Dell Inc.

PowerEdge R440 (Intel Xeon Gold 5220, 2.20 GHz)

**SPECr**ate®2017 int peak = 225

**Test Sponsor:** Dell Inc.

**Hardware Availability:** Feb-2020

**CPU2017 License:** 55

**Test Date:** Apr-2020

**Tested by:** Dell Inc.

**Software Availability:** Apr-2020

**Test Sponsor:** Dell Inc.

**Hardware Availability:** Feb-2020

**Test Date:** Apr-2020

**Tested by:** Dell Inc.

**Software Availability:** Apr-2020

### CPU Name:
Intel Xeon Gold 5220

### Max MHz:
3900

### Nominal:
2200

### Enabled:
36 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:
24.75 MB I+D on chip per chip

### Other:
None

### Memory:
384 GB (12 x 16 GB 2Rx8 PC4-3200V-R, running at 2933)

### Storage:
1.8 TB GB SATA SSD

### Other:
None

### OS:
Red Hat Enterprise Linux 8.1

### Compiler:
C/C++: Version 19.1.1.217 of Intel C/C++ Compiler for Linux;

### 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

### File System:
xfs

### 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
SPEC CPU®2017 Integer Rate Result

Copyright 2017-2020 Standard Performance Evaluation Corporation

Dell Inc.

PowerEdge R440 (Intel Xeon Gold 5220, 2.20 GHz)

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

Results Table

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</table>

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**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 = 
    
    
MALLOC_CONF = "retain:true"
```
Dell Inc.

PowerEdge R440 (Intel Xeon Gold 5220, 2.20 GHz)

SPEC CPU®2017 Integer Rate Result

<table>
<thead>
<tr>
<th>SPECrate®2017_int_base = 216</th>
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<td>SPECrate®2017_int_peak = 225</td>
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CPU2017 License: 55
Test Sponsor: Dell Inc.
Tested by: Dell Inc.

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

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:
 sync; echo 3>/proc/sys/vm/drop_caches
runcpu command invoked through numactl i.e.:
umactl --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 Thu May 21 06:54:55 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)
Dell Inc.
PowerEdge R440 (Intel Xeon Gold 5220, 2.20 GHz)

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**SPEC CPU®2017 Integer Rate Result**

**SPECrate®2017_int_peak = 225**

**Platform Notes (Continued)**

model name : Intel(R) Xeon(R) Gold 5220 CPU @ 2.20GHz

2 "physical id"s (chips)
72 "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 : 18
siblings : 36
physical 0: cores 0 1 2 3 4 8 9 10 11 16 17 18 19 20 24 25 26 27
physical 1: cores 0 1 2 3 4 8 9 10 11 16 17 18 19 20 24 25 26 27

From lscpu:
Architecture:       x86_64
CPU op-mode(s):    32-bit, 64-bit
Byte Order:        Little Endian
CPU(s): 72
On-line CPU(s) list: 0-71
Thread(s) per core: 2
Core(s) per socket: 18
Socket(s): 2
NUMA node(s): 4
Vendor ID: GenuineIntel
CPU family: 6
Model: 85
Model name: Intel(R) Xeon(R) Gold 5220 CPU @ 2.20GHz
Stepping: 6
CPU MHz: 3429.086
CPU max MHz: 3900.000
CPU min MHz: 1000.000
BogoMIPS: 4400.00
Virtualization: VT-x
L1d cache: 32K
L1i cache: 32K
L2 cache: 1024K
L3 cache: 25344K
NUMA node0 CPU(s): 0,4,8,12,16,20,24,28,32,36,40,44,48,52,56,60,64,68
NUMA node1 CPU(s): 1,5,9,13,17,21,25,29,33,37,41,45,49,53,57,61,65,69
NUMA node2 CPU(s): 2,6,10,14,18,22,26,30,34,38,42,46,50,54,58,62,66,70
NUMA node3 CPU(s): 3,7,11,15,19,23,27,31,35,39,43,47,51,55,59,63,67,71
Flags: fpu vme de pse tsc msr pae mce cmov pat pse36 clflush dts acpi mmx fxsr sse sse2 ss ht tm pbe syscall nx pdpe1gb rdtscp lm constant_tsc arch_perfmon pebs bts rep_good nopl xtopology nonstop_tsc cpuid aperfmperf pni pclmulqdq dtes64 monitor ds_cpl vmx est tm2 ssse3 sdbg fma cx16 xtrm 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 cce

(Continued on next page)
Dell Inc.
PowerEdge R440 (Intel Xeon Gold 5220, 2.20 GHz)

**CPU2017 License:** 55
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---

**SPEC CPU®2017 Integer Rate Result**

**SPECrate®2017_int_base = 216**

**SPECrate®2017_int_peak = 225**

---

**Platform Notes (Continued)**

```
avx512bw avx512vl xsaveopt xsaves qgetbv1 xsaves cqm_llc cqm_occum_ltc cqm_mbm_total
cqm_mbm_local dtherm ida arat pln pts pku ospke avx512_vnni md_clear flush_l1d
arch_capabilities

/proc/cpuinfo cache data
cache size : 25344 KB
```

From `numactl --hardware` WARNING: a numactl 'node' might or might not correspond to a physical chip.

```
available: 4 nodes (0-3)
nodem cpus: 0 4 8 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68
node 0 size: 95306 MB
node 0 free: 95034 MB
node 1 cpus: 1 5 9 13 17 21 25 29 33 37 41 45 49 53 57 61 65 69
node 1 size: 96738 MB
node 1 free: 95790 MB
node 2 cpus: 2 6 10 14 18 22 26 30 34 38 42 46 50 54 58 62 66 70
node 2 size: 96764 MB
node 2 free: 96518 MB
node 3 cpus: 3 7 11 15 19 23 27 31 35 39 43 47 51 55 59 63 67 71
node 3 size: 96763 MB
node 3 free: 96348 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 21 11 10

From /proc/meminfo
MemTotal: 394827116 kB
HugePages_Total: 0
Hugepagesize: 2048 kB

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

**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)
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 May 21 06:54 last=5

SPEC is set to: /home/cpu2017
    Filesystem Type Size Used Avail Use% Mounted on
    /dev/mapper/rhel-home xfs 1.7T 41G 1.7T 3% /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

==============================================================================
C       | 502.gcc_r(peak)
------------------------------------------------------------------------------
Intel(R) C Compiler for applications running on IA-32, Version 2021.1 NextGen

(Continued on next page)
### Compiler Version Notes (Continued)

---

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

---

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.

---

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.
# SPEC CPU®2017 Integer Rate Result

## Dell Inc.

**PowerEdge R440 (Intel Xeon Gold 5220, 2.20 GHz)**

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**SPECrated®2017_int_base = 216**

**SPECrated®2017_int_peak = 225**

### Compiler Version Notes (Continued)

```plaintext
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.
```

```plaintext
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.
```

```plaintext
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.
```

```plaintext
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.
```

```plaintext
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`

(Continued on next page)
SPEC CPU® 2017 Integer Rate Result

Dell Inc. PowerEdge R440 (Intel Xeon Gold 5220, 2.20 GHz)

**SPECrate® 2017_int_base = 216**
**SPECrate® 2017_int_peak = 225**

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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

(Continued on next page)
Dell Inc. PowerEdge R440 (Intel Xeon Gold 5220, 2.20 GHz)

SPEC CPU®2017 Integer Rate Result
Copyright 2017-2020 Standard Performance Evaluation Corporation

SPECraten\textsuperscript{®}2017\_int\_peak = 225
SPECraten\textsuperscript{®}2017\_int\_base = 216

CPU2017 License: 55
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Hardware Availability: Feb-2020
Software Availability: Apr-2020

Base Optimization Flags (Continued)

Fortran benchmarks (continued):
-\texttt{-lqkmalloc}

Peak Compiler Invocation

C benchmarks:
\texttt{icc}

C++ benchmarks:
\texttt{icpc}

Fortran benchmarks:
\texttt{ifort}

Peak Portability Flags

500.perlbench\_r: \texttt{-DSPEC\_LP64 -DSPEC\_LINUX\_X64}
502.gcc\_r: \texttt{-D\_FILE\_OFFSET\_BITS=64}
505.mcf\_r: \texttt{-DSPEC\_LP64}
520.omnetpp\_r: \texttt{-DSPEC\_LP64}
523.xalancbmk\_r: \texttt{-DSPEC\_LP64 -DSPEC\_LINUX}
525.x264\_r: \texttt{-DSPEC\_LP64}
531.deepsjeng\_r: \texttt{-DSPEC\_LP64}
541.leela\_r: \texttt{-DSPEC\_LP64}
548.exchange2\_r: \texttt{-DSPEC\_LP64}
557.xz\_r: \texttt{-DSPEC\_LP64}

Peak Optimization Flags

C benchmarks:
500.perlbench\_r: \texttt{-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
-\texttt{-L/usr/local/IntelCompiler19/compilers_and_libraries_2020.1.217/linux/compiler/lib/intel64_lin}
-\texttt{-lqkmalloc}
502.gcc\_r: \texttt{-m32}
-\texttt{-L/usr/local/IntelCompiler19/compilers_and_libraries_2020.1.217/linux/compiler/lib/ia32_lin}

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

502.gcc_r (continued):
-std=gnu89
-W1,-plugin-opt=-x86-branches-within-32B-boundaries
-W1,-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
-W1,-plugin-opt=-x86-branches-within-32B-boundaries
-W1,-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: -W1,-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
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| CPU2017 License: 55 | Test Date: Apr-2020 |
| Test Sponsor: Dell Inc. | Hardware Availability: Feb-2020 |
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