



SPEC CPU®2017 Floating Point Rate Result

Copyright 2017-2020 Standard Performance Evaluation Corporation

Lenovo Global Technology

ThinkSystem SR645
2.30 GHz, AMD EPYC 7642

SPECrate®2017_fp_base = 476

SPECrate®2017_fp_peak = 528

CPU2017 License: 9017

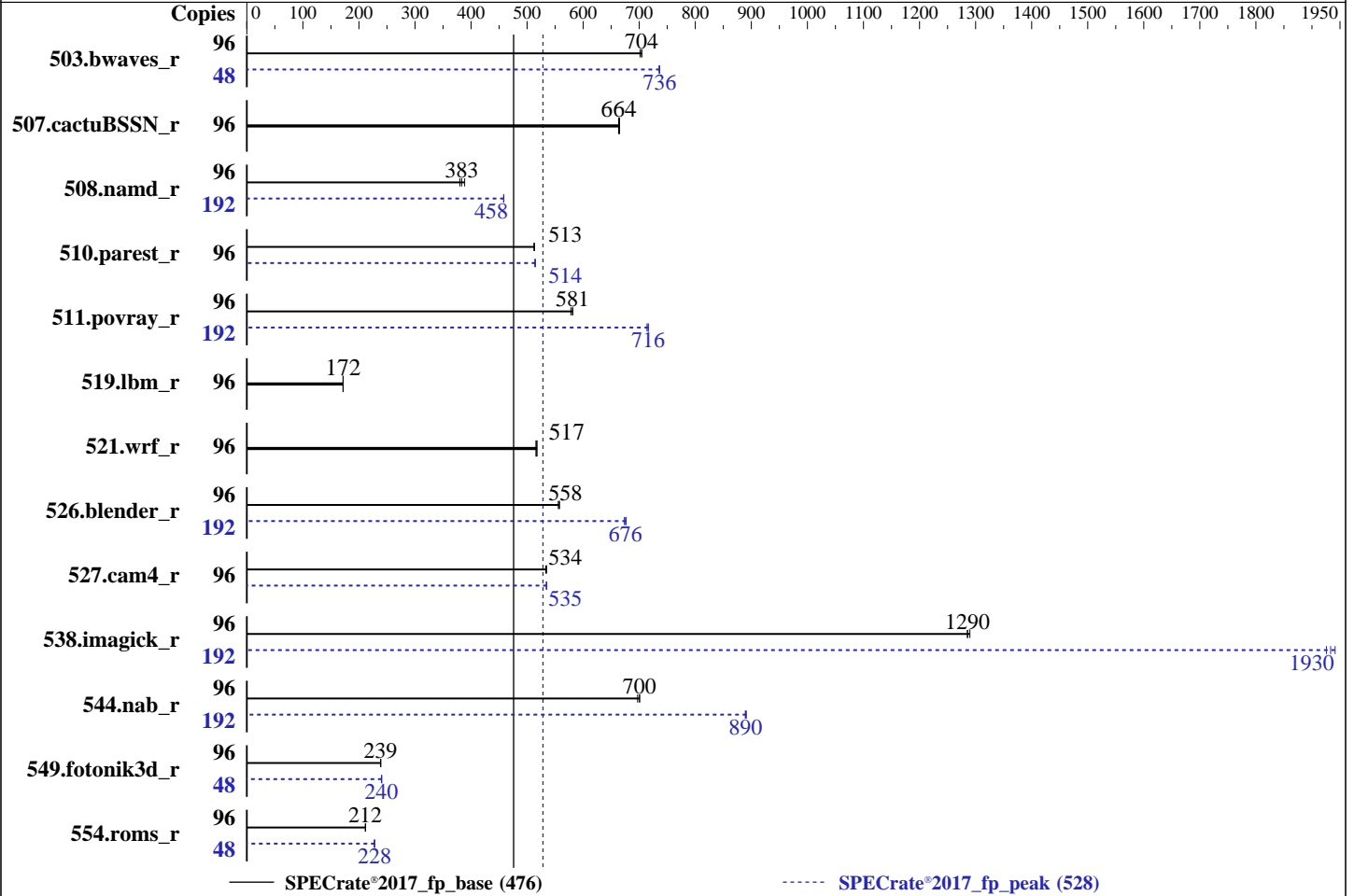
Test Sponsor: Lenovo Global Technology

Tested by: Lenovo Global Technology

Test Date: Jun-2020

Hardware Availability: Jun-2020

Software Availability: Dec-2019



Hardware

CPU Name: AMD EPYC 7642
 Max MHz: 3300
 Nominal: 2300
 Enabled: 96 cores, 2 chips, 2 threads/core
 Orderable: 1,2 chips
 Cache L1: 32 KB I + 32 KB D on chip per core
 L2: 512 KB I+D on chip per core
 L3: 256 MB I+D on chip per chip,
 16 MB shared / 3 cores
 Other: None
 Memory: 1 TB (32 x 32 GB 2Rx8 PC4-3200AA-R)
 Storage: 1 x 960 GB SATA SSD
 Other: None

Software

OS: SUSE Linux Enterprise Server 12 SP5 (x86_64)
 Kernel 4.12.14-120-default
 Compiler: C/C++/Fortran: Version 2.0.0 of AOCC
 Parallel: No
 Firmware: Lenovo BIOS Version D8E105P 1.00 released May-2020
 File System: xfs
 System State: Run level 3 (multi-user)
 Base Pointers: 64-bit
 Peak Pointers: 64-bit
 Other: jemalloc: jemalloc memory allocator library v5.2.0
 Power Management: BIOS set to prefer performance at the cost of additional power usage



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Results Table

| Benchmark | Base | | | | | | | Peak | | | | | | |
|-----------------|--------|-------------|-------------|------------|------------|-------------|------------|--------|------------|-------------|------------|------------|------------|------------|
| | Copies | Seconds | Ratio | Seconds | Ratio | Seconds | Ratio | Copies | Seconds | Ratio | Seconds | Ratio | Seconds | Ratio |
| 503.bwaves_r | 96 | 1372 | 701 | 1367 | 704 | <u>1367</u> | <u>704</u> | 48 | 654 | 736 | 655 | 735 | <u>654</u> | <u>736</u> |
| 507.cactuBSSN_r | 96 | 183 | 663 | 183 | 665 | <u>183</u> | <u>664</u> | 96 | 183 | 663 | 183 | 665 | <u>183</u> | <u>664</u> |
| 508.namd_r | 96 | <u>238</u> | <u>383</u> | 240 | 380 | 235 | 389 | 192 | <u>398</u> | <u>458</u> | 398 | 459 | 398 | 458 |
| 510.parest_r | 96 | <u>490</u> | <u>513</u> | 490 | 513 | 490 | 512 | 96 | 489 | 514 | <u>488</u> | <u>514</u> | 488 | 515 |
| 511.povray_r | 96 | 388 | 578 | <u>386</u> | <u>581</u> | 385 | 582 | 192 | <u>626</u> | <u>716</u> | 628 | 714 | 626 | 716 |
| 519.lbm_r | 96 | 590 | 172 | <u>589</u> | <u>172</u> | 589 | 172 | 96 | 590 | 172 | <u>589</u> | <u>172</u> | 589 | 172 |
| 521.wrf_r | 96 | <u>416</u> | <u>517</u> | 417 | 516 | 415 | 518 | 96 | <u>416</u> | <u>517</u> | 417 | 516 | 415 | 518 |
| 526.blender_r | 96 | 263 | 556 | 262 | 558 | <u>262</u> | <u>558</u> | 192 | 434 | 673 | <u>433</u> | <u>676</u> | 432 | 677 |
| 527.cam4_r | 96 | 314 | 535 | 315 | 533 | <u>314</u> | <u>534</u> | 96 | 314 | 535 | 314 | 534 | <u>314</u> | <u>535</u> |
| 538.imagick_r | 96 | <u>186</u> | <u>1290</u> | 185 | 1290 | 186 | 1290 | 192 | <u>247</u> | <u>1930</u> | 246 | 1940 | 248 | 1930 |
| 544.nab_r | 96 | 232 | 697 | <u>231</u> | <u>700</u> | 231 | 701 | 192 | 363 | 889 | <u>363</u> | <u>890</u> | 363 | 891 |
| 549.fotonik3d_r | 96 | <u>1567</u> | <u>239</u> | 1567 | 239 | 1567 | 239 | 48 | 777 | 241 | 779 | 240 | <u>778</u> | <u>240</u> |
| 554.roms_r | 96 | 720 | 212 | 721 | 211 | <u>721</u> | <u>212</u> | 48 | 335 | 227 | 334 | 228 | <u>335</u> | <u>228</u> |

SPECrate®2017_fp_base = **476**

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

Compiler Notes

The AMD64 AOCC Compiler Suite is available at
<http://developer.amd.com/amd-aocc/>

Submit Notes

The config file option 'submit' was used.
'numactl' was used to bind copies to the cores.
See the configuration file for details.

Operating System Notes

'ulimit -s unlimited' was used to set environment stack size
'ulimit -l 2097152' was used to set environment locked pages in memory limit

runcpu command invoked through numactl i.e.:
numactl --interleave=all runcpu <etc>

Set dirty_ratio=8 to limit dirty cache to 8% of memory
Set swappiness=1 to swap only if necessary
Set zone_reclaim_mode=1 to free local node memory and avoid remote memory
sync then drop_caches=3 to reset caches before invoking runcpu

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Operating System Notes (Continued)

dirty_ratio, swappiness, zone_reclaim_mode and drop_caches were all set using privileged echo (e.g. echo 1 > /proc/sys/vm/swappiness).

Transparent huge pages set to 'always' for this run (OS default)

Environment Variables Notes

Environment variables set by runcpu before the start of the run:

LD_LIBRARY_PATH =

```
"/home/cpu2017-1.1.0-amd-rome-aocc200-C3/amd_rate_aocc200_rome_C_lib/64;  
/home/cpu2017-1.1.0-amd-rome-aocc200-C3/amd_rate_aocc200_rome_C_lib/32:"
```

MALLOC_CONF = "retain:true"

General Notes

Binaries were compiled on a system with 2x AMD EPYC 7601 CPU + 512GB Memory using Fedora 26

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: configured and built with GCC v9.1.0 in Ubuntu 19.04 with -O3 -znver2 -flto
jemalloc 5.2.0 is available here:

<https://github.com/jemalloc/jemalloc/releases/download/5.2.0/jemalloc-5.2.0.tar.bz2>

Platform Notes

BIOS settings:

Choose Operating Mode set to Maximum Performance and then set it to Custom Mode

NUMA nodes per socket set to NPS4

Sysinfo program /home/cpu2017-1.1.0-amd-rome-aocc200-C3/bin/sysinfo

Rev: r6365 of 2019-08-21 295195f888a3d7edble6e46a485a0011

running on linux-d9uk Mon Jun 22 06:04:42 2020

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

For more information on this section, see

<https://www.spec.org/cpu2017/Docs/config.html#sysinfo>

From /proc/cpuinfo

model name : AMD EPYC 7642 48-Core Processor

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Platform Notes (Continued)

```

2 "physical id"s (chips)
192 "processors"
cores, siblings (Caution: counting these is hw and system dependent. The following
excerpts from /proc/cpuinfo might not be reliable. Use with caution.)
cpu cores : 48
siblings  : 96
physical 0: cores 0 1 2 4 5 6 8 9 10 12 13 14 16 17 18 20 21 22 24 25 26 28 29 30
32 33 34 36 37 38 40 41 42 44 45 46 48 49 50 52 53 54 56 57 58 60 61 62
physical 1: cores 0 1 2 4 5 6 8 9 10 12 13 14 16 17 18 20 21 22 24 25 26 28 29 30
32 33 34 36 37 38 40 41 42 44 45 46 48 49 50 52 53 54 56 57 58 60 61 62

```

```

From lscpu:
Architecture:          x86_64
CPU op-mode(s):        32-bit, 64-bit
Byte Order:             Little Endian
Address sizes:          43 bits physical, 48 bits virtual
CPU(s):                 192
On-line CPU(s) list:   0-191
Thread(s) per core:    2
Core(s) per socket:    48
Socket(s):              2
NUMA node(s):          8
Vendor ID:              AuthenticAMD
CPU family:             23
Model:                  49
Model name:             AMD EPYC 7642 48-Core Processor
Stepping:               0
CPU MHz:                2300.000
CPU max MHz:           2300.0000
CPU min MHz:           1500.0000
BogoMIPS:               4591.37
Virtualization:        AMD-V
L1d cache:              32K
L1i cache:              32K
L2 cache:               512K
L3 cache:               16384K
NUMA node0 CPU(s):     0-11,96-107
NUMA node1 CPU(s):     12-23,108-119
NUMA node2 CPU(s):     24-35,120-131
NUMA node3 CPU(s):     36-47,132-143
NUMA node4 CPU(s):     48-59,144-155
NUMA node5 CPU(s):     60-71,156-167
NUMA node6 CPU(s):     72-83,168-179
NUMA node7 CPU(s):     84-95,180-191
Flags:                  fpu vme de pse tsc msr pae mce cx8 apic sep mtrr pge mca cmov
pat pse36 clflush mmx fxsr sse sse2 ht syscall nx mmxext fxsr_opt pdpe1gb rdtscp lm
constant_tsc rep_good nopl nonstop_tsc cpuid extd_apicid aperfmperf pni pclmulqdq

```

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Platform Notes (Continued)

```
monitor ssse3 fma cx16 sse4_1 sse4_2 movbe popcnt aes xsave avx f16c rdrand lahf_lm
cmp_legacy svm extapic cr8_legacy abm sse4a misalignsse 3dnowprefetch osvw ibs
skinit wdt tce topoext perfctr_core perfctr_nb bpext perfctr_l2 mwaitx cpb cat_l3
cdp_l3 hw_pstate sme ssbd sev ibrs ibpb stibp vmmcall fsgsbase bmi1 avx2 smep bmi2
cqm rdt_a rdseed adx smap clflushopt clwb sha_ni xsaveopt xsavec xgetbv1 xsaves
cqm_llc cqm_occup_llc cqm_mbm_total cqm_mbm_local clzero irperf xsaveerptr wbnoinvd
arat npt lbrv svm_lock nrip_save tsc_scale vmcb_clean flushbyasid decodeassists
pausefilter pfthreshold avic v_vmsave_vmload vgif umip rdpid overflow_recov succor
smca
```

```
/proc/cpuinfo cache data
cache size : 512 KB
```

From numactl --hardware WARNING: a numactl 'node' might or might not correspond to a physical chip.

```
available: 8 nodes (0-7)
node 0 cpus: 0 1 2 3 4 5 6 7 8 9 10 11 96 97 98 99 100 101 102 103 104 105 106 107
node 0 size: 128825 MB
node 0 free: 128458 MB
node 1 cpus: 12 13 14 15 16 17 18 19 20 21 22 23 108 109 110 111 112 113 114 115 116
117 118 119
node 1 size: 129018 MB
node 1 free: 128681 MB
node 2 cpus: 24 25 26 27 28 29 30 31 32 33 34 35 120 121 122 123 124 125 126 127 128
129 130 131
node 2 size: 129018 MB
node 2 free: 128730 MB
node 3 cpus: 36 37 38 39 40 41 42 43 44 45 46 47 132 133 134 135 136 137 138 139 140
141 142 143
node 3 size: 128976 MB
node 3 free: 128638 MB
node 4 cpus: 48 49 50 51 52 53 54 55 56 57 58 59 144 145 146 147 148 149 150 151 152
153 154 155
node 4 size: 129018 MB
node 4 free: 128739 MB
node 5 cpus: 60 61 62 63 64 65 66 67 68 69 70 71 156 157 158 159 160 161 162 163 164
165 166 167
node 5 size: 129018 MB
node 5 free: 128744 MB
node 6 cpus: 72 73 74 75 76 77 78 79 80 81 82 83 168 169 170 171 172 173 174 175 176
177 178 179
node 6 size: 129018 MB
node 6 free: 128761 MB
node 7 cpus: 84 85 86 87 88 89 90 91 92 93 94 95 180 181 182 183 184 185 186 187 188
189 190 191
node 7 size: 129016 MB
node 7 free: 128734 MB
```

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Platform Notes (Continued)

```
node distances:
node   0   1   2   3   4   5   6   7
  0:  10  12  12  12  32  32  32  32
  1:  12  10  12  12  32  32  32  32
  2:  12  12  10  12  32  32  32  32
  3:  12  12  12  10  32  32  32  32
  4:  32  32  32  32  10  12  12  12
  5:  32  32  32  32  12  10  12  12
  6:  32  32  32  32  12  12  10  12
  7:  32  32  32  32  12  12  12  10
```

```
From /proc/meminfo
MemTotal:      1056676868 kB
HugePages_Total:      0
Hugepagesize:    2048 kB
```

```
From /etc/*release* /etc/*version*
SuSE-release:
  SUSE Linux Enterprise Server 12 (x86_64)
  VERSION = 12
  PATCHLEVEL = 5
  # This file is deprecated and will be removed in a future service pack or release.
  # Please check /etc/os-release for details about this release.
os-release:
  NAME="SLES"
  VERSION="12-SP5"
  VERSION_ID="12.5"
  PRETTY_NAME="SUSE Linux Enterprise Server 12 SP5"
  ID="sles"
  ANSI_COLOR="0;32"
  CPE_NAME="cpe:/o:suse:sles:12:sp5"
```

```
uname -a:
Linux linux-d9uk 4.12.14-120-default #1 SMP Thu Nov 7 16:39:09 UTC 2019 (fd9dc36)
x86_64 x86_64 x86_64 GNU/Linux
```

Kernel self-reported vulnerability status:

```
itlb_multihit:                               Not affected
CVE-2018-3620 (L1 Terminal Fault):           Not affected
Microarchitectural Data Sampling:           Not affected
CVE-2017-5754 (Meltdown):                    Not affected
CVE-2018-3639 (Speculative Store Bypass):    Mitigation: Speculative Store Bypass disabled
                                              via prctl and seccomp
CVE-2017-5753 (Spectre variant 1):           Mitigation: usercopy/swaps barriers and __user
                                              pointer sanitization
CVE-2017-5715 (Spectre variant 2):           Mitigation: Full AMD retpoline, IBPB:
```

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Platform Notes (Continued)

conditional, IBRS_FW, STIBP: conditional, RSB filling
tsx_async_abort: Not affected

run-level 3 Jun 22 06:02

SPEC is set to: /home/cpu2017-1.1.0-amd-rome-aocc200-C3
Filesystem Type Size Used Avail Use% Mounted on
/dev/sdb3 xfs 889G 82G 808G 10% /

From /sys/devices/virtual/dmi/id
BIOS: Lenovo D8E105P-1.00 05/08/2020
Vendor: Lenovo
Product: ThinkSystem SR645 MB
Product Family: ThinkSystem
Serial: 1234567890

Additional information from dmidecode 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:
32x Samsung M393A4G43AB3-CWE 32 kB 2 rank 3200

(End of data from sysinfo program)
This system support 16 DIMMs per processor, total 32 DIMMs.
32 DIMM slots installed with 32 GB DIMM for this run.

Compiler Version Notes

=====
C | 519.lbm_r(base, peak) 538.imagick_r(base, peak)
| 544.nab_r(base, peak)
=====

AOCC.LLVM.2.0.0.B191.2019_07_19 clang version 8.0.0 (CLANG: Jenkins
AOCC_2_0_0-Build#191) (based on LLVM AOCC.LLVM.2.0.0.B191.2019_07_19)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /sppo/dev/compilers/aocc-compiler-2.0.0/bin
=====

=====
C++ | 508.namd_r(base, peak) 510.parest_r(base, peak)
=====

AOCC.LLVM.2.0.0.B191.2019_07_19 clang version 8.0.0 (CLANG: Jenkins
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Compiler Version Notes (Continued)

Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /sppo/dev/compilers/aocc-compiler-2.0.0/bin

=====
C++, C | 511.povray_r(base, peak) 526.blender_r(base, peak)

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Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /sppo/dev/compilers/aocc-compiler-2.0.0/bin

=====
C++, C, Fortran | 507.cactuBSSN_r(base, peak)

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AOCC_2_0_0-Build#191) (based on LLVM AOCC.LLVM.2.0.0.B191.2019_07_19)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /sppo/dev/compilers/aocc-compiler-2.0.0/bin

=====
Fortran | 503.bwaves_r(base, peak) 549.fotonik3d_r(base, peak)
| 554.roms_r(base, peak)

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Target: x86_64-unknown-linux-gnu

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Compiler Version Notes (Continued)

Thread model: posix
InstalledDir: /sppo/dev/compilers/aocc-compiler-2.0.0/bin

Fortran, C | 521.wrf_r(base, peak) 527.cam4_r(base, peak)

AOCC.LLVM.2.0.0.B191.2019_07_19 clang version 8.0.0 (CLANG: Jenkins
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Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /sppo/dev/compilers/aocc-compiler-2.0.0/bin

Base Compiler Invocation

C benchmarks:
clang

C++ benchmarks:
clang++

Fortran benchmarks:
flang

Benchmarks using both Fortran and C:
flang clang

Benchmarks using both C and C++:
clang++ clang

Benchmarks using Fortran, C, and C++:
clang++ clang flang

Base Portability Flags

503.bwaves_r: -DSPEC_LP64
507.cactuBSSN_r: -DSPEC_LP64

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Base Portability Flags (Continued)

```

508.namd_r: -DSPEC_LP64
510.parest_r: -DSPEC_LP64
511.povray_r: -DSPEC_LP64
519.lbm_r: -DSPEC_LP64
521.wrf_r: -DSPEC_CASE_FLAG -Mbyteswapio -DSPEC_LP64
526.blender_r: -funsigned-char -D__BOOL_DEFINED -DSPEC_LP64
527.cam4_r: -DSPEC_CASE_FLAG -DSPEC_LP64
538.imagick_r: -DSPEC_LP64
544.nab_r: -DSPEC_LP64
549.fotonik3d_r: -DSPEC_LP64
554.roms_r: -DSPEC_LP64

```

Base Optimization Flags

C benchmarks:

```

-flto -Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-region-vectorize -Wl,-mllvm -Wl,-vector-library=LIBMVEC
-Wl,-mllvm -Wl,-reduce-array-computations=3 -O3 -ffast-math
-march=znver2 -fstruct-layout=3 -mllvm -unroll-threshold=50
-fremap-arrays -mllvm -function-specialize -mllvm -enable-gvn-hoist
-mllvm -reduce-array-computations=3 -mllvm -global-vectorize-slp
-mllvm -vector-library=LIBMVEC -mllvm -inline-threshold=1000
-flv-function-specialization -z muldefs -lmvec -lamdlibm -ljemalloc
-lflang

```

C++ benchmarks:

```

-std=c++98 -flto -Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-region-vectorize -Wl,-mllvm -Wl,-vector-library=LIBMVEC
-Wl,-mllvm -Wl,-reduce-array-computations=3
-Wl,-mllvm -Wl,-suppress-fmas -O3 -ffast-math -march=znver2
-mllvm -loop-unswitch-threshold=200000 -mllvm -vector-library=LIBMVEC
-mllvm -unroll-threshold=100 -flv-function-specialization
-mllvm -enable-partial-unswitch -z muldefs -lmvec -lamdlibm
-ljemalloc -lflang

```

Fortran benchmarks:

```

-flto -Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-region-vectorize -Wl,-mllvm -Wl,-vector-library=LIBMVEC
-Wl,-mllvm -Wl,-reduce-array-computations=3 -O3 -march=znver2
-funroll-loops -Mrecursive -mllvm -vector-library=LIBMVEC -z muldefs
-Kieee -fno-finite-math-only -lmvec -lamdlibm -ljemalloc -lflang

```

Benchmarks using both Fortran and C:

```

-flto -Wl,-mllvm -Wl,-function-specialize

```

(Continued on next page)



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Test Date: Jun-2020

Test Sponsor: Lenovo Global Technology

Hardware Availability: Jun-2020

Tested by: Lenovo Global Technology

Software Availability: Dec-2019

Base Optimization Flags (Continued)

Benchmarks using both Fortran and C (continued):

```
-Wl,-mllvm -Wl,-region-vectorize -Wl,-mllvm -Wl,-vector-library=LIBMVEC
-Wl,-mllvm -Wl,-reduce-array-computations=3 -O3 -ffast-math
-march=znver2 -fstruct-layout=3 -mllvm -unroll-threshold=50
-freemap-arrays -mllvm -function-specialize -mllvm -enable-gvn-hoist
-mllvm -reduce-array-computations=3 -mllvm -global-vectorize-slp
-mllvm -vector-library=LIBMVEC -mllvm -inline-threshold=1000
-flv-function-specialization -funroll-loops -Mrecursive -z muldefs
-Kieee -fno-finite-math-only -lmvec -lamdlibm -ljemalloc -lflang
```

Benchmarks using both C and C++:

```
-std=c++98 -flto -Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-region-vectorize -Wl,-mllvm -Wl,-vector-library=LIBMVEC
-Wl,-mllvm -Wl,-reduce-array-computations=3
-Wl,-mllvm -Wl,-suppress-fmas -O3 -ffast-math -march=znver2
-fstruct-layout=3 -mllvm -unroll-threshold=50 -freemap-arrays
-mllvm -function-specialize -mllvm -enable-gvn-hoist
-mllvm -reduce-array-computations=3 -mllvm -global-vectorize-slp
-mllvm -vector-library=LIBMVEC -mllvm -inline-threshold=1000
-flv-function-specialization -mllvm -loop-unswitch-threshold=200000
-mllvm -unroll-threshold=100 -mllvm -enable-partial-unswitch -z muldefs
-lmvec -lamdlibm -ljemalloc -lflang
```

Benchmarks using Fortran, C, and C++:

```
-std=c++98 -flto -Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-region-vectorize -Wl,-mllvm -Wl,-vector-library=LIBMVEC
-Wl,-mllvm -Wl,-reduce-array-computations=3
-Wl,-mllvm -Wl,-suppress-fmas -O3 -ffast-math -march=znver2
-fstruct-layout=3 -mllvm -unroll-threshold=50 -freemap-arrays
-mllvm -function-specialize -mllvm -enable-gvn-hoist
-mllvm -reduce-array-computations=3 -mllvm -global-vectorize-slp
-mllvm -vector-library=LIBMVEC -mllvm -inline-threshold=1000
-flv-function-specialization -mllvm -loop-unswitch-threshold=200000
-mllvm -unroll-threshold=100 -mllvm -enable-partial-unswitch
-funroll-loops -Mrecursive -z muldefs -Kieee -fno-finite-math-only
-lmvec -lamdlibm -ljemalloc -lflang
```

Peak Compiler Invocation

C benchmarks:

clang

C++ benchmarks:

clang++

(Continued on next page)



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Peak Compiler Invocation (Continued)

Fortran benchmarks:

flang

Benchmarks using both Fortran and C:

flang clang

Benchmarks using both C and C++:

clang++ clang

Benchmarks using Fortran, C, and C++:

clang++ clang flang

Peak Portability Flags

Same as Base Portability Flags

Peak Optimization Flags

C benchmarks:

519.lbm_r: basepeak = yes

```
538.imagick_r: -flto -Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-region-vectorize
-Wl,-mllvm -Wl,-vector-library=LIBMVEC
-Wl,-mllvm -Wl,-reduce-array-computations=3 -Ofast
-march=znver2 -mno-sse4a -fstruct-layout=5
-mllvm -vectorize-memory-aggressively
-mllvm -function-specialize -mllvm -enable-gvn-hoist
-mllvm -unroll-threshold=50 -fremap-arrays
-mllvm -vector-library=LIBMVEC
-mllvm -reduce-array-computations=3
-mllvm -global-vectorize-slp -mllvm -inline-threshold=1000
-flv-function-specialization -lmvec -lamdlibm -ljemalloc
-lflang
```

544.nab_r: Same as 538.imagick_r

C++ benchmarks:

(Continued on next page)



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Peak Optimization Flags (Continued)

```
508.namd_r: -std=c++98 -flto -Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-region-vectorize
-Wl,-mllvm -Wl,-vector-library=LIBMVEC
-Wl,-mllvm -Wl,-reduce-array-computations=3 -Ofast
-march=znver2 -flv-function-specialization
-mllvm -unroll-threshold=100
-mllvm -enable-partial-unswitch
-mllvm -loop-unswitch-threshold=200000
-mllvm -vector-library=LIBMVEC
-mllvm -inline-threshold=1000 -lmvec -lamdlibm -ljemalloc
-lflang
```

```
510.parest_r: -std=c++98 -flto -Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-region-vectorize
-Wl,-mllvm -Wl,-vector-library=LIBMVEC
-Wl,-mllvm -Wl,-reduce-array-computations=3
-Wl,-mllvm -Wl,-suppruce-fmas -Ofast -march=znver2
-flv-function-specialization -mllvm -unroll-threshold=100
-mllvm -enable-partial-unswitch
-mllvm -loop-unswitch-threshold=200000
-mllvm -vector-library=LIBMVEC
-mllvm -inline-threshold=1000 -lmvec -lamdlibm -ljemalloc
-lflang
```

Fortran benchmarks:

```
503.bwaves_r: -flto -Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-region-vectorize
-Wl,-mllvm -Wl,-vector-library=LIBMVEC
-Wl,-mllvm -Wl,-reduce-array-computations=3 -O3
-march=znver2 -funroll-loops -Mrecursive
-mllvm -vector-library=LIBMVEC -Kieee
-fno-finite-math-only -lmvec -lamdlibm -ljemalloc
-lflang
```

549.fotonik3d_r: Same as 503.bwaves_r

```
554.roms_r: -flto -Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-region-vectorize
-Wl,-mllvm -Wl,-vector-library=LIBMVEC
-Wl,-mllvm -Wl,-reduce-array-computations=3
-Wl,-mllvm -Wl,-enable-X86-prefetching -O3 -march=znver2
-funroll-loops -Mrecursive -mllvm -vector-library=LIBMVEC
-Kieee -fno-finite-math-only -lmvec -lamdlibm -ljemalloc
-lflang
```

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Peak Optimization Flags (Continued)

Benchmarks using both Fortran and C:

521.wrf_r: basepeak = yes

```
527.cam4_r: -flto -Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-region-vectorize
-Wl,-mllvm -Wl,-vector-library=LIBMVEC
-Wl,-mllvm -Wl,-reduce-array-computations=3 -Ofast
-march=znver2 -mno-sse4a -fstruct-layout=5
-mllvm -vectorize-memory-aggressively
-mllvm -function-specialize -mllvm -enable-gvn-hoist
-mllvm -unroll-threshold=50 -fremap-arrays
-mllvm -vector-library=LIBMVEC
-mllvm -reduce-array-computations=3
-mllvm -global-vectorize-slp -mllvm -inline-threshold=1000
-flv-function-specialization -O3 -funroll-loops
-Mrecursive -Kieee -fno-finite-math-only -lmvec
-lamdlibm -ljemalloc -lflang
```

Benchmarks using both C and C++:

```
511.povray_r: -std=c++98 -flto -Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-region-vectorize
-Wl,-mllvm -Wl,-vector-library=LIBMVEC
-Wl,-mllvm -Wl,-reduce-array-computations=3
-Wl,-mllvm -Wl,-x86-use-vzeroupper=false -Ofast
-march=znver2 -mno-sse4a -fstruct-layout=5
-mllvm -vectorize-memory-aggressively
-mllvm -function-specialize -mllvm -enable-gvn-hoist
-mllvm -unroll-threshold=50 -fremap-arrays
-mllvm -vector-library=LIBMVEC
-mllvm -reduce-array-computations=3
-mllvm -global-vectorize-slp -mllvm -inline-threshold=1000
-flv-function-specialization -mllvm -unroll-threshold=100
-mllvm -enable-partial-unswitch
-mllvm -loop-unswitch-threshold=200000 -lmvec -lamdlibm
-ljemalloc -lflang
```

```
526.blender_r: -std=c++98 -flto -Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-region-vectorize
-Wl,-mllvm -Wl,-vector-library=LIBMVEC
-Wl,-mllvm -Wl,-reduce-array-computations=3 -Ofast
-march=znver2 -mno-sse4a -fstruct-layout=5
-mllvm -vectorize-memory-aggressively
-mllvm -function-specialize -mllvm -enable-gvn-hoist
-mllvm -unroll-threshold=50 -fremap-arrays
```

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Peak Optimization Flags (Continued)

526.blender_r (continued):

```
-mllvm -vector-library=LIBMVEC  
-mllvm -reduce-array-computations=3  
-mllvm -global-vectorize-slp -mllvm -inline-threshold=1000  
-flv-function-specialization -mllvm -unroll-threshold=100  
-mllvm -enable-partial-unswitch  
-mllvm -loop-unswitch-threshold=200000 -lmvec -lamdlibm  
-ljemalloc -lflang
```

Benchmarks using Fortran, C, and C++:

507.cactuBSSN_r: basepeak = yes

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

<http://www.spec.org/cpu2017/flags/aocc200-flags-C3.html>

<http://www.spec.org/cpu2017/flags/Lenovo-Platform-SPECcpu2017-Flags-V1.2-Rome2P-K.html>

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

<http://www.spec.org/cpu2017/flags/aocc200-flags-C3.xml>

<http://www.spec.org/cpu2017/flags/Lenovo-Platform-SPECcpu2017-Flags-V1.2-Rome2P-K.xml>

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