



# SPEC CPU®2017 Integer Rate Result

Copyright 2017-2024 Standard Performance Evaluation Corporation

## Lenovo Global Technology

ThinkSystem ST650 V3  
(1.80 GHz, Intel Xeon Gold 5418N)

SPECrate®2017\_int\_base = 392

SPECrate®2017\_int\_peak = Not Run

CPU2017 License: 9017

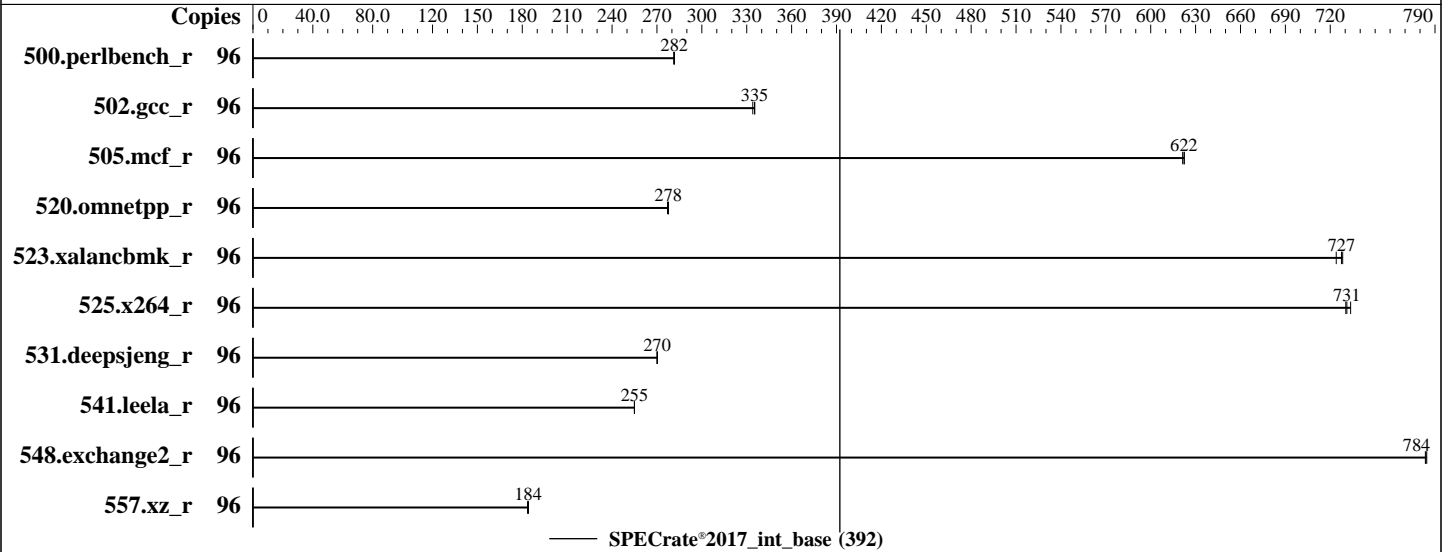
Test Sponsor: Lenovo Global Technology

Tested by: Lenovo Global Technology

Test Date: May-2023

Hardware Availability: May-2023

Software Availability: Dec-2022



### Hardware

CPU Name: Intel Xeon Gold 5418N  
 Max MHz: 3800  
 Nominal: 1800  
 Enabled: 48 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: 45 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 960 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;  
 Parallel: No  
 Firmware: Lenovo BIOS Version USE113Y 2.10 released Mar-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



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## Results Table

Benchmark	Base							Peak						
	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio
500.perlbench_r	96	543	282	544	281	<b>543</b>	<b>282</b>							
502.gcc_r	96	405	335	<b>405</b>	<b>335</b>	407	334							
505.mcf_r	96	<b>249</b>	<b>622</b>	249	622	250	621							
520.omnetpp_r	96	454	278	<b>454</b>	<b>278</b>	455	277							
523.xalancbmk_r	96	<b>139</b>	<b>727</b>	140	724	139	728							
525.x264_r	96	230	730	<b>230</b>	<b>731</b>	229	734							
531.deepsjeng_r	96	407	270	<b>407</b>	<b>270</b>	407	270							
541.leela_r	96	<b>624</b>	<b>255</b>	624	255	623	255							
548.exchange2_r	96	321	784	<b>321</b>	<b>784</b>	321	784							
557.xz_r	96	563	184	<b>564</b>	<b>184</b>	565	184							

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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](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:

Choose Operating Mode set to Maximum Performance and then set it to Custom Mode

C-States set to Legacy

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 fe91c89b7ed5c36ae2c92cc097bec197  
running on localhost Thu May 18 11:15:46 2023

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

-----  
Table of contents  
-----

1. uname -a
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/khugepaged
18. OS release
19. Disk information
20. /sys/devices/virtual/dmi/id
21. dmidecode
22. BIOS

-----  
1. uname -a

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### Platform Notes (Continued)

Linux localhost 5.14.21-150400.22-default #1 SMP PREEMPT\_DYNAMIC Wed May 11 06:57:18 UTC 2022 (49db222)  
x86\_64 x86\_64 x86\_64 GNU/Linux

2. w  
11:15:46 up 4 min, 1 user, load average: 0.01, 0.08, 0.04  
USER TTY FROM LOGIN@ IDLE JCPU PCPU WHAT  
root tty1 - 11:11 7.00s 0.87s 0.00s -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 (-i) 2062601  
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) 2062601  
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=96 -c  
ic2023.0-lin-sapphirerapids-rate-20221201.cfg --define smt-on --define cores=48 --define physicalfirst  
--define invoke\_with\_interleave --define drop\_caches --tune base -o all intrate  
runcpu --nobuild --action validate --define default-platform-flags --define numcopies=96 --configfile  
ic2023.0-lin-sapphirerapids-rate-20221201.cfg --define smt-on --define cores=48 --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/CPU2017.592/templogs/preenv.intrate.592.0.log --lognum 592.0 --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 5418N  
vendor\_id : GenuineIntel  
cpu family : 6  
model : 143  
stepping : 8  
microcode : 0x2b000190  
bugs : spectre\_v1 spectre\_v2 spec\_store\_bypass swapgs  
cpu cores : 24

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### Platform Notes (Continued)

siblings : 48  
2 physical ids (chips)  
96 processors (hardware threads)  
physical id 0: core ids 0-23  
physical id 1: core ids 0-23  
physical id 0: apicids 0-47  
physical id 1: apicids 128-175

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): 96
On-line CPU(s) list: 0-95
Vendor ID: GenuineIntel
Model name: Intel(R) Xeon(R) Gold 5418N
CPU family: 6
Model: 143
Thread(s) per core: 2
Core(s) per socket: 24
Socket(s): 2
Stepping: 8
BogoMIPS: 3600.00
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 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 cdp_l3
invpcid_single intel_ppin cdp_l2 ssbd mba ibrs ibpb stibp ibrs_enhanced
tpr_shadow vnmi flexpriority ept vpid ept_ad fsgsbase tsc_adjust bmi1 hle
avx2 smep bmi2 erms invpcid rtm cqm rdt_a avx512f avx512dq rdseed adx smap
avx512ifma clflushopt clwb intel_pt avx512cd sha_ni avx512bw avx512vl
xsaveopt xsavec xgetbv1 xsaves cqm_llc cqm_occup_llc cqm_mbm_total
cqm_mbm_local split_lock_detect avx_vnni avx512_bf16 wbnoinvd dtherm ida
arat pln pts avx512vbmi umip pku ospke waitpkg avx512_vbmi2 gfni vaes
vpclmulqdq avx512_vnni avx512_bitalg tme avx512_vpoperntdq la57 rdpid
bus_lock_detect cldemote movdiri movdir64b enqcmd fsrm md_clear serialize
tsxldtrk pconfig arch_lbr avx512_fp16 amx_tile flush_lld arch_capabilities
Virtualization: VT-x
L1d cache: 2.3 MiB (48 instances)
L1i cache: 1.5 MiB (48 instances)
L2 cache: 96 MiB (48 instances)
L3 cache: 90 MiB (2 instances)
NUMA node(s): 4
NUMA node0 CPU(s): 0-11,48-59
NUMA node1 CPU(s): 12-23,60-71
NUMA node2 CPU(s): 24-35,72-83
NUMA node3 CPU(s): 36-47,84-95
Vulnerability Itlb multihit: Not affected
Vulnerability L1tf: 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/swaps barriers and \_\_user pointer sanitization  
 Vulnerability Spectre v2: Mitigation; Enhanced IBRS, IBPB conditional, RSB filling  
 Vulnerability Srbds: Not affected  
 Vulnerability Tsx async abort: Not affected

From lscpu --cache:

NAME	ONE-SIZE	ALL-SIZE	WAYS	TYPE	LEVEL	SETS	PHY-LINE	COHERENCY-SIZE
L1d	48K	2.3M	12	Data	1	64	1	64
L1i	32K	1.5M	8	Instruction	1	64	1	64
L2	2M	96M	16	Unified	2	2048	1	64
L3	45M	90M	15	Unified	3	49152	1	64

8. numactl --hardware

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

```

available: 4 nodes (0-3)
node 0 cpus: 0-11,48-59
node 0 size: 128683 MB
node 0 free: 127865 MB
node 1 cpus: 12-23,60-71
node 1 size: 128983 MB
node 1 free: 128654 MB
node 2 cpus: 24-35,72-83
node 2 size: 129017 MB
node 2 free: 128575 MB
node 3 cpus: 36-47,84-95
node 3 size: 128989 MB
node 3 free: 128598 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: 528050272 kB

10. who -r

run-level 3 May 18 11:11

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

```

Default Target Status
multi-user      running

```

12. Services, from systemctl list-unit-files

```

STATE UNIT FILES
enabled YaST2-Firstboot YaST2-Second-Stage apparmor auditd cron getty@ haveged irqbalance
issue-generator kbdsettings klog lvm2-monitor nscd postfix purge-kernels rollback rsyslog
smartd sshd wicked wickedd-auto4 wickedd-dhcp4 wickedd-dhcp6 wickedd-nanny
enabled-runtime systemd-remount-fs
disabled autofs autoyast-initscripts blk-availability boot-sysctl ca-certificates chrony-wait
chronyd console-getty cups cups-browsed debug-shell ebttables exchange-bmc-os-info
firewalld gpm grub2-once haveged-switch-root ipmi ipmievdev issue-add-ssh-keys kexec-load
lunmask man-db-create multipathd nfs nfs-blkmap rdisc rpcbind rpmconfigcheck rsyncd

```

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### Platform Notes (Continued)

```
serial-getty@ smartd_generate_opts snmpd snmptrapd systemd-boot-check-no-failures
systemd-network-generator systemd-sysexit systemd-time-wait-sync systemd-timesyncd
indirect wickedd
```

-----  
13. Linux kernel boot-time arguments, from /proc/cmdline  
BOOT\_IMAGE=/boot/vmlinuz-5.14.21-150400.22-default  
root=UUID=17904382-c2c1-4de4-88b3-dda5a45ba9e5  
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/sda2 xfs 894G 66G 829G 8% /

20. /sys/devices/virtual/dmi/id  
Vendor: Lenovo  
Product: ThinkSystem ST650 V3 MAIN BOARD  
Product Family: ThinkSystem  
Serial: MDSN00110D

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:  
16x Samsung M321R4GA3BB0-CQKEG 32 GB 2 rank 4800, configured at 4000

22. BIOS  
(This section combines info from /sys/devices and dmidecode.)  
BIOS Vendor: Lenovo  
BIOS Version: USE113Y-2.10  
BIOS Date: 03/26/2023  
BIOS Revision: 2.10  
Firmware Revision: 2.10

### Compiler Version Notes

C | 500.perlbench\_r(base) 502.gcc\_r(base) 505.mcf\_r(base) 525.x264\_r(base) 557.xz\_r(base)

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.

C++ | 520.omnetpp\_r(base) 523.xalancbmk\_r(base) 531.deepsjeng\_r(base) 541.leela\_r(base)

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.

Fortran | 548.exchange2\_r(base)

Intel(R) Fortran Compiler for applications running on Intel(R) 64, Version 2023.0.0 Build 20221201  
Copyright (C) 1985-2022 Intel Corporation. All rights reserved.





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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
```

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
```



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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-P.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-P.xml>

<http://www.spec.org/cpu2017/flags/Intel-ic2023-official-linux64.xml>

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