# Fujitsu Server PRIMERGY Performance Report PRIMERGY RX4770 M6

This document provides an overview of benchmarks executed on the Fujitsu Server PRIMERGY RX4770 M6.

Explaines PRIMERGY RX4770 M6 performance data in comparison to other PRIMERGY models. In addition to the benchmark results, the explanation for each benchmark and benchmark environment are also included.

| Version |
| --- |
| 1.3<br>2023-10-03 |

# Contents



# Technical data

**PRIMERGY RX4770 M6**

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 RX4770 M6 |
|---|---|
| Form factor | Rack server |
| Chipset | Intel C621A |
| Number of sockets | 4 |
| Number of configurable processors | 2 or 4 |
| Processor type | 3rd Generation Intel Xeon Scalable Processors Family |
| Number of memory slots | 48 (12 per processor) |
| Maximum memory configuration | 12,288 GB |
| Onboard HDD controller | Controller with RAID (0, 1, 10) function (supports up to 8 SATA HDD/SSD) |
| PCI slots | PCI-Express 3.0 (x16 lane): 7 (3 (Low Profile) + 4 (Full Height))<br>PCI-Express 3.0 (x8 lane) : 4 (Low Profile) |
| Maximum number of internal hard disks | 2.5 inches x 24 |

| Processor | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Processor model | Number of cores | Number of threads | Cache | UPI speed | Rated frequency | Maximum turbo frequency | Maximum memory frequency | TDP |
| | | | [MB] | [GT/s] | [GHz] | [GHz] | [MHz] | [W] |
| Xeon Platinum 8380H | 28 | 56 | 38.5 | 10.4 | 2.9 | 4.3 | 3,200 | 250 |
| Xeon Platinum 8380HL | 28 | 56 | 38.5 | 10.4 | 2.9 | 4.3 | 3,200 | 250 |
| Xeon Platinum 8376H | 28 | 56 | 38.5 | 10.4 | 2.6 | 4.3 | 3,200 | 205 |
| Xeon Platinum 8376HL | 28 | 56 | 38.5 | 10.4 | 2.6 | 4.3 | 3,200 | 205 |
| Xeon Platinum 8360H | 24 | 48 | 33.0 | 10.4 | 3.0 | 4.2 | 3,200 | 225 |
| Xeon Platinum 8360HL | 24 | 48 | 33.0 | 10.4 | 3.0 | 4.2 | 3,200 | 225 |
| Xeon Platinum 8356H | 8 | 16 | 35.75 | 10.4 | 3.9 | 4.4 | 3,200 | 205 |
| Xeon Platinum 8354H | 18 | 32 | 24.75 | 10.4 | 3.1 | 4.3 | 3,200 | 205 |
| Xeon Gold 6348H | 24 | 48 | 33.0 | 10.4 | 2.3 | 4.2 | 2,933 | 165 |
| Xeon Gold 6330H | 24 | 48 | 33.0 | 10.4 | 2.0 | 3.7 | 2,933 | 135 |
| Xeon Gold 6328H | 16 | 32 | 22.0 | 10.4 | 2.8 | 4.3 | 2,933 | 165 |
| Xeon Gold 6328HL | 16 | 32 | 22.0 | 10.4 | 2.8 | 4.3 | 2,933 | 165 |
| Xeon Gold 5320H | 20 | 40 | 27.5 | 10.4 | 2.4 | 4.2 | 2,667 | 150 |
| Xeon Gold 5318H | 18 | 36 | 24.75 | 10.4 | 2.5 | 3.8 | 2,667 | 150 |

All processors that can be ordered with PRIMERGY RX4770 M6 support Intel Turbo Boost Technology 2.0. This technology allows you to operate the processor with higher frequencies than the rated frequency. The "maximum turbo frequency" listed in the processor list above is the theoretical maximum frequency when there is only one active core per processor. The maximum frequency that can actually be achieved depends on the number of active cores, current consumption, power consumption, and processor temperature.

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

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

## *Additional features of the suffixed processors of Xeon Processor*

Processors with L support larger memory capacities. The L model supports 4.5 TB, while the regular model supports 1.12 TB of memory per socket.

| Suffix | Additional feature |
|---|---|
| L | Support up to 4.5TB/socket memory |

| Memory modules | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Type | Capacity [GB] | Number of ranks | Bit width of the memory chips | Frequency [MHz] | 3DS | Load Reduced | Registered | NVDIMM | ECC |
| 8 GB (1x8 GB) 1Rx8 DDR4-3200 R ECC | 8 | 1 | 8 | 3,200 | | | ✓ | | ✓ |
| 16 GB (1x16 GB) 2Rx8 DDR4-3200 R ECC | 16 | 2 | 8 | 3,200 | | | ✓ | | ✓ |
| 16 GB (1x16 GB) 1Rx4 DDR4-3200 R ECC | 16 | 1 | 4 | 3,200 | | | ✓ | | ✓ |
| 32 GB (1x32 GB) 2Rx4 DDR4-3200 R ECC | 32 | 2 | 4 | 3,200 | | | ✓ | | ✓ |
| 64 GB (1x64 GB) 2Rx4 DDR4-3200 R ECC | 64 | 2 | 4 | 3,200 | | ✓ | ✓ | | ✓ |
| 64 GB (1x64 GB) 4Rx4 DDR4-3200 LR ECC | 64 | 4 | 4 | 3,200 | | | ✓ | | ✓ |
| 128 GB (1x128 GB) 4Rx4 DDR4-3200 3DS ECC | 128 | 4 | 4 | 3,200 | ✓ | | ✓ | | ✓ |
| 128 GB (1x128 GB) 4Rx4 DDR4-3200 LR ECC | 128 | 4 | 4 | 3,200 | | ✓ | ✓ | | ✓ |
| 256 GB (1x256 GB) 8Rx4 DDR4-3200 3DS ECC | 256 | 8 | 4 | 3,200 | ✓ | | ✓ | | ✓ |
| 128GB (1x128GB) Optane PMem-3200 | 128 | | | 3,200 | | | | ✓ | ✓ |
| 256GB (1x256GB) Optane PMem-3200 | 256 | | | 3,200 | | | | ✓ | ✓ |
| 512GB (1x512GB) Optane PMem-3200 | 512 | | | 3,200 | | | | ✓ | ✓ |

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

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

Detailed technical information is available in the data sheet of PRIMERGY RX4770 M6.

# SPEC CPU2017

## *Benchmark description*

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

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

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

| Benchmark | Number of single benchmarks | Arithmetics | Type | Compiler optimization | Measurement result |
|---|---|---|---|---|---|
| SPECspeed2017_int_peak | 10 | integer | peak | aggressive | Speed |
| SPECspeed2017_int_base | 10 | integer | base | conservative | |
| SPECrate2017_int_peak | 10 | integer | peak | aggressive | Throughput |
| SPECrate2017_int_base | 10 | integer | base | conservative | |
| SPECspeed2017_fp_peak | 10 | floating point | peak | aggressive | Speed |
| SPECspeed2017_fp_base | 10 | floating point | base | conservative | |
| SPECrate2017_fp_peak | 13 | floating point | peak | aggressive | Throughput |
| SPECrate2017_fp_base | 13 | floating point | base | conservative | |

The measurement results are the geometric average from normalized ratio values which have been determined for individual benchmarks. The geometric average - in contrast to the arithmetic average - means that there is a weighting in favor of the lower individual results. "Normalized" means that the measurement is how fast is the test system compared to a reference system. For example, value "1" was defined for the SPECspeed2017_int_base, SPECrate2017_int_base, SPECspeed2017_fp_base, and SPECrate2017_fp_base results of the reference system. A SPECspeed2017_int_base value of 2 means that the measuring system has handled this benchmark twice as fast as the reference system. A SPECrate2017_fp_base value of 4 means that the measuring system has handled this benchmark about 4/[# base copies] times faster than the reference system. "# base copies" specifies how many parallel instances of the benchmark have been executed.

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

## *Benchmark environment*

| System Under Test (SUT) | |
|---|---|
| **Hardware** | |
| • Model | PRIMERGY RX4770 M6 |
| • Processor | 4 x 3rd Generation Intel Xeon Scalable Processors Family |
| • Memory | 48 x 32 GB (1x32 GB) 2Rx4 PC4-3200AA-R |
| **Software** | |
| • BIOS settings | SPECspeed2017_int_base:<br>• Hyper Threading = Disabled<br>• Override OS Energy Performance = Enabled<br>• Energy Perfromance = Performance<br>• HWPM Support = OOB mode<br>• Satel AtoS = Disabled<br><br>SPECSpeed2017_fp_base:<br>• Hyper Threading = Disabled<br>• Adjacent Cache Line Prefetch = Disabled<br>• DCU Streamer Prefetcher = Disabled<br>• VT-d = Disabled<br>• Stale AtoS = Disabld<br>• Patrol Sxrub = Enabled<br>• FAN Control = Full<br><br>SPECrate2017_int_base:<br>• DCU Streamer Prefetcher = Disabled<br>• Intel Virtualization Technology = Disabled<br>• Utilization Profile = Unbalanced<br>• Stle AtoS = Disabled<br>• LLC Dead Line Alloc = Disabled<br>• XPT Prefetch = Enable<br>• Patrol Scrub = Enabled<br>• SNC = Enable SNC2<br>• Fan Control = Full<br><br>SPECrate2017_fp_base:<br>• Hyper Threading = Disabled*4<br>• Utilization Profile = Unbalanced<br>• Stle AtoS = Disabled<br>• LLC Dead Line Alloc = Disabled<br>• SNC = Enable SNC2<br>• Fan Control = Full |
| • Operating system | SPECrate2017_int , SPECrate2017_fp:<br>SUSE Linux Enterprise Server 15 SP2 5.3.18-22-default<br>SPECspeed2017_int, SPECspeed2017_fp:<br>Red Hat Enterprise Linux Server release 8.2 4.18.0-193.el8.x86_64 |
| • Operating system settings | Stack size set to unlimited using "ulimit -s unlimited"<br>SPECspeed2017_int, SPECrate2017:<br>Kernel Boot Parameter set with : nohz_full=1-X |

| | |
|---|---|
| | (X: logical core number -1)<br>SPECrate2017_int:<br>sched_min_granularity_ns = 15000000<br>SPECrate2017_fp:<br>service irqbalance stop |
| • Compiler | C/C++: Version 19.1.1.217 of Intel C/C++ Compiler for Linux<br>Fortran: Version 19.1.1.217 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.

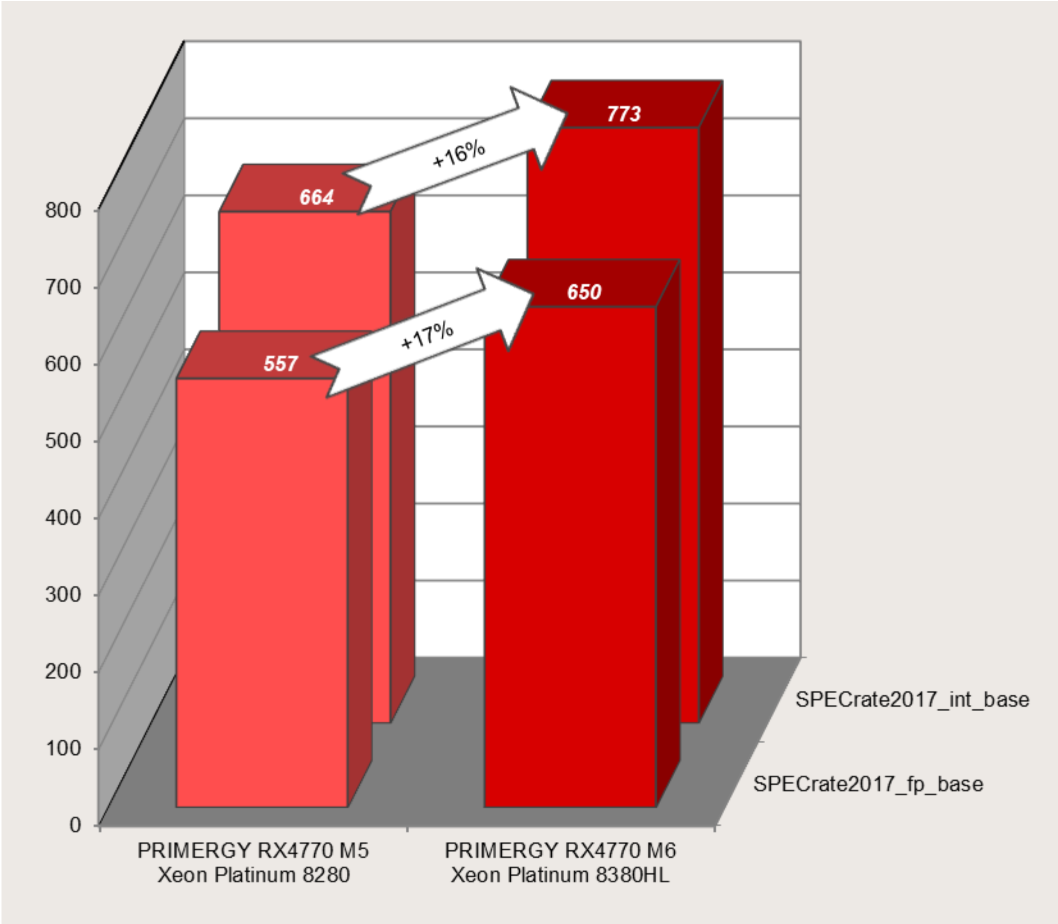
| Processor model | Number of cores | Number of processor | SPECrate2017 int_base | SPECrate2017 fp_base |
|---|---|---|---|---|
| Xeon Platinum 8380H | 28 | 4 | 773 est. | 650 est. |
| Xeon Platinum 8380HL | 28 | 4 | **773** | **650** |
| Xeon Platinum 8376H | 28 | 4 | 711 est. | 609 est. |
| Xeon Platinum 8376HL | 28 | 4 | **711** | **609** |
| Xeon Platinum 8360H | 24 | 4 | **662** | **586** |
| Xeon Platinum 8360HL | 24 | 4 | 662 est. | 586 est. |
| Xeon Platinum 8356H | 8 | 4 | **300** | **317** |
| Xeon Platinum 8354H | 18 | 4 | **541** | **508** |
| Xeon Gold 6348H | 24 | 4 | **569** | **513** |
| Xeon Gold 6330H | 24 | 4 | **539** | **496** |
| Xeon Gold 6328H | 16 | 4 | **457** | **440** |
| Xeon Gold 6328HL | 16 | 4 | 457 est. | 440 est. |
| Xeon Gold 5320H | 20 | 4 | **501** | **461** |
| Xeon Gold 5318H | 18 | 4 | **468** | **433** |

| Processor model | Number of cores | Number of processor | SPECspeed2017 int_base | SPECspeed2017 fp_base |
|---|---|---|---|---|
| Xeon Platinum 8380HL | 28 | 4 | | **254** |
| Xeon Platinum 8356H | 8 | 4 | **12.5** | |

The following graph compares the throughput of PRIMERGY RX4770 M6 and its older model, PRIMERGY RX4770 M5, with maximum performance configurations.

**SPECrate2017: Comparison of PRIMERGY RX4770 M6 and PRIMERGY RX4770 M5**




On October 28, 2020, PRIMERGY RX4770 M6 with the Xeon Platinum 8380HL processor won first place in the 4-socket Xeon category of the SPECrate2017_fp_base benchmark.

On October 28, 2020, PRIMERGY RX4770 M6 with the Xeon Platinum 8380HL processor won first place in the 4-socket Xeon category of the SPECspeed2017_int_base benchmark.

On October 28, 2020, PRIMERGY RX4770 M6 with the Xeon Platinum 8380HL processor won first place in the 4-socket Xeon category of the SPECspeed2017_fp_base benchmark.

# 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 RX4770 M6 |
| • Processor | 3rd Generation Intel Xeon Scalable Processors Family |
| • Memory | 32 GB (1x32 GB) 2Rx4 PC4-3200AA-R × 48 |
| **Software** | |
| • BIOS settings | • SNC = Enable SNC2<br>• Override OS Energy Performance = Enabled<br>• Energy Performance = Performance<br>• HWPM Support = Disabled<br>• Intel Virtualization Technology = Disabled<br>• LLC Dead Line Alloc = Disabled<br>• Stale AtoS = Enabled |
| • Operating system | Red Hat Enterprise Linux Server release 8.2 4.18.0-193.el8.x86_64 |
| • Operating system settings | Kernel Boot Parameter set with : nohz_full=1-X<br>(X: logical core number -1)<br>Transparent Huge Pages inactivated<br>sched_cfs_bandwidth_slice_us = 50000<br>sched_migration_cost_ns = 5000000<br>cpupower -c all frequency-set -g performance<br>cpupower idle-set -d 1<br>cpupower idle-set -d 2<br>cpupower idle-set -d 3<br>echo 0 > /proc/sys/kernel/numa_balancing<br>echo 1 > /proc/sys/vm/drop_caches<br>ulimit -s unlimited |
| • Compiler | C/C++: Version 19.1.1.217 of Intel C/C++ Compiler for Linux |
| • Benchmark | STREAM Version 5.10 |

## ***Benchmark results***

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

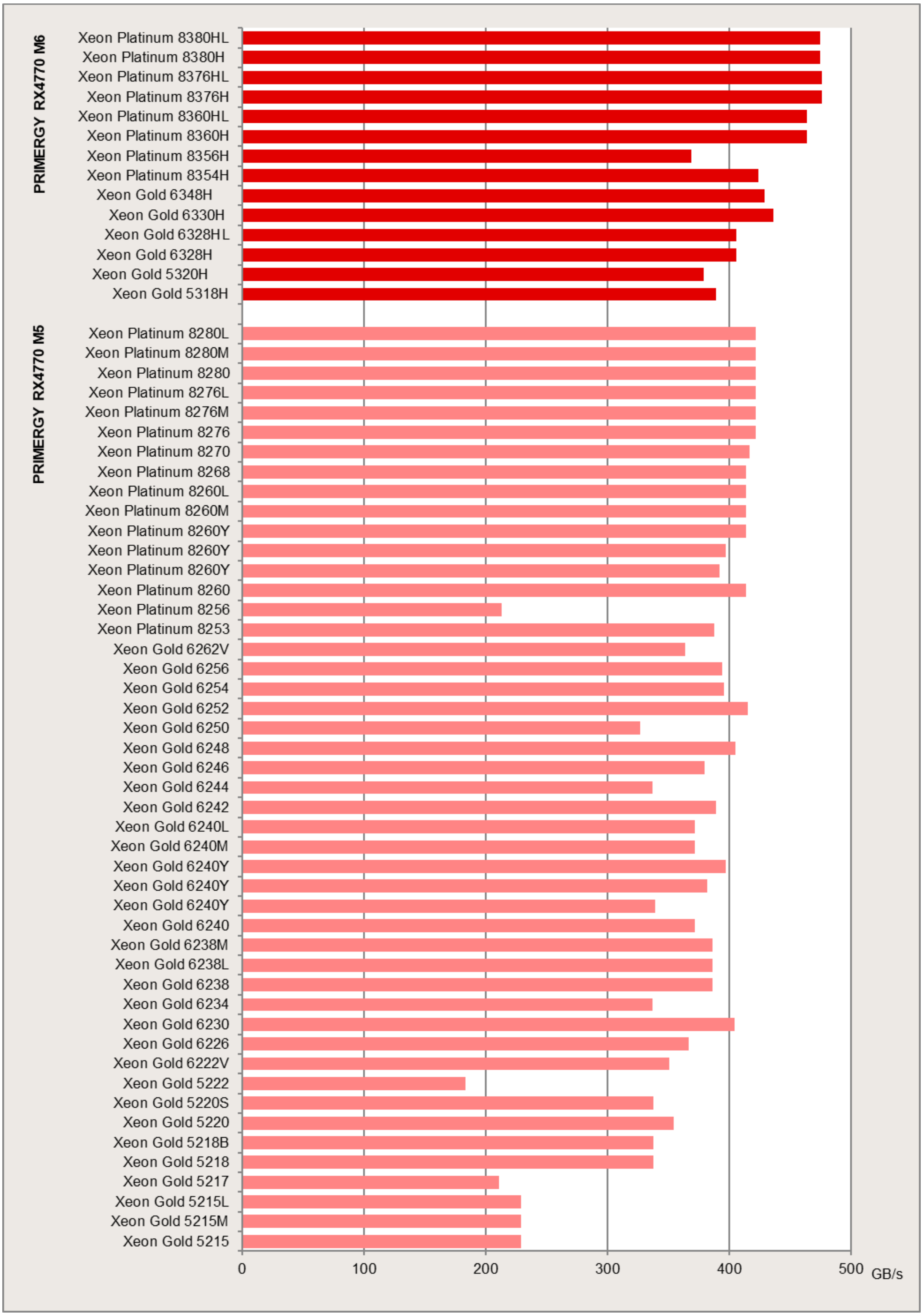
| Processor | Memory frequency [MHz] | Maximum memory bandwidth[*1] [GB/s] | Number of cores | Rated frequency [GHz] | Number of processors | TRIAD [GB/s] |
|---|---|---|---|---|---|---|
| Xeon Platinum 8380H | 3,200 | 154 | 28 | 2.9 | 4 | 475 est. |
| Xeon Platinum 8380HL | 3,200 | 154 | 28 | 2.9 | 4 | **475** |
| Xeon Platinum 8376H | 3,200 | 154 | 28 | 2.6 | 4 | 476 est. |
| Xeon Platinum 8376HL | 3,200 | 154 | 28 | 2.6 | 4 | **476** |
| Xeon Platinum 8360H | 3,200 | 154 | 24 | 3.0 | 4 | **464** |
| Xeon Platinum 8360HL | 3,200 | 154 | 24 | 3.0 | 4 | 464 est. |
| Xeon Platinum 8356H | 3,200 | 154 | 8 | 3.9 | 4 | **369** |
| Xeon Platinum 8354H | 3,200 | 154 | 18 | 3.1 | 4 | **424** |
| Xeon Gold 6348H | 3,200 | 141 | 24 | 1.9 | 4 | **429** |
| Xeon Gold 6330H | 3,200 | 141 | 24 | 3.1 | 4 | **436** |
| Xeon Gold 6328H | 3,200 | 141 | 16 | 2.1 | 4 | 406 est. |
| Xeon Gold 6328HL | 3,200 | 141 | 16 | 2.5 | 4 | **406** |
| Xeon Gold 5320H | 3,200 | 128 | 20 | 3.3 | 4 | **386** |
| Xeon Gold 5318H | 3,200 | 128 | 18 | 3.6 | 4 | **389** |

*1: Value per Processor

The following diagram illustrates the throughput of the PRIMERGY RX4770 M6in comparison to its predecessor, the RX4770 M5.

**STREAM TRIAD: Comparison of PRIMERGY RX4770 M6 and PRIMERGY RX4770 M5**



# LINPACK

## *Benchmark description*

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

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

LINPACK can be used to measure the speed of computers when solving a linear equation system. For this purpose, an n 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 http://software.intel.com/en-us/articles/intel-math-kernel-library-linpack-download/.

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

## *Benchmark environment*

| System Under Test (SUT) | |
|---|---|
| **Hardware** | |
| • Model | PRIMERGY RX4770 M6 |
| • Processor | 4 x 3rd Generation Intel Xeon Scalable Processors Family |
| • Memory | 48 x 32 GB (1x32 GB) 2Rx4 PC4-3200AA-R |
| **Software** | |
| • BIOS settings | • HyperThreading = Disabled<br>• Link Frequency Select = 10.4 GT/s<br>• HWPM Support = Disabled<br>• Intel Virtualization Technology = Disabled<br>• LLC Dead Line Alloc = Disabled<br>• Stale AtoS = Enabled<br>• Fan Control = Full |
| • Operating system | Red Hat Enterprise Linux Server release 8.2 4.18.0-193.el8.x86_64 |
| • Operating system settings | Kernel Boot Parameter set with : nohz_full=1-X<br>(X: logical core number -1)<br>cpupower -c all frequency-set -g performance<br>run with avx512 |
| • Compiler | C/C++: Version 19.1.1.217 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] | Rmax [GFlops] | Efficiency |
|---|---|---|---|---|---|---|
| Xeon Platinum 8380H | 28 | 2.9 | 4 | 10,394 | 6,929 est. | 67% |
| Xeon Platinum 8380HL | 28 | 2.9 | 4 | 10,394 | **6,929** | 67% |
| Xeon Platinum 8376H | 28 | 2.6 | 4 | 9,318 | 6,009 est. | 64% |
| Xeon Platinum 8376HL | 28 | 2.6 | 4 | 9,318 | **6,009** | 64% |
| Xeon Platinum 8360H | 24 | 3.0 | 4 | 9,216 | **5,949** | 65% |
| Xeon Platinum 8360HL | 24 | 3.0 | 4 | 9,216 | 5,949 est. | 65% |
| Xeon Platinum 8356H | 8 | 3.9 | 4 | 3,994 | **2,992** | 75% |
| Xeon Platinum 8354H | 18 | 3.1 | 4 | 7,142 | **4,825** | 68% |
| Xeon Gold 6348H | 24 | 1.9 | 4 | 7,066 | **4,534** | 64% |
| Xeon Gold 6330H | 18 | 3.1 | 4 | 6,144 | **4,020** | 65% |
| Xeon Gold 6328H | 24 | 2.1 | 4 | 5,734 | **3,929** | 69% |
| Xeon Gold 6328HL | 20 | 2.5 | 4 | 5,734 | 3,929 est. | 69% |
| Xeon Gold 5320H | 12 | 3.3 | 4 | 6,144 | **4,039** | 66% |
| Xeon Gold 5318H | 8 | 3.6 | 4 | 5,760 | **3,757** | 65% |

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

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

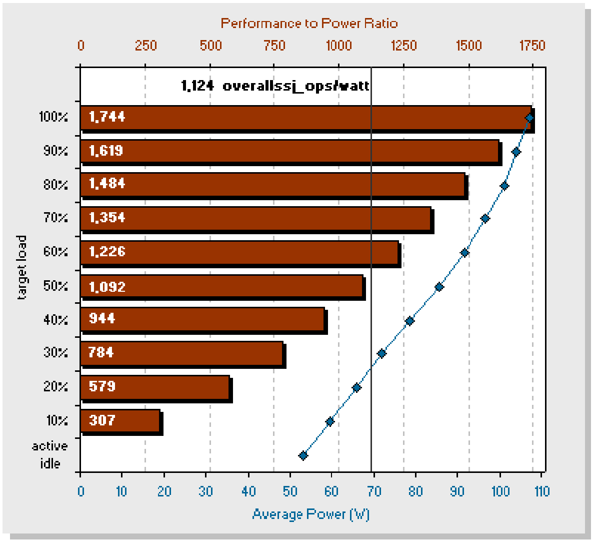
# SPECpower_ssj2008

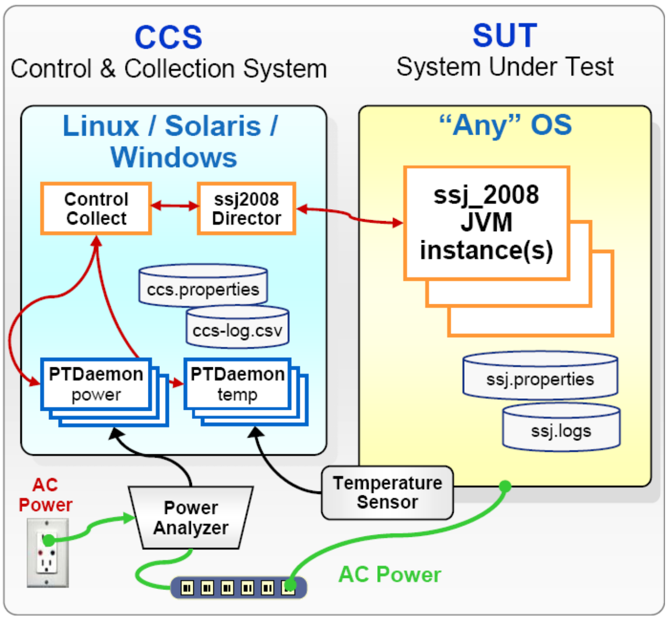
## *Benchmark description*

SPECpower_ssj2008 is the first industry-standard SPEC benchmark that evaluates the power and performance characteristics of a server. With SPECpower_ssj2008 SPEC has defined standards for server power measurements in the same way they have done for performance.

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

SPECpower_ssj2008 reports power consumption for servers at different performance levels — from 100% to “active idle” in 10% segments — over a set period of time. The graduated workload recognizes the fact that processing loads and power consumption on servers vary substantially over the course of days or weeks. To compute a power-performance metric across all levels, measured transaction throughputs for each segment are added together and then divided by the sum of the average power consumed for each segment. The result is a figure of merit called “overall ssj_ops/watt”. This ratio provides information about the energy efficiency of the measured server. The defined measurement standard enables customers to compare it with other configurations and servers measured with SPECpower_ssj2008. The diagram shows a typical graph of a SPECpower_ssj2008 result.




The benchmark runs on a wide variety of operating systems and hardware architectures and does not require extensive client or storage infrastructure. The minimum equipment for SPEC-compliant testing is two networked computers, plus a power analyzer and a temperature sensor. One computer is the System Under Test (SUT) which runs one of the supported operating systems and the JVM. The JVM provides the environment required to run the SPECpower_ssj2008 workload which is implemented in Java. The other computer is a “Control & Collection System” (CCS) which controls the operation of the benchmark and captures the power, performance, and temperature readings for reporting. The diagram provides an overview of the basic structure of the benchmark configuration and the various components.

## Benchmark environment

| System Under Test (SUT) | |
|---|---|
| **Hardware** | |
| • Model | PRIMERGY RX4770 M6 |
| • Processor | 4 x Intel Xeon Platinum 8380H |
| • Memory | 24 x 16 GB 2Rx8 PC4-3200Y R |
| • Network interface | 1 x PLAN CP I350-T4 4X 1000BASE-T OCPv3 |
| • Disk subsystem | 1 x SSD M.2 240GB, S26361-F5787-E240 |
| • Power Supply Unit | 2 x 900 W Titanium S26113-E629-V50-1 |
| **Software** | |
| • BIOS | R1.1.1 |
| • BIOS settings | ASPM Support = L1 only<br>Hardware Prefetcher = Disabled<br>Adjacent Cache Line Prefetch = Disabled<br>DCU Streamer Prefetcher = Disabled<br>Intel Virtualization Technology = Disabled<br>Turbo Mode = Disabled<br>Energy Performance = Energy Efficient<br>Override OS Energy Performance = Enabled<br>HWPM Support = Disabled<br>Package C State limit = No limit<br>UPI Link Frequency Select = 9.6GT/s<br>Local x2APIC = Disabled<br>Uncore Frequency Override = Power balanced<br>DDR Performance = Power balanced (effective memory frequency = 2400 MHz)<br>SNC(Sub NUMA) = Enabled<br>SATA Controller = Disabled<br>USB Port Control = Disable all ports<br>Serial Port = Disabled<br>Network Stack = Disabled |
| • Firmware | 3.00P |
| • Operating system | SUSE Linux Enterprise Server 15 SP2 5.3.18-19-default |

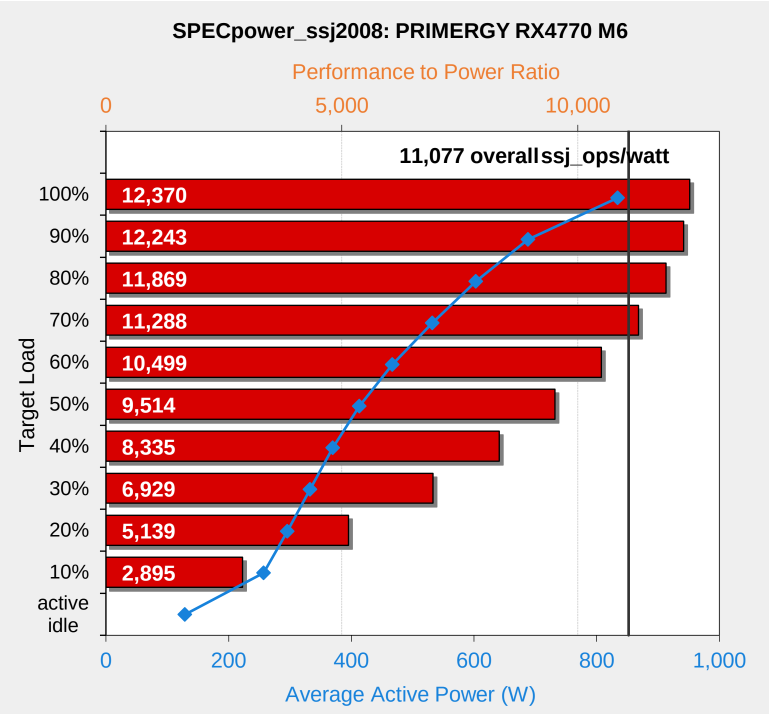
| | |
|---|---|
| • Operating system settings | kernel parameter: pcie_aspm=force pcie_aspm.policy=powersave intel_pstate=disable<br>Benchmark started via ssh<br>modprobe cpufreq_conservative<br>cpupower frequency-set -g conservative<br>echo 1000000 > /sys/devices/system/cpu/cpufreq/conservative/sampling_rate<br>echo 94 > /sys/devices/system/cpu/cpufreq/conservative/up_threshold<br>echo 0 > /sys/devices/system/cpu/cpufreq/conservative/ignore_nice_load<br>echo 1 > /sys/devices/system/cpu/cpufreq/conservative/sampling_down_factor<br>echo 1 > /sys/devices/system/cpu/cpufreq/conservative/freq_step<br>echo 93 > /sys/devices/system/cpu/cpufreq/conservative/down_threshold<br>echo always > /sys/kernel/mm/transparent_hugepage/enabled<br>sysctl -w kernel.sched_migration_cost_ns=6000<br>sysctl -w kernel.sched_min_granularity_ns=10000000<br>sysctl -w kernel.nmi_watchdog=0<br>sysctl -w vm.swappiness=50<br>sysctl -w vm.laptop_mode=5<br>powertop --auto-tune<br><Yes> The test sponsor attests, as of date of publication, that CVE-2017-5754 (Meltdown) is mitigated in the system as tested and documented.<br><Yes> The test sponsor attests, as of date of publication, that CVE-2017-5753 (Spectre variant 1) is mitigated in the system as tested and documented.<br><Yes> The test sponsor attests, as of date of publication, that CVE-2017-5715 (Spectre variant 2) is mitigated in the system as tested and documented. |
| • JVM | Oracle Java HotSpot 64-Bit Server VM 18.9 (build 11.0.8+10-LTS, mixed mode), version 11.0.8 |
| • JVM settings | -server -Xmn23000m -Xms25000m -Xmx25000m -XX:SurvivorRatio=1<br>-XX:TargetSurvivorRatio=99 -XX:AllocatePrefetchDistance=256 -XX:AllocatePrefetchLines=4<br>-XX:ParallelGCThreads=14 -XX:InlineSmallCode=3900 -XX:MaxInlineSize=270<br>-XX:FreqInlineSize=2500 -XX:+UseLargePages -XX:+UseParallelOldGC<br>-XX:AllocatePrefetchInstr=0 -XX:MinJumpTableSize=18 -XX:UseAVX=0<br>-XX:+UseHugeTLBFS -XX:+UseTransparentHugePages |

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

## *Benchmark results*

The PRIMERGY RX4770 M6 in SUSE Linux Enterprise Server 15 SP2 achieved the following result.

**SPECpower_ssj2008 = 11,077 overall ssj_ops/watt**




The graph on the left shows the above measurement results. 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 rhombus. The black vertical line shows the benchmark result of 11,077 overall ssj_ops/watt for the PRIMERGY RX4770 M6. This is the quotient of the sum of the transaction throughputs for each load level and the sum of the average power consumed for each measurement interval.

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

| Performance | | Power | Energy Efficiency |
|---|---|---|---|
| Target Load | ssj_ops | Average Power (W) | ssj_ops/watt |
| 100% | 9,904,110 | 834 | 11,882 |
| 90% | 8,914,839 | 688 | 12,956 |
| 80% | 7,933,444 | 603 | 13,158 |
| 70% | 6,944,695 | 532 | 13,043 |
| 60% | 5,948,299 | 467 | 12,729 |
| 50% | 4,956,147 | 413 | 12,004 |
| 40% | 3,966,282 | 370 | 10,727 |
| 30% | 2,973,866 | 333 | 8,931 |
| 20% | 1,980,442 | 296 | 6,697 |
| 10% | 990,995 | 257 | 3,854 |
| Active Idle | 0 | 129 | 0 |
| | | | **Σ ssj_ops / Σ power = 11,077** |

**Measurement results of SPECpower_ssj2008 (November 4, 2020)**

## 11,077 SPECpower_ssj2008

On November 4, 2020, PRIMERGY RX4770 M6 with four Xeon Platinum 8380H processors achieved a performance value of 11,077 on the SUSE Linux Enterprise Server 15 SP2 in the SPECpower_ssj2008 benchmark, in the Linux division of the 3rd Generation Intel Xeon Processor Scalable Family category and won first place in 4-socket server SPECpower_ssj2008 performance.

For the latest results of the SPECpower_ssj2008, see https://www.spec.org/power_ssj2008/results/.

# SAP Sales and Distribution (SD) Standard Application Benchmark

## *Benchmark description*

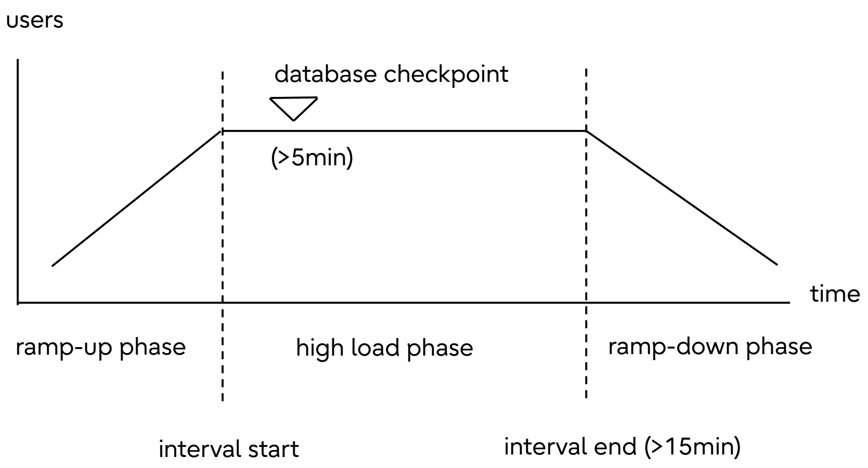
Since 1993 the SAP Standard Application Benchmarks have been developed by SAP in order to verify the performance, stability and scaling of a SAP application system and to provide information for configuring, sizing and for platform comparison. By far the most popular benchmarks from the many available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

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

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

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

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



A benchmark can only be certified if the average dialog response time is less than 1 second.

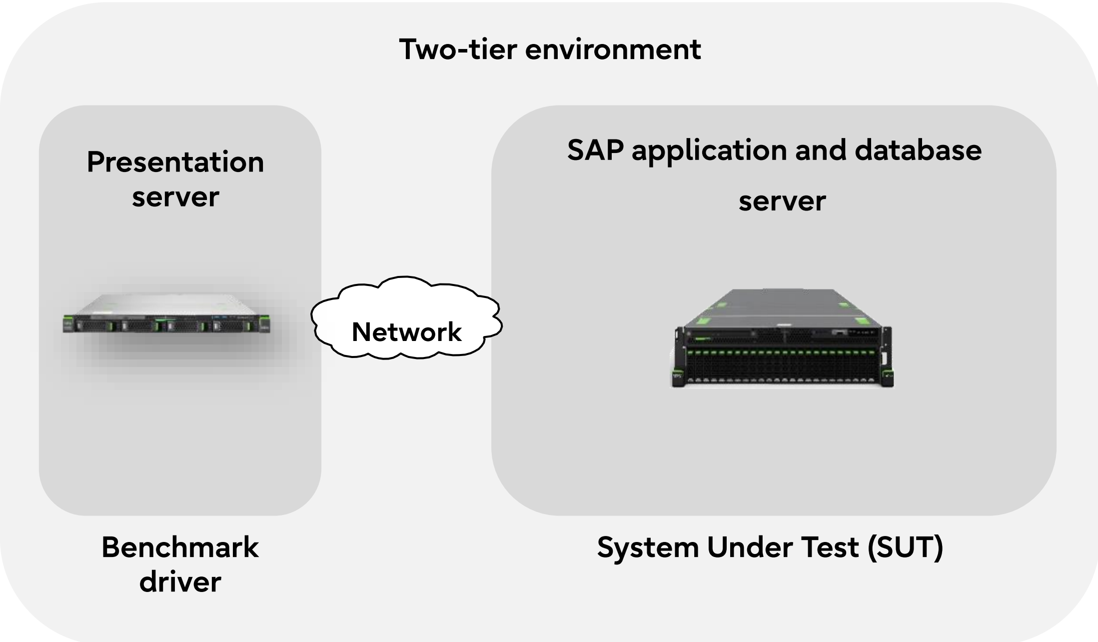
Certified and published SAP SD Benchmarks are published on SAP's benchmark site here .

## Benchmark environment

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

The SD benchmark users are simulated by the the presentation server aka benchmark driver.

The SAP SD Benchmark for PRIMERGY RX4770 M6 was performed on a two-tier configuration.




| System Under Test (SUT) | |
|---|---|
| **Hardware** | |
| • Model | PRIMERGY RX4770 M6 |
| • Processor | 4 × Intel Xeon Platinum 8380HL processor |
| • Memory | 48 × 32 GB 2Rx4 DDR4-3200 R ECC |
| • Network interface | 1 Gbit LAN |
| • Disk subsystem | PRIMERGY RX4770 M6:<br>1 × PRAID EP580i RAID Controller<br>1 × Internal HDD 900GB<br>1 × NVMe P4610-3.2TB<br>2 × PRAID EP540e RAID Controller<br>JX40 S2 × 3:<br>25 × JX40 S2 MLC SSD 960GB 3DWPD |
| **Software** | |
| • Operating system | Windows Server 2016 Datacenter |

| | |
|---|---|
| • Database | Microsoft SQL Server 2012 |
| • SAP Business Suite Software | SAP enhancement package 5 for SAP ERP 6.0 |

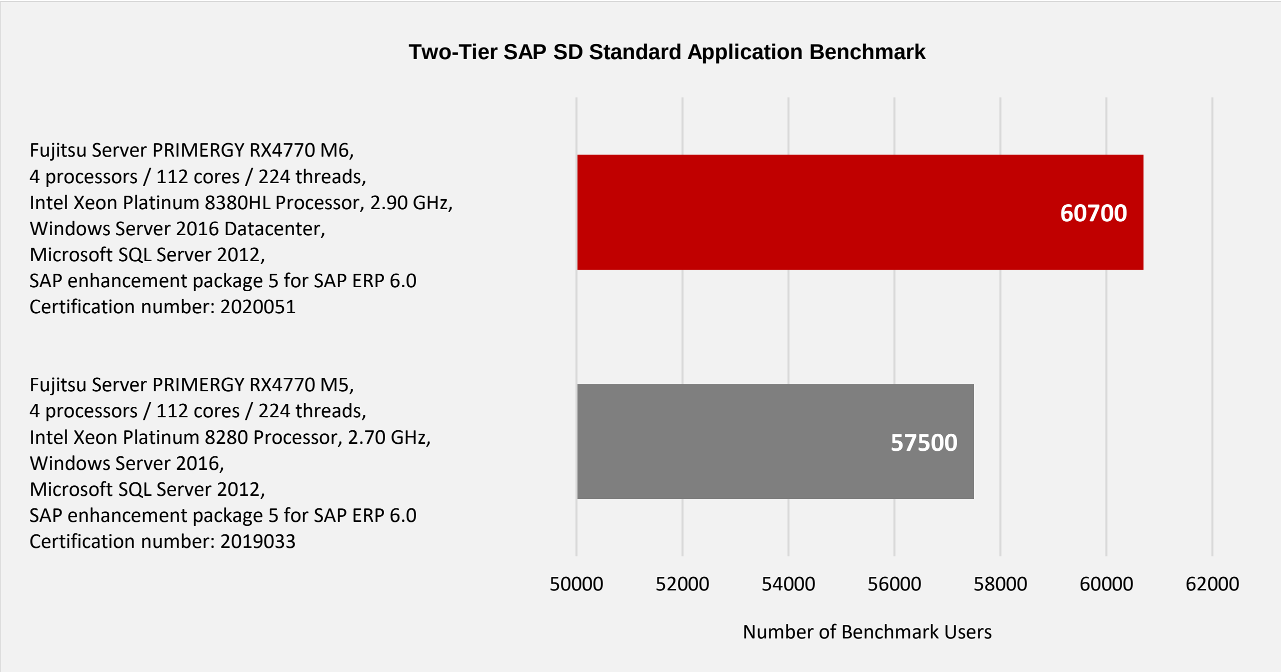
| Benchmark driver | |
|---|---|
| **Hardware** | |
| • Model | PRIMERGY RX2530 M1 |
| • Processor | 2 × Intel Xeon E5-2699 v3 processor |
| • Memory | 236 GB |
| • Network interface | 1 Gbit LAN |
| **Software** | |
| • Operating system | SUSE Linux Enterprise Server 12 SP2 |

## *Benchmark results*

| Certification number 2020051 | |
|---|---|
| • Number of SAP SD benchmark users | 60,700 |
| • Average dialog response time | 0.93 seconds |
| • Throughput<br>Fully processed order line items/hour<br>Dialog steps/hour<br>SAPS | <br>6,665,670<br>19,997,000<br>333,280 |
| • Average database request time (dialog/update) | 0.009 sec / 0.018 sec |
| • CPU utilization of central server | 98% |
| • Operating system, central server | Windows Server 2016 Datacenter |
| • RDBMS | Microsoft SQL Server 2012 |
| • SAP Business Suite software | SAP enhancement package 5 for SAP ERP 6.0 |
| • Configuration Central Server | Fujitsu Server PRIMERGY RX4770 M6,<br>4 processors / 112 cores / 224 threads,<br>Intel Xeon Platinum 8380HL Processor, 2.90 GHz, 64 KB L1 cache per core and 1,024KB L2 cache per core, 38.5 MB L3 cache per socket, 1,536 GB main memory |

The following chart compares the two-tier SAP SD Standard Application Benchmarks for PRIMERGY RX4770 M6 and its predecessor RX4770 M5, shown are the number of benchmark users.




The SAP SD Benchmark certificates can be found here: Certificate 2020051 , Certificate 2019033

# SAP BW Edition for SAP HANA Standard Application Benchmark

## Benchmark description

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

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

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

The SAP BWH Benchmark consists of 3 phases:

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

Data load phase

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

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

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

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

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

Query throughput phase

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

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

Query runtime phase

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

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

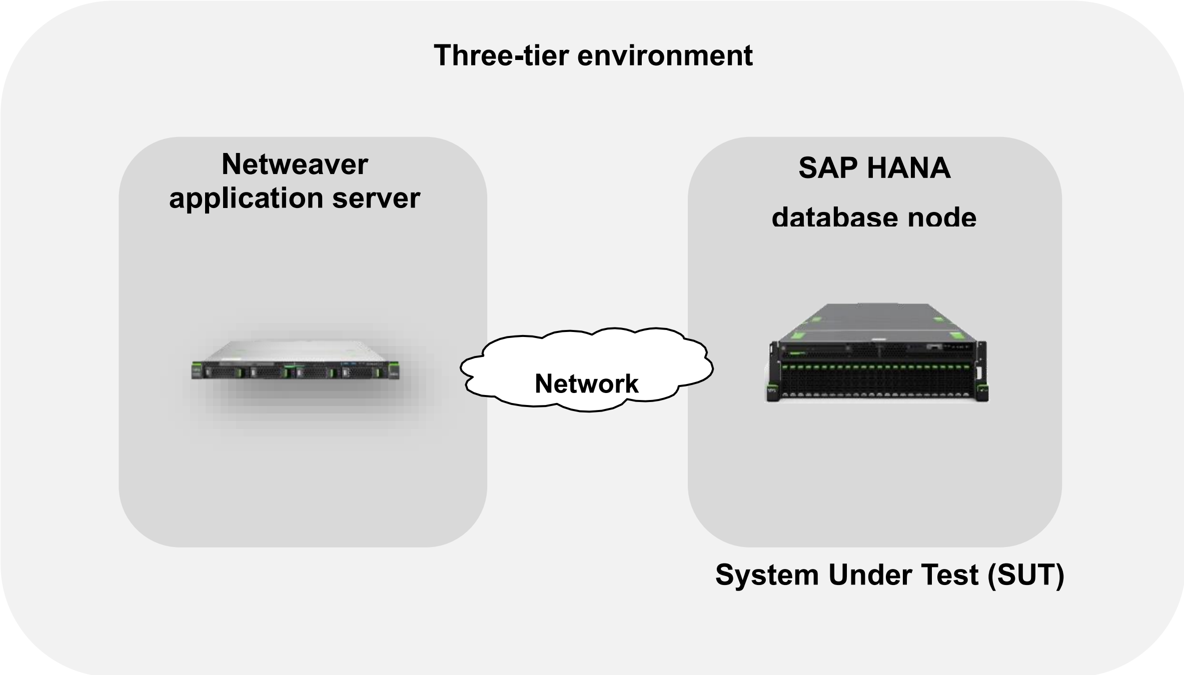
Certified and published SAP BWH Benchmarks are published on SAP's benchmark site here .

## *Benchmark environment*

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

The SAP BWH Benchmarks for PRIMERGY RX4770 M6 were performed on a scale-up configuration.




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

| System Under Test (SUT) | |
|---|---|
| **Hardware** | |
| • Model | PRIMERGY RX4770 M6 |
| • Processor | 4 × Intel Xeon Platinum 8380HL processor |
| • Memory | Configuration 1 (certification 2020039 below): 24 × 32 GB 2Rx4 DDR4-3200 R ECC and 24 x 128GB Intel Optane persistent memory 200 series<br>Configuration 2 (certification 2020040 below): 24 × 64 GB 2Rx4 DDR4-3200 R ECC and 24 x 128GB Intel Optane persistent memory 200 series |
| • Network interface | 1 Gbit LAN |
| • Disk subsystem | PRIMERGY RX4770 M6:<br>1 × PRAID EP580i RAID Controller<br>1 × Internal SAS-SSD 1.6TB<br>2 × PRAID EP540e RAID Controller<br>JX40 S2 × 3:<br>25 × JX40 S2 MLC SSD 960GB 3DWPD |
| **Software** | |
| • Operating system | SUSE Linux Enterprise Server for SAP Application 15 SP2 |
| • Database | SAP HANA 2.0 |

| Application Server | |
|---|---|
| **Hardware** | |
| • Model | PRIMERGY RX2540 M5 |
| • Processor | 2 × Intel Xeon Platinum 8280 processor |
| • Memory | 768 GB |
| • Network interface | 1 Gbit LAN |
| **Software** | |
| • Operating system | SUSE Linux Enterprise Server 12 SP4 |
| • Technology platform release | SAP Netweaver 7.50 |

## *Benchmark results*

Two SAP BWH Benchmarks were performed on PRIMERGY RX4770 M6, the first with 768 GB DRAM plus 3,072 GB Persistent Memory and 6.5 billion records, the second with 1,536 GB DRAM plus 3,072 GB Persistent Memory and 7.8 billion records.

6.5 Billion Records Scenario

On October 23, 2020, the following SAP BW edition for SAP HANA Standard Application Benchmark Version 3 was certified:

| **Certification number 2020039** | |
|---|---|
| • Benchmark Phase 1<br>• Number of initial records:<br>• Runtime of last Data Set (seconds): | <br>6,500,000,000<br>12,463 |
| • Benchmark Phase 2<br>Query Executions per Hour:<br>CPU utilization of database server: | <br>5,136<br>94% |
| • Benchmark Phase 3<br>• Total Runtime of complex query phase (seconds): | 96 |
| • Operating system: | SUSE Linux Enterprise Server 15 |
| • Database: | SAP HANA 2.0 |
| • Technology platform release: | SAP NetWeaver 7.50 |
| • Configuration Database Server | Fujitsu Server PRIMERGY RX4770 M6,<br>4 processors / 112 cores / 224 threads,<br>Intel Xeon Platinum 8380HL Processor, 2.90 GHz, 64 KB L1 cache per core and 1,024KB L2 cache per core, 38.5 MB L3 cache per socket, 768 GB DRAM and 3,072 GB Persistent Memory |

The PRIMERGY RX4770 M6, equipped with Intel's 3rd Generation Intel Xeon Scalable Processor 8380HL and Intel Optane Persistent Memory 200 Series (Barlow Pass) achieved the best results in all three phases of the SAP BWH benchmark and thus set a new overall world record in the 6.5 billion initial records category (as of 2020-10-23).

Also very remarkable, that the world record was achieved with 768 GB of DRAM and 3,072 GB Persistent Memory - a ratio of 1:4.

The SAP BWH Benchmark certificate can be found here .

### 7.8 Billion Records Scenario

On October 28, 2020, the following SAP BW edition for SAP HANA Standard Application Benchmark Version 3 was certified:

| **Certification number 2020040** | |
|---|---|
| • Benchmark Phase 1<br>• Number of initial records:<br>• Runtime of last Data Set (seconds): | <br>7,800,000,000<br>12,752 |
| • Benchmark Phase 2<br>Query Executions per Hour:<br>CPU utilization of database server: | <br>4,729<br>95% |
| • Benchmark Phase 3<br>• Total Runtime of complex query phase (seconds): | 90 |
| • Operating system: | SUSE Linux Enterprise Server 15 |
| • Database: | SAP HANA 2.0 |
| • Technology platform release: | SAP NetWeaver 7.50 |
| • Configuration Database Server | Fujitsu Server PRIMERGY RX4770 M6,<br>4 processors / 112 cores / 224 threads,<br>Intel Xeon Platinum 8380HL Processor, 2.90 GHz, 64 KB L1 cache per core and 1,024KB L2 cache per core, 38.5 MB L3 cache per socket, 1,536 GB DRAM and 3,072 GB Persistent Memory |

Right after the first world record with 6.5 billion initial records on October, 23 (see above), RX4770 M6 set another important overall scale-up world record in the next category with 7.8 billion records (as of 2020-10-28).

The memory configuration was adjusted for the higher amount of data. While 768 GB DRAM and 3,072 GB Persistent Memory (ratio 1:4) were used for the 6.5 billion records scenario, the 7.8 billion records scenario ran with 1,536 GB DRAM and 3,072 GB Persistent Memory (ratio 1:2).

The SAP BWH Benchmark certificate can be found here .

# Disk I/O: Performance of storage media

## *Benchmark description*

Performance measurements of disk subsystems for PRIMERGY servers are used for performance evaluation. It is possible to compare different storage connections as well. As standard, these performance measurements are carried out with a defined measurement method, which models the accesses of real application scenarios on the basis of specifications.

The essential specifications are as follows.

- Random access / sequential access ratio
- Read / write access ratio
- Block size (kiB)
- Number of parallel accesses (number of outstanding I/Os)

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

| Standard load profile | Access | Type of access | | Block size [kiB] | Application |
|---|---|---|---|---|---|
| | | read | write | | |
| Filecopy | Random | 50% | 50% | 64 | Copying files |
| Fileserver | Random | 67% | 33% | 64 | Fileserver |
| Database | Random | 67% | 33% | 8 | Database (data transfer)<br>Mail server |
| Streaming | Sequential | 100% | 0% | 64 | Database (log file),<br>Data backup,<br>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 "number of Outstanding I/Os" is increased from 1 to 512 (in steps to the power of two).

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

The main 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."

## *Benchmark environment*

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

| System Under Test (SUT) | | |
|---|---|---|
| **Hardware** | | |
| Controller: PRAID EP540i | | |
| Storage media | Category | Drive name |
| HDD | SAS HDD (SAS 12Gbps, 15k rpm) [512n] | ST300MP0006<br>ST600MP0006 |
| | SAS HDD (SAS 12Gbps, 10k rpm) [512e] | AL15SEB06EQ<br>AL15SEB12EQ |
| | SAS HDD (SAS 12Gbps, 10k rpm) [512n] | AL15SEB060N<br>AL15SEB120N |
| | NL-SAS HDD (SAS 12Gbps, 7.2k rpm) [512n] | ST2000NX0433 |
| | BC-SATA HDD (SATA 6Gbps, 7.2k rpm) [512e] | ST1000NX0313 |
| | BC-SATA HDD (SATA 6Gbps, 7.2k rpm) [512n] | ST1000NX0423 |
| SSD | SAS SSD (SAS 12Gbps, Write Intensive) | KPM51MUG400G<br>KPM51MUG800G<br>KPM51MUG1T60 |
| | SAS SSD (SAS 12Gbps, Mixed Use) | WUSTR6440ASS204<br>WUSTR6480ASS204<br>WUSTR6416ASS204<br>WUSTR6432ASS204 |
| | SAS SSD (SAS 12Gbps, Read Intensive) | WUSTR1548ASS204<br>WUSTR1596ASS204<br>WUSTR1519ASS204<br>WUSTR1538ASS204<br>WUSTR1576ASS204 |
| | SATA SSD (SATA 6Gbps, Mixed Use) | MTFDDAK240TDT<br>MTFDDAK480TDT<br>MTFDDAK960TDT<br>MTFDDAK1T9TDT<br>MTFDDAK3T8TDT |
| | SATA SSD (SATA 6Gbps, Read Intensive) | MTFDDAK240TDS<br>MTFDDAK480TDS<br>MTFDDAK960TDS<br>MTFDDAK1T9TDS<br>MTFDDAK3T8TDS<br>MTFDDAK7T6TDS |

| Controller: | PRAID EP540i | | |
|---|---|---|---|
| | Storage media | Category | Drive name |
| | | PCIe SSD (Write intensive) | SSDPE21K750GA |
| | | PCIe SSD (Mixed Use) | SSDPE2KE016T8<br>SSDPE2KE032T8<br>SSDPE2KE064T8 |
| | | PCIe SSD (Read intensive) | SSDPE2KX010T8<br>SSDPE2KX020T8<br>SSDPE2KX040T8 |

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

| **Software** | | |
|---|---|---|
| Operating system | | Microsoft Windows Server 2016 Standard |
| Benchmark version | | 3.0 |
| RAID type | | Type RAID 0 logical drive consisting of 1 hard disk |
| Stripe size | | HDD: 256KiB, SSD: 64 KiB |
| Measuring tool | | Iometer 1.1.0 |
| Measurement area | HDD, SSD (other than M.2) | RAW file system is used. The first 32GB of available LBA space is used for sequential access. The following 64GiB 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 64GiB is used for random access. |
| Total 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."

### Controller

The measurements were made using controllers in the table below.

| Storage media | Controller name | Cache | Supported interfaces | | RAID levels |
|---|---|---|---|---|---|
| | | | host | drive | |
| SSD/HDD | PRAID EP540i | - | 8x PCIe 3.0 | SATA 6G<br>SAS 12G<br>16x PCIe | 0, 1, 1E, 10, 5, 50 |
| M.2 Flash | C620 Standard SATA AHCI controller | - | 4x DMI 3.0 | SATA 6G | - |

### Storage media

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

| Storage media type | Interface | Form factor |
|---|---|---|
| HDD | SAS 12G | 2.5 inch |
| | SATA 6G | 2.5 inch |
| SSD | SAS 12G | 2.5 inch |
| | SATA 6G | 2.5 inch or M.2 |
| | PCIe 3.0 | 2.5 inch |

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

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

### Cache settings

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

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

### Performance values

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

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

# Storage media

## HDDs

| Capacity [GB] | Storage device | Inter face | Transactions [IO/s] | | | Throughput [MiB/s] | |
|---|---|---|---|---|---|---|---|
| | | | Database | Fileserver | Filecopy | Streaming | Restore |
| 300 | ST300MP0006 | SAS 12G | 790 | 696 | 666 | 304 | 304 |
| 600 | ST600MP0006 | SAS 12G | 736 | 651 | 601 | 301 | 300 |
| 600 | AL15SEB06EQ | SAS 12G | 670 | 570 | 603 | 260 | 259 |
| 1,200 | AL15SEB12EQ | SAS 12G | 734 | 630 | 637 | 260 | 256 |
| 600 | AL15SEB060N | SAS 12G | 684 | 565 | 584 | 231 | 232 |
| 1,200 | AL15SEB120N | SAS 12G | 746 | 609 | 604 | 230 | 219 |
| 2,000 | ST2000NX0433 | SAS 12G | 492 | 405 | 388 | 132 | 132 |
| 1,000 | ST1000NX0313 | SATA 6G | 393 | 340 | 337 | 134 | 134 |
| 1,000 | ST1000NX0423 | SATA 6G | 399 | 344 | 346 | 134 | 134 |

## SSDs

| Capacity [GB] | Storage device | Inter face | Transactions [IO/s] | | | Throughput [MiB/s] | |
|---|---|---|---|---|---|---|---|
| | | | Database | Fileserver | Filecopy | Streaming | Restore |
| 400 | KPM51MUG400G | SAS 12G | 104,184 | 14,603 | 14,780 | 1,059 | 1,032 |
| 800 | KPM51MUG800G | SAS 12G | 123,267 | 18,333 | 20,740 | 1,059 | 1,032 |
| 1,600 | KPM51MUG1T60 | SAS 12G | 123,420 | 20,967 | 22,941 | 1,058 | 1,033 |
| 400 | WUSTR6440ASS204 | SAS 12G | 110,903 | 18,389 | 15,114 | 1,074 | 635 |
| 800 | WUSTR6480ASS204 | SAS 12G | 138,943 | 24,921 | 24,087 | 1,074 | 1,019 |
| 1,600 | WUSTR6416ASS204 | SAS 12G | 137,178 | 24,932 | 27,138 | 1,074 | 1,036 |
| 3,200 | WUSTR6432ASS204 | SAS 12G | 144,367 | 24,924 | 27,671 | 1,074 | 1,038 |
| 6,400 | WUSTR6464ASS204 | SAS 12G | 148,587 | 24,891 | 27,847 | 1,074 | 1,040 |
| 480 | WUSTR1548ASS204 | SAS 12G | 90,423 | 12,036 | 10,782 | 1,074 | 579 |
| 960 | WUSTR1596ASS204 | SAS 12G | 126,502 | 19,057 | 17,422 | 1,074 | 980 |
| 1,920 | WUSTR1519ASS204 | SAS 12G | 129,456 | 21,970 | 22,623 | 1,074 | 1,038 |
| 3,840 | WUSTR1538ASS204 | SAS 12G | 134,032 | 24,860 | 26,851 | 1,074 | 1,038 |
| 7,680 | WUSTR1576ASS204 | SAS 12G | 138,973 | 24,938 | 27,233 | 1,074 | 1,034 |
| 240 | MTFDDAK240TDT | SATA 6G | 46,406 | 5,989 | 6,121 | 508 | 370 |
| 480 | MTFDDAK480TDT | SATA 6G | 49,138 | 6,383 | 6,600 | 508 | 437 |
| 960 | MTFDDAK960TDT | SATA 6G | 50,488 | 6,970 | 7,136 | 508 | 486 |
| 1,920 | MTFDDAK1T9TDT | SATA 6G | 50,669 | 7,183 | 7,336 | 508 | 487 |
| 3,840 | MTFDDAK3T8TDT | SATA 6G | 49,490 | 7,115 | 7,208 | 493 | 474 |
| 240 | MTFDDAK240TDS | SATA 6G | 42,594 | 5,435 | 5,510 | 508 | 301 |
| 480 | MTFDDAK480TDS | SATA 6G | 47,577 | 6,109 | 6,310 | 508 | 401 |
| 960 | MTFDDAK960TDS | SATA 6G | 50,134 | 6,633 | 6,852 | 506 | 480 |
| 1,920 | MTFDDAK1T9TDS | SATA 6G | 50,638 | 7,078 | 7,286 | 508 | 488 |
| 3,840 | MTFDDAK3T8TDS | SATA 6G | 49,542 | 7,097 | 7,196 | 495 | 477 |
| 7,680 | MTFDDAK7T6TDS | SATA 6G | 47,200 | 7,134 | 7,563 | 508 | 487 |
| 750 | SSDPE21K750GA | PCIe3 x4 | 194,085 | 37,392 | 36,626 | 2,561 | 2,334 |
| 1,600 | SSDPE2KE016T8 | PCIe3 x4 | 276,785 | 45,739 | 40,923 | 3,214 | 1,972 |
| 3,200 | SSDPE2KE032T8 | PCIe3 x4 | 306,446 | 53,059 | 50,093 | 3,220 | 2,461 |
| 6,400 | SSDPE2KE064T8 | PCIe3 x4 | 297,505 | 56,338 | 56,632 | 3,219 | 2,499 |
| 1,000 | SSDPE2KX01 | PCIe3 x4 | 153,263 | 25,891 | 21,942 | 2,799 | 1,109 |
| 2,000 | SSDPE2KX02 | PCIe3 x4 | 237,530 | 38,336 | 34,740 | 3,181 | 1,979 |
| 4,000 | SSDPE2KX04 | PCIe3 x4 | 242,546 | 39,242 | 38,151 | 2,905 | 2,417 |
| 240 | MTFDDAV240TDS | SATA 6G | 32,805 | 5,482 | 5,518 | 504 | 300 |
| 480 | MTFDDAV480TDS | SATA 6G | 39,927 | 6,384 | 6,575 | 497 | 397 |

# 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.

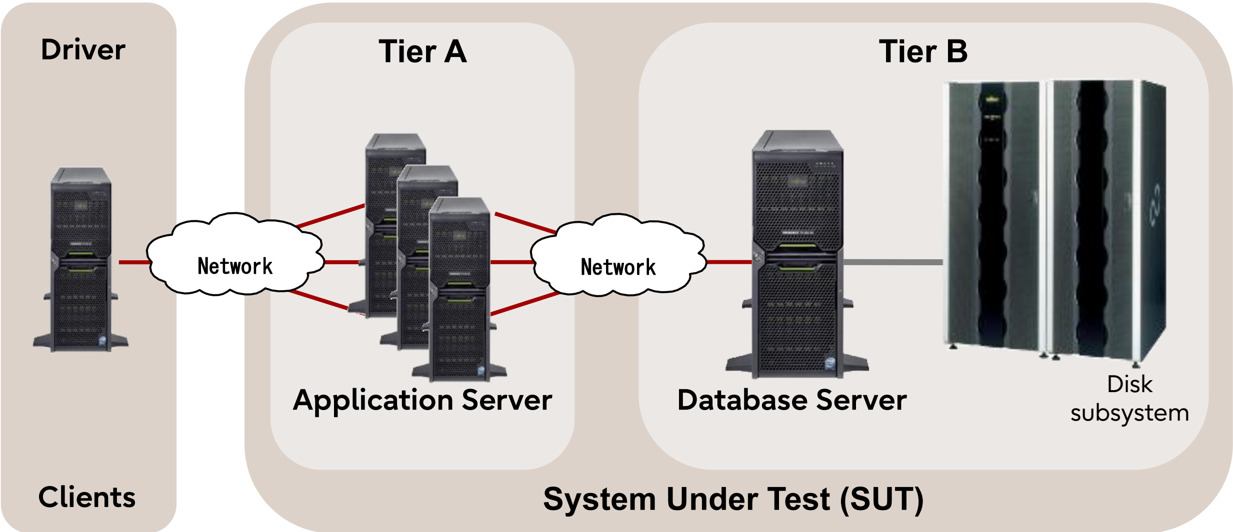
In contrast to benchmarks such as SPEC CPU and TPC-E, which were standardized by independent bodies and for which adherence to the respective rules and regulations are monitored, OLTP-2 is an internal benchmark of Fujitsu. OLTP-2 is based on the well-known database benchmark TPC-E. OLTP-2 was designed 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 following pages of PRIMERGY RX4770 M6.

| Database Server (Tier B) | |
|---|---|
| **Hardware** | |
| • Model | PRIMERGY RX4770 M6 |
| • Processor | 3rd Generation Intel Xeon Processor Scalable Family |
| • Memory | 2 processors:24 x 64 GB (1x64 GB) 2Rx4 DDR4-3200 ECC<br>4 processors:48 x 64 GB (1x64 GB) 2Rx4 DDR4-3200 ECC |
| • Network interface | 2 x Dual port LAN 10 Gbps<br>1 x Quad port onboard LAN 1 Gbps |
| • Disk subsystem | PRIMERGY RX4770 M6:RAID controller PRAID EP540i<br>6 x 1.6 TB SSD drive, RAID10 (LOG),<br>5 x RAID controller PRAID EP540e<br>10 x JX40 S2: 4 x 1.6 TB SSD drive, RAID10 (temp),<br>120 x 1.6 TB SSD drive, RAID5 (data) |
| **Software** | |
| • BIOS | Version R1.5.0 |
| • Operating system | Microsoft Windows Server 2016 Standard |
| • Database | Microsoft SQL Server 2017 Enterprise + KB4341265 |

| Application Server (Tier A) | |
|---|---|
| **Hardware** | |
| • Model | 1 x PRIMERGY RX2530 M4 |
| • Processor | 2 x Xeon Platinum 8180 |
| • Memory | 192 GB, 2666 MHz Registered ECC DDR4 |
| • Network interface | 2 x Dual port LAN 10 Gbps<br>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 |

| Clients | |
|---|---|
| **Hardware** | |
| • Model | 1 x PRIMERGY RX2530 M2 |
| • Processor | 2 x Xeon E5-2667 v4 |
| • Memory | 128 GB, 2400 MHz Registered ECC DDR4 |
| • Network interface | 1 x Quad port onboard LAN 1 Gbps |
| • Disk subsystem | 1 x 300 GB 10k rpm SAS drive |
| **Software** | |
| • Operating system | Microsoft Windows Server 2012 R2 Standard |
| • Benchmark | OLTP-2 Software EGen version 1.14.0 |

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

## *Benchmark results*

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

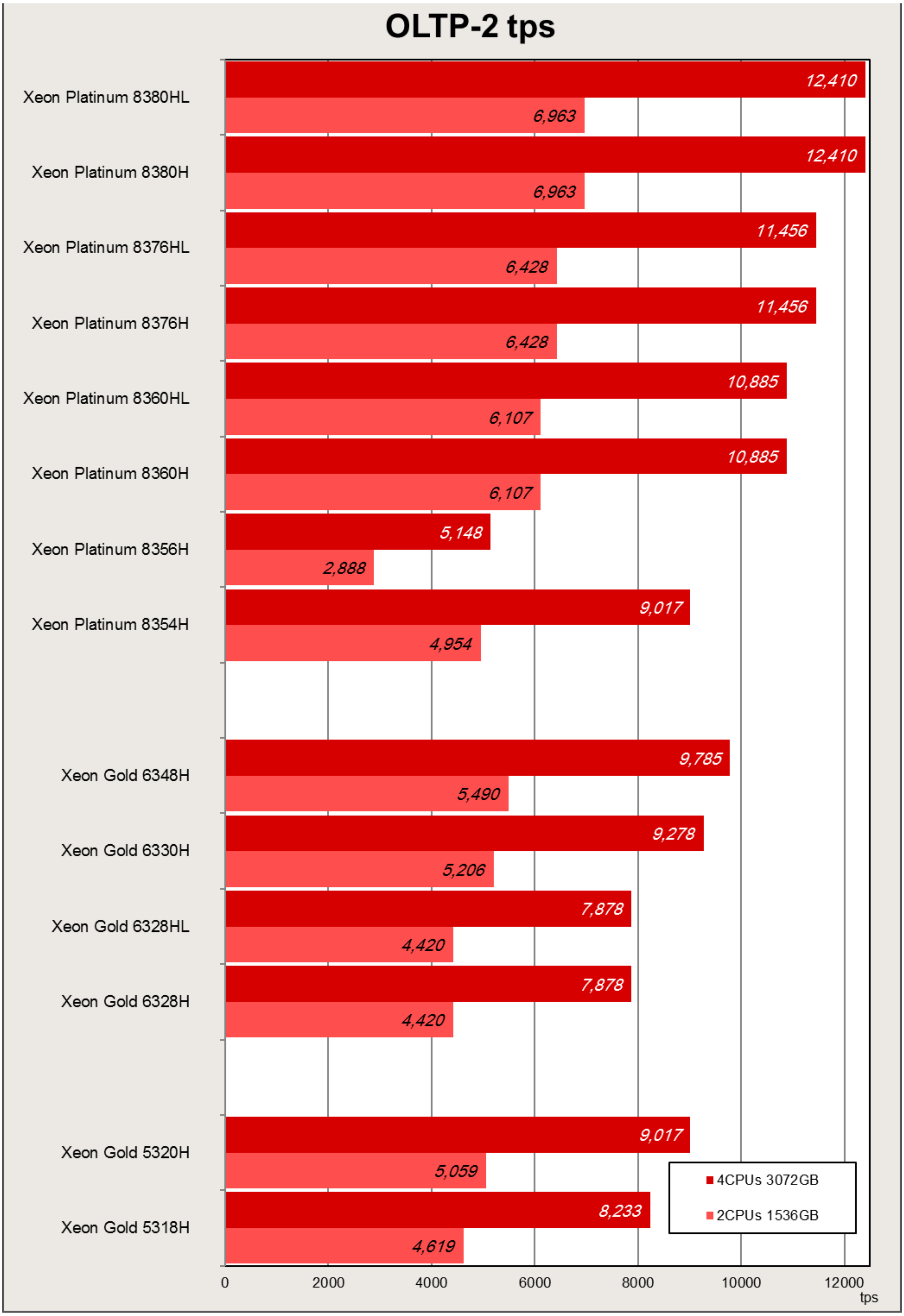
A guideline in the database environment for selecting main memory is that sufficient quantity is more important than the speed of the memory accesses. This why a configuration with a total memory of 3072 GB was considered for the measurements with four processors and a configuration with a total memory of 1536 GB for the measurements with two processors. Both memory configurations have memory access of 3200 MHz.

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

| Processor | Number of cores | Number of threads | 4CPU Score | | 2CPU Score | |
|---|---|---|---|---|---|---|
| Xeon Platinum 8380HL | 28 | 56 | 12,410 | est. | 6,963 | est. |
| Xeon Platinum 8380H | 28 | 56 | 12,410 | est. | 6,963 | est. |
| Xeon Platinum 8376HL | 28 | 56 | 11,456 | est. | 6,428 | est. |
| Xeon Platinum 8376H | 28 | 56 | 11,456 | est. | 6,428 | est. |
| Xeon Platinum 8360HL | 24 | 48 | 10,885 | est. | 6,107 | est. |
| Xeon Platinum 8360H | 24 | 48 | 10,885 | est. | 6,107 | est. |
| Xeon Platinum 8356H | 8 | 16 | 5,148 | est. | 2,888 | est. |
| Xeon Platinum 8354H | 18 | 36 | 9,017 | est. | 4,954 | est. |
| Xeon Gold 6348H | 24 | 48 | 9,785 | est. | 5,490 | est. |
| Xeon Gold 6330H | 24 | 48 | 9,278 | est. | 5,206 | est. |
| Xeon Gold 6328HL | 16 | 32 | 7,878 | est. | 4,420 | est. |
| Xeon Gold 6328H | 16 | 32 | 7,878 | est. | 4,420 | est. |
| Xeon Gold 5320H | 20 | 40 | 9,017 | est. | 5,059 | est. |
| Xeon Gold 5318H | 18 | 36 | 8,233 | est. | 4,619 | est. |

The following graph shows the OLTP-2 transaction rate obtained with the Intel Xeon Processor Scalable Family (2 or 4).



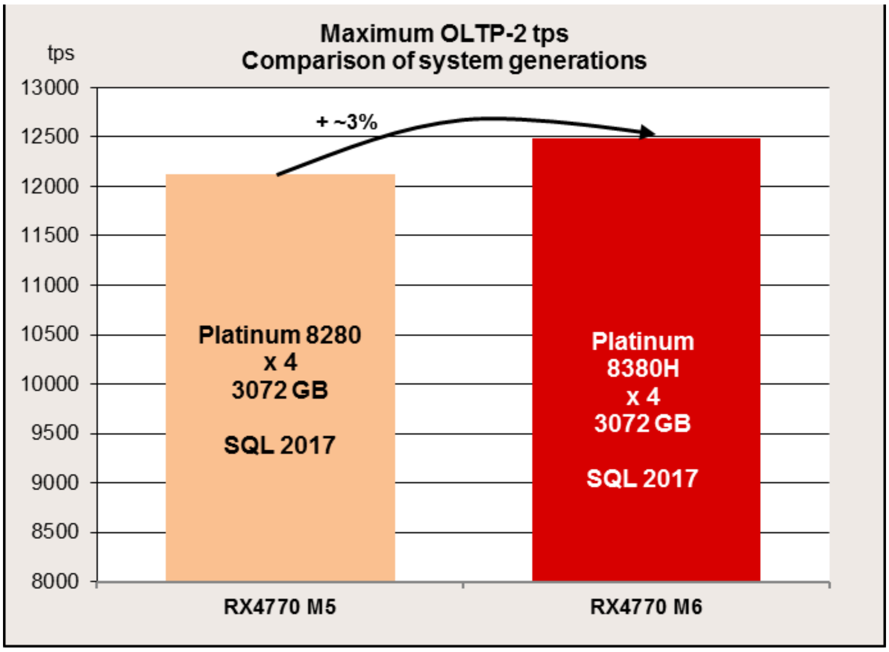
It is evident that a wide performance range is covered by the variety of released processors. If you compare the OLTP-2 value of the processor with the lowest performance (Xeon Platinum 8356H) with the value of the processor with the highest performance (Xeon Platinum 8380H) the OLTP-2 value increased by a factor of 2.4.

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

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

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

The highest value for OLTP-2 on the current PRIMERGY model is about 3% higher than the highest value on the previous model.



# VMmark V3

## *Benchmark description*

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

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

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

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

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

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

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

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

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

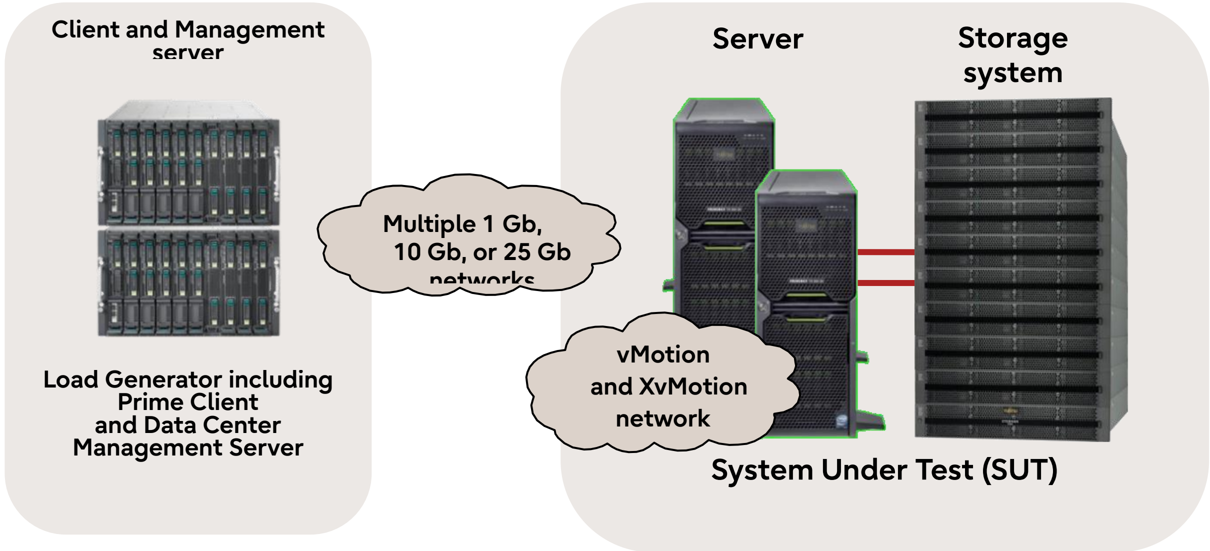
In the case of the two test types "Performance with Server Power" and "Performance with Server and Storage Power," a so-called "Server PPKW Score" and "Server and Storage PPKW Score" are determined. These are the performance scores divided by the average power consumption in kilowatts (PPKW = performance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

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

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

## *Benchmark environment*

The typical measurement set-up is illustrated below.




| System Under Test (SUT) | |
|---|---|
| **Hardware** | |
| • Number of servers | 2 |
| • Model | PRIMERGY PRIMERGY RX4770 M6 |
| • Processor | 4 x Intel Xeon Platinum 8380HL |
| • Memory | 3072 GB : 48 x 64 GB (1x64 GB) 2Rx4 DDR4-3200 R ECC |
| • Network interface | 2 x Mellanox MCX4121A-ACAT dual port 25Gb SFP28 PCIe adapter<br>1 x Intel I350-T2 1Gb quad port OCPv3 |
| • Disk subsystem | 2 x Qlogic QLE2772 dual port 32Gb PCIe adapter<br>7 x PRIMERGY RX2540 M4 & M5 configured as Fiber Channel targets<br>4 x PRIMERGY RX2540 M4:<br>2 x Micron MTFDDAK480TDC SATA SSD (480 GB, RAID1)<br>3 x Intel P4800X PCIe SSD (750 GB)<br>1 x Intel P4600 PCIe SSD (4 TB)<br>1 x PRIMERGY RX2540 M4:<br>1 x Micron MTFDDAK480TDC SATA SSD (480 GB)<br>3 x Intel P4800X PCIe SSD (750 GB)<br>1 x Intel P4600 PCIe SSD (2 TB)<br>1 x PRIMERGY RX2540 M5:<br>1 x Samsung MZ7KH480HAHQ SATA SSD (480 GB)<br>3 x Intel P4800X PCIe SSD (750 GB)<br>3 x Intel P4610 PCIe SSD (3.2 TB)<br>1 x PRIMERGY RX2540 M5:<br>1 x Samsung MZ7KH480HAHQ SATA SSD (480 GB)<br>2 x Intel P4800X PCIe SSD (750 GB)<br>2 x Intel P4610 PCIe SSD (3.2 TB) |
| **Software** | |
| • BIOS | V1.0.0.0 R1.1.0 for D33892-A1x |
| • BIOS settings | See "Details" |

| | |
|---|---|
| • Operating system | VMware ESXi 7.0 U1, Build 16850804 |
| • Operating system settings | ESX settings: see "Details" |

| Details | |
|---|---|
| Public URLs | https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/vmmark/2020-10-22-Fujitsu-RX4770M6.pdf<br>https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/vmmark/2020-10-22-Fujitsu-RX4770M6-serverPPKW.pdf<br>https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/vmmark/2020-10-22-Fujitsu-RX4770M6-serverstoragePPKW.pdf |

| Datacenter Management Server (DMS) | |
|---|---|
| **Hardware** | |
| • Model | 1 x PRIMERGY RX2540 M2 |
| • Processor | 1 x Intel Xeon E5-2698 v4 |
| • Memory | 64 GB |
| • Network interface | 1 x Emulex One Connect Oce14000 1GbE dual port PCIe adapter |
| **Software** | |
| • Operating system | VMware ESXi 6.7 EP 02a Build 9214924 |
| **Datacenter Management Server (DMS) VM** | |
| **Hardware** | |
| • Processor | 4 x Logical CPU |
| • Memory | 19 GB |
| • Network interface | 1 x 1 Gbit/s LAN |
| **Software** | |
| • Operating system | VMware vCenter Server Appliance 7.0 U1 Build 16860138 |

| Load generator | |
|---|---|
| **Hardware** | |
| • Model | 6 x PRIMERGY RX2530 M2 |
| • Processor | 4 x PRIMERGY RX2530 M2<br>2 x Intel Xeon E5-2699 v4<br>2 x PRIMERGY RX2530 M2<br>2 x Intel Xeon E5-2699A v4 |
| • Memory | 256 GB |
| • Network interface | 1 x Emulex One Connect Oce14000 1GbE dual port PCIe adapter<br>1 x Emulex One Connect Oce14000 10GbE dual port PCIe adapter |
| **Software** | |
| • Operating system | VMware ESXi 6.7 EP 08 Build 13473784 |

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

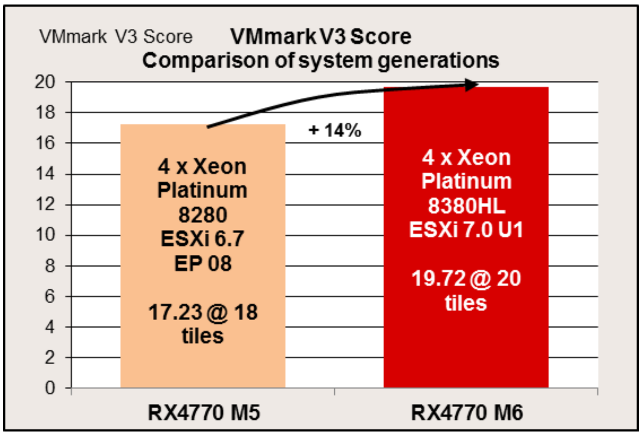
## *Benchmark results*

**"Performance Only" measurement results (October 22, 2020)**

On October 22, 2020, Fujitsu achieved a VMmark V3.1.1 score of "19.72@20 tiles" using PRIMERGY PRIMERGY RX4770 M6 with a Xeon Platinum 8380HL processor and VMware ESXi 7.0 U1. At this time, the system configuration had a total of 2 x 112 processor cores, and two identical servers were used for the "System Under Test" (SUT). Based on the above results, PRIMERGY PRIMERGY RX4770 M6 is rated as the most powerful 4-socket rack server in a "matched pair" configuration with two identical hosts in the official VMmark V3 "Performance Only" ranking (as of the date the benchmark results were published).

All comparisons for the competitor products reflect the status of October 22, 2020. For the latest VMmark V3 "Performance Only" results, as well as detailed results and configuration data, see https://www.vmware.com/products/vmmark/results3x.html.

All VMs, their application data, the host operating system, and any additional data needed are stored in a powerful Fiber Channel disk subsystem. This disk subsystem uses fast PCIe SSDs such as Intel Optane to improve storage media response time. Network connectivity with host-side load generators and infrastructure load connectivity between hosts are implemented using 25GbE LAN ports.




The graph on the left compares the VMmark V3 scores of the PRIMEGY RX4770 M6 and the previous generation PRIMEGY RX4770 M5.

The PRIMERGY RX4770 M6 achieved a 14% improvement in score compared to the previous generation PRIMERGY RX4770 M5. This is due to the improved performance of the 3rd generation Intel Xeon scalable processor and the effective use of the capabilities of the VMware ESXi hypervisor.

**"Performance with Server Power" measurement results (October 22, 2020)**
**"Performance with Server and Storage Power" measurement results (October 22, 2020)**

On October 22, 2020, Fujitsu achieved a VMmark V3.1.1 "Server PPKW" score of "6.3410@20 tiles" using PRIMERGY RX4770 M6 with a Xeon Platinum 8380HL processor and VMware ESXi 7.0 U1. At the same time, also achieved a VMmark V3.1.1 "Server and Storage PPKW" score of "3.7609@20 tiles." These were system configurations with a total of 2 x 112 processor cores, and two identical servers were used for the "System Under Test" (SUT). Based on the above results, PRIMERGY RX4770 M6 is rated as the most energy efficient virtual server in the world in the official VMmark V3 "Performance with Server Power" ranking and "Performance with Server and Storage Power" ranking (as of the date the benchmark results were published).

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

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

VMmark is a product of VMware, Inc.

# Literature


**PRIMERGY Servers**

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

**PRIMERGY RX4770 M6**

This Whitepaper

https://docs.ts.fujitsu.com/dl.aspx?id=1924db9e-fb0e-4ee0-8608-da78acb9fd5f

https://docs.ts.fujitsu.com/dl.aspx?id=b4bf88e9-201c-4408-b7c2-7fd4e3f2b61c

Data sheet

https://docs.ts.fujitsu.com/dl.aspx?id=c73aa330-ea96-4e4a-bfcc-5ac79a09ed7d

**PRIMERGY Performance**

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

**SPEC CPU2017**

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

Benchmark Overview SPECcpu2017

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

**STREAM**

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

**LINPACK**

The LINPACK Benchmark: Past, Present, and Future

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

TOP500

https://www.top500.org/

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

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

Intel Math Kernel Library – LINPACK Download

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

**SPECpower_ssj2008**

https://www.spec.org/power_ssj2008

Benchmark Overview SPECpower_ssj2008

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

**SAP SD / BWH**

https://www.sap.com/benchmark

Benchmark results

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

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

Benchmark overview

SAP SD: http://docs.ts.fujitsu.com/dl.aspx?id=0a1e69a6-e366-4fd1-a1a6-0dd93148ea10

SAP BWH: http://docs.ts.fujitsu.com/dl.aspx?id=70a4c869-586c-49f3-a6a4-47f188dd72b3

**OLTP-2**

Benchmark Overview OLTP-2
https://docs.ts.fujitsu.com/dl.aspx?id=e6f7a4c9-aff6-4598-b199-836053214d3f

## VMmark V3

https://www.vmware.com/products/vmmark.html
Benchmark Overview VMmark V3
https://docs.ts.fujitsu.com/dl.aspx?id=e6f9973c-90d6-47c6-b317-e388a978bfb7

Document change history

| Version | Date | Description |
|---|---|---|
| 1.3 | 2023-10-03 | Update:<br><br>• New Visual Identity format |
| 1.2 | 2021-07-28 | Update:<br><br>• Contact information and URLs<br>Updated to the latest one<br>• Minor correction |
| 1.0 | 2021-03-19 | New:<br><br>• Technical data<br>• SPECcpu2017, STREAM, LINPACK<br>Measured and calculated with 3rd Generation Intel Xeon Processor Scalable Family<br>• SPECpower_ssj2008<br>Measured with Intel Xeon Platinum 8380H<br>• SAP SD<br>Measured with Intel Xeon Platinum 8380HL<br>• SAP BWH<br>Measured with Intel Xeon Platinum 8380HL<br>• Disc I/O<br>Measured with 2.5 inch storage<br>• OLTP-2<br>Calculated with 3rd Generation Intel Xeon Processor Scalable Family<br>• VMmark V3<br>Measured with Intel Xeon Platinum 8380HL |

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