



# SPEC CPU®2017 Floating Point Speed Result

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## Lenovo Global Technology

ThinkSystem SR850 V3  
(2.20 GHz, Intel Xeon Gold 6416H)

SPECspeed®2017\_fp\_base = 288

SPECspeed®2017\_fp\_peak = Not Run

CPU2017 License: 9017

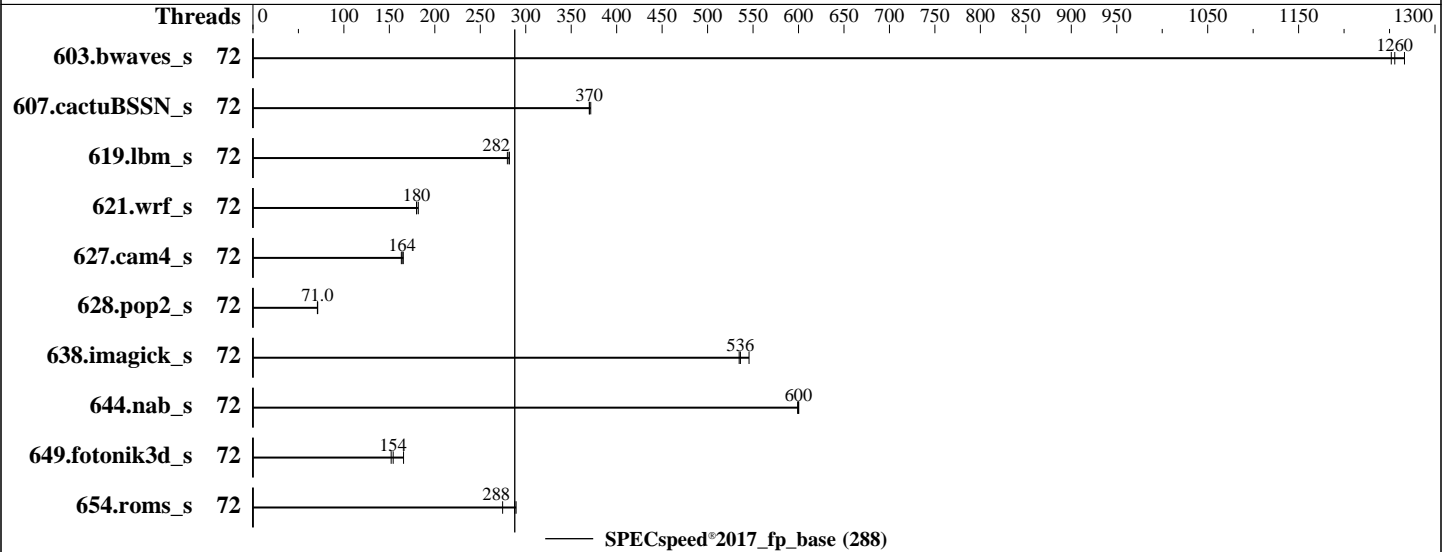
Test Sponsor: Lenovo Global Technology

Tested by: Lenovo Global Technology

Test Date: Aug-2023

Hardware Availability: Jun-2023

Software Availability: Dec-2022



### Hardware

CPU Name: Intel Xeon Gold 6416H  
 Max MHz: 4200  
 Nominal: 2200  
 Enabled: 72 cores, 4 chips  
 Orderable: 2,4 chips  
 Cache L1: 32 KB I + 48 KB D on chip per core  
 L2: 2 MB I+D on chip per core  
 L3: 45 MB I+D on chip per chip  
 Other: None  
 Memory: 2 TB (32 x 64 GB 2Rx4 PC5-4800B-R)  
 Storage: 1 x 960 GB M.2 NVME SSD  
 Other: None

### Software

OS: Red Hat Enterprise Linux 9.1 (Plow) (x86\_64)  
 Kernel 5.14.0-162.6.1.el9\_1.x86\_64  
 Compiler: C/C++: Version 2023.0 of Intel oneAPI DPC++/C++ Compiler for Linux;  
 Fortran: Version 2023.0 of Intel Fortran Compiler for Linux;  
 Parallel: Yes  
 Firmware: Lenovo BIOS Version RSE105E 1.10 released May-2023  
 File System: xfs  
 System State: Run level 3 (multi-user)  
 Base Pointers: 64-bit  
 Peak Pointers: Not Applicable  
 Other: jemalloc memory allocator V5.0.1  
 Power Management: BIOS and OS set to prefer performance at the cost of additional power usage



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## Results Table

Benchmark	Base						Peak							
	Threads	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Threads	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio
603.bwaves_s	72	46.6	1270	<u>47.0</u>	<u>1260</u>	47.1	1250							
607.cactuBSSN_s	72	<u>45.1</u>	<u>370</u>	44.9	372	45.1	370							
619.lbm_s	72	18.6	282	18.7	280	<u>18.6</u>	<u>282</u>							
621.wrf_s	72	<u>73.5</u>	<u>180</u>	73.5	180	72.7	182							
627.cam4_s	72	54.3	163	53.6	165	<u>54.0</u>	<u>164</u>							
628.pop2_s	72	167	71.2	<u>167</u>	<u>71.0</u>	167	70.9							
638.imagick_s	72	<u>26.9</u>	<u>536</u>	26.4	546	27.0	535							
644.nab_s	72	<u>29.1</u>	<u>600</u>	29.2	599	29.1	600							
649.fotonik3d_s	72	60.0	152	55.0	166	<u>59.1</u>	<u>154</u>							
654.roms_s	72	<u>54.7</u>	<u>288</u>	54.4	289	57.3	275							

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Results appear in the order in which they were run. Bold underlined text indicates a median measurement.

## Operating System Notes

Stack size set to unlimited using "ulimit -s unlimited"

## Environment Variables Notes

Environment variables set by runcpu before the start of the run:  
KMP\_AFFINITY = "granularity=fine,compact"  
LD\_LIBRARY\_PATH = "/home/cpu2017-1.1.9-ic2023.0/lib/intel64:/home/cpu2017-1.1.9-ic2023.0/je5.0.1-64"  
MALLOC\_CONF = "retain:true"  
OMP\_STACKSIZE = "192M"

## General Notes

Binaries compiled on a system with 2x Intel Xeon Platinum 8280M CPU + 384GB RAM memory using Redhat Enterprise Linux 8.0  
Transparent Huge Pages enabled by default  
Prior to runcpu invocation  
Filesystem page cache synced and cleared with:  
sync; echo 3> /proc/sys/vm/drop\_caches  
NA: The test sponsor attests, as of date of publication, that CVE-2017-5754 (Meltdown) is mitigated in the system as tested and documented.  
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.  
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.  
jemalloc, a general purpose malloc implementation  
built with the RedHat Enterprise 7.5, and the system compiler gcc 4.8.5  
sources available from jemalloc.net or <https://github.com/jemalloc/jemalloc/releases>

## Platform Notes

BIOS configuration:  
Choose Operating Mode set to Maximum Performance and then set it to Custom Mode

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## Platform Notes (Continued)

C-States set to Legacy  
Hyper-Threading set to Disabled  
Adjacent Cache Prefetch set to Disabled  
AMP Prefetch set to Enabled  
CPU P-state Control set to Autonomous  
DCU Streamer Prefetcher set to Disabled

Sysinfo program /home/cpu2017-1.1.9-ic2023.0/bin/sysinfo  
Rev: r6732 of 2022-11-07 fe91c89b7ed5c36ae2c92cc097bec197  
running on localhost.localdomain Fri Aug 4 13:06:32 2023

SUT (System Under Test) info as seen by some common utilities.

### Table of contents

1. uname -a
2. w
3. Username
4. ulimit -a
5. sysinfo process ancestry
6. /proc/cpuinfo
7. lscpu
8. numactl --hardware
9. /proc/meminfo
10. who -r
11. Systemd service manager version: systemd 250 (250-12.e19\_1)
12. Failed units, from systemctl list-units --state=failed
13. Services, from systemctl list-unit-files
14. Linux kernel boot-time arguments, from /proc/cmdline
15. cpupower frequency-info
16. sysctl
17. /sys/kernel/mm/transparent\_hugepage
18. /sys/kernel/mm/transparent\_hugepage/khugepaged
19. OS release
20. Disk information
21. /sys/devices/virtual/dmi/id
22. dmidecode
23. BIOS

```
1. uname -a
Linux localhost.localdomain 5.14.0-162.6.1.e19_1.x86_64 #1 SMP PREEMPT_DYNAMIC Fri Sep 30 07:36:03 EDT 2022
x86_64 x86_64 x86_64 GNU/Linux
```

```
2. w
13:06:32 up 1 min, 1 user, load average: 0.05, 0.02, 0.00
USER TTY LOGIN@ IDLE JCPU PCPU WHAT
root tty1 13:05 7.00s 0.99s 0.00s -bash
```

```
3. Username
From environment variable $USER: root
```

```
4. ulimit -a
real-time non-blocking time (microseconds, -R) unlimited
core file size (blocks, -c) 0
```

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### Platform Notes (Continued)

```

data seg size      (kbytes, -d) unlimited
scheduling priority (-e) 0
file size          (blocks, -f) unlimited
pending signals    (-i) 8255749
max locked memory  (kbytes, -l) 64
max memory size    (kbytes, -m) unlimited
open files         (-n) 1024
pipe size          (512 bytes, -p) 8
POSIX message queues (bytes, -q) 819200
real-time priority (-r) 0
stack size         (kbytes, -s) unlimited
cpu time           (seconds, -t) unlimited
max user processes (-u) 8255749
virtual memory     (kbytes, -v) unlimited
file locks         (-x) unlimited

```

#### 5. sysinfo process ancestry

```

/usr/lib/systemd/systemd --switched-root --system --deserialize 30
login -- root
-bash
-bash
runcpu --nobuild --action validate --define default-platform-flags -c
  ic2023.0-lin-sapphirerapids-speed-20221201.cfg --define cores=72 --tune base -o all --define drop_caches
  fpspeed
runcpu --nobuild --action validate --define default-platform-flags --configfile
  ic2023.0-lin-sapphirerapids-speed-20221201.cfg --define cores=72 --tune base --output_format all --define
  drop_caches --nopower --runmode speed --tune base --size refspeed fpspeed --nopreenv --note-preenv
  --logfile $SPEC/tmp/CPU2017.038/templogs/preenv.fpspeed.038.0.log --lognum 038.0 --from_runcpu 2
specperl $SPEC/bin/sysinfo
$SPEC = /home/cpu2017-1.1.9-ic2023.0

```

#### 6. /proc/cpuinfo

```

model name      : Intel(R) Xeon(R) Gold 6416H
vendor_id       : GenuineIntel
cpu family      : 6
model           : 143
stepping        : 8
microcode       : 0x2b0001b0
bugs            : spectre_v1 spectre_v2 spec_store_bypass swapgs eibrs_pbrsb
cpu cores       : 18
siblings        : 18

```

4 physical ids (chips)

72 processors (hardware threads)

physical id 0: core ids 0-17

physical id 1: core ids 0-17

physical id 2: core ids 0-17

physical id 3: core ids 0-17

physical id 0: apicids 0,2,4,6,8,10,12,14,16,18,20,22,24,26,28,30,32,34

physical id 1: apicids 128,130,132,134,136,138,140,142,144,146,148,150,152,154,156,158,160,162

physical id 2: apicids 256,258,260,262,264,266,268,270,272,274,276,278,280,282,284,286,288,290

physical id 3: apicids 384,386,388,390,392,394,396,398,400,402,404,406,408,410,412,414,416,418

Caution: /proc/cpuinfo data regarding chips, cores, and threads is not necessarily reliable, especially for virtualized systems. Use the above data carefully.

#### 7. lscpu

From lscpu from util-linux 2.37.4:

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### Platform Notes (Continued)

```

Architecture:                x86_64
CPU op-mode(s):              32-bit, 64-bit
Address sizes:                46 bits physical, 57 bits virtual
Byte Order:                   Little Endian
CPU(s):                       72
On-line CPU(s) list:         0-71
Vendor ID:                    GenuineIntel
BIOS Vendor ID:              Intel(R) Corporation
Model name:                   Intel(R) Xeon(R) Gold 6416H
BIOS Model name:             Intel(R) Xeon(R) Gold 6416H
CPU family:                   6
Model:                        143
Thread(s) per core:          1
Core(s) per socket:          18
Socket(s):                    4
Stepping:                     8
BogoMIPS:                     4400.00
Flags:                         fpu vme de pse tsc msr pae mce cx8 apic sep mtrr pge mca cmov pat pse36
                                clflush dts acpi mmx fxsr sse sse2 ss ht tm pbe syscall nx pdpe1gb rdtscp
                                lm constant_tsc art arch_perfmon pebs bts rep_good nopl xtopology
                                nonstop_tsc cpuid aperfmperf tsc_known_freq pni pclmulqdq dtes64 monitor
                                ds_cpl vmx smx est tm2 ssse3 sdbg fma cx16 xtpr pdcm pcid dca sse4_1
                                sse4_2 x2apic movbe popcnt tsc_deadline_timer aes xsave avx f16c rdrand
                                lahf_lm abm 3dnowprefetch cpuid_fault epb cat_l3 cat_l2 cdp_l3
                                invpcid_single intel_ppin cdp_l2 ssbd mba ibrs ibpb stibp ibrs_enhanced
                                tpr_shadow vnmi flexpriority ept vpid ept_ad fsgsbase tsc_adjust bmil avx2
                                smep bmi2 erms invpcid cqm rdt_a avx512f avx512dq rdseed adx smap
                                avx512ifma clflushopt clwb intel_pt avx512cd sha_ni avx512bw avx512vl
                                xsaveopt xsavec xgetbv1 xsaves cqm_llc cqm_occup_llc cqm_mbm_total
                                cqm_mbm_local split_lock_detect avx_vnni avx512_bf16 wbnoinvd dtherm ida
                                arat pln pts hfi avx512vbmi umip pku ospke waitpkg avx512_vbmi2 gfni vaes
                                vpclmulqdq avx512_vnni avx512_bitalg tme avx512_vpocntdq la57 rdpid
                                bus_lock_detect cldemote movdiri movdir64b enqcmd fsrm md_clear serialize
                                tsxldtrk pconfig arch_lbr amx_bf16 avx512_fp16 amx_tile amx_int8 flush_l1d
                                arch_capabilities
Virtualization:               VT-x
L1d cache:                    3.4 MiB (72 instances)
L1i cache:                    2.3 MiB (72 instances)
L2 cache:                     144 MiB (72 instances)
L3 cache:                     180 MiB (4 instances)
NUMA node(s):                 4
NUMA node0 CPU(s):           0-17
NUMA node1 CPU(s):           18-35
NUMA node2 CPU(s):           36-53
NUMA node3 CPU(s):           54-71
Vulnerability Itlb multihit:  Not affected
Vulnerability L1tf:           Not affected
Vulnerability Mds:            Not affected
Vulnerability Meltdown:       Not affected
Vulnerability Mmio stale data: Not affected
Vulnerability Retbleed:       Not affected
Vulnerability Spec store bypass: Mitigation; Speculative Store Bypass disabled via prctl
Vulnerability Spectre v1:     Mitigation; usercopy/swaps barriers and __user pointer sanitization
Vulnerability Spectre v2:     Mitigation; Enhanced IBRS, IBPB conditional, RSB filling, PBRSE-eIBRS SW
                                sequence
Vulnerability Srbds:          Not affected
Vulnerability Tsx async abort: Not affected

```

```

From lscpu --cache:
NAME ONE-SIZE ALL-SIZE WAYS TYPE          LEVEL SETS PHY-LINE COHERENCY-SIZE

```

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### Platform Notes (Continued)

L1d	48K	3.4M	12 Data	1	64	1	64
L1i	32K	2.3M	8 Instruction	1	64	1	64
L2	2M	144M	16 Unified	2	2048	1	64
L3	45M	180M	15 Unified	3	49152	1	64

#### 8. numactl --hardware

NOTE: a numactl 'node' might or might not correspond to a physical chip.

```

available: 4 nodes (0-3)
node 0 cpus: 0-17
node 0 size: 515753 MB
node 0 free: 514828 MB
node 1 cpus: 18-35
node 1 size: 516091 MB
node 1 free: 515527 MB
node 2 cpus: 36-53
node 2 size: 516091 MB
node 2 free: 515540 MB
node 3 cpus: 54-71
node 3 size: 516040 MB
node 3 free: 515465 MB
node distances:
node  0  1  2  3
0:  10  21  21  21
1:  21  10  21  21
2:  21  21  10  21
3:  21  21  21  10

```

#### 9. /proc/meminfo

MemTotal: 2113512268 kB

#### 10. who -r

run-level 3 Aug 4 13:05

#### 11. Systemd service manager version: systemd 250 (250-12.el9\_1)

Default Target Status  
multi-user degraded

#### 12. Failed units, from systemctl list-units --state=failed

```

UNIT                                LOAD    ACTIVE SUB    DESCRIPTION
* systemd-sysctl.service loaded failed failed Apply Kernel Variables

```

#### 13. Services, from systemctl list-unit-files

```

STATE      UNIT FILES
enabled    NetworkManager NetworkManager-dispatcher NetworkManager-wait-online auditd crond
           dbus-broker getty@ irqbalance kdump low-memory-monitor mdmonitor microcode nis-domainname
           rhsmcertd rsyslog rtkit-daemon selinux-autorelabel-mark sshd sssd
           systemd-network-generator udisks2 upower
enabled-runtime
           systemd-remount-fs
disabled   canberra-system-bootup canberra-system-shutdown canberra-system-shutdown-reboot
           console-getty cpupower debug-shell firewalld kvm_stat man-db-restart-cache-update nftables
           design rdisc rhsm rhsm-facts rpmdm-rebuild serial-getty@ sshd-keygen@
           systemd-boot-check-no-failures systemd-pstore systemd-sysext
indirect   sssd-autofs sssd-kcm sssd-nss sssd-pac sssd-pam sssd-ssh sssd-sudo

```

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### Platform Notes (Continued)

-----  
14. Linux kernel boot-time arguments, from /proc/cmdline  
BOOT\_IMAGE=(hd0,gpt3)/boot/vmlinuz-5.14.0-162.6.1.el9\_1.x86\_64  
root=UUID=43a7f1b1-66b0-456a-8c3f-451305a00281  
ro  
resume=UUID=58de1c40-542f-453b-bb6a-6bbd3510660a  
-----

15. cpupower frequency-info  
analyzing CPU 0:  
Unable to determine current policy  
boost state support:  
Supported: yes  
Active: yes  
-----

16. sysctl

kernel.numa_balancing	1
kernel.randomize_va_space	2
vm.compaction_proactiveness	20
vm.dirty_background_bytes	0
vm.dirty_background_ratio	10
vm.dirty_bytes	0
vm.dirty_expire_centisecs	3000
vm.dirty_ratio	20
vm.dirty_writeback_centisecs	500
vm.dirtytime_expire_seconds	43200
vm.extfrag_threshold	500
vm.min_unmapped_ratio	1
vm.nr_hugepages	0
vm.nr_hugepages_mempolicy	0
vm.nr_overcommit_hugepages	0
vm.swappiness	60
vm.watermark_boost_factor	15000
vm.watermark_scale_factor	10
vm.zone_reclaim_mode	0

-----

17. /sys/kernel/mm/transparent\_hugepage  
defrag always defer defer+madvice madvice [never]  
enabled always madvice [never]  
hpage\_pmd\_size 2097152  
shmem\_enabled always within\_size advise [never] deny force  
-----

18. /sys/kernel/mm/transparent\_hugepage/khugepaged  
alloc\_sleep\_millisecs 60000  
defrag 1  
max\_ptes\_none 511  
max\_ptes\_shared 256  
max\_ptes\_swap 64  
pages\_to\_scan 4096  
scan\_sleep\_millisecs 10000  
-----

19. OS release  
From /etc/\*-release /etc/\*-version  
os-release Red Hat Enterprise Linux 9.1 (Plow)  
redhat-release Red Hat Enterprise Linux release 9.1 (Plow)  
system-release Red Hat Enterprise Linux release 9.1 (Plow)  
-----

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### Platform Notes (Continued)

-----  
20. Disk information  
SPEC is set to: /home/cpu2017-1.1.9-ic2023.0  
Filesystem Type Size Used Avail Use% Mounted on  
/dev/nvme0n1p4 xfs 819G 15G 804G 2% /home  
-----

21. /sys/devices/virtual/dmi/id  
Vendor: Lenovo  
Product: ThinkSystem SR850 V3  
Product Family: ThinkSystem  
Serial: None  
-----

22. dmidecode  
Additional information from dmidecode 3.3 follows. WARNING: Use caution when you interpret this section. The 'dmidecode' program reads system data which is "intended to allow hardware to be accurately determined", but the intent may not be met, as there are frequent changes to hardware, firmware, and the "DMTF SMBIOS" standard.  
Memory:  
21x SK Hynix HMCG94AEBRA102N 64 GB 2 rank 4800  
4x SK Hynix HMCG94AEBRA109N 64 GB 2 rank 4800  
7x SK Hynix HMCG94AEBRA123N 64 GB 2 rank 4800  
-----

23. BIOS  
(This section combines info from /sys/devices and dmidecode.)  
BIOS Vendor: Lenovo  
BIOS Version: RSE105E-1.10  
BIOS Date: 05/12/2023  
BIOS Revision: 1.10  
Firmware Revision: 1.10  
-----

### Compiler Version Notes

=====  
C | 619.lbm\_s(base) 638.imagick\_s(base) 644.nab\_s(base)  
-----

Intel(R) oneAPI DPC++/C++ Compiler for applications running on Intel(R) 64, Version 2023.0.0 Build 20221201  
Copyright (C) 1985-2022 Intel Corporation. All rights reserved.  
-----

=====  
C++, C, Fortran | 607.cactuBSSN\_s(base)  
-----

Intel(R) oneAPI DPC++/C++ Compiler for applications running on Intel(R) 64, Version 2023.0.0 Build 20221201  
Copyright (C) 1985-2022 Intel Corporation. All rights reserved.  
Intel(R) oneAPI DPC++/C++ Compiler for applications running on Intel(R) 64, Version 2023.0.0 Build 20221201  
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Intel(R) Fortran Compiler for applications running on Intel(R) 64, Version 2023.0.0 Build 20221201  
Copyright (C) 1985-2022 Intel Corporation. All rights reserved.  
-----

=====  
Fortran | 603.bwaves\_s(base) 649.fotonik3d\_s(base) 654.roms\_s(base)  
-----

Intel(R) Fortran Compiler for applications running on Intel(R) 64, Version 2023.0.0 Build 20221201  
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Copyright (C) 1985-2022 Intel Corporation. All rights reserved.

-----  
Fortran, C | 621.wrf\_s(base) 627.cam4\_s(base) 628.pop2\_s(base)  
-----

Intel(R) Fortran Compiler for applications running on Intel(R) 64, Version 2023.0.0 Build 20221201  
Copyright (C) 1985-2022 Intel Corporation. All rights reserved.

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Copyright (C) 1985-2022 Intel Corporation. All rights reserved.  
-----

## Base Compiler Invocation

C benchmarks:

icx

Fortran benchmarks:

ifx

Benchmarks using both Fortran and C:

ifx icx

Benchmarks using Fortran, C, and C++:

icpx icx ifx

## Base Portability Flags

603.bwaves\_s: -DSPEC\_LP64  
607.cactuBSSN\_s: -DSPEC\_LP64  
619.lbm\_s: -DSPEC\_LP64  
621.wrf\_s: -DSPEC\_LP64 -DSPEC\_CASE\_FLAG -convert big\_endian  
627.cam4\_s: -DSPEC\_LP64 -DSPEC\_CASE\_FLAG  
628.pop2\_s: -DSPEC\_LP64 -DSPEC\_CASE\_FLAG -convert big\_endian  
-assume byterecl  
638.imagick\_s: -DSPEC\_LP64  
644.nab\_s: -DSPEC\_LP64  
649.fotonik3d\_s: -DSPEC\_LP64  
654.roms\_s: -DSPEC\_LP64

## Base Optimization Flags

C benchmarks:

-m64 -std=c11 -Wl,-z,muldefs -xsapphirerapids -Ofast -ffast-math

(Continued on next page)



# SPEC CPU®2017 Floating Point Speed Result

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## Lenovo Global Technology

SPECspeed®2017\_fp\_base = 288

ThinkSystem SR850 V3  
(2.20 GHz, Intel Xeon Gold 6416H)

SPECspeed®2017\_fp\_peak = Not Run

CPU2017 License: 9017

Test Date: Aug-2023

Test Sponsor: Lenovo Global Technology

Hardware Availability: Jun-2023

Tested by: Lenovo Global Technology

Software Availability: Dec-2022

## Base Optimization Flags (Continued)

C benchmarks (continued):

```
-flto -mfpmath=sse -funroll-loops -qopt-mem-layout-trans=4 -fiopenmp
-DSPEC_OPENMP -Wno-implicit-int -mprefer-vector-width=512
-L/usr/local/jemalloc64-5.0.1/lib -ljemalloc
```

Fortran benchmarks:

```
-m64 -Wl,-z,muldefs -DSPEC_OPENMP -xsapphirerapids -Ofast
-ffast-math -flto -mfpmath=sse -funroll-loops
-qopt-mem-layout-trans=4 -fiopenmp -nostandard-realloc-lhs
-align array32byte -auto -L/usr/local/jemalloc64-5.0.1/lib -ljemalloc
```

Benchmarks using both Fortran and C:

```
-m64 -std=c11 -Wl,-z,muldefs -xsapphirerapids -Ofast -ffast-math
-flto -mfpmath=sse -funroll-loops -qopt-mem-layout-trans=4 -fiopenmp
-DSPEC_OPENMP -Wno-implicit-int -mprefer-vector-width=512
-nostandard-realloc-lhs -align array32byte -auto
-L/usr/local/jemalloc64-5.0.1/lib -ljemalloc
```

Benchmarks using Fortran, C, and C++:

```
-m64 -std=c++14 -std=c11 -Wl,-z,muldefs -xsapphirerapids -Ofast
-ffast-math -flto -mfpmath=sse -funroll-loops
-qopt-mem-layout-trans=4 -fiopenmp -DSPEC_OPENMP -Wno-implicit-int
-mprefer-vector-width=512 -nostandard-realloc-lhs -align array32byte
-auto -L/usr/local/jemalloc64-5.0.1/lib -ljemalloc
```

The flags files that were used to format this result can be browsed at

<http://www.spec.org/cpu2017/flags/Lenovo-Platform-SPECcpu2017-Flags-V1.2-Eaglestream-W.html>  
<http://www.spec.org/cpu2017/flags/Intel-ic2023-official-linux64.html>

You can also download the XML flags sources by saving the following links:

<http://www.spec.org/cpu2017/flags/Lenovo-Platform-SPECcpu2017-Flags-V1.2-Eaglestream-W.xml>  
<http://www.spec.org/cpu2017/flags/Intel-ic2023-official-linux64.xml>

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