



SPEC CPU®2017 Floating Point Rate Result

Copyright 2017-2019 Standard Performance Evaluation Corporation

Dell Inc.

SPECrate®2017_fp_base = 277

PowerEdge R6525 (AMD EPYC 7302, 3.00 GHz)

SPECrate®2017_fp_peak = 281

CPU2017 License: 55

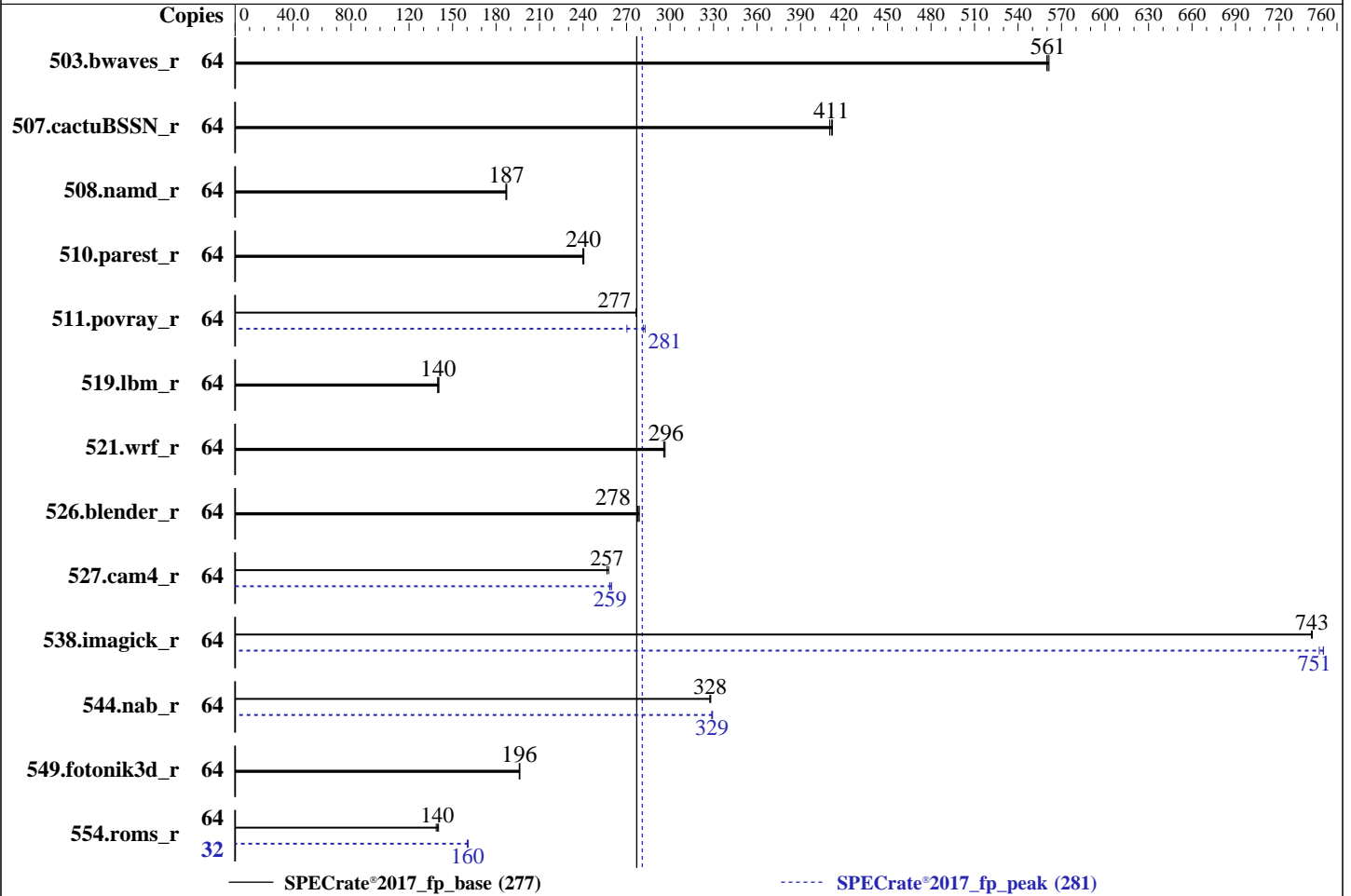
Test Date: Sep-2019

Test Sponsor: Dell Inc.

Hardware Availability: Oct-2019

Tested by: Dell Inc.

Software Availability: Aug-2019



Hardware

CPU Name: AMD EPYC 7302
 Max MHz: 3300
 Nominal: 3000
 Enabled: 32 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: 128 MB I+D on chip per chip, 16 MB shared / 2 cores
 Other: None
 Memory: 512 GB (16 x 32 GB 2Rx4 PC4-3200AA-R, running at 3200)
 Storage: 1 x 960 GB SAS SSD
 Other: None

Software

OS: SUSE Linux Enterprise Server 15 SP1 kernel 4.12.14-195-default
 Compiler: C/C++/Fortran: Version 2.0.0 of AOCC
 Parallel: No
 Firmware: Version 0.4.12 released Sep-2019
 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: --



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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	64	1146	560	<u>1145</u>	<u>561</u>	1143	561	64	1146	560	<u>1145</u>	<u>561</u>	1143	561
507.cactuBSSN_r	64	<u>197</u>	<u>411</u>	198	410	197	412	64	<u>197</u>	<u>411</u>	198	410	197	412
508.namd_r	64	325	187	<u>325</u>	<u>187</u>	326	187	64	325	187	<u>325</u>	<u>187</u>	326	187
510.parest_r	64	<u>697</u>	<u>240</u>	698	240	696	241	64	<u>697</u>	<u>240</u>	698	240	696	241
511.povray_r	64	540	277	540	277	<u>540</u>	<u>277</u>	64	<u>531</u>	<u>281</u>	528	283	553	270
519.lbm_r	64	483	140	<u>481</u>	<u>140</u>	480	141	64	483	140	<u>481</u>	<u>140</u>	480	141
521.wrf_r	64	<u>484</u>	<u>296</u>	485	296	483	297	64	<u>484</u>	<u>296</u>	485	296	483	297
526.blender_r	64	351	278	<u>351</u>	<u>278</u>	350	279	64	351	278	<u>351</u>	<u>278</u>	350	279
527.cam4_r	64	434	258	436	256	<u>436</u>	<u>257</u>	64	431	260	<u>433</u>	<u>259</u>	433	258
538.imagick_r	64	214	743	214	742	<u>214</u>	<u>743</u>	64	213	748	<u>212</u>	<u>751</u>	212	751
544.nab_r	64	<u>329</u>	<u>328</u>	329	327	328	328	64	<u>327</u>	<u>329</u>	328	329	327	329
549.fotonik3d_r	64	1270	196	<u>1272</u>	<u>196</u>	1273	196	64	1270	196	<u>1272</u>	<u>196</u>	1273	196
554.roms_r	64	725	140	733	139	<u>728</u>	<u>140</u>	32	316	161	318	160	<u>317</u>	<u>160</u>

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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)

General Notes

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

```
LD_LIBRARY_PATH = "/root/cpu2017-1.0.5/amd_rate_aocc200_rome_B_lib/64;
/root/cpu2017-1.0.5/amd_rate_aocc200_rome_B_lib/32:"
MALLOC_CONF = "retain:true"
```

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:

```
NUMA Nodes Per Socket set to 4
CCX as NUMA Domain set to Enabled
System Profile set to Custom
CPU Power Management set to Maximum Performance
Memory Frequency set to Maximum Performance
Turbo Boost Enabled
Cstates set to Enabled
Memory Patrol Scrub Disabled
Memory Refresh Rate set to 1x
PCI ASPM L1 Link Power Management Disabled
Determinism Slider set to Power Determinism
Efficiency Optimized Mode Disabled
Sysinfo program /root/cpu2017-1.0.5/bin/sysinfo
Rev: r5974 of 2018-05-19 9bcde8f2999c33d61f64985e45859ea9
running on linux-g3ob Thu Sep 12 13:52:50 2019
```

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Platform Notes (Continued)

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 7302 16-Core Processor

2 "physical id"s (chips)

64 "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 : 16

siblings : 32

physical 0: cores 0 1 4 5 8 9 12 13 16 17 20 21 24 25 28 29

physical 1: cores 0 1 4 5 8 9 12 13 16 17 20 21 24 25 28 29

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): 64

On-line CPU(s) list: 0-63

Thread(s) per core: 2

Core(s) per socket: 16

Socket(s): 2

NUMA node(s): 16

Vendor ID: AuthenticAMD

CPU family: 23

Model: 49

Model name: AMD EPYC 7302 16-Core Processor

Stepping: 0

CPU MHz: 2994.481

BogoMIPS: 5988.96

Virtualization: AMD-V

L1d cache: 32K

L1i cache: 32K

L2 cache: 512K

L3 cache: 16384K

NUMA node0 CPU(s): 0,1,32,33

NUMA node1 CPU(s): 2,3,34,35

NUMA node2 CPU(s): 4,5,36,37

NUMA node3 CPU(s): 6,7,38,39

NUMA node4 CPU(s): 8,9,40,41

NUMA node5 CPU(s): 10,11,42,43

NUMA node6 CPU(s): 12,13,44,45

NUMA node7 CPU(s): 14,15,46,47

NUMA node8 CPU(s): 16,17,48,49

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Platform Notes (Continued)

NUMA node9 CPU(s): 18,19,50,51
 NUMA node10 CPU(s): 20,21,52,53
 NUMA node11 CPU(s): 22,23,54,55
 NUMA node12 CPU(s): 24,25,56,57
 NUMA node13 CPU(s): 26,27,58,59
 NUMA node14 CPU(s): 28,29,60,61
 NUMA node15 CPU(s): 30,31,62,63

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 xtopology nonstop_tsc cpuid extd_apicid aperfmperf pni
 pclmulqdq monitor ssse3 fma cx16 sse4_1 sse4_2 movbe popcnt aes xsave avx fl6c
 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 bml 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 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: 16 nodes (0-15)
node 0 cpus: 0 1 32 33
node 0 size: 31804 MB
node 0 free: 31640 MB
node 1 cpus: 2 3 34 35
node 1 size: 32254 MB
node 1 free: 32124 MB
node 2 cpus: 4 5 36 37
node 2 size: 32255 MB
node 2 free: 32132 MB
node 3 cpus: 6 7 38 39
node 3 size: 32254 MB
node 3 free: 32141 MB
node 4 cpus: 8 9 40 41
node 4 size: 32255 MB
node 4 free: 32137 MB
node 5 cpus: 10 11 42 43
node 5 size: 32254 MB
node 5 free: 32131 MB
node 6 cpus: 12 13 44 45
node 6 size: 32255 MB
node 6 free: 32098 MB
node 7 cpus: 14 15 46 47
```

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Platform Notes (Continued)

```

node 7 size: 32242 MB
node 7 free: 32129 MB
node 8 cpus: 16 17 48 49
node 8 size: 32255 MB
node 8 free: 32123 MB
node 9 cpus: 18 19 50 51
node 9 size: 32225 MB
node 9 free: 32112 MB
node 10 cpus: 20 21 52 53
node 10 size: 32255 MB
node 10 free: 32145 MB
node 11 cpus: 22 23 54 55
node 11 size: 32254 MB
node 11 free: 32139 MB
node 12 cpus: 24 25 56 57
node 12 size: 32255 MB
node 12 free: 32146 MB
node 13 cpus: 26 27 58 59
node 13 size: 32254 MB
node 13 free: 32146 MB
node 14 cpus: 28 29 60 61
node 14 size: 32255 MB
node 14 free: 32147 MB
node 15 cpus: 30 31 62 63
node 15 size: 32253 MB
node 15 free: 32145 MB
node distances:
node  0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
  0: 10 11 12 12 12 12 12 12 32 32 32 32 32 32 32 32
  1: 11 10 12 12 12 12 12 12 32 32 32 32 32 32 32 32
  2: 12 12 10 11 12 12 12 12 32 32 32 32 32 32 32 32
  3: 12 12 11 10 12 12 12 12 32 32 32 32 32 32 32 32
  4: 12 12 12 12 10 11 12 12 32 32 32 32 32 32 32 32
  5: 12 12 12 12 11 10 12 12 32 32 32 32 32 32 32 32
  6: 12 12 12 12 12 12 10 11 32 32 32 32 32 32 32 32
  7: 12 12 12 12 12 12 11 10 32 32 32 32 32 32 32 32
  8: 32 32 32 32 32 32 32 32 10 11 12 12 12 12 12 12
  9: 32 32 32 32 32 32 32 32 11 10 12 12 12 12 12 12
 10: 32 32 32 32 32 32 32 32 12 12 10 11 12 12 12 12
 11: 32 32 32 32 32 32 32 32 12 12 11 10 12 12 12 12
 12: 32 32 32 32 32 32 32 32 12 12 12 12 10 11 12 12
 13: 32 32 32 32 32 32 32 32 12 12 12 12 11 10 12 12
 14: 32 32 32 32 32 32 32 32 12 12 12 12 12 12 10 11
 15: 32 32 32 32 32 32 32 32 12 12 12 12 12 12 11 10

```

```

From /proc/meminfo
MemTotal: 527958680 kB

```

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Platform Notes (Continued)

HugePages_Total: 0
Hugepagesize: 2048 kB

From /etc/*release* /etc/*version*
os-release:

```
NAME="SLES"
VERSION="15-SP1"
VERSION_ID="15.1"
PRETTY_NAME="SUSE Linux Enterprise Server 15 SP1"
ID="sles"
ID_LIKE="suse"
ANSI_COLOR="0;32"
CPE_NAME="cpe:/o:suse:sles:15:sp1"
```

uname -a:

```
Linux linux-g3ob 4.12.14-195-default #1 SMP Tue May 7 10:55:11 UTC 2019 (8fba516)
x86_64 x86_64 x86_64 GNU/Linux
```

Kernel self-reported vulnerability status:

```
CVE-2017-5754 (Meltdown): Not affected
CVE-2017-5753 (Spectre variant 1): Mitigation: __user pointer sanitization
CVE-2017-5715 (Spectre variant 2): Mitigation: Full AMD retpoline, IBPB: conditional,
IBRS_FW, STIBP: conditional, RSB filling
```

run-level 3 Sep 11 14:48

SPEC is set to: /root/cpu2017-1.0.5

```
Filesystem      Type  Size  Used Avail Use% Mounted on
/dev/sda2       xfs   440G   20G  421G   5% /
```

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.

```
BIOS Dell Inc. 0.4.12 09/11/2019
Memory:
16x 802C869D802C 36ASF4G72PZ-3G2E2 32 GB 2 rank 3200
16x Not Specified Not Specified
```

(End of data from sysinfo program)

Compiler Version Notes

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

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Compiler Version Notes (Continued)

| 544.nab_r(base, peak)

```
-----
AOCCLLVM.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)

```
-----
AOCCLLVM.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++, C | 511.povray_r(base, peak) 526.blender_r(base, peak)

```
-----
AOCCLLVM.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
-----
```

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

```
-----
AOCCLLVM.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)
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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)
```

```
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
```

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

Base Compiler Invocation

C benchmarks:
clang

C++ benchmarks:
clang++

Fortran benchmarks:
flang

Benchmarks using both Fortran and C:
flang clang

(Continued on next page)



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Base Compiler Invocation (Continued)

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
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
```

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CPU2017 License: 55

Test Sponsor: Dell Inc.

Tested by: Dell Inc.

Test Date: Sep-2019

Hardware Availability: Oct-2019

Software Availability: Aug-2019

Base Optimization Flags (Continued)

C++ benchmarks (continued):

```
-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
-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
```

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Base Optimization Flags (Continued)

Benchmarks using Fortran, C, and C++ (continued):

```
-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++

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
```

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Peak Optimization Flags (Continued)

538.imagick_r (continued):

```

-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:

508.namd_r: basepeak = yes

510.parest_r: basepeak = yes

Fortran benchmarks:

503.bwaves_r: basepeak = yes

549.fotonik3d_r: basepeak = yes

```

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

```

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

```

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Peak Optimization Flags (Continued)

527.cam4_r (continued):

```

-mllvm -vector-library=LIBMVEC
-mllvm -reduce-array-computations=3
-mllvm -global-vectorize-slp -mllvm -inline-threshold=1000
-flv-function-specialization -O3 -funroll-loops
-Mrecursive -Kieeee -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: basepeak = yes

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-B1-rate-Dell.html>

<http://www.spec.org/cpu2017/flags/Dell-Platform-Flags-PowerEdge-revE4.2019-10-15.html>

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

<http://www.spec.org/cpu2017/flags/aocc200-flags-B1-rate-Dell.xml>

<http://www.spec.org/cpu2017/flags/Dell-Platform-Flags-PowerEdge-revE4.2019-10-15.xml>



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