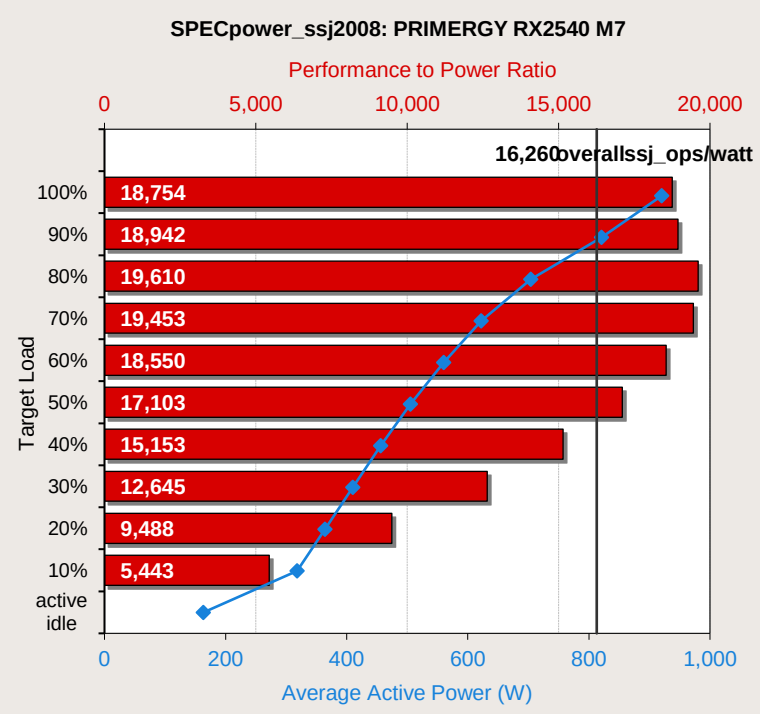
The following table shows the benchmark results for the throughput in ssj_ops, the power consumption in watts and the resulting energy efficiency for each load level.

Performance		Power	Energy Efficiency
Target Load	ssj_ops	Average Power (W)	ssj_ops/watt
100%	16,290,837	1,043	15,619
90%	14,659,192	937	15,644
80%	13,016,390	810	16,065
70%	11,400,544	677	16,839
60%	9,768,180	586	16,657
50%	8,142,534	528	15,410
40%	6,512,849	474	13,733
30%	4,882,953	427	11,445
20%	3,258,335	382	8,531
10%	1,630,320	335	4,862
Active Idle	0	184	0
			Σssj_ops / Σpower = 14,029

Benchmark results (Xeon Platinum 8592+)

The PRIMERGY RX2540 M7 in Microsoft Windows Server 2022 Standard achieved the following result:

SPECpower_ssj2008 = 16,260 overall ssj_ops/watt



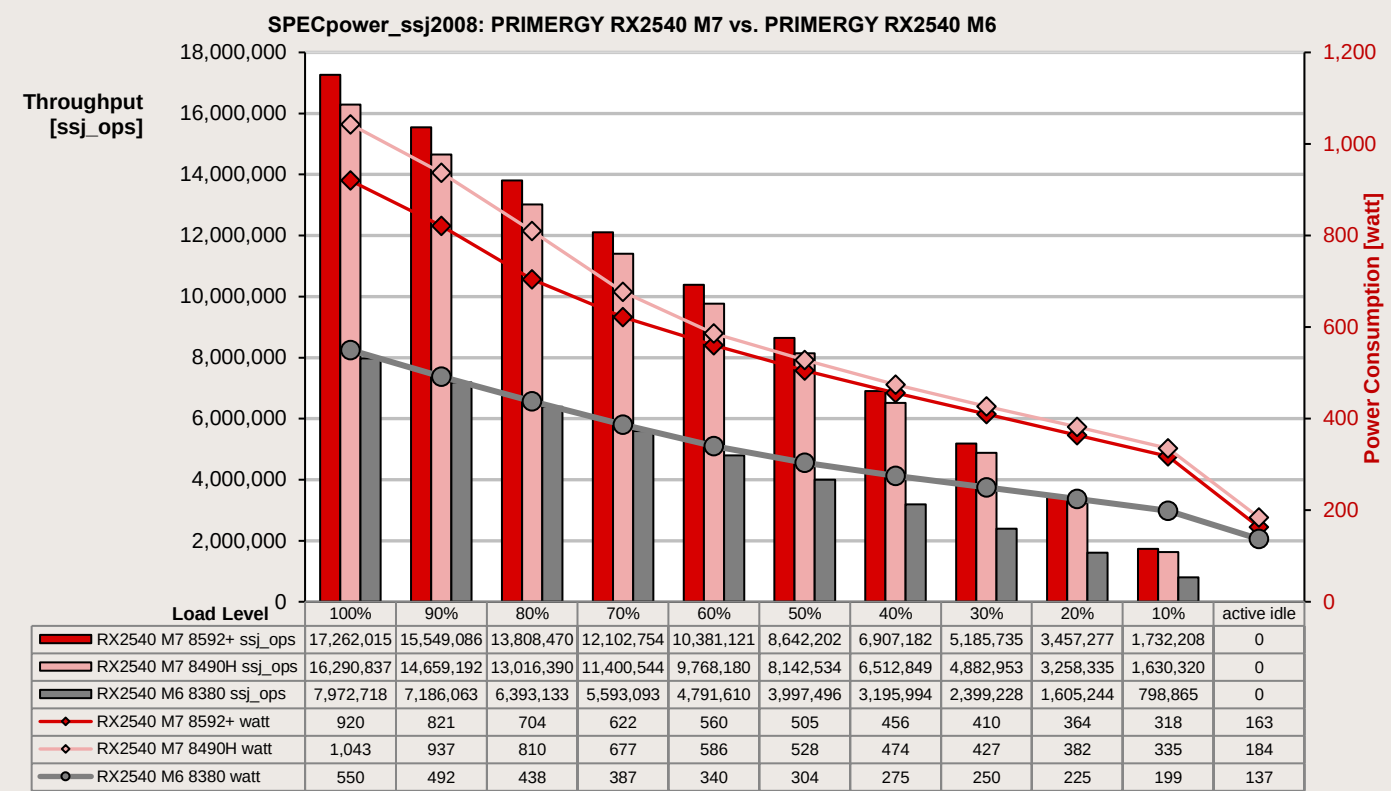
The adjoining diagram shows the result of the configuration described above. The red horizontal bars show the performance to power ratio in ssj_ops/watt (upper x-axis) for each target load level tagged on the y-axis of the diagram. The blue line shows the run of the curve for the average power consumption (bottom x-axis) at each target load level marked with a small rhomb. The black vertical line shows the benchmark result of 16,260 overall ssj_ops/watt for the PRIMERGY RX2540 M7. 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%	17,262,015	920	18,754
90%	15,549,086	821	18,942
80%	13,808,470	704	19,610
70%	12,102,754	622	19,453
60%	10,381,121	560	18,550
50%	8,642,202	505	17,103
40%	6,907,182	456	15,153
30%	5,185,735	410	12,645
20%	3,457,277	364	9,488
10%	1,732,208	318	5,443
Active Idle	0	163	0
			Σssj_ops / Σpower = 16,260

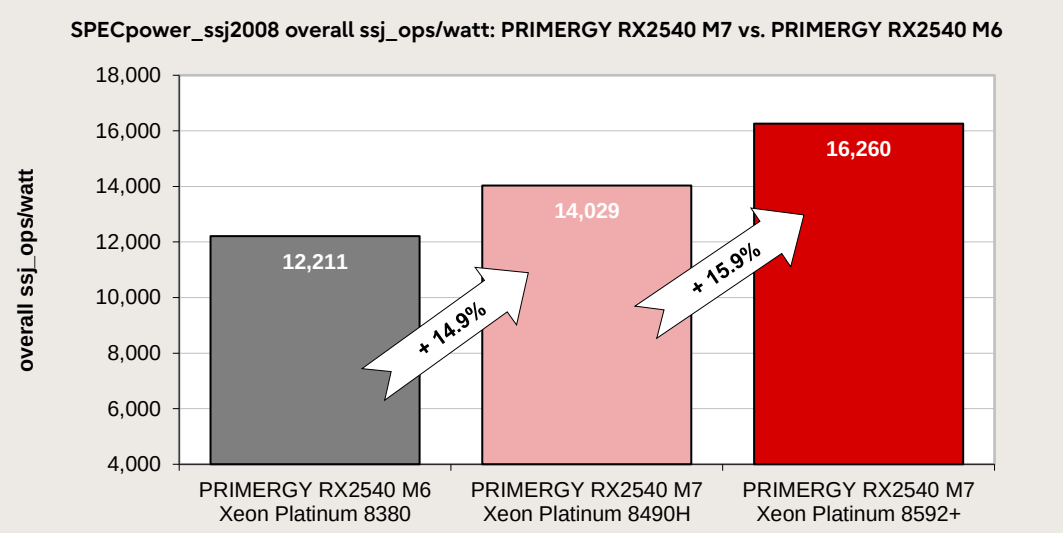
Comparison with the predecessor

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 RX2540 M7 compared to the predecessor PRIMERGY RX2540 M6.



Load Level	100%	90%	80%	70%	60%	50%	40%	30%	20%	10%	active idle
RX2540 M7 8592+ ssj_ops	17,262,015	15,549,086	13,808,470	12,102,754	10,381,121	8,642,202	6,907,182	5,185,735	3,457,277	1,732,208	0
RX2540 M7 8490H ssj_ops	16,290,837	14,659,192	13,016,390	11,400,544	9,768,180	8,142,534	6,512,849	4,882,953	3,258,335	1,630,320	0
RX2540 M6 8380 ssj_ops	7,972,718	7,186,063	6,393,133	5,593,093	4,791,610	3,997,496	3,195,994	2,399,228	1,605,244	798,865	0
RX2540 M7 8592+ watt	920	821	704	622	560	505	456	410	364	318	163
RX2540 M7 8490H watt	1,043	937	810	677	586	528	474	427	382	335	184
RX2540 M6 8380 watt	550	492	438	387	340	304	275	250	225	199	137

The energy efficiency of the PRIMERGY RX2540 M7 with the Xeon Platinum 8490H is improved by 14.9% compared to the PRIMERGY RX2540 M6. Furthermore, the energy efficiency of the PRIMERGY RX2540 M7 with the Xeon Platinum 8592+ is improved by 15.9% compared to the Xeon Platinum 8490H.



SAP Sales and Distribution (SD) Standard Application Benchmark

Description of the benchmark

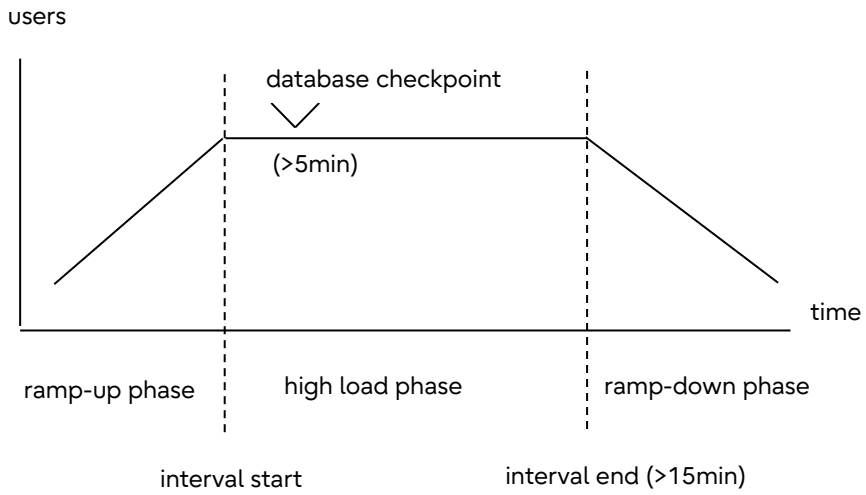
Since 1993 the SAP Standard Application Benchmarks have been developed by SAP in order to verify the performance, stability and scaling of a SAP application system and to provide information for configuring, sizing and for platform comparison. By far the most popular benchmarks from the many available are the SAP SD benchmark and the BW Edition for SAP HANA benchmark (see corresponding section).

The Sales and Distribution benchmark is one of the most CPU consuming benchmarks available and has become a de-facto standard for SAP's platform partners and in the ERP (Enterprise Resource Planning) environment.

During the benchmark a defined sequence of business transactions are run through as shown in the table below. The Sales and Distribution (SD) benchmark covers a sell-from-stock scenario (including a customer order creation, the corresponding delivery with subsequent goods movement and creation of the invoice) and consists of the following SAP transactions:

Create an order with five line items (SAP transaction VA01)
Create a delivery for this order (SAP transaction VL01N)
Display the customer order (SAP transaction VA03)
Change the delivery (SAP transaction VL02N) and post goods issue
List 40 orders for one sold-to party (SAP transaction VA05)
Create an invoice (SAP transaction VF01)

Each of the simulated users repeats this series of transactions from the start to the end of a benchmark run. The think time between two user actions is 10 seconds. During the so-called ramp-up phase the number of concurrently working users is increased until the expected limit is reached. When all users are active, the test interval starts. This performance level must be maintained for at least 15 minutes (benchmark rule). After at least 5 minutes of the high load phase one or more database checkpoints must be enforced (i.e. all log file data is flushed back to the database within the high load phase) or the amount of created dirty blocks must be written to disk for at least 5 minutes to stress the I/O subsystem in a realistic way (benchmark rule). At the end of the high load phase users are gradually taken off the system until none is active. When the test concludes, all relevant data (some are gathered with a SAP developed Operating System monitor) are then transferred to the presentation server for further evaluation.

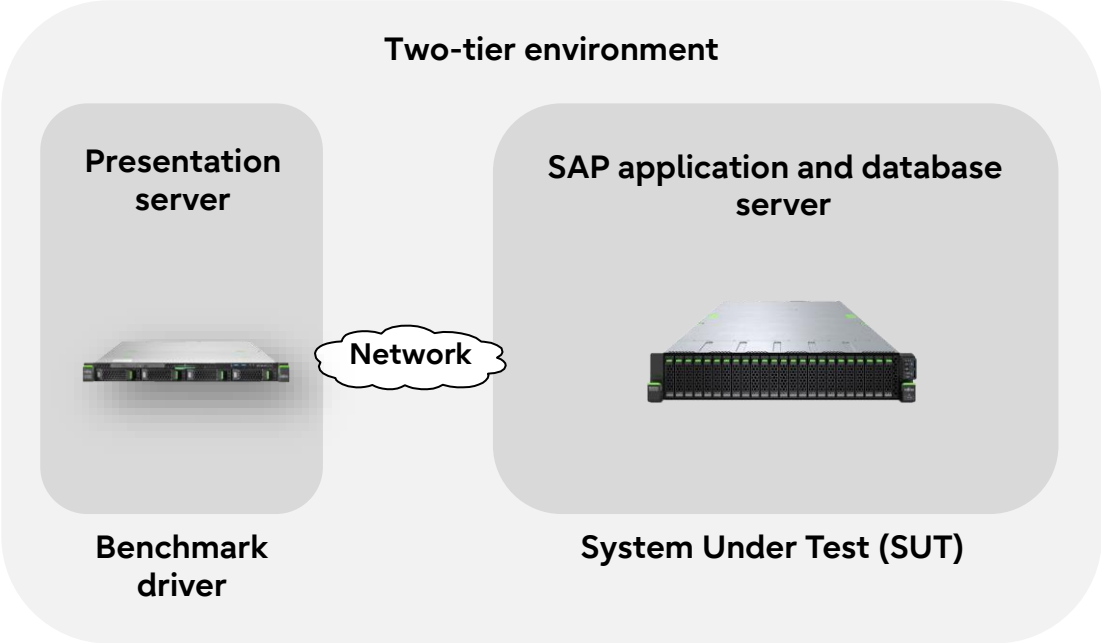


A benchmark can only be certified if the average dialog response time is less than 1 second. Certified and published SAP SD Benchmarks are published on SAP's benchmark site here.

Benchmark environment

The benchmark differentiates between a two-tier and a three-tier configuration. The two-tier configuration has the SAP application and database installed on one server. With a three-tier configuration the individual components of the SAP application can be distributed via several servers and an additional server handles the database. The SD benchmark users are simulated by the presentation server aka benchmark driver.

Two SAP SD Benchmarks were performed on PRIMERGY RX2540 M7 with 4th Gen Intel Xeon Processors, the first on Windows Server 2019, the second on SUSE Linux Enterprise Server 15, both on a two-tier configuration.



System Under Test (SUT) I: 4th Gen Intel Xeon with Windows Server 2019	
Hardware	
• Model	PRIMERGY RX2540 M7
• Processor	2 x Xeon Platinum 8490H 60C 1.9GHz 350W
• Memory	16 x 64GB (1x64GB) 2Rx4 DDR5-4800 R ECC
• Network interface	1Gbit/s (RJ45) on Motherboard
• Storage subsystem	3 x PCIe-SSD 2.5" Mixed Use 3.2TB Kioxia CM6-V
Software	
• Operating system	Windows Server 2019
• Database	Microsoft SQL Server 2019
• SAP Business Suite Software	SAP enhancement package 5 for SAP ERP 6.0

System Under Test (SUT) II: 4th Gen Intel Xeon with SUSE Linux Enterprise Server 15

Hardware

• Model	PRIMERGY RX2540 M7
• Processor	2 x Xeon Platinum 8490H 60C 1.9GHz 350W
• Memory	16 x 128GB (1x128GB) 4Rx4 DDR5-4800 R ECC
• Network interface	1Gbit/s (RJ45) on Motherboard
• Storage subsystem	3 x PCIe-SSD 2.5" Mixed Use 3.2TB Kioxia CM6-V

Software

• Operating system	SUSE Linux Enterprise Server 15
• Database	SAP ASE 16
• SAP Business Suite Software	SAP enhancement package 5 for SAP ERP 6.0

Benchmark Driver

Hardware

• Model	PRIMERGY RX2530 M1
• Processor	2 x Xeon E5-2699v3 18C/36T 2.30GHz 45MB 9.6GT/s 2133MHz 145W
• Memory	236 GB
• Network interface	1Gbit/s (RJ45) on Motherboard

Software

• Operating System	SUSE Linux Enterprise Server 12 SP2

Benchmark results

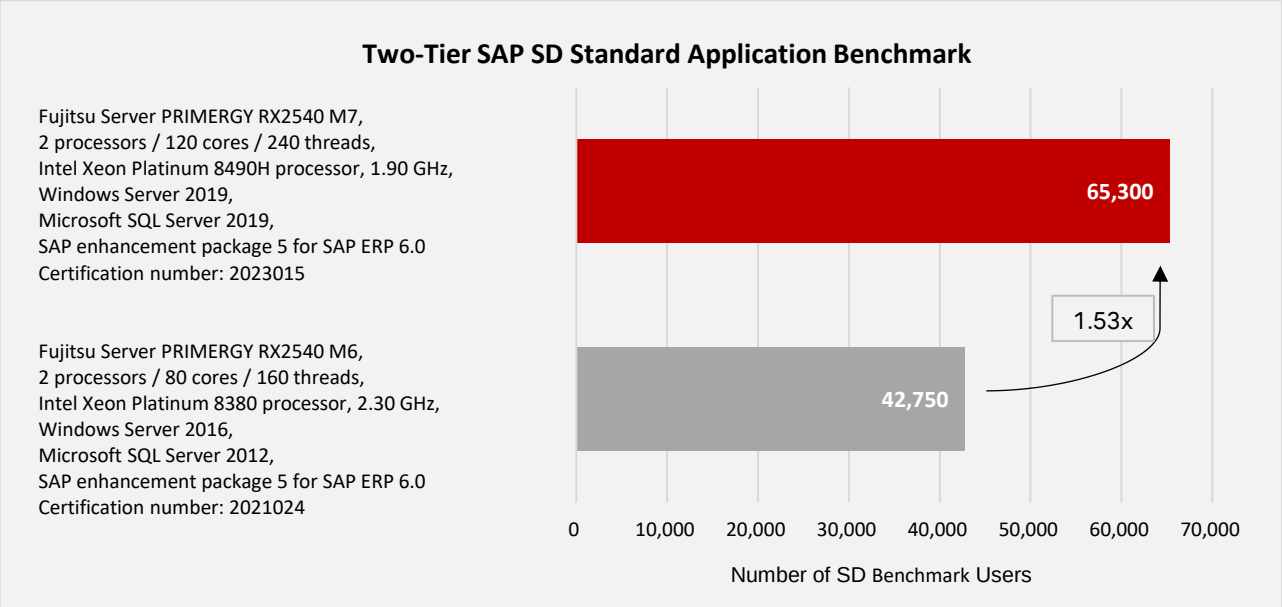
Two SAP SD Benchmark were performed on PRIMERGY RX2540 M7, the first on Windows Server 2019, the second on SUSE Linux Enterprise Server 15, both on a two-tier configuration.

SAP SD Benchmark on 4th Gen Intel Xeon with Windows Server 2019 (SUT I)

On March 09, 2023, the following SAP Sales and Distribution (SD) Standard Application Benchmark was certified:

Certification number 2023015	
• Number of SAP SD benchmark users	65,300
• Average dialog response time	0.99 seconds
• Throughput Fully processed order line items/hour Dialog steps/hour SAPS	 7,130,670 21,392,000 356,530
• Average database request time (dialog/update)	0.010 sec / 0.011 sec
• CPU utilization of central server	97%
• Operating system, central server	Windows Server 2019
• RDBMS	Microsoft SQL Server 2019
• SAP Business Suite software	SAP enhancement package 5 for SAP ERP 6.0
• Configuration Central Server	Fujitsu Server PRIMERGY RX2540 M7, 2 processors / 120 cores / 240 threads, Intel Xeon Platinum 8490H processor, 1.90 GHz, 80 KB L1 cache and 2,048 KB L2 cache per core, 112.5 MB L3 cache per processor, 1,024 GB main memory

The following chart compares the two-tier SAP SD Standard Application Benchmarks on Windows for PRIMERGY RX2540 M7 and its predecessor RX2540 M6, shown are the number of SD benchmark users.



Compared to its predecessor RX2540 M6 with 3rd Gen Intel Xeon Processors 8380, the 4th Gen Intel Xeon Processors 8490H achieve factor 1.53 more SD benchmark users.

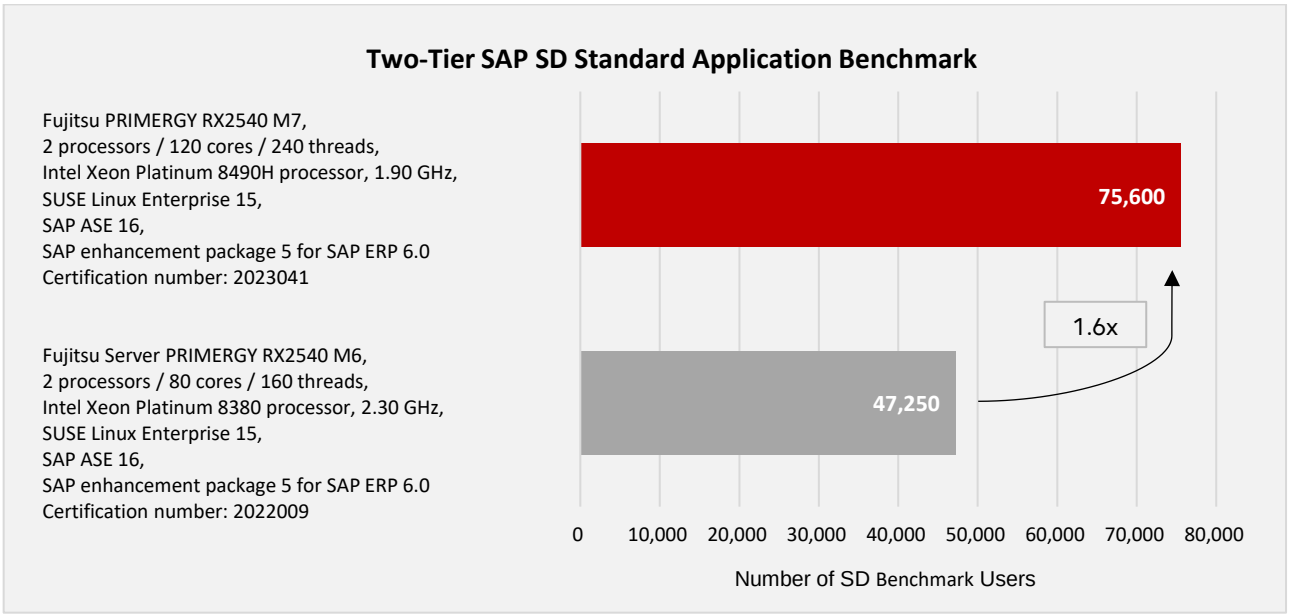
The SAP SD Benchmark certificates can be found here: Certification 2023015, Certification 2021024.

SAP SD Benchmark on 4th Gen Intel Xeon with SUSE Linux Enterprise Server 15 (SUT II)

On September 14, 2023, the following SAP Sales and Distribution (SD) Standard Application Benchmark was certified:

Certification number 2023041	
• Number of SAP SD benchmark users	75,600
• Average dialog response time	0.97 seconds
• Throughput Fully processed order line items/hour Dialog steps/hour SAPS	 8,269,000 24,807,000 413,450
• Average database request time (dialog/update)	0.010 sec / 0.012 sec
• CPU utilization of central server	95%
• Operating system, central server	SUSE Linux Enterprise Server 15
• RDBMS	SAP ASE 16
• SAP Business Suite software	SAP enhancement package 5 for SAP ERP 6.0
• Configuration Central Server	Fujitsu PRIMERGY RX2540 M7, 2 processors / 120 cores / 240 threads, Intel Xeon Platinum 8490H processor, 1.90 GHz, 80 KB L1 cache and 2,048 KB L2 cache per core, 112.5 MB L3 cache per processor, 2,048 GB main memory

The following chart compares the two-tier SAP SD Standard Application Benchmarks on Linux for PRIMERGY RX2540 M7 and its predecessor RX2540 M6, shown are the number of SD benchmark users.



The 4th Generation Xeon Scalable Processor Family (aka Sapphire Rapids) based RX2540 M7 with Intel Xeon Platinum 8490H delivers an improvement of 1.6x compared to the previous 3rd Generation Xeon Scalable Family (aka Ice Lake) based RX2540 M6 with Intel Xeon Platinum 8380 processor.

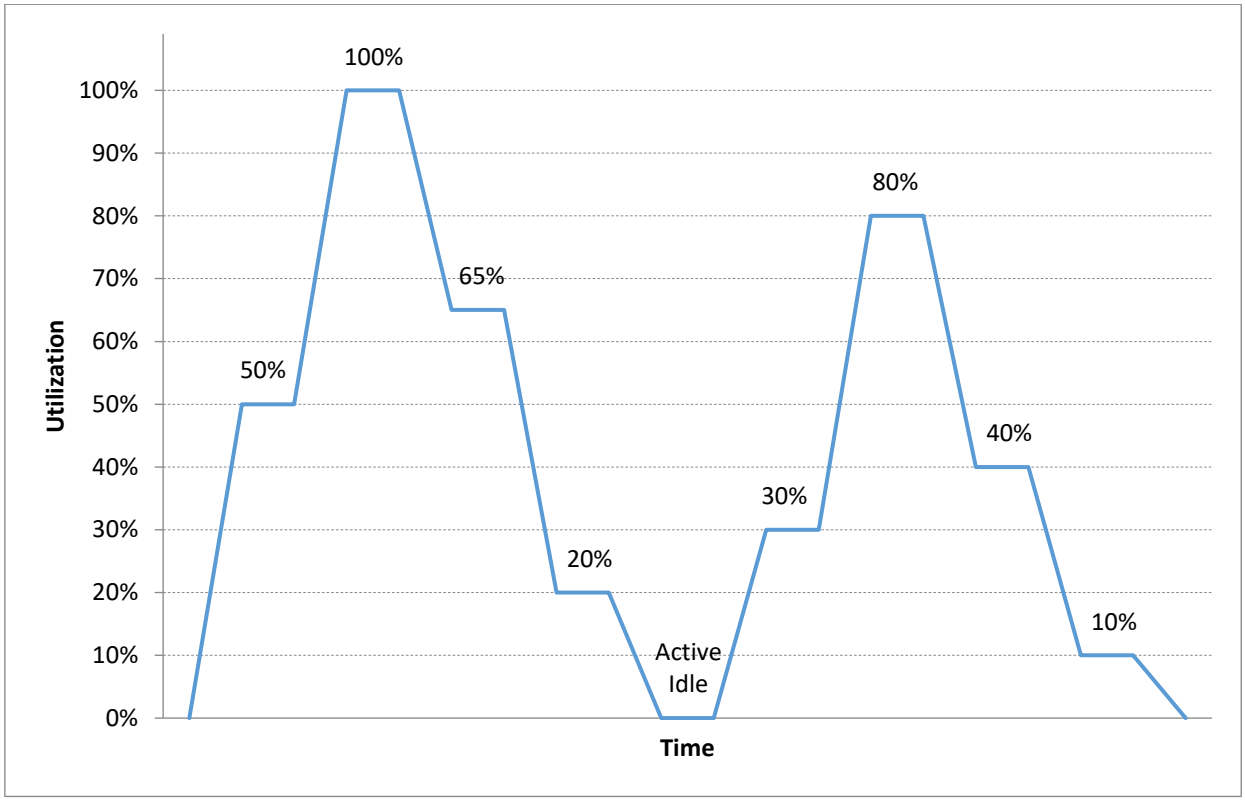
The SAP SD Benchmark certificates can be found here: Certification 2023041, Certification 2022009.

SAP Server Power Standard Application Benchmark

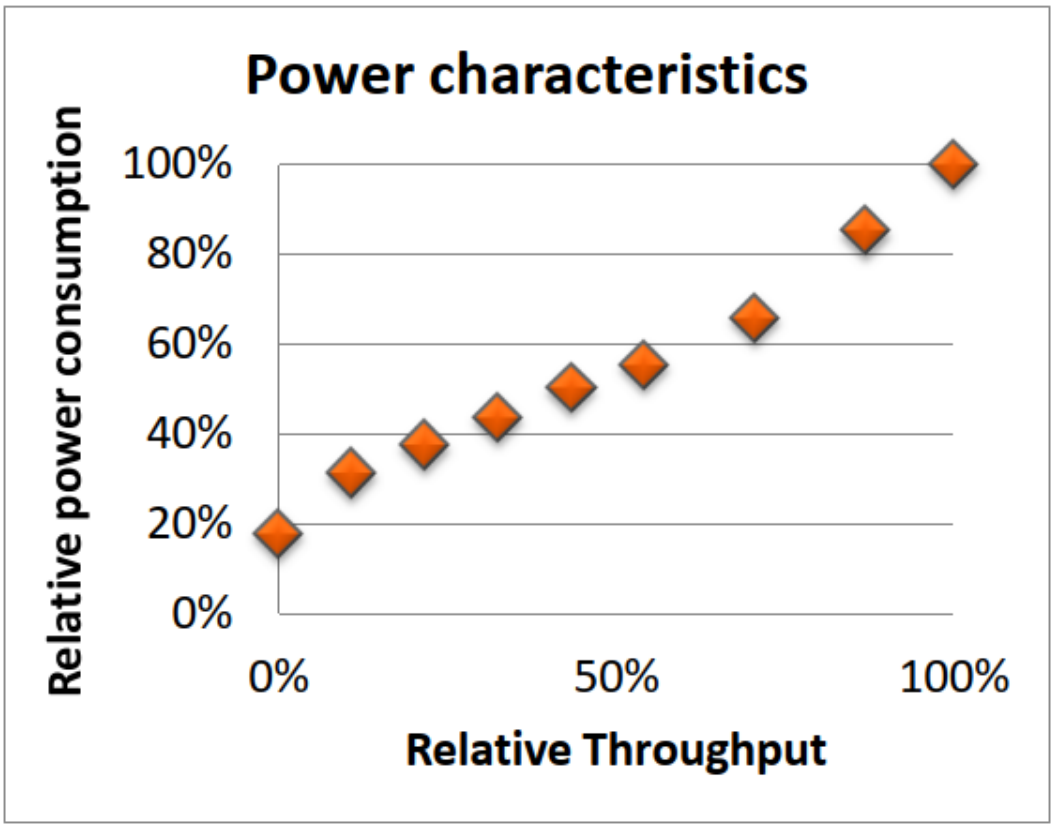
Description of the benchmark

The SAP Server Power Benchmark is based on the SAP Sales & Distribution (SD) benchmark and load profile. The load profile is performed in several load levels. In contrast to the classic SD measurement with only one measurement interval and maximum CPU utilization, the Server Power Benchmark has nine measurement intervals with load levels between Active Idle and 100% (maximum CPU utilization). The diagram below shows these load levels and in particular their sequence. The horizontal sections are the actual measurement intervals. During these phases the QoS (Quality of Service) requirements of the SD benchmark have to be fulfilled - especially the requirement for the average response time per dialog step to be less than one second. As with the SD benchmark, the same requirement of at least 15 minutes also applies for the length of the measurement interval. Between the horizontal phases the number of simulated users is adapted to the required load level in each case.

For the various load levels power measurements with a power meter are conducted.



Servers have sophisticated mechanisms for the regulation of power consumption subject to utilization. A particularly effective example is the reduction in CPU frequency at low utilization. The load level methodology in the benchmarks for energy efficiency aims to test the quality of these mechanisms. The second diagram below is taken from the certificate of the SAP Server Power Benchmark on the RX2540 M7 with 2 x Xeon Platinum 8592+ and shows the large range in power consumption between Active Idle and full load.



For the sake of completeness it should be mentioned that - apart from power consumption - room temperature is also continuously measured in the vicinity of the measuring configuration during the measurement and may at no point in time be below 20° C. The fan-driven server cooling, which is incorporated in the energy budget, should take place under realistic data center conditions.

The main metric, which is denoted as the Power Efficiency Indicator, is watts/kSAPS. This metric puts power consumption and performance into relation to each other. Performance is expressed by the SAPS throughput measurement. k stands for kilos (1,000). The main metric says how much energy (watts) is needed for the set work quantum of 1,000 SAPS - the lower the value, the better.

The efficiency metric of watts/kSAPS reveals little about which absolute performance level of the servers measured is reached. This is why the arithmetic mean of the nine SAPS values obtained is specified as the second metric: average throughput over all load levels in SAPS.

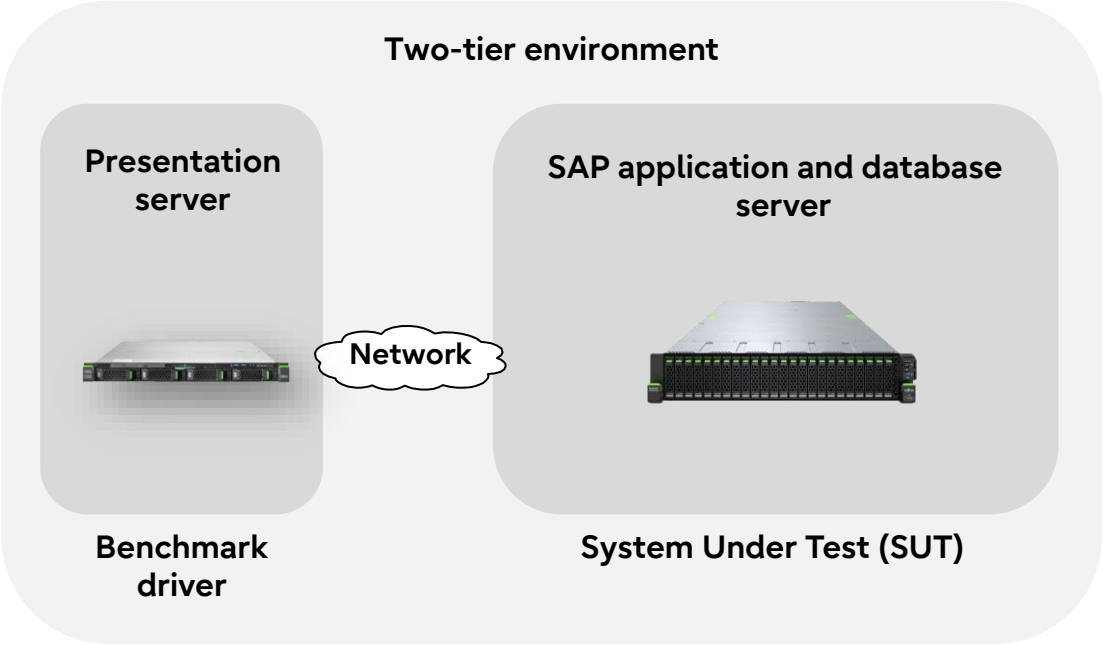
The SAPS metric is the only performance measure that is specified. The number of respectively configured benchmark users is not mentioned. In this way, the SAP Server Power Benchmark is clearly separated from the SD benchmark, for which the number of users is the primary metric. It does not make sense to compare SAP Server Power measurements and classic publications with the SD benchmark, because the respective goals of maximum energy efficiency and maximum performance are different. Likewise, the secondary SAPS metric of the SD benchmark cannot be compared with the SAPS metric of the power benchmark, because the latter is a mean value taken from nine load levels and the former is a simple value under maximum load.

The minimum room temperature obtained during the measurement is specified as the third metric on the certificate.

Benchmark environment

The benchmark differentiates between a two-tier and a three-tier configuration. The two-tier configuration has the SAP application and database installed on one server. With a three-tier configuration the individual components of the SAP application can be distributed via several servers and an additional server handles the database. The SD benchmark users are simulated by the presentation server aka benchmark driver.

Two SAP Server Power Benchmarks were performed on PRIMERGY RX2540 M7, one with 4th Gen Intel Xeon Processors, one with 5th Gen Intel Xeon Processors, both on a two-tier configuration.



System Under Test (SUT) I: 4th Gen Intel Xeon	
Hardware	
• Model	PRIMERGY RX2540 M7
• Processor	2 x Xeon Platinum 8490H 60C 1.9GHz 350W
• Memory	32 x 64GB (1x64GB) 2Rx4 DDR5-4800 R ECC
• Network interface	1Gbit/s (RJ45) on Motherboard
• Storage subsystem	1 x PCIe-SSD 2.5" Mixed Use 6.4TB Kioxia
• Power supply	2 x 1600W titanium PSU
Software	
• Operating system	SUSE Linux Enterprise Server 15
• Database	SAP ASE 16
• SAP Business Suite Software	SAP enhancement package 5 for SAP ERP 6.0

System Under Test (SUT) II: 5th Gen Intel Xeon

Hardware

• Model	PRIMERGY RX2540 M7
• Processor	2 x Xeon Platinum 8592+ 64C 1.9GHz 350W
• Memory	16 x 128GB DDR5-5600 R 3DS ECC
• Network interface	1Gbit/s (RJ45) on Motherboard
• Storage subsystem	1 x PCIe-SSD 2.5" Mixed Use 6.4TB Kioxia
• Power supply	2 x 1600W titanium PSU

Software

• Operating system	SUSE Linux Enterprise Server 15
• Database	SAP ASE 16
• SAP Business Suite Software	SAP enhancement package 5 for SAP ERP 6.0

Benchmark Driver

Hardware

• Model	PRIMERGY RX2530 M2
• Processor	2 x Xeon E5-2699v4 22C/44T 2.20GHz 55MB 9.6GT/s 2400MHz 145W
• Memory	256 GB
• Network interface	1Gbit/s (RJ45) on Motherboard

Software

• Operating System	SUSE Linux Enterprise Server 12 SP2

Benchmark results

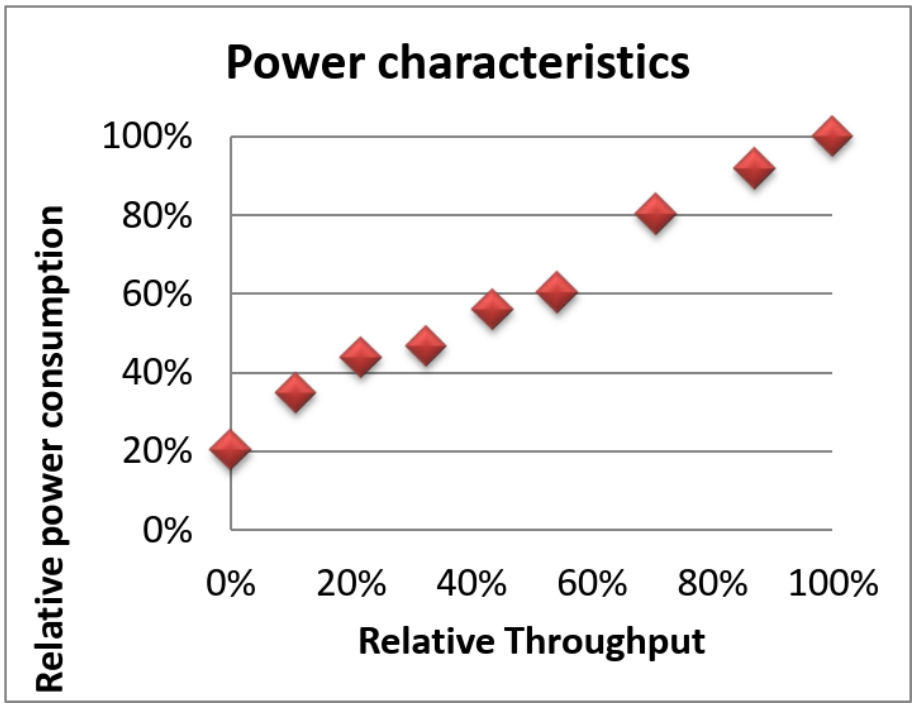
Two SAP Server Power Benchmarks where performed on PRIMERGY RX2540 M7, the first on SUT I with 4th Gen Intel Xeon Processors 8490H, the second on SUT II with 5th Gen Intel Xeon Processors 8592+.

SAP Server Power Standard Application Benchmark on 4th Gen Intel Processors

On November 21, 2023, the following SAP Server Power Standard Application Benchmark was certified:

Certification number 2023071	
• Power Efficiency Indicator – Server (watts/kSAPS)	3.89
• Average throughput over all load levels (SAPS)	180,730
• Minimum ambient temperature (degrees Celsius)	21.5
• Operating system, central server	SUSE Linux Enterprise Server 15
• RDBMS	SAP ASE 16
• SAP Business Suite software	SAP enhancement package 5 for SAP ERP 6.0
• Configuration Central Server	Fujitsu PRIMERGY RX2540 M7, 2 processors / 120 cores / 240 threads, Intel Xeon Platinum 8490H processor, 1.90 GHz, 80 KB L1 cache and 2,048 KB L2 cache per core, 112.5 MB L3 cache per processor, 2,024 GB main memory, 2 x 1600W S26113-E652-V60-1 Titanium, 1 x SSD PCIe4

The following diagram shows the range in power consumption between Active Idle and full load:



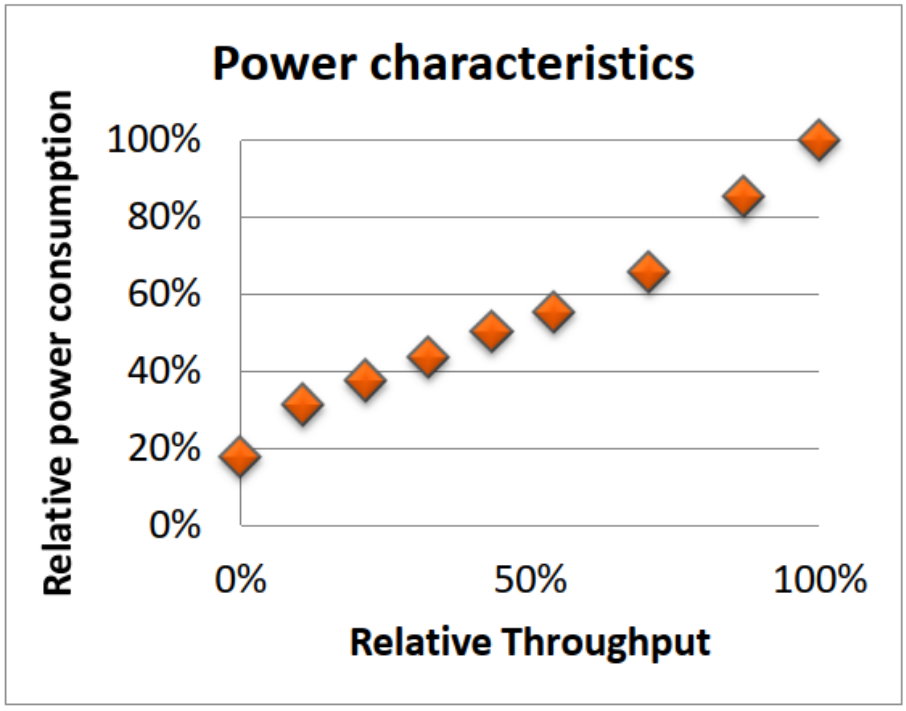
The SAP Server Power Benchmark certificate can be found here: Certification 2023071 .

SAP Server Power Standard Application Benchmark on 5th Gen Intel Processors

On June 10, 2024, the following SAP Server Power Standard Application Benchmark was certified:

Certification number 2024043	
• Power Efficiency Indicator – Server (watts/kSAPS)	2.95
• Average throughput over all load levels (SAPS)	211,940
• Minimum ambient temperature (degrees Celsius)	21.2
• Operating system, central server	SUSE Linux Enterprise Server 15
• RDBMS	SAP ASE 16
• SAP Business Suite software	SAP enhancement package 5 for SAP ERP 6.0
• Configuration Central Server	Fujitsu PRIMERGY RX2540 M7, 2 processors / 128 cores / 256 threads, Intel Xeon Platinum 8592+ processor, 1.90 GHz, 80 KB L1 cache and 2,048 KB L2 cache per core, 320 MB L3 cache per processor, 2,024 GB main memory, 2 x 1600W S26113-E652-V60-1 Titanium, 1 x SSD PCIe4

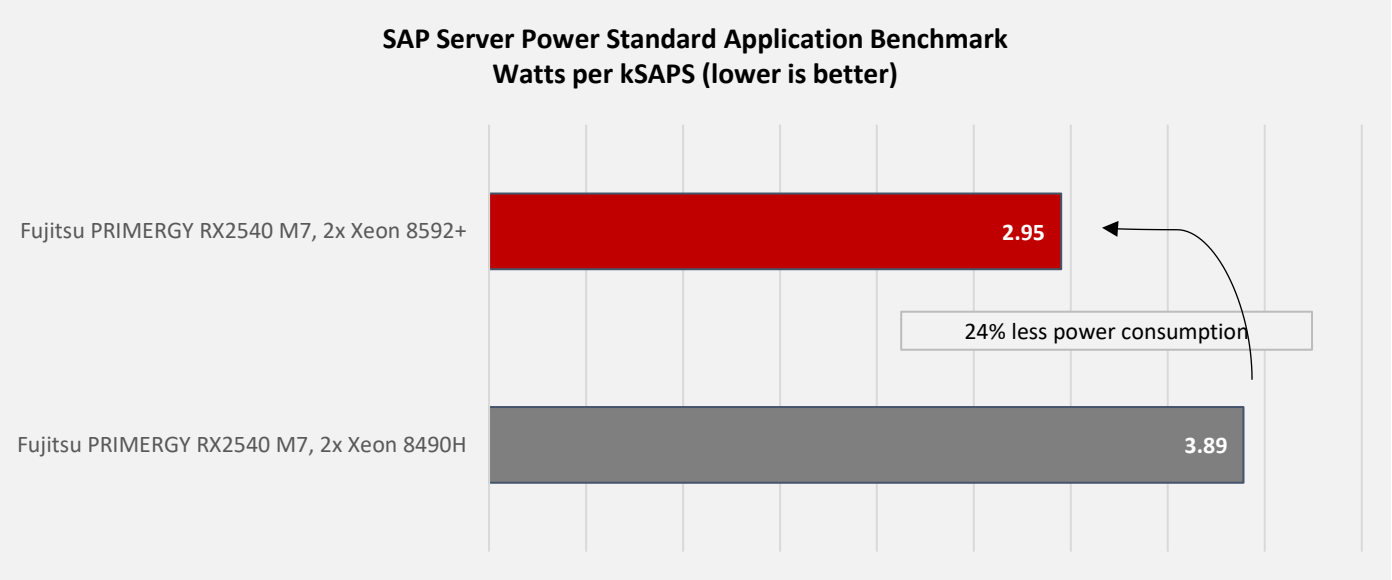
The following diagram shows the range in power consumption between Active Idle and full load:



The SAP Server Power Benchmark certificate can be found here: Certification 2024043 .

Comparison of the SAP Server Power Standard Application Benchmark results

The following chart compares the SAP Server Power Standard Application Benchmark for RX2540 M7 with the 5th Gen Intel Processors 8592+ to the RX2540 M7 with the previous 4th Gen Intel Processors 8490H.



SAP BW Edition for SAP HANA Standard Application Benchmark

Description of the benchmark

With the increasing importance of SAP HANA and in particular SAP Business Warehouse (SAP BW) on HANA, a new benchmark was introduced in July 2016: the SAP BW Edition for SAP HANA Standard Application Benchmark, referred to as SAP BWH Benchmark in the following.

The benchmark represents a typical mid-size customer scenario and volumes and utilizes the new capabilities of SAP HANA which enable customers to enhance their BW processes.

Since its first edition in 2016, the SAP BWH Benchmark has been further developed and adapted to customer requirements. In the meantime, SAP BWH Benchmark version 3 is available. Benchmarks with the older versions won't be certified anymore. The results of different versions must not be compared with each other.

The SAP BWH Benchmark consists of 3 phases:

- Data load phase
- Query throughput phase
- Query runtime phase

Data load phase

The data flow starts with a data load from the source object into the corporate memory layer. The source object is shipped with the backup.

The source object contains 1.3 billion records (= 1 data set). It is possible to load this data set of 1.3 billion records multiple times.

The data set stored in the source is fetched and propagated through the different layers in 25 load cycles. In other words, 1 load cycle processes 1/25 of the data set.

The permissible data volumes are a multiple of 1.3 billion initial data records. The minimum number of data sets to be loaded is dependent on the size of the main memory.

The data load phase takes several hours and is a combination of CPU- and IO-intensive load. When several HANA nodes are used (see "SAP HANA Scale-up and Scale-out Configuration Architecture" below), significant network load is generated.

Query throughput phase

The queries for the throughput phase must be executed via an ABAP program with a variant containing 380 queries. Users execute the set of navigation steps in random order (via asynchronous RFCs). The queries contain typical query patterns which can be found in BW productive systems of customers.

The query throughput phase runs one hour and is CPU bound. In a HANA multi-node environment, also significant network load is generated.

Query runtime phase

For the query runtime phase the same ABAP program as for the throughput phase is used with a different variant. The variant contains 10 queries which are executed sequentially. These queries are used to measure the runtime. They contain complex query patterns which are executed in BW productive systems of customers, but which are typically not executed by many users in parallel but selectively by some power users. Therefore, they are executed sequentially.

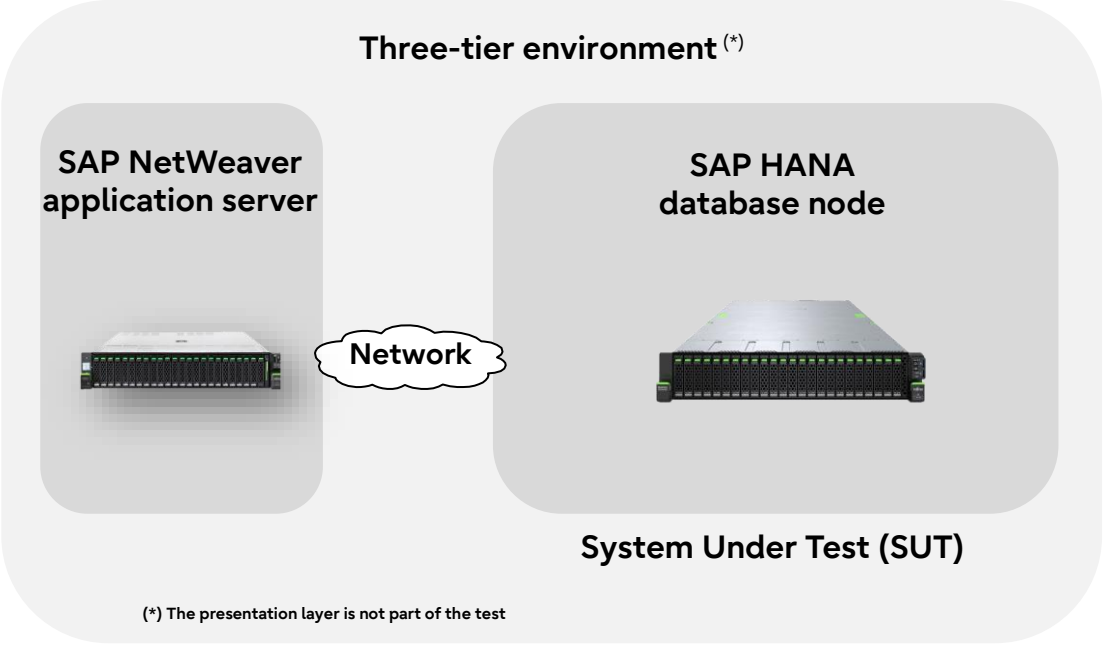
The query runtime phase takes a short time and generates a small load. Only a few processors cores are used, single thread performance is important for short runtimes.

Certified and published SAP BWH Benchmarks are published on SAP's benchmark site here.

Benchmark environment

In general, a single database node or multiple database nodes can be used for SAP benchmarks to scale the workload. In the context of SAP HANA and particularly the SAP BW Edition for SAP HANA Standard Application Benchmark it is referred to as a scale-up configuration in the case of a single database node and a scale-out configuration in the case of multi database nodes.

The SAP BWH Benchmarks for PRIMERGY RX2540 M7 were performed on 4th and 5th Gen Intel Xeon Processors, all on a scale-up configuration.



Although an application server is involved in the benchmark, neither performance metrics are measured nor does the server appear on the benchmark certificate.

System Under Test (SUT) I: 4th Gen Intel Xeon	
Hardware	
• Model	PRIMERGY RX2540 M7
• Processor	2 x Xeon Platinum 8480+ 56C 2.0GHz 350W
• Memory	32 x 64GB (1x64GB) 2Rx4 DDR5-4800 R ECC
• Network interface	1Gbit/s (RJ45) on Motherboard
• Storage subsystem	3 x PCIe-SSD 2.5" Mixed Use 3.2TB Kioxia
Software	
• Operating system	SUSE Linux Enterprise Server 15
• Database	SAP HANA 2.0

Application Server

Hardware

• Model	PRIMERGY RX2540 M5
• Processor	2 x Xeon Platinum 8280L 28C 2.7GHz 205W
• Memory	12 x 64GB (1x64GB) 2Rx4 DDR4-2933 R ECC
• Storage subsystem	2 x HDD SAS 2.5" 15K 600GB, 3 x SSD 1.5TB 1 x PACC EP P4800X AIC PCIe-SSD 750GB 1 x PRAID EP420i RAID Controller
• Network interface	1Gbit/s (RJ45) on Motherboard

Software

• Operating System	SUSE Linux Enterprise Server 15
• Technology platform release	SAP Netweaver 7.50

System Under Test (SUT) II: 5th Gen Intel Xeon

Hardware

• Model	PRIMERGY RX2540 M7
• Processor	2 x Xeon Platinum 8592+ 64C 1.9GHz 350W
• Memory	16 x 128GB DDR5-5600 R 3DS ECC
• Network interface	1Gbit/s (RJ45) on Motherboard
• Storage subsystem	5 x PCIe-SSD 2.5" Mixed Use 3.2TB Kioxia

Software

• Operating system	SUSE Linux Enterprise Server 15
• Database	SAP HANA 2.0

Application Server

Hardware

• Model	PRIMERGY RX2540 M7
• Processor	2 x Xeon Platinum 8490H 60C 1.9GHz 350W
• Memory	32 x 64GB (1x64GB) 2Rx4 DDR5-4800 R ECC
• Storage subsystem	1 x PCIe-SSD 2.5" Mixed Use 6.4TB Kioxia
• Network interface	1Gbit/s (RJ45) on Motherboard

Software

• Operating System	SUSE Linux Enterprise Server 15
• Technology platform release	SAP Netweaver 7.50

Benchmark results

Three SAP BWH Benchmarks were performed on PRIMERGY RX2540 M7, the first with 2.6 billion records, the second with 3.9 billion records, both on SUT I with 4th Gen Intel Xeon Processors 8480+. The third with 2.6 billion records on SUT II with 5th Gen Intel Xeon Processors 8592+ .

2.6 Billion Records Scenario on 4th Gen Intel Processors

On January 10, 2023, the following SAP BW edition for SAP HANA Standard Application Benchmark Version 3 was certified:

Certification number 2023001	
• Benchmark Phase 1 Number of initial records Runtime of last Data Set (seconds)	 2,600,000 8,750
• Benchmark Phase 2 Query Executions per Hour CPU utilization of database server	 11,560 99%
• Benchmark Phase 3 Total Runtime of complex query phase (seconds)	78
• Operating system	SUSE Linux Enterprise Server 15
• Database	SAP HANA 2.0
• Technology platform release	SAP Netweaver 7.50
• Configuration Database Server	Fujitsu Server PRIMERGY RX2540 M7, 2 processors / 112 cores / 224 threads, Intel Xeon Platinum 8480+ processor, 2.00 GHz, 80 KB L1 cache and 2,048 KB L2 cache per core, 105 MB L3 cache per processor, 2,048 GB DRAM

The benchmark was published along with Intel's launch of the 4th Generation Xeon Scalable Family processors, aka Sapphire Rapids SP and set an overall world record (as of 2023-01-10) on the SAP BW Edition for SAP HANA Standard Application Benchmark Version 3 in the 2.6 billion initial records category.

The SAP BWH Benchmark certificate can be found here: Certification 2023001.

3.9 Billion Records Scenario on 4th Gen Intel Processors

On January 20, 2023, the following SAP BW edition for SAP HANA Standard Application Benchmark Version 3 was certified:

Certification number 2023006	
• Benchmark Phase 1 Number of initial records Runtime of last Data Set (seconds)	 3,900,000 9,500
• Benchmark Phase 2 Query Executions per Hour CPU utilization of database server	 9,251 99%
• Benchmark Phase 3 Total Runtime of complex query phase (seconds)	84
• Operating system	SUSE Linux Enterprise Server 15
• Database	SAP HANA 2.0
• Technology platform release	SAP Netweaver 7.50
• Configuration Database Server	Fujitsu Server PRIMERGY RX2540 M7, 2 processors / 112 cores / 224 threads, Intel Xeon Platinum 8480+ processor, 2.00 GHz, 80 KB L1 cache and 2,048 KB L2 cache per core, 105 MB L3 cache per processor, 2,048 GB DRAM

Shortly after the first SAP BW Edition for SAP HANA Benchmark world record with 2.6 billion records, PRIMERGY RX2540 M7 set a second overall world record (as of 2023-01-20) on the SAP BW Edition for SAP HANA Standard Application Benchmark Version 3 in the 3.9 billion initial records category.

The SAP BWH Benchmark certificate can be found here: Certification 2023006.

2.6 Billion Records Scenario on 5th Gen Intel Processors

On March 6, 2024, the following SAP BW edition for SAP HANA Standard Application Benchmark Version 3 was certified:

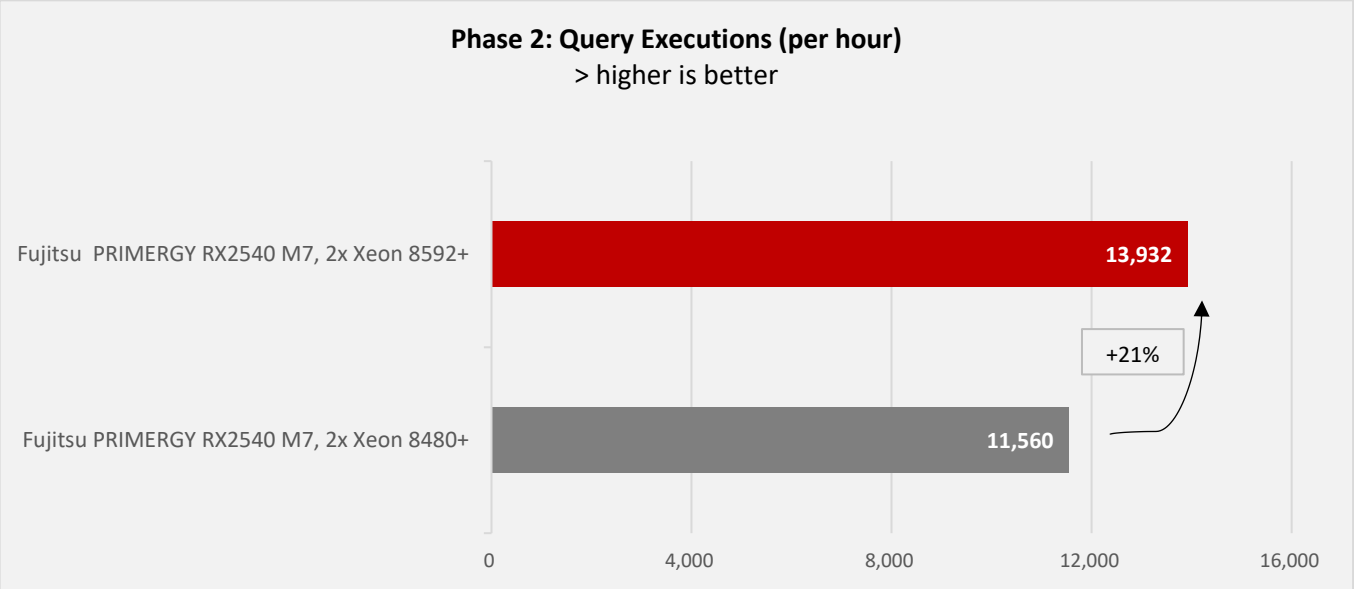
Certification number 2024013	
• Benchmark Phase 1 Number of initial records Runtime of last Data Set (seconds)	 2,600,000 6,985
• Benchmark Phase 2 Query Executions per Hour CPU utilization of database server	 13,932 96%
• Benchmark Phase 3 Total Runtime of complex query phase (seconds)	62
• Operating system	SUSE Linux Enterprise Server 15
• Database	SAP HANA 2.0
• Technology platform release	SAP Netweaver 7.50
• Configuration Database Server	Fujitsu PRIMERGY RX2540 M7, 2 processors / 128 cores / 256 threads, Intel Xeon Platinum 8592+ processor, 1.90 GHz, 80 KB L1 cache and 2,048 KB L2 cache per core, 320 MB L3 cache per processor, 2,048 GB DRAM

PRIMERGY RX2540 M7 configured with 5th Gen Intel Xeon Processors, aka Emerald Rapids, set again a new overall world record on the SAP BW Edition for SAP HANA Standard Application Benchmark Version 3 with 2.6 billion initial records (as of 2024-03-06).

The SAP BWH Benchmark certificate can be found here: Certification 2024013.

Comparison of the 2.6 Billion Records Scenario on 4th and 5th Gen Intel Processors

The query throughput phase is CPU bound and therefore best to compare generations.



PRIMERGY RX2540 M7 with 2 x Xeon 8592+ (Emerald Rapids) achieves 21% more query executions per hour, compared to RX2540 M7 with 2 x Xeon 8480+ (Sapphire Rapids), the previous 4th Gen Intel Xeon Processors.

Disk I/O: Performance of storage media

Benchmark description

Performance measurements of disk subsystems for PRIMERGY servers 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 as follows.

- Random access / sequential access ratio
- Read / write access ratio
- Block size (kiB)
- Queue Depth (number of IO requests to issue at one time)

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 Queue Depth 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 measurement items are as follows.

- Throughput [MiB/s] Throughput in megabytes per second
- Transactions [IO/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 following formula.

Data throughput [MiB/s]	*= Transaction rate [IO/s] x Block size [MiB]*
Transaction rate [IO/s]	*= Data throughput [MiB/s] / Block size [MiB]*

In this section, a power of 10 (1 TB = 10^{12} bytes) is used to indicate the capacity of the hard storage medium, and a power of 2 (1 MiB / s = 2^{20} bytes) is used to indicate the capacity of other media, file size, block size, and throughput.

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."

Controller

PRIMERGY server can use the following controllers.

Controller name	Cache	Supported interfaces			RAID levels
		host	drive	port	
PSAS CP600i	-	PCIe 4.0 x8	SATA 6G SAS 12G	16	-
PSAS CP 2100-8i	-	PCIe 3.0 x8	SATA 6G SAS 12G	8	0, 1, 10, 5
PSAS CP 2200-16i	-	PCIe 4.0 x8	SATA 6G SAS 24G	16	0, 1, 10, 5
			PCIe 4.0 x4	4	
PRAID CP500i	-	PCIe 3.1 x8	SATA 6G SAS 12G	8	0, 1, 10, 5, 50
PRAID EP520i	2GB	PCIe 3.0 x8	SATA 6G SAS 12G	8	0, 1, 1E, 10, 5, 50, 6, 60
PRAID EP540i	4GB	PCIe 3.0 x8	SATA 6G SAS 12G	16	0, 1, 1E, 10, 5, 50, 6, 60
PRAID EP580i	8GB	PCIe 3.0 x8	SATA 6G SAS 12G	16	0, 1, 1E, 10, 5, 50, 6, 60
PRAID EP640i	4GB	PCIe 4.0 x8	SATA 6G SAS 12G	8	0, 1, 1E, 10, 5, 50, 6, 60
PRAID EP680i	8GB	PCIe 4.0 x8	SATA 6G SAS 12G	16	0, 1, 1E, 10, 5, 50, 6, 60
			PCIe 4.0 x4	4	
PRAID EP 3252-8i	2GB	PCIe 4.0 x8	SATA 6G SAS 24G	8	0, 1, 10, 5, 50, 6, 60
PRAID EP 3254-8i	4GB	PCIe 4.0 x8	SATA 6G SAS 24G	8	0, 1, 10, 5, 50, 6, 60
PRAID EP 3258-16i	8GB	PCIe 4.0 x8	SATA 6G SAS 24G	16	0, 1, 10, 5, 50, 6, 60
			PCIe 4.0 x4	4	
Retimer card for 2.5" NVMe SSD	-	PCIe 5.0 x16	PCIe 5.0 x4	4	-
M.2 Riser Kit	-	DMI 3.0 x4	SATA 6G	2	-
			PCIe 3.0 x2	2	
PDUAL CP300	-	PCIe 4.0 x8	SATA 6G	2	0, 1
			PCIe 4.0 x4	2	

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(*1)	HDD	SAS 12G	3.5 inch
		SATA 6G	3.5 inch
	SSD	SAS 12G / SAS 24G	2.5 inch(*2)
		SATA 6G	2.5 inch(*2)
2.5 inch model	HDD	SAS 12G	2.5 inch
	SSD	SAS 12G / SAS 24G	2.5 inch
		SATA 6G	2.5 inch
		PCIe 4.0 / PCIe 5.0	2.5 inch
model common	SSD	SATA 6G	M.2
		PCIe 4.0	M.2

*(*1) Upgrade kit of Rear 2.5 inch bay enables you to use 2.5 inch model storage.*

*(*2) 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 system board is typically PCIe or, in the case of the integrated onboard controllers, an internal bus interface of the system board.

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 Manager" 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.

Benchmark environment

The following hardware and software components were used for benchmarking.

Hardware

3.5 inch model

Storage media	Category	Drive name
HDD	SAS HDD (SAS 12Gbps, 10k rpm) [512e]	AL15SEB18EQ AL15SEB24EQ
	SAS HDD (SAS 12Gbps, 10k rpm) [512n]	AL15SEB030N AL15SEB060N AL15SEB120N
	NL-SAS HDD (SAS 12Gbps, 7.2k rpm) [512e]	ST12000NM004J ST14000NM004J ST16000NM004J ST18000NM004J ST20000NM002D
	BC-SATA HDD (SATA 6Gbps, 7.2k rpm) [512e]	ST12000NM000J ST14000NM000J ST16000NM000J ST18000NM000J
	BC-SATA HDD (SATA 6Gbps, 7.2k rpm) [512n]	ST1000NM000A ST2000NM000B ST4000NM000B

Storage media	Category	Drive name
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)	MTFDDAK480TGB MTFDDAK960TGB MTFDDAK1T9TGB MTFDDAK3T8TGB
	SATA SSD (SATA 6Gbps, Read Intensive)	MTFDDAK240TGA MTFDDAK480TGA MTFDDAK960TGA MTFDDAK1T9TGA MTFDDAK3T8TGA MTFDDAK7T6TGA
	SAS SSD (SAS 24Gbps, Write Intensive)	PM7800G10DN PM71T6010DN
	SAS SSD (SAS 24Gbps, Mixed Use)	PM71T6003DN PM73T2003DN PM76T4003DN
	SAS SSD (SAS 24Gbps, Read Intensive)	PM71T9201DN PM73T8401DN PM77T6801DN PM715T301DN

2.5 inch model

Storage media	Category	Drive name
HDD	SAS HDD (SAS 12Gbps, 10k rpm) [512e]	AL15SEB18EQ AL15SEB24EQ
	SAS HDD (SAS 12Gbps, 10k rpm) [512n]	AL15SEB030N AL15SEB060N AL15SEB120N

Storage media	Category	Drive name
SSD	SAS SSD (SAS 12Gbps, Write Intensive)	XS400ME70084 XS800ME70084 XS1600ME70084
	SAS SSD (SAS 12Gbps, Mixed Use)	XS800LE70084 XS1600LE70084 XS3200LE70084 XS6400LE70084
	SAS SSD (SAS 12Gbps, Read Intensive)	XS960SE70084 XS1920SE70084 XS3840SE70084 XS7680SE70084 XS15360SE70084
	SATA SSD (SATA 6Gbps, Mixed Use)	MTFDDAK480TGB MTFDDAK960TGB MTFDDAK1T9TGB MTFDDAK3T8TGB
	SATA SSD (SATA 6Gbps, Read Intensive)	MTFDDAK240TGA MTFDDAK480TGA MTFDDAK960TGA MTFDDAK1T9TGA MTFDDAK3T8TGA MTFDDAK7T6TGA
	SAS SSD (SAS 24Gbps, Write Intensive)	PM7800G10DN PM71T6010DN
	SAS SSD (SAS 24Gbps, Mixed Use)	PM71T6003DN PM73T2003DN PM76T4003DN
	SAS SSD (SAS 24Gbps, Read Intensive)	PM71T9201DN PM73T8401DN PM77T6801DN PM715T301DN

Storage media	Category	Drive name
SSD	PCIe 4.0 SSD (Write Intensive)	SSDPF21Q400GB SSDPF21Q800GB SSDPF21Q016TB
	PCIe 5.0 SSD (Mixed Use)	KCMY1VUG1T60 KCMY1VUG3T20 KCMY1VUG6T40 KCMY1VUG12T8
	PCIe 5.0 SSD (Read Intensive)	KCMY1RUG1T92 KCMY1RUG3T84 KCMY1RUG7T68 KCMY1RUG15T3

Model common

Storage media	Category	Drive name
M.2 SSD	SATA M.2 drive	MTFDDAV240TGA MTFDDAV480TGA MTFDDAV960TGA
	PCIe M.2 drive	MTFDKBA480TFR MTFDKBA960TFR

Software

Operating system	Microsoft Windows Server
Measuring tool	Iometer 1.1.0 (icf: benchmark version 3.0)

Logical drive settings to measure

Target Drive		Type RAID 0 logical drive consisting of 1 drive
Stripe size		HDD : 256KB、SSD : 64 KB
Measurement area	HDD, SSD (Except M.2)	RAW file system is used. The first 32GB of available LBA space is used for sequential access. The following 64GB is used for random access.
	SSD(M.2)	NTFS file system is used. The first 32GB of available LBA space is used for sequential access. The following 64GB is used for random access.
Number of Iometer worker		Sequential Access: 1 Random Access: 1 (except SAS 24G or PCIe 5.0 SSD), 4 (SAS 24G SSD), 16 (PCIe 5.0 SSD)
Alignment of Iometer 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".

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.

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.

Values in rows with "est." are predicted values.

3.5 inch model

HDDs

Capacity [GB]	Storage device	Interface	Transactions [IO/s]			Throughput [MiB/s]	
			Database	Fileserver	Filecopy	Streaming	Restore
☐ SAS 12Gbps HDD 10krpm [512e]							
1,800	AL15SEB18EQ	SAS 12G	767	631	624	255	249
2,400	AL15SEB24EQ	SAS 12G	754	620	617	264	260
☐ SAS 12Gbps HDD 10krpm [512n]							
300	AL15SEB030N	SAS 12G	641	547	557	231	230
600	AL15SEB060N	SAS 12G	682	558	568	232	231
1,200	AL15SEB120N	SAS 12G	732	603	593	230	225
☐ NL-SAS 12Gbps HDD 7.2krpm [512e]							
12,000	ST12000NM004J	SAS 12G	609	578	534	266	266
14,000	ST14000NM004J	SAS 12G	616	589	524	270	269
16,000	ST16000NM004J	SAS 12G	610	586	548	270	270
18,000	ST18000NM004J	SAS 12G	603	578	522	265	262
20,000	ST20000NM002D	SAS 12G	642	593	502	271	271
☐ BC-SATA HDD 7.2krpm [512e]							
12,000	ST12000NM000J	SATA 6G	628	523	508	263	263
14,000	ST14000NM000J	SATA 6G	627	532	529	261	261
16,000	ST16000NM000J	SATA 6G	631	539	500	267	265
18,000	ST18000NM000J	SATA 6G	637	542	534	271	270
☐ BC-SATA HDD 7.2krpm [512n]							
1,000	ST1000NM000A	SATA 6G	328	298	307	194	194
2,000	ST2000NM000B	SATA 6G	415	366	389	197	196
4,000	ST4000NM000B	SATA 6G	468	422	435	236	236

SSDs

Capacity [GB]	Storage device	Interface	Transactions [IO/s]			Throughput [MiB/s]		
			Database	Fileserver	Filecopy	Streaming	Restore	
☐ SAS 12Gbps SSD (WI)								
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	
☐ SAS 12Gbps SSD (MU)								
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	
☐ SAS 12Gbps SSD (RI)								
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	
☐ SATA SSD (MU)								
480	MTFDDAK480TGB	SATA 6G	43,705	5,729	5,839	491	449	
960	MTFDDAK960TGB	SATA 6G	43,732	6,155	6,257	491	449	
1,920	MTFDDAK1T9TGB	SATA 6G	43,735	6,394	6,513	490	449	
3,840	MTFDDAK3T8TGB	SATA 6G	43,415	6,576	6,636	483	446	
☐ SATA SSD (RI)								
240	MTFDDAK240TGA	SATA 6G	41,808	5,120	5,293	480	360	
480	MTFDDAK480TGA	SATA 6G	43,618	5,625	5,761	490	450	
960	MTFDDAK960TGA	SATA 6G	43,631	5,878	6,033	484	449	
1,920	MTFDDAK1T9TGA	SATA 6G	43,688	6,334	6,447	491	450	
3,840	MTFDDAK3T8TGA	SATA 6G	43,392	6,539	6,626	483	445	
7,680	MTFDDAK7T6TGA	SATA 6G	42,940	7,065	7,278	491	446	
☐ SAS 24Gbps SSD (WI)								
800	PM7800G10DN	SAS 12G	168,061	20,678	23,006	1,070	1,076	
		SAS 24G	204,529	25,996	25,095	1,960	1,603	
1,600	PM71T6010DN	SAS 12G	173,094	22,676	26,505	1,070	1,076	
		SAS 24G	208,291	26,190	24,674	1,960	1,319	
☐ SAS 24Gbps SSD (MU)								
1,600	PM71T6003DN	SAS 12G	168,200	20,700	22,800	1,070	1,076	est.
		SAS 24G	204,400	26,000	25,100	1,963	1,603	est.
3,200	PM73T2003DN	SAS 12G	173,000	22,600	26,500	1,070	1,076	est.
		SAS 24G	208,200	26,100	24,600	1,960	1,318	est.
6,400	PM76T4003DN	SAS 12G	171,200	21,400	23,200	1,070	1,076	est.
		SAS 24G	190,700	23,900	22,500	1,963	1,175	est.
☐ SAS 24Gbps SSD (RI)								
1,920	PM71T9201DN	SAS 12G	168,283	20,710	22,880	1,070	1,076	
		SAS 24G	204,491	26,066	25,188	1,963	1,603	
3,840	PM73T8401DN	SAS 12G	173,000	22,600	26,500	1,070	1,076	est.
		SAS 24G	208,200	26,100	24,600	1,960	1,318	est.
7,680	PM77T6801DN	SAS 12G	171,279	21,408	23,284	1,070	1,076	
		SAS 24G	190,784	23,941	22,542	1,963	1,175	
15,360	PM715T301DN	SAS 12G	167,002	20,281	20,643	1,070	1,070	
		SAS 24G	146,385	18,465	17,688	1,963	974	

2.5 inch model

HDDs Connection interface: SAS 12Gbps

Capacity [GB]	Storage device	Interface	Transactions [IO/s]			Throughput [MiB/s]	
			Database	Fileserver	Filecopy	Streaming	Restore
SAS 12Gbps HDD 10krpm [512e]							
1,800	AL15SEB18EQ	SAS 12G	767	631	624	255	249
2,400	AL15SEB24EQ	SAS 12G	754	620	617	264	260
SAS 12Gbps HDD 10krpm [512n]							
300	AL15SEB030N	SAS 12G	641	547	557	231	230
600	AL15SEB060N	SAS 12G	682	558	568	232	231
1,200	AL15SEB120N	SAS 12G	732	603	593	230	225

SSDs

Capacity [GB]	Storage device	Interface	Transactions [IO/s]			Throughput [MiB/s]	
			Database	Fileserver	Filecopy	Streaming	Restore
SAS 12Gbps SSD (WI)							
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
SAS 12Gbps SSD (MU)							
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
6,400	XS6400LE70084	SAS 12G	123,323	23,806	19,444	1,052	881
SAS 12Gbps SSD (RI)							
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
15,360	XS15360SE70084	SAS 12G	123,969	23,749	19,619	1,052	878
SATA SSD (MU)							
480	MTFDDAK480TGB	SATA 6G	43,705	5,729	5,839	491	449
960	MTFDDAK960TGB	SATA 6G	43,732	6,155	6,257	491	449
1,920	MTFDDAK1T9TGB	SATA 6G	43,735	6,394	6,513	490	449
3,840	MTFDDAK3T8TGB	SATA 6G	43,415	6,576	6,636	483	446
SATA SSD (RI)							
240	MTFDDAK240TGA	SATA 6G	41,808	5,120	5,293	480	360
480	MTFDDAK480TGA	SATA 6G	43,618	5,625	5,761	490	450
960	MTFDDAK960TGA	SATA 6G	43,631	5,878	6,033	484	449
1,920	MTFDDAK1T9TGA	SATA 6G	43,688	6,334	6,447	491	450
3,840	MTFDDAK3T8TGA	SATA 6G	43,392	6,539	6,626	483	445
7,680	MTFDDAK7T6TGA	SATA 6G	42,940	7,065	7,278	491	446

SSDs

Capacity [GB]	Storage device	Interface	Transactions [IO/s]			Throughput [MiB/s]		
			Database	Fileserver	Filecopy	Streaming	Restore	
☐ SAS 24Gbps SSD (WI)								
800	PM7800G10DN	SAS 12G	168,061	20,678	23,006	1,070	1,076	
		SAS 24G	204,529	25,996	25,095	1,960	1,603	
1,600	PM71T6010DN	SAS 12G	173,094	22,676	26,505	1,070	1,076	
		SAS 24G	208,291	26,190	24,674	1,960	1,319	
☐ SAS 24Gbps SSD (MU)								
1,600	PM71T6003DN	SAS 12G	168,200	20,700	22,800	1,070	1,076	est.
		SAS 24G	204,400	26,000	25,100	1,963	1,603	est.
3,200	PM73T2003DN	SAS 12G	173,000	22,600	26,500	1,070	1,076	est.
		SAS 24G	208,200	26,100	24,600	1,960	1,318	est.
6,400	PM76T4003DN	SAS 12G	171,200	21,400	23,200	1,070	1,076	est.
		SAS 24G	190,700	23,900	22,500	1,963	1,175	est.
☐ SAS 24Gbps SSD (RI)								
1,920	PM71T9201DN	SAS 12G	168,283	20,710	22,880	1,070	1,076	
		SAS 24G	204,491	26,066	25,188	1,963	1,603	
3,840	PM73T8401DN	SAS 12G	173,000	22,600	26,500	1,070	1,076	est.
		SAS 24G	208,200	26,100	24,600	1,960	1,318	est.
7,680	PM77T6801DN	SAS 12G	171,279	21,408	23,284	1,070	1,076	
		SAS 24G	190,784	23,941	22,542	1,963	1,175	
15,360	PM715T301DN	SAS 12G	167,002	20,281	20,643	1,070	1,070	
		SAS 24G	146,385	18,465	17,688	1,963	974	
☐ PCIe SSD (WI)								
400	SSDPF21Q400GB	PCIe4 x4	303,783	91,576	84,727	6,693	4,562	
800	SSDPF21Q800GB	PCIe4 x4	290,266	99,852	94,882	6,738	4,512	
1,600	SSDPF21Q016TB	PCIe4 x4	304,687	108,995	110,292	6,682	4,382	
☐ PCIe SSD (MU) (*1)								
1,600	KCMY1VUG1T60	PCIe4 x4	431,300	57,900	50,400	7,204	3,430	est.
3,200	KCMY1VUG3T20	PCIe4 x4	557,564	95,486	86,744	7,219	5,079	
6,400	KCMY1VUG6T40	PCIe4 x4	557,874	109,610	102,691	7,219	5,013	
12,800	KCMY1VUG12T8	PCIe4 x4	558,473	103,865	98,998	6,728	5,111	
☐ PCIe SSD (RI) (*1)								
1,920	KCMY1RUG1T92	PCIe4 x4	431,394	57,935	50,484	7,204	3,430	
3,840	KCMY1RUG3T84	PCIe4 x4	557,352	95,493	86,690	6,963	4,406	
7,680	KCMY1RUG7T68	PCIe4 x4	609,834	107,833	98,803	7,041	4,416	
15,360	KCMY1RUG15T3	PCIe4 x4	557,277	103,784	100,005	7,183	4,429	

(*1) Performance value for PRAID EP680i connection. The drive supports PCIe 5.0, but the interface operates on PCIe 4.0.

Model common

Capacity [GB]	Storage device	Interface	Transactions [IO/s]			Throughput [MiB/s]	
			Database	Fileserver	Filecopy	Streaming	Restore
☐ M.2 SATA SSD (PDUAL CP300)							
240	MTFDDAV240TGA	SATA 6G	45,009	5,324	5,490	474	353
480	MTFDDAV480TGA	SATA 6G	48,771	5,870	6,022	501	484
960	MTFDDAV960TGA	SATA 6G	51,373	6,252	6,429	471	486
☐ M.2 NVMe SSD (PDUAL CP300)							
480	MTFDKBA480TFR	PCIe4 x4	75,126	15,502	12,241	4,923	682
960	MTFDKBA960TFR	PCIe4 x4	139,598	31,160	25,761	4,923	1,380
☐ M.2 SATA SSD (M.2 Riser Kit)							
240	MTFDDAV240TGA	SATA 6G	34,363	5,680	5,730	500	353
480	MTFDDAV480TGA	SATA 6G	43,056	6,473	6,540	503	490
960	MTFDDAV960TGA	SATA 6G	50,096	6,984	7,049	505	494
☐ M.2 NVMe SSD (M.2 Riser Kit)							
480	MTFDKBA480TFR	PCIe3 x2	74,947	15,849	12,564	1,644	685
960	MTFDKBA960TFR	PCIe3 x2	147,206	31,459	25,928	1,644	1,381

VMmark V3

Benchmark description

VMmark V3 is a benchmark developed by VMware to compare server configurations with hypervisor solutions from VMware regarding their suitability for server consolidation. In addition to the software for load generation, the benchmark consists of a defined load profile and binding regulations. The benchmark results can be submitted to VMware and are published on their Internet site after a successful review process. After the discontinuation of the proven benchmark "VMmark V2" in September 2017, it has been succeeded by "VMmark V3". VMmark V2 required a cluster of at least two servers and covers data center functions, like Cloning and Deployment of virtual machines (VMs), Load Balancing, as well as the moving of VMs with vMotion and also Storage vMotion. VMmark V3 covers the moving of VMs with XvMotion in addition to VMmark V2. Also, changes application architecture to more scalable workloads.

In addition to the "Performance Only" result, alternatively measure the electrical power consumption and publish it as a "Server Power-Performance" result (power consumption of server systems only) and/or "Server and Storage Power-Performance" result (power consumption of server systems and all storage components).

VMmark V3 is not a new benchmark in the actual sense. It is in fact a framework that consolidates already established benchmarks, as workloads in order to simulate the load of a virtualized consolidated server environment. Two proven benchmarks, which cover the application scenarios Scalable web system and E commerce system were integrated in VMmark V3.

Application scenario	Load tool	# VMs
Scalable web system	Weathervane	14
E-commerce system	DVD Store 3 client	4
Standby system		1

Each of the three application scenarios is assigned to a total of 18 dedicated virtual machines. Then add to these an 19th VM called the "standby server". These 19 VMs form a "tile". Because of the performance capability of the underlying server hardware, it is usually necessary to have started several identical tiles in parallel as part of a measurement in order to achieve a maximum overall performance.

In VMmark V3 there is an an infrastructure component, which is present once for every two hosts. It measures the efficiency levels of data center consolidation through VM Cloning and Deployment, vMotion, XvMotion and Storage vMotion. The Load Balancing capacity of the data center is also used (DRS, Distributed Resource Scheduler).

The result of VMmark V3 for test type "Performance Only" is a number, known as a "score", which provides information about the performance of the measured virtualization solution. The score is the maximum sum of the benefits of server aggregation and is used as a comparison criterion for different hardware platforms.

This score is determined from the individual results of the VMs and an infrastructure components result. Each of the five VMmark V3 application or front-end VMs provides a specific benchmark result in the form of application-specific transaction rates for each VM. In order to derive a normalized score, the individual benchmark result for each tile is put in relation to the respective results of a reference system. The resulting dimensionless performance values are then averaged geometrically and finally added up for all VMs. This value is included in the overall score with a weighting of 80%. The infrastructure workload is only present in the benchmark once for every two hosts; it determines 20% of the result. The number of transactions per hour and the average duration in seconds respectively are determined for the score of the infrastructure components workload.

In addition to the actual score, the number of VMmark V3 tiles is always specified with each VMmark V3 score. The result is thus as follows: "Score@Number of Tiles", for example "8.11@8 tiles".

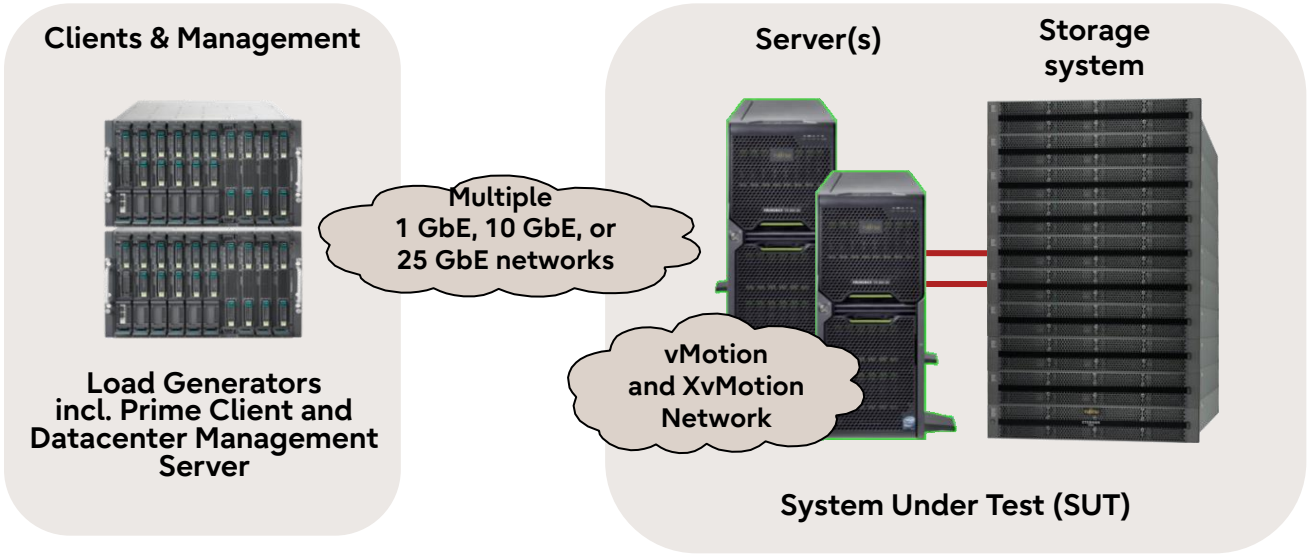
In the case of the two test types “Server Power-Performance” and “Server and Storage Power-Performance”, a so-called “Server PPKW Score” and “Server and Storage PPKW Score” are determined. These are the performance scores divided by the average power consumption in kilowatts (PPKW = performance per kilowatt (KW)).

The results of the three test types should not be compared with each other.

A detailed description of VMmark V3 is available in the document Benchmark Overview VMmark V3.

Benchmark environment

The typical measurement set-up is illustrated below:



All the benchmark results were measured with the following environment:

System Under Test (SUT, configured with Xeon Platinum 8490H)	
Hardware	
• Number of servers	2
• Model	PRIMERGY RX2540 M7
• Processor	2 x Xeon Platinum 8490H
• Memory	2048 GB : 32 x 64 GB (1x64 GB) 2Rx4 DDR5-4800 R ECC
• Network interface	2 x Mellanox MCX4121A-ACAT dual port 25Gb SFP28 PCIe adapter 1 x 1Gbit/s (RJ45) on Motherboard
• Disk subsystem	2 x Emulex LPe35002 dual port 32Gb PCIe adapter 8 x PRIMERGY RX2540 M4 & M5 configured as Fibre Channel targets 4 x PRIMERGY RX2540 M4 : 3 x Intel P4800X PCIe SSD (750 GB) 1 x Intel P4600 PCIe SSD (4 TB) 1 x PRIMERGY RX2540 M4 : 3 x Intel P4800X PCIe SSD (750 GB) 1 x Intel P4600 PCIe SSD (2 TB) 2 x PRIMERGY RX2540 M5 : 3 x Intel P4800X PCIe SSD (750 GB) 1 x Intel P4610 PCIe SSD (3.2 TB) 1 x PRIMERGY RX2540 M5 : 2 x Intel P4800X PCIe SSD (750 GB) 1 x Intel P4610 PCIe SSD (3.2 TB)
Software	
• BIOS settings	See “Details”
• Operating system	VMware ESXi 8.0 GA, Build 20513097
• Operating system settings	ESX settings: see “Details”

System Under Test (SUT, configured with Xeon Platinum 8592+)	
Hardware	
• Number of servers	2
• Model	PRIMERGY RX2540 M7
• Processor	2 x Xeon Platinum 8592+
• Memory	4096 GB : 16 x 256 GB (1x256 GB) 8Rx4 DDR5-5600 3DS R ECC
• Network interface	2 x PLAN EP E810-XXVDA2 2X 25Gb SFP28 LP 1 x 1Gbit/s (RJ45) on Motherboard
• Disk subsystem	2 x PFC EP QLE2772 2X 32GFC PCIe v4 LP 11 x PRIMERGY RX2540 M4, M5 & M6 configured as Fibre Channel targets 4 x PRIMERGY RX2540 M4 : 3 x Intel P4800X PCIe SSD (750 GB) 1 x Intel P4600 PCIe SSD (4 TB) 1 x PRIMERGY RX2540 M4 : 3 x Intel P4800X PCIe SSD (750 GB) 1 x Intel P4600 PCIe SSD (2 TB) 2 x PRIMERGY RX2540 M5 : 1 x Intel P4610 PCIe SSD (3.2 TB) 1 x PRIMERGY RX2540 M5 : 2 x Intel P4610 PCIe SSD (3.2 TB) 2 x PRIMERGY RX2540 M6 : 6 x Intel P4800X PCIe SSD (750 GB) 1 x PRIMERGY RX2540 M6 : 1 x Intel P4800X PCIe SSD (750 GB)
Software	
• BIOS settings	See “Details”
• Operating system	VMware ESXi 8.0 Update 2, Build 22380479
• Operating system settings	ESX settings: see “Details”

Detail	
See disclosure	Xeon Platinum 8490H configuration: https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/vmmark/2023-03-21-Fujitsu-PRIMERGY-RX2540M7.pdf https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/vmmark/2023-03-21-Fujitsu-PRIMERGY-RX2540M7-serverPPKW.pdf https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/vmmark/2023-03-21-Fujitsu-PRIMERGY-RX2540M7-serverstoragePPKW.pdf Xeon Platinum 8592+ configuration: https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/vmmark/2024-04-16-Fujitsu-PRIMERGY-RX2540M7.pdf https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/vmmark/2024-04-30-Fujitsu-PRIMERGY-RX2540-M7-serverPPKW.pdf

Datacenter Management Server (DMS)	
Hardware	
• Model	1 x PRIMERGY RX2530 M2
• Processor	1 x Intel Xeon E5-2698 v4
• Memory	80 GB
• Network interface	1 x Emulex One Connect Oce14000 1GbE dual port PCIe adapter
Software	
• Operating system	VMware ESXi 7.0 Update 3c, Build 19193900

Datacenter Management Server (DMS) VM	
Hardware	
• Processor	4 x Logical CPU
• Memory	21 GB
• Network interface	1 x 1 Gbit/s LAN
Software	
• Operating system	VMware vCenter Server Appliance 8.0 GA, Build 20519528

Load generator	
Hardware	
• Model	PRIMERGY RX2530 M2 × 6
• Processor	4 x PRIMERGY RX2530 M2 : 2 x Intel Xeon E5-2699 v4 2 x PRIMERGY RX2530 M2 : 2 x Intel Xeon E5-2699A v4
• Memory	6 x 256 GB
• Network interface	1 x Emulex One Connect Oce14000 1GbE dual port PCIe adapter 1 x Emulex One Connect Oce14000 10GbE dual port PCIe adapter
Software	
• Operating system	VMware ESXi 7.0 Update 3c, Build 19193900

Benchmark results

"Performance Only" measurement result (configured with Xeon Platinum 8490H, March 21, 2023)

On March 21, 2023, Fujitsu achieved a VMmark V3.1.1 score of "23.38@23 tiles" using PRIMERGY RX2540 M7 with Xeon Platinum 8490H processors and VMware ESXi 8.0 GA. At this time, the system configuration had a total of 2 x 120 processor cores, and two identical servers were used for the "System Under Test" (SUT). Based on the above results, PRIMERGY RX2540 M7 is rated as the most powerful 2-socket Intel processor based rack server in a "matched pair" configuration with two identical hosts in the official VMmark V3 "Performance Only" ranking (as of the date the benchmark results were published).

"Server Power-Performance" measurement result
"Server and Storage Power-Performance" measurement result (configured with Xeon Platinum 8490H, March 21, 2023)

On March 21, 2023, Fujitsu achieved a VMmark V3.1.1 "Server PPKW" score of "9.7059@22 tiles" using PRIMERGY RX2540 M7 with Xeon Platinum 8490H processors and VMware ESXi 8.0 GA. At the same time, it also achieved a VMmark V3.1.1 "Server and Storage PPKW" score of "4.8019@22 tiles". These were system configurations with a total of 2 x 120 processor cores, and two identical servers were used for the "System Under Test" (SUT). Based on the above results, PRIMERGY RX2540 M7 is rated as the most energy efficient Intel processor based virtual server in the world in the official VMmark V3 "Server Power-Performance" ranking and "Server and Storage Power-Performance" ranking (as of the date the benchmark results were published).

"Performance Only" measurement result (configured with Xeon Platinum 8592+, April 16, 2024)

On April 16, 2024, Fujitsu achieved a VMmark V3.1.1 score of "27.52@28 tiles" using PRIMERGY RX2540 M7 with Xeon Platinum 8592+ processors and VMware ESXi 8.0 Update 2. At this time, the system configuration had a total of 2 x 128 processor cores, and two identical servers were used for the "System Under Test" (SUT). Based on the above results, PRIMERGY RX2540 M7 is rated as the most powerful 2-socket Intel processor based rack server in a "matched pair" configuration with two identical hosts in the official VMmark V3 "Performance Only" ranking (as of the date the benchmark results were published).

"Server Power-Performance" measurement result (configured with Xeon Platinum 8592+, April 30, 2024)

On April 30, 2024, Fujitsu achieved a VMmark V3.1.1 “Server PPKW” score of “11.4640@28 tiles” using PRIMERGY RX2540 M7 with Xeon Platinum 8592+ processors and VMware ESXi 8.0 Update 2. These were system configurations with a total of 2 x 128 processor cores, and two identical servers were used for the “System Under Test” (SUT). Based on the above results, PRIMERGY RX2540 M7 is rated as the most energy efficient Intel processor based virtual server in the world in the official VMmark V3 “Server Power-Performance” ranking (as of the date the benchmark results were published).

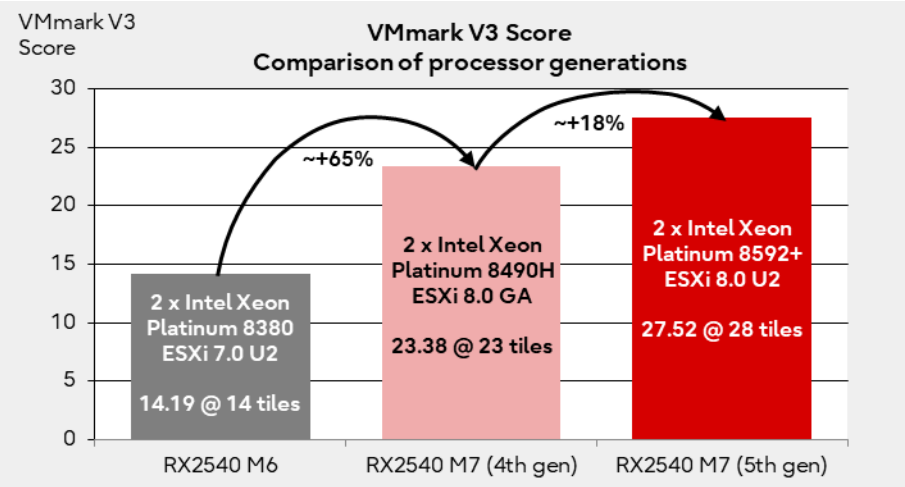
All comparisons for the competitor products reflect the status of the date of the publication. For the latest VMmark V3 "Performance Only" results, as well as detailed results and configuration data, see https://www.vmware.com/products/vmmark/results3x.html.

For the latest VMmark V3 " Server Power-Performance" results, detailed results, and configuration data, see https://www.vmware.com/products/vmmark/results3x.1.html.

For the latest VMmark V3 " Server and Storage Power-Performance" results, detailed results, and configuration data, see https://www.vmware.com/products/vmmark/results3x.2.html.

Performance comparison

The graph below compares the VMmark V3 scores of the PRIMERGY RX2540 M7 and the previous generation PRIMERGY RX2540 M6. The PRIMERGY RX2540 M7 with Xeon Platinum 8490H achieved a 65% improvement in score compared to the previous system. Furthermore, the PRIMERGY RX2540 M7 with Xeon Platinum 8592+ achieved a 18% improvement in score compared to the one with Xeon Platinum 8490H.



All VMs, their application data, the host operating system, and any additional data needed are stored in a powerful Fiber Channel disk subsystem. This disk subsystem uses fast PCIe SSDs such as Intel Optane to improve storage media response time. Network connectivity with host-side load generators and infrastructure load connectivity between hosts are implemented using 25GbE LAN ports. In addition, the improved performance of the 5th generation Intel Xeon scalable processor and the effective use of the capabilities of the VMware ESXi hypervisor brought the significant performance improvement in virtualization environment.

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.

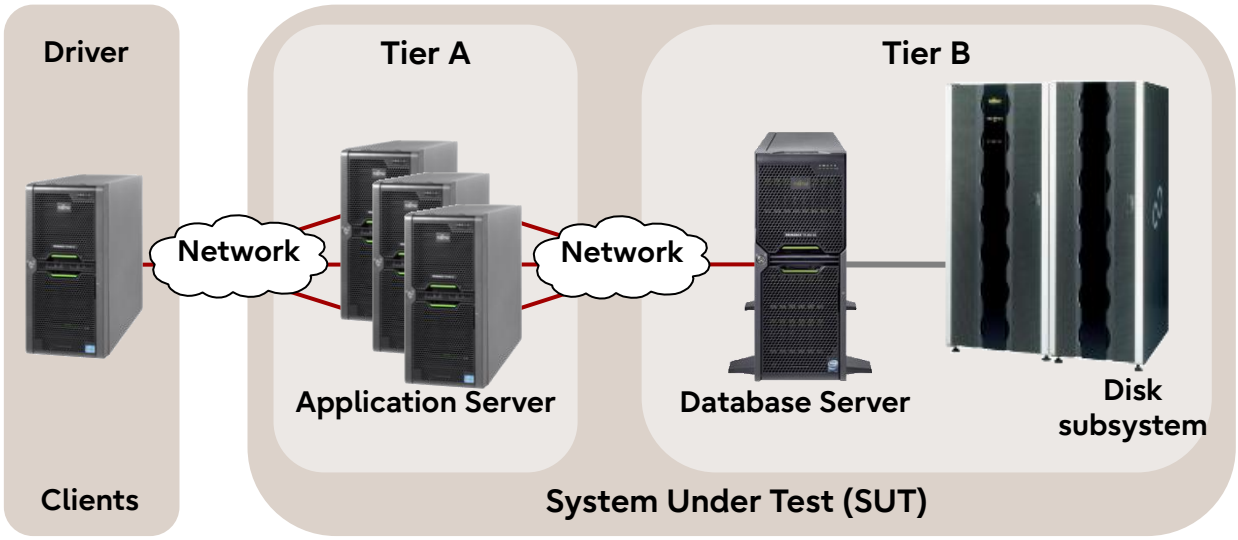
In contrast to benchmarks such as SPEC CPU and TPC-E, which were standardized by independent bodies and for which adherence to the respective rules and regulations are monitored, OLTP-2 is an internal benchmark of Fujitsu. OLTP-2 is based on the well-known database benchmark TPC-E. OLTP-2 was designed 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 measured or calculated based on the configuration of the next following pages of PRIMERGY RX2540 M7.

Database Server (Tier B)

Hardware

• Model	PRIMERGY RX2540 M7
• Processor	4th Generation Intel Xeon Scalable Processor Family
• Memory	2 processor: 32 x 64 GB (1x64 GB) 2Rx4 DDR5-4800 ECC
• Network interface	1 x Dual port LAN 10 Gbps 1 x Quad port OCPv3 LAN 1 Gbps
• Disk subsystem	RX2540 M7: 1 x RAID controller (internal, 4GB cache) 6 x 1.6 TB SSD drive, RAID10 (log) 5 x RAID controller (external, 4GB cache) 10 x JX40 S2: 4 x 1.6 TB SSD drive, RAID10(temp) 49 x 1.6 TB SSD drive, RAID5 (data) 30 x 960 GB SSD drive, RAID (data)

Software

• Operating system	Microsoft Windows Server 2022 Standard
• Database	Microsoft SQL Server 2022 Enterprise

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

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

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.

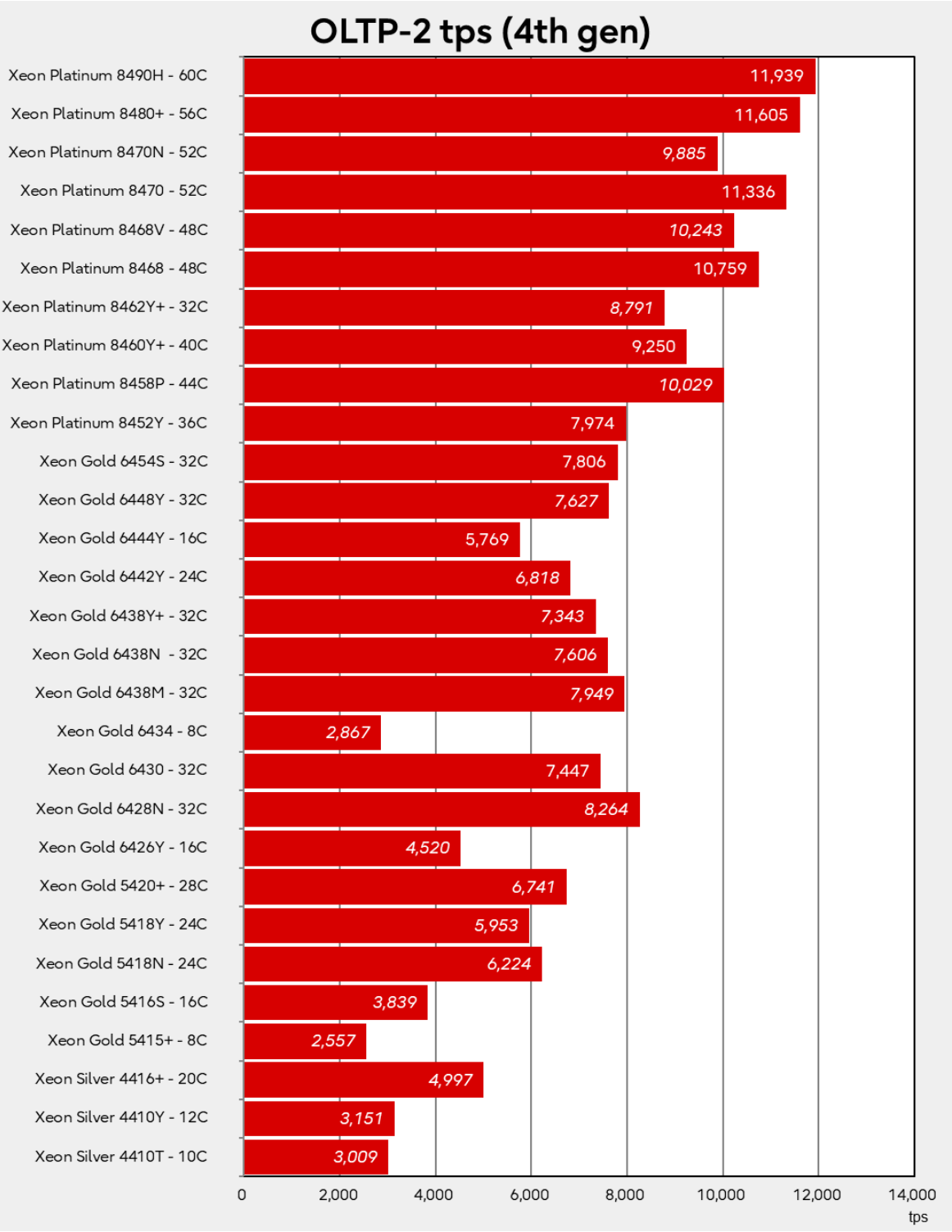
A guideline in the database environment for selecting main memory is that sufficient quantity is important. This why a configuration with a total memory of 2048 GB was considered for the measurements with two processors.

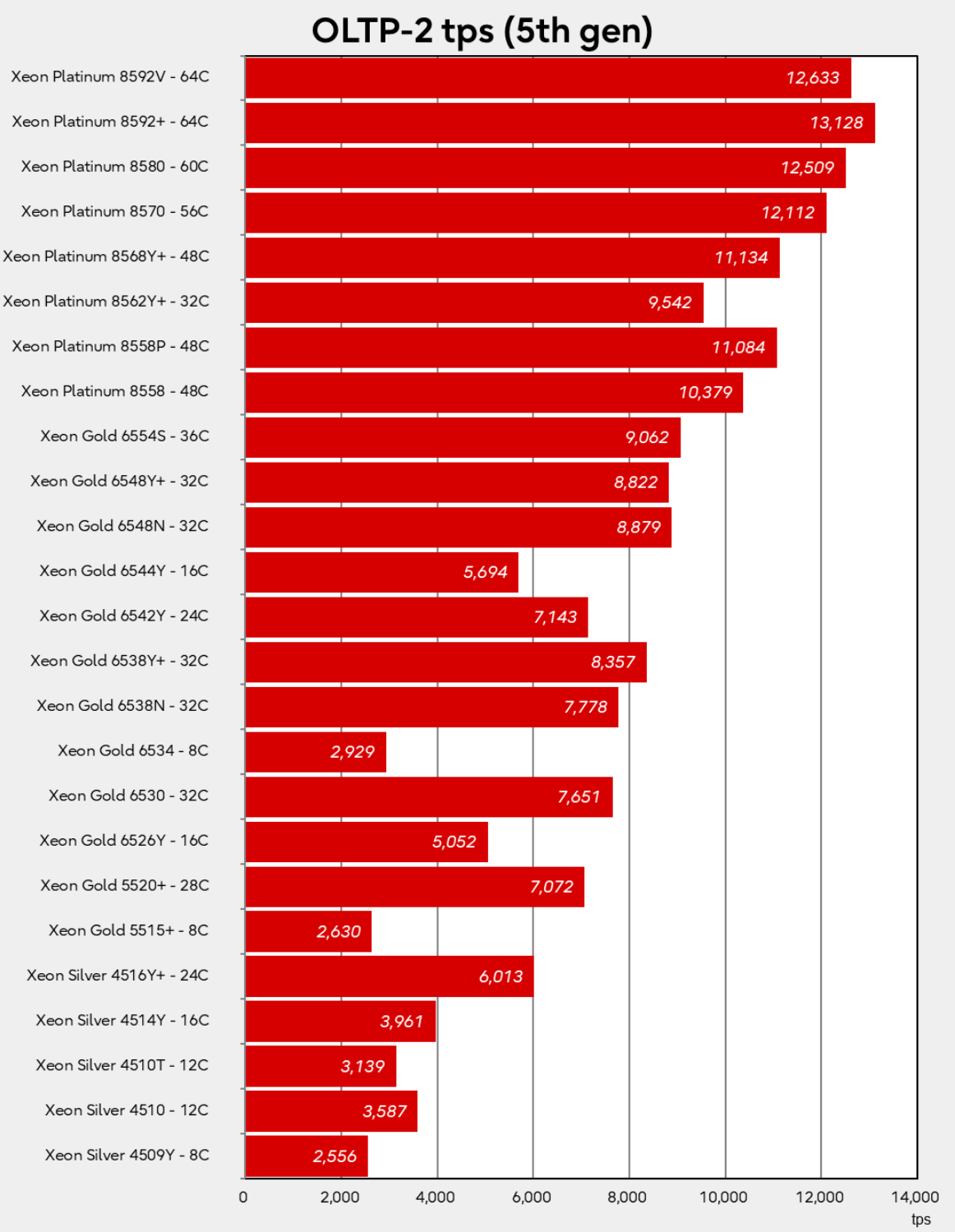
The result with "est." are the estimated values.

Processor	Cores	Threads	2CPU Score
4th Generation Xeon Scalable Processors (2CPU configuration)			
Xeon Platinum 8490H	60	120	11,939
Xeon Platinum 8480+	56	112	11,605
Xeon Platinum 8470N	52	104	9,885 est.
Xeon Platinum 8470	52	104	11,336
Xeon Platinum 8468V	48	96	10,243 est.
Xeon Platinum 8468	48	96	10,759
Xeon Platinum 8462Y+	32	64	8,791 est.
Xeon Platinum 8460Y+	40	80	9,250
Xeon Platinum 8458P	44	88	10,029 est.
Xeon Platinum 8452Y	36	72	7,974 est.
Xeon Gold 6454S	32	64	7,806
Xeon Gold 6448Y	32	64	7,627 est.
Xeon Gold 6444Y	16	32	5,769
Xeon Gold 6442Y	24	48	6,818 est.
Xeon Gold 6438Y+	32	64	7,343 est.
Xeon Gold 6438N	32	64	7,606 est.
Xeon Gold 6438M	32	64	7,949 est.
Xeon Gold 6434	8	16	2,867 est.
Xeon Gold 6430	32	64	7,447
Xeon Gold 6428N	32	64	8,264 est.
Xeon Gold 6426Y	16	32	4,520 est.
Xeon Gold 5420+	28	56	6,741 est.
Xeon Gold 5418Y	24	48	5,953 est.
Xeon Gold 5418N	24	48	6,224 est.
Xeon Gold 5416S	16	32	3,839 est.
Xeon Gold 5415+	8	16	2,557 est.
Xeon Silver 4416+	20	40	4,997 est.
Xeon Silver 4410Y	12	24	3,151 est.
Xeon Silver 4410T	10	20	3,009 est.

Processor	Cores	Threads	2CPU Score
5th Generation Xeon Scalable Processors (2CPU configuration)			
Xeon Platinum 8592V	64	128	12,633 est.
Xeon Platinum 8592+	64	128	13,128 est.
Xeon Platinum 8580	60	120	12,509 est.
Xeon Platinum 8570	56	112	12,112 est.
Xeon Platinum 8568Y+	48	96	11,134 est.
Xeon Platinum 8562Y+	32	64	9,542 est.
Xeon Platinum 8558P	48	96	11,084 est.
Xeon Platinum 8558	48	96	10,379 est.
Xeon Gold 6554S	36	72	9,062 est.
Xeon Gold 6548Y+	32	64	8,822 est.
Xeon Gold 6548N	32	64	8,879 est.
Xeon Gold 6544Y	16	32	5,694 est.
Xeon Gold 6542Y	24	48	7,143 est.
Xeon Gold 6538Y+	32	64	8,357 est.
Xeon Gold 6538N	32	64	7,778 est.
Xeon Gold 6534	8	16	2,929 est.
Xeon Gold 6530	32	64	7,651 est.
Xeon Gold 6526Y	16	32	5,052 est.
Xeon Gold 5520+	28	56	7,072 est.
Xeon Gold 5515+	8	16	2,630 est.
Xeon Platinum 8592V	64	128	2,556 est.
Xeon Platinum 8592+	64	128	12,633 est.
Xeon Platinum 8580	60	120	13,128 est.
Xeon Platinum 8570	56	112	12,509 est.
Xeon Silver 4509Y	8	16	12,112 est.

The following graph shows the OLTP-2 transaction rates obtained with the two processor of the 4th Generation Intel Xeon Scalable Processor Family and the 5th Generation Intel Xeon Scalable Processor Family.

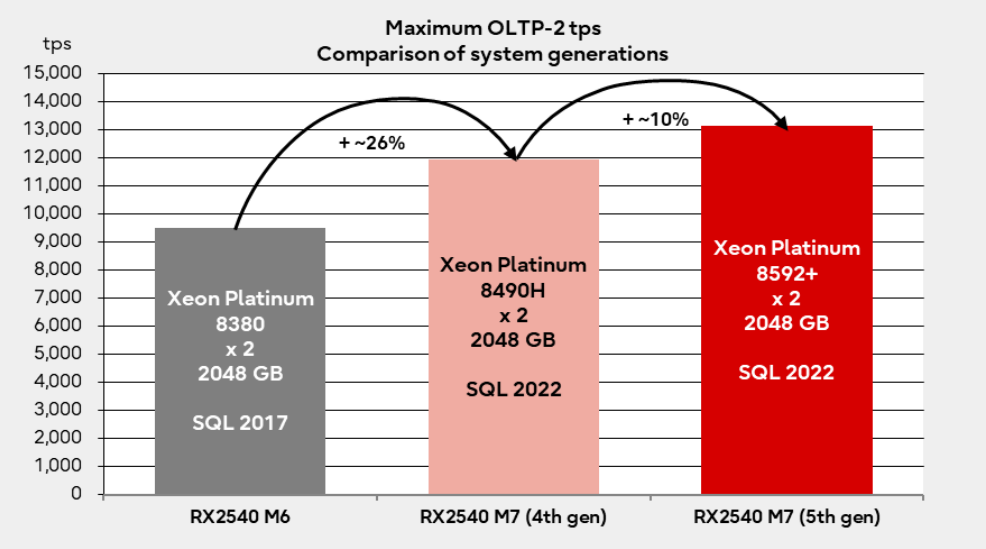




The features of the processors are summarized in the section "Technical data."

In general, 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.

The highest value for OLTP-2 on the 4th Generation Intel Xeon Scalable Processor Family based PRIMERGY RX2540 M7 is about 26% higher than that on the previous PRIMERGY RX2540 M6. Furthermore, the highest value on RX2540 M7 with the 5th Generation Intel Xeon Scalable Processor Family is improved by about 10% compared to that with the 4th Generation processor.



Literature

PRIMERGY Servers

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

PRIMERGY RX2530 M7 / RX2540 M7

This Whitepaper

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https://docs.ts.fujitsu.com/dl.aspx?id=6099b0c3-30f8-42bc-8e7d-d65349bdd981

Data sheet

RX2530 M7: https://docs.ts.fujitsu.com/dl.aspx?id=79c296f8-af2c-45dd-af82-d0f3f9cc06fd

RX2540 M7: https://docs.ts.fujitsu.com/dl.aspx?id=b066247f-ad57-44bb-9dcd-afd03e637c3c

PRIMERGY Performance

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SPEC CPU2017

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

Benchmark Overview SPECcpu2017

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The LINPACK Benchmark: Past, Present, and Future

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

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Intel Math Kernel Library – LINPACK Download

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Benchmark Overview SPECpower_ssj2008

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SAP SD / Server Power / BWH

https://www.sap.com/benchmark

Benchmark results

SAP SD: https://www.sap.com/dmc/exp/2018-benchmark-directory/#/sd

SAP Server Power: https://www.sap.com/dmc/exp/2018-benchmark-directory/#/power

SAP BWH: https://www.sap.com/dmc/exp/2018-benchmark-directory/#/bwh

Benchmark overview

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SAP Server Power:

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VMmark V3

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Benchmark Overview VMmark V3

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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
1.5	2024-11-12	Update: • Minor Correction
1.4	2024-07-02	Update: • Technical data • SPEC CPU2017, STREAM, LINPACK Measured and calculated with 5th Generation Intel Xeon Scalable Processor Family • SPECpower_ssj2008 Measured with Intel Xeon Platinum 8592+ • SAP Server Power Standard Application Benchmark Measured with Intel Xeon Platinum 8592+ • SAP BWH Standard Application Benchmark Measured with Intel Xeon Platinum 8592+ • Disk I/O Updated storage performance values for 2.5 / 3.5 inch models • VMmark V3 Measured with Intel Xeon Platinum 8592+ • OLTP-2 Calculated with 5th Generation Intel Xeon Scalable Processor Family

Version	Date	Description
1.3	2024-01-12	Update: • SAP SD Standard Application Benchmark Measured on SUSE Linux Enterprise Server 15 with Intel Xeon Platinum 8490H • SAP Server Power Standard Application Benchmark Measured with Intel Xeon Platinum 8490H
1.2	2023-11-09	Update: • Technical data • SPEC CPU2017, STREAM, LINPACK Measured and calculated additionally with 4th Generation Intel Xeon Scalable Processor Family • OLTP-2 Measured and calculated additionally with 4th Generation Intel Xeon Scalable Processor Family
1.1	2023-05-30	Update: • Technical data • SPEC CPU2017, STREAM, LINPACK Measured and calculated with 4th Generation Intel Xeon Scalable Processor Family • OLTP-2 Measured and calculated with 4th Generation Intel Xeon Scalable Processor Family
1.0	2023-04-28	New: • Technical data • SPEC CPU2017, STREAM, LINPACK Measured and calculated with 4th Generation Intel Xeon Scalable Processor Family • SPECpower_ssj2008 Measured with Intel Xeon Platinum 8490H • SAP SD Standard Application Benchmark Measured with Intel Xeon Platinum 8490H • SAP BWH Standard Application Benchmark Measured with Intel Xeon Platinum 8480+ • Disk I/O Measured with 2.5 / 3.5 inch model • VMmark V3 Measured with Intel Xeon Platinum 8490H

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