# SPEC CPU®2017 Floating Point Rate Result

## Dell Inc.

PowerEdge R540 (Intel Xeon Gold 5218R, 2.10 GHz)

### CPU2017 License: 55

Test Sponsor: Dell Inc.

Tested by: Dell Inc.

Test Date: Jun-2020

Hardware Availability: Feb-2020

Software Availability: Apr-2020

### Copies

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### SPECrate®2017_fp_base = 209

### SPECrate®2017_fp_peak = 221

### Hardware

**CPU Name:** Intel Xeon Gold 5218R

**Max MHz:** 4000

**Nominal:** 2100

**Enabled:** 40 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:** 27.5 MB I+D on chip per chip

**Other:** None

**Memory:** 384 GB (12 x 32 GB 2Rx4 PC4-2933V-R, running at 2666)

**Storage:** 1 x 480 GB SATA SSD

**Other:** None

### Software

**OS:** Red Hat Enterprise Linux 8.2

**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

**File System:** xfs

**System State:** Run level 3 (multi-user)

**Base Pointers:** 64-bit

**Peak Pointers:** 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

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

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-ic19.1u1/lib/intel64:/home/cpu2017-ic19.1u1/je5.0.1-64"

MALLOC_CONF = "retain:true"
Dell Inc. PowerEdge R540 (Intel Xeon Gold 5218R, 2.10 GHz)

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<td>Hardware Availability: Feb-2020</td>
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</table>

General Notes

Binaries compiled on a system with 1x Intel Core i9-7980XE 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.:
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:
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 /home/cpu2017-ic19.1u1/bin/sysinfo
Rev: r6365 of 2019-08-21 295195f888a3d7edbl6e646a485a0011
running on RHEL-8-2-SUT Thu Jun 18 22:29:12 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

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

From `/proc/cpuinfo`

```
model name : Intel(R) Xeon(R) Gold 5218R CPU @ 2.10GHz
  2 "physical id"s (chips)
  80 "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 : 20
siblings : 40
physical 0: cores 0 1 2 3 4 8 9 10 11 12 16 17 18 19 20 24 25 26 27 28
physical 1: cores 0 1 2 3 4 8 9 10 11 12 16 17 18 19 20 24 25 26 27 28
```

From `lscpu`:

```
Architecture:        x86_64
CPU op-mode(s):      32-bit, 64-bit
Byte Order:          Little Endian
CPU(s):              80
On-line CPU(s) list: 0-79
Thread(s) per core:  2
Core(s) per socket:  20
NUMA node(s):        4
Vendor ID:           GenuineIntel
CPU family:          6
Model:               85
Model name:          Intel(R) Xeon(R) Gold 5218R CPU @ 2.10GHz
Stepping:            7
CPU MHz:             1946.722
CPU max MHz:         4000.0000
CPU min MHz:         800.0000
BogoMIPS:            4200.00
Virtualization:      VT-x
L1d cache:           32K
L1i cache:           32K
L2 cache:            1024K
L3 cache:            28160K
NUMA node0 CPU(s):   0,4,8,12,16,20,24,28,32,36,40,44,48,52,56,60,64,68,72,76
NUMA node1 CPU(s):   2,6,10,14,18,22,26,30,34,38,42,46,50,54,58,62,66,70,74,78
NUMA node2 CPU(s):   1,5,9,13,17,21,25,29,33,37,41,45,49,53,57,61,65,69,73,77
NUMA node3 CPU(s):   3,7,11,15,19,23,27,31,35,39,43,47,51,55,59,63,67,71,75,79
Flags:               fpu vme de pse tsc msr pae mce cx8 apic sep mtrr pge mca cmov
```

(Continued on next page)
Dell Inc.

PowerEdge R540 (Intel Xeon Gold 5218R, 2.10 GHz)

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CPU2017 License: 55
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Platform Notes (Continued)

cqm mpx rdt_a avx512f avx512dq rdseed adx smap clflushopt clwb intel_pt avx512cd
avx512bw avx512vl xsaveopt xsavexc xgetbv1 xsavec cqm_llc cqm_occsp_llc cqm_mbm_total
cqm_mbm_local dtherm ida arat pln pts pku ospke avx512_vnni md_clear flush_lld
arch_capabilities

/proc/cpuinfo cache data
cache size : 28160 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 64 68 72 76
node 0 size: 95277 MB
node 0 free: 85706 MB
node 1 cpus: 1 5 9 13 17 21 25 29 33 37 41 45 49 53 57 61 65 69 73 77
node 1 size: 96763 MB
node 1 free: 96128 MB
node 2 cpus: 2 6 10 14 18 22 26 30 34 38 42 46 50 54 58 62 66 70 74 78
node 2 size: 96763 MB
node 2 free: 96551 MB
node 3 cpus: 3 7 11 15 19 23 27 31 35 39 43 47 51 55 59 63 67 71 75 79
node 3 size: 96762 MB
node 3 free: 96524 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: 394821456 kB
HugePages_Total: 0
Hugepagesize: 2048 kB

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

os-release:
NAME="Red Hat Enterprise Linux"
VERSION="8.2 (Ootpa)"
ID="rhel"
ID_LIKE="fedora"
VERSION_ID="8.2"
PLATFORM_ID="platform:el8"
PRETTY_NAME="Red Hat Enterprise Linux 8.2 (Ootpa)"
ANSI_COLOR="0;31"
redhat-release: Red Hat Enterprise Linux release 8.2 (Ootpa)
system-release: Red Hat Enterprise Linux release 8.2 (Ootpa)

(Continued on next page)
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Platform Notes (Continued)

system-release-cpe: cpe:/o:redhat:enterprise_linux:8.2:ga

uname -a:
    Linux RHEL-8-2-SUT 4.18.0-193.el8.x86_64 #1 SMP Fri Mar 27 14:35:58 UTC 2020 x86_64
    x86_64 x86_64 GNU/Linux

Kernel self-reported vulnerability status:

itlb_multihit: KVM: Vulnerable
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
tsx_async_abort: Mitigation: Clear CPU buffers; SMT vulnerable

run-level 3 Jun 18 16:14 last=5

SPEC is set to: /home/cpu2017-ic19.1u1
Filesystem Type Size Used Avail Use% Mounted on
/dev/mapper/rhel-home xfs 392G 7.0G 385G 2% /home

From /sys/devices/virtual/dmi/id
BIOS: Dell Inc. 2.7.7 05/06/2020
Vendor: Dell Inc.
Product: PowerEdge R540
Product Family: PowerEdge

Additional information from dmi.iso follows. WARNING: Use caution when you interpret this section. The 'dmi.iso' 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:
    1x 00AD00B300AD HMA84GR7CJR4N-WM 32 GB 2 rank 2933
    6x 00AD063200AD HMA84GR7CJR4N-WM 32 GB 2 rank 2933
    5x 00AD069D00AD HMA84GR7CJR4N-WM 32 GB 2 rank 2933
    4x Not Specified Not Specified

(End of data from sysinfo program)
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Compiler Version Notes

==============================================================================
| C               | 519.lbm_r(base, peak) 538.imagick_r(base, peak) 544.nab_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.
==============================================================================

==============================================================================
| C++              | 508.namd_r(base, peak) 510.parest_r(base, peak) |
|------------------------------------------------------------------------------|
Intel(R) C++ Compiler for applications running on Intel(R) 64, Version 2021.1
NextGen Build 20200304
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==============================================================================

==============================================================================
| C++, C           | 511.povray_r(base) 526.blender_r(base, peak) |
|------------------------------------------------------------------------------|
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Intel(R) C Compiler for applications running on Intel(R) 64, Version 2021.1
NextGen Build 20200304
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==============================================================================

==============================================================================
| C++, C           | 511.povray_r(peak) |
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Intel(R) C Compiler for applications running on Intel(R) 64, Version 19.1.1.217 Build 20200306
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**Compiler Version Notes (Continued)**

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**C++, C**

511.povray_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
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**C++, C, Fortran**

507.cactuBSSN_r(base, peak)

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Intel(R) C Compiler for applications running on Intel(R) 64, Version 2021.1 NextGen Build 20200304
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Intel(R) Fortran Intel(R) 64 Compiler for applications running on Intel(R) 64, Version 19.1.1.217 Build 20200306
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**Fortran**

503.bwaves_r(base, peak) 549.fotonik3d_r(base, peak)

554.roms_r(base, peak)

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**Fortran, C**

521.wrf_r(base) 527.cam4_r(base, peak)

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Intel(R) C Compiler for applications running on Intel(R) 64, Version 2021.1 NextGen Build 20200304
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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
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Base Compiler Invocation

C benchmarks:
icc

C++ benchmarks:
icpc

Fortran benchmarks:
ifort

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## Base Compiler Invocation (Continued)

Benchmarks using both Fortran and C:
- ifort icc

Benchmarks using both C and C++:
- icpc icc

Benchmarks using Fortran, C, and C++:
- icpc icc ifort

## Base Portability Flags

503.bwaves_r: -DSPEC_LP64  
507.cactuBSSN_r: -DSPEC_LP64  
508.namd_r: -DSPEC_LP64  
510.parest_r: -DSPEC_LP64  
511.povray_r: -DSPEC_LP64  
519.lbm_r: -DSPEC_LP64  
521.wrf_r: -DSPEC_LP64 -DSPEC_CASE_FLAG -convert big_endian  
526.blender_r: -DSPEC_LP64 -DSPEC_LINUX -funsigned-char  
527.cam4_r: -DSPEC_LP64 -DSPEC_CASE_FLAG  
538.imagick_r: -DSPEC_LP64  
544.nab_r: -DSPEC_LP64  
549.fotonik3d_r: -DSPEC_LP64  
554.roms_r: -DSPEC_LP64

## Base Optimization Flags

**C benchmarks:**
- -m64 -qnextgen -std=c11  
- -Wl, -plugin-opt=-x86-branches-within-32B-boundaries -Wl, -z, muldefs  
- -fuse-ld=gold -xcORE-AVX512 -Ofast -ffast-math -flto -mfpmath=sse  
- -funroll-loops -gopt-mem-layout-trans=4  
- -L/usr/local/jemalloc64-5.0.1/lib -ljemalloc

**C++ benchmarks:**
- -m64 -qnextgen -Wl, -plugin-opt=-x86-branches-within-32B-boundaries  
- -Wl, -z, muldefs -fuse-ld=gold -xcORE-AVX512 -Ofast -ffast-math -flto  
- -mfpmath=sse -funroll-loops -gopt-mem-layout-trans=4  
- -L/usr/local/jemalloc64-5.0.1/lib -ljemalloc

**Fortran benchmarks:**
- -m64 -Wl, -plugin-opt=-x86-branches-within-32B-boundaries -Wl, -z, muldefs

*(Continued on next page)*
**SPEC CPU®2017 Floating Point Rate Result**

**Dell Inc.**

PowerEdge R540 (Intel Xeon Gold 5218R, 2.10 GHz)

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<tr>
<th>SPECrate®2017_fp_base = 209</th>
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**Base Optimization Flags (Continued)**

Fortran benchmarks (continued):
- `-fuse-ld=gold -xCORE-AVX512 -O3 -ipo -no-prec-div -qopt-prefetch`
- `-ffinite-math-only -qopt-multiple-gather-scatter-by-shuffles`
- `-qopt-mem-layout-trans=4 -nostandard-realloc-lhs -align array32byte`
- `-auto -mbranches-within-32B-boundaries`
- `-L/usr/local/jemalloc64-5.0.1/lib -ljemalloc`

Benchmarks using both Fortran and C:
- `-m64 -gnextgen -std=c11`
- `-Wl,--plugin-opt=-x86-branches-within-32B-boundaries -Wl,-z,muldefs`
- `-fuse-ld=gold -xCORE-AVX512 -Ofast -ffast-math -flto -mfpmath=sse`
- `-funroll-loops -qopt-mem-layout-trans=4 -O3 -ipo -no-prec-div`
- `-qopt-prefetch -ffinite-math-only`
- `-qopt-multiple-gather-scatter-by-shuffles -nostandard-realloc-lhs`
- `-align array32byte -auto -mbranches-within-32B-boundaries`
- `-L/usr/local/jemalloc64-5.0.1/lib -ljemalloc`

Benchmarks using both C and C++:
- `-m64 -gnextgen -std=c11`
- `-Wl,--plugin-opt=-x86-branches-within-32B-boundaries -Wl,-z,muldefs`
- `-fuse-ld=gold -xCORE-AVX512 -Ofast -ffast-math -flto -mfpmath=sse`
- `-funroll-loops -qopt-mem-layout-trans=4 -L/usr/local/jemalloc64-5.0.1/lib -ljemalloc`

Benchmarks using Fortran, C, and C++:
- `-m64 -gnextgen -std=c11`
- `-Wl,--plugin-opt=-x86-branches-within-32B-boundaries -Wl,-z,muldefs`
- `-fuse-ld=gold -xCORE-AVX512 -Ofast -ffast-math -flto -mfpmath=sse`
- `-funroll-loops -qopt-mem-layout-trans=4 -O3 -ipo -no-prec-div`
- `-qopt-prefetch -ffinite-math-only`
- `-qopt-multiple-gather-scatter-by-shuffles -nostandard-realloc-lhs`
- `-align array32byte -auto -mbranches-within-32B-boundaries`
- `-L/usr/local/jemalloc64-5.0.1/lib -ljemalloc`

**Peak Compiler Invocation**

- **C benchmarks:**
  - `icc`

- **C++ benchmarks:**
  - `icpc`

- **Fortran benchmarks:**
  - `ifort`

(Continued on next page)
Peak Compiler Invocation (Continued)

Benchmarks using both Fortran and C:
ifort icc

Benchmarks using both C and C++:
icpc icc

Benchmarks using Fortran, C, and C++:
icpc icc ifort

Peak Portability Flags

Same as Base Portability Flags

Peak Optimization Flags

C benchmarks:
519.ibm_r: basepeak = yes
538.imagick_r: basepeak = yes
544.nab_r: basepeak = yes

C++ benchmarks:
508.namd_r: basepeak = yes
510.parest_r: -m64 -qnextgen
-Wl,-plugin-opt=-x86-branches-within-32B-boundaries
-Wl,-z,muldefs -fuse-ld=gold -xCORE-AVX512 -Ofast
-ffast-math -fito -mpmath=sse -funroll-loops
-qopt-mem-layout-trans=4 -L/usr/local/jemalloc64-5.0.1/lib
-ljemalloc

Fortran benchmarks:
503.bwaves_r: -m64 -Wl,-plugin-opt=-x86-branches-within-32B-boundaries
-Wl,-z,muldefs -fuse-ld=gold -xCORE-AVX512 -O3 -ipo
-no-prec-div -qopt-prefetch -ffinite-math-only
-qopt-multiple-gather-scatter-by-shuffles

(Continued on next page)
Dell Inc.  
PowerEdge R540 (Intel Xeon Gold 5218R, 2.10 GHz)

SPEC®CPU2017 Floating Point Rate Result
Copyright 2017-2020 Standard Performance Evaluation Corporation

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Peak Optimization Flags (Continued)

503.bwaves_r (continued):
- qopt-mem-layout-trans=4 -nostandard-realloc-lhs  
- align array32byte -auto -mbranches-within-32B-boundaries  
- L/usr/local/jemalloc64-5.0.1/lib -ljemalloc

549.fotonik3d_r.basepeak = yes  
554.roms_r. Same as 503.bwaves_r

Benchmarks using both Fortran and C:

521.wrf_r. -prof-gen(pass 1) -prof-use(pass 2) -xCORE-AVX512 -03  
-ipo -no-prec-div -qopt-prefetch -ffinite-math-only  
- qopt-multiple-gather-scatter-by-shuffles  
- qopt-mem-layout-trans=4 -mbranches-within-32B-boundaries  
- L/usr/local/jemalloc64-5.0.1/lib -ljemalloc

526.blender_r. basepeak = yes

Benchmarks using Fortran, C, and C++:

507.cactuBSSN_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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