SPEC CPU®2017 Floating Point Speed Result

Copyright 2017-2019 Standard Performance Evaluation Corporation

Hewlett Packard Enterprise

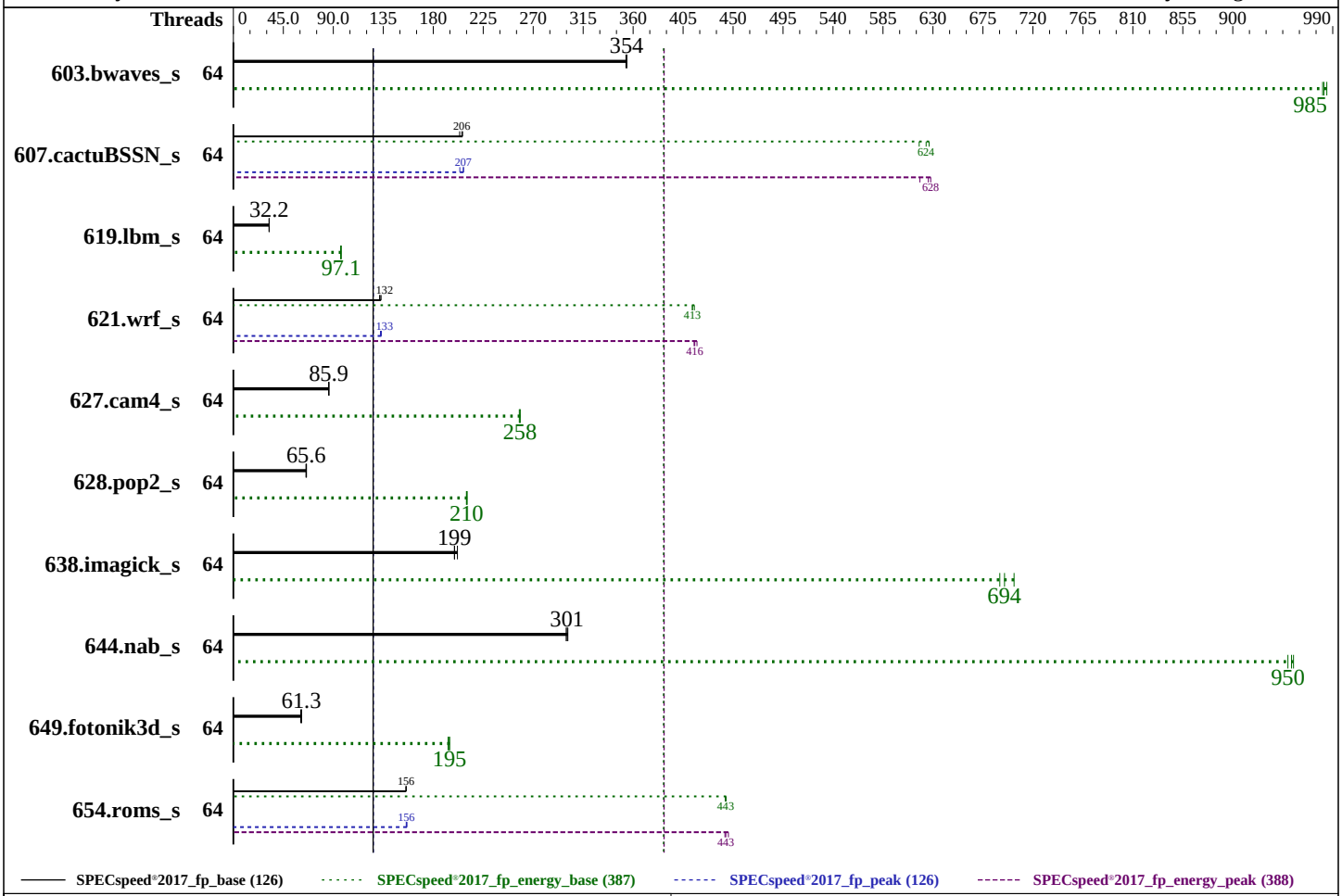
(Test Sponsor: HPE)

ProLiant DL325 Gen10
(2.00 GHz, AMD EPYC 7702P)

SPECspeed®2017_fp_base =	126
SPECspeed®2017_fp_energy_base =	387
SPECspeed®2017_fp_peak =	126
SPECspeed®2017_fp_energy_peak =	388

CPU2017 License: 003
Test Sponsor: HPE
Tested by: HPE

Test Date: Aug-2019
Hardware Availability: Oct-2019
Software Availability: Aug-2019



Hardware

CPU Name:	AMD EPYC 7702P
Max MHz:	3350
Nominal:	2000
Enabled:	64 cores, 1 chip
Orderable:	1 chip
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 / 4 cores
Other:	None
Memory:	256 GB (8 x 32 GB 2Rx4 PC4-2933Y-L)
Storage:	1 x HPE 480 GB SATA 6G SSD
Other:	None

Software

OS:	SUSE Linux Enterprise Server 15 (x86_64) SP1 Kernel 4.12.14-195-default
Compiler:	C/C++/Fortran: Version 2.0.0 of AOCC
Parallel:	Yes
Firmware:	HPE BIOS Version A41 07/20/2019 released Aug-2019
File System:	btrfs
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:	Disabled

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Software Availability: Aug-2019

Power

Max. Power (W): 400.27
Idle Power (W): 191.07
Min. Temperature (C): 20.75
Elevation (m): 132
Line Standard: 208 V / 60 Hz / 1 phase / 2 wires
Provisioning: Line-powered

Power Settings

Management FW: Version 1.43 of iLO5 released May 23 2019
Memory Mode: Normal

Power-Relevant Hardware

Power Supply: 1 x 800 W (non-redundant)
Details: HPE 800W Flex Slot Titanium Hot Plug Low Halogen Power Supply Kit (865438-B21)
Backplane: 8 SFF NVMe with optional optical drive
Other Storage: Embedded SATA Controller
Storage Model #s: P05976-B21
NICs Installed: 1 x HPE Ethernet 4-port 331i Adapter @ 1 Gb
NICs Enabled (FW/OS): 4 / 4
NICs Connected/Speed: 2 @ 1 Gb
Other HW Model #s: 7 x High Performance fans

Power Analyzer

Power Analyzer: 10.216.1.15:8888
Hardware Vendor: Yokogawa
Model: YokogawaWT210
Serial Number: 91K308562
Input Connection: GPIB via NI GIPB-USB-HS
Metrology Institute: NIST
Calibration By: TRANSCAT
Calibration Label: 5-E553M-20-1
Calibration Date: 21-May-2019
PTDaemon™ Version: 1.9.1 (a2d19f26; 2019-07-17)
Setup Description: SUT Power Supply 1 via neoXt NXB 20815
Current Ranges Used: 1A, 2A
Voltage Range Used: 300V

Temperature Meter

Temperature Meter: 10.216.1.15:8889
Hardware Vendor: Digi International Inc.
Model: DigiWATCHPORT_H
Serial Number: V45297862
Input Connection: USB
PTDaemon Version: 1.9.1 (a2d19f26; 2019-07-17)
Setup Description: 5 mm in front of SUT main intake

Base Results Table

Benchmark	Threads	Seconds	Ratio	Energy (kJ)	Energy Ratio	Average Power	Maximum Power	Seconds	Ratio	Energy (kJ)	Energy Ratio	Average Power	Maximum Power	Seconds	Ratio	Energy (kJ)	Energy Ratio	Average Power	Maximum Power
603.bwaves_s	64	**167**	**354**	**65.4**	**985**	**392**	**399**	167	354	65.6	981	394	399	167	354	65.5	982	393	399
607.cactuBSSN_s	64	**81.0**	**206**	**29.2**	**624**	**361**	**376**	81.8	204	29.5	618	361	376	80.8	206	29.1	627	360	376
619.lbm_s	64	**163**	**32.2**	**61.3**	**97.1**	**377**	**383**	162	32.3	61.4	97.0	378	384	163	32.2	61.6	96.6	378	384
621.wrf_s	64	100	132	34.9	413	348	359	**100**	**132**	**34.9**	**413**	**349**	**359**	99.4	133	34.8	415	350	359
627.cam4_s	64	103	86.0	37.3	258	362	394	**103**	**85.9**	**37.4**	**258**	**362**	**393**	103	85.9	37.5	257	363	394
628.pop2_s	64	**181**	**65.6**	**62.1**	**210**	**343**	**355**	182	65.4	62.2	210	342	355	180	65.8	62.0	211	344	357
638.imagick_s	64	**72.4**	**199**	**22.6**	**694**	**313**	**358**	71.5	202	22.4	703	313	351	72.5	199	22.8	690	314	350
644.nab_s	64	58.0	301	19.9	955	343	356	58.3	300	19.9	953	342	356	**58.1**	**301**	**20.0**	**950**	**344**	**356**
649.fotonik3d_s	64	149	61.4	52.6	194	354	381	**149**	**61.3**	**52.6**	**195**	**353**	**380**	150	60.7	52.9	193	353	380
654.roms_s	64	101	156	39.7	443	393	399	101	155	39.7	444	391	398	**101**	**156**	**39.7**	**443**	**392**	**398**

SPECspeed®2017_fp_base = 126

SPECspeed®2017_fp_energy_base = 387

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

Hewlett Packard Enterprise

(Test Sponsor: HPE)

ProLiant DL325 Gen10 (2.00 GHz, AMD EPYC 7702P)

SPECspeed®2017_fp_base =	126
SPECspeed®2017_fp_energy_base =	387
SPECspeed®2017_fp_peak =	126
SPECspeed®2017_fp_energy_peak =	388

CPU2017 License: 003
Test Sponsor: HPE
Tested by: HPE

Test Date: Aug-2019
Hardware Availability: Oct-2019
Software Availability: Aug-2019

Peak Results Table

Benchmark	Threads	Seconds	Ratio	Energy (kJ)	Energy Ratio	Average Power	Maximum Power	Seconds	Ratio	Energy (kJ)	Energy Ratio	Average Power	Maximum Power	Seconds	Ratio	Energy (kJ)	Energy Ratio	Average Power	Maximum Power
603.bwaves_s	64	**167**	**354**	**65.4**	**985**	**392**	**399**	167	354	65.6	981	394	399	167	354	65.5	982	393	399
607.cactuBSSN_s	64	80.4	207	29.1	626	362	377	81.7	204	29.5	618	361	376	**80.5**	**207**	**29.0**	**628**	**361**	**376**
619.lbm_s	64	**163**	**32.2**	**61.3**	**97.1**	**377**	**383**	162	32.3	61.4	97.0	378	384	163	32.2	61.6	96.6	378	384
621.wrf_s	64	99.8	132	34.8	415	349	358	99.2	133	34.6	417	349	358	**99.5**	**133**	**34.8**	**416**	**349**	**359**
627.cam4_s	64	103	86.0	37.3	258	362	394	**103**	**85.9**	**37.4**	**258**	**362**	**393**	103	85.9	37.5	257	363	394
628.pop2_s	64	**181**	**65.6**	**62.1**	**210**	**343**	**355**	182	65.4	62.2	210	342	355	180	65.8	62.0	211	344	357
638.imagick_s	64	**72.4**	**199**	**22.6**	**694**	**313**	**358**	71.5	202	22.4	703	313	351	72.5	199	22.8	690	314	350
644.nab_s	64	58.0	301	19.9	955	343	356	58.3	300	19.9	953	342	356	**58.1**	**301**	**20.0**	**950**	**344**	**356**
649.fotonik3d_s	64	149	61.4	52.6	194	354	381	**149**	**61.3**	**52.6**	**195**	**353**	**380**	150	60.7	52.9	193	353	380
654.roms_s	64	**101**	**156**	**39.7**	**443**	**393**	**399**	101	156	39.5	446	392	399	101	156	39.8	443	393	399

SPECspeed®2017_fp_peak = **126**

SPECspeed®2017_fp_energy_peak = **388**

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

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:
GOMP_CPU_AFFINITY = "0-63"
LD_LIBRARY_PATH =
     "/cpu2017/amd_speed_aocc200_rome_C_lib/64;/cpu2017/amd_speed_aocc200_rom
     e_C_lib/32:"
MALLOC_CONF = "retain:true"
OMP_DYNAMIC = "false"
OMP_SCHEDULE = "static"
OMP_STACKSIZE = "128M"
OMP_THREAD_LIMIT = "64"

Environment variables set by runcpu during the 607.cactuBSSN_s peak run:
GOMP_CPU_AFFINITY = "0-63"

Environment variables set by runcpu during the 621.wrf_s peak run:
GOMP_CPU_AFFINITY = "0-63"

Environment variables set by runcpu during the 654.roms_s peak run:
GOMP_CPU_AFFINITY = "0-63"
```

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 5.1.0 is available here:
https://github.com/jemalloc/jemalloc/releases/download/5.1.0/jemalloc-5.1.0.tar.bz2


Submitted_by: "Bucek, James" <james.bucek@hpe.com>
Submitted: Tue Sep 17 00:02:18 EDT 2019
Submission: cpu2017-20190903-17798.sub

Submitted_by: "Bucek, James" <james.bucek@hpe.com>
Submitted: Tue Sep 17 09:00:11 EDT 2019
Submission: cpu2017-20190903-17798.sub
```

Platform Notes

```
BIOS Configuration:
 AMD SMT Option set to Disabled
 Thermal Configuration set to Maximum Cooling
 Determinism Control set to Manual
 Performance Determinism set to Power Deterministic
 Memory Patrol Scrubbing set to Disabled
 NUMA memory domains per socket set to Four memory domains per socket
 Workload Profile set to General Peak Frequency Compute
 Minimum Processor Idle Power Core C-State set to C6 State

 Sysinfo program /cpu2017/bin/sysinfo
 Rev: r6365 of 2019-08-21 295195f888a3d7edb1e6e46a485a0011
 running on dl325gen10 Sat Aug 31 19:41:38 2019

 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 7702P 64-Core Processor
       1  "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 : 64
       siblings  : 64
       physical 0: cores 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
       25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52
       53 54 55 56 57 58 59 60 61 62 63

 From lscpu:
      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):              64
      On-line CPU(s) list: 0-63
      Thread(s) per core:  1
      Core(s) per socket:  64
      Socket(s):           1
      NUMA node(s):        4
      Vendor ID:           AuthenticAMD
      CPU family:          23
      Model:               49
      Model name:          AMD EPYC 7702P 64-Core Processor
```

(Continued on next page)

Platform Notes (Continued)

```
      Stepping:              0
      CPU MHz:               2000.000
      CPU max MHz:           2000.0000
      CPU min MHz:           1500.0000
      BogoMIPS:              3992.33
      Virtualization:        AMD-V
      L1d cache:             32K
      L1i cache:             32K
      L2 cache:              512K
      L3 cache:              16384K
      NUMA node0 CPU(s):     0-15
      NUMA node1 CPU(s):     16-31
      NUMA node2 CPU(s):     32-47
      NUMA node3 CPU(s):     48-63
      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 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 ssbd 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 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: 4 nodes (0-3)
    node 0 cpus: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
    node 0 size: 64290 MB
    node 0 free: 64154 MB
    node 1 cpus: 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
    node 1 size: 64507 MB
    node 1 free: 64367 MB
    node 2 cpus: 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47
    node 2 size: 64507 MB
    node 2 free: 64211 MB
    node 3 cpus: 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63
    node 3 size: 64465 MB
    node 3 free: 64330 MB
    node distances:
```

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Platform Notes (Continued)

```
  node   0   1   2   3
    0:  10  12  12  12
    1:  12  10  12  12
    2:  12  12  10  12
    3:  12  12  12  10

From /proc/meminfo
   MemTotal:       263958144 kB
   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 dl325gen10 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-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: __user pointer sanitization
CVE-2017-5715 (Spectre variant 2):        Mitigation: Full AMD retpoline, IBPB:
                                          conditional, IBRS_FW, STIBP: disabled, RSB
                                          filling

run-level 3 Aug 31 13:56

SPEC is set to: /cpu2017
   Filesystem     Type   Size  Used Avail Use% Mounted on
   /dev/sda2      btrfs   40G   11G   29G  28% /

From /sys/devices/virtual/dmi/id
```

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Platform Notes (Continued)

```
     BIOS:    HPE A41 07/20/2019
     Vendor:  HPE
     Product: ProLiant DL325 Gen10
     Product Family: ProLiant
     Serial:  CN781302PS

 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:
     8x UNKNOWN NOT AVAILABLE
     8x UNKNOWN NOT AVAILABLE 32 GB 2 rank 2933

 (End of data from sysinfo program)
```

Power Settings Notes

```
PTDaemon to measure power and temperature was run on a ProLiant DL360 Gen9 as a controller
with 2x Intel Xeon E5-2660 v3 CPU and 128 GB of memory using Windows Server 2012 R2.
Power management in the OS was disabled by setting Linux CPU governor to performance for all cores:
 cpupower frequency-set -r -g performance
Power management in the BIOS was default except for any settings mentioned in BIOS Configuration.
No power management settings were set in the management firmware.
The optional optical drive was not installed.
The system was configured with 7 HPE Small Form Factor Hard Drive Blanks (666987-B21), 8 DIMM blanks
2 high performance heatsinks and baffles that fit over the high performance
heatsinks in order to produce correct airflow and cooling.
The run was started and observed through the management firmware.
The Embedded SATA controller was the HPE Smart Array S100i SR Gen10 SW RAID.
```

Compiler Version Notes

```
==============================================================================
C               | 619.lbm_s(base, peak) 638.imagick_s(base, peak)
                | 644.nab_s(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
------------------------------------------------------------------------------
```

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Compiler Version Notes (Continued)

```
==============================================================================
C++, C, Fortran | 607.cactuBSSN_s(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
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
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
------------------------------------------------------------------------------

==============================================================================
Fortran         | 603.bwaves_s(base, peak) 649.fotonik3d_s(base, peak)
                | 654.roms_s(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      | 621.wrf_s(base, peak) 627.cam4_s(base, peak)
                | 628.pop2_s(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
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
```

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Compiler Version Notes (Continued)

```
InstalledDir: /sppo/dev/compilers/aocc-compiler-2.0.0/bin
------------------------------------------------------------------------------
```

Base Compiler Invocation

C benchmarks:
clang

Fortran benchmarks:
flang

Benchmarks using both Fortran and C:
flang clang

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

Base Portability Flags

603.bwaves_s: -DSPEC_LP64
607.cactuBSSN_s: -DSPEC_LP64
619.lbm_s: -DSPEC_LP64
621.wrf_s: -DSPEC_CASE_FLAG -Mbyteswapio -DSPEC_LP64
627.cam4_s: -DSPEC_CASE_FLAG -DSPEC_LP64
628.pop2_s: -DSPEC_CASE_FLAG -Mbyteswapio -DSPEC_LP64
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:
-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

(Continued on next page)

Base Optimization Flags (Continued)

C benchmarks (continued):
-mllvm -vector-library=LIBMVEC -mllvm -inline-threshold=1000
-flv-function-specialization -z muldefs -DSPEC_OPENMP -fopenmp
-DUSE_OPENMP -fopenmp=libomp -lomp -lpthread -ldl -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 -DSPEC_OPENMP -fopenmp -DUSE_OPENMP
-fopenmp=libomp -lomp -lpthread -ldl -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
-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 -funroll-loops -Mrecursive -z muldefs
-Kieee -fno-finite-math-only -DSPEC_OPENMP -fopenmp -DUSE_OPENMP
-fopenmp=libomp -lomp -lpthread -ldl -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 -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 -mllvm -loop-unswitch-threshold=200000
-mllvm -unroll-threshold=100 -mllvm -enable-partial-unswitch
-funroll-loops -Mrecursive -z muldefs -Kieee -fno-finite-math-only
-DSPEC_OPENMP -fopenmp -DUSE_OPENMP -fopenmp=libomp -lomp -lpthread
-ldl -lmvec -lamdlibm -ljemalloc -lflang

Base Other Flags

C benchmarks:
`-Wno-return-type`

Fortran benchmarks:
`-Wno-return-type`

Benchmarks using both Fortran and C:
`-Wno-return-type`

Benchmarks using Fortran, C, and C++:
`-Wno-return-type`

Peak Compiler Invocation

C benchmarks:
`clang`

Fortran benchmarks:
`flang`

Benchmarks using both Fortran and C:
`flang clang`

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

Peak Portability Flags

`Same as Base Portability Flags`

Peak Optimization Flags

C benchmarks:

619.lbm_s: `basepeak = yes`

(Continued on next page)

Peak Optimization Flags (Continued)

638.imagick_s: basepeak = yes

644.nab_s: basepeak = yes

Fortran benchmarks:

603.bwaves_s: basepeak = yes

649.fotonik3d_s: basepeak = yes

654.roms_s: -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 -DSPEC_OPENMP -fopenmp
-DUSE_OPENMP -fopenmp=libomp -lomp -lpthread -ldl
-lmvec -lamdlibm -ljemalloc -lflang

Benchmarks using both Fortran and C:

621.wrf_s: -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 -DSPEC_OPENMP
-fopenmp -DUSE_OPENMP -fopenmp=libomp -lomp -lpthread
-ldl -lmvec -lamdlibm -ljemalloc -lflang

627.cam4_s: basepeak = yes

628.pop2_s: basepeak = yes

Benchmarks using Fortran, C, and C++:
-std=c++98 -flto -Wl,-mllvm -Wl,-function-specialize

(Continued on next page)

Peak Optimization Flags (Continued)

Benchmarks using Fortran, C, and C++ (continued):
-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 -mllvm -unroll-threshold=100
-mllvm -enable-partial-unswitch -mllvm -loop-unswitch-threshold=200000
-O3 -funroll-loops -Mrecursive -Kieee -fno-finite-math-only
-DSPEC_OPENMP -fopenmp -DUSE_OPENMP -fopenmp=libomp -lomp -lpthread
-ldl -lmvec -lamdlibm -ljemalloc -lflang

Peak Other Flags

C benchmarks:
-Wno-return-type

Fortran benchmarks:
-Wno-return-type

Benchmarks using both Fortran and C:
-Wno-return-type

Benchmarks using Fortran, C, and C++:
-Wno-return-type

The flags files that were used to format this result can be browsed at
http://www.spec.org/cpu2017/flags/aocc200-flags-C1-HPE.html
http://www.spec.org/cpu2017/flags/HPE-Platform-Flags-AMD-V1.2-EPYC-revF.html

You can also download the XML flags sources by saving the following links:
http://www.spec.org/cpu2017/flags/aocc200-flags-C1-HPE.xml
http://www.spec.org/cpu2017/flags/HPE-Platform-Flags-AMD-V1.2-EPYC-revF.xml

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