



SPEC CPU®2017 Integer Rate Result

Copyright 2017-2020 Standard Performance Evaluation Corporation

Dell Inc.

SPECrate®2017_int_base = 217

PowerEdge R640 (Intel Xeon Gold 6226R, 2.90 GHz)

SPECrate®2017_int_peak = 224

CPU2017 License: 55

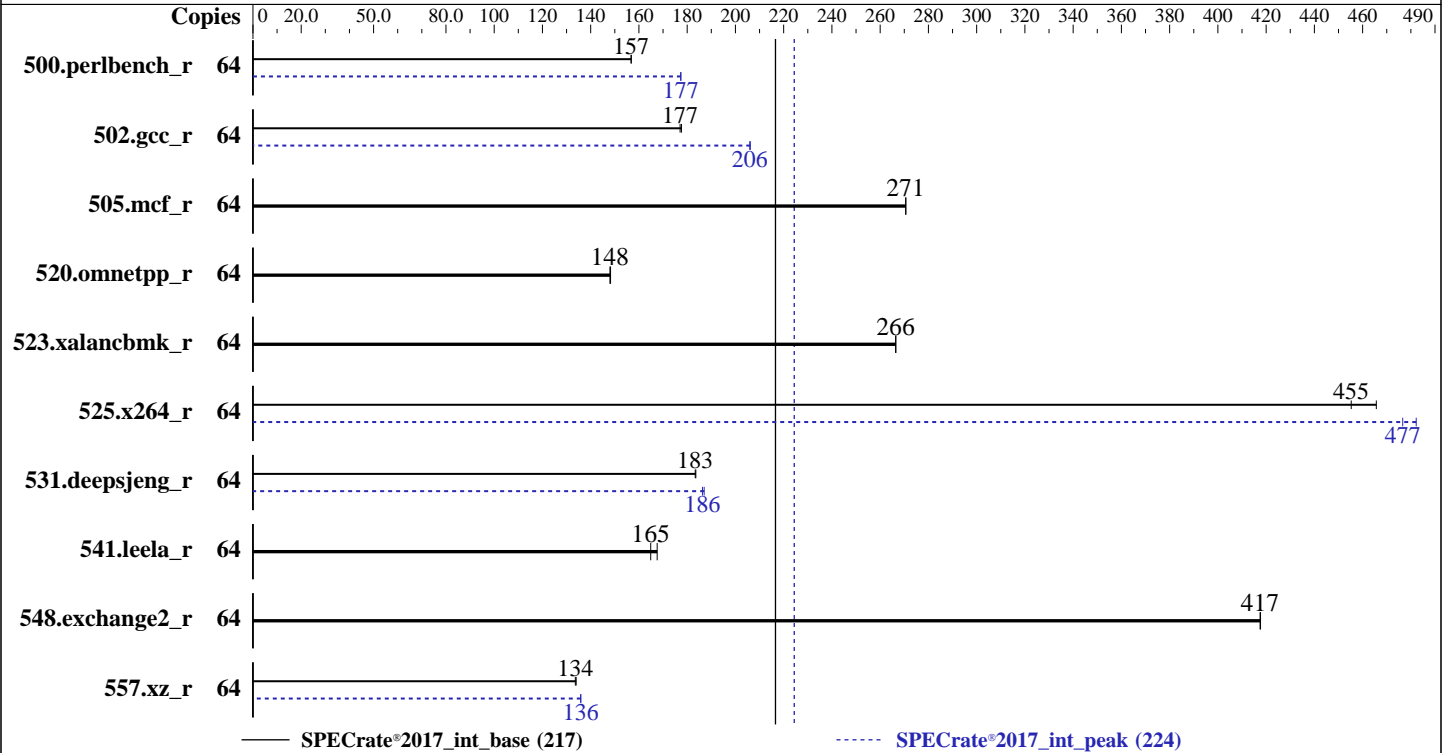
Test Date: Apr-2020

Test Sponsor: Dell Inc.

Hardware Availability: Feb-2020

Tested by: Dell Inc.

Software Availability: Nov-2019



Hardware

CPU Name: Intel Xeon Gold 6226R
 Max MHz: 3900
 Nominal: 2900
 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 (24 x 16 GB 2Rx8 PC4-2933V-R, running at 2933)
 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 19.0.5.281 of Intel C/C++ Compiler for Linux;
 Fortran: Version 19.0.5.281 of Intel Fortran Compiler for Linux
 Parallel: No
 Firmware: Version 2.5.4 released Jan-2020
 File System: tmpfs
 System State: Run level 3 (multi-user)
 Base Pointers: 64-bit
 Peak Pointers: 32/64-bit
 Other: jemalloc memory allocator V5.0.1
 Power Management: BIOS set to prefer performance at the cost of additional power usage.



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Results Table

Benchmark	Base							Peak						
	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio
500.perlbench_r	64	650	157	650	157			64	575	177	574	177		
502.gcc_r	64	512	177	510	178			64	440	206	440	206		
505.mcf_r	64	382	271	382	271			64	382	271	382	271		
520.omnetpp_r	64	566	148	567	148			64	566	148	567	148		
523.xalancbmk_r	64	254	266	254	267			64	254	266	254	267		
525.x264_r	64	246	455	241	466			64	232	482	235	477		
531.deepsjeng_r	64	400	184	400	183			64	394	186	392	187		
541.leela_r	64	633	168	643	165			64	633	168	643	165		
548.exchange2_r	64	402	417	401	418			64	402	417	401	418		
557.xz_r	64	517	134	516	134			64	509	136	509	136		

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

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 =
"/mnt/ramdisk/cpu2017/lib/intel64:/mnt/ramdisk/cpu2017/lib/ia32:/mnt/ramdisk/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.

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General Notes (Continued)

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:

```
sync; echo 3> /proc/sys/vm/drop_caches
```

runcpu command invoked through numactl i.e.:

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

Benchmark run from a 225 GB ramdisk created with the cmd: "mount -t tmpfs -o size=225G tmpfs /mnt/ramdisk"

jemalloc, a general purpose malloc implementation

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

sources available from jemalloc.net or <https://github.com/jemalloc/jemalloc/releases>

Platform Notes

BIOS settings:

Sub NUMA Cluster enabled

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 /mnt/ramdisk/cpu2017/bin/sysinfo

Rev: r6365 of 2019-08-21 295195f888a3d7edble6e46a485a0011

running on rhel-8-1-sut Fri Apr 17 17:50:44 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

```
model name : Intel(R) Xeon(R) Gold 6226R CPU @ 2.90GHz
```

```
2 "physical id"s (chips)
```

```
64 "processors"
```

cores, siblings (Caution: counting these is hw and system dependent. The following

(Continued on next page)



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Platform Notes (Continued)

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:            6
Model:                85
Model name:            Intel(R) Xeon(R) Gold 6226R CPU @ 2.90GHz
Stepping:              7
CPU MHz:               3581.053
CPU max MHz:           3900.0000
CPU min MHz:           1200.0000
BogoMIPS:              5800.00
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 pdpelt rdtscp
lm constant_tsc art arch_perfmon pebs bts rep_good nopl xtopology nonstop_tsc cpuid
aperfmpperf pni pclmulqdq dtes64 monitor ds_cpl vmx smx est tm2 ssse3 sdbg fma cx16
xtpr 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_l3
invpcid_single intel_ppin ssbd mba ibrs ibpb stibp ibrs_enhanced tpr_shadow vnmi
flexpriority ept vpid fsgsbase tsc_adjust bmi1 hle avx2 smep bmi2 erms invpcid rtm
cqm mpx rdt_a avx512f avx512dq rdseed adx smap clflushopt clwb intel_pt avx512cd
avx512bw avx512vl xsaveopt xsavec xgetbv1 xsaves cqm_llc cqm_occup_llc cqm_mbm_total
cqm_mbm_local dtherm ida arat pln pts pku ospke avx512_vnni md_clear flush_l1d
arch_capabilities

```

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Platform Notes (Continued)

```
/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: 79610 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: 96320 MB
node 2 cpus: 2 6 10 14 18 22 26 30 34 38 42 46 50 54 58 62
node 2 size: 96739 MB
node 2 free: 96446 MB
node 3 cpus: 3 7 11 15 19 23 27 31 35 39 43 47 51 55 59 63
node 3 size: 96764 MB
node 3 free: 96565 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: 394828124 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
```

```
uname -a:
Linux rhel-8-1-sut 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
```

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Platform Notes (Continued)

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/swaps barriers and __user pointer sanitization
CVE-2017-5715 (Spectre variant 2):	Mitigation: Enhanced IBRS, IBPB: conditional, RSB filling

run-level 3 Apr 17 17:42 last=5

SPEC is set to: /mnt/ramdisk/cpu2017

Filesystem	Type	Size	Used	Avail	Use%	Mounted on
tmpfs	tmpfs	225G	7.4G	218G	4%	/mnt/ramdisk

From /sys/devices/virtual/dmi/id

```

BIOS:      Dell Inc. 2.5.4 01/13/2020
Vendor:    Dell Inc.
Product:   PowerEdge R640
Product Family: PowerEdge
Serial:    FPFXCH2

```

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:

```

10x 002C069D002C 18ASF2G72PDZ-2G9E1 16 GB 2 rank 2933
4x 00AD00B300AD HMA82GR7CJR8N-WM 16 GB 2 rank 2933
8x 00AD00B300AD HMA82GR7CJR8N-XN 16 GB 2 rank 3200
2x 00AD063200AD HMA82GR7CJR8N-WM 16 GB 2 rank 2933

```

(End of data from sysinfo program)

Compiler Version Notes

C | 502.gcc_r(peak)

```

Intel(R) C Compiler for applications running on IA-32, Version 19.0.5 NextGen
Technology Build 20190729
Copyright (C) 1985-2019 Intel Corporation. All rights reserved.

```

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Compiler Version Notes (Continued)

```
=====
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 19.0.5
NextGen Technology Build 20190729
Copyright (C) 1985-2019 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 19.0.5.281 Build 20190815
Copyright (C) 1985-2019 Intel Corporation. All rights reserved.
-----
```

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

```
Intel(R) C Compiler for applications running on IA-32, Version 19.0.5 NextGen
Technology Build 20190729
Copyright (C) 1985-2019 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 19.0.5
NextGen Technology Build 20190729
Copyright (C) 1985-2019 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 19.0.5.281 Build 20190815
Copyright (C) 1985-2019 Intel Corporation. All rights reserved.
-----
```

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

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Compiler Version Notes (Continued)

Intel(R) C Compiler for applications running on IA-32, Version 19.0.5 NextGen
Technology Build 20190729
Copyright (C) 1985-2019 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 19.0.5
NextGen Technology Build 20190729
Copyright (C) 1985-2019 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 19.0.5.281 Build 20190815
Copyright (C) 1985-2019 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 19.0.5
NextGen Technology Build 20190729
Copyright (C) 1985-2019 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 19.0.5.281 Build 20190815
Copyright (C) 1985-2019 Intel Corporation. All rights reserved.

Base Compiler Invocation

C benchmarks:

icc

C++ benchmarks:

icpc

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Base Compiler Invocation (Continued)

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 -std=c11 -Wl,-z,muldefs -xCORE-AVX512 -Ofast -flto
-mfpmath=sse -funroll-loops -qnextgen -fuse-ld=gold
-qopt-mem-layout-trans=4
-L/usr/local/IntelCompiler19/compilers_and_libraries_2019.5.281/linux/compiler/lib/intel64_lin
-lqkmalloc
```

C++ benchmarks:

```
-m64 -Wl,-z,muldefs -xCORE-AVX512 -Ofast -flto -mfpmath=sse
-funroll-loops -qnextgen -fuse-ld=gold -qopt-mem-layout-trans=4
-L/usr/local/IntelCompiler19/compilers_and_libraries_2019.5.281/linux/compiler/lib/intel64_lin
-lqkmalloc
```

Fortran benchmarks:

```
-m64 -Wl,-z,muldefs -xCORE-AVX512 -O3 -ipo -no-prec-div
-qopt-mem-layout-trans=4 -nostandard-realloc-lhs
-L/usr/local/IntelCompiler19/compilers_and_libraries_2019.5.281/linux/compiler/lib/intel64_lin
-lqkmalloc
```



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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-AVX512 -ipo -O3 -no-prec-div
-qopt-mem-layout-trans=4 -fno-strict-overflow
-L/usr/local/IntelCompiler19/compilers_and_libraries_2019.5.281/linux/compiler/lib/intel64_lin
-lqkmallocc

502.gcc_r: -m32
-L/usr/local/IntelCompiler19/compilers_and_libraries_2019.5.281/linux/compiler/lib/ia32_lin
-std=gnu89 -Wl,-z,muldefs -fprofile-generate(pass 1)
-fprofile-use=default.profddata(pass 2) -xCORE-AVX512 -flto
-Ofast(pass 1) -O3 -ffast-math -qnextgen -fuse-ld=gold
-qopt-mem-layout-trans=4 -L/usr/local/je5.0.1-32/lib
-ljemalloc

505.mcf_r: basepeak = yes
```

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Peak Optimization Flags (Continued)

```
525.x264_r: -m64 -std=c11 -Wl,-z,muldefs -xCORE-AVX512 -flto -O3
-ffast-math -qnextgen -fuse-ld=gold
-qopt-mem-layout-trans=4 -fno-alias
-L/usr/local/IntelCompiler19/compilers_and_libraries_2019.5.281/linux/compiler/lib/intel64_lin
-lqkmallocc
```

```
557.xz_r: -Wl,-z,muldefs -xCORE-AVX512 -ipo -O3 -no-prec-div
-qopt-mem-layout-trans=4
-L/usr/local/IntelCompiler19/compilers_and_libraries_2019.5.281/linux/compiler/lib/intel64_lin
-lqkmallocc
```

C++ benchmarks:

```
520.omnetpp_r: basepeak = yes
```

```
523.xalancbmk_r: basepeak = yes
```

```
531.deepsjeng_r: -m64 -Wl,-z,muldefs -fprofile-generate(pass 1)
-fprofile-use=default.profddata(pass 2) -xCORE-AVX512 -flto
-Ofast(pass 1) -O3 -ffast-math -qnextgen -fuse-ld=gold
-qopt-mem-layout-trans=4
-L/usr/local/IntelCompiler19/compilers_and_libraries_2019.5.281/linux/compiler/lib/intel64_lin
-lqkmallocc
```

```
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

http://www.spec.org/cpu2017/flags/Intel-ic19.0u5-official-linux64_revD.html

<http://www.spec.org/cpu2017/flags/Dell-Platform-Flags-PowerEdge-revE9.html>

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

http://www.spec.org/cpu2017/flags/Intel-ic19.0u5-official-linux64_revD.xml

<http://www.spec.org/cpu2017/flags/Dell-Platform-Flags-PowerEdge-revE9.xml>

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

Tested with SPEC CPU®2017 v1.1.0 on 2020-04-17 18:50:43-0400.

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