Lenovo Global Technology
ThinkSystem SD665 V3
(2.50 GHz, AMD EPYC 9224)

CPU2017 License: 9017
Test Sponsor: Lenovo Global Technology
Tested by: Lenovo Global Technology

603.bwaves_s 48 409
607.cactuBSSN_s 48
619.lbm_s 48 149
621.wrf_s 48 182
627.cam4_s 48 197
628.pop2_s 48 166
638.imagick_s 48 318
644.nab_s 48 478
649.fotonik3d_s 48 187
654.roms_s 48 363

SPECspeed®2017_fp_base = 259
SPECspeed®2017_fp_peak = 261

Hardware
CPU Name: AMD EPYC 9224
Max MHz: 3700
Nominal: 2500
Enabled: 48 cores, 2 chips
Orderable: 2 chips
Cache L1: 32 KB I + 32 KB D on chip per core
L2: 1 MB I+D on chip per core
L3: 64 MB I+D on chip per chip,
    16 MB shared / 6 cores
Other: None
Memory: 768 GB (24 x 32 GB 2Rx8 PC5-4800B-R)
Storage: 1 x 3.84 TB NVME SSD
Other: None

Software
OS: SUSE Linux Enterprise Server 15 SP4 (x86_64)
Kernel 5.14.21-150400.22-default
Compiler: C/C++/Fortran: Version 4.0.0 of AOCC
Parallel: Yes
Firmware: Lenovo BIOS Version QGE105O 1.10 released Dec-2022
File System: xfs
System State: Run level 3 (multi-user)
Base Pointers: 64-bit
Peak Pointers: 64-bit
Other: None
Power Management: BIOS and OS set to prefer performance at the cost of additional power usage

Test Date: Jan-2023
Hardware Availability: Dec-2022
Software Availability: Nov-2022

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SPECspeed®2017_fp_base (259) SPECspeed®2017_fp_peak (261)
## Results Table

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<td>43.4</td>
<td>363</td>
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<td>43.3</td>
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</tbody>
</table>

### 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 cores 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.
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.

(Continued on next page)
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**Operating System Notes (Continued)**

To enable Transparent Hugepages (THP) for all allocations,
'echo always > /sys/kernel/mm/transparent_hugepage/defrag' run as root.
To always enable THP for peak runs of:
603.bwaves_s, 607.cactuBSSN_s, 627.cam4_s, 628.pop2_s, 638.imagick_s, 644.nab_s, 649.fotonik3d_s:
'echo madvise > /sys/kernel/mm/transparent_hugepage/defrag' run as root.
To disable THP for peak runs of 621.wrf_s:
'echo never > /sys/kernel/mm/transparent_hugepage/defrag' run as root.
To enable THP only on request for peak runs of 654.roms_s:
'echo madvise > /sys/kernel/mm/transparent_hugepage/defrag' run as root.

---

**Environment Variables Notes**

Environment variables set by runcpu before the start of the run:
GOMP_CPU_AFFINITY = "0-47"
LD_LIBRARY_PATH = "/home/cpu2017-1.1.8-amd-aocc400-genoa-B1b/amd_speed_aocc400_genoa_B_lib/lib;"
LIBOMP_NUM_HIDDEN_HELPER_THREADS = "0"
MALLOCC_CONF = "oversize_threshold:0,retain:true"
OMP_DYNAMIC = "false"
OMP_SCHEDULE = "static"
OMP_STACKSIZE = "128M"
OMP_THREAD_LIMIT = "48"

Environment variables set by runcpu during the 603.bwaves_s peak run:
GOMP_CPU_AFFINITY = "0-47"

Environment variables set by runcpu during the 621.wrf_s peak run:
GOMP_CPU_AFFINITY = "0-47"

Environment variables set by runcpu during the 628.pop2_s peak run:
GOMP_CPU_AFFINITY = "0-47"

Environment variables set by runcpu during the 638.imagick_s peak run:
GOMP_CPU_AFFINITY = "0-47"

Environment variables set by runcpu during the 649.fotonik3d_s peak run:
GOMP_CPU_AFFINITY = "0-47"
PGHPF_ZMEM = "yes"
General Notes

Binaries were compiled on a system with 2x AMD EPYC 9174F CPU + 1.5TiB Memory using RHEL 8.6

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.

Platform Notes

BIOS configuration:
Operating Mode set to Maximum Performance
SMT Mode set to Disabled

 Sysinfo program /home/cpu2017-1.1.8-amd-aocc400-genoa-B1b/bin/sysinfo
 Rev: r6622 of 2021-04-07 982a61ec0915b55891ef0e16aca6c64d
 running on localhost Mon Jan 23 19:04:13 2023

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 9224 24-Core Processor
  2 "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 : 24
  physical 0: cores 0 1 2 3 4 5 16 17 18 19 20 21 32 33 34 35 36 37 48 49 50 51 52 53
  physical 1: cores 0 1 2 3 4 5 16 17 18 19 20 21 32 33 34 35 36 37 48 49 50 51 52 53

From lscpu from util-linux 2.37.2:
  Architecture: x86_64
  CPU op-mode(s): 32-bit, 64-bit
  Address sizes: 52 bits physical, 57 bits virtual
  Byte Order: Little Endian
  CPU(s): 48
  On-line CPU(s) list: 0-47
  Vendor ID: AuthenticAMD
  Model name: AMD EPYC 9224 24-Core Processor
  CPU family: 25
  Model: 17
Platform Notes (Continued)

Thread(s) per core: 1
Core(s) per socket: 24
Socket(s): 2
Stepping: 1
Frequency boost: enabled
CPU max MHz: 3706.0540
CPU min MHz: 1500.0000
BogoMIPS: 4999.71
Flags: fpu vme de pse tsc msr pae mce cx8 apic sep mtrr
pg e 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
aperfmonperf rapl pni pclmulqdq monitor ssse3 fma cx16 pcid sse4_1 sse4_2 x2apic movbe
popcnt aes xsave avx f16c rdrand lahf_lm cmp_legacy svm extapic cr8_legacy abm sse4a
misalignsse 3nowprefetch osuw ibs skim_t wdঃ tco topeext perfctr_core perfctr_nb
bext perfctr_llc mwAITx cpb cat_l3 cdп_l3 invpcid_single hw_pstate ssbd mba ibrs
lbrv svm_lock nirп save tsc_scale vmcb_clean flushbyasid decodeassists pausefilter
pf threshold avic v_msvare_vmload vgif v_spec_ctr1 avx512vmbi umip pku ospke
avx512 vmbi2 gfnı vaes vpcmulqdq axv512_vnnı axv512 bitalq axv512 vpocntdq la57
rdpid overflow_reco v succor smca fsm flush_l1d
Virtualization: AMD-V
L1d cache: 1.5 MiB (48 instances)
L1i cache: 1.5 MiB (48 instances)
L2 cache: 48 MiB (48 instances)
L3 cache: 128 MiB (8 instances)
NUMA node(s): 2
NUMA node0 CPU(s): 0-23
NUMA node1 CPU(s): 24-47
Vulnerability Itlb multihit: Not affected
Vulnerability L1tf: Not affected
Vulnerability Mds: Not affected
Vulnerability Meltdown: Not affected
Vulnerability Spec store bypass: Mitigation; Speculative Store Bypass disabled via
prct1 and seccomp
Vulnerability Spectre v1: Mitigation; usercopy/swapgs barriers and __user
pointer sanitization
Vulnerability Spectre v2: Mitigation; Retpolines, IBPB conditional, IBRS_FW,
STIBP disabled, RSB filling
Vulnerability Srbd: Not affected
Vulnerability Tsx async abort: Not affected

From lscpu --cache:
NAME ONE-SIZE ALL-SIZE WAYS TYPE LEVEL SETS PHY-LINE COHERENCY-SIZE
L1d 32K 1.5M 8 Data 1 64 1 64

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Platform Notes (Continued)

L1i  32K  1.5M  8 Instruction  1  64  1  64
L2  1M   48M  8 Unified       2  2048 1  64
L3  16M  128M 16 Unified      3 16384 1  64

/platforminfo cache data
    cache size : 1024 KB

From numactl --hardware
WARNING: a numactl 'node' might or might not correspond to a physical chip.
available: 2 nodes (0-1)
node 0 cpus: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
node 0 size: 386636 MB
node 0 free: 385136 MB
node 1 cpus: 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47
node 1 size: 386779 MB
node 1 free: 385850 MB
node distances:
    node 0  1
    0:  10  32
    1:  32  10

From /proc/meminfo
    MemTotal:       791977960 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-SP4"
        VERSION_ID="15.4"
        PRETTY_NAME="SUSE Linux Enterprise Server 15 SP4"
        ID="sles"
        ID_LIKE="suse"
        ANSI_COLOR="0;32"
        CPE_NAME="cpe:/o:suse:sles:15:sp4"

uname -a:
    Linux localhost 5.14.21-150400.22-default #1 SMP PREEMPT_DYNAMIC Wed May 11 06:57:18 UTC 2022 (49db222) x86_64 x86_64 x86_64 GNU/Linux

Kernel self-reported vulnerability status:
    CVE-2018-12207 (iTLB Multihit): Not affected
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Platform Notes (Continued)

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: Retpolines, IBPB: conditional, IBRS_FW, STIBP: disabled, RSB filling
CVE-2020-0543 (Special Register Buffer Data Sampling): Not affected
CVE-2019-11135 (TSX Asynchronous Abort): Not affected
run-level 3 Jan 22 16:55
SPEC is set to: /home/cpu2017-1.1.8-amd-aocc400-genoa-B1b
Filesystem Type Size Used Avail Use% Mounted on
/dev/nvme0n1p3 xfs 3.5T 28G 3.5T 1% /

From /sys/devices/virtual/dmi/id
Vendor: Lenovo
Product: ThinkSystem SD665 V3
Product Family: ThinkSystem
Serial: 1234567890

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:
2x Samsung M321R4GA3BB0–CQKEG 32 GB 2 rank 4800
3x Samsung M321R4GA3BB0–CQKMG 32 GB 2 rank 4800
7x Samsung M321R4GA3BB0–CQKV 32 GB 2 rank 4800
5x Samsung M321R4GA3BB6–CQKEG 32 GB 2 rank 4800
7x Samsung M321R4GA3BB6–CQKV 32 GB 2 rank 4800

BIOS:
BIOS Vendor: Lenovo
BIOS Version: QGE1050–1.10
BIOS Date: 12/19/2022
BIOS Revision: 1.10
Firmware Revision: 0.90

(End of data from sysinfo program)
## Lenovo Global Technology

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### SPEC CPU®2017 Floating Point Speed Result

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| Lenovo Global Technology | Lenovo Global Technology |

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### Compiler Version Notes

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<td>638.imagick_s(base, peak)</td>
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<td>C++, C, Fortran</td>
<td>607.cactuBSSN_s(base, peak)</td>
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**Compiler Version Notes (Continued)**

- LLVM Mirror.Version.14.0.6
- Target: x86_64-unknown-linux-gnu
- Thread model: posix
- InstalledDir: /opt/AMD/aocc/aocc-compiler-rel-4.0-3206-389/bin

AMD clang version 14.0.6 (CLANG: AOCC_4.0.0-Build#389 2022_10_07) (based on LLVM Mirror.Version.14.0.6)
- Target: x86_64-unknown-linux-gnu
- Thread model: posix
- InstalledDir: /opt/AMD/aocc/aocc-compiler-rel-4.0-3206-389/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
- 623.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
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Base Optimization Flags

C benchmarks:
-m64 -Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3 -O3 -march=znver4
-fvcc=AMDLIBM -ffast-math -fopenmp -flto -fstruct-layout=7
-mllvm -unroll-threshold=50 -mllvm -inline-threshold=1000
-fremap-arrays -fstrip-mining -mllvm -reduce-array-computations=3
-DSPEC_OPENMP -zopt -fopenmp=libomp -lomp -lamdlibm -lamdalloc
-lflang

Fortran benchmarks:
-m64 -Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3
-Wl,-mllvm -Wl,-enable-X86-prefetching -DSPEC_OPENMP -O3 -march=znver4
-fvcc=AMDLIBM -ffast-math -fopenmp -flto -Mrecursive
-funroll-loops -mllvm -lsr-in-nested-loop
-mllvm -reduce-array-computations=3 -zopt -fopenmp=libomp -lomp
-lamdlibm -lamdalloc -lflang

Benchmarks using both Fortran and C:
-m64 -Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3
-Wl,-mllvm -Wl,-enable-X86-prefetching -DSPEC_OPENMP -O3 -march=znver4
-fvcc=AMDLIBM -ffast-math -fopenmp -flto -Mrecursive
-fstruct-layout=7
-mllvm -unroll-threshold=50 -mllvm -inline-threshold=1000
-fremap-arrays -fstrip-mining -mllvm -reduce-array-computations=3
-DSPEC_OPENMP -zopt -Mrecursive -funroll-loops
-mllvm -lsr-in-nested-loop -fopenmp=libomp -lomp -lamdlibm -lamdalloc
-lflang

Benchmarks using Fortran, C, and C++:
-m64 -Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3
-Wl,-mllvm -Wl,-x86-use-vzeroupper=false -O3 -march=znver4
-fvcc=AMDLIBM -ffast-math -fopenmp -flto -fstruct-layout=7
-mllvm -unroll-threshold=50 -mllvm -inline-threshold=1000
-fremap-arrays -fstrip-mining -mllvm -reduce-array-computations=3
-DSPEC_OPENMP -zopt -mllvm -unroll-threshold=100 -finline-aggressive
-mllvm -loop-unswitch-threshold=200000 -Mrecursive -funroll-loops
-mllvm -lsr-in-nested-loop -fopenmp=libomp -lomp -lamdlibm -lamdalloc
-lflang
Lenovo Global Technology
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SPECspeed®2017_fp_base = 259
SPECspeed®2017_fp_peak = 261

Base Other Flags

C benchmarks:
-Wno-return-type -Wno-unused-command-line-argument

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

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

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

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

638.imagick_s: -m64 -Wl,-mlllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mlllvm -Wl,-reduce-array-computations=3 -Ofast
-march=znver4 -fveclib=AMDLIBM -ffast-math -fopenmp
-flto -fstruct-layout=9 -mlllvm -unroll-threshold=50

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Lenovo Global Technology
ThinkSystem SD665 V3
(2.50 GHz, AMD EPYC 9224)

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<th>9017</th>
<th>Test Date:</th>
<th>Jan-2023</th>
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<td>Lenovo Global Technology</td>
<td>Hardware Availability:</td>
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<td>Lenovo Global Technology</td>
<td>Software Availability:</td>
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</table>

### SPECspeed®2017_fp_base = 259

### SPECspeed®2017_fp_peak = 261

**Peak Optimization Flags (Continued)**

638.imagick_s (continued):
- `fremap-arrays -fstrip-mining`
- `-mlirv -inline-threshold=1000`
- `-mlirv -reduce-array-computations=3 -DSPEC_OPENMP -zopt`
- `-fopenmp=libomp -lomp -lamdlibm -lamdalloc -lflang`

644.nab_s: basepeak = yes

Fortran benchmarks:

603.bwaves_s: `-m64 -Wl,-mlirv -Wl,-align-all-nofallthru-blocks=6`
- `-Wl,-mlirv -Wl,-reduce-array-computations=3`
- `-Wl,-mlirv -Wl,-enable-X86-prefetching -DSPEC_OPENMP`
- `-Ofast -march=znver4 -iveclib=AMDLIBM -ffast-math`
- `-fopenmp -Mrecursive -mlirv -reduce-array-computations=3`
- `-fvector-transform -fscalar-transform -fopenmp=libomp`
- `-lomp -lamdlibm -lamdalloc -lflang`

649.fotonik3d_s: `-m64 -Wl,-mlirv -Wl,-align-all-nofallthru-blocks=6`
- `-Wl,-mlirv -Wl,-reduce-array-computations=3`
- `-Wl,-mlirv -Wl,-enable-X86-prefetching -DSPEC_OPENMP`
- `-Ofast -march=znver4 -iveclib=AMDLIBM -ffast-math`
- `-fopenmp -flto -Mrecursive`
- `-mlirv -reduce-array-computations=3 -zopt -fopenmp=libomp`
- `-lomp -lamdlibm -lamdalloc -lflang`

654.roms_s: basepeak = yes

Benchmarks using both Fortran and C:

621.wrf_s: `-m64 -Wl,-mlirv -Wl,-align-all-nofallthru-blocks=6`
- `-Wl,-mlirv -Wl,-reduce-array-computations=3`
- `-Wl,-mlirv -Wl,-enable-X86-prefetching -Ofast`
- `-march=znver4 -iveclib=AMDLIBM -ffast-math -fopenmp`
- `-flto -fstruct-layout=9 -mlirv -unroll-threshold=50`
- `-fremap-arrays -fstrip-mining`
- `-mlirv -inline-threshold=1000`
- `-mlirv -reduce-array-computations=3 -DSPEC_OPENMP -zopt`
- `-O3 -Mrecursive -funroll-loops -mlirv -lsr-in-nested-loop`
- `-fopenmp=libomp -lomp -lamdlibm -lamdalloc -lflang`

627.cam4_s: basepeak = yes

628.pop2_s: `-m64 -Wl,-mlirv -Wl,-align-all-nofallthru-blocks=6`
- `-Wl,-mlirv -Wl,-reduce-array-computations=3`
- `-Wl,-mlirv -Wl,-enable-X86-prefetching -Ofast`

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SPECspeed®2017_fp_base = 259
SPECspeed®2017_fp_peak = 261

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Peak Optimization Flags (Continued)

628.pop2_s (continued):
-march=zner4 -fveclib=AMDLIBM -ffast-math -fopenmp
-flto -fstruct-layout=9 -mllvm -unroll-threshold=50
-fremap-arrays -fstrip-mining
-mllvm -inline-threshold=1000
-mllvm -reduce-array-computations=3 -DSPEC_OPENMP -zopt
-Mrecursive -fvector-transform -fscalar-transform
-fopenmp=libomp -lomp -lamdlibm -lamdalloc -lflang

Benchmarks using Fortran, C, and C++:
607.cactuBSSN_s: basepeak = yes

Peak Other Flags

C benchmarks:
-Wno-return-type -Wno-unused-command-line-argument

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

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

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

The flags files that were used to format this result can be browsed at
http://www.spec.org/cpu2017/flags/Lenovo-Platform-SPECcpu2017-Flags-V1.2-Genoa-Q.html
http://www.spec.org/cpu2017/flags/aocc400-flags.html

You can also download the XML flags sources by saving the following links:
http://www.spec.org/cpu2017/flags/Lenovo-Platform-SPECcpu2017-Flags-V1.2-Genoa-Q.xml
http://www.spec.org/cpu2017/flags/aocc400-flags.xml

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