ZTE Corporation
ZTE R8500G5 Server System
(2.40 GHz, Intel Xeon Gold 6448H)

SPECrater®2017_int_base = 1200
SPECrater®2017_int_peak = 1240

CPU2017 License: 9061
Test Date: May-2024
Test Sponsor: ZTE Corporation
Hardware Availability: Apr-2023
Tested by: ZTE Corporation
Software Availability: Dec-2023

Tested by: ZTE Corporation
Software Availability: Dec-2023
CPU Name: Intel Xeon Gold 6448H
Max MHz: 4100
Enabled: 128 cores, 4 chips, 2 threads/core
Orderable: 2,4 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: 2 TB (32 x 64 GB 2Rx4 PC5-4800B-R)
Storage: 1 x 960 GB SATA SSD
Other: CPU Cooling: Air

OS: Red Hat Enterprise Linux 9.0 (Plow)
Compiler: C/C++: Version 2023.2.3 of Intel oneAPI DPC++/C++
Compiler for Linux: Fortran: Version 2023.2.3 of Intel Fortran
Firmware: Version 04.24.01.10 released Mar-2024
File System: xfs
System State: Run level 3 (multi-user)
Base Pointers: 64-bit
Peak Pointers: 32/64-bit
Other: jemalloc memory allocator V5.0.1
Power Management: BIOS and OS set to prefer performance at the cost of additional power usage.
## Results Table

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Copies</th>
<th>Seconds</th>
<th>Ratio</th>
<th>Seconds</th>
<th>Ratio</th>
<th>Seconds</th>
<th>Ratio</th>
<th>Copies</th>
<th>Seconds</th>
<th>Ratio</th>
<th>Seconds</th>
<th>Ratio</th>
<th>Seconds</th>
<th>Ratio</th>
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<td>500.perlbench_r</td>
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<td>455</td>
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<td>165</td>
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<td>165</td>
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<td>256</td>
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<tr>
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<td>2560</td>
<td>261</td>
<td>2570</td>
<td>256</td>
<td>264</td>
<td>2540</td>
<td>262</td>
<td>2560</td>
<td>261</td>
<td>2570</td>
</tr>
<tr>
<td>557.xz_r</td>
<td>256</td>
<td>461</td>
<td>600</td>
<td>466</td>
<td>594</td>
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<td>256</td>
<td>461</td>
<td>600</td>
<td>466</td>
<td>594</td>
<td>465</td>
<td>594</td>
</tr>
</tbody>
</table>

**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"

OS set to performance mode via cpupower frequency-set ~g performance

**Environment Variables Notes**

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

```
LD_LIBRARY_PATH = "~/home/spec2017/lib/intel64:/home/spec2017/lib/ia32:/home/spec2017/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

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.:

```
umactl --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)

(Continued on next page)
General Notes (Continued)

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

Platform Notes

BIOS Configuration:
ENERGY_PERF_BIAS_CFG mode = performance
LLC dead line alloc = Disabled
Patrol Scrub = Disabled
Intel VT for Directed I/O (VT-d) = Disabled
SR-IOV Support = Disabled
Sub NUMA (SNC) = Enable SNC2

Sysinfo program /home/spec2017/bin/sysinfo
Rev: r6732 of 2022-11-07 fe91c89b7ed5c36ae2c92cc097bec197
running on localhost.localdomain Tue May 21 10:21:22 2024

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

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16. sysctl
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18. /sys/kernel/mm/transparent_hugepage/transparent
19. OS release
20. Disk information
21. /sys/devices/virtual/dmi/id
22. dmidecode
23. BIOS

1. uname -a
Linux localhost.localdomain 5.14.0-70.13.1.el9_0.x86_64 #1 SMP PREEMPT Thu Apr 14 12:42:38 EDT 2022 x86_64
x86_64 x86_64 GNU/Linux

2. w
10:21:22 up 10:36, 1 user, load average: 0.54, 0.22, 0.08
USER    TTY     LOGIN@   IDLE     JCPU     PCPU WHAT
root pts/0 23:45     10.00s   2.59s     0.00s /bin/sh

(Continued on next page)
Platform Notes (Continued)

3. Username
From environment variable $USER: root

4. ulimit -a
   real-time non-blocking time (microseconds, -R) unlimited
   core file size       (blocks, -c) 0
   data seg size       (kbytes, -d) unlimited
   pending signals      (-i) 8253210
   max locked memory        (kbytes, -l) 64
   max memory size       (kbytes, -m) unlimited
   open files            (-n) 1024
   POSIX message queues (bytes, -q) 819200
   real-time priority     (-r) 0
   stack size            (kbytes, -s) unlimited
   cpu time               (seconds, -t) unlimited
   file locks             (-x) unlimited

5. sysinfo process ancestry
   /usr/lib/systemd/systemd --system --deserialize 21
   sshd: /usr/sbin/sshd -D [listener] 0 of 10-100 startups
   sshd: root [priv]
   sshd: root@pts/0
   -bash
   /bin/sh ./reportable-ic2023.2.3-lin-sapphirerapids-rate-smt-on-20231121.sh
   runcpu --nobuild --action validate --define default-platform-flags --define numcopies=256 --configfile ic2023.2.3-lin-sapphirerapids-rate-20231121.cfg --define smt-on --define cores=128 --define physicalfirst --define invoke_with_interleave --define drop_caches --tune base,peak --o all intrate
   runcpu --nobuild --action validate --define default-platform-flags --define numcopies=256 --configfile ic2023.2.3-lin-sapphirerapids-rate-20231121.cfg --define smt-on --define cores=128 --define physicalfirst --define invoke_with_interleave --define drop_caches --tune base,peak --output_format all --nopower --runmode rate --tune base:peak --size refrate intrate --nopreenv --note-preenv --logfile $SPEC/tmp/CPU2017.003/templogs/preenv.intrate.003.0.log --lognum 003.0 --from_runcpu 2
   specperl $SPEC/bin/sysinfo
   $SPEC = /home/spec2017

6. /proc/cpuinfo
   model name      : Intel(R) Xeon(R) Gold 6448H
   vendor_id       : GenuineIntel
   cpu family      : 6
   model           : 143
   stepping        : 8
   microcode       : 0x2b0000571
   bugs            : spectre_v1 spectre_v2 spec_store_bypass swappgs
   cpu cores       : 32
   siblings        : 64
   4 physical ids (chips)
   256 processors (hardware threads)
   physical id 0: core ids 0-31
   physical id 1: core ids 0-31
ZTE Corporation
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CPU2017 License: 9061
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SPECrate®2017_int_base = 1200
SPECrate®2017_int_peak = 1240

Test Date: May-2024
Hardware Availability: Apr-2023
Software Availability: Dec-2023

7. lscpu

From lscpu from util-linux 2.37.4:
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): 256
On-line CPU(s) list: 0-255
Vendor ID: GenuineIntel
BIOS Vendor ID: Intel(R) Corporation
Model name: Intel(R) Xeon(R) Gold 6448H
BIOS Model name: Intel(R) Xeon(R) Gold 6448H
CPU family: 6
Model: 143
Thread(s) per core: 2
Core(s) per socket: 32
Socket(s): 4
Stepping: 8
CPU max MHz: 4100.0000
CPU min MHz: 800.0000
BogoMIPS: 4800.00

Flags: fpu vme de pse tsc msr pae mca cmov pat pse36
clflush dtls acpi mmx fxsr sse sse2 ss ht tm pbe syscall nx pdpe1gb rdtsdp
lm constant_tsc art arch_perfmon pebs bts rep_good nopl xtopology
nonstop_tsc cpuid aperfmperf tsc_known_freq pni pclmulqdq dtes64 monitor
des_cpl 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 coprocessor apic sm mce pxrsvts cx16 xtpr pdcm pcid
dm cpuidprimaryKey pen uprivvd ar Sa atomic cpuid immediate field
ltr fmsbxs fnmcompmc pbe mtmcc md_clear

physical id 2: core ids 0-31
physical id 3: core ids 0-31
physical id 0: apicids 0-63
physical id 1: apicids 128-191
physical id 2: apicids 256-319
physical id 3: apicids 384-447

Caution: /proc/cpuinfo data regarding chips, cores, and threads is not necessarily reliable, especially for virtualized systems. Use the above data carefully.

(Continued on next page)
Platform Notes (Continued)

NUMA node6 CPU(s): 96-111,224-239
NUMA node7 CPU(s): 112-127,240-255
Vulnerability Itlb multihit: Not affected
Vulnerability Lttf: Not affected
Vulnerability Mds: Not affected
Vulnerability Meltdown: Not affected
Vulnerability Spec store bypass: Mitigation; Speculative Store Bypass disabled via prctl
Vulnerability Spectre v1: Mitigation; usercopy/swapgs 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:

<table>
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<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>
</tr>
</thead>
<tbody>
<tr>
<td>L1d</td>
<td>48K</td>
<td>6M</td>
<td>12</td>
<td>Data</td>
<td>1</td>
<td>64</td>
<td>1</td>
<td>64</td>
</tr>
<tr>
<td>L1i</td>
<td>32K</td>
<td>4M</td>
<td>8</td>
<td>Instruction</td>
<td>1</td>
<td>64</td>
<td>1</td>
<td>64</td>
</tr>
<tr>
<td>L2</td>
<td>2M</td>
<td>256M</td>
<td>16</td>
<td>Unified</td>
<td>2</td>
<td>2048</td>
<td>1</td>
<td>64</td>
</tr>
<tr>
<td>L3</td>
<td>60M</td>
<td>240M</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: 8 nodes (0-7)
node 0 cpus: 0-15,128-143
node 0 size: 257075 MB
node 0 free: 255793 MB
node 1 cpus: 16-31,144-159
node 1 size: 258041 MB
node 1 free: 257217 MB
node 2 cpus: 32-47,160-175
node 2 size: 258041 MB
node 2 free: 256659 MB
node 3 cpus: 48-63,176-191
node 3 size: 258041 MB
node 3 free: 257526 MB
node 4 cpus: 64-79,192-207
node 4 size: 258041 MB
node 4 free: 257625 MB
node 5 cpus: 80-95,208-223
node 5 size: 258041 MB
node 5 free: 257615 MB
node 6 cpus: 96-111,224-239
node 6 size: 258041 MB
node 6 free: 256921 MB
node 7 cpus: 112-127,240-255
node 7 size: 258021 MB
node 7 free: 257098 MB
node distances:

node 0 1 2 3 4 5 6 7
0: 10 12 21 21 21 21 21 21
1: 12 10 21 21 21 21 21 21
2: 21 21 10 12 21 21 21 21
3: 21 21 12 10 21 21 21 21
4: 21 21 21 10 12 21 21 21
5: 21 21 21 21 12 10 21 21
6: 21 21 21 21 21 10 12 10
7: 21 21 21 21 21 12 10 10

9. /proc/meminfo

(Continued on next page)
**Spec CPU®2017 Integer Rate Result**

**ZTE Corporation**

ZTE R8500G5 Server System  
(2.40 GHz, Intel Xeon Gold 6448H)

---

**CPU2017 License:** 9061

**Test Sponsor:** ZTE Corporation

---

**Platform Notes (Continued)**

```
MemTotal: 2112863164 kB
```

---

10. who -r

```
run-level 3 May 20 23:44
```

---

11. Systemd service manager version: systemd 250 (250-6.el9_0)

```
Default Target Status
multi-user degraded
```

---

12. Failed units, from systemctl list-units --state=failed

```
UNIT LOAD ACTIVE SUB DESCRIPTION
* dnf-makecache.service loaded failed failed dnf makecache
```

---

13. Services, from systemctl list-unit-files

```
STATE UNIT FILES
enabled NetworkManager NetworkManager-dispatcher NetworkManager-wait-online auditd chronyd crond
dbus-broker firewalld getty@ irqbalance kdump lvm2-monitor mdmmonitor microcode
nis-domainname rhsmcertd rayslog selinux-autorelabel-mark sshd ssd
systemd-network-generator udisks2
```

---

14. Linux kernel boot-time arguments, from /proc/cmdline

```
BOOT_IMAGE=(hd0,gpt2)/vmlinuz-5.14.0-70.13.1.e19_0.x86_64
root=/dev/mapper/rhel-root
ro
crashkernel=1G-4G:192M,4G-64G:256M,64G-:512M
resume=/dev/mapper/rhel-swap
rd.lvm.lv=rhel/root
rd.lvm.lv=rhel/swap
```

---

15. cpupower frequency-info

```
analyzing CPU 0:
current policy: frequency should be within 800 MHz and 4.10 GHz.
The governor "performance" may decide which speed to use
within this range.
```

boost state support:
Supported: yes
Active: yes

---

16. sysctl

```
kernell numa_balancing 1
kernell 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
```

(Continued on next page)
Platform Notes (Continued)

```
vm.dirty_writeback_centisecs  500
vm.dirtytime_expire_seconds  43200
vm.extrfrag_threshold       500
vm.min_unmapped_ratio       1
vm.nr_hugepages             0
vm.nr_hugepages_mempolicy   0
vm.nr_overcommit_hugepages  0
vm.swapiness                60
vm.watermark_boost_factor   15000
vm.watermark_scale_factor   10
vm.zone_reclaim_mode        0
```

```
17. /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
```

```
18. /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
```

```
19. OS release
   From /etc/*-release /etc/*-version
   os-release     Red Hat Enterprise Linux 9.0 (Plow)
   redhat-release Red Hat Enterprise Linux release 9.0 (Plow)
   system-release Red Hat Enterprise Linux release 9.0 (Plow)
```

```
20. Disk information
   SPEC is set to: /home/spec2017
   Filesystem            Type  Size  Used Avail Use% Mounted on
   /dev/mapper/rhel-home xfs   819G   57G  763G   7% /home
```

```
21. /sys/devices/virtual/dmi/id
   Vendor:         ZTE
   Product:        R8500 G5
   Product Family: Server
   Serial:         219413636851
```

```
22. 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:
      32x Samsung M321R8GA0BB0-CQKMG 64 GB 2 rank 4800
```

(Continued on next page)
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Test Date: May-2024

Platform Notes (Continued)

23. BIOS
(This section combines info from /sys/devices and dmidecode.)
  BIOS Vendor: American Megatrends Inc.
  BIOS Version: 04.24.01.10
  BIOS Date: 03/13/2024
  BIOS Revision: 4.24

Compiler Version Notes

============================================================================================================
C        | 502.gcc_r(peak)
Intel(R) oneAPI DPC++/C++ Compiler for applications running on IA-32, Version 2023.2.3 Build x
Copyright (C) 1985-2023 Intel Corporation. All rights reserved.
============================================================================================================
C        | 500.perlbench_r(base, peak) 502.gcc_r(base) 505.mcf_r(base, peak) 525.x264_r(base, peak)
| 557.xz_r(base, peak)
Intel(R) oneAPI DPC++/C++ Compiler for applications running on Intel(R) 64, Version 2023.2.3 Build x
Copyright (C) 1985-2023 Intel Corporation. All rights reserved.
============================================================================================================
C        | 502.gcc_r(peak)
Intel(R) oneAPI DPC++/C++ Compiler for applications running on IA-32, Version 2023.2.3 Build x
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============================================================================================================
C        | 500.perlbench_r(base, peak) 502.gcc_r(base) 505.mcf_r(base, peak) 525.x264_r(base, peak)
| 557.xz_r(base, peak)
Intel(R) oneAPI DPC++/C++ Compiler for applications running on Intel(R) 64, Version 2023.2.3 Build x
Copyright (C) 1985-2023 Intel Corporation. All rights reserved.
============================================================================================================
C++      | 520.omnetpp_r(base, peak) 523.xalancbmk_r(base, peak) 531.deepsjeng_r(base, peak)
| 541.leela_r(base, peak)
Intel(R) oneAPI DPC++/C++ Compiler for applications running on Intel(R) 64, Version 2023.2.3 Build x
Copyright (C) 1985-2023 Intel Corporation. All rights reserved.
============================================================================================================
Fortran  | 548.exchange2_r(base, peak)
Intel(R) Fortran Compiler for applications running on Intel(R) 64, Version 2023.2.3 Build x
Copyright (C) 1985-2023 Intel Corporation. All rights reserved.

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**Base Compiler Invocation**

C benchmarks:
- icx

C++ benchmarks:
- icpx

Fortran benchmarks:
- ifx

**Base Portability Flags**

- perlbench_r: -DSPEC_LP64 -DSPEC_LINUX_X64
- gcc_r: -DSPEC_LP64
- mcf_r: -DSPEC_LP64
- omnetpp_r: -DSPEC_LP64
- xalancbmk_r: -DSPEC_LP64 -DSPEC_LINUX
- x264_r: -DSPEC_LP64
- deepsjeng_r: -DSPEC_LP64
- leela_r: -DSPEC_LP64
- exchange2_r: -DSPEC_LP64
- 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/home/specdev/new_compilers/ic2023.2.3/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/home/specdev/new_compilers/ic2023.2.3/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/home/specdev/new_compilers/ic2023.2.3/compiler/lib/intel64_lin
- -lqkmalloc
## Peak Compiler Invocation

- **C benchmarks:** icx
- **C++ benchmarks:** icpx
- **Fortran benchmarks:** ifx

## Peak Portability Flags

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Flags</th>
</tr>
</thead>
<tbody>
<tr>
<td>perlbench_r</td>
<td><code>--DSPEC_LP64 --DSPEC_LINUX_X64</code></td>
</tr>
<tr>
<td>gcc_r</td>
<td><code>--D_FILE_OFFSET_BITS=64</code></td>
</tr>
<tr>
<td>mcf_r</td>
<td><code>--DSPEC_LP64</code></td>
</tr>
<tr>
<td>omnetpp_r</td>
<td><code>--DSPEC_LP64</code></td>
</tr>
<tr>
<td>valchmark_r</td>
<td><code>--DSPEC_LP64 --DSPEC_LINUX</code></td>
</tr>
<tr>
<td>x264_r</td>
<td><code>--DSPEC_LP64</code></td>
</tr>
<tr>
<td>deepsjeng_r</td>
<td><code>--DSPEC_LP64</code></td>
</tr>
<tr>
<td>leela_r</td>
<td><code>--DSPEC_LP64</code></td>
</tr>
<tr>
<td>xz_r</td>
<td><code>--DSPEC_LP64</code></td>
</tr>
</tbody>
</table>

## Peak Optimization Flags

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</tr>
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<tbody>
<tr>
<td>perlbench_r</td>
<td><code>--std=c11 -m64 -Wl,-z,muldefs -fprofile-generate(pass 1)</code></td>
</tr>
<tr>
<td>gcc_r</td>
<td><code>--std=gnu89 -Wl,-z,muldefs -fprofile-generate(pass 1)</code></td>
</tr>
</tbody>
</table>

(Continued on next page)
ZTE Corporation

ZTE R8500G5 Server System
(2.40 GHz, Intel Xeon Gold 6448H)

SPECrate®2017_int_base = 1200
SPECrate®2017_int_peak = 1240

Peak Optimization Flags (Continued)

505.mcf_r: basepeak = yes

525.x264_r: -w -std=c11 -m64 -Wl,-z,muldefs -xsapphirerapids -Ofast
-ffast-math -flto -mfpmath=sse -funroll-loops
-qopt-mem-layout-trans=4 -fno-alias
-L/home/specdev/new_compilers/ic2023.2.3/compiler/lib/intel64_lin
-lqkmalloc

557.xz_r: basepeak = yes

C++ benchmarks:

520.omnetpp_r: basepeak = yes

523.xalancbmk_r: basepeak = yes

531.deepsjeng_r: basepeak = yes

541.leela_r: basepeak = yes

Fortran benchmarks:

548.exchange2_r: basepeak = yes

The flags files that were used to format this result can be browsed at
http://www.spec.org/cpu2017/flags/Intel-ic2023p2-official-linux64.html
http://www.spec.org/cpu2017/flags/ZTE-Platform-Settings-SPR-V1.11.html

You can also download the XML flags sources by saving the following links:
http://www.spec.org/cpu2017/flags/Intel-ic2023p2-official-linux64.xml
http://www.spec.org/cpu2017/flags/ZTE-Platform-Settings-SPR-V1.11.xml