White Paper
FUJITSU Server PRIMERGY
Performance Report PRIMERGY TX1320 M1

This document contains a summary of the benchmarks executed for the FUJITSU Server PRIMERGY TX1320 M1.

The PRIMERGY TX1320 M1 performance data are compared with the data of other PRIMERGY models and discussed. In addition to the benchmark results, an explanation has been included for each benchmark and for the benchmark environment.

Version
1.0a
2015-06-30

Contents

Document history

Version 1.0

New:

- Technical data
- SPECcpu2006
  Measurements with Celeron G1820, Pentium G3420, Core i3-4330 and Intel® Xeon® Processor E3-1200 v3 Product Family
- SPECpower_ssj2008
  Measurement with Xeon E3-1275L v3
- STREAM
  Measurements with Celeron G1820, Pentium G3420, Core i3-4330 and Intel® Xeon® Processor E3-1200 v3 Product Family

Version 1.0a

Updated:

- SPECpower_ssj2008
  Minor correction
- STREAM
  Minor corrections

Technical data

PRIMERGY TX1320 M1

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 TX1320 M1
Model versions	PY TX1320M1/LFF PY TX1320M1/SFF
Form factor	Tower server
Chipset	Intel® C224
Number of sockets	1
Processor type	Intel® Celeron® G1820 Intel® Pentium® G3420 Intel® Core™ i3-4330 Intel® Xeon® Processor E3-1200 v3 Product Family
Number of memory slots	4
Maximum memory configuration	32 GB
Onboard LAN controller	2 × 1 Gbit/s
Onboard HDD controller	Controller with RAID 0, RAID 1 or RAID 10 for up to 4 SATA HDDs
PCI slots	2 × PCI-Express 3.0 x8 1 × PCI-Express 2.0 x1 (mech. X4) 1 × PCI-Express 2.0 x4 (mech. x8)
Max. number of internal hard disks	PY TX1320M1/LFF: 2 PY TX1320M1/SFF: 6

Processors (since system release)							
Processor	Cores	Threads	Cache [MB]	Rated Frequency [Ghz]	Max. Turbo Frequency [Ghz]	Max. Memory Frequency [MHz]	TDP [Watt]
Celeron G1820	2	2	2	2.70	n/a	1333	54
Pentium G3420	2	2	3	3.20	n/a	1600	54
Core i3-4330	2	4	4	3.50	n/a	1600	54
Xeon E3-1220 v3	4	4	8	3.10	3.50	1600	80
Xeon E3-1240L v3	4	8	8	2.00	3.00	1600	25
Xeon E3-1275L v3	4	8	8	2.70	3.90	1600	45
Xeon E3-1231 v3	4	8	8	3.40	3.80	1600	80
Xeon E3-1241 v3	4	8	8	3.50	3.90	1600	80
Xeon E3-1271 v3	4	8	8	3.60	4.00	1600	80
Xeon E3-1281 v3	4	8	8	3.70	4.10	1600	82

All the processors of Intel® Xeon® Processor E3-1200 v3 Product Family that can be ordered with the PRIMERGY TX1320 M1 support Intel® Turbo Boost Technology 2.0. This technology allows you to operate the processor with higher frequencies than the nominal frequency. Listed in the processor table is "Max. Turbo Frequency" for the theoretical frequency maximum with only one active core per processor. The maximum frequency that can actually be achieved depends on the number of active cores, the current consumption, electrical power consumption and the temperature of the processor.

As a matter of principle Intel does not guarantee that the maximum turbo frequency will be reached. This is related to manufacturing tolerances, which result in a variance regarding the performance of various examples of a processor model. The range of the variance covers the entire scope between the nominal frequency and the maximum turbo frequency.

The turbo functionality can be set via BIOS option. Fujitsu generally recommends leaving the "Turbo Mode" option set at the standard setting "Enabled", as performance is substantially increased by the higher frequencies. However, since the higher frequencies depend on general conditions and are not always guaranteed, it can be advantageous to disable the "Turbo Mode" option for application scenarios with intensive use of AVX instructions and a high number of instructions per clock unit, as well as for those that require constant performance or lower electrical power consumption.

Memory modules (since system release)								
Memory module	Capacity [GB]	Ranks	Bit width of the memory chips	Frequency [MHz]	Low voltage	Load reduced	Registered	ECC
4GB (1x4GB) 1Rx8 L DDR3-1600 U ECC (4 GB 1Rx8 PC3L-12800E)	4	1	8	1600	✓			✓
8GB (1x8GB) 2Rx8 L DDR3-1600 U ECC (8 GB 2Rx8 PC3L-12800E)	8	2	8	1600	✓			✓

Power supplies (since system release)	Max. number
Standard PSU 250W	1

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

Detailed technical information is available in the data sheet PRIMERGY TX1320 M1.

SPECcpu2006

Benchmark description

SPECcpu2006 is a benchmark which measures the system efficiency with integer and floating-point operations. It consists of an integer test suite (SPECint2006) containing 12 applications and a floating-point test suite (SPECfp2006) containing 17 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.

SPECcpu2006 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.

SPECcpu2006 contains two different performance measurement methods: the first method (SPECint2006 or SPECfp2006) determines the time which is required to process single task. The second method (SPECint_rate2006 or SPECfp_rate2006) 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” which differ in the use of compiler optimization. When publishing the results the base values are always used; the peak values are optional.

Benchmark	Arithmetics	Type	Compiler optimization	Measurement result	Application
SPECint2006	integer	peak	aggressive	Speed	single-threaded
SPECint_base2006	integer	base	conservative		
SPECint_rate2006	integer	peak	aggressive	Throughput	multi-threaded
SPECint_rate_base2006	integer	base	conservative		
SPECfp2006	floating point	peak	aggressive	Speed	single-threaded
SPECfp_base2006	floating point	base	conservative		
SPECfp_rate2006	floating point	peak	aggressive	Throughput	multi-threaded
SPECfp_rate_base2006	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 favour of the lower individual results. Normalized means that the measurement is how fast is the test system compared to a reference system. Value “1” was defined for the SPECint_base2006-, SPECint_rate_base2006, SPECfp_base2006 and SPECfp_rate_base2006 results of the reference system. For example, a SPECint_base2006 value of 2 means that the measuring system has handled this benchmark twice as fast as the reference system. A SPECfp_rate_base2006 value of 4 means that the measuring system has handled this benchmark some 4/[# base copies] times faster than the reference system. “# base copies” specify how many parallel instances of the benchmark have been executed.

Not every SPECcpu2006 measurement is submitted by us for publication at SPEC. This is why the SPEC web pages do not have every result. As we archive the log files for all measurements, we can prove the correct implementation of the measurements at any time.

Benchmark environment

System Under Test (SUT)	
Hardware	
Model	PRIMERGY TX1320 M1
Processor	Celeron G1820 Pentium G3420 Core i3-4330 Intel® Xeon® Processor E3-1200 v3 Product Family
Memory	4 × 8GB (1x8GB) 2Rx8 L DDR3-1600 U ECC
Software	
Operating system	Red Hat Enterprise Linux Server release 6.5
Operating system settings	echo always > /sys/kernel/mm/redhat_transparent_hugepage/enabled
Compiler	C/C++: Version 14.0.0.080 of Intel C++ Studio XE for Linux Fortran: Version 14.0.0.080 of Intel Fortran Studio XE for Linux

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

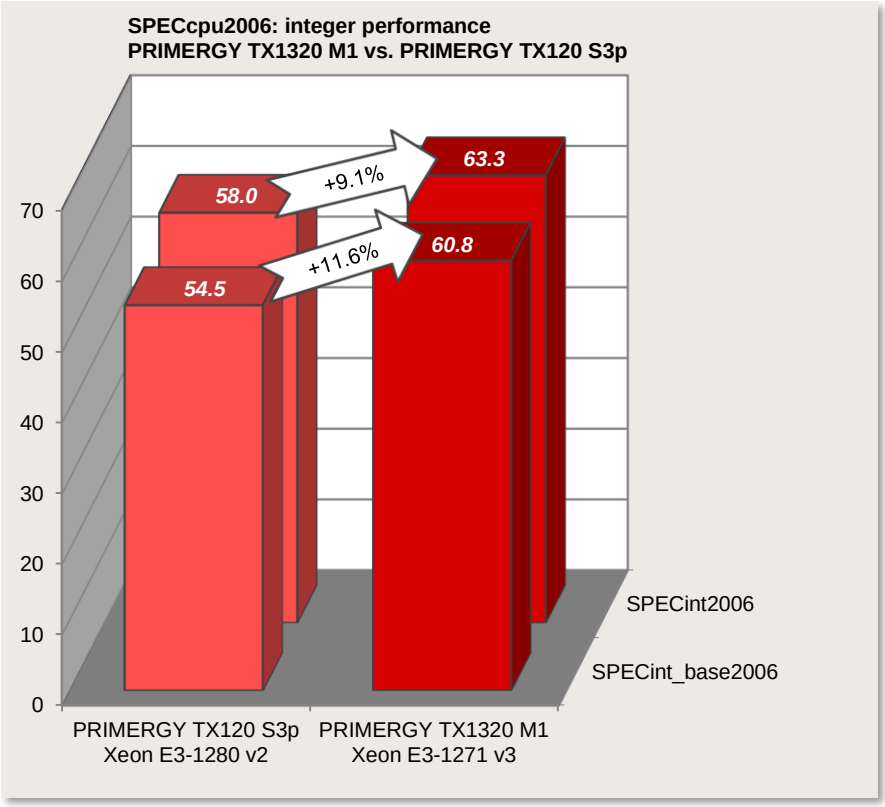
Benchmark results

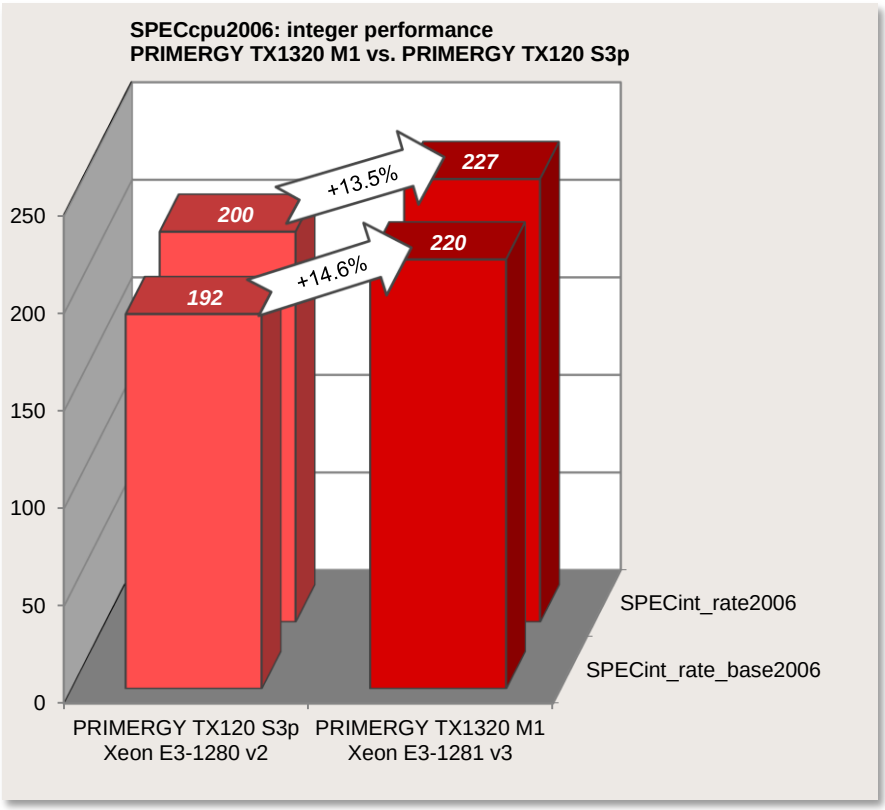
In terms of processors the benchmark result depends primarily on the size of the processor cache, the support for Hyper-Threading, the number of processor cores and on the processor frequency. In the case of processors with Turbo mode the number of cores, which are loaded by the benchmark, determines 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.

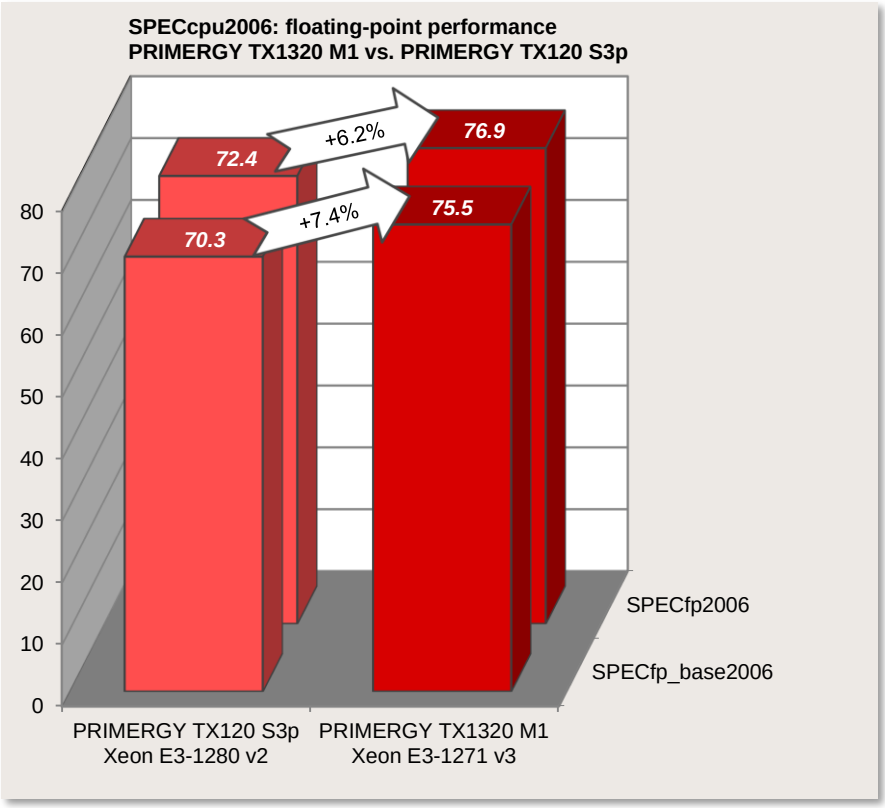
Processor	SPECint_base2006	SPECint2006	SPECint_rate_base2006	SPECint_rate2006
Celeron G1820	36.9	38.6	66.5	69.2
Pentium G3420	44.4	46.5	79.2	82.4
Core i3-4330	n/a	n/a	111	115
Xeon E3-1220 v3	n/a	n/a	169	176
Xeon E3-1240L v3	n/a	n/a	n/a	n/a
Xeon E3-1275L v3	58.5	61.3	197	203
Xeon E3-1231 v3	58.3	60.7	207	214
Xeon E3-1241 v3	59.6	62.2	211	218
Xeon E3-1271 v3	60.8	63.3	215	223
Xeon E3-1281 v3	n/a	n/a	220	227

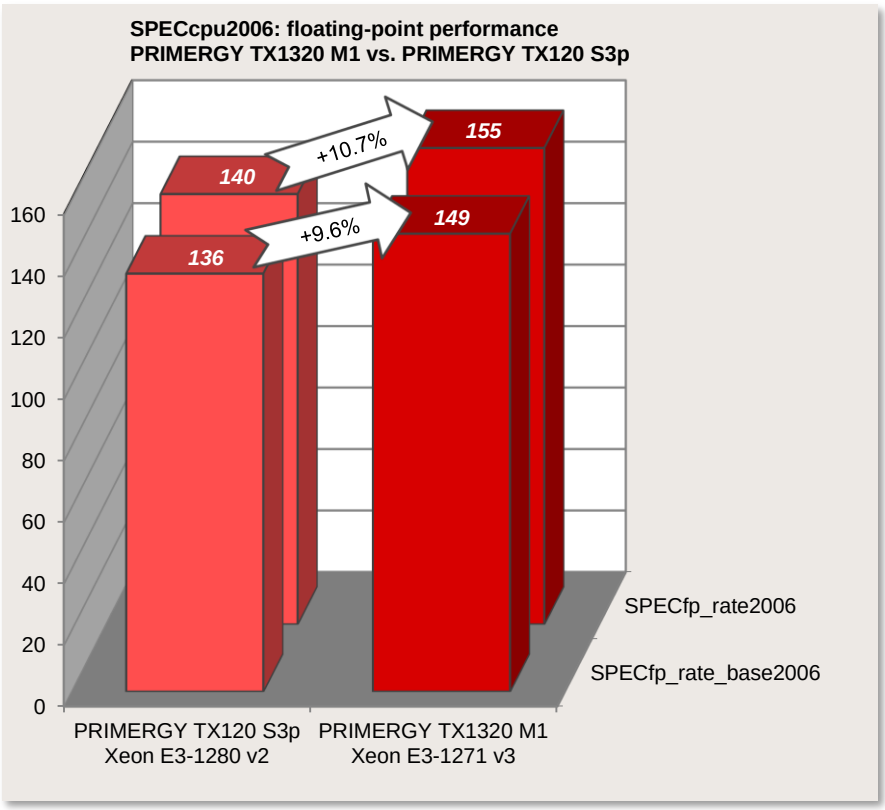
Processor	SPECfp_base2006	SPECfp2006	SPECfp_rate_base2006	SPECfp_rate2006
Celeron G1820	46.8	47.3	67.7	68.9
Pentium G3420	53.6	54.3	76.4	77.8
Core i3-4330	63.2	64.3	98.3	101
Xeon E3-1220 v3	n/a	n/a	136	139
Xeon E3-1240L v3	61.6	62.7	n/a	n/a
Xeon E3-1275L v3	71.4	73.6	139	144
Xeon E3-1231 v3	72.9	74.2	n/a	n/a
Xeon E3-1241 v3	74.1	75.5	147	152
Xeon E3-1271 v3	75.5	76.9	149	155
Xeon E3-1281 v3	n/a	n/a	n/a	n/a

The following four diagrams illustrate the throughput of the PRIMERGY TX1320 M1 in comparison to its predecessor PRIMERGY TX120 S3p, in their respective most performant configuration.






SPECcpu2006: floating-point performance
PRIMERGY TX1320 M1 vs. PRIMERGY TX120 S3p
80
70
60
50
40
30
20
10
0
72.4
70.3
76.9
75.5
+6.2%
+7.4%
SPECfp2006
SPECfp_base2006
PRIMERGY TX120 S3p
Xeon E3-1280 v2
PRIMERGY TX1320 M1
Xeon E3-1271 v3


SPECcpu2006: floating-point performance
PRIMERGY TX1320 M1 vs. PRIMERGY TX120 S3p
160
140
120
100
80
60
40
20
0
140
136
155
149
+10.7%
+9.6%
SPECfp_rate2006
SPECfp_rate_base2006
PRIMERGY TX120 S3p
Xeon E3-1280 v2
PRIMERGY TX1320 M1
Xeon E3-1271 v3

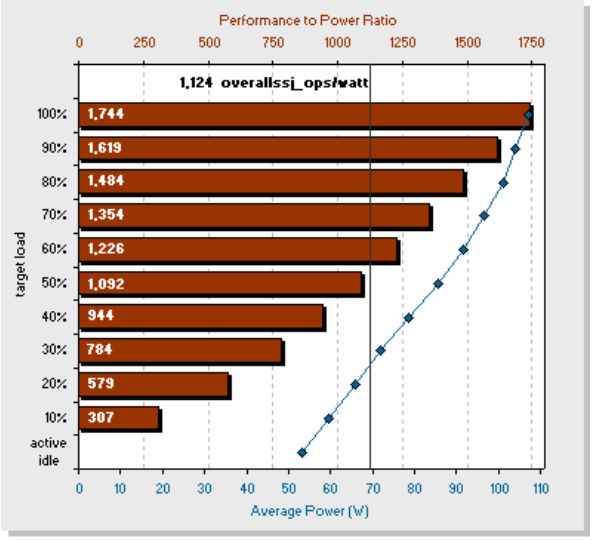
SPECpower_ssj2008

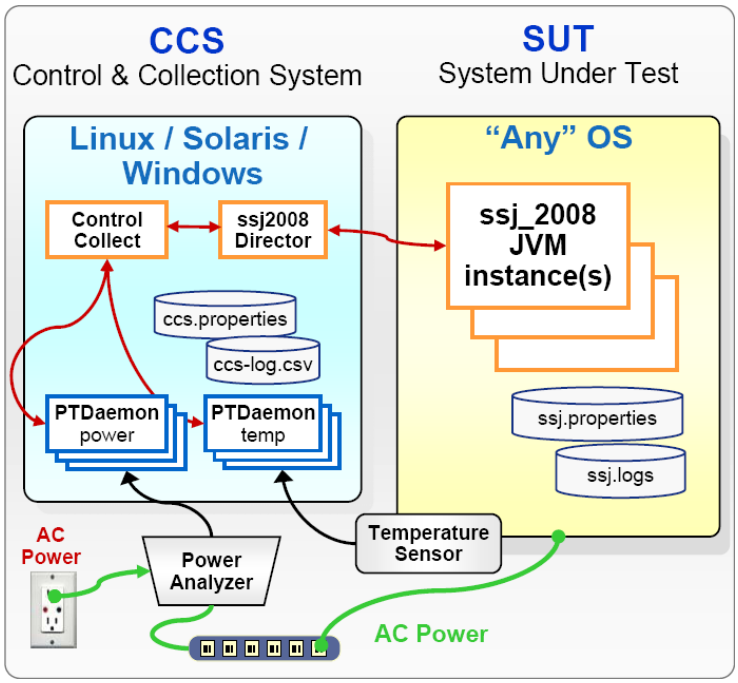
Benchmark description

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

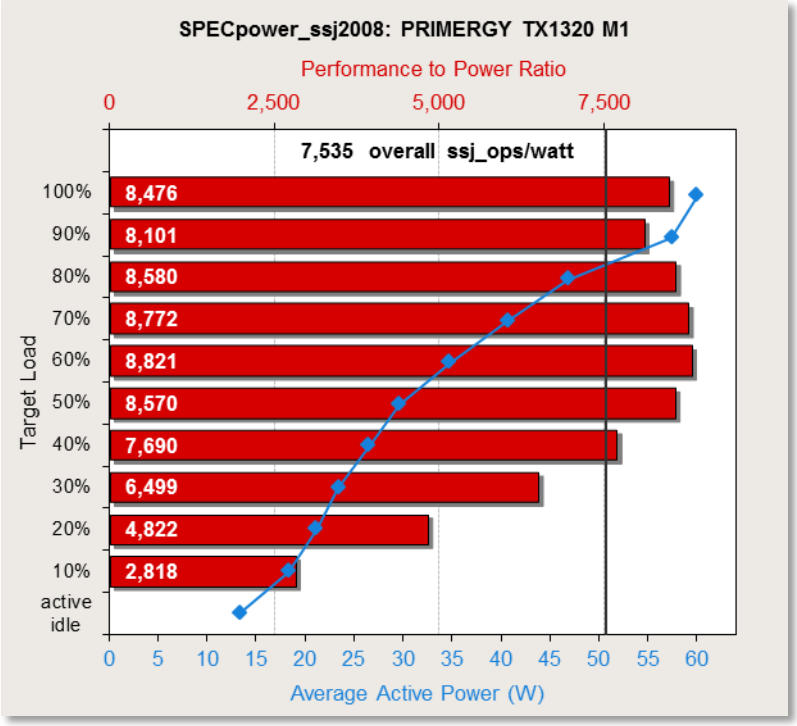
System Under Test (SUT)	
Hardware	
Model	PRIMERGY TX1320 M1
Model version	PY TX1320M1/SFF
Processor	Xeon E3-1275L v3
Memory	2 × 8GB (1x8GB) 2Rx8 L DDR3-1600 U ECC
Network-Interface	Onboard LAN-Controller (1 port used)
Disk-Subsystem	Onboard HDD controller 1 × SSD SATA 6G 64GB DOM N H-P
Power Supply Unit	1 × Standard PSU 250W
Software	
BIOS	R2.10.0
BIOS settings	Hardware Prefetcher = Disabled Adjacent Cache Line Prefetch = Disabled DCU Streamer Prefetcher = Disabled Onboard USB Controllers = Disabled ASPM Support = Auto DMI Control = Gen1 LAN 1 Controller = Disabled Intel Virtualization Technology = Disabled
Firmware	7.69F
Operating system	Microsoft Windows Server 2008 R2 Enterprise SP1
Operating system settings	Using the local security settings console, “lock pages in memory” was enabled for the user running the benchmark. Power Management: Enabled (“Fujitsu Enhanced Power Settings” power plan) Set “Turn off hard disk after = 1 Minute” in OS. Benchmark was started via Windows Remote Desktop Connection.
JVM	IBM J9 VM (build 2.6, JRE 1.7.0 Windows Server 2008 R2 amd64-64 20120322_106209 (JIT enabled, AOT enabled)
JVM settings	start /AFFINITY [0x3,0xC,0x30,0xC0] -Xaggressive -Xcompressedrefs -Xgcpolicy:gencon -Xmx1875m -Xms1875m -Xmn1400m -XlockReservation -Xnoloa -XtlhPrefetch -Xlp -Xconcurrentlevel0 -Xthr:minimizeusercpu
Other software	IBM WebSphere Application Server V8.5.0.0

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

Benchmark results

The PRIMERGY TX1320 M1 achieved the following result:

SPECpower_ssj2008 = 7,535 overall ssj_ops/watt

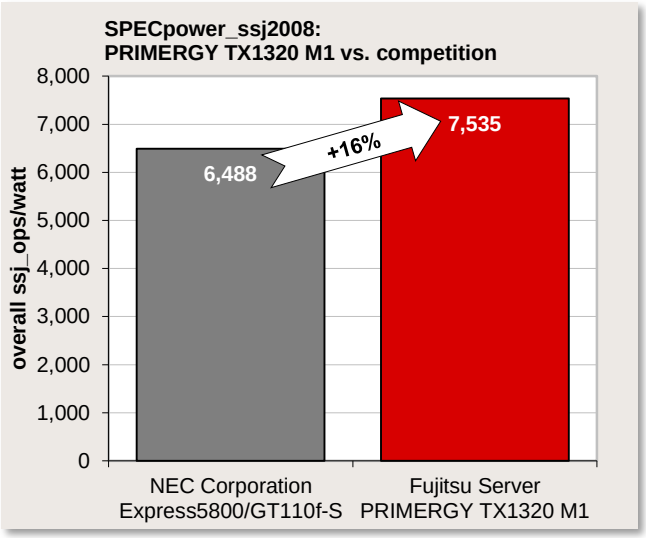


The adjoining diagram shows the result of the configuration described above. The red horizontal bars show the performance to power ratio in ssj_ops/watt (upper x-axis) for each target load level tagged on the y-axis of the diagram. The blue line shows the run of the curve for the average power consumption (bottom x-axis) at each target load level marked with a small rhomb. The black vertical line shows the benchmark result of 7,535 overall ssj_ops/watt for the PRIMERGY TX1320 M1. 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.

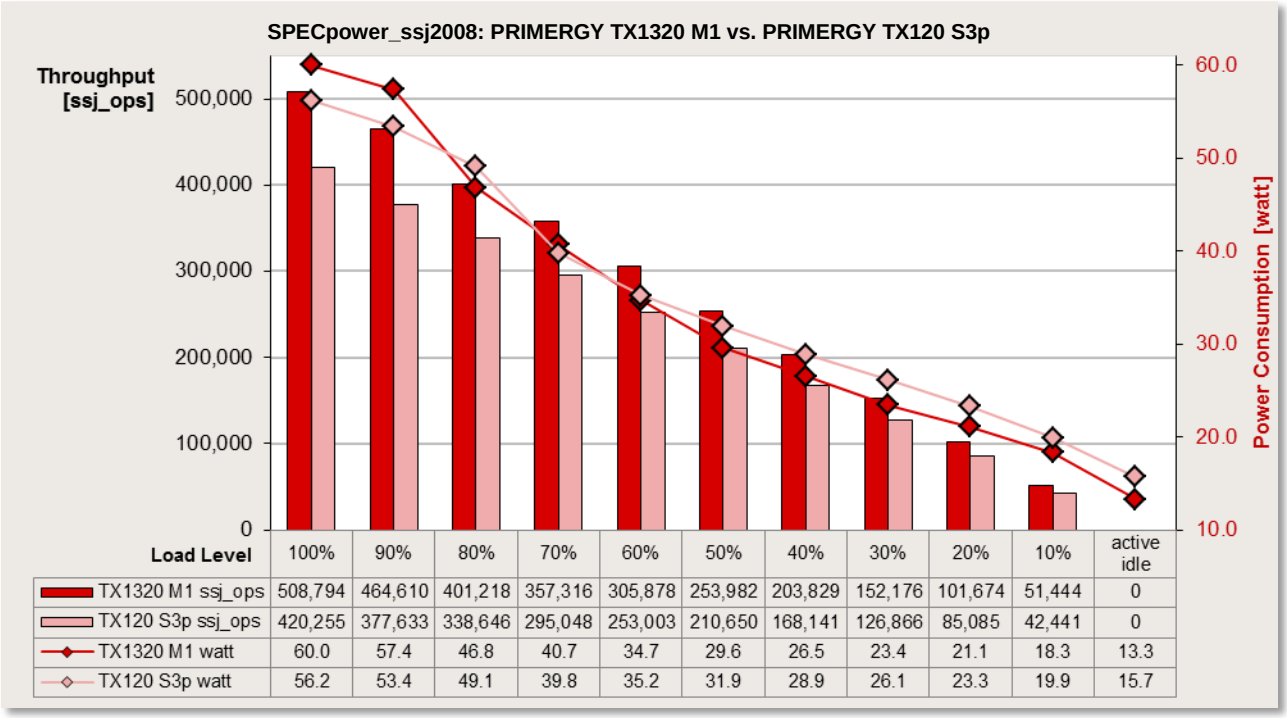
Performance		Power	Energy Efficiency
Target Load	ssj_ops	Average Power (W)	ssj_ops/watt
100%	508,794	60.0	8,476
90%	464,610	57.4	8,101
80%	401,218	46.8	8,580
70%	357,316	40.7	8,772
60%	305,878	34.7	8,821
50%	253,982	29.6	8,570
40%	203,829	26.5	7,690
30%	152,176	23.4	6,499
20%	101,674	21.1	4,822
10%	51,444	18.3	2,818
Active Idle	0	13.3	0
		∑ssj_ops / ∑power = 7,535	

The PRIMERGY TX1320 M1 achieved a new class record with this result, thus surpassing the best result of the competition by 16% (date: February 4, 2015). Thus, the PRIMERGY TX1320 M1 proves itself to be the most energy-efficient 1-socket server in the world. For the latest SPECpower_ssj2008 benchmark results, visit: http://www.spec.org/power_ssj2008/results.



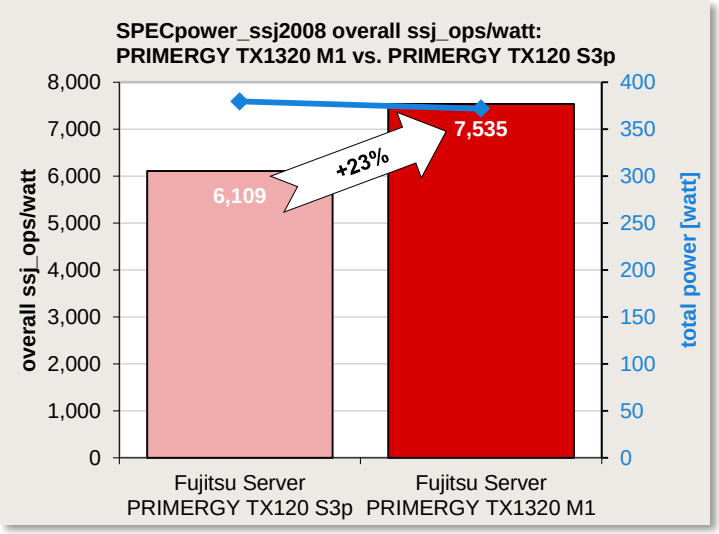
The comparison with the competition makes the advantage of the PRIMERGY TX1320 M1 in the field of energy efficiency evident. With 16% more energy efficiency than the best result of the competition in the class of 1-socket servers, the NEC Corporation Express5800/GT110f-S server, the PRIMERGY TX1320 M1 is setting new standards.

The following diagram shows for each load level the power consumption (on the right y-axis) and the throughput (on the left y-axis) of the PRIMERGY TX1320 M1 compared to the predecessor PRIMERGY TX120 S3p.



Load Level	100%	90%	80%	70%	60%	50%	40%	30%	20%	10%	active idle
TX1320 M1 ssj_ops	508,794	464,610	401,218	357,316	305,878	253,982	203,829	152,176	101,674	51,444	0
TX120 S3p ssj_ops	420,255	377,633	338,646	295,048	253,003	210,650	168,141	126,866	85,085	42,441	0
TX1320 M1 watt	60.0	57.4	46.8	40.7	34.7	29.6	26.5	23.4	21.1	18.3	13.3
TX120 S3p watt	56.2	53.4	49.1	39.8	35.2	31.9	28.9	26.1	23.3	19.9	15.7

Thanks to the new Haswell Refresh processors the PRIMERGY TX1320 M1 has in comparison with the PRIMERGY TX120 S3p a higher throughput at lower power consumption in total. Both result in an overall increase in energy efficiency in the PRIMERGY TX1320 M1 of 23%.



STREAM

Benchmark description

STREAM is a synthetic benchmark that has been used for many years to determine memory throughput and which 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, consequently achieving optimal load distribution to the available processor cores.

During implementation the defined data area, consisting of 8-byte elements, is successively copied to four types, and arithmetic calculations are also performed to some extent.

Type	Execution	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.

This chapter specifies throughputs on a basis of 10 (1 GB/s = 10^9 Byte/s).

Benchmark environment

System Under Test (SUT)	
Hardware	
Model	PRIMERGY TX1320 M1
Processor	Celeron G1820 Pentium G3420 Core i3-4330 Intel® Xeon® Processor E3-1200 v3 Product Family
Memory	4 × 8GB (1x8GB) 2Rx8 L DDR3-1600 U ECC
Software	
Operating system	Red Hat Enterprise Linux Server release 6.5
Operating system settings	Stack size set to unlimited using "ulimit -s unlimited"
Compiler	Intel C++ Composer XE 2013 SP1 for Linux Update 1
Benchmark	Stream.c Version 5.9

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

Benchmark results

Processor	Memory Frequency [MHz]	Max. Memory Bandwidth [GB/s]	Cores	Processor Frequency [MHz]	TRIAD [GB/s]
Celeron G1820	1333	21.3	2	2.70	18.8
Pentium G3420	1600	25.6	2	3.20	19.0
Core i3-4330	1600	25.6	2	3.50	22.0
Xeon E3-1220 v3	1600	25.6	4	3.10	22.9
Xeon E3-1240L v3	1600	25.6	4	2.00	22.8
Xeon E3-1275L v3	1600	25.6	4	2.70	22.9
Xeon E3-1231 v3	1600	25.6	4	3.40	22.9
Xeon E3-1241 v3	1600	25.6	4	3.50	22.9
Xeon E3-1271 v3	1600	25.6	4	3.60	22.9
Xeon E3-1281 v3	1600	25.6	4	3.70	22.9

Literature

PRIMERGY Servers

http://primergy.com/

PRIMERGY TX1320 M1

This White Paper:

http://docs.ts.fujitsu.com/dl.aspx?id=2cdc2de1-400a-4ac5-aee6-4936946297de
http://docs.ts.fujitsu.com/dl.aspx?id=34abab30-1b0f-4602-9813-6559916a8dfb
http://docs.ts.fujitsu.com/dl.aspx?id=ce49003f-0493-4ccc-9a52-4515bd5d1115

Data sheet
http://docs.ts.fujitsu.com/dl.aspx?id=f65d763d-7299-4c5c-871d-b5ac975c4dd8

PRIMERGY Performance

http://www.fujitsu.com/fts/x86-server-benchmarks

Performance of Server Components

http://www.fujitsu.com/fts/products/computing/servers/mission-critical/benchmarks/x86-components.html

RAID Controller Performance
http://docs.ts.fujitsu.com/dl.aspx?id=e2489893-cab7-44f6-bff2-7aeea97c5aef

SPECcpu2006

http://www.spec.org/osg/cpu2006

Benchmark overview SPECcpu2006
http://docs.ts.fujitsu.com/dl.aspx?id=1a427c16-12bf-41b0-9ca3-4cc360ef14ce

SPECpower_ssj2008

http://www.spec.org/power_ssj2008

Benchmark Overview SPECpower_ssj2008
http://docs.ts.fujitsu.com/dl.aspx?id=166f8497-4bf0-4190-91a1-884b90850ee0

STREAM

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

Contact

FUJITSU

Website: http://www.fujitsu.com/

PRIMERGY Product Marketing

mailto:Primergy-PM@ts.fujitsu.com

PRIMERGY Performance and Benchmarks

mailto:primergy.benchmark@ts.fujitsu.com

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