Fujitsu Server PRIMERGY
Performance Report
PRIMERGY CX2550 M7 / CX2560 M7

This document provides an overview of benchmarks executed on the Fujitsu Server PRIMERGY CX2550 M7 / CX2560 M7.

Explaines PRIMERGY CX2550 M7 / CX2560 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
1.3
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Contents

Technical data

PRIMERGY CX400 M7 Chassis

PRIMERGY CX2550 M7

PRIMERGY CX2560 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 CX2550 M7	PRIMERGY CX2560 M7
Cooling method	Air cooling / Liquid cooling	Air cooling
Form factor	Server node	
Chipset	Intel C741	
Number of sockets	2	
Number of configurable processors	1*1 or 2	
Processor type	4th Generation Intel Xeon Scalable Processors Family 5th Generation Intel Xeon Scalable Processors Family	
Number of memory slots	16 (8 per processor)	24 (12 per processor)
Maximum memory configuration	4,096 GB	6,144 GB
Maximum number of internal storage disks	2.5 inch: 2	2.5 inch: 6
Maximum number of PCI slots	PCI-Express 5.0: 2	

*1 Air cooling only

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 Intel Xeon Scalable Processors Family (1CPU and 2CPU supported processor)									
Xeon Max 9480 *1	HBM	56	112	15	16	1.90	3.50	4,800	350
Xeon Max 9470 *1	HBM	52	104	105	16	2.00	3.50	4,800	350
Xeon Max 9468 *1	HBM	48	96	105	16	2.10	3.50	4,800	350
Xeon Max 9468 *1	HBM	48	96	105	16	2.10	3.50	4,800	350
Xeon Max 9462 *1	HBM	32	64	75	16	2.70	3.50	4,800	350
Xeon Platinum 8490H *1	XCC	60	120	112.5	16	1.90	3.50	4,800	350
Xeon Platinum 8480+ *1	XCC	56	112	105	16	2.00	3.80	4,800	350
Xeon Platinum 8470Q *1	XCC	52	104	105	16	2.10	3.80	4,800	350
Xeon Platinum 8470N *1	XCC	52	104	97.5	16	1.70	3.60	4,800	300
Xeon Platinum 8470 *1	XCC	52	104	105	16	2.00	3.80	4,800	350
Xeon Platinum 8468V *1	XCC	48	96	97.5	16	2.40	3.80	4,800	330
Xeon Platinum 8468 *1	XCC	48	96	105	16	2.10	3.80	4,800	350
Xeon Platinum 8462Y+ *1	MCC	32	64	60	16	2.80	4.10	4,800	300
Xeon Platinum 8460Y+ *1	XCC	40	80	105	16	2.00	3.70	4,800	300
Xeon Platinum 8458P *1	XCC	44	88	82.5	16	2.70	3.80	4,800	350
Xeon Platinum 8452Y *1	XCC	36	72	67.5	16	2.00	3.20	4,800	300
Xeon Gold 6458Q *1	MCC	32	64	60	16	3.10	4.00	4,800	350
Xeon Gold 6454S *1	XCC	32	64	60	16	2.20	3.40	4,800	270
Xeon Gold 6448Y *1	MCC	32	64	60	16	2.10	4.10	4,800	225
Xeon Gold 6444Y *1	MCC	16	32	45	16	3.60	4.00	4,800	270
Xeon Gold 6442Y *1	MCC	24	48	60	16	2.60	4.00	4,800	225
Xeon Gold 6438Y+ *1	MCC	32	64	60	16	2.00	4.00	4,800	205
Xeon Gold 6438N *1	MCC	32	64	60	16	2.00	3.60	4,800	205
Xeon Gold 6438M *1	MCC	32	64	60	16	2.20	3.90	4,800	205
Xeon Gold 6434 *1	MCC	8	16	22.5	16	3.70	4.10	4,800	195
Xeon Gold 6430 *1	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+ *1	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

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 Intel Xeon Scalable Processors Family (1CPU and 2CPU supported processor, continued)									
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
4th Generation Intel Xeon Scalable Processors Family (1CPU supported processor)									
Xeon Gold 5412U *2	MCC	24	48	45	-	2.10	3.90	4,400	185
Xeon Bronze 3408U *2	MCC	8	8	22.5	-	1.80	1.90	4,000	125
5th Generation Intel Xeon Scalable Processors Family (1CPU and 2CPU supported processor)									
Xeon Platinum 8592V *1	XCC	64	128	320	16	2.00	3.90	4,800	330
Xeon Platinum 8592+ *1	XCC	64	128	320	20	1.90	3.90	5,600	350
Xeon Platinum 8580 *1	XCC	60	120	300	20	2.00	4.00	5,600	350
Xeon Platinum 8570 *1	XCC	56	112	300	20	2.10	4.00	5,600	350
Xeon Platinum 8568Y+ *1	XCC	48	96	300	20	2.30	4.00	5,600	350
Xeon Platinum 8562Y+ *1	MCC	32	64	60	20	2.80	4.10	5,600	300
Xeon Platinum 8558P *1	XCC	48	96	260	20	2.70	4.00	5,600	350
Xeon Platinum 8558 *1	XCC	48	96	260	20	2.10	4.00	5,200	330
Xeon Gold 6558Q *1	MCC	32	64	60	20	3.20	4.10	5,200	350
Xeon Gold 6554S *1	XCC	36	72	180	20	2.20	4.00	5,200	270
Xeon Gold 6548Y+ *1	MCC	32	64	60	20	2.50	4.10	5,200	250
Xeon Gold 6548N *1	MCC	32	64	60	20	2.80	4.10	5,200	250
Xeon Gold 6544Y *1	MCC	16	32	45	20	3.60	4.10	5,200	270
Xeon Gold 6542Y *1	MCC	24	48	60	20	2.90	4.10	5,200	250
Xeon Gold 6538Y+ *1	MCC	32	64	60	20	2.20	4.00	5,200	225
Xeon Gold 6538N *1	MCC	32	64	60	20	2.10	4.10	5,200	205
Xeon Gold 6534 *1	MCC	8	16	22.5	20	3.90	4.20	4,800	195
Xeon Gold 6530 *1	XCC	32	64	160	20	2.10	4.00	4,800	270
Xeon Gold 6526Y *1	MCC	16	32	37.5	20	2.80	3.90	5,200	195
Xeon Gold 5520+ *1	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 Intel Xeon Scalable Processors Family (1CPU supported processor)									
Xeon Gold 5512U*2	MCC	28	56	52.5	-	2.10	3.70	4,800	185
Xeon Bronze 3508U*2	LCC	8	8	22.5	-	2.10	2.20	4,400	125

*1 Liquid cooling of CX2550 M7 only

*2 Air cooling only

All processors that can be ordered with PRIMERGY CX2550 M7 / CX2560 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			✓		✓
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	2,600W titanium PSU	2

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

Detailed technical information is available in the data sheet of PRIMERGY CX2550 M7 / CX2560 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 CX2550 M7 / CX2560 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 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 SPECrate2017_int_base: • DCU Streamer Prefetcher = Disabled • Package C State limit = C0 • CPU Performance Boost = Aggressive • SNC(Sub NUMA) =Enable SNC4 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)

System Under Test (SUT)

Software (continued)

• BIOS settings	**5th Generation Intel Xeon Scalable Processors Family** SPECspeed2017_int_base: • LLC Prefetch = Enabled • XPT Prefetch = Enabled 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 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 SPECrate2017_fp_base: • Intel Virtualization Technology = Disabled • Utilization Profile = Unbalanced • CPU Performance Boost = Aggressive • 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** 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"
• 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	
			CX2550 M7	CX2560 M7	CX2550 M7	CX2560 M7
4th Generation Intel Xeon Scalable Processors Family (2CPU configuration, Continued)						
Xeon Max 9480	56	2	**888**	Unsupported	**1,120**	Unsupported
Xeon Max 9470	52	2	846 est.	Unsupported	1,060 est.	Unsupported
Xeon Max 9468	48	2	784 est.	Unsupported	1,010 est.	Unsupported
Xeon Max 9462	32	2	613 est.	Unsupported	846 est.	Unsupported
Xeon Max 9460	40	2	688 est.	Unsupported	932 est.	Unsupported
Xeon Platinum 8490H	60	2	**980**	Unsupported	**986**	Unsupported
Xeon Platinum 8480+	56	2	**933**	Unsupported	**957**	Unsupported
Xeon Platinum 8470Q	52	2	**901**	Unsupported	**939**	Unsupported
Xeon Platinum 8470N	52	2	**819**	Unsupported	**870**	Unsupported
Xeon Platinum 8470	52	2	**892**	Unsupported	**930**	Unsupported
Xeon Platinum 8468V	48	2	**818**	Unsupported	**876**	Unsupported
Xeon Platinum 8468	48	2	**853**	Unsupported	**908**	Unsupported
Xeon Platinum 8462Y+	32	2	667 est.	Unsupported	771 est.	Unsupported
Xeon Platinum 8460Y+	40	2	**691**	Unsupported	**806**	Unsupported
Xeon Platinum 8458P	44	2	807 est.	Unsupported	874 est.	Unsupported
Xeon Platinum 8452Y	36	2	626 est.	Unsupported	724 est.	Unsupported
Xeon Gold 6548Q	32	2	**711**	Unsupported	**807**	Unsupported
Xeon Gold 6454S	32	2	**560**	Unsupported	**684**	Unsupported
Xeon Gold 6448Y	32	2	579 est.	Unsupported	694 est.	Unsupported
Xeon Gold 6444Y	16	2	388 est.	Unsupported	524 est.	Unsupported
Xeon Gold 6442Y	24	2	**490**	Unsupported	**631**	Unsupported
Xeon Gold 6438Y+	32	2	550 est.	Unsupported	650 est.	Unsupported
Xeon Gold 6438N	32	2	547 est.	Unsupported	655 est.	Unsupported
Xeon Gold 6438M	32	2	**558**	Unsupported	**659**	Unsupported
Xeon Gold 6434	8	2	**198**	Unsupported	**283**	Unsupported
Xeon Gold 6430	32	2	529 est.	Unsupported	636 est.	Unsupported
Xeon Gold 6428N	32	2	**501**	**503**	**589**	**591**
Xeon Gold 6426Y	16	2	333 est.	335 est.	446 est.	448 est.

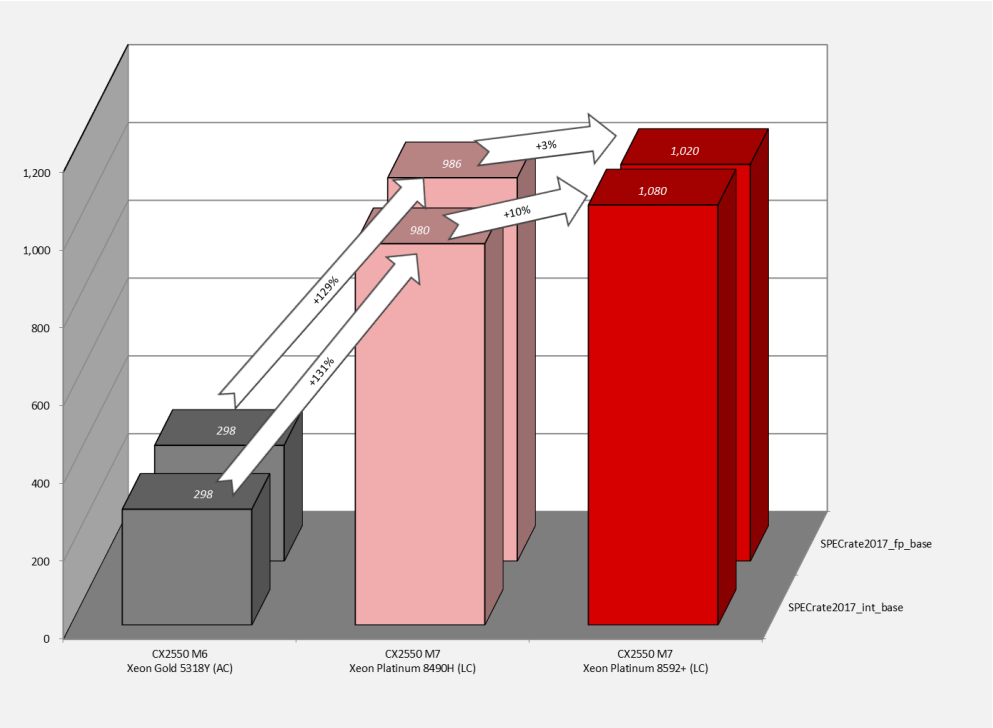
Processor model	Number of cores	Number of processors	SPECrate2017_int_base		SPECrate2017_fp_base	
			CX2550 M7	CX2560 M7	CX2550 M7	CX2560 M7
4th Generation Intel Xeon Scalable Processors Family (2CPU configuration, Continued)						
Xeon Gold 5420+	28	2	480 est.	Unsupported	593 est.	Unsupported
Xeon Gold 5418Y	24	2	418 est.	**419**	535 est.	537 est.
Xeon Gold 5418N	24	2	395 est.	**397**	483 est.	**485**
Xeon Gold 5416S	16	2	283 est.	284 est.	385 est.	386 est.
Xeon Gold 5415+	8	2	**178**	**178**	**254**	255 est.
Xeon Silver 4416+	20	2	**362**	364 est.	**457**	459 est.
Xeon Silver 4410Y	12	2	216 est.	**217**	321 est.	**322**
Xeon Silver 4410T	10	2	212 est.	213 est.	293 est.	294 est.
4th Generation Intel Xeon Scalable Processors Family (1CPU configuration)						
Xeon Gold 5412U	24	1	220 est.	**221**	282 est.	**283**
Xeon Bronze 3408U	8	1	43.2 est.	43.3 est.	75.6 est.	75.9 est.
5th Generation Intel Xeon Scalable Processors Family (2CPUconfiguration)						
Xeon Platinum 8592V	64	2	1040 est.	Unsupported	1,120 est.	Unsupported
Xeon Platinum 8592+	64	2	**1080**	Unsupported	**1,200**	Unsupported
Xeon Platinum 8580	60	2	1040 est.	Unsupported	1,170 est.	Unsupported
Xeon Platinum 8570	56	2	998 est.	Unsupported	1,130 est.	Unsupported
Xeon Platinum 8568Y+	48	2	918 est.	Unsupported	1,090 est.	Unsupported
Xeon Platinum 8562Y+	32	2	690 est.	Unsupported	847 est.	Unsupported
Xeon Platinum 8558P	48	2	914 est.	Unsupported	1,070 est.	Unsupported
Xeon Platinum 8558	48	2	856 est.	Unsupported	1,010 est.	Unsupported
Xeon Gold 6558Q	32	2	719 est.	Unsupported	844 est.	Unsupported
Xeon Gold 6554S	36	2	656 est.	Unsupported	830 est.	Unsupported
Xeon Gold 6548Y+	32	2	638 est.	Unsupported	783 est.	Unsupported
Xeon Gold 6548N	32	2	642 est.	Unsupported	787 est.	Unsupported
Xeon Gold 6544Y	16	2	389 est.	Unsupported	555 est.	Unsupported
Xeon Gold 6542Y	24	2	518 est.	Unsupported	692 est.	Unsupported
Xeon Gold 6538Y+	32	2	604 est.	Unsupported	750 est.	Unsupported
Xeon Gold 6538N	32	2	562 est.	Unsupported	718 est.	Unsupported
Xeon Gold 6534	8	2	200 est.	Unsupported	306 est.	Unsupported
Xeon Gold 6530	32	2	554 est.	Unsupported	745 est.	Unsupported
Xeon Gold 6526Y	16	2	345 est.	Unsupported	490 est.	Unsupported
Xeon Gold 5520+	28	2	511 est.	Unsupported	658 est.	Unsupported
Xeon Gold 5515+	8	2	177 est.	177 est.	284 est.	284 est.

Processor model	Number of cores	Number of processors	SPECrate2017_int_base		SPECrate2017_fp_base	
			CX2550 M7	CX2560 M7	CX2550 M7	CX2560 M7
5th Generation Intel Xeon Scalable Processors Family (2CPUconfiguration, Continued)						
Xeon Silver 4516Y+	24	2	428 est.	**428**	579 est.	**579**
Xeon Silver 4514Y	16	2	266 est.	266 est.	399 est.	399 est.
Xeon Silver 4510T	12	2	211 est.	211 est.	314 est.	314 est.
Xeon Silver 4510	12	2	242 est.	242 est.	363 est.	363 est.
Xeon Silver 4509Y	8	2	172 est.	172 est.	259 est.	259 est.
5th Generation Intel Xeon Scalable Processors Family (1CPU Configuration)						
Xeon Gold 5512U	28	1	258 est.	258 est.	340 est.	340 est.
Xeon Bronze 3508U	8	1	46.3 est.	46.3 est.	83.1 est.	83.1 est.

Processor model	Number of cores	Number of processors	SPECspeed2017_int_base		SPECspeed2017_fp_base	
			CX2550 M7	CX2560 M7	CX2550 M7	CX2560 M7
4th Generation Intel Xeon Scalable Processors Family						
Xeon Platinum 8490H	60	2	-	Unsupported	**356**	Unsupported
Xeon Platinum 8462Y+	32	2	**16.0**	Unsupported	-	Unsupported
Xeon Gold 6428N	32	2	-	-	**277**	277 est.
Xeon Gold 6426Y	16	2	**15.8**	15.8 est.	-	-
5th Generation Intel Xeon Scalable Processors Family						
Xeon Platinum 8592+	64	2	-	Unsupported	**416**	Unsupported
Xeon Platinum 8562Y+	32	2	**14.9**	Unsupported		Unsupported
Xeon Gold 5515+	8	2	-	**14.1**	-	-
Xeon Silver 4516Y+	12	2	-	-	-	**280**

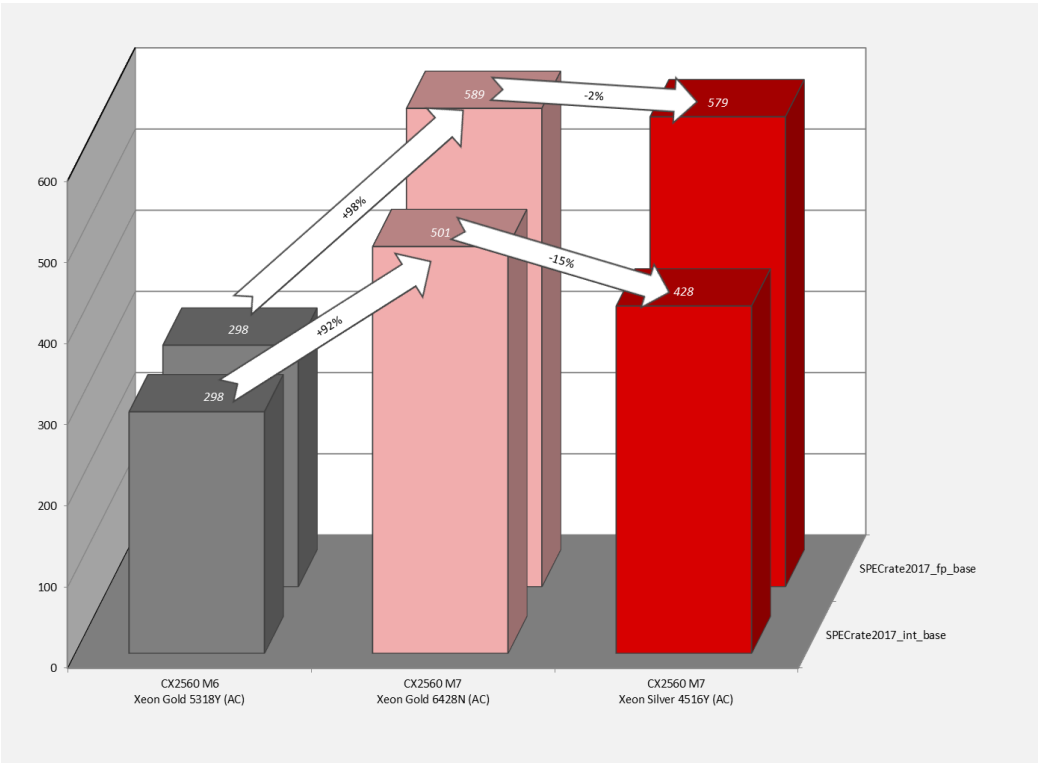
The following graphs compare the throughputs of PRIMERGY CX2550 M7 / CX2560 M7 and their older models, PRIMERGY CX2550 M6 / CX2560 M6, with maximum performance configurations.

Due to the lack of liquid-cooling support in CX2550 M6 (the previous generation), compared to the air-cooled Xeon Gold 5318Y (3rd Generation Xeon Scalable Processor), the CX2550 M7 with the liquid-cooled Xeon Platinum 8490H (4th Generation Xeon Scalable Processor) showed significant performance improvements of +129% to +131%. In addition, compared to the Xeon Platinum 8490H, the Xeon Platinum 8592+ (5th Generation Xeon Scalable Processor), which is also liquid-cooled, showed a performance improvement of +3% to +10%.



SPECrate2017: Comparison of PRIMERGY CX2550 M6 and PRIMERGY CX2550 M7

On the CX2560 M7, which only supports air-cooling, the Xeon Gold 6428N (4th Generation Xeon Scalable Processor) has a significant performance improvement of +92% to +98% over the previous generation Xeon Gold 5318Y (3rd Generation Xeon Scalable Processor). On the other hand, the Xeon Silver 4516Y (5th Generation Xeon Scalable Processor) achieved -2% to -15% worse performance than the Xeon Gold 6428N. This is because the Silver 4516Y, which has the largest core count in Intel 5th Generation Xeon Scalable Processor lineup supported by the CX2560 M7, has fewer cores than the Gold 6428 N.



SPECrate2017: Comparison of PRIMERGY CX2560 M6 and PRIMERGY CX2560 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 CX2550 M7 / CX2560 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.

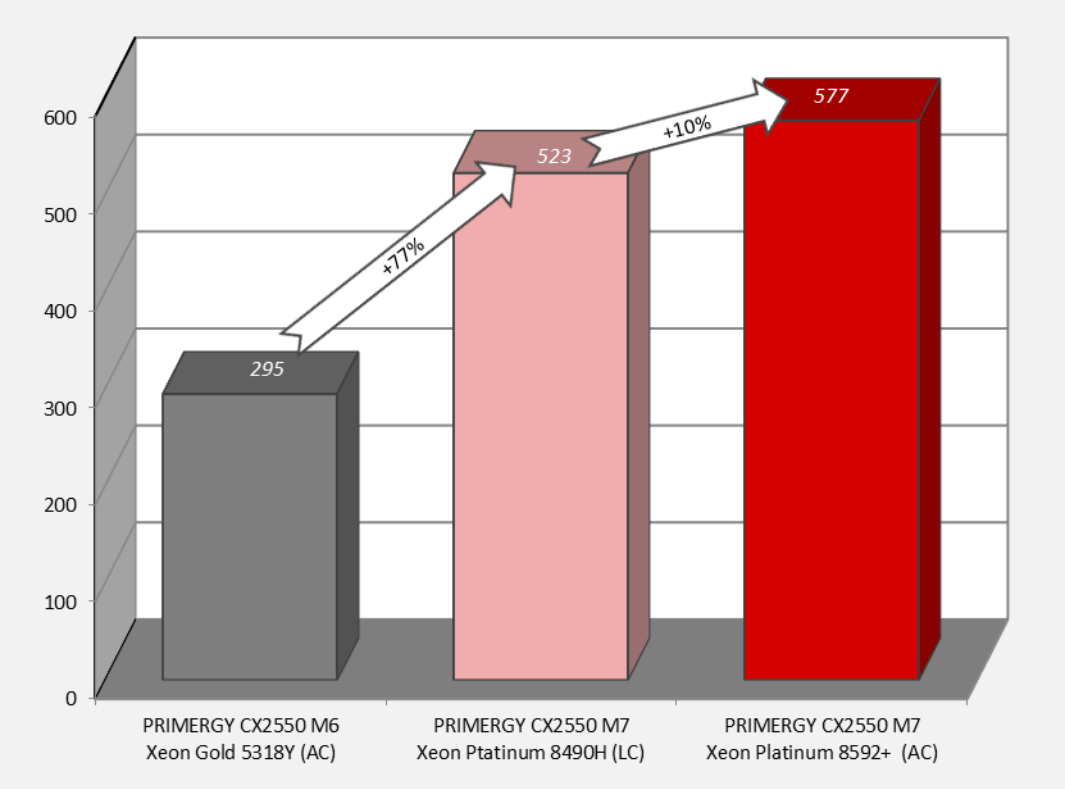
Processor	Memory tranfer rate [MT/s]	Maximum memory bandwidth [GB/s]	Number of cores	Rated frequency [GHz]	Number of processors	TRIAD [GB/s]	
						CX2550 M7	CX2560 M7
4th Generation Intel Xeon Scalable Processors Family (2CPU configuration)							
Xeon Max 9480	4,800	307	56	1.90	2	**516**	Unsupported
Xeon Max 9470	4,800	307	52	2.00	2	513 est.	Unsupported
Xeon Max 9468	4,800	307	48	2.10	2	514 est.	Unsupported
Xeon Max 9462	4,800	307	32	2.70	2	491 est.	Unsupported
Xeon Max 9460	4,800	307	40	2.20	2	514 est.	Unsupported
Xeon Platinum 8490H	4,800	307	60	1.90	2	**523**	Unsupported
Xeon Platinum 8480+	4,800	307	56	2.00	2	**518**	Unsupported
Xeon Platinum 8470Q	4,800	307	52	2.10	2	**492**	Unsupported
Xeon Platinum 8470N	4,800	307	52	1.70	2	**487**	Unsupported
Xeon Platinum 8470	4,800	307	52	2.00	2	**511**	Unsupported
Xeon Platinum 8468V	4,800	307	48	2.40	2	**490**	Unsupported
Xeon Platinum 8468	4,800	307	48	2.10	2	**485**	Unsupported
Xeon Platinum 8462Y+	4,800	307	32	2.80	2	474 est.	Unsupported
Xeon Platinum 8460Y+	4,800	307	40	2.00	2	**469**	Unsupported
Xeon Platinum 8458P	4,800	307	44	2.70	2	498 est.	Unsupported
Xeon Platinum 8452Y	4,800	307	36	2.00	2	452 est.	Unsupported
Xeon Gold 6548Q	4,800	307	32	3.10	2	**444**	Unsupported
Xeon Gold 6454S	4,800	307	32	2.20	2	**445**	Unsupported
Xeon Gold 6448Y	4,800	307	32	2.10	2	467 est.	Unsupported
Xeon Gold 6444Y	4,800	307	16	3.60	2	383 est.	Unsupported
Xeon Gold 6442Y	4,800	307	24	2.60	2	**454**	Unsupported
Xeon Gold 6438Y+	4,800	307	32	2.00	2	463 est.	Unsupported
Xeon Gold 6438N	4,800	307	32	2.00	2	464 est.	Unsupported
Xeon Gold 6438M	4,800	307	32	2.20	2	464 est.	Unsupported
Xeon Gold 6434	4,800	307	8	3.70	2	**234**	Unsupported
Xeon Gold 6430	4,400	282	32	2.10	2	419 est.	Unsupported
Xeon Gold 6428N	4,000	256	32	1.80	2	**407**	**408**
Xeon Gold 6426Y	4,800	307	16	2.50	2	348 est.	349 est.

Processor	Memory tranfer rate [MT/s]	Maximum memory bandwidth [GB/s]	Number of cores	Rated frequency [GHz]	Number of processors	TRIAD [GB/s]	
						CX2550 M7	CX2560 M7
4th Generation Intel Xeon Scalable Processors Family (2CPU configuration, Continued)							
Xeon Gold 5420+	4,400	282	28	2.00	2	418 est.	Unsupported
Xeon Gold 5418Y	4,400	282	24	2.00	2	387 est.	**387**
Xeon Gold 5418N	4,000	256	24	1.80	2	361 est.	**361**
Xeon Gold 5416S	4,400	282	16	2.00	2	287 est.	**288**
Xeon Gold 5415+	4,400	282	8	2.90	2	**215**	215 est.
Xeon Silver 4416+	4,000	256	20	2.00	2	**331**	332 est.
Xeon Silver 4410Y	4,000	256	12	2.00	2	266 est.	**267**
Xeon Silver 4410T	4,000	256	10	2.70	2	239 est.	239 est.
4th Generation Intel Xeon Scalable Processors Family (1CPU configuration)							
Xeon Gold 5412U	4,400	282	24	2.10	1	207 est.	**207**
Xeon Bronze 3408U	4,000	256	8	1.80	1	123 est.	123 est.
5th Generation Intel Xeon Scalable Processors Family (2CPU configuration)							
Xeon Platinum 8592V	4,800	307	64	2.00	2	524 est.	Unsupported
Xeon Platinum 8592+	5,600	358	64	1.90	2	**577**	Unsupported
Xeon Platinum 8580	5,600	358	60	2.00	2	574 est.	Unsupported
Xeon Platinum 8570	5,600	358	56	2.10	2	578 est.	Unsupported
Xeon Platinum 8568Y+	5,600	358	48	2.30	2	568 est.	Unsupported
Xeon Platinum 8562Y+	5,600	358	32	2.80	2	495 est.	Unsupported
Xeon Platinum 8558P	5,600	358	48	2.70	2	566 est.	Unsupported
Xeon Platinum 8558	5,200	333	48	2.10	2	540 est.	Unsupported
Xeon Gold 6558Q	5,200	333	32	3.20	2	467 est.	Unsupported
Xeon Gold 6554S	5,200	333	36	2.20	2	493 est.	Unsupported
Xeon Gold 6548Y+	5,200	333	32	2.50	2	471 est.	Unsupported
Xeon Gold 6548N	5,200	333	32	2.80	2	474 est.	Unsupported
Xeon Gold 6544Y	5,200	333	16	3.60	2	393 est.	Unsupported
Xeon Gold 6542Y	5,200	333	24	2.90	2	464 est.	Unsupported
Xeon Gold 6538Y+	5,200	333	32	2.20	2	467 est.	Unsupported
Xeon Gold 6538N	5,200	333	32	2.10	2	466 est.	Unsupported
Xeon Gold 6534	4,800	307	8	3.90	2	239 est.	Unsupported
Xeon Gold 6530	4,800	307	32	2.10	2	464 est.	Unsupported
Xeon Gold 6526Y	5,200	333	16	2.80	2	359 est.	Unsupported
Xeon Gold 5520+	4,800	307	28	2.20	2	433 est.	Unsupported

Processor	Memory tranfer rate [MT/s]	Maximum memory bandwidth [GB/s]	Number of cores	Rated frequency [GHz]	Number of processors	TRIAD [GB/s]	
						CX2550 M7	CX2560 M7
5th Generation Intel Xeon Scalable Processors Family (2CPU configuration, Continued)							
Xeon Gold 5515+	4,800	307	8	3.20	2	248 est.	248 est.
Xeon Silver 4516Y+	4,400	282	24	2.20	2	403 est.	**403**
Xeon Silver 4514Y	4,400	282	16	2.00	2	308 est.	308 est.
Xeon Silver 4510T	4,400	282	12	2.00	2	288 est.	288 est.
Xeon Silver 4510	4,400	282	12	2.40	2	299 est.	299 est.
Xeon Silver 4509Y	4,400	282	8	2.60	2	222 est.	222 est.
5th Generation Intel Xeon Scalable Processors Family (1CPU configuration)							
Xeon Gold 5512U	4,800	307	28	2.10	1	242 est.	242 est.
Xeon Bronze 3508U	4,400	282	8	2.10	1	133 est.	133 est.

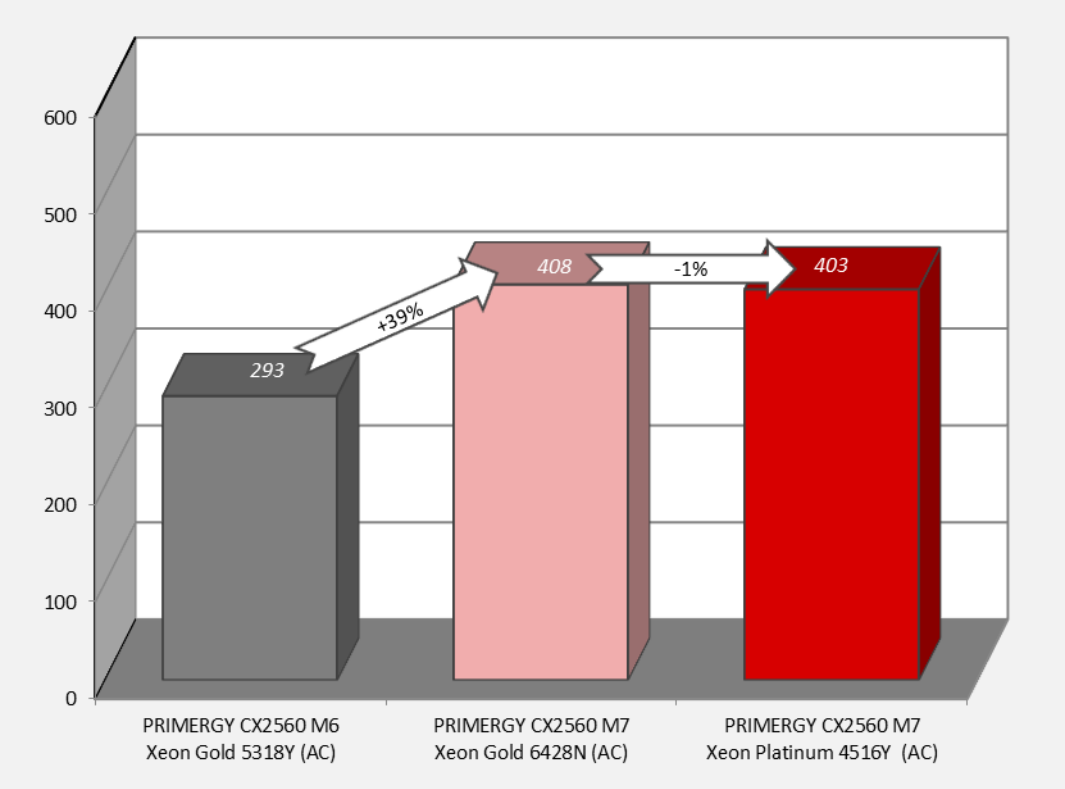
The following graphs compare the throughputs of PRIMERGY CX2550 M7 / CX2560 M7 and their older models, PRIMERGY CX2550 M6 / CX2560 M6, with maximum performance configurations.

Due to the lack of liquid-cooling support in CX2550 M6 (the previous generation), compared to the air-cooled Xeon Gold 5318Y (3rd Generation Xeon Scalable Processor), the CX2550 M7 with the liquid-cooled Xeon Platinum 8490H (4th Generation Xeon Scalable Processor) showed a significant performance improvement of +77%. In addition, compared to the Xeon Platinum 8490H, the Xeon Platinum 8592+ (5th Generation Xeon Scalable Processor), which is also liquid-cooled, showed a performance improvement of +10%.



STREAM: Comparison of PRIMERGY CX2550 M6 and PRIMERGY CX2560 M7

On the CX2560 M7, which only supports air-cooling, the Xeon Gold 6428N (4th Generation Xeon Scalable Processor) has a significant performance improvement of +39% over the previous generation Xeon Gold 5318Y (3rd Generation Xeon Scalable Processor). On the other hand, the Xeon Silver 4516Y (5th Generation Xeon Scalable Processor) achieved almost same performance as the Xeon Gold 6428N.



STREAM: Comparison of PRIMERGY CX2550 M6 and PRIMERGY CX2560 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 http://www.top500.org/. This requires using an HPL-based LINPACK version (see http://www.netlib.org/benchmark/hpl/).

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

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

System Under Test (SUT)	
Hardware	
• Model	PRIMERGY CX2550 M7 / CX2560 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
• 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]	CX2550 M7		CX2560 M7	
					Rmax [GFlops]	Effic.	Rmax [GFlops]	Effic.
4th Generation Intel Xeon Scalable Processors Family (2CPU configuration)								
Xeon Max 9480	56	1.90	2	6,810	**6,781**	100%	Unsupported	
Xeon Max 9470	52	2.00	2	6,656	6,706 est.	101%	Unsupported	
Xeon Max 9468	48	2.10	2	6,451	6,616 est.	103%	Unsupported	
Xeon Max 9462	32	2.70	2	5,530	5,545 est.	123%	Unsupported	
Xeon Max 9460	40	2.20	2	5,632	6,092 est.	108%	Unsupported	
Xeon Platinum 8490H	60	1.90	2	7,296	**7,584**	100%	Unsupported	
Xeon Platinum 8480+	56	2.00	2	7,168	**7,293**	102%	Unsupported	
Xeon Platinum 8470Q	52	2.10	2	6,989	**7,051**	101%	Unsupported	
Xeon Platinum 8470N	52	1.70	2	5,658	**6,264**	111%	Unsupported	
Xeon Platinum 8470	52	2.00	2	6,656	**7,051**	106%	Unsupported	
Xeon Platinum 8468V	48	2.40	2	7,373	**7,022**	95%	Unsupported	
Xeon Platinum 8468	48	2.10	2	6,451	**6,698**	104%	Unsupported	
Xeon Platinum 8462Y+	32	2.80	2	5,734	5,810 est.	101%	Unsupported	
Xeon Platinum 8460Y+	40	2.00	2	5,120	**5,538**	108%	Unsupported	
Xeon Platinum 8458P	44	2.70	2	7,603	6,483 est.	85%	Unsupported	
Xeon Platinum 8452Y	36	2.00	2	4,608	5,444 est.	118%	Unsupported	
Xeon Gold 6548Q	32	3.10	2	6,349	**6,160**	97%	Unsupported	
Xeon Gold 6454S	32	2.20	2	4,506	**4,667**	104%	Unsupported	
Xeon Gold 6448Y	32	2.10	2	4,301	4,724 est.	110%	Unsupported	
Xeon Gold 6444Y	16	3.60	2	3,686	3,679 est.	100%	Unsupported	
Xeon Gold 6442Y	24	2.60	2	3,994	**4,133**	103%	Unsupported	
Xeon Gold 6438Y+	32	2.00	2	4,096	4,426 est.	108%	Unsupported	
Xeon Gold 6438N	32	2.00	2	4,096	4,536 est.	111%	Unsupported	
Xeon Gold 6438M	32	2.20	2	4,506	4,600 est.	102%	Unsupported	
Xeon Gold 6434	8	3.70	2	1,894	1,933 est.	102%	Unsupported	
Xeon Gold 6430	32	2.10	2	4,301	4,544 est.	106%	Unsupported	
Xeon Gold 6428N	32	1.80	2	3,686	**4,025**	109%	4,132 est.	112%
Xeon Gold 6426Y	16	2.50	2	2,560	3,006 est.	117%	3,086 est.	121%
Xeon Gold 5420+	28	2.00	2	3,584	4,125 est.	115%	Unsupported	
Xeon Gold 5418Y	24	2.00	2	3,072	3,452 est.	112%	**3,544**	115%
Xeon Gold 5418N	24	1.80	2	2,765	3,080 est.	111%	3,162 est.	114%

Processor	Number of cores	Rated frequency [GHz]	Number of processors	Rpeak [GFlops]	CX2550 M7		CX2560 M7	
					Rmax [GFlops]	Effic.	Rmax [GFlops]	Effic.
4th Generation Intel Xeon Scalable Processors Family (2CPU configuration, Continued)								
Xeon Gold 5416S	16	2.00	2	2,048	2,303 est.	112%	2,364 est.	115%
Xeon Gold 5415+	8	2.90	2	1,485	**1,590**	107%	1,632 est.	110%
Xeon Silver 4416+	20	2.00	2	2,560	**2,940**	115%	3,018 est.	118%
Xeon Silver 4410Y	12	2.00	2	1,536	1,833 est.	119%	1,881 est.	122%
Xeon Silver 4410T	10	2.70	2	1,728	1,964 est.	114%	2,016 est.	117%
4th Generation Intel Xeon Scalable Processors Family (1CPU configuration)								
Xeon Gold 5412U	24	2.10	1	1,613	1,840 est.	114%	**1,888**	117%
Xeon Bronze 3408U	8	1.80	1	230	255 est.	111%	261 est.	113%
5th Generation Intel Xeon Scalable Processors Family (2CPU configuration)								
Xeon Platinum 8592V	64	2.00	2	8,192	8,159 est.	100%	Unsupported	
Xeon Platinum 8592+	64	1.90	2	7,782	**8,542**	110%	Unsupported	
Xeon Platinum 8580	60	2.00	2	7,680	8,253 est.	107%	Unsupported	
Xeon Platinum 8570	56	2.10	2	7,526	7,916 est.	105%	Unsupported	
Xeon Platinum 8568Y+	48	2.30	2	7,066	7,465 est.	106%	Unsupported	
Xeon Platinum 8562Y+	32	2.80	2	5,734	6,368 est.	111%	Unsupported	
Xeon Platinum 8558P	48	2.70	2	8,294	7,387 est.	89%	Unsupported	
Xeon Platinum 8558	48	2.10	2	6,451	7,040 est.	109%	Unsupported	
Xeon Gold 6558Q	32	3.20	2	6,349	7,181 est.	113%	Unsupported	
Xeon Gold 6554S	36	2.20	2	5,069	5,341 est.	105%	Unsupported	
Xeon Gold 6548Y+	32	2.50	2	5,120	5,725 est.	112%	Unsupported	
Xeon Gold 6548N	32	2.80	2	5,734	5,603 est.	98%	Unsupported	
Xeon Gold 6544Y	16	3.60	2	3,686	3,986 est.	108%	Unsupported	
Xeon Gold 6542Y	24	2.90	2	4,454	4,880 est.	110%	Unsupported	
Xeon Gold 6538Y+	32	2.20	2	4,506	5,206 est.	116%	Unsupported	
Xeon Gold 6538N	32	2.10	2	4,301	4,809 est.	112%	Unsupported	
Xeon Gold 6534	8	3.90	2	1,997	2,068 est.	104%	Unsupported	
Xeon Gold 6530	32	2.10	2	4,301	5,063 est.	118%	Unsupported	
Xeon Gold 6526Y	16	2.80	2	2,867	3,242 est.	113%	Unsupported	
Xeon Gold 5520+	28	2.20	2	3,942	4,524 est.	115%	Unsupported	
Xeon Gold 5515+	8	3.20	2	1,638	1,594 est.	97%	1,594 est.	97%
Xeon Silver 4516Y+	24	2.20	2	3,379	3,394 est.	100%	**3,394**	100%
Xeon Silver 4514Y	16	2.00	2	2,048	2,272 est.	111%	2,272 est.	111%
Xeon Silver 4510T	12	2.00	2	1,536	1,536 est.	100%	1,536 est.	100%

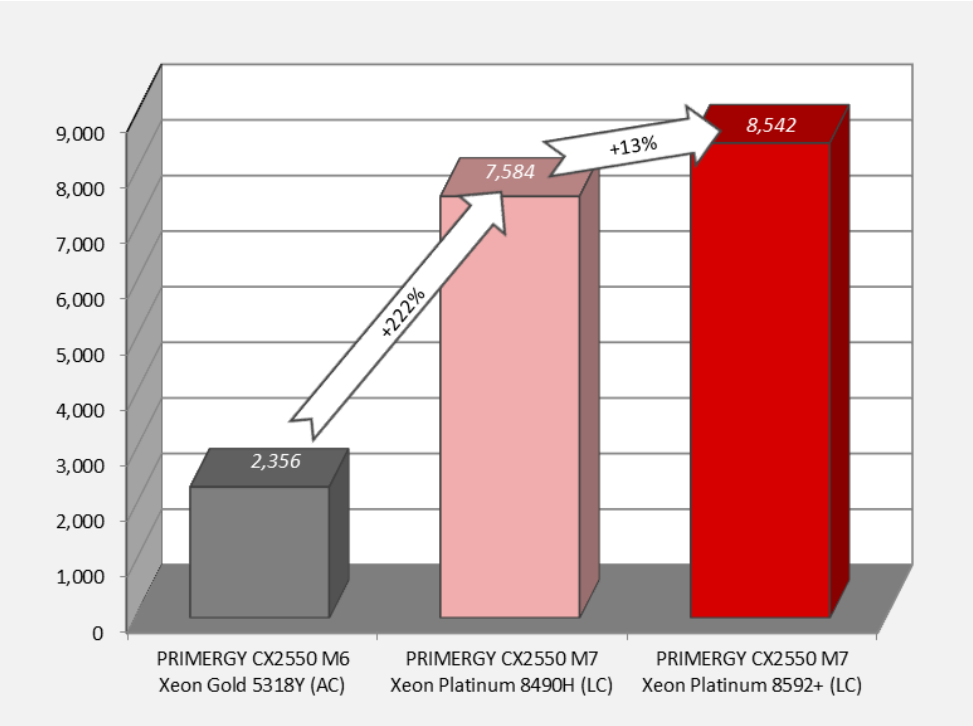
Processor	Number of cores	Rated frequency [GHz]	Number of processors	Rpeak [GFlops]	CX2550 M7		CX2560 M7	
					Rmax [GFlops]	Effic.	Rmax [GFlops]	Effic.
5th Generation Intel Xeon Scalable Processors Family (2CPU configuration, Continued)								
Xeon Silver 4510	12	2.40	2	1,843	1,784 est.	97%	1,784 est.	97%
Xeon Silver 4509Y	8	2.60	2	1,331	1,196 est.	90%	1,196 est.	90%
5th Generation Intel Xeon Scalable Processors Family (1CPU configuration)								
Xeon Gold 5512U	28	2.10	1	1,882	1,911 est.	102%	1,911 est.	102%
Xeon Bronze 3508U	8	2.10	1	269	227 est.	84%	227 est.	84%

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.

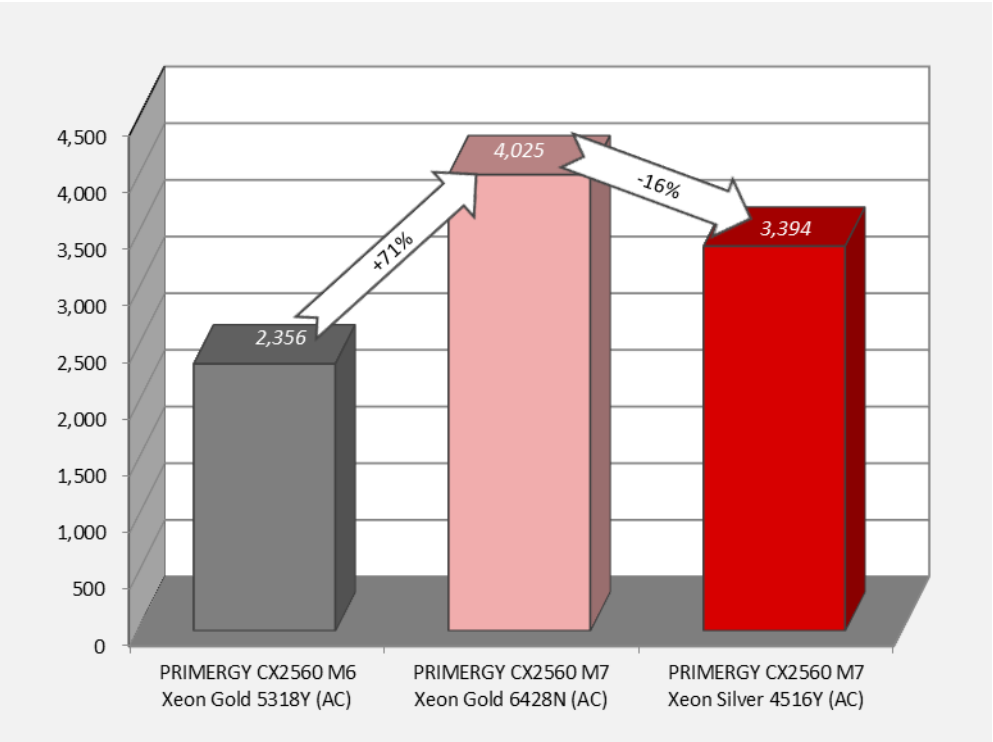
The following graphs compare the throughputs of PRIMERGY CX2550 M7 / CX2560 M7 and their older models, PRIMERGY CX2550 M6 / CX2560 M6, with maximum performance configurations.

Due to the lack of liquid-cooling support in CX2550 M6 (the previous generation), compared to the air-cooled Xeon Gold 5318Y (3rd Generation Xeon Scalable Processor), the CX2550 M7 with the liquid-cooled Xeon Platinum 8490H (4th Generation Xeon Scalable Processor) showed a significant performance improvement of +22%. In addition, compared to the Xeon Platinum 8490H, the Xeon Platinum 8592+ (5th Generation Xeon Scalable Processor), which is also liquid-cooled, showed a performance improvement of +13%.



LINPACK: Comparison of PRIMERGY CX2550 M6 and PRIMERGY CX2550 M7

On the CX2560 M7, which only supports air-cooling, the Xeon Gold 6428N (4th Generation Xeon Scalable Processor) has a significant performance improvement of +71% over the previous generation Xeon Gold 5318Y (3rd Generation Xeon Scalable Processor). On the other hand, the Xeon Silver 4516Y (5th Generation Xeon Scalable Processor) achieved -16% worse performance than the Xeon Gold 6428N. This is because the Silver 4516Y, which has the largest core count in Intel 5th Generation Xeon Scalable Processor lineup supported by the CX2560 M7, has fewer cores than the Gold 6428 N.



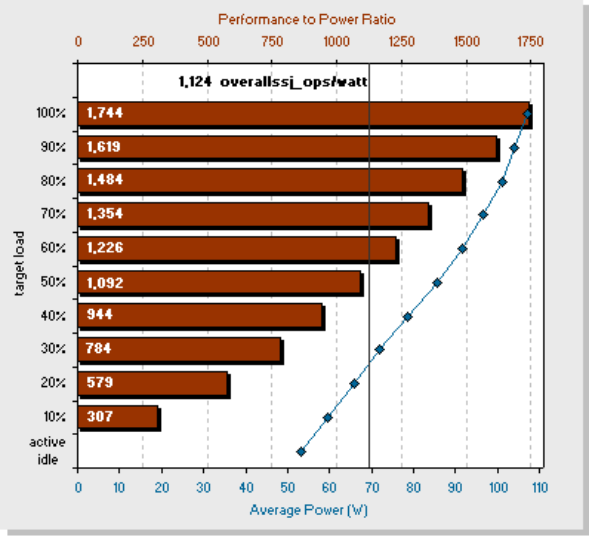
LINPACK: Comparison of PRIMERGY CX2560 M6 and PRIMERGY CX2560 M7

SPECpower_ssj2008

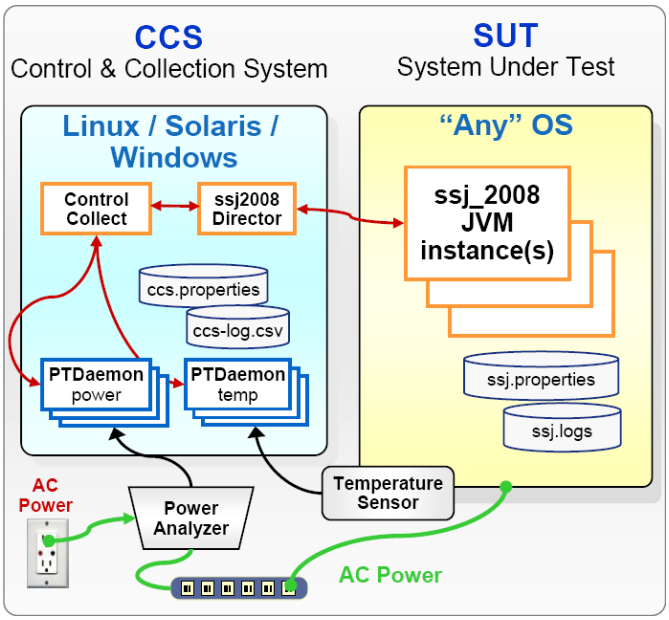
Benchmark description

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 (chassis)

• Enclosure	PRIMERGY CX400 M7
• Power Supply Unit	2 x 2600W titanium PSU
• Number of servers	4
• Model	PRIMERGY CX2560 M7

Hardware (per node)

• Processor	2 x Xeon Gold 6428N 32C 1.80GHz 185W
• Memory	16 x 16GB (1x16GB) 1Rx8 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

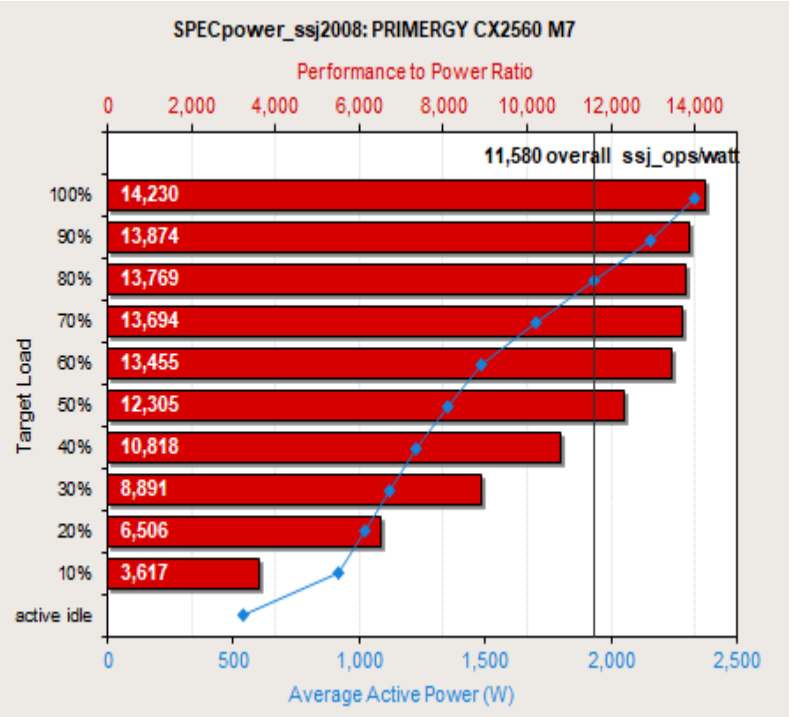
Software

• BIOS settings	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 SNC2 SATA Controller = Disabled USB Port Control = Disable all ports Network Stack = 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% Turn off display after = 1 Minute POWERCFG /SETACVALUEINDEX SCHEME_CURRENT SUB_PROCESSOR PERFBOOSTMODE 4 POWERCFG /SETACVALUEINDEX SCHEME_CURRENT SUB_PROCESSOR PERFINCTHRESHOLD 95 POWERCFG /SETACVALUEINDEX SCHEME_CURRENT SUB_PROCESSOR PERFDECTHRESHOLD 93 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	Oracle Java HotSpot(TM) 64-Bit Server VM 18.9 (build 11.0.16.1+1-LTS, mixed mode)
• JVM settings	-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

Benchmark results

The PRIMERGY CX2560 M7 in Microsoft Windows Server 2022 Standard achieved the following result:

SPECpower_ssj2008 = 11,580 overall ssj_ops/watt



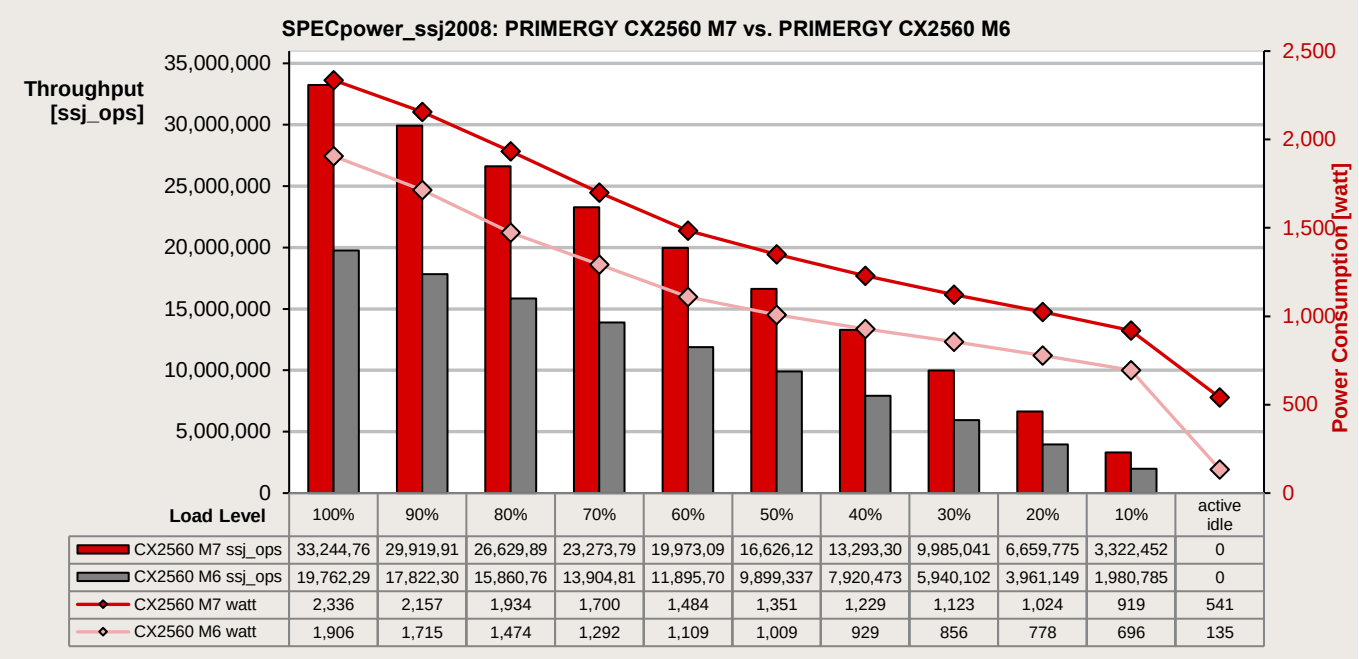
The adjoining diagram shows the result of the configuration described above. The red horizontal bars show the performance to power ratio in ssj_ops/watt (upper x-axis) for each target load level tagged on the y-axis of the diagram. The blue line shows the run of the curve for the average power consumption (bottom x-axis) at each target load level marked with a small rhomb. The black vertical line shows the benchmark result of 11,580 overall ssj_ops/watt for the PRIMERGY CX2560 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%	33,244,766	2,336	14,230
90%	29,919,914	2,157	13,874
80%	26,629,892	1,934	13,769
70%	23,273,792	1,700	13,694
60%	19,973,092	1,484	13,455
50%	16,626,128	1,351	12,305
40%	13,293,306	1,229	10,818
30%	9,985,041	1,123	8,891
20%	6,659,775	1,024	6,506
10%	3,322,452	919	3,617
Active Idle	0	541	0
			Σ ssj_ops / Σ power = 11,580

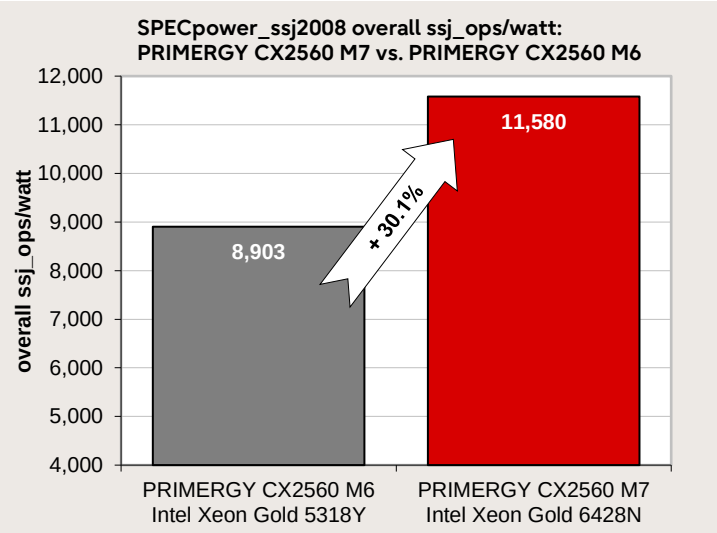
Comparison with the predecessor

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 CX2560 M7 compared to the predecessor PRIMERGY CX2560 M6.



Load Level	100%	90%	80%	70%	60%	50%	40%	30%	20%	10%	active idle
CX2560 M7 ssj_ops	33,244,76	29,919,91	26,629,89	23,273,79	19,973,09	16,626,12	13,293,30	9,985,041	6,659,775	3,322,452	0
CX2560 M6 ssj_ops	19,762,29	17,822,30	15,860,76	13,904,81	11,895,70	9,899,337	7,920,473	5,940,102	3,961,149	1,980,785	0
CX2560 M7 watt	2,336	2,157	1,934	1,700	1,484	1,351	1,229	1,123	1,024	919	541
CX2560 M6 watt	1,906	1,715	1,474	1,292	1,109	1,009	929	856	778	696	135

Thanks to the 4th Generation Intel Xeon Scalable Processors Family, the PRIMERGY CX2560 M7 has a higher throughput. This results in an overall 30.1% increase in energy efficiency in the PRIMERGY CX2560 M7.



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	
PRAID CP600i	-	PCIe 4.0 x8	SATA 6G SAS 12G	8	0, 1, 10
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
Onboard M.2 Slot	-	DMI 3.0 x4	SATA 6G	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.

Storage media type	Interface	Form factor
HDD	SAS 12G	2.5 inch
SSD	SAS 12G	2.5 inch
	SATA 6G	2.5 inch
SSD	SATA 6G	M.2

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

Storage media	Category	Drive name
HDD	SAS HDD (SAS 12Gbps, 10k rpm) [512e]	AL15SEB18EQ (*1)
		AL15SEB24EQ (*1)
	SAS HDD (SAS 12Gbps, 10k rpm) [512n]	AL15SEB030N (*1)
		AL15SEB120N (*1)

(*1) Not supported on CX2550 M7.

Storage media	Category	Drive name
SSD	SAS SSD (SAS 12Gbps, Write Intensive)	XS400ME70084 (*1)
		XS800ME70084 (*1)
		XS1600ME70084 (*1)
	SAS SSD (SAS 12Gbps, Mixed Use)	XS800LE70084 (*1)
		XS1600LE70084 (*1)
		XS3200LE70084 (*1)
		XS6400LE70084 (*1)
	SAS SSD (SAS 12Gbps, Read Intensive)	XS960SE70084 (*1)
		XS1920SE70084 (*1)
		XS3840SE70084 (*1)
		XS7680SE70084 (*1)
		XS15360SE70084 (*1)
	SATA SSD (SATA 6Gbps, Mixed Use)	MTFDDAK480TGB
		MTFDDAK960TGB
		MTFDDAK1T9TGB
		MTFDDAK3T8TGB
	SATA SSD (SATA 6Gbps, Read Intensive)	MTFDDAK240TGA
		MTFDDAK480TGA
		MTFDDAK960TGA
		MTFDDAK1T9TGA
		MTFDDAK3T8TGA

(*1) Not supported on CX2550 M7.

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

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		1
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.

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
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

M.2 SSDs

Capacity [GB]	Storage device	Interface	Transactions [IO/s]			Throughput [MiB/s]	
			Database	Fileserver	Filecopy	Streaming	Restore
☐ M.2 SATA SSD (Onboard M.2 slot)							
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

OLTP-2

Benchmark description

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

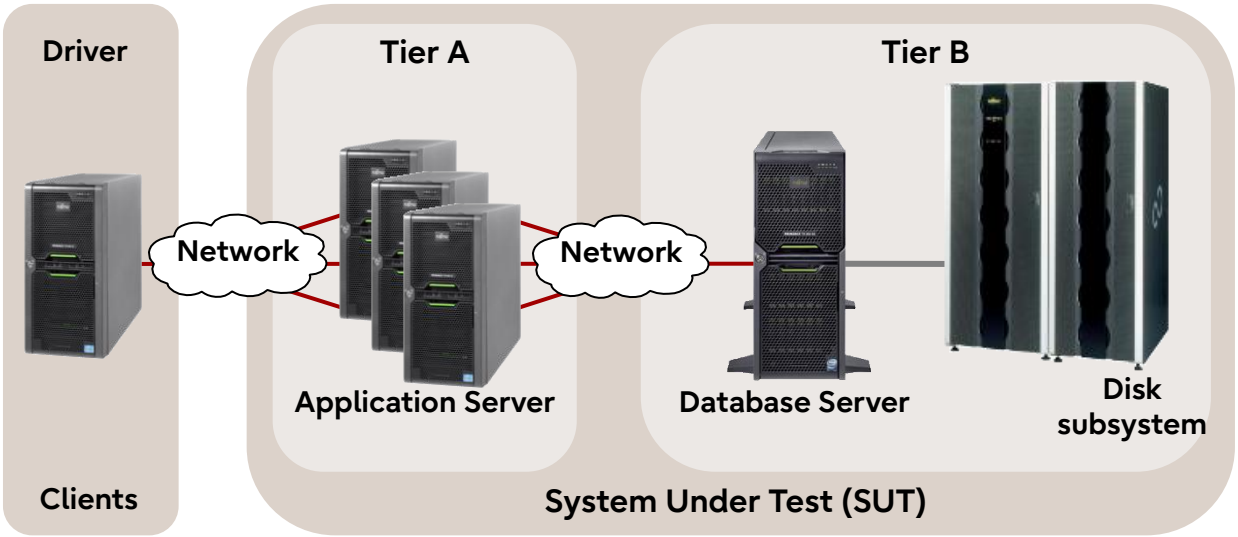
In contrast to benchmarks such as SPEC CPU and TPC-E, which were standardized by independent bodies and for which adherence to the respective rules and regulations are monitored, OLTP-2 is an internal benchmark of Fujitsu. OLTP-2 is based on the well-known database benchmark TPC-E. OLTP-2 was designed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

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

Further information can be found in the document Benchmark Overview OLTP-2.

Benchmark environment

The typical measurement set-up is illustrated below:



All OLTP-2 results were calculated based on the configuration of the next following pages of PRIMERGY RX2540 M7.

Database Server (Tier B)

Hardware

• Model	PRIMERGY RX2540 M7
• Processor	4th Generation Intel Xeon Scalable Processor Family
• Memory	32 x 64 GB (1x64 GB) 2Rx4 DDR5-4800 ECC
• Network interface	1 x PLAN EP X710-DA2 2x10Gb SFP+ 1 x PLAN CP I350-T4 4X 1000BASE-T OCPv3 PT
• 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 28C 2.5GHz 205W
• Memory	12 x 16GB (1x16GB) 1Rx4 DDR4-2666 R ECC
• Network interface	1 x PLAN EP X710-DA2 2x10Gb SFP+ LP 2 x RJ45 1GbE ports on systemboard
• Disk subsystem	2 x HDD SAS 2.5" 10K 512n (SFF) 300GB

Software

• Operating system	Microsoft Windows Server 2016 Standard

Client

Hardware

• Model	1 x PRIMERGY RX2530 M2
• Processor	2 x Xeon E5-2667v4 8C/16T 3.20GHz 25MB 9.6GT/s 2400MHz 135W
• Memory	8 x 16GB (1x16GB) 2Rx4 DDR4-2400 R ECC
• Network interface	1 x PLAN EM 4x1Gb T interface card
• Disk subsystem	1 x HDD SAS 2.5" 10K 512n (SFF) 300GB

Software

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

Benchmark results

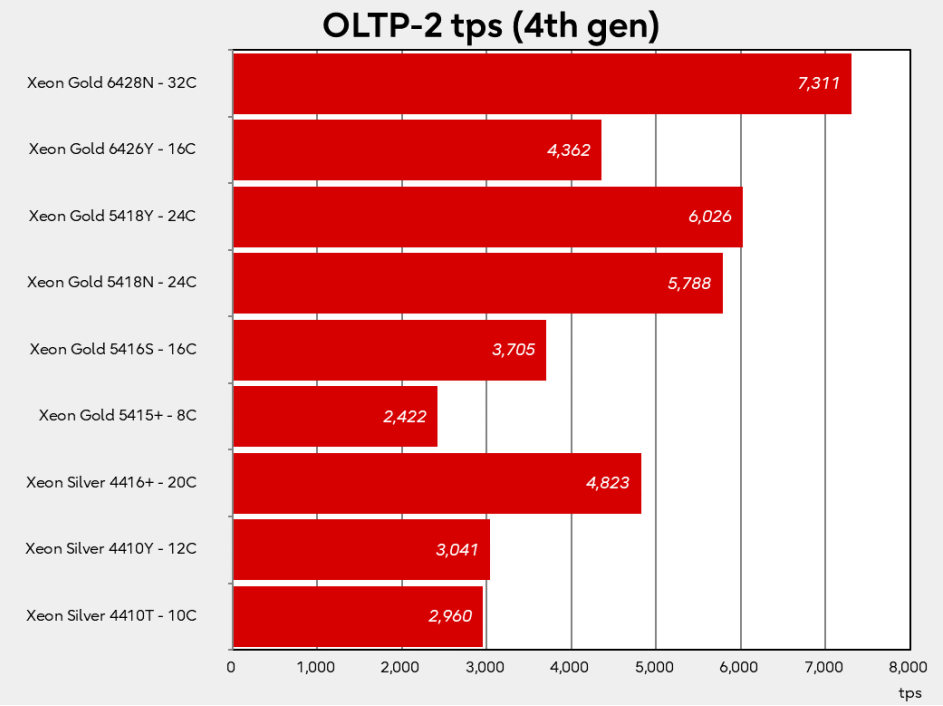
Database performance greatly depends on the configuration options with CPU, memory and on the connectivity of an adequate disk subsystem for the database. In the following scaling considerations for the processors we assume that both the memory and the disk subsystem has been adequately chosen and is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

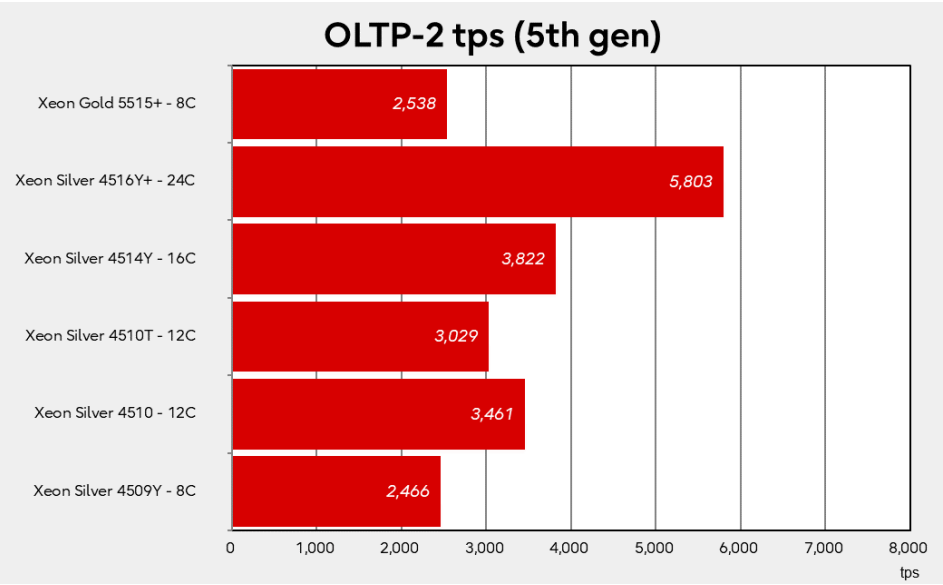
A guideline in the database environment for selecting main memory is that sufficient quantity is important. This why a configuration with a total memory of 1024 GB was considered for the estimation with two processors.

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

Processor	Cores	Threads	2CPU Score
4th Generation Xeon Scalable Processors (2CPU configuration)			
Xeon Gold 6428N	32	64	7,311 est.
Xeon Gold 6426Y	16	32	4,362 est.
Xeon Gold 5418Y	24	48	6,026 est.
Xeon Gold 5418N	24	48	5,788 est.
Xeon Gold 5416S	16	32	3,705 est.
Xeon Gold 5415+	8	16	2,422 est.
Xeon Silver 4416+	20	40	4,823 est.
Xeon Silver 4410Y	12	24	3,041 est.
Xeon Silver 4410T	10	20	2,960 est.
5th Generation Xeon Scalable Processors (2CPU configuration)			
Xeon Gold 5418N	24	48	2,538 est.
Xeon Gold 5416S	16	32	5,803 est.
Xeon Gold 5415+	8	16	3,822 est.
Xeon Silver 4416+	20	40	3,029 est.
Xeon Silver 4410Y	12	24	3,461 est.
Xeon Silver 4410T	10	20	2,466 est.

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

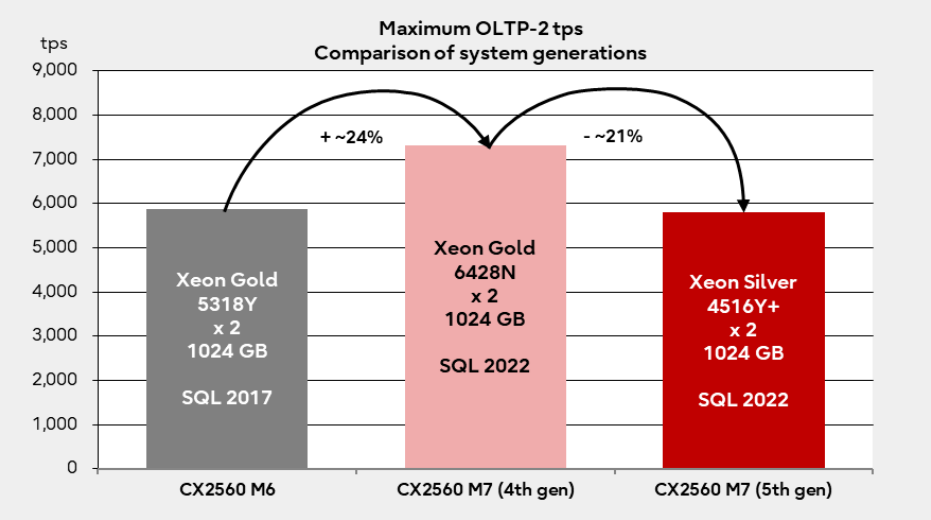




The features of the processors are summarized in the section "Technical data."

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 CX2560 M7 is about 24% higher than that on the previous PRIMERGY CX2560 M6. On the other hand, the highest value on CX2560 M7 with the 5th Generation Intel Xeon Scalable Processor Family is dropped by about 21% compared to that with the 4th Generation processor. This is because Intel's processor lineup of 5th Generation Xeon Scalable Processor available to the CX2560 M7 has a lower maximum core count. If the number of cores matters, we recommend to select a processor from the 4th Generation Intel Xeon Processor family.



Literature

PRIMERGY Servers

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

PRIMERGY CX2550 M7 / CX2560 M7

This Whitepaper

https://docs.ts.fujitsu.com/dl.aspx?id=b5a565d4-3621-4ee4-abd8-5520f477c68d

https://docs.ts.fujitsu.com/dl.aspx?id=ff75ca36-4545-45dc-9856-7f38c1f5b85e

Data sheet

CX400 M7: https://docs.ts.fujitsu.com/dl.aspx?id=b4d5aa5c-bc24-46c7-8bdb-341d3022b2d0

CX2550 M7: https://docs.ts.fujitsu.com/dl.aspx?id=75d4b451-3e2b-49ba-b986-1ddd7902e904

CX2560 M7: https://docs.ts.fujitsu.com/dl.aspx?id=75238bfe-708f-44fe-b654-e789712a0ce6

PRIMERGY Performance

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

SPEC CPU2017

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

Benchmark Overview SPECcpu2017

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

STREAM

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

LINPACK

The LINPACK Benchmark: Past, Present, and Future

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

TOP500

https://www.top500.org/

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

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

Intel Math Kernel Library – LINPACK Download

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

SPECpower_ssj2008

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Benchmark Overview SPECpower_ssj2008

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

OLTP-2

Benchmark Overview OLTP-2

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

Document change history

Version	Date	Description
1.3	2024-07-02	Update: • Technical data • SPEC CPU2017, STREAM, LINPACK Measured and calculated with 5th Generation Intel Xeon Scalable Processor Family • OLTP-2 Calculated with 5th Generation Intel Xeon Scalable Processor Family
1.2	2023-11-07	Update: • Technical data • SPEC CPU2017, STREAM, LINPACK Measured and calculated additionally with 4th Generation Intel Xeon Scalable Processor Family
1.1	2023-07-25	Update: • Technical data, • SPEC CPU2017, STREAM, LINPACK Update Supported CPU
1.0	2023-07-04	New: • Technical data • SPEC CPU2017, STREAM, LINPACK Measured and calculated with 4th Generation Intel Xeon Scalable Processor Family • SPECpower_ssj2008 Measured with Intel Xeon Gold 6428N • Disk I/O Measured with 2.5 inch model • OLTP-2 Calculated with 4th Generation Intel Xeon Scalable Processor Family

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