SPEC® CPU2017 Integer Speed Result

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Hewlett Packard Enterprise

(Test Sponsor: HPE)

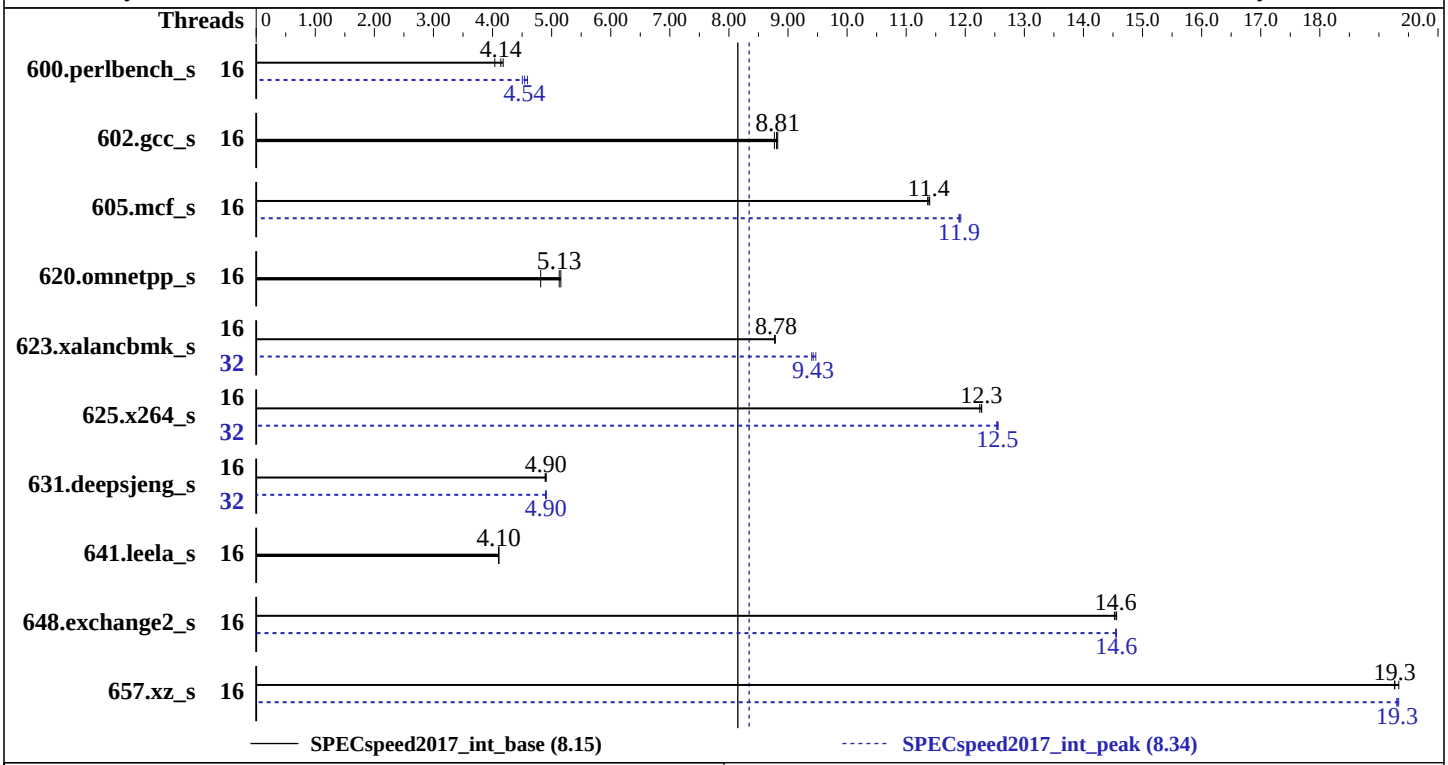
ProLiant DL325 Gen10
(3.10 GHz, AMD EPYC 7371)

SPECspeed2017_int_base = 8.15

SPECspeed2017_int_peak = 8.34

CPU2017 License: 3
Test Sponsor: HPE
Tested by: HPE

Test Date: Feb-2019
Hardware Availability: Apr-2019
Software Availability: Jul-2018



Hardware

CPU Name:	AMD EPYC 7371
Max MHz.:	3800
Nominal:	3100
Enabled:	16 cores, 1 chip
Orderable:	1 chip
Cache L1:	64 KB I + 32 KB D on chip per core
L2:	512 KB I+D on chip per core
L3:	64 MB I+D on chip per chip, 8 MB shared / 2 cores
Other:	None
Memory:	512 GB (8 x 64 GB 4Rx4 PC4-2666V-L)
Storage:	1 x 400 GB SAS SSD RAID 0
Other:	None

Software

OS:	SUSE linux Enterprise Server 12 (x86_64) SP3 Kernel version 4.4.132-94.33-default
Compiler:	C/C++: Version 1.2.1 of AOCC Fortran: Version 4.8.2 of GCC
Parallel:	Yes
Firmware:	HPE BIOS Version A41 10/02/2018 released Oct-2018
File System:	btrfs
System State:	Run level 3 (multi-user)
Base Pointers:	64-bit
Peak Pointers:	32/64-bit
Other:	jemalloc memory allocator library V5.1.0

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Results Table

Benchmark	Base							Peak						
	Threads	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Threads	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio
600.perlbench_s	16	**429**	**4.14**	425	4.18	440	4.04	16	**391**	**4.54**	387	4.59	394	4.50
602.gcc_s	16	451	8.83	454	8.77	**452**	**8.81**	16	451	8.83	454	8.77	**452**	**8.81**
605.mcf_s	16	414	11.4	415	11.4	**415**	**11.4**	16	**397**	**11.9**	396	11.9	397	11.9
620.omnetpp_s	16	**318**	**5.13**	316	5.16	339	4.81	16	**318**	**5.13**	316	5.16	339	4.81
623.xalancbmk_s	16	**161**	**8.78**	161	8.78	161	8.77	32	**150**	**9.43**	151	9.40	150	9.47
625.x264_s	16	144	12.2	144	12.3	**144**	**12.3**	32	141	12.5	140	12.6	**141**	**12.5**
631.deepsjeng_s	16	292	4.91	**292**	**4.90**	293	4.89	32	292	4.91	**292**	**4.90**	293	4.90
641.leela_s	16	416	4.10	415	4.11	**416**	**4.10**	16	416	4.10	415	4.11	**416**	**4.10**
648.exchange2_s	16	**202**	**14.6**	202	14.5	202	14.6	16	202	14.5	202	14.6	**202**	**14.6**
657.xz_s	16	321	19.3	320	19.3	**321**	**19.3**	16	320	19.3	**320**	**19.3**	320	19.3

SPECspeed2017_int_base = 8.15

SPECspeed2017_int_peak = 8.34

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/

The AOCC Gold Linker plugin was installed and used for the link stage.

The AOCC Fortran Plugin version 1.2.0 was used to leverage AOCC optimizers
with gfortran. It is available here:
http://developer.amd.com/amd-aocc/

jemalloc uses environment variable MALLOC_CONF with values narenas and lg_chunk:
  narenas: sets the maximum number of arenas to use for automatic multiplexing of
           threads and arenas.
  lg_chunk: set the virtual memory chunk size (log base 2). For example,
            lg_chunk:21 sets the default chunk size to 2^21 = 2MiB.
```

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

runspec command invoked through numactl i.e.:
numactl --interleave=all runspec <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
```

(Continued on next page)

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 were enabled for this run (OS default)
```

General Notes

```
Environment variables set by runcpu before the start of the run:
GOMP_CPU_AFFINITY = "0-31"
LD_LIBRARY_PATH = "/home/cpu2017/amd1806-speed-libs-revA/64:/home/cpu2017/amd1806-speed-libs-revA/32:"
OMP_PROC_BIND = "true"
OMP_STACKSIZE = "192M"
OMP_WAIT_POLICY = "active"

Binaries were compiled on a system with 2x AMD EPYC 7601 CPU + 512GB Memory using RHEL 7.4

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 v7.2 under default conditions.
jemalloc: sources available from jemalloc.net or https://github.com/jemalloc/jemalloc/releases
```

Platform Notes

```
BIOS Configuration
 AMD SMT Option set to Disabled
 Thermal Configuration set to Maximum Cooling
 Performance Determinism set to Power Deterministic
 Workload Power and Utilization Monitoring set to Disabled
 Minimum Processor Idle Power core C-State set to C6 State
 Sysinfo program /home/cpu2017/bin/sysinfo
 Rev: r5974 of 2018-05-19 9bcde8f2999c33d61f64985e45859ea9
 running on linux-qlr8 Thu Feb  7 14:37:19 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 7371 16-Core Processor
       1  "physical id"s (chips)
       16 "processors"
```

(Continued on next page)

Platform Notes (Continued)

```
    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  : 16
       physical 0: cores 0 1 8 9 16 17 24 25 32 33 40 41 48 49 56 57

 From lscpu:
      Architecture:          x86_64
      CPU op-mode(s):        32-bit, 64-bit
      Byte Order:            Little Endian
      CPU(s):                16
      On-line CPU(s) list:   0-15
      Thread(s) per core:    1
      Core(s) per socket:    16
      Socket(s):             1
      NUMA node(s):          4
      Vendor ID:             AuthenticAMD
      CPU family:            23
      Model:                 1
      Model name:            AMD EPYC 7371 16-Core Processor
      Stepping:              2
      CPU MHz:               3100.000
      CPU max MHz:           3100.0000
      CPU min MHz:           2500.0000
      BogoMIPS:              6188.22
      Virtualization:        AMD-V
      L1d cache:             32K
      L1i cache:             64K
      L2 cache:              512K
      L3 cache:              8192K
      NUMA node0 CPU(s):     0-3
      NUMA node1 CPU(s):     4-7
      NUMA node2 CPU(s):     8-11
      NUMA node3 CPU(s):     12-15
      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 extd_apicid amd_dcm aperfmperf eagerfpu 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 skinit wdt tce topoext perfctr_core perfctr_nb bpext perfctr_l2 mwaitx arat cpb
      hw_pstate ssbd retpoline retpoline_amd npt lbrv svm_lock nrip_save tsc_scale
      vmcb_clean flushbyasid decodeassists pausefilter pfthreshold vmmcall avic fsgsbase
      bmi1 avx2 smep bmi2 rdseed adx smap clflushopt sha_ni xsaveopt xsavec xgetbv1 clzero
      irperf ibpb overflow_recov succor smca

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

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Platform Notes (Continued)

```
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
  node 0 size: 128841 MB
  node 0 free: 128663 MB
  node 1 cpus: 4 5 6 7
  node 1 size: 129022 MB
  node 1 free: 128871 MB
  node 2 cpus: 8 9 10 11
  node 2 size: 129022 MB
  node 2 free: 128916 MB
  node 3 cpus: 12 13 14 15
  node 3 size: 129022 MB
  node 3 free: 128850 MB
  node distances:
  node   0   1   2   3
    0:  10  16  16  16
    1:  16  10  16  16
    2:  16  16  10  16
    3:  16  16  16  10

From /proc/meminfo
   MemTotal:       528291400 kB
   HugePages_Total:       0
   Hugepagesize:       2048 kB

/usr/bin/lsb_release -d
   SUSE Linux Enterprise Server 12 SP3

From /etc/*release* /etc/*version*
   SuSE-release:
      SUSE Linux Enterprise Server 12 (x86_64)
      VERSION = 12
      PATCHLEVEL = 3
      # 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-SP3"
      VERSION_ID="12.3"
      PRETTY_NAME="SUSE Linux Enterprise Server 12 SP3"
      ID="sles"
      ANSI_COLOR="0;32"
      CPE_NAME="cpe:/o:suse:sles:12:sp3"
```

(Continued on next page)

Platform Notes (Continued)

```
 uname -a:
    Linux linux-qlr8 4.4.132-94.33-default #1 SMP Tue May 29 20:09:56 UTC 2018 (76aae3b)
    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

 run-level 3 Feb 7 14:36

 SPEC is set to: /home/cpu2017
    Filesystem     Type  Size  Used Avail Use% Mounted on
    /dev/sda4      xfs   331G  4.4G  326G   2% /home

 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 HPE A41 10/02/2018
   Memory:
    8x UNKNOWN NOT AVAILABLE
    8x UNKNOWN NOT AVAILABLE 64 GB 4 rank 2666

 (End of data from sysinfo program)
```

Compiler Version Notes

```
==============================================================================
 CXXC 623.xalancbmk_s(peak)
------------------------------------------------------------------------------
AOCC.LLVM.1.2.1.B29.2018_05_14 clang version 6.0.0 (CLANG:
  b6b3d31d6df08fb7da935a28842b39b7b3c2c55b) (llvm/cpu/llvm
  18855c80ed252fc4ba4ac41e2086627ef2bddd04) (based on LLVM
  AOCC.LLVM.1.2.1.B29.2018_05_14)
Target: i386-unknown-linux-gnu
Thread model: posix
InstalledDir: /root/work/compilers/aocc1.2.1/AOCC-1.2.1-Compiler/bin
------------------------------------------------------------------------------

==============================================================================
 CC  600.perlbench_s(base) 602.gcc_s(base, peak) 605.mcf_s(base, peak)
      625.x264_s(base) 657.xz_s(base, peak)
------------------------------------------------------------------------------
AOCC.LLVM.1.2.1.B29.2018_05_14 clang version 6.0.0 (CLANG:
```

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Compiler Version Notes (Continued)

```
  b6b3d31d6df08fb7da935a28842b39b7b3c2c55b) (llvm/cpu/llvm
  18855c80ed252fc4ba4ac41e2086627ef2bddd04) (based on LLVM
  AOCC.LLVM.1.2.1.B29.2018_05_14)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /root/work/compilers/aocc1.2.1/AOCC-1.2.1-Compiler/bin
------------------------------------------------------------------------------

==============================================================================
 CXXC 620.omnetpp_s(base, peak) 623.xalancbmk_s(base) 631.deepsjeng_s(base,
      peak) 641.leela_s(base)
------------------------------------------------------------------------------
AOCC.LLVM.1.2.1.B29.2018_05_14 clang version 6.0.0 (CLANG:
  b6b3d31d6df08fb7da935a28842b39b7b3c2c55b) (llvm/cpu/llvm
  18855c80ed252fc4ba4ac41e2086627ef2bddd04) (based on LLVM
  AOCC.LLVM.1.2.1.B29.2018_05_14)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /root/work/compilers/aocc1.2.1/AOCC-1.2.1-Compiler/bin
------------------------------------------------------------------------------

==============================================================================
CC   600.perlbench_s(peak) 625.x264_s(peak)
------------------------------------------------------------------------------
AOCC.LLVM.1.2.1.B29.2018_05_14 clang version 6.0.0 (CLANG:
  b6b3d31d6df08fb7da935a28842b39b7b3c2c55b) (llvm/cpu/llvm
  18855c80ed252fc4ba4ac41e2086627ef2bddd04) (based on LLVM
  AOCC.LLVM.1.2.1.B29.2018_05_14)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /root/work/compilers/aocc1.2.1/AOCC-1.2.1-Compiler/bin
------------------------------------------------------------------------------

==============================================================================
CXXC 641.leela_s(peak)
------------------------------------------------------------------------------
AOCC.LLVM.1.2.1.B29.2018_05_14 clang version 6.0.0 (CLANG:
  b6b3d31d6df08fb7da935a28842b39b7b3c2c55b) (llvm/cpu/llvm
  18855c80ed252fc4ba4ac41e2086627ef2bddd04) (based on LLVM
  AOCC.LLVM.1.2.1.B29.2018_05_14)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /root/work/compilers/aocc1.2.1/AOCC-1.2.1-Compiler/bin
------------------------------------------------------------------------------

==============================================================================
 FC  648.exchange2_s(base, peak)
```

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Compiler Version Notes (Continued)

```
------------------------------------------------------------------------------
GNU Fortran (GCC) 4.8.2
Copyright (C) 2013 Free Software Foundation, Inc.
GNU Fortran comes with NO WARRANTY, to the extent permitted by law.
You may redistribute copies of GNU Fortran
under the terms of the GNU General Public License.
For more information about these matters, see the file named COPYING
------------------------------------------------------------------------------
```

Base Compiler Invocation

C benchmarks:
clang

C++ benchmarks:
clang++

Fortran benchmarks:
clang gfortran

Base Portability Flags

600.perlbench_s: -DSPEC_LINUX_X64 -DSPEC_LP64
602.gcc_s: -DSPEC_LP64
605.mcf_s: -DSPEC_LP64
620.omnetpp_s: -DSPEC_LP64
623.xalancbmk_s: -DSPEC_LINUX -DSPEC_LP64
625.x264_s: -DSPEC_LP64
631.deepsjeng_s: -DSPEC_LP64
641.leela_s: -DSPEC_LP64
648.exchange2_s: -DSPEC_LP64
657.xz_s: -DSPEC_LP64

Base Optimization Flags

C benchmarks:
-flto -fuse-ld=lld -Wl,-mllvm -Wl,-function-specialize -O3
-ffast-math -march=znver1 -fstruct-layout=3
-mllvm -unroll-threshold=50 -fremap-arrays -mno-avx2
-mllvm -inline-threshold=1000 -flv-function-specialization
-mllvm -enable-gvn-hoist -mllvm -function-specialize -z muldefs

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Base Optimization Flags (Continued)

C benchmarks (continued):
-lamdlibm -DSPEC_OPENMP -fopenmp -fopenmp=libomp -lomp -ljemalloc

C++ benchmarks:
-Wl,-mllvm -Wl,-x86-use-vzeroupper=false -flto -fuse-ld=lld
-Wl,-mllvm -Wl,-function-specialize -O3 -march=znver1 -ffast-math
-mllvm -unroll-threshold=100 -flv-function-specialization
-mllvm -enable-partial-unswitch -fremap-arrays
-mllvm -inline-threshold=1000 -z muldefs -lamdlibm -DSPEC_OPENMP
-fopenmp -fopenmp=libomp -lomp -ljemalloc

Fortran benchmarks:
-Wl,-mllvm -Wl,-inline-recursion=4 -Wl,-mllvm -Wl,-lsr-in-nested-loop
-Wl,-mllvm -Wl,-enable-iv-split -Wl,-mllvm -Wl,-merge-constant
-Wl,-mllvm -Wl,-unroll-aggressive -Wl,-mllvm -Wl,-unroll-threshold=150
-flto -fuse-ld=lld -Wl,-mllvm -Wl,-function-specialize -O3
-funroll-loops -ffast-math -z muldefs -lamdlibm -fplugin=dragonegg.so
-specs=integrated-as.specs
-fplugin-arg-dragonegg-llvm-option=-disable-indvar-simplify
-fplugin-arg-dragonegg-llvm-option=-unroll-aggressive
-fplugin-arg-dragonegg-llvm-option=-unroll-threshold:150 -DSPEC_OPENMP
-fopenmp -fopenmp=libomp -lomp -ljemalloc -lgfortran

Base Other Flags

C benchmarks:
-Wno-return-type -DUSE_OPENMP

C++ benchmarks:
-Wno-return-type -DUSE_OPENMP

Fortran benchmarks:
-DUSE_OPENMP -Wno-return-type

Peak Compiler Invocation

C benchmarks:
clang

C++ benchmarks:
clang++

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Peak Compiler Invocation (Continued)

Fortran benchmarks:
clang gfortran

Peak Portability Flags

600.perlbench_s: -DSPEC_LINUX_X64 -DSPEC_LP64
602.gcc_s: -DSPEC_LP64
605.mcf_s: -DSPEC_LP64
620.omnetpp_s: -DSPEC_LP64
623.xalancbmk_s: -DSPEC_LINUX -D_FILE_OFFSET_BITS=64
625.x264_s: -DSPEC_LP64
631.deepsjeng_s: -DSPEC_LP64
641.leela_s: -DSPEC_LP64
648.exchange2_s: -DSPEC_LP64
657.xz_s: -DSPEC_LP64

Peak Optimization Flags

C benchmarks:

600.perlbench_s: -flto -fuse-ld=lld -Wl,-mllvm -Wl,-function-specialize
-fprofile-instr-generate(pass 1)
-fprofile-instr-use(pass 2) -Ofast -march=znver1
-mno-sse4a -fstruct-layout=5
-mllvm -vectorize-memory-aggressively -mno-avx2
-mllvm -unroll-threshold=50 -fremap-arrays
-mllvm -inline-threshold=1000 -mllvm -enable-gvn-hoist
-flv-function-specialization
-mllvm -enable-vectorize-compares -z muldefs -lamdlibm
-DSPEC_OPENMP -fopenmp -fopenmp=libomp -lomp -ljemalloc

602.gcc_s: basepeak = yes

605.mcf_s: -flto -fuse-ld=lld -Wl,-mllvm -Wl,-function-specialize
-Ofast -march=znver1 -mno-sse4a -fstruct-layout=5
-mllvm -vectorize-memory-aggressively -mno-avx2
-mllvm -unroll-threshold=50 -fremap-arrays
-mllvm -inline-threshold=1000 -mllvm -enable-gvn-hoist
-flv-function-specialization
-mllvm -enable-vectorize-compares -z muldefs -lamdlibm
-DSPEC_OPENMP -fopenmp -fopenmp=libomp -lomp -ljemalloc

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Peak Optimization Flags (Continued)

625.x264_s: `Same as 600.perlbench_s`

657.xz_s: `Same as 605.mcf_s`

C++ benchmarks:

620.omnetpp_s: `basepeak = yes`

623.xalancbmk_s: `-m32 -fuse-ld=lld -Wl,-mllvm -Wl,-x86-use-vzeroupper=false -flto -Wl,-mllvm -Wl,-function-specialize -Ofast -march=znver1 -flv-function-specialization -mllvm -unroll-threshold=100 -fremap-arrays -mllvm -inline-threshold=1000 -z muldefs -DSPEC_OPENMP -fopenmp -fopenmp=libomp -lomp -libs-revA/32 -ljemalloc`

631.deepsjeng_s: `-Wl,-mllvm -Wl,-x86-use-vzeroupper=false -flto -fuse-ld=lld -Wl,-mllvm -Wl,-function-specialize -Ofast -march=znver1 -flv-function-specialization -mllvm -unroll-threshold=100 -fremap-arrays -mllvm -inline-threshold=1000 -z muldefs -lamdlibm -DSPEC_OPENMP -fopenmp -fopenmp=libomp -lomp -ljemalloc`

641.leela_s: `basepeak = yes`

Fortran benchmarks:
`-Wl,-mllvm -Wl,-inline-recursion=4 -Wl,-mllvm -Wl,-lsr-in-nested-loop -Wl,-mllvm -Wl,-enable-iv-split -Wl,-mllvm -Wl,-merge-constant -Wl,-mllvm -Wl,-unroll-aggressive -Wl,-mllvm -Wl,-unroll-threshold=150 -flto -fuse-ld=lld -Wl,-mllvm -Wl,-function-specialize -O3 -funroll-loops -ffast-math -z muldefs -lamdlibm -fplugin=dragonegg.so -specs=integrated-as.specs -fplugin-arg-dragonegg-llvm-option=-disable-indvar-simplify -fplugin-arg-dragonegg-llvm-option=-unroll-aggressive -fplugin-arg-dragonegg-llvm-option=-unroll-threshold:150 -DSPEC_OPENMP -fopenmp -fopenmp=libomp -lomp -ljemalloc -lgfortran`

Peak Other Flags

C benchmarks:
`-Wno-return-type -DUSE_OPENMP`

C++ benchmarks (except as noted below):
`-Wno-return-type -DUSE_OPENMP`

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Peak Other Flags (Continued)

623.xalancbmk_s: `-Wno-return-type -DUSE_OPENMP -L/root/work/cpu2017/v105/amd1806-speed`

Fortran benchmarks:
`-DUSE_OPENMP -Wno-return-type`

The flags files that were used to format this result can be browsed at
`http://www.spec.org/cpu2017/flags/aocc100-flags-revC-I.2018-11-13.html`
`http://www.spec.org/cpu2017/flags/gcc.2017-11-20.html`
`http://www.spec.org/cpu2017/flags/HPE-Platform-Flags-AMD-V1.2-EPYC-revD.html`

You can also download the XML flags sources by saving the following links:
`http://www.spec.org/cpu2017/flags/aocc100-flags-revC-I.2018-11-13.xml`
`http://www.spec.org/cpu2017/flags/gcc.2017-11-20.xml`
`http://www.spec.org/cpu2017/flags/HPE-Platform-Flags-AMD-V1.2-EPYC-revD.xml`

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Tested with SPEC CPU2017 v1.0.5 on 2019-02-07 15:37:18-0500.
Report generated on 2019-04-03 17:24:08 by CPU2017 PS formatter v6067.
Originally published on 2019-04-03.