



# SPEC® CPU2017 Integer Rate Result

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**Hewlett Packard Enterprise**

(Test Sponsor: HPE)

ProLiant DL325 Gen10

(2.30 GHz, AMD EPYC 7451)

SPECrate2017\_int\_base = 118

SPECrate2017\_int\_peak = Not Run

CPU2017 License: 3

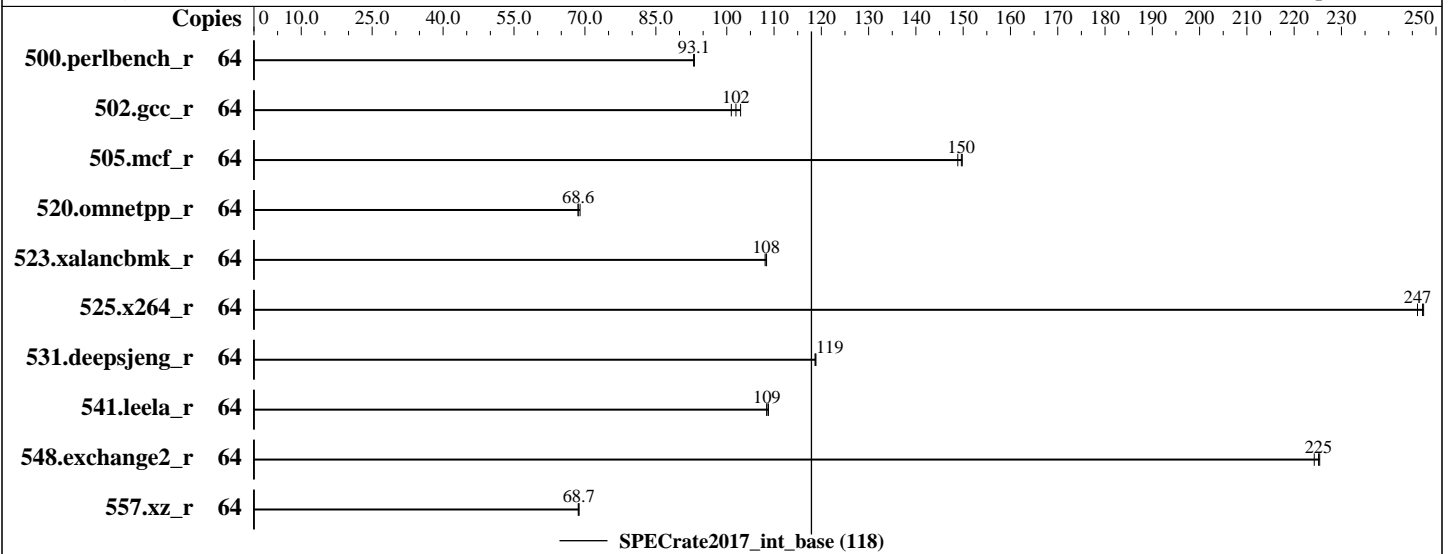
Test Sponsor: HPE

Tested by: HPE

Test Date: Jul-2018

Hardware Availability: Jul-2018

Software Availability: Apr-2018



## Hardware

CPU Name: AMD EPYC 7451  
 Max MHz.: 3200  
 Nominal: 2300  
 Enabled: 24 cores, 1 chip, 2 threads/core  
 Orderable: 1 chip  
 Cache L1: 64 KB I + 32 KB D on chip per core  
 L2: 512 KB I+D on chip per core  
 L3: 64 MB I+D on chip per chip, 8 MB shared / 3 cores  
 Other: None  
 Memory: 512 GB (8 x 64 GB 4Rx4 PC4-2666V-L)  
 Storage: 1 x 480 GB SATA SSD, RAID 0  
 Other: None

## Software

OS: SUSE Linux Enterprise Server 12 (x86\_64) SP3  
 Kernel 4.4.114-94.11-default  
 Compiler: C/C++: Version 1.0.0 of AOCC  
 Fortran: Version 4.8.2 of GCC  
 Parallel: No  
 Firmware: HPE BIOS Version A41 04/06/2018 released Apr-2018  
 File System: xfs  
 System State: Run level 3 (multi-user)  
 Base Pointers: 64-bit  
 Peak Pointers: Not Applicable  
 Other: jemalloc general purpose malloc implementation v4.5.0



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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	64	<b><u>1095</u></b>	<b><u>93.1</u></b>	1094	93.1	1096	93.0							
502.gcc_r	64	898	101	<b><u>889</u></b>	<b><u>102</u></b>	880	103							
505.mcf_r	64	695	149	690	150	<b><u>691</u></b>	<b><u>150</u></b>							
520.omnetpp_r	64	<b><u>1224</u></b>	<b><u>68.6</u></b>	1225	68.6	1217	69.0							
523.xalancbmk_r	64	<b><u>624</u></b>	<b><u>108</u></b>	623	108	625	108							
525.x264_r	64	453	247	455	246	<b><u>453</u></b>	<b><u>247</u></b>							
531.deepsjeng_r	64	618	119	<b><u>618</u></b>	<b><u>119</u></b>	617	119							
541.leela_r	64	974	109	977	108	<b><u>977</u></b>	<b><u>109</u></b>							
548.exchange2_r	64	<b><u>745</u></b>	<b><u>225</u></b>	748	224	744	225							
557.xz_r	64	1005	68.8	1008	68.6	<b><u>1006</u></b>	<b><u>68.7</u></b>							

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

## Submit Notes

The config file option 'submit' was used.  
'numactl' was used to bind copies to the cores.  
See the configuration file for details.

## Operating System Notes

'ulimit -s unlimited' was used to set environment stack size  
'ulimit -l 2097152' was used to set environment locked pages in memory limit

runspec command invoked through numactl i.e.:  
numactl --interleave=all runspec <etc>

Set dirty\_ratio=8 to limit dirty cache to 8% of memory  
Set swappiness=1 to swap only if necessary  
Set zone\_reclaim\_mode=1 to free local node memory and avoid remote memory  
sync then drop\_caches=3 to reset caches before invoking runcpu  
Linux governor set to performance with cpupower "cpupower frequency-set -r -g performance"  
dirty\_ratio, swappiness, zone\_reclaim\_mode and drop\_caches were  
all set using privileged echo (e.g. echo 1 > /proc/sys/vm/swappiness).  
Transparent huge pages were enabled for this run (OS default)  
Huge pages were not configured for this run.  
IRQ balance service stopped using "systemctl stop irqbalance.service"  
Tuned profile set with "tuned-adm profile throughput-performance"



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## General Notes

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

```
LD_LIBRARY_PATH = "/home/cpu2017/amd1704-rate-libs-revC/64;/home/cpu2017/amd1704-rate-libs-revC/32:"
MALLOCONF = "lg_chunk:26"
```

The AMD64 AOCC Compiler Suite is available at  
<http://developer.amd.com/amd-aocc/>

Binaries were compiled on a system with 2x AMD EPYC 7601 CPU + 512GB Memory using RHEL 7.4

The AOCC Gold Linker plugin was installed and used for the link stage.

The AOCC Fortran Plugin version 1.0 was used to leverage AOCC optimizers with gfortran. It is available here:  
<http://developer.amd.com/amd-aocc/>

- 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.

jemalloc, a general purpose malloc implementation, was obtained at  
<https://github.com/jemalloc/jemalloc/releases/download/4.5.0/jemalloc-4.5.0.tar.bz2>  
jemalloc was built with GCC v4.8.5 in RHEL v7.2 under default conditions.  
jemalloc uses environment variable MALLOCONF with values narenas and lg\_chunk:  
narenas: sets the maximum number of arenas to use for automatic multiplexing of threads and arenas.  
lg\_chunk: set the virtual memory chunk size (log base 2). For example, lg\_chunk:21 sets the default chunk size to 2<sup>21</sup> = 2MiB.

## Platform Notes

BIOS Configuration:

Thermal Configuration set to Maximum Cooling  
Memory Patrol Scrubbing set to Disabled  
Performance Determinism set to Power Deterministic  
Processor Power and Utilization Monitoring set to Disabled  
Workload Profile set to General Throughput Compute  
Minimum Processor Idle Power Core C-State set to C6 State  
Sysinfo program /home/cpu2017/bin/sysinfo  
Rev: r5797 of 2017-06-14 96c45e4568ad54c135fd618bcc091c0f  
running on dl325g10-7501 Wed Jan 3 16:41:28 2001

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

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## Platform Notes (Continued)

For more information on this section, see  
<https://www.spec.org/cpu2017/Docs/config.html#sysinfo>

From /proc/cpuinfo

model name : AMD EPYC 7451 24-Core Processor

1 "physical id"s (chips)

48 "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 : 24

siblings : 48

physical 0: cores 0 1 2 4 5 6 8 9 10 12 13 14 16 17 18 20 21 22 24 25 26 28 29 30

From lscpu:

Architecture: x86\_64  
CPU op-mode(s): 32-bit, 64-bit  
Byte Order: Little Endian  
CPU(s): 48  
On-line CPU(s) list: 0-47  
Thread(s) per core: 2  
Core(s) per socket: 24  
Socket(s): 1  
NUMA node(s): 4  
Vendor ID: AuthenticAMD  
CPU family: 23  
Model: 1  
Model name: AMD EPYC 7451 24-Core Processor  
Stepping: 2  
CPU MHz: 2300.000  
CPU max MHz: 2300.0000  
CPU min MHz: 1200.0000  
BogoMIPS: 4591.26  
Virtualization: AMD-V  
L1d cache: 32K  
L1i cache: 64K  
L2 cache: 512K  
L3 cache: 8192K  
NUMA node0 CPU(s): 0-5,24-29  
NUMA node1 CPU(s): 6-11,30-35  
NUMA node2 CPU(s): 12-17,36-41  
NUMA node3 CPU(s): 18-23,42-47

Flags: fpu vme de pse tsc msr pae mce cx8 apic sep mtrr pge mca cmov pat pse36 clflush mmx fxsr sse sse2 ht syscall nx mmxext fxsr\_opt pdpe1gb rdtscp lm constant\_tsc rep\_good nopl nonstop\_tsc extd\_apicid amd\_dcm aperfmperf eagerfpu pni pclmulqdq monitor ssse3 fma cx16 sse4\_1 sse4\_2 movbe popcnt aes xsave avx f16c rdrand lahf\_lm cmp\_legacy svm extapic cr8\_legacy abm sse4a misalignsse 3dnowprefetch osvw skinit wdt tce topoext perfctr\_core perfctr\_nb bpext perfctr\_l2 mwaitx arat

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## Platform Notes (Continued)

```
hw_pstate rds retpoline retpoline_amd npt lbrv svm_lock nrip_save tsc_scale
vmcb_clean flushbyasid decodeassists pausefilter pfthreshold vmmcall avic fsgsbase
bmi1 avx2 smep bmi2 rdseed adx smap clflushopt sha_ni xsaveopt xsavec xgetbv1 clzero
irperf ibpb overflow_recov succor smca
```

```
/proc/cpuinfo cache data
cache size : 512 KB
```

From numactl --hardware WARNING: a numactl 'node' might or might not correspond to a physical chip.

```
available: 4 nodes (0-3)
node 0 cpus: 0 1 2 3 4 5 24 25 26 27 28 29
node 0 size: 128769 MB
node 0 free: 128564 MB
node 1 cpus: 6 7 8 9 10 11 30 31 32 33 34 35
node 1 size: 129021 MB
node 1 free: 128842 MB
node 2 cpus: 12 13 14 15 16 17 36 37 38 39 40 41
node 2 size: 129021 MB
node 2 free: 128849 MB
node 3 cpus: 18 19 20 21 22 23 42 43 44 45 46 47
node 3 size: 128899 MB
node 3 free: 128710 MB
node distances:
node  0  1  2  3
 0:  10  16  16  16
 1:  16  10  16  16
 2:  16  16  10  16
 3:  16  16  16  10
```

```
From /proc/meminfo
MemTotal: 528089652 kB
HugePages_Total: 0
Hugepagesize: 2048 kB
```

```
/usr/bin/lsb_release -d
SUSE Linux Enterprise Server 12 SP3
```

```
From /etc/*release* /etc/*version*
SuSE-release:
SUSE Linux Enterprise Server 12 (x86_64)
VERSION = 12
PATCHLEVEL = 3
# This file is deprecated and will be removed in a future service pack or release.
# Please check /etc/os-release for details about this release.
os-release:
NAME="SLES"
```

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## Platform Notes (Continued)

```
VERSION="12-SP3"
VERSION_ID="12.3"
PRETTY_NAME="SUSE Linux Enterprise Server 12 SP3"
ID="sles"
ANSI_COLOR="0;32"
CPE_NAME="cpe:/o:suse:sles:12:sp3"
```

uname -a:

```
Linux dl325g10-7501 4.4.131-94.25-default #1 SMP Mon May 7 11:22:19 UTC 2018 (9700bac)
x86_64 x86_64 x86_64 GNU/Linux
```

run-level 3 Jan 3 16:39

SPEC is set to: /home/cpu2017

```
Filesystem      Type  Size  Used Avail Use% Mounted on
/dev/sdc3        xfs   407G  6.0G  401G   2% /home
```

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.

BIOS HPE A41 04/06/2018

Memory:

```
8x UNKNOWN NOT AVAILABLE
8x UNKNOWN NOT AVAILABLE 64 GB 4 rank 2666
```

(End of data from sysinfo program)

## Compiler Version Notes

```
=====  
CC 500.perlbench_r(base) 502.gcc_r(base) 505.mcf_r(base) 525.x264_r(base)  
557.xz_r(base)  
=====
```

```
AOCC.LLVM.4.0.0.B35.2017_04_26 clang version 4.0.0 (CLANG:) (based on LLVM  
AOCC.LLVM.4.0.0.B35.2017_04_26)  
Target: x86_64-unknown-linux-gnu  
Thread model: posix  
InstalledDir: /root/work/compilers/AOCC-1.0-Compiler/bin  
=====
```

```
=====  
CXXC 520.omnetpp_r(base) 523.xalancbmk_r(base) 531.deepsjeng_r(base)  
541.leela_r(base)  
=====
```

```
AOCC.LLVM.4.0.0.B35.2017_04_26 clang version 4.0.0 (CLANG:) (based on LLVM
```

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## Compiler Version Notes (Continued)

```
AOCC.LLVM.4.0.0.B35.2017_04_26)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /root/work/compilers/AOCC-1.0-Compiler/bin
```

```
=====
FC 548.exchange2_r(base)
=====
```

```
GNU Fortran (GCC) 4.8.2
Copyright (C) 2013 Free Software Foundation, Inc.
GNU Fortran comes with NO WARRANTY, to the extent permitted by law.
You may redistribute copies of GNU Fortran
under the terms of the GNU General Public License.
For more information about these matters, see the file named COPYING
=====
```

## Base Compiler Invocation

C benchmarks:

clang

C++ benchmarks:

clang++

Fortran benchmarks:

clang gfortran

## Base Portability Flags

```
500.perlbench_r: -DSPEC_LINUX_X64 -DSPEC_LP64
502.gcc_r: -DSPEC_LP64
505.mcf_r: -DSPEC_LP64
520.omnetpp_r: -DSPEC_LP64
523.xalancbmk_r: -DSPEC_LINUX -DSPEC_LP64
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
```



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## Base Optimization Flags

C benchmarks:

```
-flto -Wl, -plugin-opt= -merge-constant -lsr-in-nested-loop  
-disable-vect-cmp -O3 -ffast-math -march=znver1 -fstruct-layout=2  
-mllvm -unroll-threshold=100 -fremap-arrays -mno-avx2  
-inline-threshold=1000 -z muldefs -ljemalloc
```

C++ benchmarks:

```
-flto -Wl, -plugin-opt= -merge-constant -lsr-in-nested-loop  
-disable-vect-cmp -O3 -march=znver1 -mllvm -unroll-threshold=100  
-finline-aggressive -fremap-arrays -inline-threshold=1000 -z muldefs  
-ljemalloc
```

Fortran benchmarks:

```
-flto -Wl, -plugin-opt= -merge-constant -lsr-in-nested-loop  
-disable-vect-cmp -O3 -mavx -madox -funroll-loops -ffast-math  
-z muldefs -Ofast -fdefault-integer-8 -fplugin=dragonegg.so  
-fplugin-arg-dragonegg-llvm-option=" -enable-iv-split  
-inline-threshold:1000 -disable-vect-cmp" -ljemalloc -lgfortran  
-lamdlibm
```

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

<http://www.spec.org/cpu2017/flags/HPE-Platform-Flags-AMD-V1.2-EPYC-revD.html>

<http://www.spec.org/cpu2017/flags/aocc100-flags-revC-I.2018-02-16.html>

<http://www.spec.org/cpu2017/flags/gcc.2018-02-16.html>

You can also download the XML flags sources by saving the following links:

<http://www.spec.org/cpu2017/flags/HPE-Platform-Flags-AMD-V1.2-EPYC-revD.xml>

<http://www.spec.org/cpu2017/flags/aocc100-flags-revC-I.2018-02-16.xml>

<http://www.spec.org/cpu2017/flags/gcc.2018-02-16.xml>

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