SPEC CPU®2017 Floating Point Rate Result

Cisco Systems

Cisco UCS C225 M6 (AMD EPYC 7473X)

SPECrate®2017_fp_base = 254

SPECrate®2017_fp_peak = 259
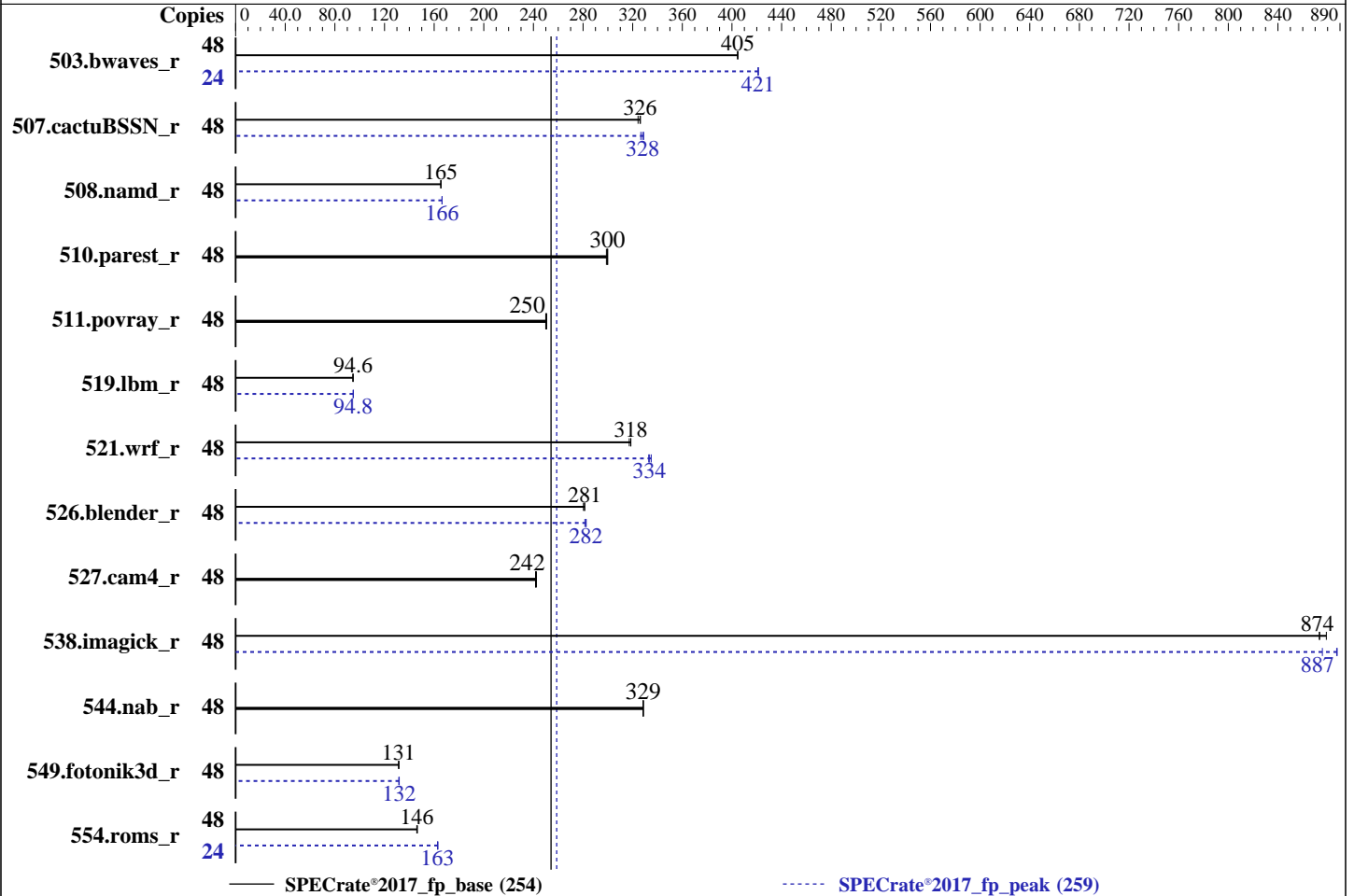
CPU2017 License: 9019
Test Sponsor: Cisco Systems
Tested by: Cisco Systems

Test Date: Apr-2022
Hardware Availability: Mar-2022
Software Availability: Dec-2021

Benchmark	Copies	base	peak
503.bwaves_r	48 / 24	405	421
507.cactuBSSN_r	48	326	328
508.namd_r	48	165	166
510.parest_r	48	300	
511.povray_r	48	250	
519.lbm_r	48	94.6	94.8
521.wrf_r	48	318	334
526.blender_r	48	281	282
527.cam4_r	48	242	
538.imagick_r	48	874	887
544.nab_r	48	329	
549.fotonik3d_r	48	131	132
554.roms_r	48 / 24	146	163

SPECrate®2017_fp_base (254)   SPECrate®2017_fp_peak (259)

Hardware

CPU Name: AMD EPYC 7473X
 Max MHz: 3700
 Nominal: 2800
Enabled: 24 cores, 1 chip, 2 threads/core
Orderable: 1 chips
Cache L1: 32 KB I + 32 KB D on chip per core
 L2: 512 KB I+D on chip per core
 L3: 768 MB I+D on chip per chip, 96 MB shared / 3 cores
 Other: None
Memory: 1 TB (8 x 128 GB 4Rx4 PC4-3200V-L)
Storage: 1 x 960 GB M.2 SSD SATA
Other: None

Software

OS: SUSE Linux Enterprise Server 15 SP2 (x86_64) kernel version 5.3.18-22-default
Compiler: C/C++/Fortran: Version 3.2.0 of AOCC
Parallel: No
Firmware: Version 4.2.1.30 released Feb-2022
File System: xfs
System State: Run level 3 (multi-user)
Base Pointers: 64-bit
Peak Pointers: 64-bit
Other: jemalloc: jemalloc memory allocator library v5.1.0
Power Management: BIOS and OS set to prefer performance at the cost of additional power usage

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Results Table

Benchmark	Base Copies	Base Seconds	Base Ratio	Base Seconds	Base Ratio	Base Seconds	Base Ratio	Peak Copies	Peak Seconds	Peak Ratio	Peak Seconds	Peak Ratio	Peak Seconds	Peak Ratio
503.bwaves_r	48	**1190**	**405**	1189	405	1190	405	24	571	421	**571**	**421**	572	421
507.cactuBSSN_r	48	187	324	**186**	**326**	186	326	48	185	329	186	327	**185**	**328**
508.namd_r	48	275	166	276	165	**276**	**165**	48	274	166	274	166	**274**	**166**
510.parest_r	48	420	299	**419**	**300**	419	300	48	420	299	**419**	**300**	419	300
511.povray_r	48	447	251	448	250	**448**	**250**	48	447	251	448	250	**448**	**250**
519.lbm_r	48	535	94.6	534	94.7	**535**	**94.6**	48	**534**	**94.8**	533	94.8	534	94.8
521.wrf_r	48	338	319	**338**	**318**	339	317	48	321	335	323	333	**322**	**334**
526.blender_r	48	260	281	261	280	**260**	**281**	48	260	281	**259**	**282**	259	282
527.cam4_r	48	346	242	347	242	**347**	**242**	48	346	242	347	242	**347**	**242**
538.imagick_r	48	**137**	**874**	136	879	137	873	48	134	888	**135**	**887**	136	876
544.nab_r	48	246	329	246	328	**246**	**329**	48	246	329	246	328	**246**	**329**
549.fotonik3d_r	48	1422	132	1423	131	**1423**	**131**	48	**1420**	**132**	1419	132	1422	132
554.roms_r	48	522	146	521	146	**522**	**146**	24	234	163	234	163	**234**	**163**

SPECrate®2017_fp_base =	**254**
SPECrate®2017_fp_peak =	**259**

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 limit
'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>

To limit dirty cache to 8% of memory, 'sysctl -w vm.dirty_ratio=8' run as root.
To limit swap usage to minimum necessary, 'sysctl -w vm.swappiness=1' run as root.
To free node-local memory and avoid remote memory usage,
'sysctl -w vm.zone_reclaim_mode=1' run as root.

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Operating System Notes (Continued)

```
To clear filesystem caches, 'sync; sysctl -w vm.drop_caches=3' run as root.
To disable address space layout randomization (ASLR) to reduce run-to-run
variability, 'sysctl -w kernel.randomize_va_space=0' run as root.

To enable Transparent Hugepages (THP) for all allocations,
'echo always > /sys/kernel/mm/transparent_hugepage/enabled' and
'echo always > /sys/kernel/mm/transparent_hugepage/defrag' run as root.
```

Environment Variables Notes

```
Environment variables set by runcpu before the start of the run:
LD_LIBRARY_PATH =
     "/home/cpu2017/amd_rate_aocc320_milanx_A_lib/lib;/home/cpu2017/amd_rate_
     aocc320_milanx_A_lib/lib32:"
MALLOC_CONF = "retain:true"
```

General Notes

```
Binaries were compiled on a system with 2x AMD EPYC 7742 CPU + 1TiB Memory using OpenSUSE 15.2

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 v4.8.2 in RHEL 7.4 (No options specified)
jemalloc 5.1.0 is available here:
https://github.com/jemalloc/jemalloc/releases/download/5.1.0/jemalloc-5.1.0.tar.bz2
```

Platform Notes

```
BIOS Configuration
 SMT Mode set to Auto
 NUMA nodes per socket set to NPS4
 ACPI SRAT L3 Cache As NUMA Domain set to Enabled
 DRAM Scrub Time set to Disabled
 Determinism Slider set to Power
 Memory Interleaving set to Disabledd
 APBDIS set to 1
```

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Standard Performance Evaluation Corporation (info@spec.org)

https://www.spec.org/

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Platform Notes (Continued)

```
Sysinfo program /home/cpu2017/bin/sysinfo
Rev: r6622 of 2021-04-07 982a61ec0915b55891ef0e16acafc64d
running on localhost Mon Apr  4 21:12:14 2022

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 7473X 24-Core Processor
      1  "physical id"s (chips)
      48 "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 : 24
      siblings  : 48
      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

From lscpu from util-linux 2.33.1:
      Architecture:        x86_64
      CPU op-mode(s):      32-bit, 64-bit
      Byte Order:          Little Endian
      Address sizes:       48 bits physical, 48 bits virtual
      CPU(s):              48
      On-line CPU(s) list: 0-47
      Thread(s) per core:  2
      Core(s) per socket:  24
      Socket(s):           1
      NUMA node(s):        8
      Vendor ID:           AuthenticAMD
      CPU family:          25
      Model:               1
      Model name:          AMD EPYC 7473X 24-Core Processor
      Stepping:            2
      CPU MHz:             1795.766
      CPU max MHz:         2800.0000
      CPU min MHz:         1500.0000
      BogoMIPS:            5589.69
      Virtualization:      AMD-V
      L1d cache:           32K
      L1i cache:           32K
      L2 cache:            512K
      L3 cache:            98304K
      NUMA node0 CPU(s):   0-2,24-26
      NUMA node1 CPU(s):   3-5,27-29
      NUMA node2 CPU(s):   6-8,30-32
      NUMA node3 CPU(s):   9-11,33-35
```

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Cisco Systems

Cisco UCS C225 M6 (AMD EPYC 7473X)

SPECrate®2017_fp_base = 254

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Platform Notes (Continued)

```
      NUMA node4 CPU(s):     12-14,36-38
      NUMA node5 CPU(s):     15-17,39-41
      NUMA node6 CPU(s):     18-20,42-44
      NUMA node7 CPU(s):     21-23,45-47
      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
   monitor ssse3 fma cx16 pcid 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_llc mwaitx cpb
   cat_l3 cdp_l3 invpcid_single hw_pstate ssbd mba ibrs ibpb stibp vmmcall fsgsbase
   bmi1 avx2 smep bmi2 invpcid 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 v_vmsave_vmload vgif
   umip pku ospke vaes vpclmulqdq 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 24 25 26
   node 0 size: 128805 MB
   node 0 free: 128564 MB
   node 1 cpus: 3 4 5 27 28 29
   node 1 size: 129020 MB
   node 1 free: 128832 MB
   node 2 cpus: 6 7 8 30 31 32
   node 2 size: 129022 MB
   node 2 free: 128802 MB
   node 3 cpus: 9 10 11 33 34 35
   node 3 size: 129020 MB
   node 3 free: 128827 MB
   node 4 cpus: 12 13 14 36 37 38
   node 4 size: 129022 MB
   node 4 free: 128774 MB
   node 5 cpus: 15 16 17 39 40 41
   node 5 size: 129020 MB
   node 5 free: 128840 MB
   node 6 cpus: 18 19 20 42 43 44
   node 6 size: 129022 MB
   node 6 free: 128825 MB
   node 7 cpus: 21 22 23 45 46 47
   node 7 size: 129008 MB
   node 7 free: 128824 MB
```

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Platform Notes (Continued)

```
  node distances:
  node   0   1   2   3   4   5   6   7
    0:  10  11  12  12  12  12  12  12
    1:  11  10  12  12  12  12  12  12
    2:  12  12  10  11  12  12  12  12
    3:  12  12  11  10  12  12  12  12
    4:  12  12  12  12  10  11  12  12
    5:  12  12  12  12  11  10  12  12
    6:  12  12  12  12  12  12  10  11
    7:  12  12  12  12  12  12  11  10

From /proc/meminfo
   MemTotal:       1056707532 kB
   HugePages_Total:        0
   Hugepagesize:        2048 kB

/sys/devices/system/cpu/cpu*/cpufreq/scaling_governor has
   performance

From /etc/*release* /etc/*version*
   os-release:
      NAME="SLES"
      VERSION="15-SP2"
      VERSION_ID="15.2"
      PRETTY_NAME="SUSE Linux Enterprise Server 15 SP2"
      ID="sles"
      ID_LIKE="suse"
      ANSI_COLOR="0;32"
      CPE_NAME="cpe:/o:suse:sles:15:sp2"

uname -a:
   Linux localhost 5.3.18-22-default #1 SMP Wed Jun 3 12:16:43 UTC 2020 (720aeba) x86_64
   x86_64 x86_64 GNU/Linux

Kernel self-reported vulnerability status:

CVE-2018-12207 (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/swapgs
                                             barriers and __user pointer
                                             sanitization
CVE-2017-5715 (Spectre variant 2):           Mitigation: Full AMD retpoline,
```

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Platform Notes (Continued)

```
                                          IBPB: conditional, IBRS_FW, STIBP:
                                          always-on, RSB filling
  CVE-2020-0543 (Special Register Buffer Data Sampling): Not affected
  CVE-2019-11135 (TSX Asynchronous Abort):               Not affected

  run-level 3 Apr 3 23:54

  SPEC is set to: /home/cpu2017
     Filesystem      Type  Size  Used Avail Use% Mounted on
     /dev/sdb2       xfs   223G  9.1G  214G   5% /

  From /sys/devices/virtual/dmi/id
     Vendor:         Cisco Systems Inc
     Product:        UCSC-C225-M6S
     Serial:         WZP252408JE

  Additional information from dmidecode 3.2 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:
      8x 0xCE00 M386AAG40AM3-CWE 128 GB 4 rank 3200
      24x Unknown Unknown

  BIOS:
     BIOS Vendor:       Cisco Systems, Inc.
     BIOS Version:      C225M6.4.2.1.30.0221222139
     BIOS Date:         02/21/2022
     BIOS Revision:     5.22

  (End of data from sysinfo program)
```

Compiler Version Notes

```
==============================================================================
C                 | 519.lbm_r(base, peak) 538.imagick_r(base, peak)
                  | 544.nab_r(base, peak)
------------------------------------------------------------------------------
AMD clang version 13.0.0 (CLANG: AOCC_3.2.0-Build#128 2021_11_12) (based on
  LLVM Mirror.Version.13.0.0)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /opt/AMD/aocc-compiler-3.2.0/bin
------------------------------------------------------------------------------


==============================================================================
```

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Compiler Version Notes (Continued)

```
C++            | 508.namd_r(base, peak) 510.parest_r(base, peak)
-------------------------------------------------------------------------------
AMD clang version 13.0.0 (CLANG: AOCC_3.2.0-Build#128 2021_11_12) (based on
  LLVM Mirror.Version.13.0.0)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /opt/AMD/aocc-compiler-3.2.0/bin
-------------------------------------------------------------------------------


===============================================================================
C++, C         | 511.povray_r(base, peak) 526.blender_r(base, peak)
-------------------------------------------------------------------------------
AMD clang version 13.0.0 (CLANG: AOCC_3.2.0-Build#128 2021_11_12) (based on
  LLVM Mirror.Version.13.0.0)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /opt/AMD/aocc-compiler-3.2.0/bin
AMD clang version 13.0.0 (CLANG: AOCC_3.2.0-Build#128 2021_11_12) (based on
  LLVM Mirror.Version.13.0.0)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /opt/AMD/aocc-compiler-3.2.0/bin
-------------------------------------------------------------------------------


===============================================================================
C++, C, Fortran | 507.cactuBSSN_r(base, peak)
-------------------------------------------------------------------------------
AMD clang version 13.0.0 (CLANG: AOCC_3.2.0-Build#128 2021_11_12) (based on
  LLVM Mirror.Version.13.0.0)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /opt/AMD/aocc-compiler-3.2.0/bin
AMD clang version 13.0.0 (CLANG: AOCC_3.2.0-Build#128 2021_11_12) (based on
  LLVM Mirror.Version.13.0.0)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /opt/AMD/aocc-compiler-3.2.0/bin
AMD clang version 13.0.0 (CLANG: AOCC_3.2.0-Build#128 2021_11_12) (based on
  LLVM Mirror.Version.13.0.0)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /opt/AMD/aocc-compiler-3.2.0/bin
-------------------------------------------------------------------------------


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

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Compiler Version Notes (Continued)

```
--------------------------------------------------------------------------
AMD clang version 13.0.0 (CLANG: AOCC_3.2.0-Build#128 2021_11_12) (based on
  LLVM Mirror.Version.13.0.0)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /opt/AMD/aocc-compiler-3.2.0/bin
--------------------------------------------------------------------------


==========================================================================
Fortran, C      | 521.wrf_r(base, peak) 527.cam4_r(base, peak)
--------------------------------------------------------------------------
AMD clang version 13.0.0 (CLANG: AOCC_3.2.0-Build#128 2021_11_12) (based on
  LLVM Mirror.Version.13.0.0)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /opt/AMD/aocc-compiler-3.2.0/bin
AMD clang version 13.0.0 (CLANG: AOCC_3.2.0-Build#128 2021_11_12) (based on
  LLVM Mirror.Version.13.0.0)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /opt/AMD/aocc-compiler-3.2.0/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
```

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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:
-m64 -flto -Wl,-mllvm -Wl,-region-vectorize
-Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3
-Wl,-mllvm -Wl,-enable-loop-fusion -O3 -march=znver3 -fveclib=AMDLIBM
-ffast-math -fstruct-layout=5 -mllvm -unroll-threshold=50
-mllvm -inline-threshold=1000 -fremap-arrays
-mllvm -function-specialize -flv-function-specialization
-mllvm -enable-gvn-hoist -mllvm -global-vectorize-slp=true
-mllvm -enable-licm-vrp -mllvm -reduce-array-computations=3
-mllvm -enable-loop-fusion -z muldefs -lamdlibm -ljemalloc -lflang

C++ benchmarks:
-m64 -std=c++98 -mno-adx -mno-sse4a
-Wl,-mllvm -Wl,-x86-use-vzeroupper=false -flto
-Wl,-mllvm -Wl,-region-vectorize -Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3
-Wl,-mllvm -Wl,-enable-loop-fusion -O3 -march=znver3 -fveclib=AMDLIBM
-ffast-math -mllvm -enable-partial-unswitch
-mllvm -unroll-threshold=100 -finline-aggressive
-flv-function-specialization -mllvm -loop-unswitch-threshold=200000
-mllvm -reroll-loops -mllvm -aggressive-loop-unswitch
-mllvm -extra-vectorizer-passes -mllvm -reduce-array-computations=3
-mllvm -global-vectorize-slp=true -mllvm -convert-pow-exp-to-int=false
-mllvm -enable-loop-fusion -z muldefs -lamdlibm -ljemalloc -lflang

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Cisco Systems

Cisco UCS C225 M6 (AMD EPYC 7473X)

SPECrate®2017_fp_base = 254

SPECrate®2017_fp_peak = 259

CPU2017 License: 9019
Test Sponsor: Cisco Systems
Tested by: Cisco Systems

Test Date: Apr-2022
Hardware Availability: Mar-2022
Software Availability: Dec-2021

Base Optimization Flags (Continued)

Fortran benchmarks:
```
-m64 -Wl,-mllvm -Wl,-enable-X86-prefetching
-Wl,-mllvm -Wl,-enable-licm-vrp -flto -Wl,-mllvm -Wl,-region-vectorize
-Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3
-Wl,-mllvm -Wl,-enable-loop-fusion -Hz,1,0x1 -O3 -march=znver3
-fveclib=AMDLIBM -ffast-math -Kieee -Mrecursive
-mllvm -fuse-tile-inner-loop -funroll-loops
-mllvm -extra-vectorizer-passes -mllvm -lsr-in-nested-loop
-mllvm -enable-licm-vrp -mllvm -reduce-array-computations=3
-mllvm -global-vectorize-slp=true -mllvm -enable-loop-fusion
-mllvm -enable-loopinterchange -mllvm -compute-interchange-order
-z muldefs -lamdlibm -ljemalloc -lflang
```

Benchmarks using both Fortran and C:
```
-m64 -Wl,-mllvm -Wl,-enable-X86-prefetching
-Wl,-mllvm -Wl,-enable-licm-vrp -flto -Wl,-mllvm -Wl,-region-vectorize
-Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3
-Wl,-mllvm -Wl,-enable-loop-fusion -O3 -march=znver3 -fveclib=AMDLIBM
-ffast-math -fstruct-layout=5 -mllvm -unroll-threshold=50
-mllvm -inline-threshold=1000 -fremap-arrays
-mllvm -function-specialize -flv-function-specialization
-mllvm -enable-gvn-hoist -mllvm -global-vectorize-slp=true
-mllvm -enable-licm-vrp -mllvm -reduce-array-computations=3
-mllvm -enable-loop-fusion -Hz,1,0x1 -Kieee -Mrecursive
-mllvm -fuse-tile-inner-loop -funroll-loops
-mllvm -extra-vectorizer-passes -mllvm -lsr-in-nested-loop
-mllvm -enable-loopinterchange -mllvm -compute-interchange-order
-z muldefs -lamdlibm -ljemalloc -lflang
```

Benchmarks using both C and C++:
```
-m64 -std=c++98 -mno-adx -mno-sse4a
-Wl,-mllvm -Wl,-x86-use-vzeroupper=false -flto
-Wl,-mllvm -Wl,-region-vectorize -Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3
-Wl,-mllvm -Wl,-enable-loop-fusion -O3 -march=znver3 -fveclib=AMDLIBM
-ffast-math -fstruct-layout=5 -mllvm -unroll-threshold=50
-mllvm -inline-threshold=1000 -fremap-arrays
-mllvm -function-specialize -flv-function-specialization
-mllvm -enable-gvn-hoist -mllvm -global-vectorize-slp=true
-mllvm -enable-licm-vrp -mllvm -reduce-array-computations=3
-mllvm -enable-loop-fusion -mllvm -enable-partial-unswitch
```

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Base Optimization Flags (Continued)

Benchmarks using both C and C++ (continued):
```
-mllvm -unroll-threshold=100 -finline-aggressive
-mllvm -loop-unswitch-threshold=200000 -mllvm -reroll-loops
-mllvm -aggressive-loop-unswitch -mllvm -extra-vectorizer-passes
-mllvm -convert-pow-exp-to-int=false -z muldefs -lamdlibm -ljemalloc
-lflang
```

Benchmarks using Fortran, C, and C++:
```
-m64 -std=c++98 -mno-adx -mno-sse4a
-Wl,-mllvm -Wl,-x86-use-vzeroupper=false -flto
-Wl,-mllvm -Wl,-region-vectorize -Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3
-Wl,-mllvm -Wl,-enable-loop-fusion -O3 -march=znver3 -fveclib=AMDLIBM
-ffast-math -fstruct-layout=5 -mllvm -unroll-threshold=50
-mllvm -inline-threshold=1000 -fremap-arrays
-mllvm -function-specialize -flv-function-specialization
-mllvm -enable-gvn-hoist -mllvm -global-vectorize-slp=true
-mllvm -enable-licm-vrp -mllvm -reduce-array-computations=3
-mllvm -enable-loop-fusion -mllvm -enable-partial-unswitch
-mllvm -unroll-threshold=100 -finline-aggressive
-mllvm -loop-unswitch-threshold=200000 -mllvm -reroll-loops
-mllvm -aggressive-loop-unswitch -mllvm -extra-vectorizer-passes
-mllvm -convert-pow-exp-to-int=false -Hz,1,0x1 -Kieee -Mrecursive
-mllvm -fuse-tile-inner-loop -funroll-loops -mllvm -lsr-in-nested-loop
-mllvm -enable-loopinterchange -mllvm -compute-interchange-order
-z muldefs -lamdlibm -ljemalloc -lflang
```

Base Other Flags

C benchmarks:
```
-Wno-unused-command-line-argument
```

C++ benchmarks:
```
-Wno-unused-command-line-argument
```

Fortran benchmarks:
```
-Wno-unused-command-line-argument
```

Benchmarks using both Fortran and C:
```
-Wno-unused-command-line-argument
```

Benchmarks using both C and C++:
```
-Wno-unused-command-line-argument
```

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Base Other Flags (Continued)

Benchmarks using Fortran, C, and C++:
```
-Wno-unused-command-line-argument
```

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: -m64 -flto -Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3 -Ofast
-march=znver3 -fveclib=AMDLIBM -ffast-math
-fstruct-layout=7 -mllvm -unroll-threshold=50
-fremap-arrays -flv-function-specialization
-mllvm -inline-threshold=1000 -mllvm -enable-gvn-hoist
```

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Peak Optimization Flags (Continued)

519.lbm_r (continued):
```
-mllvm -global-vectorize-slp=true
-mllvm -function-specialize -mllvm -enable-licm-vrp
-mllvm -reduce-array-computations=3 -lamdlibm -ljemalloc
```

538.imagick_r: `Same as 519.lbm_r`

544.nab_r: `basepeak = yes`

C++ benchmarks:

508.namd_r: `-m64 -std=c++98 -mno-adx -mno-sse4a`
```
-Wl,-mllvm -Wl,-x86-use-vzeroupper=false
-Wl,-mllvm -Wl,-enable-licm-vrp -flto
-Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3 -Ofast
-march=znver3 -fveclib=AMDLIBM -ffast-math
-finline-aggressive -mllvm -unroll-threshold=100
-flv-function-specialization -mllvm -enable-licm-vrp
-mllvm -reroll-loops -mllvm -aggressive-loop-unswitch
-mllvm -reduce-array-computations=3
-mllvm -global-vectorize-slp=true -lamdlibm -ljemalloc
```

510.parest_r: `basepeak = yes`

Fortran benchmarks:

503.bwaves_r: `-m64 -Wl,-mllvm -Wl,-enable-X86-prefetching`
```
-Wl,-mllvm -Wl,-enable-licm-vrp -flto
-Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3 -Ofast
-march=znver3 -fveclib=AMDLIBM -ffast-math -Mrecursive
-mllvm -reduce-array-computations=3
-mllvm -global-vectorize-slp=true -mllvm -enable-licm-vrp
-lamdlibm -ljemalloc -lflang
```

549.fotonik3d_r: `-m64 -Wl,-mllvm -Wl,-enable-X86-prefetching`
```
-Wl,-mllvm -Wl,-enable-licm-vrp -flto
-Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3 -Ofast
-march=znver3 -fveclib=AMDLIBM -ffast-math -Kieee
-Mrecursive -mllvm -reduce-array-computations=3
-mllvm -global-vectorize-slp=true -mllvm -enable-licm-vrp
```

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Peak Optimization Flags (Continued)

549.fotonik3d_r (continued):
```
-lamdlibm -ljemalloc -lflang
```

554.roms_r: `-m64 -Wl,-mllvm -Wl,-enable-X86-prefetching`
```
-Wl,-mllvm -Wl,-enable-licm-vrp -flto
-Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3 -Ofast
-march=znver3 -fveclib=AMDLIBM -ffast-math -Mrecursive
-mllvm -reduce-array-computations=3
-mllvm -global-vectorize-slp=true -mllvm -enable-licm-vrp
-Hz,1,0x1 -mllvm -fuse-tile-inner-loop -lamdlibm
-ljemalloc -lflang
```

Benchmarks using both Fortran and C:

521.wrf_r: `-m64 -Wl,-mllvm -Wl,-enable-X86-prefetching`
```
-Wl,-mllvm -Wl,-enable-licm-vrp -flto
-Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3 -Ofast
-march=znver3 -fveclib=AMDLIBM -ffast-math
-fstruct-layout=7 -mllvm -unroll-threshold=50
-fremap-arrays -flv-function-specialization
-mllvm -inline-threshold=1000 -mllvm -enable-gvn-hoist
-mllvm -global-vectorize-slp=true
-mllvm -function-specialize -mllvm -enable-licm-vrp
-mllvm -reduce-array-computations=3 -Mrecursive -lamdlibm
-ljemalloc -lflang
```

527.cam4_r: `basepeak = yes`

Benchmarks using both C and C++:

511.povray_r: `basepeak = yes`

526.blender_r: `-m64 -std=c++98 -mno-adx -mno-sse4a`
```
-Wl,-mllvm -Wl,-x86-use-vzeroupper=false
-Wl,-mllvm -Wl,-enable-licm-vrp -flto
-Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3 -Ofast
-march=znver3 -fveclib=AMDLIBM -ffast-math
-fstruct-layout=7 -mllvm -unroll-threshold=50
-fremap-arrays -flv-function-specialization
-mllvm -inline-threshold=1000 -mllvm -enable-gvn-hoist
```

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Peak Optimization Flags (Continued)

526.blender_r (continued):
```
-mllvm -global-vectorize-slp=true
-mllvm -function-specialize -mllvm -enable-licm-vrp
-mllvm -reduce-array-computations=3 -finline-aggressive
-mllvm -unroll-threshold=100 -mllvm -reroll-loops
-mllvm -aggressive-loop-unswitch -lamdlibm -ljemalloc
```

Benchmarks using Fortran, C, and C++:
```
-m64 -std=c++98 -mno-adx -mno-sse4a
-Wl,-mllvm -Wl,-x86-use-vzeroupper=false -Wl,-mllvm -Wl,-enable-licm-vrp
-flto -Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3 -Ofast -march=znver3
-fveclib=AMDLIBM -ffast-math -fstruct-layout=7
-mllvm -unroll-threshold=50 -fremap-arrays -flv-function-specialization
-mllvm -inline-threshold=1000 -mllvm -enable-gvn-hoist
-mllvm -global-vectorize-slp=true -mllvm -function-specialize
-mllvm -enable-licm-vrp -mllvm -reduce-array-computations=3
-mllvm -unroll-threshold=100 -mllvm -loop-unswitch-threshold=200000
-finline-aggressive -mllvm -reroll-loops
-mllvm -aggressive-loop-unswitch -mllvm -extra-vectorizer-passes
-mllvm -convert-pow-exp-to-int=false -Mrecursive -lamdlibm -ljemalloc
-lflang
```

Peak Other Flags

C benchmarks:
```
-Wno-unused-command-line-argument
```

C++ benchmarks:
```
-Wno-unused-command-line-argument
```

Fortran benchmarks:
```
-Wno-unused-command-line-argument
```

Benchmarks using both Fortran and C:
```
-Wno-unused-command-line-argument
```

Benchmarks using both C and C++:
```
-Wno-unused-command-line-argument
```

Benchmarks using Fortran, C, and C++:
```
-Wno-unused-command-line-argument
```

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The flags files that were used to format this result can be browsed at
http://www.spec.org/cpu2017/flags/aocc320-flags-A1.html
http://www.spec.org/cpu2017/flags/Cisco-Platform-Settings-AMD-v2-revD.html

You can also download the XML flags sources by saving the following links:
http://www.spec.org/cpu2017/flags/aocc320-flags-A1.xml
http://www.spec.org/cpu2017/flags/Cisco-Platform-Settings-AMD-v2-revD.xml

For questions about this result, please contact the tester. For other inquiries, please contact info@spec.org.

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