# SPEC CPU®2017 Integer Rate Result

**Dell Inc.**  
PowerEdge R440 (Intel Xeon Silver 4216, 2.10 GHz)

<table>
<thead>
<tr>
<th>Test Sponsor:</th>
<th>Dell Inc.</th>
<th>Hardware Availability: Apr-2020</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Software Availability: Apr-2020</td>
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<tr>
<td>CPU2017 License:</td>
<td>55</td>
<td>Test Date: Apr-2020</td>
</tr>
</tbody>
</table>

**SPECrack®2017_int_base** = 186  
**SPECrack®2017_int_peak** = 193

**Copies**

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Copies</th>
<th>SPECrate®2017_int_base (186)</th>
<th>SPECrate®2017_int_peak (193)</th>
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</thead>
<tbody>
<tr>
<td>perlbench_r</td>
<td>64</td>
<td>147</td>
<td>308</td>
</tr>
<tr>
<td>gcc_r</td>
<td>64</td>
<td>146</td>
<td>312</td>
</tr>
<tr>
<td>mcf_r</td>
<td>64</td>
<td>169</td>
<td>355</td>
</tr>
<tr>
<td>omnetpp_r</td>
<td>64</td>
<td>131</td>
<td>243</td>
</tr>
<tr>
<td>xalancbmk_r</td>
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<td>243</td>
<td>347</td>
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<td>146</td>
<td></td>
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<tr>
<td>leela_r</td>
<td>64</td>
<td>136</td>
<td></td>
</tr>
<tr>
<td>exchange2_r</td>
<td>64</td>
<td>355</td>
<td></td>
</tr>
<tr>
<td>xz_r</td>
<td>64</td>
<td>113</td>
<td></td>
</tr>
</tbody>
</table>

**Hardware**

- **CPU Name:** Intel Xeon Silver 4216
- **Max MHz:** 3200
- **Nominal:** 2100
- **Enabled:** 32 cores, 2 chips, 2 threads/core
- **Orderable:** 1.2 chips
- **Cache L1:** 32 KB I + 32 KB D on chip per core
- **L2:** 1 MB I+D on chip per core
- **L3:** 22 MB I+D on chip per chip
- **Other:** None
- **Memory:** 384 GB (12 x 32 GB 2Rx8 PC4-3200V-R, running at 2400)
- **Storage:** 1 x 1.92 TB SATA SSD
- **Other:** None

**Software**

- **OS:** Red Hat Enterprise Linux 8.1  
  kernel 4.18.0-147.el8.x86_64
- **Compiler:** C/C++: Version 19.1.1.217 of Intel C/C++ Compiler for Linux;  
  Fortran: Version 19.1.1.217 of Intel Fortran Compiler for Linux
- **Parallel:** No
- **Firmware:** Version 2.7.7 released May-2020
  - BIOS set to prefer performance at the cost of additional power usage
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**Materials**

- **SPECrate®2017_int_base = 186**
- **SPECrate®2017_int_peak = 193**

---

**Results Table**

<table>
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<tr>
<th>Benchmark</th>
<th>Copies</th>
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<th>Ratio</th>
<th>Seconds</th>
<th>Ratio</th>
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<tr>
<td>500.perlbench_r</td>
<td>64</td>
<td>823</td>
<td>124</td>
<td>825</td>
<td>123</td>
<td>502.gcc_r</td>
<td>64</td>
<td>620</td>
<td>146</td>
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<td>335</td>
<td>308</td>
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<td>64</td>
<td>643</td>
<td>131</td>
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<td>131</td>
</tr>
<tr>
<td>523.xalanbmk_r</td>
<td>64</td>
<td>277</td>
<td>244</td>
<td>278</td>
<td>243</td>
<td>525.x264_r</td>
<td>64</td>
<td>315</td>
<td>356</td>
<td>315</td>
<td>355</td>
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<td>503</td>
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<td>782</td>
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</table>

**Compiler Notes**

The inconsistent Compiler version information under Compiler Version section is due to a discrepancy in Intel Compiler. The correct version of C/C++ compiler is: Version 19.1.1.217 Build 20200306 Compiler for Linux

The correct version of Fortran compiler is: Version 19.1.1.217 Build 20200306 Compiler for Linux

**Submit Notes**

The numactl mechanism was used to bind copies to processors. The config file option 'submit' was used to generate numactl commands to bind each copy to a specific processor. For details, please see the config file.

**Operating System Notes**

Stack size set to unlimited using "ulimit -s unlimited"

**Environment Variables Notes**

Environment variables set by runcpu before the start of the run:

```
LD_LIBRARY_PATH = 
"/home/cpu2017/lib/intel64:/home/cpu2017/lib/ia32:/home/cpu2017/je5.0.1-32"
```

```
MALLOC_CONF = "retain:true"
```
### General Notes

Binaries compiled on a system with 1x Intel Core i9-9900K CPU + 64GB RAM memory using Redhat Enterprise Linux 8.0

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.

Transparent Huge Pages enabled by default

Prior to runcpu invocation

Filesystem page cache synced and cleared with:

```bash
csync; echo 3>/proc/sys/vm/drop_caches
```

runcpu command invoked through numactl i.e.:

```bash
numactl --interleave=all runcpu <etc>
```

jemalloc, a general purpose malloc implementation

built with the RedHat Enterprise 7.5, and the system compiler gcc 4.8.5


### Platform Notes

BIOS settings:

- Virtualization Technology disabled
- System Profile set to Custom
- CPU Performance set to Maximum Performance
- C States set to Autonomous
- C1E disabled
- Uncore Frequency set to Dynamic
- Energy Efficiency Policy set to Performance
- Memory Patrol Scrub set to standard
- Logical Processor enabled
- CPU Interconnect Bus Link Power Management disabled
- PCI ASPM L1 Link Power Management disabled
- UPI Prefetch enabled
- LLC Prefetch disabled
- Dead Line LLC Alloc enabled
- Directory AtoS disabled

Sysinfo program /home/cpu2017/bin/sysinfo

Rev: r6365 of 2019-08-21 295195f888a3d7edble6e46a485a0011
running on localhost.localdomain Wed Jun 10 15:59:06 2020

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

(Continued on next page)
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**Platform Notes (Continued)**

model name : Intel(R) Xeon(R) Silver 4216 CPU @ 2.10GHZ
2 "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 : 16
siblings : 32
physical 0: cores 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
physical 1: 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:** 16
- **Socket(s):** 2
- **NUMA node(s):** 4
- **Vendor ID:** GenuineIntel
- **CPU family:** 65
- **Model:** 85
- **Model name:** Intel(R) Xeon(R) Silver 4216 CPU @ 2.10GHZ
- **Stepping:** 6
- **CPU MHz:** 1305.805
- **CPU max MHz:** 3200.0000
- **CPU min MHz:** 800.0000
- **BogoMIPS:** 4200.00
- **Virtualization:** VT-x
- **L1d cache:** 32K
- **L1i cache:** 32K
- **L2 cache:** 1024K
- **L3 cache:** 22528K
- **NUMA node0 CPU(s):** 0,4,8,12,16,20,24,28,32,36,40,44,48,52,56,60
- **NUMA node1 CPU(s):** 1,5,9,13,17,21,25,29,33,37,41,45,49,53,57,61
- **NUMA node2 CPU(s):** 2,6,10,14,18,22,26,30,34,38,42,46,50,54,58,62
- **NUMA node3 CPU(s):** 3,7,11,15,19,23,27,31,35,39,43,47,51,55,59,63
- **Flags:** fpu vme de pse tsc msr pae mce cx8 apic sep mtrr pge mca cmov pat pse36 clflush dts acpi mmx fxsr sse sse2 ss ht tm pbe syscall nx pdpe1gb rdtscp lm constant_tsc art arch_perfmon pebs bts rep_good nopl xtopology nonstop_tsc cpuid aperfmperf pni pclmulqdq dtes64 monitor ds_cpl vmx smx est tm2 ssse3 sdbg fma cx16 xtrunc pdcm pcid dca sse4_1 sse4_2 x2apic movbe popcnt tsc_deadline_timer aes xsave avx f16c rdrand lahf_lm abm 3dnowprefetch cpuid_fault epb cat_l3 cdp_c3 invpcid_single intel_pinned ssbd mba ibrs ibpb stibp ibrs_enhanced tpr_shadow vnmi flexpriority ept vpid fsgsbase tsc_adjust bmi1 hle avx2 smep bmi2 64bit lms invpcid rtm cqm mpx rdar ndt_a avx512f avx512dq rdseed adx smap clflushopt clwb intel_pt avx512cd

(Continued on next page)
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CPU2017 License: 55
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Tested by: Dell Inc.

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Test Sponsor: Dell Inc.
Hardware Availability: Apr-2020
Software Availability: Apr-2020

Platform Notes (Continued)

avx512bw avx512vl xsaveopt xsavex xgetbv1 xsaves cqm_llc cqm_occucll cqm_mbm_total
cqm_mbm_local dtherm ida arat plc pts pku ospke avx512_vnni md_clear flush_lid
darch_capabilities

/proc/cpuinfo cache data
cache size: 22528 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 4 8 12 16 20 24 28 32 36 40 44 48 52 56 60
node 0 size: 95306 MB
node 0 free: 94772 MB
node 1 cpus: 1 5 9 13 17 21 25 29 33 37 41 45 49 53 57 61
node 1 size: 96764 MB
node 1 free: 96117 MB
node 2 cpus: 2 6 10 14 18 22 26 30 34 38 42 46 50 54 58 62
node 2 size: 96764 MB
node 2 free: 96467 MB
node 3 cpus: 3 7 11 15 19 23 27 31 35 39 43 47 51 55 59 63
node 3 size: 96738 MB
node 3 free: 96343 MB
node distances:
node 0 1 2 3
0: 10 21 11 21
1: 21 10 21 11
2: 11 21 10 21
3: 21 11 21 10

From /proc/meminfo
MemTotal: 394828848 KB
HugePages_Total: 0
Hugepagesize: 2048 KB

From /etc/*release*/etc/*version*
os-release:
NAME="Red Hat Enterprise Linux"
VERSION="8.1 (Ootpa)"
ID="rhel"
ID_LIKE="fedora"
VERSION_ID="8.1"
PLATFORM_ID="platform:el8"
PRETTY_NAME="Red Hat Enterprise Linux 8.1 (Ootpa)"
ANSI_COLOR="0;31"
redhat-release: Red Hat Enterprise Linux release 8.1 (Ootpa)
system-release: Red Hat Enterprise Linux release 8.1 (Ootpa)
system-release-cpe: cpe:/o:redhat:enterprise_linux:8.1:ga

(Continued on next page)
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Platform Notes (Continued)

uname -a:
Linux localhost.localdomain 4.18.0-147.el8.x86_64 #1 SMP Thu Sep 26 15:52:44 UTC 2019
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: usercopy/swapgs barriers and __user pointer sanitization
CVE-2017-5715 (Spectre variant 2): Mitigation: Enhanced IBRS, IBPB: conditional, RSB filling

run-level 3 Jun 10 15:58 last=5
SPEC is set to: /home/cpu2017
Filesystem Type Size Used Avail Use% Mounted on
/dev/mapper/rhel-home xfs 1.7T 23G 1.7T 2% /home

From /sys/devices/virtual/dmi/id
BIOS: Dell Inc. 2.7.7 05/06/2020
Vendor: Dell Inc.
Product: PowerEdge R440
Product Family: PowerEdge
Serial: F9TD613

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:
12x 002C069D002C 36ASF4G72PZ-3G2E2 32 GB 2 rank 3200
4x Not Specified Not Specified

(End of data from sysinfo program)

Compiler Version Notes

==============================================================================
<table>
<thead>
<tr>
<th>C</th>
<th>502.gcc_r(peak)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intel(R) C Compiler for applications running on IA-32, Version 2021.1 NextGen</td>
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SPEC CPU®2017 Integer Rate Result

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CPU2017 License: 55
Test Sponsor: Dell Inc.
Tested by: Dell Inc.

Build 20200304
Test Date: Apr-2020
Hardware Availability: Apr-2020
Software Availability: Apr-2020

---

Compiler Version Notes (Continued)

Build 20200304
Copyright (C) 1985-2020 Intel Corporation. All rights reserved.

==============================================================================
C       | 500.perlbench_r(base) 502.gcc_r(base) 505.mcf_r(base, peak)
       | 525.x264_r(base, peak) 557.xz_r(base)
==============================================================================

Intel(R) C Compiler for applications running on Intel(R) 64, Version 2021.1
NextGen Build 20200304
Copyright (C) 1985-2020 Intel Corporation. All rights reserved.

==============================================================================
C       | 500.perlbench_r(peak) 557.xz_r(peak)
==============================================================================

Intel(R) C Intel(R) 64 Compiler for applications running on Intel(R) 64,
Version 19.1.1.217 Build 20200306
Copyright (C) 1985-2020 Intel Corporation. All rights reserved.

==============================================================================
C       | 502.gcc_r(peak)
==============================================================================

Intel(R) C Compiler for applications running on IA-32, Version 2021.1 NextGen
Build 20200304
Copyright (C) 1985-2020 Intel Corporation. All rights reserved.

==============================================================================
C       | 500.perlbench_r(base) 502.gcc_r(base) 505.mcf_r(base, peak)
       | 525.x264_r(base, peak) 557.xz_r(base)
==============================================================================

Intel(R) C Compiler for applications running on Intel(R) 64, Version 2021.1
NextGen Build 20200304
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==============================================================================
C       | 500.perlbench_r(peak) 557.xz_r(peak)
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Software Availability: Apr-2020

Compiler Version Notes (Continued)

C       | 502.gcc_r(peak)
------------------------------------------------------------------------------
Intel(R) C Compiler for applications running on IA-32, Version 2021.1 NextGen Build 20200304
Copyright (C) 1985-2020 Intel Corporation. All rights reserved.
------------------------------------------------------------------------------

C | 500.perlbench_r(base) 502.gcc_r(base) 505.mcf_r(base, peak)
  525.x264_r(base, peak) 557.xz_r(base)
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C | 500.perlbench_r(peak) 557.xz_r(peak)
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Intel(R) C Intel(R) 64 Compiler for applications running on Intel(R) 64, Version 19.1.1.217 Build 20200306
Copyright (C) 1985-2020 Intel Corporation. All rights reserved.
------------------------------------------------------------------------------

C++     | 520.omnetpp_r(base, peak) 523.xalancbmk_r(base, peak)
     | 531.deepsjeng_r(base, peak) 541.leela_r(base, peak)
------------------------------------------------------------------------------
Intel(R) C++ Compiler for applications running on Intel(R) 64, Version 2021.1 NextGen Build 20200304
Copyright (C) 1985-2020 Intel Corporation. All rights reserved.
------------------------------------------------------------------------------

Fortran | 548.exchange2_r(base, peak)
------------------------------------------------------------------------------
Intel(R) Fortran Intel(R) 64 Compiler for applications running on Intel(R) 64, Version 19.1.1.217 Build 20200306
Copyright (C) 1985-2020 Intel Corporation. All rights reserved.
------------------------------------------------------------------------------

Base Compiler Invocation

C benchmarks:
  icc

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**Base Compiler Invocation (Continued)**

C++ benchmarks:
- icpc

Fortran benchmarks:
- ifort

**Base Portability Flags**

500.perlbench_r: -DSPEC_LP64 -DSPEC_LINUX_X64
502.gcc_r: -DSPEC_LP64
505.mcf_r: -DSPEC_LP64
520.omnetpp_r: -DSPEC_LP64
523.xalancbmk_r: -DSPEC_LP64 -DSPEC_LINUX
525.x264_r: -DSPEC_LP64
531.deepsjeng_r: -DSPEC_LP64
541.leela_r: -DSPEC_LP64
548.exchange2_r: -DSPEC_LP64
557.xz_r: -DSPEC_LP64

**Base Optimization Flags**

C benchmarks:
- -m64 -qnextgen -std=c11
- -Wl,-plugin-opt=-x86-branches-within-32B-boundaries -Wl,-z,muldefs
- -xCORE-AVX2 -O3 -ffast-math -ftlo -mfpmath=sse -funroll-loops
- -fuse-ld=gold -qopt-mem-layout-trans=4
- -L/usr/local/IntelCompiler19/compilers_and_libraries_2020.1.217/linux/compiler/lib/intel64_lin
- -lqkmalloc

C++ benchmarks:
- -m64 -qnextgen -Wl,-plugin-opt=-x86-branches-within-32B-boundaries
- -Wl,-z,muldefs -xCORE-AVX2 -O3 -ffast-math -ftlo -mfpmath=sse
- -funroll-loops -fuse-ld=gold -qopt-mem-layout-trans=4
- -L/usr/local/IntelCompiler19/compilers_and_libraries_2020.1.217/linux/compiler/lib/intel64_lin
- -lqkmalloc

Fortran benchmarks:
- -m64 -Wl,-plugin-opt=-x86-branches-within-32B-boundaries -Wl,-z,muldefs
- -xCORE-AVX2 -O3 -ipo -no-prec-div -qopt-mem-layout-trans=4
- -nostandard-realloc-lhs -align array32byte -auto
- -mbranches-within-32B-boundaries
- -L/usr/local/IntelCompiler19/compilers_and_libraries_2020.1.217/linux/compiler/lib/intel64_lin

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Base Optimization Flags (Continued)

Fortran benchmarks (continued):
- -lqkmalloc

Peak Compiler Invocation

C benchmarks:
icc
C++ benchmarks:
icpc

Fortran benchmarks:
ifort

Peak Portability Flags

500.perlbench_r: -DSPEC_LP64 -DSPEC_LINUX_X64
502.gcc_r: -D_FILE_OFFSET_BITS=64
505.mcf_r: -DSPEC_LP64
520.omnetpp_r: -DSPEC_LP64
523.xalancbmk_r: -DSPEC_LP64 -DSPEC_LINUX
525.x264_r: -DSPEC_LP64
531.deepsjeng_r: -DSPEC_LP64
541.leela_r: -DSPEC_LP64
548.exchange2_r: -DSPEC_LP64
557.xz_r: -DSPEC_LP64

Peak Optimization Flags

C benchmarks:
500.perlbench_r: -Wl,-z,muldefs -prof-gen(pass 1) -prof-use(pass 2)
-xCORE-AVX2 -ipo -O3 -no-prec-div
-qopt-mem-layout-trans=4 -fno-strict-overflow
-mbranches-within-32B-boundaries
-L/usr/local/IntelCompiler19/compilers_and_libraries_2020.1.217/linux/compiler/lib/intel64_lin
-lqkmalloc
502.gcc_r: -m32
-L/usr/local/IntelCompiler19/compilers_and_libraries_2020.1.217/linux/compiler/lib/ia32_lin

(Continued on next page)
Dell Inc.  
PowerEdge R440 (Intel Xeon Silver 4216, 2.10 GHz)  

spec

SPEC CPU®2017 Integer Rate Result  
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PowerEdge R440 (Intel Xeon Silver 4216, 2.10 GHz)  

SPECrater®2017_int_base = 186  
SPECrater®2017_int_peak = 193

CPU2017 License: 55  
Test Sponsor: Dell Inc.  
Tested by: Dell Inc.  

Test Date: Apr-2020  
Hardware Availability: Apr-2020  
Software Availability: Apr-2020

Peak Optimization Flags (Continued)

502.gcc_r (continued):
  -std=gnu89
  -Wl,-plugin-opt=-x86-branches-within-32B-boundaries
  -Wl,-z,muldefs -fprofile-generate(pass 1)
  -fprofile-use=default.profdata(pass 2) -xCORE-AVX2 -flto
  -Ofast(pass 1) -O3 -ffast-math -qnextgen -fuse-ld=gold
  -qopt-mem-layout-trans=4 -L/usr/local/jemalloc32-5.0.1/lib
  -ljemalloc

505.mcf_r: basepeak = yes

525.x264_r: -m64 -qnextgen -std=c11
  -Wl,-plugin-opt=-x86-branches-within-32B-boundaries
  -Wl,-z,muldefs -xCORE-AVX2 -flto -O3 -ffast-math
  -fuse-ld=gold -qopt-mem-layout-trans=4 -fno-alias
  -L/usr/local/IntelCompiler19/compilers_and_libraries_2020.1.217/linux/compiler/lib/intel64_lin
  -lqkmalloc

557.xz_r: -Wl,-z,muldefs -xCORE-AVX2 -ipo -O3 -no-prec-div
  -qopt-mem-layout-trans=4 -mbranches-within-32B-boundaries
  -L/usr/local/IntelCompiler19/compilers_and_libraries_2020.1.217/linux/compiler/lib/intel64_lin
  -lqkmalloc

C++ benchmarks:

520.omnetpp_r: basepeak = yes

523.xalancbmk_r: basepeak = yes

531.deepsjeng_r: basepeak = yes

541.leela_r: basepeak = yes

Fortran benchmarks:

548.exchange2_r: basepeak = yes

The flags files that were used to format this result can be browsed at


You can also download the XML flags sources by saving the following links:

http://www.spec.org/cpu2017/flags/Intel-ic19.1u1-official-linux64_revA.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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