**SPEC CPU®2017 Integer Speed Result**

**Hewlett Packard Enterprise**  
(Test Sponsor: HPE)  
ProLiant DL345 Gen11  
(3.00 GHz, AMD EPYC 9124)

**SPECspeed®2017_int_base = 12.8**  
**SPECspeed®2017_int_peak = 12.8**

<table>
<thead>
<tr>
<th>Threads</th>
<th>SPECspeed®2017_int_base (12.8)</th>
<th>SPECspeed®2017_int_peak (12.8)</th>
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<tbody>
<tr>
<td>600.perlbench_s</td>
<td>16</td>
<td>8.06</td>
</tr>
<tr>
<td>602.gcc_s</td>
<td>16</td>
<td>19.7</td>
</tr>
<tr>
<td>605.mcf_s</td>
<td>16</td>
<td>6.70</td>
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<td>620.omnetpp_s</td>
<td>16</td>
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<td>623.xalancbmk_s</td>
<td>16</td>
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<tr>
<td>625.x264_s</td>
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<td>6.84</td>
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<tr>
<td>631.deepsjeng_s</td>
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<td>5.83</td>
</tr>
<tr>
<td>641.leela_s</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>648.exchange2_s</td>
<td>16</td>
<td>25.9</td>
</tr>
<tr>
<td>657.xz_s</td>
<td>16</td>
<td>21.5</td>
</tr>
</tbody>
</table>

**Hardware**

- **CPU Name:** AMD EPYC 9124  
- **Max MHz:** 3700  
- **Nominal:** 3000  
- **Enabled:** 16 cores, 1 chip  
- **Orderable:** 1 chip  
- **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 / 4 cores  
- **Other:** None  
- **Memory:** 384 GB (12 x 32 GB 2Rx8 PC5-4800B-R)  
- **Storage:** 1 x 1.6 TB NVMe SSD, RAID 0  
- **Other:** None

**Software**

- **OS:** Ubuntu 22.04.1 LTS  
- **Kernel:** 5.15.0-53-generic  
- **Compiler:** C/C++/Fortran: Version 4.0.0 of AOCC  
- **Parallel:** Yes  
- **Firmware:** HPE BIOS Version v1.12 11/24/2022 released  
- **File System:** ext4  
- **System State:** Run level 5 (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
Results Table

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Threads</th>
<th>Seconds</th>
<th>Ratio</th>
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<td>25.4</td>
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<tr>
<td>657.xz_s</td>
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<td>287</td>
<td>21.5</td>
<td>287</td>
<td>21.5</td>
</tr>
</tbody>
</table>

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.
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.
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**Operating System Notes (Continued)**

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:
- GOMP_CPU_AFFINITY = "0-15"
- LD_LIBRARY_PATH = "/home/cpu2017/amd_speed_aocc400_genoa_B_lib/lib:"
- LIBOMP_NUM_HIDDEN_HELPER_THREADS = "0"
- MALLOC_CONF = "oversize_threshold:0,retain:true"
- OMP_DYNAMIC = "false"
- OMP_SCHEDULE = "static"
- OMP_STACKSIZE = "128M"
- OMP_THREADLIMIT = "16"

Environment variables set by runcpu during the 605.mcf_s peak run:
- GOMP_CPU_AFFINITY = "15"

Environment variables set by runcpu during the 620.omnetpp_s peak run:
- GOMP_CPU_AFFINITY = "15"

**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
- Workload Profile set to General Peak Frequency Compute
- Determinism Control set to Manual
- Performance Determinism set to Power Deterministic
- AMD SMT Option set to Disabled
- NUMA memory domains per socket set to Four memory domains per socket
- Last-Level Cache (LLC) as NUMA Node set to Enabled

(Continued on next page)
Hewlett Packard Enterprise

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CPU2017 License: 3
Test Sponsor: HPE
Test Date: Dec-2022
Tested by: HPE
Hardware Availability: Dec-2022
Software Availability: Nov-2022

Platform Notes (Continued)

ACPI CST C2 Latency set to 18 microseconds
Memory PStates set to Disabled
Thermal Configuration set to Maximum Cooling

The system ROM used for this result contains microcode version 0x0A10110e for the AMD EPYC 9nn4X family of processors. The reference code/AGESA version used in this ROM is version GenoaPI 1.0.0.1-L6

Sysinfo program /home/cpu2017/bin/sysinfo
Rev: r6622 of 2021-04-07 982a61ec0915b55891ef0e16aaca64d
running on admin1 Mon Jun 27 18:34:27 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 9124 16-Core Processor
 1 "physical id"s (chips)
 16 "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 : 16
siblings : 16
physical 0: cores 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

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): 16
On-line CPU(s) list: 0-15
Vendor ID: AuthenticAMD
Model name: AMD EPYC 9124 16-Core Processor
CPU family: 25
Model: 17
Thread(s) per core: 1
Core(s) per socket: 16
Socket(s): 1
Stepping: 1
Frequency boost: enabled
CPU max MHz: 3713.0000
CPU min MHz: 400.0000
BogoMIPS: 5990.64
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

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**Platform Notes (Continued)**

```
pdpe1gb rdtscp lm constant_tsc rep_good nop1 nonstop_tsc cpuid extd_apicid
aperfmonperf rapi 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 osvw ibs skinit wdt tce topoext perfctr_core perfctr_nb
bpxext perfctr_l1l mwaitx cpb cat_l3 cdp_l3 invpcid_single hw_pstate ssbd mba ibrs
ibpb stibp vmmcall fsqsb base bni1 avx2 smep bni2 erms invpcid cm qrdt_a avx512f
avx512dq rdseed adv smap avx512ifma clflushopt clwb avx512cd sha_ni avx512bw
avx512vl xsaveopt xsaveopt xgetbv1 xsaves cm qmb cmq _occup_l1l cmq _mbm _total

cmq _mbm _local avx512_bf16 clzero irperf xsavepr tr dp ru wboin v d amd _ppin cppc arat

t npi lbrv svm _lock nr _i _save tsc _scale vmcb _clean flushbyas id decodeassists
pausefilter pff _threshold avic v_vmsave_vmload vg _if _v _spec _ctrl avx512vbmi umpk pku
ospke avx512_vmb i2 gfin vaes vpcm ul dq avx512_vnni avx512 _bitalg avx512_vpopcntdq
la57 rdpid overflow _reco v succor smca fsrm flush_l1d

Virtualization: AMD-V
```

```
L1d cache: 512 KiB (16 instances)
L1i cache: 512 KiB (16 instances)
L2 cache: 16 MiB (16 instances)
L3 cache: 64 MiB (4 instances)
NUMA node(s): 4
NUMA node0 CPU(s): 0-3
NUMA node1 CPU(s): 8-11
NUMA node2 CPU(s): 12-15
NUMA node3 CPU(s): 4-7

Vulnerability Itlb multihit: Not affected
Vulnerability L1tf: Not affected
Vulnerability Mds: Not affected
Vulnerability Meltdown: Not affected
Vulnerability Mmio stale data: Not affected
Vulnerability Retbleed: Not affected
Vulnerability Spec store bypass: Mitigation; Speculative Store Bypass disabled via prctl 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, PBRSB-eIBRS Not affected
Vulnerability Srbds: Not affected
Vulnerability Tsx async abort: Not affected

From lscpu --cache:
```
<table>
<thead>
<tr>
<th>NAME</th>
<th>ONE-SIZE</th>
<th>ALL-SIZE</th>
<th>WAYS</th>
<th>TYPE</th>
<th>LEVEL</th>
<th>SETS</th>
<th>PHY-LINE</th>
<th>COHERENCY-SIZE</th>
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<tr>
<td>L1d</td>
<td>32K</td>
<td>512K</td>
<td>8</td>
<td>Data</td>
<td>1</td>
<td>64</td>
<td>1</td>
<td>64</td>
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<tr>
<td>L1i</td>
<td>32K</td>
<td>512K</td>
<td>8</td>
<td>Instruction</td>
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<td>64</td>
<td>1</td>
<td>64</td>
</tr>
<tr>
<td>L2</td>
<td>1M</td>
<td>16M</td>
<td>8</td>
<td>Unified</td>
<td>2</td>
<td>2048</td>
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<td>64</td>
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<tr>
<td>L3</td>
<td>16M</td>
<td>64M</td>
<td>16</td>
<td>Unified</td>
<td>3</td>
<td>16384</td>
<td>1</td>
<td>64</td>
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</tbody>
</table>
```

/proc/cpuinfo cache data
```
cache size : 1024 KB
```

(Continued on next page)
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<tbody>
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<td>Hardware Availability:</td>
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<td>Tested by: HPE</td>
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</tr>
</tbody>
</table>

**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: 96456 MB
node 0 free: 96152 MB
node 1 cpus: 8 9 10 11
node 1 size: 96766 MB
node 1 free: 96395 MB
node 2 cpus: 12 13 14 15
node 2 size: 96693 MB
node 2 free: 96363 MB
node 3 cpus: 4 5 6 7
node 3 size: 96766 MB
node 3 free: 96530 MB

node distances:

<table>
<thead>
<tr>
<th>node</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
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<td>10</td>
<td>11</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>1:</td>
<td>11</td>
<td>10</td>
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<tr>
<td>2:</td>
<td>11</td>
<td>10</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>3:</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>10</td>
</tr>
</tbody>
</table>

From `/proc/meminfo`

MemTotal: 395963896 kB
HugePages_Total: 0
Hugepagesize: 2048 kB

/sbin/tuned-adm active

Current active profile: throughput-performance

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

/usr/bin/lsb_release -d

Ubuntu 22.04.1 LTS

From `/etc/*release` /etc/*version*

debian_version: bookworm/sid

os-release:

    PRETTY_NAME="Ubuntu 22.04.1 LTS"
    NAME="Ubuntu"
    VERSION_ID="22.04"
    VERSION="22.04.1 LTS (Jammy Jellyfish)"
    VERSION_CODENAME=jammy
    ID=ubuntu
    ID_LIKE=debian

(Continued on next page)
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Platform Notes (Continued)

HOME_URL="https://www.ubuntu.com/"

uname -a:
    Linux admin1 5.15.0-53-generic #59-Ubuntu SMP Mon Oct 17 18:53:30 UTC 2022 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
mmap_stale_data: Not affected
retbleed: 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, PBRSB-eIBRS: Not affected
CVE-2020-0543 (Special Register Buffer Data Sampling): Not affected
CVE-2019-11135 (TSX Asynchronous Abort): Not affected

run-level 5 Jun 27 18:30

SPEC is set to: /home/cpu2017

From /sys/devices/virtual/dmi/id
    Vendor: HPE
    Product: ProLiant DL345 Gen11
    Product Family: ProLiant
    Serial: DL3x5GEN11

Additional information from dmidecode 3.3 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:
    4x Hynix HMC8G8AE8RA168N 32 GB 2 rank 4800
    4x Hynix HMC8G8M8E8RA113N 32 GB 2 rank 4800
    4x Hynix HMC8G8M8E8RA115N 32 GB 2 rank 4800

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**Tested by:** HPE

**Platform Notes (Continued)**

**BIOS:**

- **BIOS Vendor:** HPE  
- **BIOS Version:** 1.12  
- **BIOS Date:** 11/24/2022  
- **BIOS Revision:** 1.12  
- **Firmware Revision:** 1.10

(End of data from sysinfo program)

**Compiler Version Notes**

---

**C**

- 600.perlbench_s(base, peak)  
- 602.gcc_s(base, peak)  
- 605.mcf_s(base, peak)  
- 625.x264_s(base, peak)  
- 657.xz_s(base, peak)

**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

---

**C++**

- 620.omnetpp_s(base, peak)  
- 623.xalancbmk_s(base, peak)  
- 631.deepsjeng_s(base, peak)  
- 641.leela_s(base, peak)

**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

---

**Fortran**

- 648.exchange2_s(base, peak)

**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
SPEC CPU®2017 Integer Speed Result
Copyright 2017-2023 Standard Performance Evaluation Corporation

Hewlett Packard Enterprise
(Test Sponsor: HPE)
ProLiant DL345 Gen11
(3.00 GHz, AMD EPYC 9124)

SPECspeed®2017_int_base = 12.8
SPECspeed®2017_int_peak = 12.8

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</tr>
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<td>Software Availability: Nov-2022</td>
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</tbody>
</table>

Base Compiler Invocation

C benchmarks:
clang

C++ benchmarks:
clang++

Fortran benchmarks:
flang

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:
-m64 -Wl,-mlvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mlvm -Wl,-reduce-array-computations=3
-Wl,-allow-multiple-definition -O3 -march=znver4 -fveclib=AMDLIBM
-ffast-math -fopenmp -flto -fstruct-layout=7
-mlvm -unroll-threshold=50 -mlvm -inline-threshold=1000
-fremap-arrays -fstrip-mining -mlvm -reduce-array-computations=3
-DSPEC_OPENMP -zopt -fopenmp=libomp -lomp -lamdlibm -llflang
-landalloc

C++ benchmarks:
-m64 -Wl,-mlvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mlvm -Wl,-reduce-array-computations=3 -O3 -march=znver4
-fveclib=AMDLIBM -ffast-math -fopenmp -flto
-mlvm -unroll-threshold=100 -finline-aggressive
-mlvm -loop-unschedule-threshold=200000
-mlvm -reduce-array-computations=3 -DSPEC_OPENMP -zopt
-fvirtual-function-elimination -fvisibility=hidden -fopenmp=libomp

(Continued on next page)
Base Optimization Flags (Continued)

C++ benchmarks (continued):
- lomp -lamdlibm -lflang -lamdalloc-ext

Fortran benchmarks:
- m64 -W1,-mllvm -W1,-lm -W1,-align-all-nofallthru-blocks=6
- W1,-mllvm -W1,-reduce-array-computations=3
- W1,-mllvm -W1,-inline-recursion=4 -W1,-mllvm -W1,-lsr-in-nested-loop
- W1,-mllvm -W1,-enable-iv-split -O3 -march=znver4 -fveclib=AMDLIBM
- fffast-math -fopenmp -flto -mllvm -march=native -optimize-strided-mem-cost
- mllvm -unroll-aggressive -mllvm -unroll-threshold=150 -fopenmp=libomp
- lomp -lamdlibm -lflang -lamdalloc

Base Other Flags

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

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

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

Peak Compiler Invocation

C benchmarks:
clang

C++ benchmarks:
clang++

Fortran benchmarks:
flang

Peak Portability Flags

Same as Base Portability Flags
Peak Optimization Flags

C benchmarks:

600.perlbench_s: basepeak = yes

602.gcc_s: basepeak = yes

605.mcf_s: -m64 -Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6 -Wl,-mllvm -Wl,-reduce-array-computations=3 -Wl,-allow-multiple-definition -Ofast -march=znver4 -fveclib=AMDLIBM -ffast-math -fopenmp -flto
-fstruct-layout=9 -mllvm -unroll-threshold=50 -fremap-arrays -fstrip-mining -mllvm -inline-threshold=1000

625.x264_s: basepeak = yes

657.xz_s: basepeak = yes

C++ benchmarks:

620.omnetpp_s: -m64 -Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6 -Wl,-mllvm -Wl,-reduce-array-computations=3 -Ofast -march=znver4 -fveclib=AMDLIBM -ffast-math -fopenmp -flto -finline-aggressive -mllvm -unroll-threshold=100
-fvirtual-function-elimination -fvisibility=hidden -fopenmp=libomp -lomp -lamdlibm -lamdalloc -lflang

623.xalancbmk_s: basepeak = yes

631.deepsjeng_s: basepeak = yes

641.leela_s: basepeak = yes

Fortran benchmarks:

648.exchange2_s: basepeak = yes

Peak Other Flags

C benchmarks:

-Wno-return-type -Wno-unused-command-line-argument

(Continued on next page)
Hewlett Packard Enterprise  
(Test Sponsor: HPE)  
ProLiant DL345 Gen11  
(3.00 GHz, AMD EPYC 9124)  

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### SPEC CPU®2017 Integer Speed Result

**SPECspeed®2017_int_base = 12.8**  
**SPECspeed®2017_int_peak = 12.8**

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**Peak Other Flags (Continued)**

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

Fortran benchmarks:  
- `-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/HPE-Platform-Flags-AMD-Genoa-rev2.1.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/HPE-Platform-Flags-AMD-Genoa-rev2.1.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.

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