Lenovo Global Technology
ThinkSystem SN850
(2.70 GHz, Intel Xeon Gold 5220S)

CPU2017 License: 9017
Test Sponsor: Lenovo Global Technology
Tested by: Lenovo Global Technology
Test Date: Sep-2019
Hardware Availability: Jul-2019
Software Availability: May-2019

Threads

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Threads</th>
<th>SPECspeed®2017_fp_base</th>
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<tbody>
<tr>
<td>603.bwaves_s</td>
<td>72</td>
<td>169</td>
</tr>
<tr>
<td>607.cactuBSSN_s</td>
<td>72</td>
<td>155</td>
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<tr>
<td>619.lbm_s</td>
<td>72</td>
<td>122</td>
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<tr>
<td>621.wrf_s</td>
<td>72</td>
<td>126</td>
</tr>
<tr>
<td>627.cam4_s</td>
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<td>58.0</td>
</tr>
<tr>
<td>628.pop2_s</td>
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<td>106</td>
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<tr>
<td>638.imagick_s</td>
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</tr>
<tr>
<td>644.nab_s</td>
<td>72</td>
<td>220</td>
</tr>
</tbody>
</table>

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Hardware

CPU Name: Intel Xeon Gold 5220S
Max MHz: 3900
Enabled: 72 cores, 4 chips, 2 threads/core
Orderable: 2.4 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: 768 GB (48 x 16 GB 2Rx8 PC4-2933Y-R, running at 2666)
Storage: 800 GB tmpfs
Other: None

Software

OS: Red Hat Enterprise Linux Server release 7.6 (Maipo)
Kernel 3.10.0-957.el7.x86_64
Compiler: C/C++: Version 19.0.4.227 of Intel C/C++
Compiler for Linux;
Fortran: Version 19.0.4.227 of Intel Fortran
Compiler for Linux
Parallel: Yes
Firmware: Lenovo BIOS Version IVE142E 2.30 released Aug-2019 tested as IVE141E 2.30 Jul-2019
File System: tmpfs
System State: Run level 3 (multi-user)
Base Pointers: 64-bit
Peak Pointers: Not Applicable
Other: None
Power Management: --
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Results Table

<table>
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<tr>
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<th>Seconds</th>
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</tr>
</tbody>
</table>

SPECspeed®2017_fp_base = 169
SPECspeed®2017_fp_peak = Not Run

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

Operating System Notes

Stack size set to unlimited using "ulimit -s unlimited"
Tmpfs filesystem can be set with:
  mount -t tmpfs -o size=800g tmpfs /home
Process tuning setting:
  echo 50000 > /proc/sys/kernel/sched_cfs_bandwidth_slice_us

General Notes

Environment variables set by runcpu before the start of the run:
KMP_AFFINITY = "granularity=fine,compact,1,0"
LD_LIBRARY_PATH = "/home/cpu2017-1.0.5-ic19.0u4/lib/intel64"
OMP_STACKSIZE = "192M"

Binaries compiled on a system with 1x Intel Core i9-799X CPU + 32GB RAM
memory using Redhat Enterprise Linux 7.5
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
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.
Yes: The test sponsor attests, as of date of publication, that CVE-2018-3640 (Spectre variant 3a) is mitigated in the system as tested and documented.

(Continued on next page)
General Notes (Continued)

Yes: The test sponsor attests, as of date of publication, that CVE-2018-3639 (Spectre variant 4) is mitigated in the system as tested and documented.

Platform Notes

BIOS configuration:
Choose Operating Mode set to Maximum Performance
Choose Operating Mode set to Custom Mode
Memory Power Management set to Automatic
MONITOR/MWAIT set to Enable
Trusted Execution Technology set to Enable
Stale AtoS set to Enable
Sysinfo program /home/cpu2017-1.0.5-ic19.0u4/bin/sysinfo
Rev: r5974 of 2018-05-19 9bcde8f2999c33d61f64985e45859ea9
running on localhost.localdomain Wed Sep 18 00:38:54 2019

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 5220S CPU @ 2.70GHz
4 "physical id"s (chips)
144 "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
physical 2: cores 0 1 2 3 4 8 9 10 11 16 17 18 19 20 24 25 26 27
physical 3: 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): 144
On-line CPU(s) list: 0-143
Thread(s) per core: 2
Core(s) per socket: 18
Socket(s): 4
NUMA node(s): 4
Vendor ID: GenuineIntel
CPU family: 6
Model: 85

(Continued on next page)
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SPECSpeed®2017_fp_base = 169
SPECSpeed®2017_fp_peak = Not Run

CPU2017 License: 9017
Test Sponsor: Lenovo Global Technology
CPU MHz: 2700.000
BogoMIPS: 5400.00
Virtualization: VT-x
L1d cache: 32K
L1i cache: 32K
L2 cache: 1024K
L3 cache: 25344K
NUMA node0 CPU(s): 0-17,72-89
NUMA node1 CPU(s): 18-35,90-107
NUMA node2 CPU(s): 36-53,108-125
NUMA node3 CPU(s): 54-71,126-143

Platform Notes (Continued)

Model name: Intel(R) Xeon(R) Gold 5220S CPU @ 2.70GHz
Stepping: 7
CPU MHz: 2700.000
BogoMIPS: 5400.00
Virtualization: VT-x
L1d cache: 32K
L1i cache: 32K
L2 cache: 1024K
L3 cache: 25344K
NUMA node0 CPU(s): 0-17,72-89
NUMA node1 CPU(s): 18-35,90-107
NUMA node2 CPU(s): 36-53,108-125
NUMA node3 CPU(s): 54-71,126-143

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 apic sm mce ppp mtrrpst mtrr aperfmperf eagerfpu pni pclmulqdq dtles64 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 fl64 c rdrand lahf_lm abm 3nowprefetch ebpx cat_l3 cdp_l3 intel_ppin intel_pt ssbd mba ibrs lbpb stibp ibrs_enhanced tpr_shadow vnmi flexpriority ept vpid fsgsbasedate tsc_adjust bmi1 hle avx2 smep bmi2 erms invpcid rtm cqm mpx rdt_a avx512if avx512dq rdseed adx smap clflushopt clwb avx512cd avx512bw avx512vl xsaveopt xsaves xsaveopt xcnvb xgetbv1 cqm_llc cqm_occupy_llc cqm_mmbs_total cqm_mmbs_local dtherm ida arat pln pts hwp_epp pku ospke avx512_vnni spec_ctrl intel_stibp flush_l1d arch_capabilities

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 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89
node 0 size: 196277 MB
node 0 free: 191685 MB
node 1 cpus: 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107
node 1 size: 196608 MB
node 1 free: 187785 MB
node 2 cpus: 113 114 115 116 117 118 119 120 121 122 123 124 125
node 2 size: 196608 MB
node 2 free: 182910 MB
node 3 cpus: 131 132 133 134 135 136 137 138 139 140 141 142 143 130
node 3 size: 196608 MB
node 3 free: 192068 MB

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SPECSpeed®2017_fp_base = 169
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Platform Notes (Continued)

node distances:
node  0  1  2  3
 0: 10 21 21 31
 1: 21 10 31 21
 2: 21 31 10 21
 3: 31 21 21 10

From /proc/meminfo
  MemTotal:    792236448 kB
  HugePages_Total:       0
  Hugepagesize:       2048 kB

From /etc/*release* /etc/*version*
  os-release:
    NAME="Red Hat Enterprise Linux Server"
    VERSION="7.6 (Maipo)"
    ID="rhel"
    ID_LIKE="fedora"
    VARIANT="Server"
    VARIANT_ID="server"
    VERSION_ID="7.6"
    PRETTY_NAME="Red Hat Enterprise Linux Server 7.6 (Maipo)"
  redhat-release: Red Hat Enterprise Linux Server release 7.6 (Maipo)
  system-release: Red Hat Enterprise Linux Server release 7.6 (Maipo)

uname -a:
  Linux localhost.localdomain 3.10.0-957.el7.x86_64 #1 SMP Thu Oct 4 20:48:51 UTC 2018
  x86_64 x86_64 x86_64 GNU/Linux

Kernel self-reported vulnerability status:

CVE-2017-5754 (Meltdown): Not affected
CVE-2017-5753 (Spectre variant 1): Mitigation: Load fences, __user pointer sanitization
CVE-2017-5715 (Spectre variant 2): Mitigation: Enhanced IBRS

run-level 3 Sep 17 23:48

SPEC is set to: /home/cpu2017-1.0.5-ic19.0u4
  Filesystem Type Size Used Avail Use% Mounted on
tmpfs   tmpfs  800G 8.3G 792G  2% /home

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 SMI BIOS" standard.

BIOS Lenovo -[IVE141E-2.30]- 07/02/2019

(Continued on next page)
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Software Availability: May-2019

Platform Notes (Continued)

Memory:
48x Samsung M393A2K43CB2-CVF 16 GB 2 rank 2933, configured at 2666

(End of data from sysinfo program)

Compiler Version Notes

==============================================================================
C               | 619.lbm_s(base) 638.imagick_s(base) 644.nab_s(base)
Intel(R) C Intel(R) 64 Compiler for applications running on Intel(R) 64,
Version 19.0.4.227 Build 20190416
Copyright (C) 1985-2019 Intel Corporation. All rights reserved.
==============================================================================

C++, C, Fortran | 607.cactuBSSN_s(base)

Intel(R) C++ Intel(R) 64 Compiler for applications running on Intel(R) 64,
Version 19.0.4.227 Build 20190416
Copyright (C) 1985-2019 Intel Corporation. All rights reserved.
Intel(R) C Intel(R) 64 Compiler for applications running on Intel(R) 64,
Version 19.0.4.227 Build 20190416
Copyright (C) 1985-2019 Intel Corporation. All rights reserved.
Intel(R) Fortran Intel(R) 64 Compiler for applications running on Intel(R)
64, Version 19.0.4.227 Build 20190416
Copyright (C) 1985-2019 Intel Corporation. All rights reserved.
==============================================================================

Fortran         | 603.bwaves_s(base) 649.fotonik3d_s(base) 654.roms_s(base)

Intel(R) Fortran Intel(R) 64 Compiler for applications running on Intel(R)
64, Version 19.0.4.227 Build 20190416
Copyright (C) 1985-2019 Intel Corporation. All rights reserved.
==============================================================================

Fortran, C      | 621.wrf_s(base) 627.cam4_s(base) 628.pop2_s(base)

Intel(R) Fortran Intel(R) 64 Compiler for applications running on Intel(R)
64, Version 19.0.4.227 Build 20190416
Copyright (C) 1985-2019 Intel Corporation. All rights reserved.
Intel(R) C Intel(R) 64 Compiler for applications running on Intel(R) 64,
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SPEC CPU®2017 Floating Point Speed Result

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Compiler Version Notes (Continued)

Base Compiler Invocation

C benchmarks:
icc -m64 -std=c11

Fortran benchmarks:
ifort -m64

Benchmarks using both Fortran and C:
ifort -m64 icc -m64 -std=c11

Benchmarks using Fortran, C, and C++:
icpc -m64 icc -m64 -std=c11 ifort -m64

Base Portability Flags

603.bwaves_s: -DSPEC_LP64
607.cactuBSSN_s: -DSPEC_LP64
619.ibm_s: -DSPEC_LP64
621.wrf_s: -DSPEC_LP64 -DSPEC_CASE_FLAG -convert big_endian
627.cam4_s: -DSPEC_LP64 -DSPEC_CASE_FLAG
628.pop2_s: -DSPEC_LP64 -DSPEC_CASE_FLAG -convert big_endian
-assume byterecl
638.imagick_s: -DSPEC_LP64
644.nab_s: -DSPEC_LP64
649.fotonik3d_s: -DSPEC_LP64
654.roms_s: -DSPEC_LP64

Base Optimization Flags

C benchmarks:
-xCORE-AVX512 -ipo -O3 -no-prec-div -qopt-prefetch
-ffinite-math-only -qopt-mem-layout-trans=4 -qopenmp -DSPEC_OPENMP

Fortran benchmarks:
-DSPEC_OPENMP -xCORE-AVX512 -ipo -O3 -no-prec-div -qopt-prefetch
-ffinite-math-only -qopt-mem-layout-trans=4 -qopenmp
-nostandard-realloc-lhs

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

Benchmarks using both Fortran and C:
- `-xCORE-AVX512`  
- `-ipo`  
- `-no-prec-div`  
- `-gopt-prefetch`  
- `-ffinite-math-only`  
- `-gopt-mem-layout-trans=4`  
- `-qopenmp`  
- `-DSPEC_OPENMP`  
- `-nostandard-realloc-lhs`

Benchmarks using Fortran, C, and C++:
- `-xCORE-AVX512`  
- `-ipo`  
- `-no-prec-div`  
- `-gopt-prefetch`  
- `-ffinite-math-only`  
- `-gopt-mem-layout-trans=4`  
- `-qopenmp`  
- `-DSPEC_OPENMP`  
- `-nostandard-realloc-lhs`

The flags files that were used to format this result can be browsed at:
- [http://www.spec.org/cpu2017/flags/Lenovo-Platform-SPECcpu2017-Flags-V1.2-CLX-F.html](http://www.spec.org/cpu2017/flags/Lenovo-Platform-SPECcpu2017-Flags-V1.2-CLX-F.html)

You can also download the XML flags sources by saving the following links:
- [http://www.spec.org/cpu2017/flags/Lenovo-Platform-SPECcpu2017-Flags-V1.2-CLX-F.xml](http://www.spec.org/cpu2017/flags/Lenovo-Platform-SPECcpu2017-Flags-V1.2-CLX-F.xml)