



SPEC CPU®2017 Integer Rate Result

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Hewlett Packard Enterprise

(Test Sponsor: HPE)

ProLiant DL560 Gen11

(2.20 GHz, Intel Xeon Gold 6416H)

SPECrate®2017_int_base = 664

SPECrate®2017_int_peak = Not Run

CPU2017 License: 3

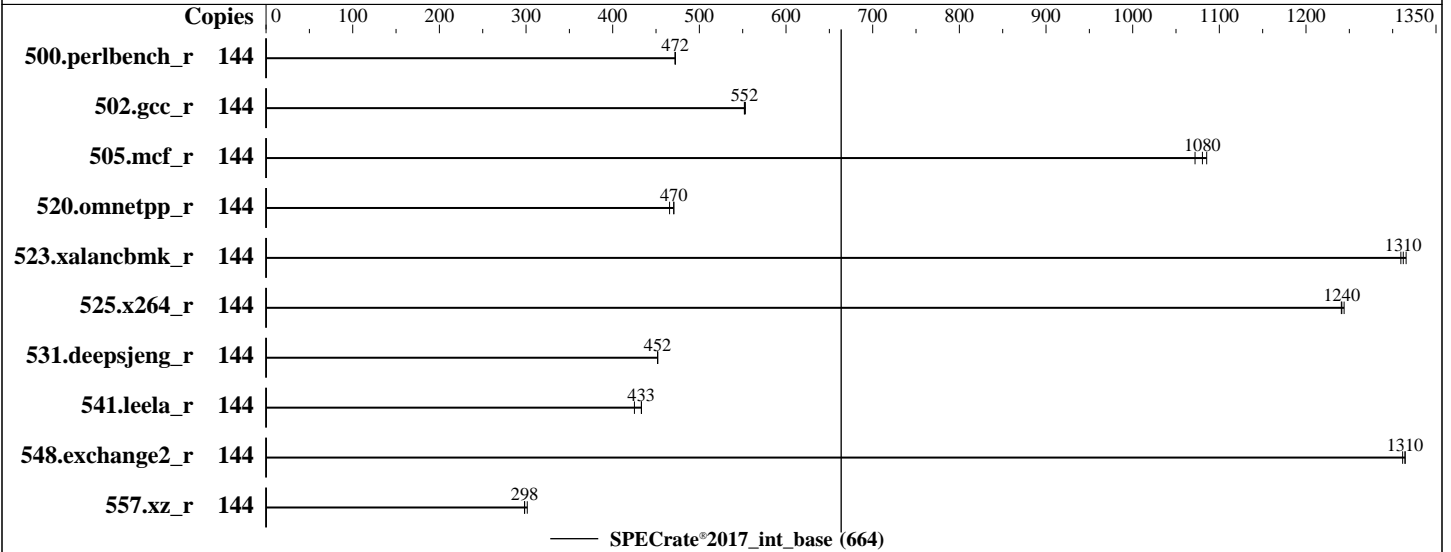
Test Sponsor: HPE

Tested by: HPE

Test Date: Apr-2023

Hardware Availability: May-2023

Software Availability: Mar-2023



Hardware

CPU Name: Intel Xeon Gold 6416H
 Max MHz: 4200
 Nominal: 2200
 Enabled: 72 cores, 4 chips, 2 threads/core
 Orderable: 1, 2, 4 chip(s)
 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: 1 TB (32 x 32 GB 2Rx8 PC5-4800B-R)
 Storage: 1 x 480 GB SATA SSD
 Other: None

Software

OS: Ubuntu 22.04.1 LTS
 Kernel 5.15.0-69-generic
 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: HPE BIOS Version v1.30 03/01/2023 released Mar-2023
 File System: ext4
 System State: Run level 5 (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	144	485	472	485	472	486	472							
502.gcc_r	144	369	552	369	553	369	552							
505.mcf_r	144	217	1070	214	1090	215	1080							
520.omnetpp_r	144	406	466	402	471	402	470							
523.xalancbmk_r	144	116	1310	116	1310	116	1320							
525.x264_r	144	203	1240	203	1240	203	1240							
531.deepsjeng_r	144	365	452	365	452	365	452							
541.leela_r	144	561	425	551	433	550	433							
548.exchange2_r	144	288	1310	287	1310	287	1310							
557.xz_r	144	516	301	521	298	522	298							

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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), 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"
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>
IRQ balance service was stopped using "systemctl stop irqbalance.service"
tuned-adm profile was set to Accelerator-Performance using "tuned-adm profile accelerator-performance"
perf-bias for all the CPUs is set using "cpupower set -b 0"



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Environment Variables Notes

Environment variables set by runcpu before the start of the run:

LD_LIBRARY_PATH = "/home/cpu2017/lib/intel64:/home/cpu2017/lib/ia32:/home/cpu2017/je5.0.1-32"

MALLOC_CONF = "retain:true"

General Notes

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

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

The system ROM used for this result contains Intel microcode version 0x2b0001b0 for the Intel Xeon Gold 6416H Processor

BIOS Configuration

Workload Profile set to General Throughput Compute

Memory Patrol Scrubbing set to Disabled

Last Level Cache (LLC) Dead Line Allocation set to Disabled

Enhanced Processor Performance Profile set to Aggressive

Thermal Configuration set to Maximum Cooling

Workload Profile set to Custom

Adjacent Sector Prefetch set to Disabled

DCU Stream Prefetcher set to Disabled

Intel UPI Link Power Management set to Enabled

Minimum Processor Idle Power Package C-State set to Package C6 (non-retention) State

Sysinfo program /home/cpu2017/bin/sysinfo

Rev: r6732 of 2022-11-07 fe91c89b7ed5c36ae2c92cc097bec197

running on admin1 Thu Mar 2 13:04:49 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 (249.11-0ubuntu3.7)
12. Failed units, from systemctl list-units --state=failed
13. Services, from systemctl list-unit-files
14. Linux kernel boot-time arguments, from /proc/cmdline
15. cpupower frequency-info
16. tuned-adm active
17. sysctl

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Platform Notes (Continued)

- 18. /sys/kernel/mm/transparent_hugepage
- 19. /sys/kernel/mm/transparent_hugepage/khugepaged
- 20. OS release
- 21. Disk information
- 22. /sys/devices/virtual/dmi/id
- 23. dmidecode
- 24. BIOS

```
-----
1. uname -a
Linux admin1 5.15.0-69-generic #76-Ubuntu SMP Fri Mar 17 17:19:29 UTC 2023 x86_64 x86_64 x86_64 GNU/Linux
-----
```

```
-----
2. w
13:04:49 up 6 min, 3 users, load average: 0.01, 0.05, 0.02
USER      TTY      FROM          LOGIN@      IDLE        JCPU        PCPU        WHAT
admin1    tty1     -             13:00       4:33        0.04s       0.01s      -bash
admin1    pts/0    172.16.0.100 13:01       3:05        0.01s       0.01s      sshd: admin1 [priv]
admin1    pts/1    172.16.0.100 13:01       9.00s       1.11s       0.01s      sudo -i
-----
```

```
-----
3. Username
From environment variable $USER:  root
From the command 'logname':      admin1
-----
```

```
-----
4. ulimit -a
time(seconds)      unlimited
file(blocks)       unlimited
data(kbytes)       unlimited
stack(kbytes)      unlimited
coredump(blocks)   0
memory(kbytes)     unlimited
locked memory(kbytes) 132057788
process            4126350
nofiles            1024
vmemory(kbytes)    unlimited
locks              unlimited
rtprio             0
-----
```

```
-----
5. sysinfo process ancestry
/sbin/init
sshd: /usr/sbin/sshd -D [listener] 0 of 10-100 startups
sshd: admin1 [priv]
sshd: admin1@pts/0
-bash
sudo -i
sudo -i
-bash
-bash
runcpu --nobuild --action validate --define default-platform-flags --define numcopies=144 -c
ic2023.0-lin-sapphirerapids-rate-20221201.cfg --define smt-on --define cores=72 --define physicalfirst
--define invoke_with_interleave --define drop_caches --tune base -o all intrate
runcpu --nobuild --action validate --define default-platform-flags --define numcopies=144 --configfile
ic2023.0-lin-sapphirerapids-rate-20221201.cfg --define smt-on --define cores=72 --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/CPU2017.015/temlogs/preenv.intrate.015.0.log --lognum 015.0 --from_runcpu 2
-----
```

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Platform Notes (Continued)

```
specperl $SPEC/bin/sysinfo
$SPEC = /home/cpu2017
```

```
-----
6. /proc/cpuinfo
  model name      : Intel(R) Xeon(R) Gold 6416H
  vendor_id       : GenuineIntel
  cpu family      : 6
  model           : 143
  stepping        : 7
  microcode       : 0x2b0001b0
  bugs             : spectre_v1 spectre_v2 spec_store_bypass swapgs eibrs_pbrsb
  cpu cores       : 18
  siblings        : 36
  4 physical ids (chips)
  144 processors (hardware threads)
  physical id 0:  core ids 0-17
  physical id 1:  core ids 0-17
  physical id 2:  core ids 0-17
  physical id 3:  core ids 0-17
  physical id 0:  apicids 0-35
  physical id 1:  apicids 128-163
  physical id 2:  apicids 256-291
  physical id 3:  apicids 384-419
```

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):                144
On-line CPU(s) list:   0-143
Vendor ID:             GenuineIntel
Model name:            Intel(R) Xeon(R) Gold 6416H
CPU family:            6
Model:                143
Thread(s) per core:    2
Core(s) per socket:    18
Socket(s):             4
Stepping:              7
BogoMIPS:              4400.00
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 cdp_l2 ssbd mba ibrs ibpb stibp ibrs_enhanced tpr_shadow
                      vnmi flexpriority ept vpid ept_ad fsgsbase tsc_adjust bmi1 avx2 smep bmi2
                      erms invpcid 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
```

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Platform Notes (Continued)

avx512_vnni avx512_bitalg tme avx512_vpopcntdq la57 rdpid bus_lock_detect
cldemote movdiri movdir64b enqcmd fsrm md_clear serialize tsxldtrk pconfig
arch_lbr amx_bf16 avx512_fp16 amx_tile amx_int8 flush_llid
arch_capabilities

Virtualization:

L1d cache: 3.4 MiB (72 instances)
L1i cache: 2.3 MiB (72 instances)
L2 cache: 144 MiB (72 instances)
L3 cache: 180 MiB (4 instances)

NUMA node(s): 8
NUMA node0 CPU(s): 0-8,72-80
NUMA node1 CPU(s): 9-17,81-89
NUMA node2 CPU(s): 18-26,90-98
NUMA node3 CPU(s): 27-35,99-107
NUMA node4 CPU(s): 36-44,108-116
NUMA node5 CPU(s): 45-53,117-125
NUMA node6 CPU(s): 54-62,126-134
NUMA node7 CPU(s): 63-71,135-143

Vulnerability Itlb multihit: Not affected
Vulnerability L1tf: Not affected
Vulnerability Mds: Not affected
Vulnerability Meltdown: Not affected
Vulnerability Mmio stale data: Not affected
Vulnerability Retbleed: Not affected
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, PBRSE-eIBRS SW sequence
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	3.4M	12	Data	1	64	1	64
L1i	32K	2.3M	8	Instruction	1	64	1	64
L2	2M	144M	16	Unified	2	2048	1	64
L3	45M	180M	15	Unified	3	49152	1	64

8. numactl --hardware

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

available: 8 nodes (0-7)
node 0 cpus: 0-8,72-80
node 0 size: 128606 MB
node 0 free: 127764 MB
node 1 cpus: 9-17,81-89
node 1 size: 129019 MB
node 1 free: 128529 MB
node 2 cpus: 18-26,90-98
node 2 size: 128984 MB
node 2 free: 128708 MB
node 3 cpus: 27-35,99-107
node 3 size: 129019 MB
node 3 free: 128771 MB
node 4 cpus: 36-44,108-116
node 4 size: 129019 MB
node 4 free: 128746 MB
node 5 cpus: 45-53,117-125
node 5 size: 129019 MB
node 5 free: 128727 MB

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Platform Notes (Continued)

```

node 6 cpus: 54-62,126-134
node 6 size: 129019 MB
node 6 free: 128751 MB
node 7 cpus: 63-71,135-143
node 7 size: 129013 MB
node 7 free: 128689 MB
node distances:
node  0  1  2  3  4  5  6  7
0:  10  20  30  30  30  30  30  30
1:  20  10  30  30  30  30  30  30
2:  30  30  10  20  30  30  30  30
3:  30  30  20  10  30  30  30  30
4:  30  30  30  30  10  20  30  30
5:  30  30  30  30  20  10  30  30
6:  30  30  30  30  30  30  10  20
7:  30  30  30  30  30  30  20  10

```

```

9. /proc/meminfo
MemTotal:      1056462312 kB

```

```

10. who -r
run-level 5 Mar 2 13:00

```

```

11. Systemd service manager version: systemd 249 (249.11-0ubuntu3.7)
Default Target Status
graphical          degraded

```

```

12. Failed units, from systemctl list-units --state=failed
UNIT                                LOAD    ACTIVE SUB    DESCRIPTION
* systemd-networkd-wait-online.service loaded failed failed Wait for Network to be Configured

```

```

13. Services, from systemctl list-unit-files
STATE UNIT FILES
enabled ModemManager apparmor blk-availability cloud-config cloud-final cloud-init
cloud-init-local console-setup cron dmesg e2scrub_reap finalrd getty@ gpu-manager
grub-common grub-initrd-fallback irqbalance keyboard-setup lvm2-monitor lxd-agent
multipathd networkd-dispatcher open-iscsi open-vm-tools pollinate rsyslog secureboot-db
setvtrgb snapd ssh systemd-networkd systemd-networkd-wait-online systemd-pstore
systemd-resolved systemd-timesyncd thermald tuned ua-reboot-cmds ubuntu-advantage udisks2
ufw unattended-upgrades vgauth
enabled-runtime netplan-ovs-cleanup systemd-fsck-root systemd-remount-fs
disabled console-getty debug-shell iscsid nftables powertop rsync serial-getty@
systemd-boot-check-no-failures systemd-network-generator systemd-sysext
systemd-time-wait-sync upower
generated apport
indirect uidd
masked cryptdisks cryptdisks-early hwclock lvm2 multipath-tools-boot rc rcS screen-cleanup sudo
x11-common

```

```

14. Linux kernel boot-time arguments, from /proc/cmdline
BOOT_IMAGE=/vmlinuz-5.15.0-69-generic
root=/dev/mapper/ubuntu--vg-ubuntu--lv
ro

```

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Platform Notes (Continued)

15. cpupower frequency-info

analyzing CPU 0:

Unable to determine current policy

boost state support:

Supported: yes

Active: yes

16. tuned-adm active

Current active profile: accelerator-performance

17. 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	40
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	10
vm.watermark_boost_factor	15000
vm.watermark_scale_factor	10
vm.zone_reclaim_mode	0

18. /sys/kernel/mm/transparent_hugepage

defrag	always	defer	defer+madvise	[madvise]	never
enabled	always	[madvise]	never		
hpage_pmd_size	2097152				
shmem_enabled	always	within_size	advise	[never]	deny force

19. /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

20. OS release

From /etc/*-release /etc/*-version
os-release Ubuntu 22.04.1 LTS

21. Disk information

SPEC is set to: /home/cpu2017

Filesystem	Type	Size	Used	Avail	Use%	Mounted on
------------	------	------	------	-------	------	------------

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Platform Notes (Continued)

/dev/mapper/ubuntu--vg-ubuntu--lv ext4 437G 343G 76G 82% /

22. /sys/devices/virtual/dmi/id

Vendor: HPE
Product: ProLiant DL560 Gen11
Product Family: ProLiant
Serial: CNX2250G5V

23. dmidecode

Additional information from dmidecode 3.3 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:

3x Samsung M321R4GA3BB0-CQKDG 32 GB 2 rank 4800
29x Samsung M321R4GA3BB6-CQKDG 32 GB 2 rank 4800
32x UNKNOWN NOT AVAILABLE

24. BIOS

(This section combines info from /sys/devices and dmidecode.)

BIOS Vendor: HPE
BIOS Version: 1.30
BIOS Date: 03/01/2023
BIOS Revision: 1.30
Firmware Revision: 1.30

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
```



SPEC CPU®2017 Integer Rate Result

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Hewlett Packard Enterprise

(Test Sponsor: HPE)

ProLiant DL560 Gen11

(2.20 GHz, Intel Xeon Gold 6416H)

SPECrate®2017_int_base = 664

SPECrate®2017_int_peak = Not Run

CPU2017 License: 3

Test Sponsor: HPE

Tested by: HPE

Test Date: Apr-2023

Hardware Availability: May-2023

Software Availability: Mar-2023

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

<http://www.spec.org/cpu2017/flags/HPE-Platform-Flags-Intel-SPR-rev1.2.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/HPE-Platform-Flags-Intel-SPR-rev1.2.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.

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