SPEC CPU®2017 Floating Point Rate Result

Copyright 2017-2020 Standard Performance Evaluation Corporation

Lenovo Global Technology

ThinkSystem ST50
(3.40 GHz, Intel Xeon E-2224)

SPECrate®2017_fp_base = 31.9
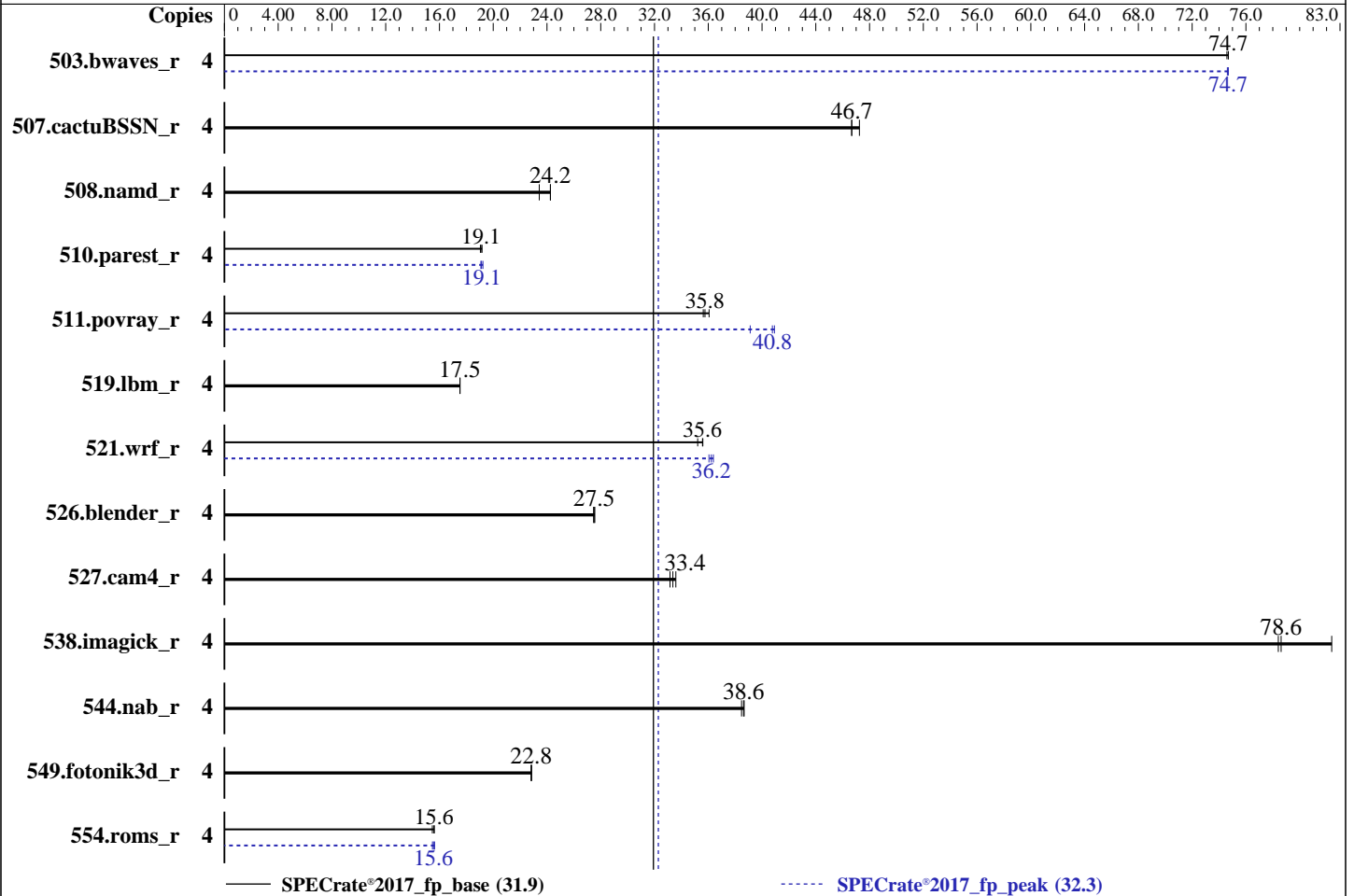
SPECrate®2017_fp_peak = 32.3

CPU2017 License: 9017　　　　　　　　　　　　　　　　　　**Test Date:** Jun-2020
Test Sponsor: Lenovo Global Technology　　　　　　　　**Hardware Availability:** Mar-2020
Tested by: Lenovo Global Technology　　　　　　　　　**Software Availability:** Apr-2020

Benchmark	Copies	Base	Peak
503.bwaves_r	4	74.7	74.7
507.cactuBSSN_r	4	46.7	
508.namd_r	4	24.2	
510.parest_r	4	19.1	19.1
511.povray_r	4	35.8	40.8
519.lbm_r	4	17.5	
521.wrf_r	4	35.6	36.2
526.blender_r	4	27.5	
527.cam4_r	4	33.4	
538.imagick_r	4	78.6	
544.nab_r	4	38.6	
549.fotonik3d_r	4	22.8	
554.roms_r	4	15.6	15.6

SPECrate®2017_fp_base (31.9)　　　　　　　　SPECrate®2017_fp_peak (32.3)

Hardware

CPU Name: Intel Xeon E-2224
　Max MHz: 4600
　Nominal: 3400
Enabled: 4 cores, 1 chip
Orderable: 1 chip
Cache L1: 32 KB I + 32 KB D on chip per core
　L2: 256 KB I+D on chip per core
　L3: 8 MB I+D on chip per chip
　Other: None
Memory: 64 GB (4 x 16 GB 2Rx8 PC4-2666V-E)
Storage: 1 x 960 GB SATA SSD
Other: None

Software

OS: Red Hat Enterprise Linux 8.1
　　(Ootpa)
　　Kernel 4.18.0-147.el8.x86_64
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: Lenovo BIOS Version ITE109B released Apr-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

(Continued on next page)

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CPU2017 License: 9017	**Test Date:** Jun-2020
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Tested by: Lenovo Global Technology	**Software Availability:** Apr-2020

Software (Continued)

Power Management: BIOS set to prefer performance at the cost of additional power usage

Results Table

Benchmark	Base						Peak					
	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio
503.bwaves_r	4	538	74.6	537	74.7	**537**	**74.7**	4	**537**	**74.7**	538	74.6	537	74.7
507.cactuBSSN_r	4	109	46.7	107	47.2	**108**	**46.7**	4	109	46.7	107	47.2	**108**	**46.7**
508.namd_r	4	**157**	**24.2**	162	23.4	157	24.3	4	**157**	**24.2**	162	23.4	157	24.3
510.parest_r	4	549	19.0	546	19.2	**548**	**19.1**	4	544	19.2	548	19.1	**547**	**19.1**
511.povray_r	4	262	35.6	**261**	**35.8**	259	36.1	4	239	39.1	228	40.9	**229**	**40.8**
519.lbm_r	4	**241**	**17.5**	241	17.5	241	17.5	4	**241**	**17.5**	241	17.5	241	17.5
521.wrf_r	4	**252**	**35.6**	252	35.6	254	35.2	4	249	36.1	246	36.4	**247**	**36.2**
526.blender_r	4	221	27.6	**221**	**27.5**	222	27.5	4	221	27.6	**221**	**27.5**	222	27.5
527.cam4_r	4	208	33.6	**210**	**33.4**	211	33.2	4	208	33.6	**210**	**33.4**	211	33.2
538.imagick_r	4	**127**	**78.6**	121	82.4	127	78.4	4	**127**	**78.6**	121	82.4	127	78.4
544.nab_r	4	174	38.7	**174**	**38.6**	175	38.5	4	174	38.7	**174**	**38.6**	175	38.5
549.fotonik3d_r	4	**683**	**22.8**	683	22.8	682	22.9	4	**683**	**22.8**	683	22.8	682	22.9
554.roms_r	4	**408**	**15.6**	407	15.6	411	15.5	4	411	15.5	407	15.6	**409**	**15.6**

SPECrate®2017_fp_base =	**31.9**
SPECrate®2017_fp_peak =	**32.3**

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 taskset mechanism was used to bind copies to processors. The config file option 'submit' was used to generate taskset 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/cpu2017-1.1.0-ic19.1.1/lib/intel64:/home/cpu2017-1.1.0-ic19.1.1/j

(Continued on next page)

Lenovo Global Technology

ThinkSystem ST50
(3.40 GHz, Intel Xeon E-2224)

SPECrate®2017_fp_base = 31.9

SPECrate®2017_fp_peak = 32.3

CPU2017 License: 9017
Test Sponsor: Lenovo Global Technology
Tested by: Lenovo Global Technology

Test Date: Jun-2020
Hardware Availability: Mar-2020
Software Availability: Apr-2020

Environment Variables Notes (Continued)

```
     e5.0.1-64"
MALLOC_CONF = "retain:true"
```

General Notes

```
 Binaries compiled on a system with 1x Intel Core i9-7980XE CPU + 64GB RAM
 memory using Redhat Enterprise Linux 8.0
 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
Yes: 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.
 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 configuration:
ICE Performance Mode set to 4HD Cooling Mode

 Sysinfo program /home/cpu2017-1.1.0-ic19.1.1/bin/sysinfo
 Rev: r6365 of 2019-08-21 295195f888a3d7edb1e6e46a485a0011
 running on localhost.localdomain Sat Jun 13 17:10:08 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) E-2224 CPU @ 3.40GHz
       1  "physical id"s (chips)
       4 "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 : 4
       siblings  : 4
       physical 0: cores 0 1 2 3

 From lscpu:
```

Lenovo Global Technology

SPECrate®2017_fp_base = 31.9

ThinkSystem ST50
(3.40 GHz, Intel Xeon E-2224)

SPECrate®2017_fp_peak = 32.3

CPU2017 License: 9017
Test Sponsor: Lenovo Global Technology
Tested by: Lenovo Global Technology

Test Date: Jun-2020
Hardware Availability: Mar-2020
Software Availability: Apr-2020

Platform Notes (Continued)

```
         Architecture:          x86_64
         CPU op-mode(s):        32-bit, 64-bit
         Byte Order:            Little Endian
         CPU(s):                4
         On-line CPU(s) list:   0-3
         Thread(s) per core:    1
         Core(s) per socket:    4
         Socket(s):             1
         NUMA node(s):          1
         Vendor ID:             GenuineIntel
         CPU family:            6
         Model:                 158
         Model name:            Intel(R) Xeon(R) E-2224 CPU @ 3.40GHz
         Stepping:              10
         CPU MHz:               4476.841
         CPU max MHz:           4600.0000
         CPU min MHz:           800.0000
         BogoMIPS:              6816.00
         Virtualization:        VT-x
         L1d cache:             32K
         L1i cache:             32K
         L2 cache:              256K
         L3 cache:              8192K
         NUMA node0 CPU(s):     0-3
         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 pdpe1gb rdtscp
     lm constant_tsc art arch_perfmon pebs bts rep_good nopl xtopology nonstop_tsc cpuid
     aperfmperf tsc_known_freq pni pclmulqdq dtes64 monitor ds_cpl vmx smx est tm2 ssse3
     sdbg fma cx16 xtpr pdcm pcid sse4_1 sse4_2 x2apic movbe popcnt tsc_deadline_timer
     aes xsave avx f16c rdrand lahf_lm abm 3dnowprefetch cpuid_fault epb invpcid_single
     pti ssbd ibrs ibpb stibp tpr_shadow vnmi flexpriority ept vpid fsgsbase tsc_adjust
     bmi1 hle avx2 smep bmi2 erms invpcid rtm mpx rdseed adx smap clflushopt intel_pt
     xsaveopt xsavec xgetbv1 xsaves dtherm ida arat pln pts hwp hwp_notify hwp_act_window
     hwp_epp md_clear flush_l1d

  /proc/cpuinfo cache data
     cache size : 8192 KB

  From numactl --hardware  WARNING: a numactl 'node' might or might not correspond to a
  physical chip.
     available: 1 nodes (0)
     node 0 cpus: 0 1 2 3
     node 0 size: 64296 MB
     node 0 free: 62886 MB
     node distances:
     node   0
       0:  10
```

(Continued on next page)

Lenovo Global Technology

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SPECrate®2017_fp_peak = 32.3

CPU2017 License: 9017   **Test Date:** Jun-2020
Test Sponsor: Lenovo Global Technology   **Hardware Availability:** Mar-2020
Tested by: Lenovo Global Technology   **Software Availability:** Apr-2020

Platform Notes (Continued)

```
From /proc/meminfo
   MemTotal:       65839256 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 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):        Mitigation: PTE Inversion; VMX: conditional
                                          cache flushes, SMT disabled
Microarchitectural Data Sampling:         Mitigation: Clear CPU buffers; SMT disabled
CVE-2017-5754 (Meltdown):                 Mitigation: PTI
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: Full generic retpoline, IBPB:
                                          conditional, IBRS_FW, STIBP: disabled, RSB
                                          filling


run-level 3 Jun 13 13:24

SPEC is set to: /home/cpu2017-1.1.0-ic19.1.1
   Filesystem      Type  Size  Used Avail Use% Mounted on
   /dev/sda3       xfs   812G   66G  747G   9% /home

From /sys/devices/virtual/dmi/id
    BIOS:    LENOVO ITE109B 04/24/2020
    Vendor:  LENOVO
```

(Continued on next page)

Lenovo Global Technology

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CPU2017 License: 9017	**Test Date:** Jun-2020
Test Sponsor: Lenovo Global Technology	**Hardware Availability:** Mar-2020
Tested by: Lenovo Global Technology	**Software Availability:** Apr-2020

Platform Notes (Continued)

```
      Product: INVALID
      Product Family: Lenovo Product
      Serial:  INVALID

 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:
     4x SK Hynix HMA82GU7CJR8N-VK 16 GB 2 rank 2666


 (End of data from sysinfo program)
```

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


==============================================================================
C++, C             | 511.povray_r(base) 526.blender_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.
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++, C             | 511.povray_r(peak)
------------------------------------------------------------------------------
```

(Continued on next page)

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CPU2017 License: 9017

Test Sponsor: Lenovo Global Technology

Tested by: Lenovo Global Technology

Test Date: Jun-2020

Hardware Availability: Mar-2020

Software Availability: Apr-2020

Compiler Version Notes (Continued)

```
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.
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.
------------------------------------------------------------------------------


==============================================================================
C++, C            | 511.povray_r(base) 526.blender_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.
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++, C            | 511.povray_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.
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.
------------------------------------------------------------------------------


==============================================================================
C++, C, Fortran | 507.cactuBSSN_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.
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) 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.
------------------------------------------------------------------------------


==============================================================================
Fortran           | 503.bwaves_r(base, peak) 549.fotonik3d_r(base, peak)
                  | 554.roms_r(base, peak)
```

(Continued on next page)

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Test Date: Jun-2020
Hardware Availability: Mar-2020
Software Availability: Apr-2020

Compiler Version Notes (Continued)

```
--------------------------------------------------------------------------------
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.
--------------------------------------------------------------------------------


================================================================================
Fortran, C       | 521.wrf_r(base) 527.cam4_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.
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.
--------------------------------------------------------------------------------


================================================================================
Fortran, C       | 521.wrf_r(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.
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.
--------------------------------------------------------------------------------


================================================================================
Fortran, C       | 521.wrf_r(base) 527.cam4_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.
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.
--------------------------------------------------------------------------------


================================================================================
Fortran, C       | 521.wrf_r(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.
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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CPU2017 License: 9017
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Test Date: Jun-2020
Hardware Availability: Mar-2020
Software Availability: Apr-2020

Compiler Version Notes (Continued)

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

Base Compiler Invocation

C benchmarks:
`icc`

C++ benchmarks:
`icpc`

Fortran benchmarks:
`ifort`

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`

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Tested by: Lenovo Global Technology

Test Date: Jun-2020
Hardware Availability: Mar-2020
Software Availability: Apr-2020

Base Optimization Flags

C benchmarks:
```
-m64 -qnextgen -std=c11
-Wl,-plugin-opt=-x86-branches-within-32B-boundaries -Wl,-z,muldefs
-fuse-ld=gold -xCORE-AVX2 -Ofast -ffast-math -flto -mfpmath=sse
-funroll-loops -qopt-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-AVX2 -Ofast -ffast-math -flto
-mfpmath=sse -funroll-loops -qopt-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
-fuse-ld=gold -xCORE-AVX2 -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 -qnextgen -std=c11
-Wl,-plugin-opt=-x86-branches-within-32B-boundaries -Wl,-z,muldefs
-fuse-ld=gold -xCORE-AVX2 -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 -qnextgen -std=c11
-Wl,-plugin-opt=-x86-branches-within-32B-boundaries -Wl,-z,muldefs
-fuse-ld=gold -xCORE-AVX2 -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 -qnextgen -std=c11
-Wl,-plugin-opt=-x86-branches-within-32B-boundaries -Wl,-z,muldefs
-fuse-ld=gold -xCORE-AVX2 -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
```

Lenovo Global Technology

ThinkSystem ST50
(3.40 GHz, Intel Xeon E-2224)

SPECrate®2017_fp_base = 31.9

SPECrate®2017_fp_peak = 32.3

CPU2017 License: 9017
Test Sponsor: Lenovo Global Technology
Tested by: Lenovo Global Technology

Test Date: Jun-2020
Hardware Availability: Mar-2020
Software Availability: Apr-2020

Base Optimization Flags (Continued)

Benchmarks using Fortran, C, and C++ (continued):
```
-L/usr/local/jemalloc64-5.0.1/lib -ljemalloc
```

Peak Compiler Invocation

C benchmarks:
```
icc
```

C++ benchmarks:
```
icpc
```

Fortran benchmarks:
```
ifort
```

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.lbm_r: `basepeak = yes`

538.imagick_r: `basepeak = yes`

544.nab_r: `basepeak = yes`

C++ benchmarks:

(Continued on next page)

Lenovo Global Technology

SPECrate®2017_fp_base = 31.9

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Peak Optimization Flags (Continued)

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-AVX2 -Ofast
-ffast-math -flto -mfpmath=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-AVX2 -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

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-AVX2 -O3 -ipo
-no-prec-div -qopt-prefetch -ffinite-math-only
-qopt-multiple-gather-scatter-by-shuffles
-qopt-mem-layout-trans=4 -mbranches-within-32B-boundaries
-nostandard-realloc-lhs -align array32byte -auto
-L/usr/local/jemalloc64-5.0.1/lib -ljemalloc

527.cam4_r: basepeak = yes

Benchmarks using both C and C++:

511.povray_r: -prof-gen(pass 1) -prof-use(pass 2) -xCORE-AVX2 -O3 -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++:

(Continued on next page)

SPEC CPU®2017 Floating Point Rate Result

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(3.40 GHz, Intel Xeon E-2224)

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Peak Optimization Flags (Continued)

507.cactuBSSN_r: basepeak = yes

The flags files that were used to format this result can be browsed at

http://www.spec.org/cpu2017/flags/Intel-ic19.1u1-official-linux64_revA.html
http://www.spec.org/cpu2017/flags/Lenovo-Platform-SPECcpu2017-Flags-V1.2-CFL-B.html

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
http://www.spec.org/cpu2017/flags/Lenovo-Platform-SPECcpu2017-Flags-V1.2-CFL-B.xml

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

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