Performance comparison of Intel C++ Compiler 9.1 for Linux and GNU gcc 4.1.1 on AMD- and Intel-processor-based systems

Executive summary
Intel Corporation (Intel) commissioned Principled Technologies (PT) to measure and compare 64-bit, multi-threaded, floating-point application performance using an industry standard benchmark (SPEC CPU2000 SPECfp_rate_base) with leading software compilers on the latest available dual-core 2-way servers. PT created the necessary executables with the Intel C++ Compiler 9.1 and GNU gcc 4.1.1 on the following two similarly configured servers:

- Dual-Core AMD Opteron 285-based server with 8GB of DDR2 memory
- Dual-Core Intel Xeon Processor 5160-based server with 8GB of FBD memory

In Figure 1, we show the best results for each compiler on each server. For details of the performance of each compiler and server, see the Test results section.

KEY FINDINGS

- **Compiler**: The Intel C++ Compiler 9.1 outperformed the GNU gcc 4.1.1 compiler by a significant margin while running an industry-standard benchmark (SPECfp_rate_base) on both the AMD Opteron 285-based server and the Intel Xeon Processor 5160-based server.
- **System**: The Intel Xeon Processor 5160-based server outperformed the AMD Opteron 285-based server on versions of SPECfp_rate_base we built with both the GNU gcc 4.1.1 and the Intel C++ 9.1 compilers.

![SPECfp_rate_base Results](image)

Figure 1: SPECfp_rate_base results for the two test servers running the two compilers.

SPEC CPU2000 Workload
SPEC CPU2000 is an industry-standard benchmark created by the Standard Performance Evaluation Corp. (SPEC) to measure a server’s compute-intensive performance. The benchmark consequently stresses the CPU and memory subsystems of the system under test. SPEC CPU2000 consists of two benchmark suites, each of which focuses on a different aspect of compute-intensive performance. CINT2000 measures and compares compute-intensive integer performance, while CFP2000 measures and compares compute-intensive floating-point
performance. A “rate” version of each, which runs multiple instances of the benchmark to assess server throughput, is also available. We ran only the CFP2000 SPECfp_rate_base benchmark. (For more information on SPEC CPU2000 and other SPEC benchmarks, see www.spec.org.)

The SPEC CPU2000 workload includes two benchmark suites: CINT2000 and CFP2000. We ran only the CFP2000 benchmark, which focuses on measuring and comparing compute-intensive floating-point performance. Specifically, we measured the SPECfp_rate_base2000 results for the two compilers and test servers with four benchmark “users” (simultaneously running copies of the benchmark). This number typically equals the number of physical cores in a processor for maximum performance. The workload's result is the average of fourteen normalized throughput ratios. Figure 2 lists the fourteen components of CFP2000 and their respective languages that compose the CFP2000 benchmark.

<table>
<thead>
<tr>
<th>Name</th>
<th>Language</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>168.wupwise</td>
<td>Fortran 77</td>
<td>Physics/Quantum chromodynamics</td>
</tr>
<tr>
<td>171.swim</td>
<td>Fortran 77</td>
<td>FPGA circuit placement and routing</td>
</tr>
<tr>
<td>172.mgrid</td>
<td>Fortran 77</td>
<td>Multi-grid solver: 3D potential field</td>
</tr>
<tr>
<td>173.applu</td>
<td>Fortran 77</td>
<td>Parabolic/Elliptic partial differential equations</td>
</tr>
<tr>
<td>177.mesa</td>
<td>C</td>
<td>3D graphics library</td>
</tr>
<tr>
<td>178.galgel</td>
<td>Fortran 90</td>
<td>Computational fluid dynamics</td>
</tr>
<tr>
<td>179.art</td>
<td>C</td>
<td>Image recognition/Neural networks</td>
</tr>
<tr>
<td>183.equake</td>
<td>C</td>
<td>Seismic wave propagation simulation</td>
</tr>
<tr>
<td>187.facerec</td>
<td>Fortran 90</td>
<td>Image processing: Face recognition</td>
</tr>
<tr>
<td>188.ammp</td>
<td>C</td>
<td>Computational chemistry</td>
</tr>
<tr>
<td>189.lucas</td>
<td>Fortran 90</td>
<td>Number theory/Primality testing</td>
</tr>
<tr>
<td>191.fma3d</td>
<td>Fortran 90</td>
<td>Finite-element crash simulation</td>
</tr>
<tr>
<td>200.sixtrack</td>
<td>Fortran 77</td>
<td>High energy nuclear physics accelerator design</td>
</tr>
<tr>
<td>301.aspi</td>
<td>Fortran 77</td>
<td>Meteorology: Pollutant distribution</td>
</tr>
</tbody>
</table>

Figure 2: The applications that make up the CFP2000 benchmark.

A CFP2000 run performs each of the 14 application (tasks) three times and reports the median for each. It also calculates the geometric mean of those 14 results to produce an overall score. A corresponding rate run executes the same test simultaneously for multiple users. In these tests, that number of users was set to four. We built the benchmark with each compiler using conservative optimization.

Test results

Figure 3 shows the SPECfp_rate_base2000 results for both servers and both compilers with four users. (In SPEC’s terms, these results are estimates, meaning we are not posting them on the SPEC Web site with all the SPEC required files. We do present here all the data necessary to reproduce these results.) The comparative result is relative to the performance of the AMD-based system; a higher comparative result indicates better performance.
Figure 3: SPECfp_rate_base results for both compilers and servers with the number of users set to four. Higher numbers are better.

Test methodology
Figure 4 summarizes some key aspects of the configurations of the two server systems; Appendix A provides detailed configuration information.

Intel configured and provided both servers.

The difference in RAM types reflects the capabilities of the two motherboards: The Intel S5000PSL motherboard offered two independent front-side busses at a speed of 1333 MHz and contained Fully-Buffered DIMM (FBDIMM) modules that used commodity DDR2 PC2-5300 667MHz memory components. The UNIWIDE motherboard supported 184-pin DDR memory, and the highest memory speed available for the Dual-Core AMD Opteron 285-based server was DDR PC3200 400MHz RAM.

We began by installing a fresh copy of Fedora Core 5 on each server. We followed this process for each installation:

1. Set the hostname to manual, and enter “Server” as the hostname.
2. Select “remove all partitions”.
3. Uncheck “Office and Productivity”.
4. Check “Software Development”.

We applied the following updates using the yum package update client the Fedora distribution included. (We used the command: “yum update kernel gcc”.)

- kernel-2.6.16-1.2133_FC5.x86_64
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SPECCPU2000 configuration
We followed SPEC's standard instructions for building the CFP2000 executables. We used the following compilers:

- Intel Compiler:
  - Intel C++ Compiler 9.1.038 for EM64T Build 20060323
  - Intel Fortran Compiler 9.1.032 for EM64T Build 20060323

- GNU gcc Compiler:
  - GNU gcc (GCC) 4.1.1 20060525 (Red Hat 4.1.1-1)
  - GNU Fortran 95 (GCC) 4.1.1 20060525 (Red Hat 4.1.1-1)

The benchmark requires configuration files. From the SPEC Web site we chose the most recent (as of the testing for this report) published SPECCPU2000 results that used an Intel compiler on the Linux operating system. We copied the configuration files for those results and used them, with modifications to reflect the appropriate system information about the servers under test, in our testing. As of the testing for this report, there were no gcc version 4 or newer compiler results on the SPEC Web to use as references. We consequently began with the example SPEC configuration file "linux-amd64-gcc4.cfg" that came with SPEC CPU2000 and optimized for each platform. Appendixes B, C, D, and E provide the configuration files we used for each compiler and each server.

We report only the base metrics for the SPECfp_rate test. SPEC requires the base metrics for all reported results and sets compilation guidelines that testers must follow in building the executables for those tests. (SPEC also offers options for more aggressive, or "peak," tests. We are not reporting those results here and did not run those tests.)

To install SPECCPU2000, we performed the following steps:

2. From the command line, change to the /cpu2000 directory.
3. Type './install.sh' at the command prompt to run the installer. A list of valid toolsets will be displayed.
4. Enter "linux-glibc22-x86_64" as the architecture you are using and the installer will select the appropriate toolset.

To begin the benchmark, we performed the following steps:

1. Reboot the computer.
2. After rebooting, do NOT log in from the GUI. Instead, press Ctrl-Alt-F1 to go to a command-line terminal. Log in there.
3. Once logged in, type 'init 3'. Note that this may blank the screen. If it does, press Ctrl-Alt-F1 again.
5. Type sh to start a Bourne-compatible shell at the command prompt.
6. Type ‘./shrc’ at the command prompt. The space between the dots is necessary for the command to work properly.

7. Enter "runspec -c <config file name> -T base -r -u <#> --reportable fp", where
   • <config file name> = name of the configuration file
   • <#> = is 2 or 4, depending on the number of users (for all our testing, this was set to 4)

When the run completes, the benchmark puts the results in the directory /cpu2000/result. The result file names are of the form CFP2000.<number>.<suffix>. The suffixes are html, asc, raw, and pdf. The number is three digits and associates a result file with its log, e.g. CFP2000.002, asc and log.002.
Appendix A – Test server configuration information

This appendix provides detailed configuration information about each of the test server systems, which we list in alphabetical order.

<table>
<thead>
<tr>
<th>Processors</th>
<th>Dual-Core AMD Opteron 285</th>
<th>Dual-Core Intel Xeon Processor 5160</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>System configuration information</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>General</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Processor and OS kernel: (physical, core, logical) / (UP, MP)</td>
<td>2P4C4L / MP</td>
<td>2P4C4L / MP</td>
</tr>
<tr>
<td>Number of physical processors</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Single/Dual-core processors</td>
<td>Dual</td>
<td>Dual</td>
</tr>
<tr>
<td>System Power Management Policy</td>
<td>Always On</td>
<td>Always On</td>
</tr>
<tr>
<td><strong>CPU</strong></td>
<td></td>
<td></td>
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<tr>
<td>System type</td>
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<td>Server</td>
</tr>
<tr>
<td>Vendor</td>
<td>AMD</td>
<td>Intel</td>
</tr>
<tr>
<td>Name</td>
<td>Dual-Core AMD Opteron 285</td>
<td>Dual-Core Intel Xeon Processor 5160</td>
</tr>
<tr>
<td>Stepping</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Socket type</td>
<td>940</td>
<td>LGA775</td>
</tr>
<tr>
<td>Core frequency (GHz)</td>
<td>2.6 GHz</td>
<td>3.0 GHz</td>
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<tr>
<td>Front-side bus frequency (MHz)</td>
<td>2000 MHz HyperTransport</td>
<td>1333 MHz Dual Independent Busses (DIB)</td>
</tr>
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<td>64KB + 64KB</td>
<td>32KB + 32KB</td>
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<tr>
<td>L2 Cache</td>
<td>2MB (1MB per core)</td>
<td>4MB (Shared)</td>
</tr>
<tr>
<td><strong>Platform</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vendor and model number</td>
<td>Dual-Core AMD Opteron 285 server</td>
<td>Dual-Core Intel Xeon Processor 5160 server</td>
</tr>
<tr>
<td>Motherboard model number</td>
<td>UNIWIDE SS232-128-03</td>
<td>Supermicro X7DB8+</td>
</tr>
<tr>
<td>Motherboard chipset</td>
<td>NVIDIA nForce4 Chipset</td>
<td>Intel 5000P Chipset</td>
</tr>
<tr>
<td>Motherboard revision number</td>
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<tr>
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<td>TM63S00221</td>
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<td>BIOS name and version</td>
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<td>Phoenix Technologies 6.00 5/03/2006</td>
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<td>BIOS settings</td>
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<td>Default</td>
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<tr>
<td><strong>Memory module(s)</strong></td>
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<tr>
<td>Vendor and model number</td>
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<td>Micron MT18HTF12872FDY</td>
</tr>
<tr>
<td>Type</td>
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<td>PC2-5300</td>
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<tr>
<td>Speed (MHz)</td>
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<td>667 MHz</td>
</tr>
<tr>
<td>Speed in the system currently running @ (MHz)</td>
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<td>667 MHz</td>
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<tr>
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<td>5-5-5-12</td>
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<tr>
<td>Size</td>
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<td>8192MB</td>
</tr>
<tr>
<td>Number of sticks</td>
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<td>8</td>
</tr>
<tr>
<td>Chip organization</td>
<td>Double-sided</td>
<td>Double-sided</td>
</tr>
<tr>
<td>Channel</td>
<td>Dual</td>
<td>Dual</td>
</tr>
<tr>
<td><strong>Hard disk</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vendor and model number</td>
<td>Western Digital WD1600YD</td>
<td>Western Digital WD1600YD</td>
</tr>
<tr>
<td>Number of disks in system</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
Figure 5: Detailed system configuration information for the two test servers.
Appendix B – Configuration file for the GNU gcc 4.1.1 compiler on the Intel processor-based server

This appendix contains the benchmark configuration file we used to test the Dual-Core Intel Xeon Processor 5160-based server using the GNU gcc 4.1.1 compiler.

# Invocation command line:
# /cpu2000/bin/runspec -c linux-nocona-gcc4.1.1.cfg -T base -r -u 4 --reportable fp
# SPEC2000 configuration file for Intel "nocona" and GCC 4.1.1
############################################################################
# SPEC2000 configuration file for Intel "nocona" and GCC 4.1.1
############################################################################
company_name = Principled Technologies
hw_cpu = Dual-Core Intel Xeon Processor 5160 (3.0GHz, 1333 MHz bus)
hw_cpu_mhz = 3000
hw_disk = SATA, 160 GB
hw_fpu = Integrated
hw_memory = 8 x 1GB, PC2-5300
hw_vendor = Intel
hw_model = Supermicro X7DB8 motherboard (3.0 GHz, Dual-Core Intel Xeon Processor 5160)
hw_avail =
hw_ncpu = 4 cores, 2 chips, 2 core/chip
hw_ncpuorder = 1,2
hw_ocache = N/A
hw_other = None
hw_parallel = No
hw_pcach = 32KBI + 32KBD on chip
hw_scach = 4MB (Shared)
hw_tcache = N/A
sw_file = Linux/ext3
sw_os = Fedora Core 5
sw_state = Multi-user Run level 3
VENDOR = Intel
action = validate
tune = base
output_format = asc,html,config,ps,pdf
ext = gcc4-high-opt
check_md5 = 1
reportable = 1
feedback = 1
ONESTEP = 1
basepeak = yes
expand_notes = 1

# These are listed as benchmark-tuning-extension-machine
#
default=default=default=default:
CC = gcc
CXX = g++
FC = gfortran
F77 = gfortran

# Architecture Optimization

# High Optimization:
default=base=gcc4-high-opt=default:
CARCH_FLAGS= -march=nocona -m64
CXXARCH_FLAGS= -march=nocona -m64
FARCH_FLAGS= -march=nocona -m64

# Portability Flags

255.vortex=default=default=default:
notes0045= 255.vortex: CPORTABILITY=-DSPEC_CPU2000_LP64
CPORTABILITY = -DSPEC_CPU2000_LP64

186.crafty=default=default=default:
notes0050= 186.crafty: CPORTABILITY=-DLINUX_i386
CPORTABILITY = -DLINUX_i386

252.eon=default=default=default:
notes0051= 252.eon: CXXPORTABILITY=-DHAS_ERRLIST -DSPEC_CPU2000_LP64
CXXPORTABILITY = -DHAS_ERRLIST -DSPEC_CPU2000_LP64

253.perlbmk=default=default=default:
notes0053=                             -DSPEC_CPU2000_LP64
CPORTABILITY = -DSPEC_CPU2000_NEED_BOOL -DSPEC_CPU2000_LINUX_I386 -DSPEC_CPU2000_LP64

254.gap=default=default=default:
notes0055= 254.gap: CPORTABILITY=-DSYS_IS_USG -DSYS_HAS_IOCTL_PROTO -DSYS_HAS_TIME_PROTO
notes0056=                             -DSYS_HAS_MALLOC_PROTO
notes0057=                             -DSPEC_CPU2000_LP64
CPORTABILITY = -DSYS_HAS_MALLOC_PROTO -DSYS_HAS_CALLOC_PROTO -DSYS_HAS_IOCTL_PROTO -
DSYS_HAS_TIME_PROTO -DSPEC_CPU2000_LP64

178.galgel=default=default=default:
notes0050= 178.galgel:     -ffixed-form
FPORTABILITY= -ffixed-form

# Baseline Tuning Flags

# int2000
# Base tuning default optimization
# int=base=gcc4-low-opt=default:
notes0080= Baseline C: gcc -O2
COPTIMIZE = -O2

# High Optimization:
int=base=gcc4-high-opt=default:
notes0086= Baseline C++: g++ -O3 $(CARCH_FLAGS)
notes0085= Baseline C++: g++ -O3 $(CXXARCH_FLAGS)
COPTIMIZE = -O3 $(CARCH_FLAGS)
PASS1_CFLAGS = -fprofile-generate
PASS2_CFLAGS = -fprofile-use
CXXOPTIMIZE = -O3 $(CXXARCH_FLAGS)
PASS1_CXXFLAGS = -fprofile-generate
PASS2_CXXFLAGS = -fprofile-use
PASS1_LDFLAGS = -fprofile-generate
PASS2_LDFLAGS = -fprofile-use

# fp2000
# Base tuning default optimization
# # Fortran benchmarks
#
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# High Optimization:

```plaintext
fp=base=gcc4-low-opt=default:
notes0085= Baseline: Fortran gfortran -O2
notes0080= Baseline: C gcc -O2
FOPTIMIZE = -O2
F77OPTIMIZE = -O2
COPTIMIZE = -O2

# High Optimization:

fp=base=gcc4-high-opt=default:
notes0085= Baseline: Fortran gfortran -O3 $(CARCH_FLAGS)
notes0080= Baseline: C gcc -O3 $(CARCH_FLAGS)
COPTIMIZE = -O3 $(CARCH_FLAGS)
PASS1_CFLAGS = -fprofile-generate
PASS2_CFLAGS = -fprofile-use
FOPTIMIZE = -O3 $(FARCH_FLAGS)
PASS1_FFLAGS = -fprofile-generate
PASS2_FFLAGS = -fprofile-use
PASS1_LDFLAGS = -fprofile-generate
PASS2_LDFLAGS = -fprofile-use
```

# Peak Tuning Flags

```
# Peak Tuning Flags

# int2000
# Peak tuning
#
int=peak=default=default:
notes0087= All peak: basepeak=yes
basepeak = yes

# fp2000
# Peak tuning
#
fp=peak=default=default:
notes0087= All peak: basepeak=yes
basepeak = yes
```

# Default Compiler Flags

```
int=default=default=default:
notes0030= Portability:
sw_avail= June-2006
sw_compiler0000= GNU gcc (GCC) 4.1.1 20060525 (Red Hat 4.1.1-1)
sw_compiler0001= GNU Fortran 95 (GCC) 4.1.1 20060525 (Red Hat 4.1.1-1)

fp=default=default=default:
sw_avail= June-2006
sw_compiler0000= GNU gcc (GCC) 4.1.1 20060525 (Red Hat 4.1.1-1)
sw_compiler0001= GNU Fortran 95 (GCC) 4.1.1 20060525 (Red Hat 4.1.1-1)
```
Appendix C – Configuration file for the GNU gcc 4.1.1 compiler on the AMD processor-based server

This appendix contains the configuration file we used to test the Dual-Core AMD Opteron 285-based server using the GNU gcc 4.1.1 compiler.

# Invocation command line:
# /cpu2000/bin/runspec -c linux-opteron-gcc4.1.1.cfg -T base -r -u 4 --reportable fp

# SPEC2000 configuration file for AMD "opteron" and GCC 4.1.1

cOMPANY_NAME = Principled_Technologies
hw_cpu = Dual-Core AMD Opteron 285 (2.6 GHz, 2000 MHz HT)
hw_cpu_mhz = 2600
hw_disk = SATA, 160 GB
hw_fpu = Integrated
hw_memory = 8 x 1GB, PC-3200
hw_vendor = AMD
hw_model = UNIWISE Technologies SS232-128-03, AMD Opteron (TM) 285
hw_avail =
hw_ncpu = 4 cores, 2 chips, 2 core/chip
hw_ocache = N/A
hw_other = None
hw_parallel = No
hw_pcache = 64KBI + 64KBD on chip
hw_scache = 2MB (1MB per core)
hw_tcache = N/A
sw_file = Linux/ext3
sw_os = Fedora Core 5
sw_state = Multi-user Run level 3

VENDOR = AMD
action = validate
tune = base
output_format = asc,html,config,ps,pdf
ext = gcc4-high-opt
check_md5 = 1
reportable = 1
ONESTEP = 1
basepeak = yes

# These are listed as benchmark-tuning-extension-machine
#
default=default=default=default:
CC = gcc
CXX = g++
FC = gfortran
F77 = gfortran

# Architecture Optimization

# High Optimization:
default=base=gcc4-high-opt=default:
CARCH_FLAGS = -march=opteron -m64

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CXXARCH_FLAGS= -march=opteron -m64
FARCH_FLAGS= -march=opteron -m64

# Portability Flags

255.vortex=default=default=default:
notes0045= 255.vortex: CPORTABILITY=-DSPEC_CPU2000_LP64
CPORTABILITY = -DSPEC_CPU2000_LP64

186.crafty=default=default=default:
notes0050= 186.crafty: CPORTABILITY=-DLINUX_i386
CPORTABILITY = -DLINUX_i386

252.eon=default=default=default:
notes0051= 252.eon: CXXPORTABILITY=-DHAS_ERRLIST -DSPEC_CPU2000_LP64
CXXPORTABILITY = -DHAS_ERRLIST -DSPEC_CPU2000_LP64

253.perlbmk=default=default=default:
notes0053=                             -DSPEC_CPU2000_LP64
CPORTABILITY = -DSPEC_CPU2000_NEED_BOOL -DSPEC_CPU2000_LINUX_I386 -DSPEC_CPU2000_LP64

254.gap=default=default=default:
notes0055= 254.gap: CPORTABILITY=-DSYS_IS_USG -DSYS_HAS_IOCTL_PROTO -DSYS_HAS_TIME_PROTO
notes0056=                             -DSYS_HAS_MALLOC_PROTO -DSYS_HAS_MALLOC_PROTO
CPORTABILITY = -DSYS_HAS_MALLOC_PROTO -DSYS_HAS_MALLOC_PROTO -DSYS_IS_USG -DSYS_HAS_IOCTL_PROTO -DSYS_HAS_TIME_PROTO -DSPEC_CPU2000_LP64

178.galgel=default=default=default:
notes0050= 178.galgel: -ffixed-form
FPORTABILITY = -ffixed-form

# Baseline Tuning Flags

# int2000
# Base tuning default optimization
#
int=base=gcc4-low-opt=default:
notes0080= Baseline C: gcc -O2
COPTIMIZE = -O2

# High Optimization:
int=base=gcc4-high-opt=default:
notes0080= Baseline C: gcc -O3 $(CARCH_FLAGS)
notes0085= Baseline C++: g++ -O3 $(CXXARCH_FLAGS)
COPTIMIZE = -O3 $(CARCH_FLAGS)
PASS1_CFLAGS = -fprofile-generate
PASS2_CFLAGS = -fprofile-use
CXXOPTIMIZE = -O3 $(CXXARCH_FLAGS)
PASS1_CXXFLAGS = -fprofile-generate
PASS2_CXXFLAGS = -fprofile-use

# fp2000
# Base tuning default optimization
#
# Fortran benchmarks
#
fp=base=gcc4-low-opt=default:
notes0085= Baseline: Fortran gfortran -O2
notes0080= Baseline: C    gcc -O2
#High Optimization:

```
FOPTIMIZE = -O2
F77OPTIMIZE = -O2
COPTIMIZE = -O2
```

```
fp=base=gcc4-high-opt=default:
notes0080= Baseline: C      gcc      -O3 ${CARCH_FLAGS}
notes0085= Baseline: Fortran gfortran -O3 ${FARCH_FLAGS}
COPTIMIZE = -O3 ${CARCH_FLAGS}
PASS1_CFLAGS = -fprofile-generate
PASS2_CFLAGS = -fprofile-use
FOPTIMIZE = -O3 ${FARCH_FLAGS}
PASS1_FFLAGS = -fprofile-generate
PASS2_FFLAGS = -fprofile-use
```

```
# Peak Tuning Flags
```

```
# int2000
# Peak tuning
#
int=peak=default=default:
notes0087= All peak: basepeak=yes
basepeak = yes
```

```
# fp2000
# Peak tuning
#
fp=peak=default=default:
notes0087= All peak: basepeak=yes
basepeak = yes
```

```
# Default Compiler Flags
```

```
int=default=default=default:
notes0030= Portability:
sw_avail= June-2006
sw_compiler0000= GNU gcc (GCC) 4.1.1 20060525 (Red Hat 4.1.1-1)
sw_compiler0001= GNU Fortran 95 (GCC) 4.1.1 20060525 (Red Hat 4.1.1-1)
```

```
fp=default=default=default:
sw_avail= June-2006
sw_compiler0000= GNU gcc (GCC) 4.1.1 20060525 (Red Hat 4.1.1-1)
sw_compiler0001= GNU Fortran 95 (GCC) 4.1.1 20060525 (Red Hat 4.1.1-1)
```
Appendix D – Configuration file for the Intel 9.1 C++/Fortran compiler on the Intel processor-based server

This appendix contains the benchmark configuration file we used to test the Dual-Core Intel Xeon Processor 5160-based server using the Intel 9.1 C/Fortran compiler.

# Invocation command line:
# /cpu2000/bin/runspec -c linux-woodcrest-intel9.1.cfg -T base -r -u 4 --reportable fp
############################################################################
action      = validate
tune        = base
ext         = cpu2000.v1.3.ic91p.woodcrest.sse3.linux64.em64t
check_md5=1
reportable=1
teeout=yes
teerunout=yes
default=default=default=default:
ONESTEP=YES
basepeak=yes
CC  = icc
CXX = icpc
F77 = ifort
FC  = ifort
default=default=default=default:
PORTABILITY = -DSPEC_CPU2000_LP64
notes002= -DSPEC_CPU2000_LP64 applied to all benchmarks
186.crafty=default=default=default:
CPORTABILITY=-DLINUX_i386
notes004= 186.crafty: -DLINUX_i386
252.eon=default=default=default:
CXXPORTABILITY=-DHAS_ERRLIST
notes005= 252.eon: -DHAS_ERRLIST
253.perlbmk=default=default=default:
254.gap=default=default=default:
CPORTABILITY=-DSYS_IS_USG -DSYS_HAS_IOCTL_PROTO -DSYS_HAS_TIME_PROTO -DSYS_HAS_SIGNAL_PROTO -DSYS_HAS_ANSI -DSYS_HAS_CALLOC_PROTO
notes007= 254.gap: -DSYS_IS_USG -DSYS_HAS_IOCTL_PROTO -DSYS_HAS_TIME_PROTO -DSYS_HAS_SIGNAL_PROTO
notes008=          -DSYS_HAS_ANSI -DSYS_HAS_CALLOC_PROTO
178.galgel=default=default=default:
EXTRA_FFLAGS = -FI
notes002: 178.galgel: -FI for fixed-format Fortran
int=base=default=default:
OPTIMIZE=
PASS1_CFLAGS= -fast -prof_gen -auto_ilp32
PASS2_CFLAGS= -fast -prof_use -auto_ilp32
notes001= Portability for integer benchmarks
notes010= Optimization flags
notes011= ONESTEP=YES for all benchmarks
notes012: +FDO implies feedback-directed optimization
PASS1: -prof_gen PAS2: -prof_use
notes013: Baseline optimizations for C: -fast -auto_ilp32 +FDO
notes015: Baseline optimizations for C++: -fast -auto_ilp32 +FDO
notes016: basepeak=yes set for all benchmarks
252.eon=base=default=default:
OPTIMIZE=
PASS1_CXXFLAGS= -fast -prof_gen -auto_ilp32
PASS2_CXXFLAGS= -fast -prof_use -auto_ilp32

fp=base=default=default:
OPTIMIZE=
PASS1_CFLAGS= -fast -prof_gen
PASS2_CFLAGS= -fast -prof_use
PASS1_FFLAGS= -fast -prof_gen
PASS2_FFLAGS= -fast -prof_use

notes001= Portability for fp benchmarks
notes010= Optimization flags
notes011= ONESTEP=yes for all benchmarks
notes012: +FDO implies feedback-directed optimization PASS1: -prof_gen  PAS2: -prof_use
notes013: Baseline optimizations for C and Fortran: -fast +FDO
notes014: basepeak=yes set for all benchmarks

##########################################################################
# System config information
##########################################################################
default=default=default:
hw_vendor= Intel
hw_model= Supermicro X7DB8 motherboard( 3.0 GHz, Dual-Core Intel Xeon Processor 5160)
hw_cpu= Dual-Core Intel Xeon Processor 5160 ( 3.0 GHz, 1333 MHz bus)
hw_cpu_mhz= 3000
hw_fpu= Integrated
hw_ncpu= 4 cores, 2 chips, 2 core/chip
hw_ncpuorder= 1,2
hw_parallel= No
hw_pcache= 32KBI + 32KBD on chip
hw_scache= 4MB (Shared)
hw_tcache= N/A
hw_ocache= N/A
hw_memory= 8 x 1GB, PC2-5300
hw_disk= SATA, 160 GB
hw_other= None
sw_os= Fedora Core 5
sw_file= ext3
sw_state= Multi-user Run level 3
company_name= Principled Technologies
license_num= 0
tester_name= 
test_date= 
hw_avail= 
sw_avail= 
prepared_by= 
config= 

##########################################################################
# Software information (Compilers and libraries)
##########################################################################
int=default=default=default:
sw_compiler1=Intel C++ Compiler 9.1.038 for EM64T Build 20060323

fp=default=default=default:
sw_compiler1=Intel C++ Compiler 9.1.038 for EM64T Build 20060323
sw_compiler2=Intel Fortran Compiler 9.1.032 for EM64T Build 20060323

Principled Technologies, Inc.: Performance comparison of Intel C++ Compiler 9.1 for Linux and GNU gcc 4.1.1 on AMD- and Intel-processor-based systems
Appendix E – Configuration file for the Intel 9.1 C++/Fortran compiler on the AMD processor-based server

This appendix contains the configuration file we used to test the Dual-Core AMD Opteron 285-based server using the Intel 9.1 C/Fortran compiler.

# Invocation command line:
# /cpu2000/bin/runspec -c linux-opteron-intel9.1.cfg -T base -u 4 --reportable fp
#******************************************************************************
action      = validate
tune        = base
ext         = cpu2000.v1.3.ic91p.opteron.sse2.linux64.em64t
check_md5=1
reportable=1
teeout=yes
teeerror=yes
default=default=default:
ONESTEP=YES
basepeak=yes
CC  = icc
CXX = icpc
F77 = ifort
FC  = ifort
default=default=default:
PORTABILITY = -DSPEC_CPU2000_LP64
notes002= -DSPEC_CPU2000_LP64 applied to all benchmarks
186.crafty=default=default=default:
CPORTABILITY=-DLINUX_i386
notes004= 186.crafty: -DLINUX_i386
252.eon=default=default=default:
CXXPORTABILITY=-DHAS_ERRLIST
notes005= 252.eon: -DHAS_ERRLIST
253.perlbmk=default=default=default:
254.gap=default=default=default:
CPORTABILITY=-DSYS_IS_USG -DSYS_HAS_IOCTL_PROTO -DSYS_HAS_TIME_PROTO -DSYS_HAS_SIGNAL_PROTO -DSYS_HAS_ANSI -DSYS_HAS_CALLOC_PROTO
notes007= 254.gap: -DSYS_IS_USG -DSYS_HAS_IOCTL_PROTO -DSYS_HAS_TIME_PROTO -DSYS_HAS_SIGNAL_PROTO -DSYS_HAS_ANSI -DSYS_HAS_CALLOC_PROTO
notes008=          -DSYS_HAS_ANSI -DSYS_HAS_CALLOC_PROTO
178.galgel=default=default=default:
EXTRA_FFLAGS = -FI
notes002: 178.galgel: -FI for fixed-format Fortran
int=default=default:
OPTIMIZE=
PASS1_CFLAGS= -O3 -ipo -no-prec-div -static -xW -prof_gen -auto_ilp32
PASS2_CFLAGS= -O3 -ipo -no-prec-div -static -xW -prof_use -auto_ilp32
notes001= Portability for integer benchmarks
notes010= Optimization flags
notes011= ONESTEP=yes for all benchmarks
notes012: +FDO implies feedback-directed optimization PASS1: -prof_gen PAS2: -prof_use
notes013: Baseline optimizations for C: -O3 -ipo -no-prec-div -static -xW -auto_ilp32 +FDO
notes015: Baseline optimizations for C++: -O3 -ipo -no-prec-div -static -xW -auto_ilp32 +FDO
notes016: basepeak=yes set for all benchmarks
Principled Technologies, Inc.: Performance comparison of Intel C++ Compiler 9.1 for Linux and GNU gcc 4.1.1 on AMD- and Intel-processor-based systems
Appendix F – SPECfp_rate output
This appendix provides the output of the SPECfp_rate_base runs on both test servers with both compilers.

Dual-Core Intel Xeon Processor 5160-based server with gcc 4.1.1 compiler (4 users):

### CFP2000 Result

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Base Cycles</th>
<th>Base Runtime</th>
<th>Base Rate</th>
<th>Copy Cycles</th>
<th>Copy Time</th>
<th>Ratio</th>
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</table>

### Hardware

- **CPU:** Dual-Core Intel Xeon Processor 5160 (3.0GHz, 1333 MHz bus)
- **CPU MHz:** 3000
- **FPU:** Integrated
- **CPU(s) enabled:** 4 cores, 2 caps, 2 core/cap
- **CPU(s) orderable:** 1,2
- **Parallel:** No
- **Primary Cache:** 128KB + 32KB on chip
- **Secondary Cache:** 4MB (Shared)
- **L3 Cache:** N/A
- **Other Cache:** N/A
- **Memory:** 8 x 1GB, PC2-5300
- **Disk Subsystem:** SATA, 160 GB
- **Other Hardware:** None

### Software

- **Operating System:** Fedora Core 5
- **Compiler:** GNU gcc (GCC) 4.1.1 20060625 (Red Hat 4.1.1-1) ORI GNU (GCC) 4.1.2 20060625 (Red Hat 4.1.1-1)
- **File System:** Linux ext3
- **System Store:** Multi-user Run level 3

### Notes/Tuning Information

- Tested by Principled Technologies
  - **178. galgel:** -ffixed-foin
  - **Baseline:** C gcc -o -march=-nocona -m64
  - **Baseline:** Fortran gfortran -o -march=-nocona -m64
  - **All peak:** base peak = yes

---

Standard Performance Evaluation Corporation
info@spec.org
http://www.spec.org/
Dual-Core AMD Opteron 285-based server with gcc 4.1.1 compiler (4 users):

## CFP2000 Result

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<th>Base Runtime</th>
<th>Base Rate</th>
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### Hardware
- **CPU**: Dual-Core AMD Opteron 285 (2.6 GHz, 2000 MHz RT)
- **CPU MHz**: 2600
- **FPUs**: Integrated
- **CPU(s) enabled**: 1,2
- **Parallel**: No
- **Primary Cache**: 64KB = 64KB on chip
- **Secondary Cache**: 2MB (1MB per core)
- **L3 Cache**: N/A
- **Other Cache**: N/A
- **Memory**: 8 GB, PC-3200
- **Disk Subsystem**: SATA, 160 GB
- **Other Hardware**: None

### Software
- **Operating System**: Fedora Core 5
- **Compiler**: GCC 4.1.1 20060525 (Red Hat 4.1.1-1)
- **File System**: Linux
- **System Flags**: Multi-user Run level 3

### Notes/Tuning Information
- Tested by Principled Technologies
- **Baseline**: C gcc -03 -march-opteron -n64
- **Baseline**: Fortran gfortran -03 -march-opteron -n64
- **All peaks**: baseline=1.64

---

Principled Technologies, Inc.: Performance comparison of Intel C++ Compiler 9.1 for Linux and GNU gcc 4.1.1 on AMD- and Intel-processor-based systems
Dual-Core Intel Xeon Processor 5160-based server with Intel C++/Fortran 9.1 compiler (4 users):  

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</table>

**Hardware**  
- **CPU:** Dual-Core Intel Xeon Processor 5160 (3.0 GHz, 1333 MHz bus)  
- **CPU MHz:** 3000  
- **FPUs:** Integrated  
- **CPU(s) enabled:** 2 cores, 2 ctags, 2 core-cup  
- **CPU(s) orderable:** 1,2  
- **Parallel:** No  
- **Primary Cache:** 32KB + 32KB I/O on chip  
- **Secondary Cache:** 4MB (Shared)  
- **L3 Cache:** N/A  
- **Other Cache:** N/A  
- **Memory:** 8x2 GB, PC2-5300  
- **Disk Subsystem:** SATA, 160 GB  
- **Other Hardware:** None  

**Software**  
- **Operating System:** Fedora Core 5  
- **Compiler:** Intel C++ Compiler 9.1.09b for IA64® Build 20060623  
- **File System:** Linux-initrd  
- **System Store:** Multi-user Run level 3  

**Notes/Tuning Information**  
- Portability for fp benchmarks  
- -RSPC_CPU2000_LP64 applied to all benchmarks  
- Optimization fTags  
- ONESTEP=yes for all benchmarks  

---

Principled Technologies, Inc.: Performance comparison of Intel C++ Compiler 9.1 for Linux and GNU gcc 4.1.1 on AMD- and Intel-processor-based systems
Dual-Core AMD Opteron 285-based server with Intel C++/Fortran 9.1 compiler (4 users):

### CFP2000 Result

**AMD**

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</table>

**Performance Comparison**

| Benchmark          | Base Rate | Base Runtime | Base Rate | Base Runtime | Base Rate | Base Runtime | Base Rate | Base Runtime | Rate | Hardware
|--------------------|-----------|--------------|-----------|--------------|-----------|--------------|-----------|--------------|------|-----------
| 16f.wupwise        | 4         | 59.8         | 127       |              |           |              |           |              |      | CPU: Dual-Core AMD Opteron 285 (2.6 GHz, 3000 MHz/HT)
| 17i.swim           | 4         | 245          | 58.7      |              |           |              |           |              |      | CPU MHz: 2600
| 172.mgrid          | 4         | 159          | 52.4      |              |           |              |           |              |      | FPU: Integrated
| 173.appu           | 4         | 175          | 55.7      |              |           |              |           |              |      | CPU(0) enabled: 4 cores, 2 capps, 2 core-capp
|                    |           |              |           |              |           |              |           |              |      | CPU(0) orderable: 1.2
|                    |           |              |           |              |           |              |           |              |      | Parallel: No
|                    |           |              |           |              |           |              |           |              |      | Primary Cache: 64KB = 64KB on chip
|                    |           |              |           |              |           |              |           |              |      | Secondary Cache: 2MB (1MB per core)
|                    |           |              |           |              |           |              |           |              |      | L3 Cache: N/A
|                    |           |              |           |              |           |              |           |              |      | Other Cache: N/A
|                    |           |              |           |              |           |              |           |              |      | Memory: 8 GB, PC-3200
| 177.mess           | 4         | 64.5         | 101       |              |           |              |           |              |      | Disk Subsystem: SATA, 160 GB
| 178.gagel          | 4         | 120          | 112       |              |           |              |           |              |      | Other Hardware: None
| 179.art            | 4         | 112          | 107       |              |           |              |           |              |      | Software
|                    |           |              |           |              |           |              |           |              |      | Operating System: Fedora Core 5
|                    |           |              |           |              |           |              |           |              |      | Compiler: Intel C++ Compiler 9.1.098 for i686 on AMD 64-bit Build 20060328
|                    |           |              |           |              |           |              |           |              |      | File System: Linux
|                    |           |              |           |              |           |              |           |              |      | System Type: Multi-user, Run level 3
| 181.eqquake        | 4         | 106          | 56.3      |              |           |              |           |              |      | Notes/Tuning Information
|                    |           |              |           |              |           |              |           |              |      | Portability for fp benchmarks
|                    |           |              |           |              |           |              |           |              |      | -DSPEC_CFP2000_LP64 applied to all benchmarks
|                    |           |              |           |              |           |              |           |              |      | Optimization时不加注
|                    |           |              |           |              |           |              |           |              |      | CXX=NESTERO=yes for all benchmarks

Standard Performance Evaluation Corporation

http://www.spec.org/
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