**Lenovo Global Technology**  
ThinkSystem SR650 V3  
(1.80 GHz, Intel Xeon Gold 6428N)  

<table>
<thead>
<tr>
<th>SPECrate®2017_int_base = 501</th>
<th>SPECrate®2017_int_peak = Not Run</th>
</tr>
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<tbody>
<tr>
<td>CPU2017 License: 9017</td>
<td>Test Date: Feb-2023</td>
</tr>
<tr>
<td>Test Sponsor: Lenovo Global Technology</td>
<td>Hardware Availability: Feb-2023</td>
</tr>
<tr>
<td>Tested by: Lenovo Global Technology</td>
<td>Software Availability: Dec-2022</td>
</tr>
</tbody>
</table>

### Hardware

- **CPU Name:** Intel Xeon Gold 6428N  
- **Max MHz:** 3800  
- **Nominal:** 1800  
- **Enabled:** 64 cores, 2 chips, 2 threads/core  
- **Orderable:** 1.2 chips  
- **Cache L1:** 32 KB I + 48 KB D on chip per core  
- **L2:** 2 MB I+D on chip per core  
- **L3:** 60 MB I+D on chip per chip  
- **Other:** None  
- **Memory:** 512 GB (16 x 32 GB 2Rx8 PC5-4800B-R, running at 4000)  
- **Storage:** 1 x 480 GB SATA SSD  
- **Other:** None  

### Software

- **OS:** SUSE Linux Enterprise Server 15 SP4 (x86_64)  
  Kernel 5.14.21-150400.22-default  
- **Compiler:** C/C++: Version 2023.0 of Intel oneAPI DPC++/C++  
  Compiler for Linux;  
  Fortran: Version 2023.0 of Intel Fortran Compiler for Linux;  
- **Firmware:** Lenovo BIOS Version ESE109L 1.10 released Jan-2023  
- **File System:** xfs  
- **System State:** Run level 3 (multi-user)  
- **Base Pointers:** 64-bit  
- **Peak Pointers:** Not Applicable  
- **Other:** None  
- **Power Management:** BIOS and OS set to prefer performance at the cost of additional power usage  

### SPEC CPU®2017 Integer Rate Result

<table>
<thead>
<tr>
<th>Test</th>
<th>Copies</th>
<th>SPECrate®2017_int_base (501)</th>
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<tbody>
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<td>367</td>
</tr>
<tr>
<td>502.gcc_r</td>
<td>128</td>
<td>419</td>
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<td>505.mcf_r</td>
<td>128</td>
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<tr>
<td>520.omnetpp_r</td>
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<tr>
<td>523.xalancbmk_r</td>
<td>128</td>
<td>978</td>
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<td>525.x264_r</td>
<td>128</td>
<td>953</td>
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<tr>
<td>531.deepsjeng_r</td>
<td>128</td>
<td>347</td>
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<tr>
<td>541.leela_r</td>
<td>128</td>
<td>327</td>
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<tr>
<td>548.exchange2_r</td>
<td>128</td>
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Results Table

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<tr>
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</table>

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

Compiler Notes

SPEC has ruled that the compiler used for this result was performing a compilation that specifically improves the performance of the 523.xalancbmk_r / 623.xalancbmk_s benchmarks using a priori knowledge of the SPEC code and dataset to perform a transformation that has narrow applicability.

In order to encourage optimizations that have wide applicability (see rule 1.4 https://www.spec.org/cpu2017/Docs/runrules.html#rule_1.4), SPEC will no longer publish results using this optimization.

This result is left in the SPEC results database for historical reference.

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/cpu2017-1.1.9-ic2023.0/lib/intel64:/home/cpu2017-1.1.9-ic2023.0/lib/ia32:/home/cpu2017-1.1.9-ic2023.0/je5.0.1-32"
MALLOC_CONF = "retain:true"
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General Notes

Binaries compiled on a system with 2x Intel Xeon Platinum 8280M CPU + 384GB RAM
memory using Red Hat Enterprise Linux 8.4
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>
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.

Platform Notes

BIOS configuration:
Operating Mode set to Maximum Performance and then set it to Custom Mode
MONITOR/MWAIT set to Enabled
SNC set to SNC2
LLC Prefetch set to Disabled
UPI Link Disable set to Disabled 1 Link

Sysinfo program: /home/cpu2017-1.1.9-ic2023.0/bin/sysinfo
Rev: r6732 of 2022-11-07 fe91c89b7ed5c6a2c92cc097bec197
running on localhost Tue Feb 28 17:39:50 2023

SUT (System Under Test) info as seen by some common utilities.

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2. w
3. Username
4. ulimit -a
5. sysinfo process ancestry
6. /proc/cpuinfo
7. lscpu
8. numactl --hardware
9. /proc/meminfo
10. who -r
11. Systemd service manager version: systemd 249 (249.11+suse.124.g2bc0b2c447)
12. Services, from systemctl list-unit-files
13. Linux kernel boot-time arguments, from /proc/cmdline
14. cpupower frequency-info
15. sysctl
16. /sys/kernel/mm/transparent_hugepage
17. /sys/kernel/mm/transparent_hugepage/klugepaged
18. OS release
19. Disk information
20. /sys/devices/virtual/dmi/id
21. dmidecode
22. BIOS

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SPEC CPU®2017 Integer Rate Result

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Platform Notes (Continued)

2. w
   17:39:50 up 4 min, 1 user, load average: 0.31, 1.40, 0.76
   USER   TTY     FROM             LOGIN@   IDLE   JCPU   PCPU WHAT
   root   tty1     -                17:36    6.00s  1.28s  0.01s -bash

3. Username
   From environment variable $USER: root

4. ulimit -a
   core file size (blocks, -c) unlimited
   data seg size (kbytes, -d) unlimited
   scheduling priority (-e) 0
   file size (blocks, -f) unlimited
   pending signals (-l) 2062489
   max locked memory (kbytes, -l) 64
   max memory size (kbytes, -m) unlimited
   open files (-n) 1024
   pipe size (512 bytes, -p) 8
   POSIX message queues (bytes, -q) 819200
   real-time priority (-r) 0
   stack size (kbytes, -s) unlimited
   cpu time (seconds, -t) unlimited
   max user processes (-u) 2062489
   virtual memory (kbytes, -v) unlimited
   file locks (-x) unlimited

5. sysinfo process ancestry
   /usr/lib/systemd/systemd --switched-root --system --deserialize 30
   login -- root
   -bash
   -bash
   -bash
   runcpu --nobuild --action validate --define default-platform-flags --define numcopies=128 -c
   ic2023.0-lin-sapphirerapids-rate-20221201.cfg --define smt-on --define cores=64 --define physicalfirst
   --define invoke_with_interleave --define drop_caches --tune base -o all intrate
   runcpu --nobuild --action validate --define default-platform-flags --define numcopies=128 --configfile
   ic2023.0-lin-sapphirerapids-rate-20221201.cfg --define smt-on --define cores=64 --define physicalfirst
   --define invoke_with_interleave --define drop_caches --tune base --output_format all --nopower --runmode
   rate --tune base --size refrate intrate --nopreenv --note-preenv --logfile
   $SPEC/tmp/CPU2017.158/templogs/preenv.intrate.158.0.log --lognum 158.0 --from_runcpu 2
   specperl $SPEC/bin/sysinfo
   $SPEC = /home/cpu2017-1.1.9-ic2023.0

6. /proc/cpuinfo
   model name : Intel(R) Xeon(R) Gold 6428N
   vendor_id : GenuineIntel
   cpu family : 6
   model : 143
   stepping : 8
   microcode : 0x2b000161
   bug : spectre_v1 spectre_v2 spec_store_bypass swaps
   cpu cores : 32

(Continued on next page)
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Platform Notes (Continued)

siblings : 64
2 physical ids (chips)
128 processors (hardware threads)
physical id 0: core ids 0-31
physical id 1: core ids 0-31
physical id 0: apic ids 0-63
physical id 1: apic ids 128-191
Caution: /proc/cpuinfo data regarding chips, cores, and threads is not necessarily reliable, especially for virtualized systems. Use the above data carefully.

7. lscpu

From lscpu from util-linux 2.37.2:
Architecture:                    x86_64
CPU op-mode(s):                  32-bit, 64-bit
Address sizes:                   46 bits physical, 57 bits virtual
Byte Order:                      Little Endian
CPU(s):                          128
On-line CPU(s) list:             0-127
Vendor ID:                       GenuineIntel
Model name:                      Intel(R) Xeon(R) Gold 6428N
CPU family:                      6
Model:                           143
Thread(s) per core:              2
Core(s) per socket:              32
Socket(s):                       2
Stepping:                        8
BogoMIPS:                        3600.00
Flags:                           fpu vme de pse mce cmov pat pse36
                                 cmplt flush dts acpi mmx fxsr sse sse2 ss ht tm pbe syscall nx pdpe1gb rdscp
                                 lm constant_tsc arch_perfmon pebs bts rep_good nopl xtopology
                                 nonstop_ts cpuid aperfmperf tsc_known_freq pni pclmulqdq dtes64 monitor
data_cpl vmx 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 cat_l2 cd pcpuid_single intel_ppp
core ibs ibrs ibsd mba ibrs ibsd ibrs_enhanced
trash_pmr vmm_reduces vmpwrmsre xsaveopt clflushopt clwb intel_pt avx12ifma clflushopt clwb intel_pt avx12cd
                             sha_avx2 opt xsaveopt xsaves axatb1 xsaves cqm llc cqm_occ Arn llc cqm-mm_total
                             cqm-mm-local split_lock detect avx_vnni avx512_bif16 vbnoinvd dtherm ida
                             arat pln pts avx512vbmi umip pku ospke waipt kg pkw avx512_vmbmi2 gfn vaes
                             vpmulqd q avx512_vnni avx512_bitalg fone ax512_vpopcnt dq l57 rdp
dx bus lock detect clidemote modir modir164b enqcmd farn md_clear serializer
txsl_key pconfig arch_lbr avx512_fp16 amx_tile flush_l1d arch_capabilities
Virtualization:                 VT-x
L1d cache:                      3 MiB (64 instances)
L1i cache:                      2 MiB (64 instances)
L2 cache:                      128 MiB (64 instances)
L3 cache:                      120 MiB (2 instances)
NUMA node(s):                   4
NUMA node0 CPU(s):             0-15,64-79
NUMA node1 CPU(s):            16-31, 80-95
NUMA node2 CPU(s):            32-47, 96-111
NUMA node3 CPU(s):            48-63, 112-127
Vulnerability Itlb multihit:   Not affected
Vulnerability Lft:             Not affected
Vulnerability Mds:             Not affected
Vulnerability Meltdown:        Not affected

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Platform Notes (Continued)

Vulnerability Spec store bypass: Mitigation; Speculative Store Bypass disabled via prctl and seccomp
Vulnerability Spectre v1: Mitigation; usercopy/swapgs barriers and __user pointer sanitization
Vulnerability Spectre v2: Mitigation; Enhanced IBRS, IBPB conditional, RSB filling
Vulnerability Srbdos: Not affected
Vulnerability Tx sync abort: Not affected

From lscpu --cache:

<table>
<thead>
<tr>
<th>NAME</th>
<th>ONE-SIZE</th>
<th>ALL-SIZE</th>
<th>WAYS</th>
<th>TYPE</th>
<th>LEVEL</th>
<th>SETS</th>
<th>PHY-LINE</th>
<th>COHERENCY-SIZE</th>
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<td>L1d</td>
<td>48K</td>
<td>3M</td>
<td>12</td>
<td>Data</td>
<td>1</td>
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<td>1</td>
<td>64</td>
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<td>L1i</td>
<td>32K</td>
<td>2M</td>
<td>8</td>
<td>Instruction</td>
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<td>L2</td>
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<td>120M</td>
<td>15</td>
<td>Unified</td>
<td>3</td>
<td>65536</td>
<td>1</td>
<td>64</td>
</tr>
</tbody>
</table>

------------------------------------------------------------

8. numactl --hardware

NOTE: a numactl 'node' might or might not correspond to a physical chip.

available: 4 nodes (0-3)
node 0 cpus: 0-15,64-79
node 0 size: 128679 MB
node 0 free: 128047 MB
node 1 cpus: 16-31,80-95
node 1 size: 129015 MB
node 1 free: 128714 MB
node 2 cpus: 32-47,96-111
node 2 size: 128981 MB
node 2 free: 128354 MB
node 3 cpus: 48-63,112-127
node 3 size: 128969 MB
node 3 free: 128412 MB
node distances:
node   0   1   2   3
0:  10  12  21  21
1:  12  10  21  21
2:  21  21  10  12
3:  21  21  12  10

------------------------------------------------------------

9. /proc/meminfo

MemTotal: 528021756 kB

------------------------------------------------------------

10. who -r

run-level 3 Feb 28 17:36

------------------------------------------------------------

11. Systemd service manager version: systemd 249 (249.11+su3-124.g2bc0b2c447)

Default Target Status
multi-user running

------------------------------------------------------------

12. Services, from systemctl list-unit-files

STATE | UNIT FILES
YaST2-Firstboot YaST2-Second-Stage apparmor auditd cron getty@ havedeg irqbalance iscsi
issue-generator kbdsettings klog lvm2-monitor nscd postfix purge-kernels rollback rsyslog
smartd sshd wicked wickedd-auto4 wickedd-dhcpc4 wickedd-dhcpc6 wickedd-nanny

systemd-remount-fs

autofs autostart-initscripts blk-availability boot-systemctl ca-certificates chrony-wait
console-getty cups cups-browsed debug-shell etables exchange-bmc-os-info
firewalld gpm grub2-once havedeg-switch-root ipmi ipmiyevd iscsi-init iscsid iscsiui0
issue-ssh-keys kexec-load lummask man-db-create multipathd nfs nfs-bikmap nmb rdisc

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Platform Notes (Continued)

rpcbind rpmconfigcheck rsyncd serial-getty@ smartd_generate_opts smb snmpd snmptrapd systemd-boot-check-no-failures systemd-network-generator systemd-sysext systemd-time-wait-sync systemd-timesyncd udisks2
indirect wickedd

13. Linux kernel boot-time arguments, from /proc/cmdline
   BOOT_IMAGE=/boot/vmlinuz-5.14.21-150400.22-default
   root=UUID=cf0c8526-2665-4565-b656-0513c168d1bb
   splash=silent
   mitigations=auto
   quiet
   security=apparmor

14. cpupower frequency-info
   analyzing CPU 0:
   Unable to determine current policy
   boost state support:
   Supported: yes
   Active: yes

15. sysctl
   kernel.numa_balancing 1
   kernel.randomize_va_space 2
   vm.compaction_proactiveness 20
   vm.dirty_background_bytes 0
   vm.dirty_background_ratio 10
   vm.dirty_bytes 0
   vm.dirty_expire_centisecs 3000
   vm.dirty_ratio 20
   vm.dirty_writeback_centisecs 500
   vm.dirtytime_expire_seconds 43200
   vm.extfrag_threshold 500
   vm.min_unmapped_ratio 1
   vm.nr_hugepages 0
   vm.nr_hugepages_mempolicy 0
   vm.nr_overcommit_hugepages 0
   vm.swappiness 60
   vm.watermark_boost_factor 15000
   vm.watermark_scale_factor 10
   vm.zone_reclaim_mode 0

16. /sys/kernel/mm/transparent_hugepage
   defrag always defer defer+madvice [madvice] never
   enabled [always] madvice never
   hpage_pmd_size 2097152
   shmem_enabled always within_size advise [never] deny force

17. /sys/kernel/mm/transparent_hugepage/khugepaged
   alloc_sleep_millisecs 60000
   defrag 1
   max_ptes_none 511
   max_ptes_shared 256
   max_ptes_swap 64
   pages_to_scan 4096
   scan_sleep_millisecs 10000

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Platform Notes (Continued)

18. OS release
From /etc/*-release /etc/*-version
os-release SUSE Linux Enterprise Server 15 SP4

19. Disk information
SPEC is set to: /home/cpu2017-1.1.9-ic2023.0
Filesystem Type Size Used Avail Use% Mounted on
/dev/sda3 xfs 446G 54G 393G 12% /

20. /sys/devices/virtual/dmi/id
Vendor: Lenovo
Product: ThinkSystem SR650 V3 MB, EGS, DDR5, SH, 2U
Product Family: ThinkSystem
Serial: 1234567890

21. dmidecode
Additional information from dmidecode 3.2 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:
9x Samsung M321R4GA3BB0-CQKEG 32 GB 2 rank 4800, configured at 4000
7x Samsung M321R4GA3BB0-CQKVG 32 GB 2 rank 4800, configured at 4000

22. BIOS
(This section combines info from /sys/devices and dmidecode.)
BIOS Vendor: Lenovo
BIOS Version: ESE109L-1.10
BIOS Date: 01/07/2023
BIOS Revision: 1.10
Firmware Revision: 1.0

Compiler Version Notes

<table>
<thead>
<tr>
<th>C</th>
<th>500.perlbench_r(base) 502.gcc_r(base) 505.mcf_r(base) 525.x264_r(base) 557.xz_r(base)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Intel(R) oneAPI DPC++/C++ Compiler for applications running on Intel(R) 64, Version 2023.0.0 Build 20221201 Copyright (C) 1985-2022 Intel Corporation. All rights reserved.</td>
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<tr>
<td></td>
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<tr>
<td>C++</td>
<td>520.omnetpp_r(base) 523.xalancbmk_r(base) 531.deepsjeng_r(base) 541.leela_r(base)</td>
</tr>
<tr>
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</tr>
<tr>
<td></td>
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<tr>
<td>Fortran</td>
<td>548.exchange2_r(base)</td>
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<tr>
<td></td>
<td>Intel(R) Fortran Compiler for applications running on Intel(R) 64, Version 2023.0.0 Build 20221201</td>
</tr>
</tbody>
</table>

(Continued on next page)
Lenovo Global Technology
ThinkSystem SR650 V3
(1.80 GHz, Intel Xeon Gold 6428N)

SPECrater®2017_int_base = 501
SPECrater®2017_int_peak = Not Run

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

Test Date: Feb-2023
Hardware Availability: Feb-2023
Software Availability: Dec-2022

Compiler Version Notes (Continued)

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Base Compiler Invocation

C benchmarks:
icx

C++ benchmarks:
icpx

Fortran benchmarks:
ifx

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 -xsapphirerapids -O3 -ffast-math
-flto -mfpmath=sse -funroll-loops -qopt-mem-layout-trans=4
-L/usr/local/intel/compiler/2023.0.0/linux/compiler/lib/intel64_lin
-lqkmalloc

C++ benchmarks:
-w -std=c++14 -m64 -Wl,-z,muldefs -xsapphirerapids -O3 -ffast-math
-flto -mfpmath=sse -funroll-loops -qopt-mem-layout-trans=4
-L/usr/local/intel/compiler/2023.0.0/linux/compiler/lib/intel64_lin
-lqkmalloc

(Continued on next page)
Lenovo Global Technology
ThinkSystem SR650 V3
(1.80 GHz, Intel Xeon Gold 6428N)

SPECrate®2017_int_base = 501
SPECrate®2017_int_peak = Not Run

Base Optimization Flags (Continued)

Fortran benchmarks:
-w -m64 -Wl,-z,muldefs -xsapphirerapids -O3 -ffast-math -flto
-mfpmath=sse -funroll-loops -qopt-mem-layout-trans=4
-nostandard-realloc-lhs -align array32byte -auto
-L/usr/local/intel/compiler/2023.0.0/linux/compiler/lib/intel64_lin
-lqkmalloc

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-Eaglestream-O.html
http://www.spec.org/cpu2017/flags/Intel-ic2023-official-linux64.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-Eaglestream-O.xml
http://www.spec.org/cpu2017/flags/Intel-ic2023-official-linux64.xml

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

Tested with SPEC CPU®2017 v1.1.9 on 2023-02-28 04:39:50-0500.
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