Dell Inc.

PowerEdge C6520 (Intel Xeon Gold 6326, 2.90 GHz)

<table>
<thead>
<tr>
<th>Test Date:</th>
<th>May-2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Sponsor:</td>
<td>Dell Inc.</td>
</tr>
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<td>Tested by:</td>
<td>Dell Inc.</td>
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<tr>
<td>Hardware Availability:</td>
<td>Apr-2021</td>
</tr>
<tr>
<td>Software Availability:</td>
<td>Dec-2020</td>
</tr>
</tbody>
</table>

| SPECrate®2017_int_base = 261 | SPECrate®2017_int_peak = 271 |

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<tr>
<th>Copy</th>
<th>500.perlbench_r</th>
<th>502.gcc_r</th>
<th>505.mcf_r</th>
<th>520.omnetpp_r</th>
<th>523.xalancbmk_r</th>
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<th>531.deepsjeng_r</th>
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<th>548.exchange2_r</th>
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</thead>
<tbody>
<tr>
<td>64</td>
<td>178</td>
<td>209</td>
<td>216</td>
<td>250</td>
<td>334</td>
<td>540</td>
<td>566</td>
<td>448</td>
<td>531</td>
<td>143</td>
</tr>
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</table>

**Hardware**

<table>
<thead>
<tr>
<th>CPU Name:</th>
<th>Intel Xeon Gold 6326</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max MHz:</td>
<td>3500</td>
</tr>
<tr>
<td>Nominal:</td>
<td>2900</td>
</tr>
<tr>
<td>Enabled:</td>
<td>32 cores, 2 chips, 2 threads/core</td>
</tr>
<tr>
<td>Orderable:</td>
<td>1.2 chips</td>
</tr>
<tr>
<td>Cache L1:</td>
<td>32 KB I + 48 KB D on chip per core</td>
</tr>
<tr>
<td>L2:</td>
<td>1.25 MB I+D on chip per core</td>
</tr>
<tr>
<td>L3:</td>
<td>24 MB I+D on chip per chip</td>
</tr>
<tr>
<td>Other:</td>
<td>None</td>
</tr>
<tr>
<td>Memory:</td>
<td>512 GB (16 x 32 GB 2Rx8 PC4-3200AA-R)</td>
</tr>
<tr>
<td>Storage:</td>
<td>125 GB on tmpfs</td>
</tr>
<tr>
<td>Other:</td>
<td>None</td>
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**Software**

<table>
<thead>
<tr>
<th>OS:</th>
<th>Red Hat Enterprise Linux 8.3 (Ootpa)</th>
</tr>
</thead>
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<tr>
<td></td>
<td>4.18.0-240.el8.x86_64</td>
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<tr>
<td>Compiler:</td>
<td>C/C++: Version 2021.1 of Intel oneAPI DPC++/C++</td>
</tr>
<tr>
<td></td>
<td>Compiler Build 20201113 for Linux;</td>
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<tr>
<td></td>
<td>Fortran: Version 2021.1 of Intel Fortran Compiler</td>
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<td>Classic Build 20201112 for Linux;</td>
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<tr>
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<td>C/C++: Version 2021.1 of Intel C/C++ Compiler</td>
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<td>Classic Build 20201112 for Linux</td>
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<tr>
<td>Parallel:</td>
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<td>Firmware:</td>
<td>Version 1.1.3 released Apr-2021</td>
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<tr>
<td>File System:</td>
<td>tmpfs</td>
</tr>
<tr>
<td>System State:</td>
<td>Run level 3 (multi-user)</td>
</tr>
<tr>
<td>Base Pointers:</td>
<td>64-bit</td>
</tr>
<tr>
<td>Peak Pointers:</td>
<td>32/64-bit</td>
</tr>
<tr>
<td>Other:</td>
<td>jemalloc memory allocator V5.0.1</td>
</tr>
<tr>
<td>Power Management:</td>
<td>BIOS and OS set to prefer performance at the cost of additional power usage.</td>
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## Results Table

<table>
<thead>
<tr>
<th>Benchmark</th>
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<th>Seconds</th>
<th>Ratio</th>
<th>Seconds</th>
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<td>166</td>
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</table>

### 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:

```bash
LD_LIBRARY_PATH = 
"/mnt/ramdisk/cpu2017-1.1.7-ic2021.1/lib/intel64:/mnt/ramdisk/cpu2017-1.1.7-ic2021.1/lib/ia32:/mnt/ramdisk/cpu2017-1.1.7-ic2021.1/je5.0.1-32"

MALLOC_CONF = "retain:true"
```

### General Notes

Binaries compiled on a system with 1x Intel Core i9-7980XE CPU + 64GB RAM memory using Red Hat Enterprise Linux 8.1

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)
## SPEC CPU®2017 Integer Rate Result

**Dell Inc.**

**PowerEdge C6520** (Intel Xeon Gold 6326, 2.90 GHz)

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>SPECrate®2017_int_peak</td>
<td>271</td>
</tr>
</tbody>
</table>

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

### 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>
  ```
jemalloc, a general purpose malloc implementation
built with the RedHat Enterprise 7.5, and the system compiler gcc 4.8.5

Benchmark run from a 125 GB ramdisk created with the cmd: "mount -t tmpfs -o size=125G tmpfs /mnt/ramdisk"

---

### Platform Notes

**BIOS Settings:**
- Sub NUMA Cluster : 2-Way Clustering
- Virtualization Technology : Disabled

- System Profile : Custom
- CPU Power Management : Maximum Performance
- C1E : Disabled
- C States : Autonomous
- Memory Patrol Scrub : Disabled
- Energy Efficiency Policy : Performance
- CPU Interconnect Bus Link
- Power Management : Disabled

**Sysinfo program /mnt/ramdisk/cpu2017-1.1.7-ic2021.1/bin/sysinfo**
Rev: r6538 of 2020-09-24 e8664e66d2d7080afeaa89d4b38e2f1c
running on localhost.localdomain Mon May 17 07:40:14 2021

**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

```bash
From /proc/cpuinfo
  model name : Intel(R) Xeon(R) Gold 6326 CPU @ 2.90GHz
  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.)
```

(Continued on next page)
### Dell Inc. PowerEdge C6520 (Intel Xeon Gold 6326, 2.90 GHz)

**SPECrate®2017_int_base** = 261  
**SPECrate®2017_int_peak** = 271

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<td>Software Availability:</td>
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**Platform Notes (Continued)**

```
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:** 106
- **Model name:** Intel(R) Xeon(R) Gold 6326 CPU @ 2.90GHz
- **Stepping:** 6
- **CPU MHz:** 1982.161
- **BogoMIPS:** 5800.00
- **Virtualization:** VT-x
- **L1d cache:** 48K
- **L1i cache:** 32K
- **L2 cache:** 1280K
- **L3 cache:** 24576K
- **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 cmov pat pse36 clflush dts acpi mmx fxsr sse sse2 ss ht tm pbe syscall nx pdeldbg rdtscp lm constant_tsc 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 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 invpcid_single intel_pinn ssbd mba ibrs ibpb stibp ibrs_enhanced fsgsbase tsc_adjust bmi1 hle avx2 smep bmi2 erms invpcid cmq rdt_a avx512f avx512dq rdseed adx smap avx512ifma clflushopt clwb intel_pt avx512cd sha尼 avx512bw avx512vl xsaves xsaveopt xsavec xgetbv1 xsavec cmq_llc cmq_occunp_llc cmq_mbb_total cmq_mbb_local split_lock_detect wbinvd dtcpc mds ida arat pni pts avx512vbm1 umip kpu ospe avx512_vbm2 gfeni vaes vpcmulqdq avx512_vnni avx512_bitalg tme avx512_vpopcntdq la57 rdpid md_clear pconfig flush_l1d arch_capabilities

/proc/cpuinfo cache data
```
cache size : 24576 KB
```

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

Dell Inc.

PowerEdge C6520 (Intel Xeon Gold 6326, 2.90 GHz)

SPECrate®2017_int_base = 261
SPECrate®2017_int_peak = 271

CPU2017 License: 55
Test Sponsor: Dell Inc.
Test Date: May-2021
Tested by: Dell Inc.
Hardware Availability: Apr-2021
Software Availability: Dec-2020

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 4 8 12 16 20 24 28 32 36 40 44 48 52 56 60
node 0 size: 126360 MB
node 0 free: 128103 MB
node 1 cpus: 2 6 10 14 18 22 26 30 34 38 42 46 50 54 58 62
node 1 size: 126908 MB
node 1 free: 128554 MB
node 2 cpus: 1 5 9 13 17 21 25 29 33 37 41 45 49 53 57 61
node 2 size: 126726 MB
node 2 free: 128833 MB
node 3 cpus: 3 7 11 15 19 23 27 31 35 39 43 47 51 55 59 63
node 3 size: 126913 MB
node 3 free: 119726 MB
node distances:
node   0   1   2   3
0:  10  11  20  20
1:  11  10  20  20
2:  20  20  10  11
3:  20  20  11  10

From /proc/meminfo
MemTotal:       527805516 kB
HugePages_Total:       0
Hugepagesize:       2048 kB

/sbin/tuned-adm active
Current active profile: throughput-performance

From /etc/*release* /etc/*version*
os-release:
  NAME="Red Hat Enterprise Linux"
  VERSION="8.3 (Ootpa)"
  ID="rhel"
  ID_LIKE="fedora"
  VERSION_ID="8.3"
  PLATFORM_ID="platform:el8"
  PRETTY_NAME="Red Hat Enterprise Linux 8.3 (Ootpa)"
  ANSI_COLOR="0;31"
redhat-release: Red Hat Enterprise Linux release 8.3 (Ootpa)
system-release: Red Hat Enterprise Linux release 8.3 (Ootpa)
system-release-cpe: cpe:/o:redhat:enterprise_linux:8.3:ga

uname -a:
Linux localhost.localdomain 4.18.0-240.el8.x86_64 #1 SMP Wed Sep 23 05:13:10 EDT 2020

(Continued on next page)
### Dell Inc.

PowerEdge C6520 (Intel Xeon Gold 6326, 2.90 GHz)

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</tr>
</tbody>
</table>

### Platform Notes (Continued)

- **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
- **CVE-2018-3639 (Speculative Store Bypass):** Not affected
  - Mitigation: Speculative Store Bypass disabled via prctl and seccomp
  - Mitigation: usercopy/swapgs barriers and __user pointer sanitization
- **CVE-2017-5753 (Spectre variant 1):**
- **CVE-2017-5715 (Spectre variant 2):**
  - Mitigation: Enhanced IBRS, IBPB: conditional, RSB filling
- **CVE-2020-0543 (Special Register Buffer Data Sampling):** Not affected
- **CVE-2019-11135 (TSX Asynchronous Abort):** Not affected

**run-level 3** May 17 07:34

**SPEC is set to:** /mnt/ramdisk/cpu2017-1.1.7-ic2021.1

**Filesystem** | **Type** | **Size** | **Used** | **Avail** | **Use%** | **Mounted on**
--- | --- | --- | --- | --- | --- | ---
tmpfs | tmpfs | 125G | 4.4G | 121G | 4% | /mnt/ramdisk

**From /sys/devices/virtual/dmi/id**

- **Vendor:** Dell Inc.
- **Product:** PowerEdge C6520
- **Product Family:** PowerEdge

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:**
- 6x 002C00B3002C 18ASF4G72PD2-3G2E1 32 GB 2 rank 3200
- 10x 00AD063200AD HMMA4GR7AJR8N-XN 32 GB 2 rank 3200

**BIOS:**

- **BIOS Vendor:** Dell Inc.
- **BIOS Version:** 1.1.3
- **BIOS Date:** 04/27/2021
- **BIOS Revision:** 1.1

*(End of data from sysinfo program)*
**Dell Inc.**

**PowerEdge C6520 (Intel Xeon Gold 6326, 2.90 GHz)**

**SPEC CPU®2017 Integer Rate Result**

---

**Compiler Version Notes**

```
C    | 500.perlbench_r(peak)

Intel(R) C Intel(R) 64 Compiler Classic for applications running on Intel(R) 64, Version 2021.1 Build 20201112_000000
Copyright (C) 1985-2020 Intel Corporation. All rights reserved.
```

```
C    | 502.gcc_r(peak)

Intel(R) oneAPI DPC++/C++ Compiler for applications running on IA-32, Version 2021.1 Build 20201113
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, peak)

Intel(R) oneAPI DPC++/C++ Compiler for applications running on Intel(R) 64, Version 2021.1 Build 20201113
Copyright (C) 1985-2020 Intel Corporation. All rights reserved.
```

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C    | 500.perlbench_r(peak)

Intel(R) C Intel(R) 64 Compiler Classic for applications running on Intel(R) 64, Version 2021.1 Build 20201112_000000
Copyright (C) 1985-2020 Intel Corporation. All rights reserved.
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C    | 502.gcc_r(peak)

Intel(R) oneAPI DPC++/C++ Compiler for applications running on IA-32, Version 2021.1 Build 20201113
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```

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C    | 500.perlbench_r(base) 502.gcc_r(base) 505.mcf_r(base, peak)
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Intel(R) oneAPI DPC++/C++ Compiler for applications running on Intel(R) 64, Version 2021.1 Build 20201113
```

(Continued on next page)
## Dell Inc.

**PowerEdge C6520 (Intel Xeon Gold 6326, 2.90 GHz)**

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<th>SPEC CPU®2017 Integer Rate Result</th>
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### Compiler Version Notes (Continued)

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

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Intel(R) C Intel(R) 64 Compiler Classic for applications running on Intel(R) 64, Version 2021.1 Build 20201112_000000
Copyright (C) 1985-2020 Intel Corporation. All rights reserved.

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Intel(R) oneAPI DPC++/C++ Compiler for applications running on IA-32, Version 2021.1 Build 20201113
Copyright (C) 1985-2020 Intel Corporation. All rights reserved.

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</tr>
</tbody>
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Intel(R) oneAPI DPC++/C++ Compiler for applications running on Intel(R) 64, Version 2021.1 Build 20201113
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<table>
<thead>
<tr>
<th>C++</th>
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</tr>
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Intel(R) oneAPI DPC++/C++ Compiler for applications running on Intel(R) 64, Version 2021.1 Build 20201113
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<tr>
<th>Fortran</th>
<th>548.exchange2_r(base, peak)</th>
</tr>
</thead>
</table>

Intel(R) Fortran Intel(R) 64 Compiler Classic for applications running on Intel(R) 64, Version 2021.1 Build 20201112_000000
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SPEC CPU®2017 Integer Rate Result

Dell Inc.

PowerEdge C6520 (Intel Xeon Gold 6326, 2.90 GHz)

SPECrates®2017_int_base = 261
SPECrates®2017_int_peak = 271

CPU2017 License: 55
Test Sponsor: Dell Inc.
Test Date: May-2021
Tested by: Dell Inc.
Hardware Availability: Apr-2021
Software Availability: Dec-2020

Base Compiler Invocation

C benchmarks:
icx

C++ benchmarks:
icpx

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:
-w -std=c11 -m64 -Wl,-z,muldefs -xCORE-AVX512 -O3 -ffast-math
-flto -mfpmath=sse -funroll-loops -qopt-mem-layout-trans=4
-mbranches-within-32B-boundaries
-L/opt/intel/oneapi/compiler/2021.1.1/linux/compiler/lib/intel64_lin
-lqkmalloc

C++ benchmarks:
-w -m64 -Wl,-z,muldefs -xCORE-AVX512 -O3 -ffast-math -flto
-mfpmath=sse -funroll-loops -qopt-mem-layout-trans=4
-mbranches-within-32B-boundaries
-L/opt/intel/oneapi/compiler/2021.1.1/linux/compiler/lib/intel64_lin
-lqkmalloc

Fortran benchmarks:
-w -m64 -Wl,-z,muldefs -xCORE-AVX512 -O3 -ipo -no-prec-div
-qopt-mem-layout-trans=4 -nostandard-realloc-lhs -align array32byte
-auto -mbranches-within-32B-boundaries

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

Fortran benchmarks (continued):
- `-L/opt/intel/oneapi/compiler/2021.1.1/linux/compiler/lib/intel64_lin`
- `-lqkmalloc`

### Peak Compiler Invocation

C benchmarks (except as noted below):
- `icx`
- `500.perlbench_r: icc`

C++ benchmarks:
- `icpx`

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 -03 -no-prec-div`
- `-qopt-mem-layout-trans=4 -fno-strict-overflow`
- `-mbranches-within-32B-boundaries`
- `-L/opt/intel/oneapi/compiler/2021.1.1/linux/compiler/lib/intel64_lin`
- `-lqkmalloc`

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

502.gcc_r: -m32
-L/opt/intel/oneapi/compiler/2021.1.1/linux/compiler/lib/ia32_lin
-std=gnu89 -Wl,-z,muldefs -fprofile-generate(pass 1)
-fprofile-use=default.profdata(pass 2) -xCORE-AVX512 -flto
-Ofast(pass 1) -O3 -ffast-math -qopt-mem-layout-trans=4
-mbranches-within-32B-boundaries
-L/usr/local/jemalloc32-5.0.1/lib -ljemalloc

505.mcf_r: basepeak = yes
525.x264_r: -w -std=c11 -m64 -Wl,-z,muldefs -xCORE-AVX512 -flto
-O3 -ffast-math -qopt-mem-layout-trans=4 -fno-alias
-mbranches-within-32B-boundaries
-L/opt/intel/oneapi/compiler/2021.1.1/linux/compiler/lib/intel64_lin
-lqkmalloc

557.xz_r: basepeak = yes

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-ic2021-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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