Fujitsu Server PRIMERGY
Performance Report
PRIMERGY TX2550 M7

This document provides an overview of benchmarks executed on the Fujitsu Server PRIMERGY TX2550 M7.

Explaines PRIMERGY TX2550 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.

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Technical data

PRIMERGY TX2550 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 TX2550 M7
Form factor	Tower / 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	16 (8 per processor)
Maximum memory configuration	4,096 GB
Maximum number of internal storage disks	3.5 inch: 12 2.5 inch: 32
Maximum number of PCI slots	PCI-Express 5.0 : 6

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 Platinum 8450H	XCC	28	56	75	16	2.00	3.50	4,800	250
Xeon Platinum 8444H	XCC	16	32	45	16	2.90	4.00	4,800	270
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 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 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 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 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
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

Processor model	Type	Number of cores	Number of threads	L3 Cache [MB]	UPI speed [GT/s]	Rated frequency [GHz]	Maximum turbo frequency [GHz]	Maximum memory transfer rate [MT/s]	TDP [W]
5th Generation Xeon Scalable Processors (1CPU and 2CPU supported processor)									
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 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 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
5th Generation Xeon Scalable Processors (1CPU supported processor)									
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 TX2550 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
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
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	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

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 TX2550 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 TX2550 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
4th Generation Intel Xeon Scalable Processors Family (2CPU Configuration)				
Xeon Platinum 8450H	28	2	482 est.	619 est.
Xeon Platinum 8444H	16	2	344 est.	480 est.
Xeon Gold 6454S	32	2	559 est.	679 est.
Xeon Gold 6448Y	32	2	**582**	**700**
Xeon Gold 6442Y	24	2	495 est.	636 est.
Xeon Gold 6438Y+	32	2	552 est.	656 est.
Xeon Gold 6434	8	2	200 est.	289 est.
Xeon Gold 6430	32	2	532 est.	641 est.
Xeon Gold 6426Y	16	2	335 est.	450 est.
Xeon Gold 5420+	28	2	482 est.	598 est.
Xeon Gold 5418Y	24	2	423 est.	528 est.
Xeon Gold 5416S	16	2	284 est.	374 est.
Xeon Gold 5415+	8	2	179 est.	256 est.
Xeon Silver 4416+	20	2	367 est.	461 est.
Xeon Silver 4410Y	12	2	220 est.	325 est.
Xeon Silver 4410T	10	2	213 est.	296 est.
4th Generation Intel Xeon Scalable Processors Family (1CPU Configuration)				
Xeon Gold 6414U	32	1	269 est.	340 est.
Xeon Gold 5412U	24	1	223 est.	287 est.
Xeon Bronze 3408U	8	1	43.4 est.	76.3 est.

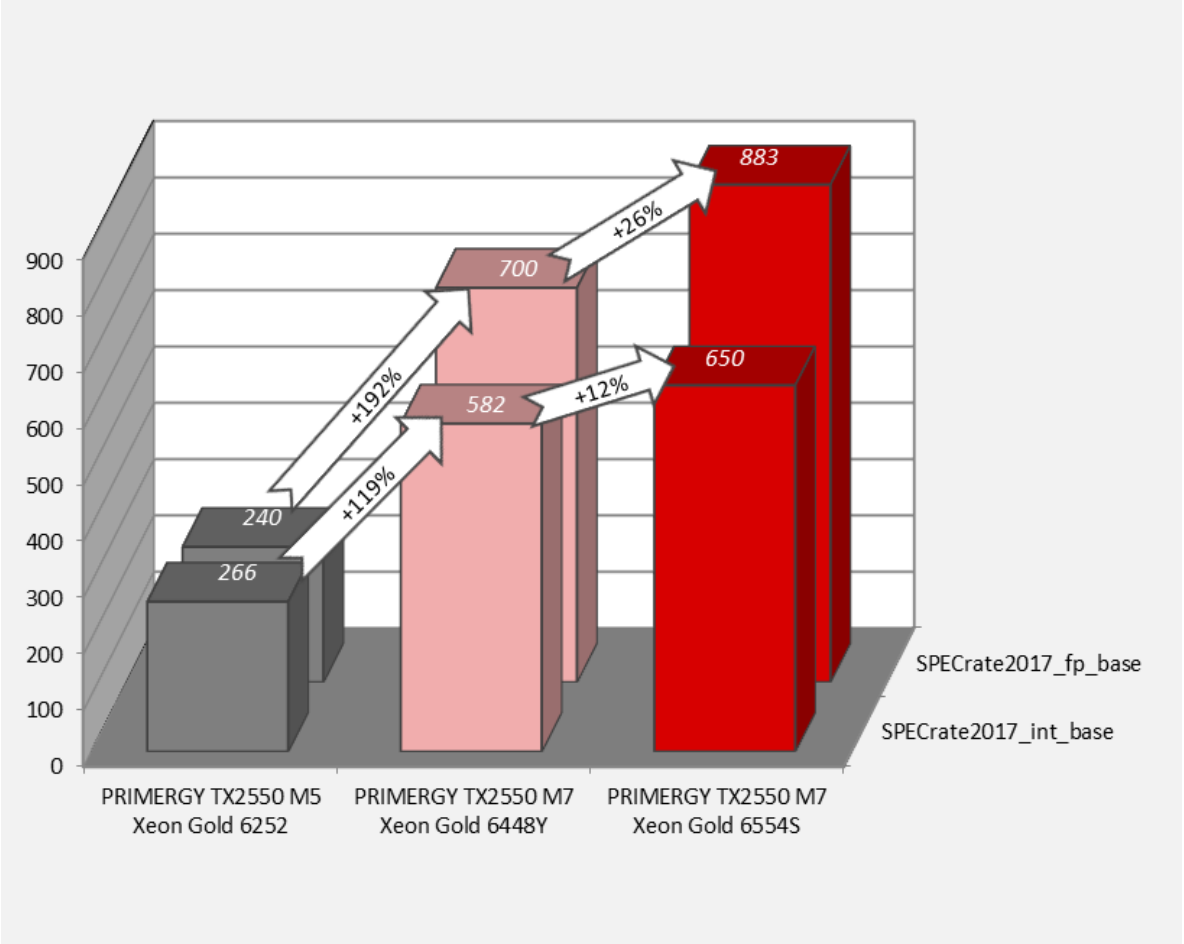
Processor model	Number of cores	Number of processors	SPECrate2017_int_base	SPECrate2017_fp_base
5th Generation Intel Xeon Scalable Processors Family (1CPU Configuration)				
Xeon Gold 6554S	36	2	**650**	**833**
Xeon Gold 6548Y+	32	2	632 est.	787 est.
Xeon Gold 6542Y	24	2	513 est.	695 est.
Xeon Gold 6538Y+	32	2	599 est.	753 est.
Xeon Gold 6534	8	2	198 est.	307 est.
Xeon Gold 6530	32	2	549 est.	748 est.
Xeon Gold 6526Y	16	2	341 est.	492 est.
Xeon Gold 5520+	28	2	506 est.	660 est.
Xeon Gold 5515+	8	2	178 est.	286 est.
Xeon Silver 4516Y+	24	2	431 est.	583 est.
Xeon Silver 4514Y	16	2	268 est.	401 est.
Xeon Silver 4510T	12	2	212 est.	316 est.
Xeon Silver 4510	12	2	243 est.	365 est.
Xeon Silver 4509Y	8	2	173 est.	261 est.
5th Generation Intel Xeon Scalable Processors Family (1CPU Configuration)				
Xeon Gold 5512U	28	1	259 est.	342 est.
Xeon Bronze 3508U	8	1	46.5 est.	83.6 est.

Processor model	Number of cores	Number of processors	SPECspeed2017_int_base	SPECspeed2017_fp_base
5th Generation Intel Xeon Scalable Processors Family (2CPU Configuration)				
Xeon Gold 6554S	36	2	-	**332**
Xeon Gold 6548Y	32	2	**14.9**	-

The following graphs compare the throughputs of PRIMERGY TX2550 M7 and their older models, PRIMERGY TX2550 M5, with maximum performance configurations.

PRIMERGY TX2550 M7 showed significant performance improvements over the previous generation.

Compared to TX2550 M5 with the Xeon Gold 6252 (2nd Generation Xeon Scalable Processor), TX2550 M7 with the Xeon Gold 6448Y (4th Generation Xeon Scalable Processor) showed significant performance improvements of +119% to +192%. In addition, compared to the Xeon Gold 6448Y, the Xeon Gold 6554S (5th Generation Xeon Scalable Processor) showed performance improvements of +12% to +26%.



SPECrate2017: Comparison of PRIMERGY TX2550 M5 and PRIMERGY TX2550 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 TX2550 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

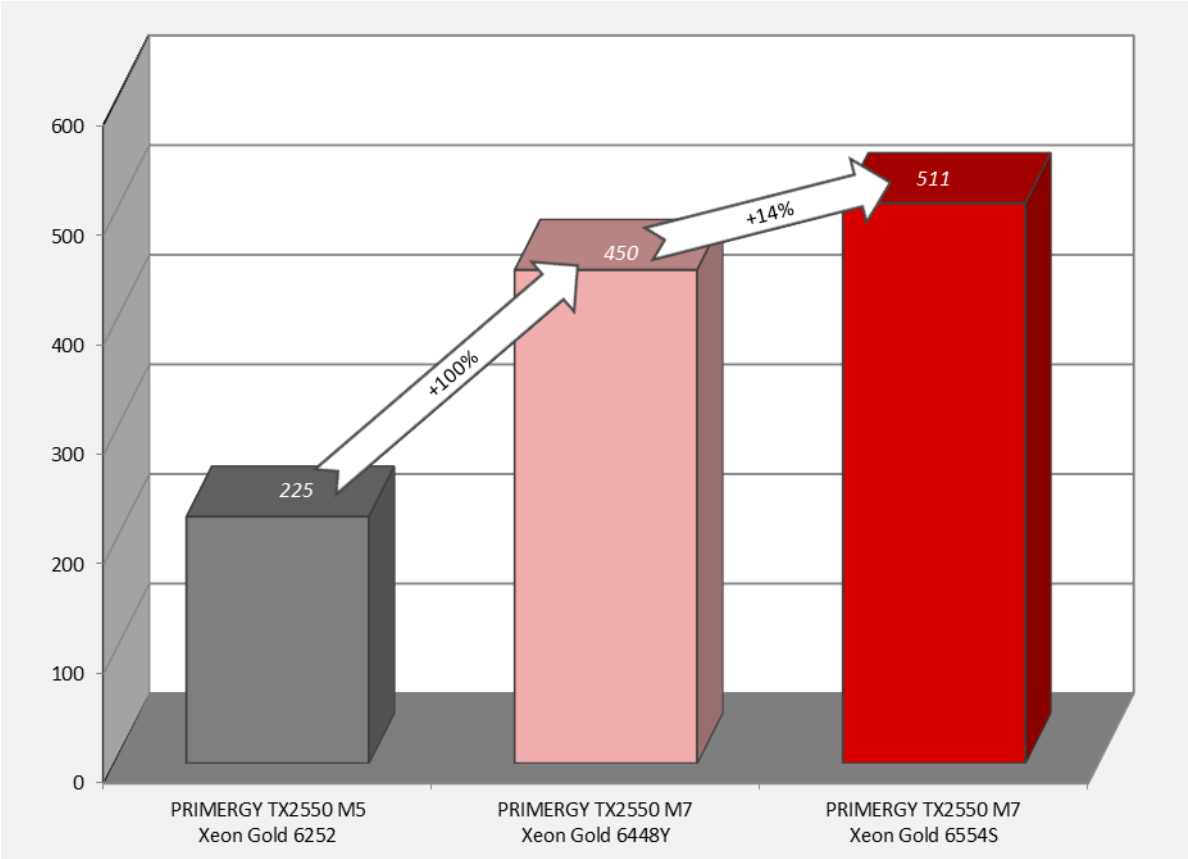
The results with "est." are the estimated values.

Processor	Memory transfer rate [MT/s]	Maximum memory bandwidth [GB/s]	Number of cores	Rated frequency [GHz]	Number of processors	TRIAD [GB/s]
4th Generation Intel Xeon Scalable Processors Family (2CPU Configuration)						
Xeon Platinum 8450H	4,800	307	28	2.00	2	454 est.
Xeon Platinum 8444H	4,800	307	16	2.90	2	371 est.
Xeon Gold 6454S	4,800	307	32	2.20	2	**428**
Xeon Gold 6448Y	4,800	307	32	2.10	2	450 est.
Xeon Gold 6442Y	4,800	307	24	2.60	2	425 est.
Xeon Gold 6438Y+	4,800	307	32	2.00	2	446 est.
Xeon Gold 6434	4,800	307	8	3.70	2	219 est.
Xeon Gold 6430	4,400	282	32	2.10	2	404 est.
Xeon Gold 6426Y	4,800	307	16	2.50	2	336 est.
Xeon Gold 5420+	4,400	282	28	2.00	2	403 est.
Xeon Gold 5418Y	4,400	282	24	2.00	2	372 est.
Xeon Gold 5416S	4,400	282	16	2.00	2	274 est.
Xeon Gold 5415+	4,400	282	8	2.90	2	206 est.
Xeon Silver 4416+	4,000	256	20	2.00	2	318 est.
Xeon Silver 4410Y	4,000	256	12	2.00	2	254 est.
Xeon Silver 4410T	4,000	256	10	2.70	2	230 est.
4th Generation Intel Xeon Scalable Processors Family (1CPU Configuration)						
Xeon Gold 6414U	4,800	307	32	2.00	1	230 est.
Xeon Gold 5412U	4,400	282	24	2.10	1	201 est.
Xeon Bronze 3408U	4,000	256	8	1.80	1	119 est.

Processor	Memory transfer rate [MT/s]	Maximum memory bandwidth [GB/s]	Number of cores	Rated frequency [GHz]	Number of processors	TRIAD [GB/s]
5th Generation Intel Xeon Scalable Processors Family (2CPU Configuration)						
Xeon Gold 6554S	5,200	333	36	2.20	2	**511**
Xeon Gold 6548Y+	5,200	333	32	2.50	2	488 est.
Xeon Gold 6542Y	5,200	333	24	2.90	2	481 est.
Xeon Gold 6538Y+	5,200	333	32	2.20	2	484 est.
Xeon Gold 6534	4,800	307	8	3.90	2	248 est.
Xeon Gold 6530	4,800	307	32	2.10	2	481 est.
Xeon Gold 6526Y	5,200	333	16	2.80	2	372 est.
Xeon Gold 5520+	4,800	307	28	2.20	2	449 est.
Xeon Gold 5515+	4,800	307	8	3.20	2	245 est.
Xeon Silver 4516Y+	4,400	282	24	2.20	2	397 est.
Xeon Silver 4514Y	4,400	282	16	2.00	2	304 est.
Xeon Silver 4510T	4,400	282	12	2.00	2	284 est.
Xeon Silver 4510	4,400	282	12	2.40	2	295 est.
Xeon Silver 4509Y	4,400	282	8	2.60	2	219 est.
5th Generation Intel Xeon Scalable Processors Family (2CPU Configuration)						
Xeon Gold 5512U	4,800	307	28	2.10	1	239 est.
Xeon Bronze 3508U	4,400	282	8	2.10	1	131 est.

The following graphs compare the throughputs of PRIMERGY TX2550 M7 and their older models, PRIMERGY TX2550 M5, with maximum performance configurations.

Compared to TX2550 M5 with the Xeon Gold 6252 (2nd Generation Xeon Scalable Processor), TX2550 M7 with the Xeon Gold 6448Y (4th Generation Xeon Scalable Processor) showed a significant performance improvement of +100%. In addition, compared to the Xeon Gold 6448Y, the Xeon Gold 6554S (5th Generation Xeon Scalable Processor) showed a performance improvements of +14%.



STREAM: Comparison of PRIMERGY TX2550 M5 and PRIMERGY TX2550 M7

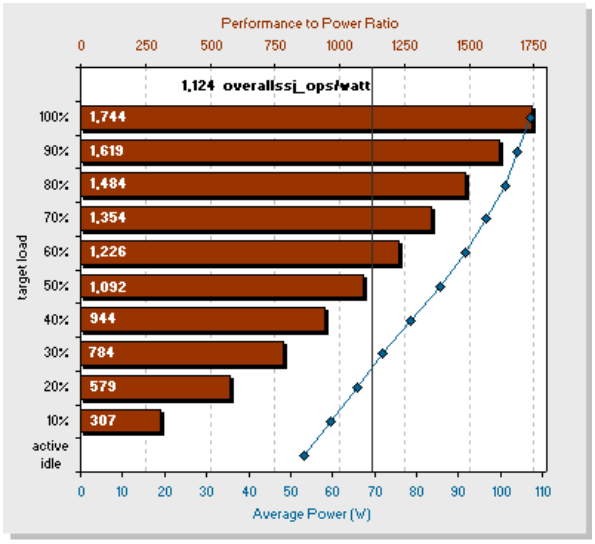
SPECpower_ssj2008

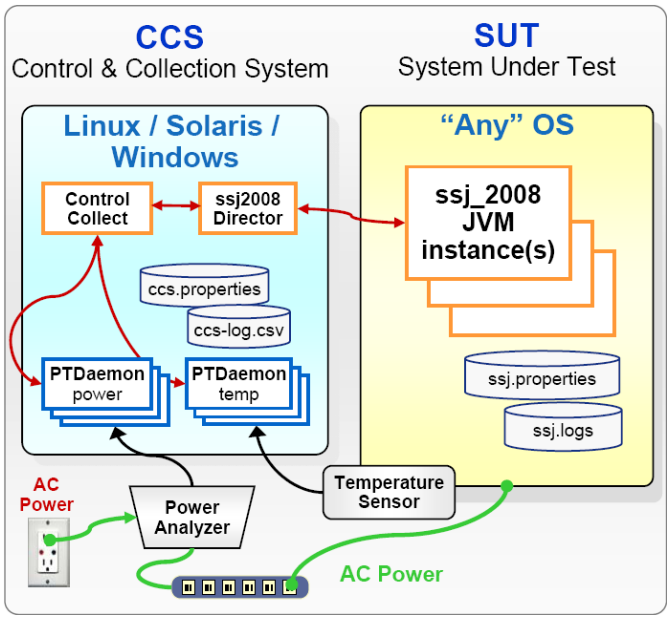
Benchmark description

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 TX2550 M7
• Processor	2 x Xeon Gold 6438Y+ 2 x Xeon Gold 6538Y+
• Memory	**When using Xeon Gold 6438Y+ processors** 16 x 32GB (1x32GB) 2Rx8 DDR5-4800 R ECC **When using Xeon Gold 6538Y+ processors** 16 x 32GB (1x32GB) 2Rx8 DDR5-5600 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 Gold 6438Y+ processors** 2 x 900W titanium PSU **When using Xeon Gold 6538Y+ processors** 1 x 1,600W titanium PSU

System Under Test (SUT)

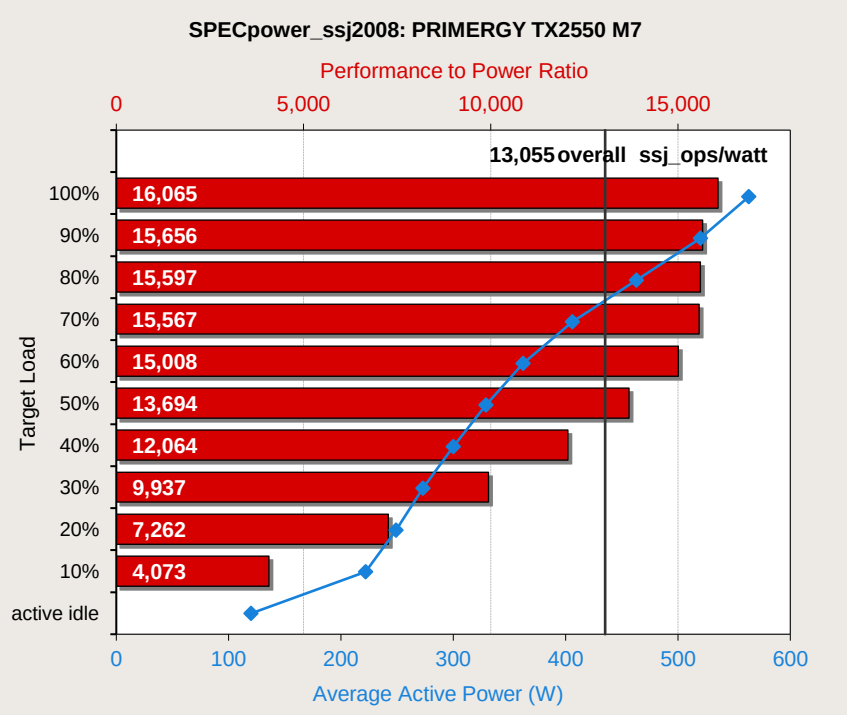
Software

• BIOS settings	**When using Xeon Gold 6438Y+ 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 SNC2 SATA Controller = Disabled USB Port Control = Disable all ports Serial Port = Disabled Network Stack = Disabled **When using Xeon Gold 6538Y+ processors** DCU Streamer Prefetcher = Disabled 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 Gold 6438Y+ 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 Gold 6438Y+ processors** Oracle Java HotSpot(TM) 64-Bit Server VM 18.9 (build 11.0.16.1+1-LTS, mixed mode) **When using Xeon Gold 6538Y+ processors** OpenJDK 64-Bit Server VM Temurin-17.0.9+9 (build 17.0.9+9, mixed mode, sharing)
• JVM settings	**When using Xeon Gold 6438Y+ 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 Gold 6538Y+ 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

Benchmark results (Xeon Gold 6438Y+)

The PRIMERGY TX2550 M7 in Microsoft Windows Server 2022 Standard achieved the following result:

SPECpower_ssj2008 = 13,055 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 13,055 overall ssj_ops/watt for the PRIMERGY TX2550 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.

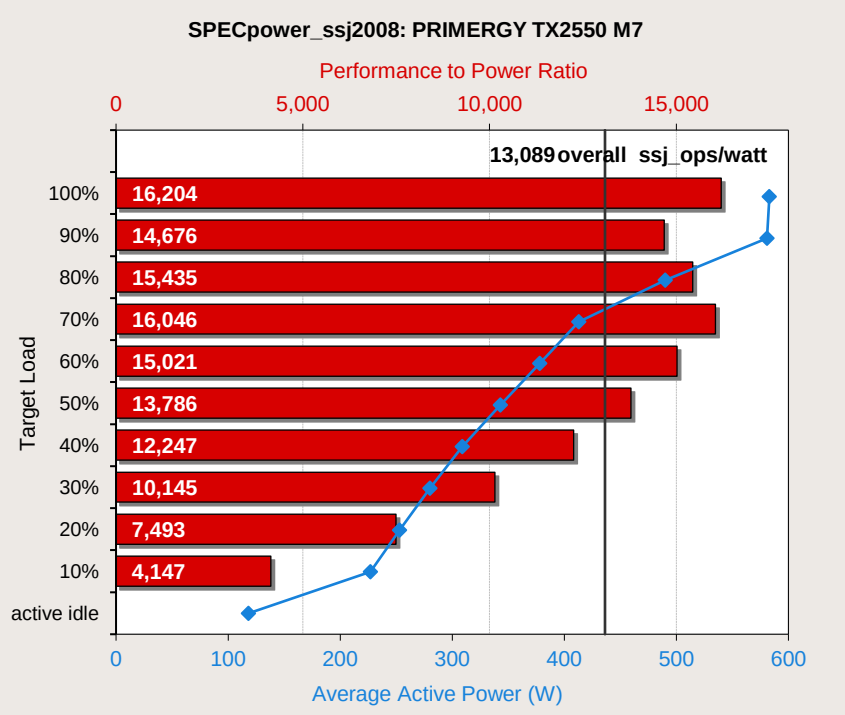
The following table shows the benchmark results for the throughput in ssj_ops, the power consumption in watts and the resulting energy efficiency for each load level.

Performance		Power	Energy Efficiency
Target Load	ssj_ops	Average Power (W)	ssj_ops/watt
100%	9,040,604	563	16,065
90%	8,142,124	520	15,656
80%	7,221,043	463	15,597
70%	6,326,586	406	15,567
60%	5,426,798	362	15,008
50%	4,510,954	329	13,694
40%	3,615,218	300	12,064
30%	2,716,354	273	9,937
20%	1,805,349	249	7,262
10%	905,374	222	4,073
Active Idle	0	120	0
			Σ ssj_ops / Σ power = 13,055

Benchmark results (Xeon Gold 6538Y+)

The PRIMERGY TX2550 M7 in Microsoft Windows Server 2022 Standard achieved the following result:

SPECpower_ssj2008 = 13,089 overall ssj_ops/watt



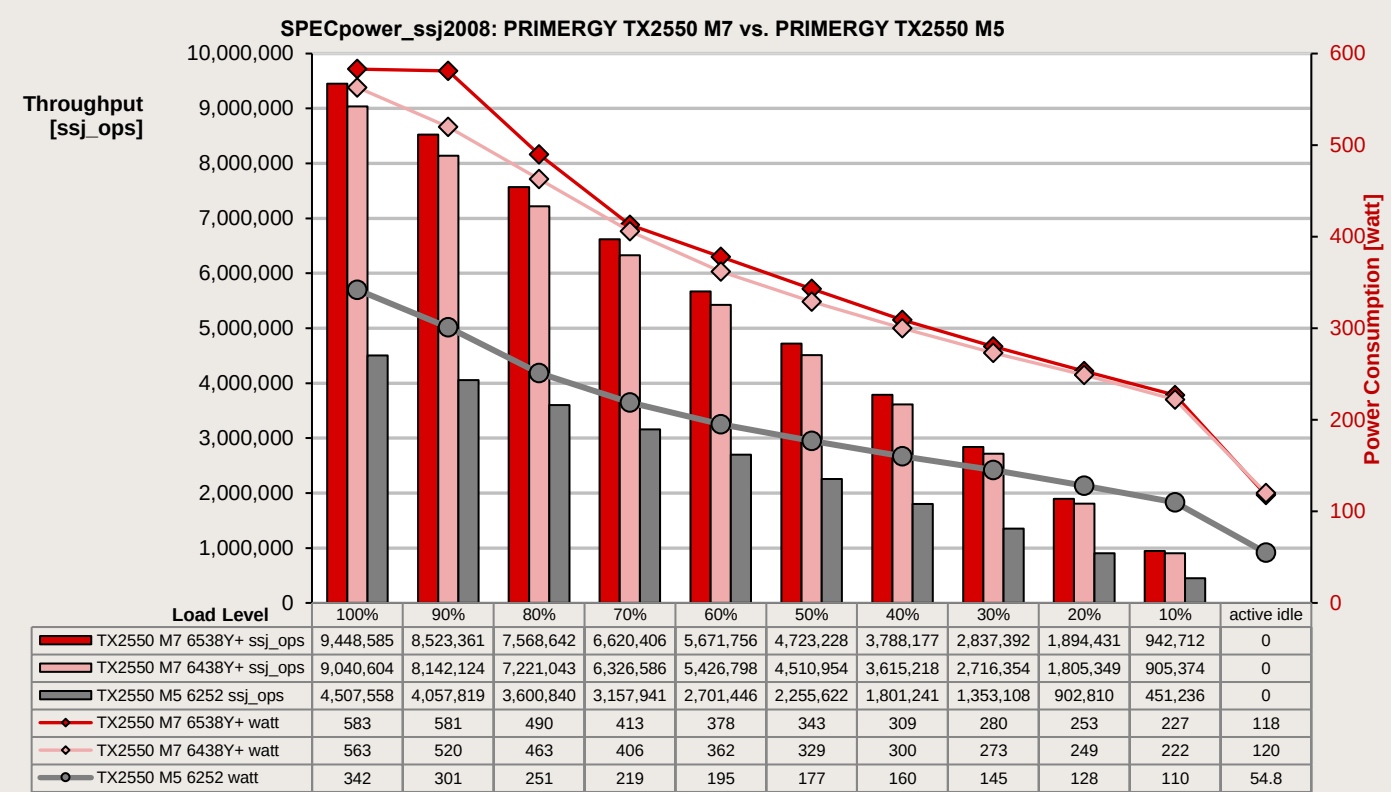
The adjoining diagram shows the result of the configuration described above. The red horizontal bars show the performance to power ratio in ssj_ops/watt (upper x-axis) for each target load level tagged on the y-axis of the diagram. The blue line shows the run of the curve for the average power consumption (bottom x-axis) at each target load level marked with a small rhomb. The black vertical line shows the benchmark result of 13,089 overall ssj_ops/watt for the PRIMERGY TX2550 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%	9,448,585	583	16,204
90%	8,523,361	581	14,676
80%	7,568,642	490	15,435
70%	6,620,406	413	16,046
60%	5,671,756	378	15,021
50%	4,723,228	343	13,786
40%	3,788,177	309	12,247
30%	2,837,392	280	10,145
20%	1,894,431	253	7,493
10%	942,712	227	4,147
Active Idle	0	118	0
			Σ ssj_ops / Σ power = 13,089

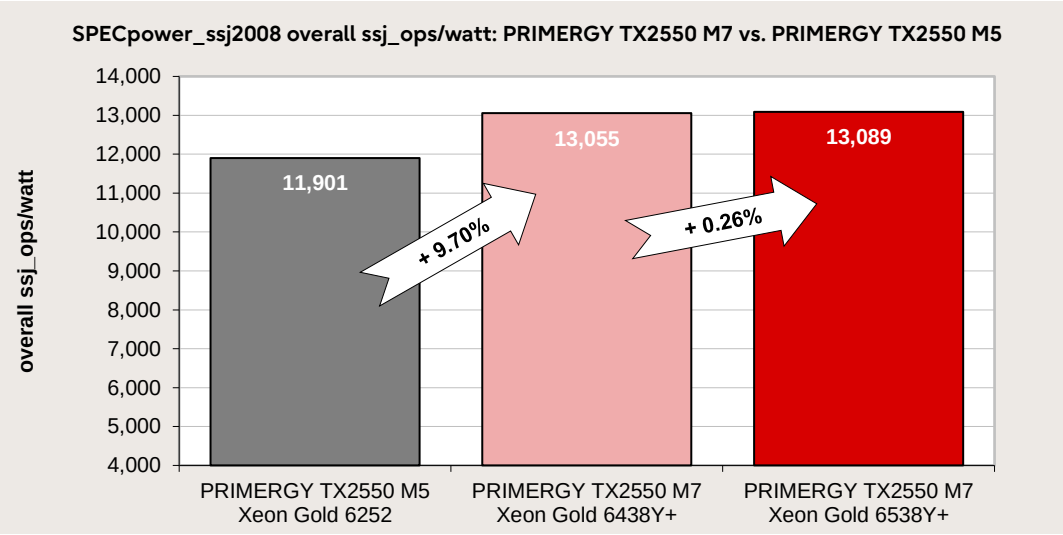
Comparison with the predecessor

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 TX2550 M7 compared to the predecessor PRIMERGY TX2550 M5.



Load Level	100%	90%	80%	70%	60%	50%	40%	30%	20%	10%	active idle
TX2550 M7 6538Y+ ssj_ops	9,448,585	8,523,361	7,568,642	6,620,406	5,671,756	4,723,228	3,788,177	2,837,392	1,894,431	942,712	0
TX2550 M7 6438Y+ ssj_ops	9,040,604	8,142,124	7,221,043	6,326,586	5,426,798	4,510,954	3,615,218	2,716,354	1,805,349	905,374	0
TX2550 M5 6252 ssj_ops	4,507,558	4,057,819	3,600,840	3,157,941	2,701,446	2,255,622	1,801,241	1,353,108	902,810	451,236	0
TX2550 M7 6538Y+ watt	583	581	490	413	378	343	309	280	253	227	118
TX2550 M7 6438Y+ watt	563	520	463	406	362	329	300	273	249	222	120
TX2550 M5 6252 watt	342	301	251	219	195	177	160	145	128	110	54.8

The energy efficiency of the PRIMERGY TX2550 M7 with the Xeon Gold 6438Y+ is improved by 9.70% compared to the PRIMERGY TX2550 M5. Furthermore, the energy efficiency of the PRIMERGY TX2550 M7 with the Xeon Gold 6538Y+ is almost the same as that of the Xeon Gold 6438Y+.



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 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
			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	
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	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]	MG08SDA600E MG08SDA800E ST12000NM004J ST14000NM004J ST18000NM004J ST20000NM002D
	NL-SAS HDD (SAS 12Gbps, 7.2k rpm) [512n]	ST2000NM001B ST4000NM001B
	BC-SATA HDD (SATA 6Gbps, 7.2k rpm) [512e]	MG08ADA600E MG08ADA800E ST12000NM000J ST14000NM000J ST16000NM000J ST18000NM000J
	BC-SATA HDD (SATA 6Gbps, 7.2k rpm) [512n]	ST1000NM000A ST2000NM000B ST4000NM000B

Storage media	Category	Drive name
SSD	SATA SSD (SATA 6Gbps, Mixed Use)	MTFDDAK480TGB MTFDDAK960TGB MTFDDAK1T9TGB MTFDDAK3T8TGB
	SATA SSD (SATA 6Gbps, Read Intensive)	MTFDDAK240TGA MTFDDAK480TGA MTFDDAK960TGA MTFDDAK1T9TGA MTFDDAK3T8TGA MTFDDAK7T6TGA

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
	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]							
6,000	MG08SDA600E	SAS 12G	545	455	442	234	234
8,000	MG08SDA800E	SAS 12G	542	449	449	250	250
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
☐ NL-SAS 12Gbps HDD 7.2krpm [512n]							
2,000	ST2000NM001B	SAS 12G	489	431	428	200	200
4,000	ST4000NM001B	SAS 12G	541	486	471	239	239

HDDs

Capacity [GB]	Storage device	Interface	Transactions [IO/s]			Throughput [MiB/s]	
			Database	Fileserver	Filecopy	Streaming	Restore
☐ BC-SATA HDD 7.2krpm [512e]							
6,000	MG08ADA600E	SATA 6G	497	452	447	239	239
8,000	MG08ADA800E	SATA 6G	477	429	430	248	248
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
☐ 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

2.5 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

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	
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.

SSDs

Capacity [GB]	Storage device	Interface	Transactions [IO/s]			Throughput [MiB/s]		
			Database	Fileserver	Filecopy	Streaming	Restore	
☐ 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

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.

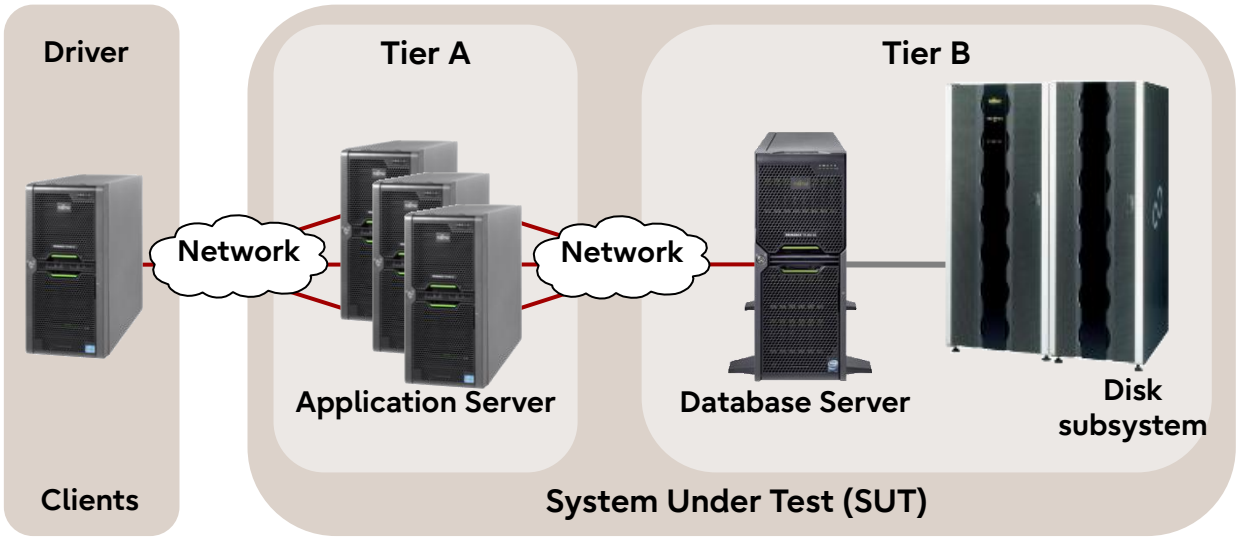
In contrast to benchmarks such as SPEC CPU and TPC-E, which were standardized by independent bodies and for which adherence to the respective rules and regulations are monitored, OLTP-2 is an internal benchmark of Fujitsu. OLTP-2 is based on the well-known database benchmark TPC-E. OLTP-2 was designed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

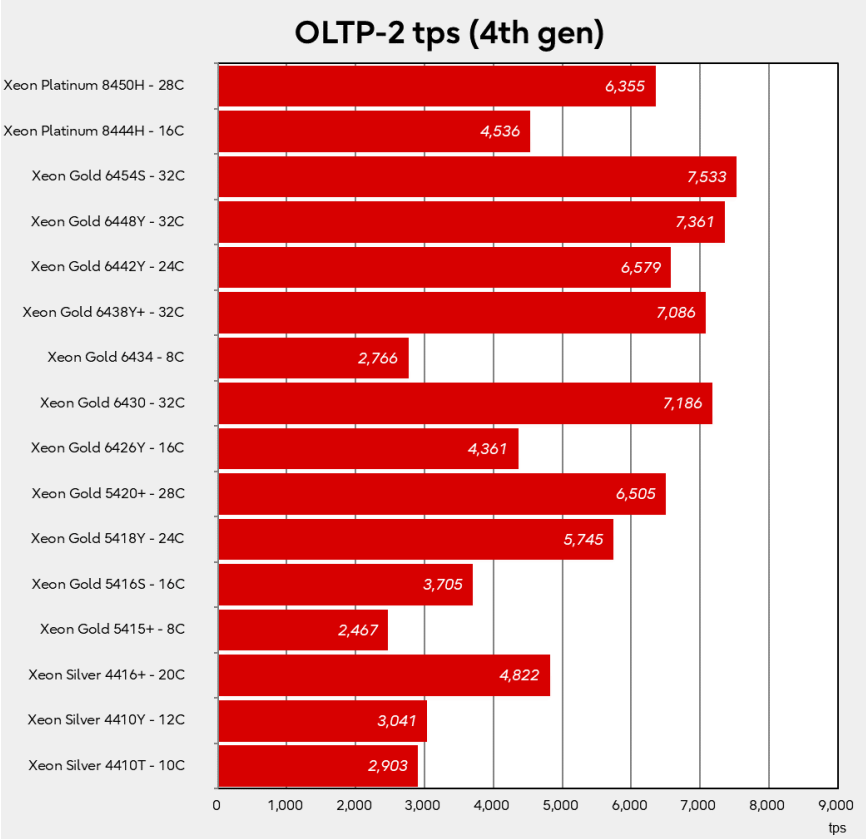
Database performance greatly depends on the configuration options with CPU, memory and on the connectivity of an adequate disk subsystem for the database. In the following scaling considerations for the processors we assume that both the memory and the disk subsystem has been adequately chosen and is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

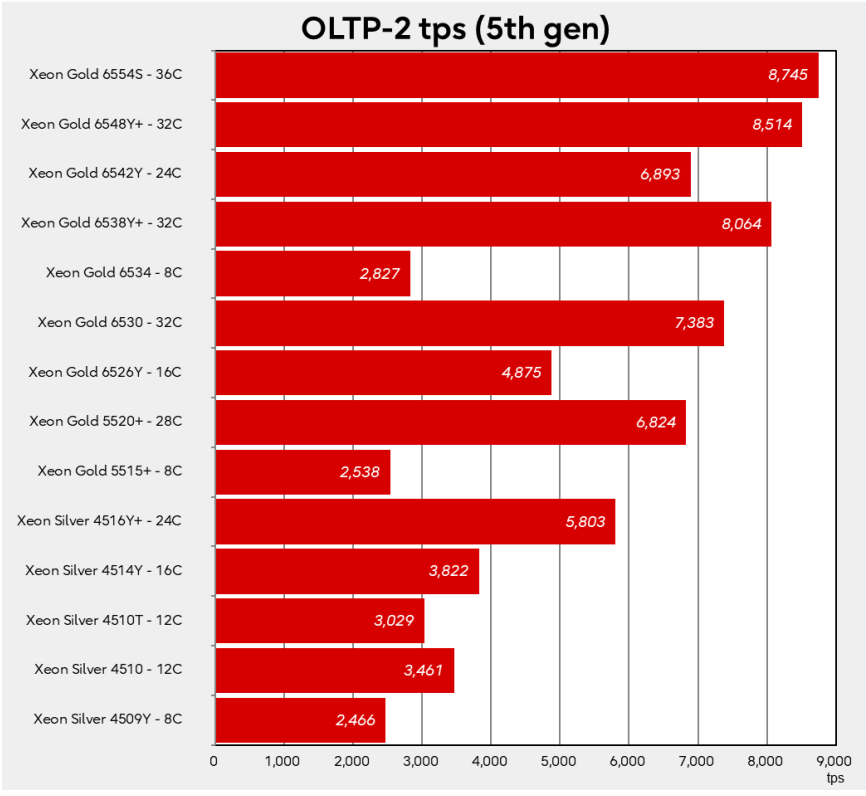
A guideline in the database environment for selecting main memory is that sufficient quantity is important. This why a configuration with a total memory of 1024 GB was considered for the measurements with two processors.

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

Processor	Cores	Threads	2CPU Score
4th Generation Xeon Scalable Processors (2CPU configuration)			
Xeon Platinum 8450H	28	56	6,355 est.
Xeon Platinum 8444H	16	32	4,536 est.
Xeon Gold 6454S	32	64	7,533 est.
Xeon Gold 6448Y	32	64	7,361 est.
Xeon Gold 6442Y	24	48	6,579 est.
Xeon Gold 6438Y+	32	64	7,086 est.
Xeon Gold 6434	8	16	2,766 est.
Xeon Gold 6430	32	64	7,186 est.
Xeon Gold 6426Y	16	32	4,361 est.
Xeon Gold 5420+	28	56	6,505 est.
Xeon Gold 5418Y	24	48	5,745 est.
Xeon Gold 5416S	16	32	3,705 est.
Xeon Gold 5415+	8	16	2,467 est.
Xeon Silver 4416+	20	40	4,822 est.
Xeon Silver 4410Y	12	24	3,041 est.
Xeon Silver 4410T	10	20	2,903 est.
5th Generation Xeon Scalable Processors (2CPU configuration)			
Xeon Gold 6554S	36	72	8,745 est.
Xeon Gold 6548Y+	32	64	8,514 est.
Xeon Gold 6542Y	24	48	6,893 est.
Xeon Gold 6538Y+	32	64	8,064 est.
Xeon Gold 6534	8	16	2,827 est.
Xeon Gold 6530	32	64	7,383 est.
Xeon Gold 6526Y	16	32	4,875 est.
Xeon Gold 5520+	28	56	6,824 est.
Xeon Gold 5515+	8	16	2,538 est.
Xeon Silver 4516Y+	24	48	5,803 est.
Xeon Silver 4514Y	16	32	3,822 est.
Xeon Silver 4510T	12	24	3,029 est.
Xeon Silver 4510	12	24	3,461 est.
Xeon Silver 4509Y	8	16	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.

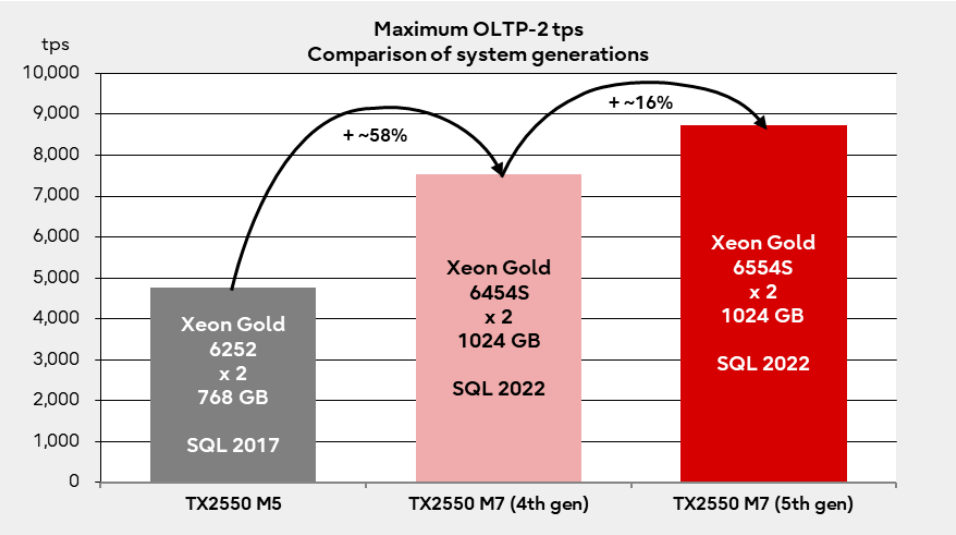




The features of the processors are summarized in the section “Technical data.”

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 TX2550 M7 is about 58% higher than that on the previous PRIMERGY TX2550 M5. Furthermore, the highest value on TX2550 M7 with the 5th Generation Intel Xeon Scalable Processor Family is improved by about 16% compared to that with the 4th Generation processor.



Literature

PRIMERGY Servers

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PRIMERGY TX2550 M7

This Whitepaper

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Data sheet

TX2550 M7: https://docs.ts.fujitsu.com/dl.aspx?id=28d1e428-c1ff-4d2e-b477-e7cfe4da59eb

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

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Benchmark Overview SPECcpu2017

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Benchmark Overview SPECpower_ssj2008

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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
1.1	2024-07-02	Update: • Technical data • SPEC CPU2017, STREAM Measured and calculated with 5th Generation Intel Xeon Scalable Processor Family • SPECpower_ssj2008 Measured with Intel Xeon Platinum 6538Y+ • Disk I/O Updated measured with 2.5 / 3.5 inch model • OLTP2 Calculated with 5th Generation Intel Xeon Scalable Processor Family
1.0	2023-05-30	New: • Technical data • SPEC CPU2017, STREAM Measured and calculated with 4th Generation Intel Xeon Scalable Processor Family • SPECpower_ssj2008 Measured with Intel Xeon Platinum 6438Y+ • Disk I/O Measured with 2.5 / 3.5 inch model • OLTP2 Measured and calculated with 4th Generation Intel Xeon Scalable Processor Family

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