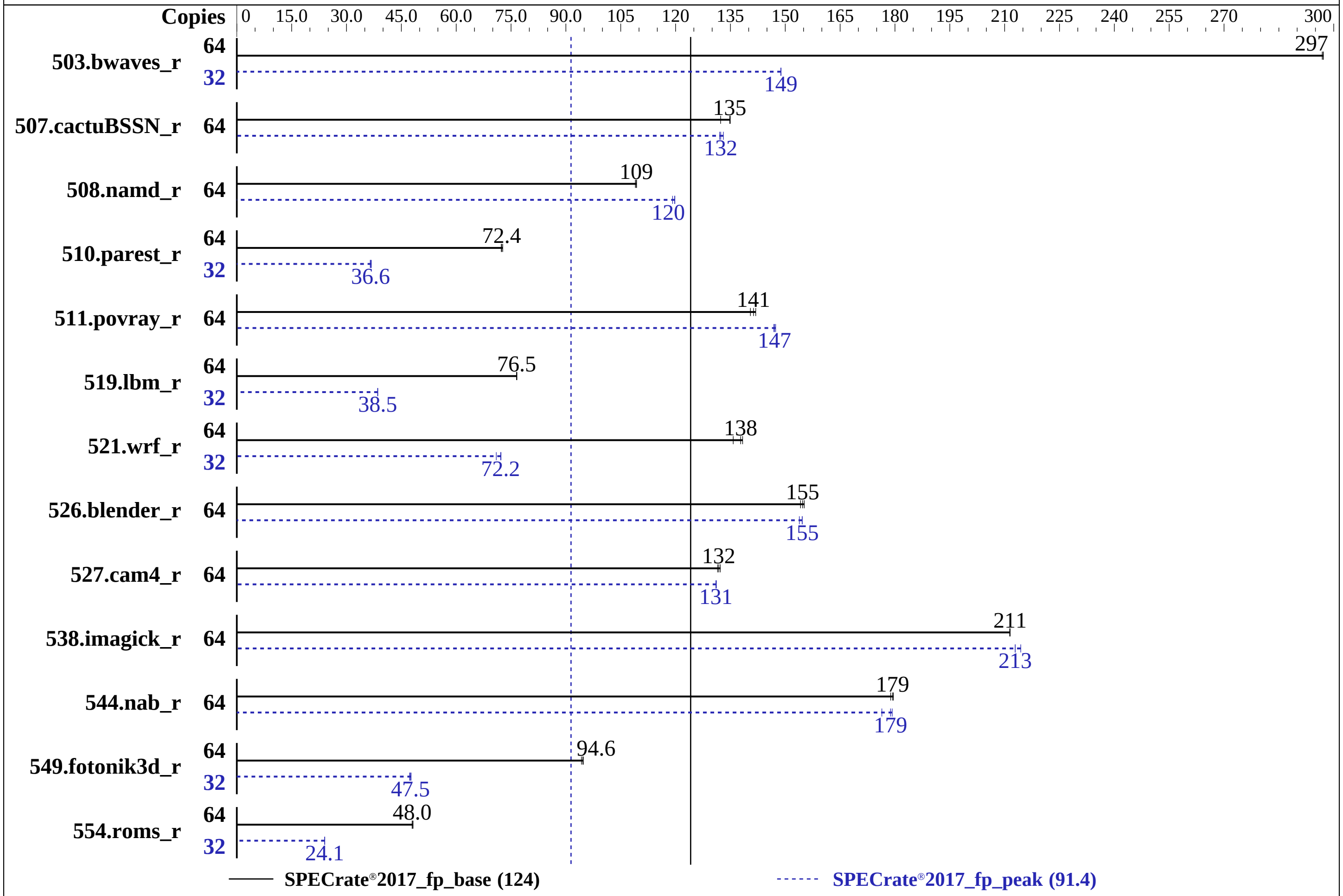
SPEC CPU®2017 Floating Point Rate Result

Hewlett Packard Enterprise
(Test Sponsor: HPE)
Cloudline CL3150 Gen10
(2.20 GHz, AMD EPYC 7601)

SPECrate®2017_fp_base = 124

SPECrate®2017_fp_peak = 91.4

CPU2017 License:	3	**Test Date:**	Nov-2017
Test Sponsor:	HPE	**Hardware Availability:**	Nov-2017
Tested by:	HPE	**Software Availability:**	Sep-2017



Hardware

CPU Name:	AMD EPYC 7601
Max MHz:	3200
Nominal:	2200
Enabled:	32 cores, 1 chip, 2 threads/core
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 / 4 cores
Other:	None
Memory:	512 GB (8 x 64 GB 4Rx4 PC4-2666V-L)
Storage:	1 x 960 GB SATA SSD, RAID 0
Other:	None

Software

OS:	SUSE Linux Enterprise Server 12 (x86_64) SP2 Kernel 4.4.21-69-default
Compiler:	C/C++: Version 1.0.0 of AOCC Fortran: Version 4.8.2 of GCC
Parallel:	No
Firmware:	BIOS Version 2.1.1 released Jun-2017 (tested with 2.1.1 06/15/2017)
File System:	xfs
System State:	Run level 3 (mulit-user)
Base Pointers:	64-bit
Peak Pointers:	64-bit
Other:	jemalloc general purpose malloc implementation v4.5.0
Power Management:	--

Results Table

Benchmark	Base							Peak						
	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio
503.bwaves_r	64	2160	297	2162	297	**2160**	**297**	32	**2156**	**149**	2156	149	2157	149
507.cactuBSSN_r	64	**601**	**135**	600	135	612	132	64	609	133	**612**	**132**	614	132
508.namd_r	64	**556**	**109**	556	109	558	109	64	**508**	**120**	507	120	510	119
510.parest_r	64	2315	72.3	**2311**	**72.4**	2302	72.7	32	2276	36.8	**2288**	**36.6**	2294	36.5
511.povray_r	64	**1057**	**141**	1053	142	1064	140	64	1017	147	**1016**	**147**	1014	147
519.lbm_r	64	882	76.5	**881**	**76.5**	880	76.6	32	874	38.6	876	38.5	**875**	**38.5**
521.wrf_r	64	**1040**	**138**	1036	138	1056	136	32	992	72.2	**993**	**72.2**	1010	71.0
526.blender_r	64	**630**	**155**	632	154	628	155	64	630	155	**630**	**155**	634	154
527.cam4_r	64	**849**	**132**	851	131	847	132	64	854	131	853	131	**854**	**131**
538.imagick_r	64	753	211	**753**	**211**	753	211	64	748	213	**748**	**213**	742	214
544.nab_r	64	**601**	**179**	600	180	602	179	64	611	176	601	179	**602**	**179**
549.fotonik3d_r	64	2632	94.8	**2635**	**94.6**	2646	94.3	32	2617	47.7	**2626**	**47.5**	2638	47.3
554.roms_r	64	2110	48.2	2121	47.9	**2120**	**48.0**	32	2113	24.1	**2114**	**24.1**	2115	24.0

SPECrate®2017_fp_base = 124

SPECrate®2017_fp_peak = 91.4

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

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

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

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)

Huge pages were not configured for this run.
```

General Notes

```
Environment variables set by runcpu before the start of the run:
LD_LIBRARY_PATH = "/home/cpu2017/amd1704-rate-libs-revC/64;/home/cpu2017/amd1704-rate-libs-revC/32:"
MALLOC_CONF = "lg_chunk:28"

The AMD64 AOCC Compiler Suite is available at
http://developer.amd.com/tools-and-sdks/cpu-development/amd-optimizing-cc-compiler/

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

jemalloc, a general purpose malloc implementation, was obtained at
https://github.com/jemalloc/jemalloc/releases/download/4.5.0/jemalloc-4.5.0.tar.bz2
jemalloc was built with GCC v4.8.5 in RHEL v7.2 under default conditions.
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.

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

The AOCC Fortran Plugin version 1.0 was used to leverage AOCC optimizers
with gfortran. It is available here:
http://developer.amd.com/amd-aocc/

No: The test sponsor attests, as of date of publication, that CVE-2017-5754 (Meltdown) is mitigated in the system as
     tested and documented.
No: 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.
No: 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.
```

Platform Notes

```
BIOS was run with default values
Sysinfo program /home/cpu2017/bin/sysinfo
Rev: r5797 of 2017-06-14 96c45e4568ad54c135fd618bcc091c0f
running on linux-e6ov Mon Dec 18 05:53:32 2017

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 7601 32-Core Processor
      1  "physical id"s (chips)
      64 "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 : 32
       siblings  : 64
       physical 0: cores 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

 From lscpu:
      Architecture:          x86_64
      CPU op-mode(s):        32-bit, 64-bit
      Byte Order:            Little Endian
      CPU(s):                64
      On-line CPU(s) list:   0-63
      Thread(s) per core:    2
      Core(s) per socket:    32
      Socket(s):             1
      NUMA node(s):          4
      Vendor ID:             AuthenticAMD
      CPU family:            23
      Model:                 1
      Model name:            AMD EPYC 7601 32-Core Processor
      Stepping:              2
      CPU MHz:               1200.000
      CPU max MHz:           2200.0000
      CPU min MHz:           1200.0000
      BogoMIPS:              4391.65
      Virtualization:        AMD-V
      L1d cache:             32K
      L1i cache:             64K
      L2 cache:              512K
      L3 cache:              8192K
      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 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
      hw_pstate npt lbrv svm_lock nrip_save tsc_scale vmcb_clean flushbyasid decodeassists
      pausefilter pfthreshold vmmcall fsgsbase bmi1 avx2 smep bmi2 rdseed adx smap
      clflushopt sha_ni xsaveopt xsavec xgetbv1 clzero irperf 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 4 5 6 7 8 9 10 11 12 13 14 15
  node 0 size: 128893 MB
  node 0 free: 128376 MB
  node 1 cpus: 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
  node 1 size: 129019 MB
  node 1 free: 128640 MB
  node 2 cpus: 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47
  node 2 size: 129019 MB
  node 2 free: 128669 MB
  node 3 cpus: 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63
  node 3 size: 129017 MB
  node 3 free: 128526 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:       528332584 kB
   HugePages_Total:       0
   Hugepagesize:       2048 kB

/usr/bin/lsb_release -d
   SUSE Linux Enterprise Server 12 SP2

From /etc/*release* /etc/*version*
   SuSE-release:
      SUSE Linux Enterprise Server 12 (x86_64)
      VERSION = 12
      PATCHLEVEL = 2
      # 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-SP2"
      VERSION_ID="12.2"
      PRETTY_NAME="SUSE Linux Enterprise Server 12 SP2"
      ID="sles"
      ANSI_COLOR="0;32"
      CPE_NAME="cpe:/o:suse:sles:12:sp2"

uname -a:
```

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Platform Notes (Continued)

```
    Linux linux-e6ov 4.4.21-69-default #1 SMP Tue Oct 25 10:58:20 UTC 2016 (9464f67)
    x86_64 x86_64 x86_64 GNU/Linux

 run-level 3 Dec 17 17:44

 SPEC is set to: /home/cpu2017
    Filesystem     Type  Size  Used Avail Use% Mounted on
    /dev/nvme0n1p4 xfs   852G  4.6G  848G   1% /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 2.1.1 06/15/2017
   Memory:
    8x Samsung M386A8K40BM2-CTD 64 GB 4 rank 2666

 (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)
------------------------------------------------------------------------------
AOCC.LLVM.4.0.0.B35.2017_04_26 clang version 4.0.0 (CLANG:) (based on LLVM
  AOCC.LLVM.4.0.0.B35.2017_04_26)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /root/work/compilers/AOCC-1.0-Compiler/bin
------------------------------------------------------------------------------

==============================================================================
C++              | 508.namd_r(base, peak) 510.parest_r(base, peak)
------------------------------------------------------------------------------
AOCC.LLVM.4.0.0.B35.2017_04_26 clang version 4.0.0 (CLANG:) (based on LLVM
  AOCC.LLVM.4.0.0.B35.2017_04_26)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /root/work/compilers/AOCC-1.0-Compiler/bin
------------------------------------------------------------------------------

==============================================================================
C++, C           | 511.povray_r(base, peak) 526.blender_r(base, peak)
------------------------------------------------------------------------------
AOCC.LLVM.4.0.0.B35.2017_04_26 clang version 4.0.0 (CLANG:) (based on LLVM
```

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Compiler Version Notes (Continued)

```
  AOCC.LLVM.4.0.0.B35.2017_04_26)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /root/work/compilers/AOCC-1.0-Compiler/bin
AOCC.LLVM.4.0.0.B35.2017_04_26 clang version 4.0.0 (CLANG:) (based on LLVM
  AOCC.LLVM.4.0.0.B35.2017_04_26)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /root/work/compilers/AOCC-1.0-Compiler/bin
------------------------------------------------------------------------------

==============================================================================
C++, C, Fortran | 507.cactuBSSN_r(base, peak)
------------------------------------------------------------------------------
AOCC.LLVM.4.0.0.B35.2017_04_26 clang version 4.0.0 (CLANG:) (based on LLVM
  AOCC.LLVM.4.0.0.B35.2017_04_26)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /root/work/compilers/AOCC-1.0-Compiler/bin
AOCC.LLVM.4.0.0.B35.2017_04_26 clang version 4.0.0 (CLANG:) (based on LLVM
  AOCC.LLVM.4.0.0.B35.2017_04_26)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /root/work/compilers/AOCC-1.0-Compiler/bin
GNU Fortran (GCC) 4.8.2
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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
------------------------------------------------------------------------------

==============================================================================
Fortran         | 503.bwaves_r(base, peak) 549.fotonik3d_r(base, peak)
                | 554.roms_r(base, peak)
------------------------------------------------------------------------------
GNU Fortran (GCC) 4.8.2
Copyright (C) 2013 Free Software Foundation, Inc.
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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
------------------------------------------------------------------------------

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

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Compiler Version Notes (Continued)

```
GNU Fortran (GCC) 4.8.2
Copyright (C) 2013 Free Software Foundation, Inc.
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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
AOCC.LLVM.4.0.0.B35.2017_04_26 clang version 4.0.0 (CLANG:) (based on LLVM
  AOCC.LLVM.4.0.0.B35.2017_04_26)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /root/work/compilers/AOCC-1.0-Compiler/bin
------------------------------------------------------------------------------
```

Base Compiler Invocation

C benchmarks:
clang

C++ benchmarks:
clang++

Fortran benchmarks:
clang gfortran

Benchmarks using both Fortran and C:
clang gfortran

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

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

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 -fconvert=big-endian -DSPEC_LP64
526.blender_r: -funsigned-char -D__BOOL_DEFINED -DSPEC_LP64

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Base Portability Flags (Continued)

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,-plugin-opt= -merge-constant
-Wl,-plugin-opt=-lsr-in-nested-loop -disable-vect-cmp -O3 -ffast-math
-march=znver1 -fstruct-layout=2 -mllvm -unroll-threshold=100
-fremap-arrays -mno-avx2 -inline-threshold=1000 -z muldefs -ljemalloc

C++ benchmarks:
-flto -Wl,-plugin-opt= -merge-constant
-Wl,-plugin-opt=-lsr-in-nested-loop -disable-vect-cmp -O3
-march=znver1 -mllvm -unroll-threshold=100 -finline-aggressive
-fremap-arrays -inline-threshold=1000 -z muldefs -ljemalloc

Fortran benchmarks:
-flto -Wl,-plugin-opt= -merge-constant
-Wl,-plugin-opt=-lsr-in-nested-loop -disable-vect-cmp -O3(gfortran)
-O3(clang) -mavx -madx -funroll-loops -ffast-math -z muldefs
-fplugin=dragonegg.so
-fplugin-arg-dragonegg-llvm-option="-merge-constant -disable-vect-cmp"
-ljemalloc -lgfortran -lamdlibm

Benchmarks using both Fortran and C:
-flto -Wl,-plugin-opt= -merge-constant
-Wl,-plugin-opt=-lsr-in-nested-loop -disable-vect-cmp -O3(clang)
-ffast-math -march=znver1 -fstruct-layout=2 -mllvm
-unroll-threshold=100 -fremap-arrays -mno-avx2 -inline-threshold=1000
-O3(gfortran) -mavx -madx -funroll-loops -z muldefs
-fplugin=dragonegg.so
-fplugin-arg-dragonegg-llvm-option="-merge-constant -disable-vect-cmp"
-ljemalloc -lgfortran -lamdlibm

Benchmarks using both C and C++:
-flto -Wl,-plugin-opt= -merge-constant
-Wl,-plugin-opt=-lsr-in-nested-loop -disable-vect-cmp -O3 -ffast-math
-march=znver1 -fstruct-layout=2 -mllvm -unroll-threshold=100
-fremap-arrays -mno-avx2 -inline-threshold=1000 -finline-aggressive
-z muldefs -ljemalloc

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Base Optimization Flags (Continued)

Benchmarks using Fortran, C, and C++:
-flto -Wl,-plugin-opt= -merge-constant
-Wl,-plugin-opt=-lsr-in-nested-loop -disable-vect-cmp -O3(clang)
-ffast-math -march=znver1 -fstruct-layout=2 -mllvm
-unroll-threshold=100 -fremap-arrays -mno-avx2 -inline-threshold=1000
-finline-aggressive -O3(gfortran) -mavx -madx -funroll-loops
-z muldefs -fplugin=dragonegg.so
-fplugin-arg-dragonegg-llvm-option="-merge-constant -disable-vect-cmp"
-ljemalloc

Peak Compiler Invocation

C benchmarks:
clang

C++ benchmarks:
clang++

Fortran benchmarks:
clang gfortran

Benchmarks using both Fortran and C:
clang gfortran

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

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

Peak Portability Flags

Same as Base Portability Flags

Peak Optimization Flags

C benchmarks:
-flto -Wl,-plugin-opt= -merge-constant

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Peak Optimization Flags (Continued)

C benchmarks (continued):
-Wl,-plugin-opt=-lsr-in-nested-loop -Ofast -march=znver1
-fstruct-layout=3 -mllvm -vectorize-memory-aggressively -mno-avx2
-unroll-threshold=100 -fremap-arrays -inline-threshold=1000 -ljemalloc

C++ benchmarks:
-flto -Wl,-plugin-opt= -merge-constant
-Wl,-plugin-opt=-lsr-in-nested-loop -Ofast -march=znver1
-finline-aggressive -mllvm -unroll-threshold=100 -fremap-arrays
-inline-threshold=1000 -ljemalloc

Fortran benchmarks:
-flto -Wl,-plugin-opt= -merge-constant
-Wl,-plugin-opt=-lsr-in-nested-loop -O3(gfortran) -O3(clang) -mavx2
-madx -funroll-loops -ffast-math -fplugin=dragonegg.so
-fplugin-arg-dragonegg-llvm-option="-merge-constant
-inline-threshold:1000" -ljemalloc -lgfortran -lamdlibm

Benchmarks using both Fortran and C:

521.wrf_r: -flto -Wl,-plugin-opt= -merge-constant
-Wl,-plugin-opt=-lsr-in-nested-loop -O3(clang) -mavx
-ffast-math -O3(gfortran) -funroll-loops
-fplugin=dragonegg.so
-fplugin-arg-dragonegg-llvm-option="-merge-constant
-inline-threshold:1000" -ljemalloc -lgfortran -lamdlibm

527.cam4_r: -flto -Wl,-plugin-opt= -merge-constant
-Wl,-plugin-opt=-lsr-in-nested-loop -Ofast -march=znver1
-fstruct-layout=3 -mllvm -vectorize-memory-aggressively
-mno-avx2 -unroll-threshold=100 -fremap-arrays
-inline-threshold=1000 -O3(gfortran) -O3(clang) -mavx2
-madx -funroll-loops -ffast-math -fplugin=dragonegg.so
-fplugin-arg-dragonegg-llvm-option="-merge-constant
-inline-threshold:1000" -ljemalloc -lgfortran -lamdlibm

Benchmarks using both C and C++:
-flto -Wl,-plugin-opt= -merge-constant
-Wl,-plugin-opt=-lsr-in-nested-loop -Ofast -march=znver1
-fstruct-layout=3 -mllvm -vectorize-memory-aggressively -mno-avx2
-unroll-threshold=100 -fremap-arrays -inline-threshold=1000
-finline-aggressive -ljemalloc

Benchmarks using Fortran, C, and C++:
-flto -Wl,-plugin-opt= -merge-constant
-Wl,-plugin-opt=-lsr-in-nested-loop -Ofast -march=znver1

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Peak Optimization Flags (Continued)

Benchmarks using Fortran, C, and C++ (continued):
-fstruct-layout=3 -mllvm -vectorize-memory-aggressively -mno-avx2
-unroll-threshold=100 -fremap-arrays -inline-threshold=1000
-finline-aggressive -O3 -mavx2 -madx -funroll-loops -ffast-math
-fplugin=dragonegg.so
-fplugin-arg-dragonegg-llvm-option="-merge-constant
-inline-threshold:1000" -ljemalloc

The flags files that were used to format this result can be browsed at
http://www.spec.org/cpu2017/flags/gcc.2017-11-20.html
http://www.spec.org/cpu2017/flags/aocc100-flags-revC-I.html

You can also download the XML flags sources by saving the following links:
http://www.spec.org/cpu2017/flags/gcc.2017-11-20.xml
http://www.spec.org/cpu2017/flags/aocc100-flags-revC-I.xml

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

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