SPEC CPU2006 SPECfp_rate performance on Red Hat Enterprise Linux 5.2 Intel-based servers

Executive summary

Red Hat®, Inc. (Red Hat) commissioned Principled Technologies (PT) to measure the SPEC® CPU2006 SPECfp®_rate performance of the following two configurations:

- Red Hat Enterprise Linux 5.2 running native on an Intel Xeon® X7460-based (2.66 GHz) server
- Red Hat Enterprise Linux 5.2 running as a guest on Red Hat Enterprise Linux 5.2 on an Intel Xeon X7460-based (2.66 GHz) server

SPEC CPU2006 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. (For more information on SPEC CPU2006 and other SPEC benchmarks, see www.spec.org.)

The SPEC CPU2006 benchmark consists of two benchmark suites, each of which focuses on a different aspect of compute-intensive performance. CINT2006 measures and compares compute-intensive integer performance, while CFP2006 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 CFP2006 SPECfp_rate benchmark. We configured the benchmark to utilize all of the cores of the Intel Xeon 7460 processor running both native and as a guest on Red Hat Enterprise Linux 5.2.

In this section, we discuss the best results for each server. For complete details of the performance of each server, see the Test results section.

KEY FINDING

- Red Hat Enterprise Linux 5.2 guest on an Intel Xeon X7460-based server achieved 92 percent of the performance of running native on Red Hat Enterprise Linux 5.2 (see Figure 1).
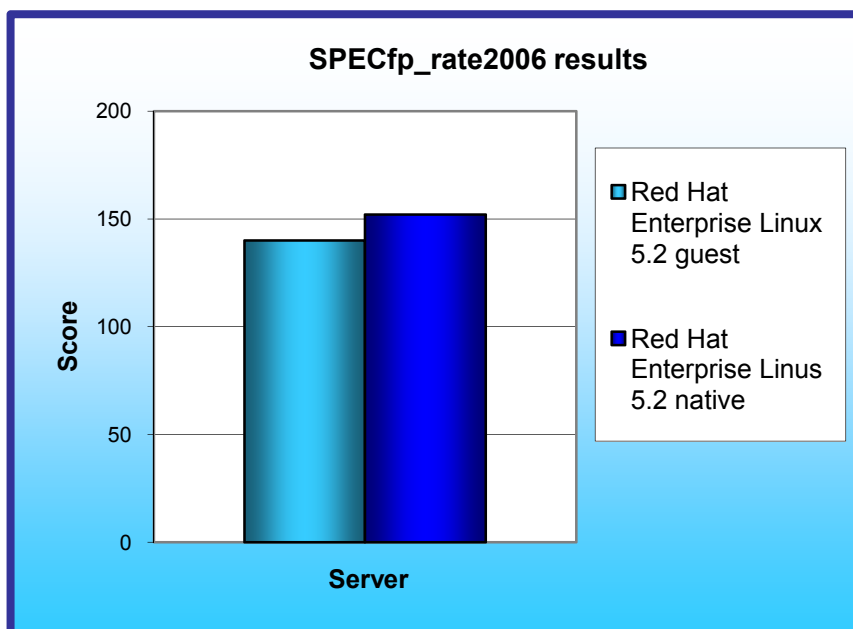

Figure 1 shows the SPECfp_rate2006 peak performance of each configuration. Each result is the median peak score of three runs of the benchmark. See the Test results section for complete set of results. A higher SPECfp_rate2006 score indicates the server can handle a greater load.

The Red Hat Enterprise Linux 5.2 guest on Red Hat Enterprise Linux 5.2 configuration achieved a score of 140, which is 92 percent of the performance of running native on Red Hat Enterprise Linux 5.2. That configuration achieved a score of 152.

Figure 1: SPECfp_rate2006 results of the test configurations on an Intel Xeon X7460-based server. Higher numbers are better.

Workload

The SPEC CPU2006 workload includes two benchmark suites: CINT2006 and CFP2006. (Note: SPEC and SPECfp are trademarks of the Standard Performance Evaluation Corporation.) We ran only the CFP2006 benchmark, which focuses on measuring and comparing compute-intensive floating-point performance. Specifically, we measured the SPECfp_rate2006 results for the test servers with 24 users.

Generally, a system achieves the best SPECfp_rate2006 score using the same number of users as execution units for a given server. The optimum user count for our testing on both systems was 24, the number of execution units (logical or physical processors) on those servers.

Figure 2 lists the 17 applications that compose the CFP2006 benchmark. SPEC wrote six of the applications in Fortran, three using C, four using both Fortran and C, and four in C++.

Name	Application area
410.bwaves	Fluid Dynamics
416.gamess	Quantum Chemistry
433.mic	Physics/Quantum Chromodynamics
434.zeusmp	Physics/CFD
435.gromacs	Biochemistry/Molecular Dynamics
436.cactusADM	Physics/General Relativity
437.leslie3d	Fluid Dynamics
444.namd	Biology/Molecular Dynamics
447.dealII	Finite Element Analysis
450.soplex	Linear Programming, Optimization
453.povray	Image Ray-tracing
454.calculix	Structural Mechanics
459.GemsFDTD	Computational Electromagnetics
465.tonto	Quantum Chemistry
470.lBM	Fluid Dynamics
481.wrf	Weather
482.sphinx3	Speech recognition

Figure 2: The applications that make up the CFP2006 benchmark.

A CFP2006 run performs each of the 17 application (tasks) three times and reports the median for each. It also calculates the geometric mean of those 17 results to produce an overall score.

Test results

Figure 3 details the results of our tests with 24 users for SPECfp_rate2006. We determined the number of users based on the number of execution units in a given server. We used the same number of SPECfp_rate2006 users as processor execution units, so there is a one-to-one ratio.

SPECfp_rate2006 performs three runs of each benchmark in the test suite and records the median, so the final score is a median of three runs. Higher scores are better.

Server	SPECfp_rate_base2006 results	SPECfp_rate2006 results
Red Hat Enterprise Linux 5.2 server: Intel Xeon X7460-based server	140	152
Red Hat Enterprise Linux 5.2 guest on Red Hat Enterprise Linux 5.2 server: Intel Xeon X7460-based server	129	140

Figure 3: SPECfp_rate2006 results for the two systems under test. Higher numbers are better.

Test methodology

Red Hat configured and provided the test system.

We began by installing a fresh copy of Red Hat Enterprise Linux on the test system. For the Red Hat Enterprise Linux 5.2 native installation, we installed only the Software Development package, and disabled the firewall and SELinux. We used the same installation method for the Red Hat Enterprise Linux 5.2 guest installation, but installed Virtualization on the native installation for this configuration. We made no additional changes to the default installation options.

With the following exceptions, we used the default BIOS settings on each server: enabled AHCI, Intel Virtualization Technology, and High Bandwidth.

SPECCPU2006 configuration

We followed SPEC's standard instructions for building the CFP2006 executables. After studying the best results for this benchmark on the SPEC Web site, we chose the following software tools:

- Intel C/C++ Compiler 11.0.042
- Intel Fortran Compiler 11.0.042

The benchmark requires configuration files. The configuration files we used appear in Appendix B.

To begin the benchmark, we performed the following steps:

- Open a command prompt.
- Change to the cpu2006 directory.
- Type ". ./shrc" at the command prompt.
- Enter "runspec -c <config file name> -r 24 -T base -v 10 fp" where
  - o <config file name> = name of the configuration file
  - o Where 24 = number of users

When the run completes, the benchmark puts the results in the directory \cpu2006\result. The result file names are of the form CFP2006.<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., CFP2006.002. asc and log.002.

Appendix A – Test system configuration information

This appendix provides detailed configuration information about the test server.

Server	Red Hat Enterprise Linux 5.2 server on the Intel Xeon X7460-based server	Red Hat Enterprise Linux 5.2 guest on Red Hat Enterprise Linux 5.2 server on the Intel Xeon X7460-based server
General processor setup		
Number of processor packages	4	4
Number of cores per processor package	6	6
Number of hardware threads per core	1	1
CPU		
Vendor	Intel	Intel
Name	Intel Xeon X7460	Intel Xeon X7460
Stepping	1	1
Socket type	Socket P (478)	Socket P (478)
Core frequency (GHz)	2.66	2.66
Front-side bus frequency (MHz)	1,066	1,066
L1 cache	32 KB + 32 KB (per core)	32 KB + 32 KB (per core)
L2 cache	3 x 3 MB (each 3 MB shared by 2 cores)	3 x 3 MB (each 3 MB shared by 2 cores)
L3 cache	16 MB	16 MB
Platform		
Vendor and model number	Intel	Intel
Motherboard model number	S7000FC4UR	S7000FC4UR
Motherboard chipset	Intel ID3600	Intel ID3600
Motherboard revision number	01	01
BIOS name and version	Intel SFC4UR.86B.01.00.S005 06/05/2008	Intel SFC4UR.86B.01.00.S005 06/05/2008
BIOS settings	- Enabled AHCI - Enabled Intel® Virtualization Technology - Enabled High Bandwidth	- Enabled AHCI - Enabled Intel® Virtualization Technology - Enabled High Bandwidth
Memory module(s)		
Vendor and model number	Samsung M395T5750EZ4	Samsung M395T5750EZ4
Type	PC2-5300 FB-DDR2	PC2-5300 FB-DDR2
Speed (MHz)	667	667
Speed in the system currently running @ (MHz)	667	667
Timing/Latency (tCL-tRCD-iRP-tRASmin)	5-5-5-11	5-5-5-11
Size	65,536 MB*	30,720 MB*
Number of RAM modules	32	16
Chip organization	Double-sided	Double-sided
Hard disk		
Vendor and model number	Seagate ST973401SS	Seagate ST973401SS
Number of disks in system	1	1
Size	73.4 GB	73.4 GB
Buffer size	8 MB	8 MB
RPM	10,000	10,000
Type	SAS	SAS

Server	Red Hat Enterprise Linux 5.2 server on the Intel Xeon X7460-based server	Red Hat Enterprise Linux 5.2 guest on Red Hat Enterprise Linux 5.2 server on the Intel Xeon X7460-based server
Hard disk (additional)		
Vendor and model number	Seagate ST973401SS	Seagate ST973401SS
Number of disks in system	1	1
Size	73.4 GB	73.4 GB
Buffer size	8 MB	8 MB
RPM	10,000	10,000
Type	SAS	SAS
Controller	Integrated Intel RAID Controller SROMBSASFC	Integrated Intel RAID Controller SROMBSASFC
Driver	00.00.03.15-RH1	00.00.03.15-RH1
Operating system		
Name	Red Hat Enterprise Linux 5.2	Red Hat Enterprise Linux 5.2
Kernel release	2.6.18-92.el5 x86_64	2.6.18-92.el5xen x86_64
Kernel version	#1 SMP Tue Apr 29 13:16:15 EDT 2008	#1 SMP Tue Apr 29 13:31:30 EDT 2008
File system	ext3	ext3
Language	English	English
Graphics		
Vendor and model number	ATI ES1000	Xen Virtual Framebuffer
Chipset	ES1000	ES1000
BIOS version	BK-ATI VER008.005.031.000	BK-ATI VER008.005.031.000
Type	Integrated	Virtual
Memory size	32 MB	32 MB
Resolution	1,024 x 768	1,024 x 768
Network card/subsystem		
Vendor and model number	Intel PRO/1000 EB	Xen Virtual Ethernet
Type	Integrated	Virtual
Driver	e1000 - 7.3.20-k2-NAPI	e1000 - 7.3.20-k2-NAPI
Optical drive		
Vendor and model number	Optiarc DVD-ROM DDU810A	Optiarc DVD-ROM DDU810A
USB ports		
Number	5	5
Type	USB 2.0	USB 2.0
Power Supplies		
Total number	2	2
Wattage of each	1,570W	1,570W
Cooling Fans		
Total Number	8	8
Dimensions	4 x 80 mm + 4 x 120 mm	4 x 80 mm + 4 x 120 mm
Voltage	12V	12V
Amps	4 x 1.76 A + 4 x 3.3 A	4 x 1.76 A + 4 x 3.3 A

Figure 4: Detailed system configuration information for the three test servers.

* The size of the memory modules differs between the two configurations because we installed memory in all memory slots for optimum performance. The guest OS is virtualized and therefore does not see all memory. The guest OS only needed 30GB of memory to achieve the best possible results. The native OS will generally have more memory than a virtualized OS because it needs memory to operate.

Appendix B – SPECfp_rate2006 configuration files

This appendix contains the benchmark configuration files we used to test the servers.

Red Hat Enterprise Linux 5.2 server: Intel Xeon X7460-based server

```
# Invocation command line:
# /data1/cpu2006-1.1/bin/runspec --rate 24 -c cpu2006.1.1.ic11.0.linux64.dgt.rate.cfg --flagsurl=Intel-ic11.0-fp-linux64-revA.xml,Intel-Linux64-
Platform.xml --define dgt4p24cores -T all -o asc -v 7 fp
# output_root was not used for this run
##############################################################################
##############################################################################
# This is a sample config file. It was tested with:
#
#     Compiler name/version:     Intel Compiler 11.0
#     Hardware:                  Intel Core 2 and compatible Intel processors
#                                supporting Intel 64 and SSE4.1
#
##############################################################################
# SPEC CPU2006 Intel Linux64 config file
# July 2008 Intel Compiler 11.0 for Linux64
##############################################################################
action    = validate
tune      = base
ext       = cpu2006.1.1.ic11.0.linux64.dgt.rate
PATHSEP   = /
check_md5=1
reportable=1


#
# These are listed as benchmark-tuning-extension-machine
#
default=default=default=default:
CC  = icc
CXX = icpc
FC=ifort
OBJ = .o
SMARTHEAP_DIR = /spec/cpu2006.1.1/lib

submit= MYMASK=`printf '0x%x' \$((1<<\$SPECCOPYNUM))`; taskset \$MYMASK $command


####################################################################
# Compiler options
# for Dunnington use -xSSE4.1
# for processors prior to dunnington, replace -xSSE4.1 with -xSSSE3
####################################################################

SSE       = -xSSE4.1
FAST      = $(SSE) -ipo -O3 -no-prec-div -static
FASTNOSTATIC = $(SSE) -ipo -O3 -no-prec-div


##############################################################
#
# portability & libraries
#
#################### Portability Flags and Notes ####################

400.perlbench=default:
CPORTABILITY=    -DSPEC_CPU_LINUX_IA32

403.gcc=default:
EXTRA_CFLAGS=    -Dalloca=_alloca

462.libquantum=default:
CPORTABILITY=    -DSPEC_CPU_LINUX

483.xalancbmk=default:
CXXPORTABILITY=   -DSPEC_CPU_LINUX
```

```
fp=default:
PORTABILITY = -DSPEC_CPU_LP64

435.gromacs=default=default=default:
LDPORTABILITY = -nofor_main

436.cactusADM=default=default=default:
LDPORTABILITY = -nofor_main

454.calculix=default=default=default:
LDPORTABILITY = -nofor_main

481.wrf=default=default=default:
CPORTABILITY = -DSPEC_CPU_CASE_FLAG -DSPEC_CPU_LINUX



# Tuning Flags
####################################################################

#
# Base tuning default optimization
# Feedback directed optimization not allowed in baseline for CPU2006
# However there is no limit on the number of flags as long as the same
# flags are used in the same order for all benchmarks of a given language

471.omnetpp,473.astar,483.xalancbmk=default:
EXTRA_LIBS=  -L$(SMARTHEAP_DIR) -lsmartheap
EXTRA_LDFLAGS= -Wl,-z,muldefs

int=base=default=default:
COPTIMIZE=    $(FAST) -inline-calloc -opt-malloc-options=3  -opt-prefetch
CXXOPTIMIZE=  $(FASTNOSTATIC)  -opt-prefetch

fp=base=default=default:
OPTIMIZE=   $(FAST)  -opt-prefetch

####################################################################
# Peak Tuning Flags int 2006 fast
####################################################################
int=peak=default:
COPTIMIZE=      $(FAST) -opt-prefetch
CXXOPTIMIZE=    $(FASTNOSTATIC)  -opt-prefetch
PASS1_CFLAGS =  -prof-gen
PASS2_CFLAGS =  -prof-use
PASS1_CXXFLAGS = -prof-gen
PASS2_CXXFLAGS = -prof-use
PASS1_LDFLAGS =  -prof-gen
PASS2_LDFLAGS =  -prof-use

400.perlbench=peak=default:
COPTIMIZE= $(FAST) -ansi-alias -opt-prefetch

401.bzip2=peak=default:
CC= /opt/intel/Compiler/11.0/042/bin/intel64/icc -L/opt/intel/Compiler/11.0/042/ipp/em64t/lib -I/opt/intel/Compiler/11.0/042/ipp/em64t/include
CPORTABILITY= -DSPEC_CPU_LP64
COPTIMIZE= $(FAST) -opt-prefetch -ansi-alias

403.gcc=peak=default:
COPTIMIZE = $(FAST) -inline-calloc -opt-malloc-options=3
feedback=0

429.mcf=peak=default:
COPTIMIZE= $(FAST) -opt-prefetch

445.gobmk=peak=default:
COPTIMIZE= $(SSE) -O2 -ipo -no-prec-div -ansi-alias
```

456.hmmer=peak=default:
CC= /opt/intel/Compiler/11.0/042/bin/intel64/icc -L/opt/intel/Compiler/11.0/042/ipp/em64t/lib -I/opt/intel/Compiler/11.0/042/ipp/em64t/include
CPORTABILITY= -DSPEC_CPU_LP64
COPTIMIZE= $(FAST) -unroll2 -ansi-alias
feedback=no

458.sjeng=peak=default:
COPTIMIZE= $(FAST) -unroll4

462.libquantum=peak=default:
COPTIMIZE= $(FAST) -opt-malloc-options=3 -parallel -par-runtime-control -opt-prefetch
feedback=no
copies=1
submit=

464.h264ref=peak=default:
COPTIMIZE= $(FAST) -unroll2 -ansi-alias

471.omnetpp=peak=default:
CXXOPTIMIZE= $(FASTNOSTATIC) -ansi-alias -opt-ra-region-strategy=block

473.astar=peak=default:
CXXOPTIMIZE= $(FASTNOSTATIC) -ansi-alias -opt-ra-region-strategy=routine

483.xalancbmk=peak=default:
basepeak=yes

###
Peak Tuning Flags for FP
###
fp=peak=default:
OPTIMIZE= $(FAST)
COPTIMIZE=   -auto-ilp32
CXXOPTIMIZE= -auto-ilp32
PASS1_CFLAGS =   -prof-gen
PASS2_CFLAGS =   -prof-use
PASS1_CXXFLAGS = -prof-gen
PASS2_CXXFLAGS = -prof-use
PASS1_FFLAGS =   -prof-gen
PASS2_FFLAGS =   -prof-use
PASS1_LDFLAGS = -prof-gen
PASS2_LDFLAGS = -prof-use

410.bwaves=peak=default:
OPTIMIZE= $(FAST) -opt-prefetch
feedback=0
##
###################
%ifdef %{stoakleydp8cores}
copies=4
submit= if `test $SPECCOPYNUM -le 1`; then taskset -c $SPECCOPYNUM $command ; else taskset -c `expr $SPECCOPYNUM + 4`
$command ; fi
%endif
##
###################

416.gamess=peak=default:
OPTIMIZE= $(FAST) -unroll2 -Ob0 -ansi-alias -scalar-rep-

433.milc=peak=default:
OPTIMIZE= $(FAST) -fno-alias
COPTIMIZE=

435.gromacs=peak=default:
OPTIMIZE= $(FAST) -opt-prefetch

436.cactusADM=peak=default:
OPTIMIZE= $(FAST) -unroll2 -opt-prefetch -parallel
copies=1

submit=

437.leslie3d=peak=default:
PORTABILITY =
FC= /opt/intel/Compiler/11.0/042/bin/ia32/ifort -L/opt/intel/Compiler/11.0/042/ipp/ia32/lib -I/opt/intel/Compiler/11.0/042/ipp/ia32/include
OPTIMIZE= $(FAST) -opt-malloc-options=3 -opt-prefetch
##
###################
%ifdef %{stoakleydp8cores}
copies=4
submit= if `test $SPECCOPYNUM -le 1`; then taskset -c $SPECCOPYNUM $command ; else taskset -c `expr $SPECCOPYNUM + 4`
$command ; fi
%endif
##
#################

444.namd=peak=default:
CXXOPTIMIZE= $(FAST) -fno-alias -auto-ilp32

447.dealII=peak=default:
CXXOPTIMIZE= $(FAST) -unroll2 -ansi-alias -scalar-rep-

450.soplex=peak=default:
PORTABILITY =
CXX= /opt/intel/Compiler/11.0/042/bin/ia32/icpc -L/opt/intel/Compiler/11.0/042/ipp/ia32/lib -I/opt/intel/Compiler/11.0/042/ipp/ia32/include
OPTIMIZE= $(FAST) -opt-malloc-options=3
CXXOPTIMIZE=

453.povray=peak=default:
CXXOPTIMIZE= $(FAST) -unroll4 -ansi-alias

454.calculix=peak=default:
OPTIMIZE= $(FAST)
feedback=0

459.GemsFDTD=peak=default:
OPTIMIZE= $(FAST) -unroll2 -Ob0 -opt-prefetch

465.tonto=peak=default:
OPTIMIZE= $(FAST) -unroll4 -auto

470.lbm=peak=default:
OPTIMIZE= $(FAST) -opt-prefetch
feedback=no

##
###################
%ifdef %{bensleydp8cores}
copies=2
submit= if `test $SPECCOPYNUM -le 0`; then taskset -c $SPECCOPYNUM $command ; else taskset -c `expr $SPECCOPYNUM + 4`
$command ; fi
%endif

%ifdef %{stoakleydp8cores}
copies=4
submit= if `test $SPECCOPYNUM -le 1`; then taskset -c $SPECCOPYNUM $command ; else taskset -c `expr $SPECCOPYNUM + 4`
$command ; fi
%endif

%ifdef %{tgt4p16cores}
copies=8
submit= if `test $SPECCOPYNUM -le 3`; then taskset -c $SPECCOPYNUM $command ; else taskset -c `expr $SPECCOPYNUM + 8`
$command ; fi
%endif

%ifdef %{dgt4p24cores}
copies=12
submit= $[top]/mysubmit.pl $SPECCOPYNUM "$command"
%endif

```
%ifdef %{dgt4p16cores}
copies=8
submit= $[top]/mysubmit.pl $SPECCOPYNUM "$command"
%endif
##################################################################################################
###################
```

481.wrf=peak=default:
basepeak=yes

482.sphinx3=peak=default:
PORTABILITY =
CC= /opt/intel/Compiler/11.0/042/bin/ia32/icc -L/opt/intel/Compiler/11.0/042/ipp/ia32/lib -I/opt/intel/Compiler/11.0/042/ipp/ia32/include
COPTIMIZE= -unroll2
feedback=no

```
##################################################################################################
###################
%ifdef %{stoakleydp8cores}
copies=4
submit= if `test $SPECCOPYNUM -le 1`; then  taskset -c $SPECCOPYNUM $command ; else taskset -c `expr $SPECCOPYNUM + 4`
$command ; fi
%endif

%ifdef %{tgt4p16cores}
copies=8
submit= if `test $SPECCOPYNUM -le 3`; then  taskset -c $SPECCOPYNUM $command ; else taskset -c `expr $SPECCOPYNUM + 8`
$command ; fi
%endif

%ifdef %{dgt4p24cores}
copies=12
submit= $[top]/mysubmit.pl $SPECCOPYNUM "$command"
%endif

%ifdef %{dgt4p16cores}
copies=8
submit= $[top]/mysubmit.pl $SPECCOPYNUM "$command"
%endif
##################################################################################################
###################
```

```
#####################################################################
# (Edit this to match your system)
#####################################################################

default=default=default=default:
license_num     = 3184
test_sponsor    = Red Hat
hw_avail        = Sep-2008
sw_avail        = Sep-2008
tester          = Principled Technologies
hw_cpu_name     = Intel Xeon X7460
hw_cpu_char     =
hw_cpu_mhz      = 2666
hw_disk         = 73.4 GB SATA, 10,000RPM
hw_fpu          = Integrated
hw_memory       = 64 GB (32 x 2GB)
hw_model000     = Intel Server Board S7000FC4UR
hw_model001 = (Intel Xeon X7460, 2.66 GHz)
hw_ncpuorder    = 1,2,4 chips
hw_ncores       = 24
```

```
hw_nchips        = 4
hw_ncoresperchip = 6
hw_nthreadspercore = 1
hw_other         = None
hw_pcache        = 32 KB I + 32 KB D on chip per core
hw_scache        = 9 MB I+D on chip per chip, 3 MB shared / 2 cores
hw_tcache        = 16 MB I+D on chip per chip
hw_ocache        = None
hw_vendor        = Intel Corporation
prepared_by      = PT
sw_file          = ext3
sw_os000         = Red Hat Enterprise Linux Server release 5.2
sw_os001 = Kernel 2.6.18-92.el5 x86_64
sw_state         = Run level 3 (multi-user)
sw_other000      = Microquill SmartHeap V8.1


int=default=default=default:
sw_compiler001   = Intel C++ Compiler 11.0 for Linux
sw_compiler002   = Build 20080730 Package ID: l_cc_b_11.0.042
sw_base_ptrsize  = 32-bit
sw_peak_ptrsize  = 32/64-bit
notes_020        = All benchmarks compiled in 32-bit mode except 401.bzip2 and 456.hmmer,
notes_025        = for peak, are compiled in 64-bit mode
notes_026        = taskset was used to bind processes to cores except
notes_027        = for 462.libquantum peak
notes_028        = OMP_NUM_THREADS set to number of processors
notes_029        = KMP_AFFINITY set to "physical,0"
notes_030        = KMP_STACKSIZE set to 64M


fp=default=default=default:
sw_compiler000   = Intel C++ and Fortran Compiler 11.0 for Linux
sw_compiler001   = Build 20080730 Package ID: l_cc_b_11.0.042,
sw_compiler002 = l_fc_b_11.0.042
sw_base_ptrsize  = 64-bit
sw_peak_ptrsize  = 32/64-bit
notes_000        = All benchmarks compiled in 64-bit mode except 437.leslie3d, 450.soplex
notes_005        = and 482.sphinx3, at peak, are compiled in 32-bit mode
notes_010        = taskset was used to bind processes to cores except
notes_015        = for 436.cactusADM peak
notes_020        = OMP_NUM_THREADS set to number of processors
notes_025        = KMP_AFFINITY set to "physical,0"
notes_030        = KMP_STACKSIZE set to 64M
notes_035 = 'ulimit -s unlimited' was used to set the stacksize to unlimited prior to run
notes_040 = Hardware Prefetcher: Disabled
notes_045 = Adjacent Cache Line Prefetcher: Disabled
notes_050 = High Bandwidth Option: Enabled




# The following section was added automatically, and contains settings that
# did not appear in the original configuration file, but were added to the
# raw file after the run.
default:
flagsurl000 = Intel-ic11.0-fp-linux64-revA.xml
flagsurl001 = Intel-Linux64-Platform.xml
```

Red Hat Enterprise Linux 5.2 guest on Red Hat Enterprise Linux 5.2 server: Intel Xeon X7460-based server

```
# Invocation command line:
# /data1/cpu2006-1.1/bin/runspec --rate 24 -c cpu2006.1.1.ic11.0.linux64.dgt.rate.cfg --flagsurl=Intel-ic11.0-fp-linux64-revA.xml,Intel-Linux64-
Platform.xml --define dgt4p24cores -T all -o asc -v 7 fp
# output_root was not used for this run
################################################################################
################################################################################
# This is a sample config file. It was tested with:
#
#    Compiler name/version:     Intel Compiler 11.0
#    Hardware:                  Intel Core 2 and compatible Intel processors
#                               supporting Intel 64 and SSE4.1
#
################################################################################
# SPEC CPU2006 Intel Linux64 config file
# July 2008 Intel Compiler 11.0 for Linux64
################################################################################
action     = validate
tune       = base
ext        = cpu2006.1.1.ic11.0.linux64.dgt.rate
PATHSEP    = /
check_md5=1
reportable=1


#
# These are listed as benchmark-tuning-extension-machine
#
default=default=default=default:
CC  = icc
CXX = icpc
FC=ifort
OBJ = .o
SMARTHEAP_DIR = /spec/cpu2006.1.1/lib

submit= MYMASK=`printf '0x%x' \$((1<<\$SPECCOPYNUM))`; taskset \$MYMASK $command

#####################################################################
# Compiler options
# for Dunnington use -xSSE4.1
# for processors prior to dunnington, replace -xSSE4.1 with -xSSSE3
#####################################################################

SSE        = -xSSE4.1
FAST       = $(SSE) -ipo -O3 -no-prec-div -static
FASTNOSTATIC = $(SSE) -ipo -O3 -no-prec-div


################################################################
#
# portability & libraries
#
################### Portability Flags and Notes #####################

400.perlbench=default:
CPORTABILITY=     -DSPEC_CPU_LINUX_IA32

403.gcc=default:
EXTRA_CFLAGS=      -Dalloca=_alloca

462.libquantum=default:
CPORTABILITY=     -DSPEC_CPU_LINUX

483.xalancbmk=default:
CXXPORTABILITY=   -DSPEC_CPU_LINUX

fp=default:
PORTABILITY = -DSPEC_CPU_LP64

435.gromacs=default=default=default:
```

```
LDPORTABILITY = -nofor_main

436.cactusADM=default=default=default:
LDPORTABILITY = -nofor_main

454.calculix=default=default=default:
LDPORTABILITY = -nofor_main

481.wrf=default=default=default:
CPORTABILITY = -DSPEC_CPU_CASE_FLAG -DSPEC_CPU_LINUX



# Tuning Flags
################################################################

#
# Base tuning default optimization
# Feedback directed optimization not allowed in baseline for CPU2006
# However there is no limit on the number of flags as long as the same
# flags are used in the same order for all benchmarks of a given language

471.omnetpp,473.astar,483.xalancbmk=default:
EXTRA_LIBS=  -L$(SMARTHEAP_DIR) -lsmartheap
EXTRA_LDFLAGS= -Wl,-z,muldefs

int=base=default=default:
COPTIMIZE=    $(FAST) -inline-calloc -opt-malloc-options=3  -opt-prefetch
CXXOPTIMIZE=  $(FASTNOSTATIC)  -opt-prefetch

fp=base=default=default:
OPTIMIZE=  $(FAST)  -opt-prefetch

################################################################
# Peak Tuning Flags int 2006 fast
################################################################
int=peak=default:
COPTIMIZE=      $(FAST) -opt-prefetch
CXXOPTIMIZE=    $(FASTNOSTATIC)  -opt-prefetch
PASS1_CFLAGS =  -prof-gen
PASS2_CFLAGS =  -prof-use
PASS1_CXXFLAGS = -prof-gen
PASS2_CXXFLAGS = -prof-use
PASS1_LDFLAGS =  -prof-gen
PASS2_LDFLAGS =  -prof-use

400.perlbench=peak=default:
COPTIMIZE= $(FAST) -ansi-alias -opt-prefetch

401.bzip2=peak=default:
CC= /opt/intel/Compiler/11.0/042/bin/intel64/icc -L/opt/intel/Compiler/11.0/042/ipp/em64t/lib -I/opt/intel/Compiler/11.0/042/ipp/em64t/include
CPORTABILITY= -DSPEC_CPU_LP64
COPTIMIZE= $(FAST) -opt-prefetch -ansi-alias

403.gcc=peak=default:
COPTIMIZE = $(FAST) -inline-calloc -opt-malloc-options=3
feedback=0

429.mcf=peak=default:
COPTIMIZE= $(FAST) -opt-prefetch

445.gobmk=peak=default:
COPTIMIZE= $(SSE) -O2 -ipo -no-prec-div -ansi-alias

456.hmmer=peak=default:
CC= /opt/intel/Compiler/11.0/042/bin/intel64/icc -L/opt/intel/Compiler/11.0/042/ipp/em64t/lib -I/opt/intel/Compiler/11.0/042/ipp/em64t/include
CPORTABILITY= -DSPEC_CPU_LP64
COPTIMIZE=  $(FAST) -unroll2 -ansi-alias
feedback=no
```

```
458.sjeng=peak=default:
COPTIMIZE= $(FAST) -unroll4

462.libquantum=peak=default:
COPTIMIZE= $(FAST) -opt-malloc-options=3 -parallel -par-runtime-control -opt-prefetch
feedback=no
copies=1
submit=

464.h264ref=peak=default:
COPTIMIZE= $(FAST) -unroll2 -ansi-alias

471.omnetpp=peak=default:
CXXOPTIMIZE=  $(FASTNOSTATIC) -ansi-alias -opt-ra-region-strategy=block

473.astar=peak=default:
CXXOPTIMIZE=  $(FASTNOSTATIC)  -ansi-alias -opt-ra-region-strategy=routine

483.xalancbmk=peak=default:
basepeak=yes

###############################################################
# Peak Tuning Flags for FP
###############################################################
fp=peak=default:
OPTIMIZE=    $(FAST)
COPTIMIZE=  -auto-ilp32
CXXOPTIMIZE= -auto-ilp32
PASS1_CFLAGS =  -prof-gen
PASS2_CFLAGS =  -prof-use
PASS1_CXXFLAGS = -prof-gen
PASS2_CXXFLAGS = -prof-use
PASS1_FFLAGS =   -prof-gen
PASS2_FFLAGS =   -prof-use
PASS1_LDFLAGS =  -prof-gen
PASS2_LDFLAGS =  -prof-use

410.bwaves=peak=default:
OPTIMIZE=    $(FAST) -opt-prefetch
feedback=0
##########################################################################################################################
###################
%ifdef %{stoakleydp8cores}
copies=4
submit= if `test $SPECCOPYNUM -le 1`; then  taskset -c $SPECCOPYNUM $command ; else taskset -c `expr $SPECCOPYNUM + 4`
$command ; fi
%endif
##########################################################################################################################
###################

416.gamess=peak=default:
OPTIMIZE= $(FAST) -unroll2 -Ob0 -ansi-alias -scalar-rep-

433.milc=peak=default:
OPTIMIZE= $(FAST) -fno-alias
COPTIMIZE=

435.gromacs=peak=default:
OPTIMIZE=   $(FAST) -opt-prefetch

436.cactusADM=peak=default:
OPTIMIZE= $(FAST) -unroll2 -opt-prefetch  -parallel
copies=1
submit=

437.leslie3d=peak=default:
PORTABILITY =
FC= /opt/intel/Compiler/11.0/042/bin/ia32/ifort -L/opt/intel/Compiler/11.0/042/ipp/ia32/lib -I/opt/intel/Compiler/11.0/042/ipp/ia32/include
```

```
OPTIMIZE=    $(FAST)  -opt-malloc-options=3 -opt-prefetch
##############################################################################################################
###################
%ifdef %{stoakleydp8cores}
copies=4
submit= if `test $SPECCOPYNUM -le 1`; then  taskset -c $SPECCOPYNUM $command ; else taskset -c `expr $SPECCOPYNUM + 4`
$command ; fi
%endif
##############################################################################################################
###################

444.namd=peak=default:
CXXOPTIMIZE= $(FAST) -fno-alias -auto-ilp32

447.dealII=peak=default:
CXXOPTIMIZE= $(FAST) -unroll2 -ansi-alias -scalar-rep-

450.soplex=peak=default:
PORTABILITY =
CXX= /opt/intel/Compiler/11.0/042/bin/ia32/icpc -L/opt/intel/Compiler/11.0/042/ipp/ia32/lib -I/opt/intel/Compiler/11.0/042/ipp/ia32/include
OPTIMIZE= $(FAST) -opt-malloc-options=3
CXXOPTIMIZE=

453.povray=peak=default:
CXXOPTIMIZE= $(FAST) -unroll4 -ansi-alias

454.calculix=peak=default:
OPTIMIZE= $(FAST)
feedback=0

459.GemsFDTD=peak=default:
OPTIMIZE= $(FAST)  -unroll2 -Ob0 -opt-prefetch

465.tonto=peak=default:
OPTIMIZE= $(FAST) -unroll4 -auto

470.lbm=peak=default:
OPTIMIZE=   $(FAST) -opt-prefetch
feedback=no

##############################################################################################################
###################
%ifdef %{bensleydp8cores}
copies=2
submit= if `test $SPECCOPYNUM -le 0`; then  taskset -c $SPECCOPYNUM $command ; else taskset -c `expr $SPECCOPYNUM + 4`
$command ; fi
%endif

%ifdef %{stoakleydp8cores}
copies=4
submit= if `test $SPECCOPYNUM -le 1`; then  taskset -c $SPECCOPYNUM $command ; else taskset -c `expr $SPECCOPYNUM + 4`
$command ; fi
%endif

%ifdef %{tgt4p16cores}
copies=8
submit= if `test $SPECCOPYNUM -le 3`; then  taskset -c $SPECCOPYNUM $command ; else taskset -c `expr $SPECCOPYNUM + 8`
$command ; fi
%endif

%ifdef %{dgt4p24cores}
copies=12
submit= $[top]/mysubmit.pl $SPECCOPYNUM "$command"
%endif

%ifdef %{dgt4p16cores}
copies=8
submit= $[top]/mysubmit.pl $SPECCOPYNUM "$command"
%endif
```

```
#####################################################################################################
##################
```

481.wrf=peak=default:
basepeak=yes

482.sphinx3=peak=default:
PORTABILITY =
CC= /opt/intel/Compiler/11.0/042/bin/ia32/icc -L/opt/intel/Compiler/11.0/042/ipp/ia32/lib -I/opt/intel/Compiler/11.0/042/ipp/ia32/include
COPTIMIZE= -unroll2
feedback=no

```
#####################################################################################################
##################
```
%ifdef %{stoakleydp8cores}
copies=4
submit= if `test $SPECCOPYNUM -le 1`; then taskset -c $SPECCOPYNUM $command ; else taskset -c `expr $SPECCOPYNUM + 4` $command ; fi
%endif

%ifdef %{tgt4p16cores}
copies=8
submit= if `test $SPECCOPYNUM -le 3`; then taskset -c $SPECCOPYNUM $command ; else taskset -c `expr $SPECCOPYNUM + 8` $command ; fi
%endif

%ifdef %{dgt4p24cores}
copies=12
submit= $[top]/mysubmit.pl $SPECCOPYNUM "$command"
%endif

%ifdef %{dgt4p16cores}
copies=8
submit= $[top]/mysubmit.pl $SPECCOPYNUM "$command"
%endif
```
#####################################################################################################
##################
```

```
##################################################################
# (Edit this to match your system)
##################################################################
```

default=default=default=default:
license_num   = 3184
test_sponsor   = Red Hat
hw_avail   = Sep-2008
sw_avail   = Sep-2008
tester   = Principled Technologies
hw_cpu_name   = Intel Xeon X7460
hw_cpu_char   =
hw_cpu_mhz   = 2666
hw_disk   = 73.4 GB SATA, 10,000RPM
hw_fpu   = Integrated
hw_memory   = 64 GB (32 x 2GB)
hw_model000   = Intel Server Board S7000FC4UR
hw_model001 = (Intel Xeon X7460, 2.66 GHz)
hw_ncpuorder   = 1,2,4 chips
hw_ncores   = 24
hw_nchips   = 4
hw_ncoresperchip = 6
hw_nthreadspercore = 1
hw_other   = None
hw_pcache   = 32 KB I + 32 KB D on chip per core

```
hw_scache      = 9 MB I+D on chip per chip, 3 MB shared / 2 cores
hw_tcache      = 16 MB I+D on chip per chip
hw_ocache      = None
hw_vendor      = Intel Corporation
prepared_by    = PT
sw_file        = ext3
sw_os000       = Red Hat Enterprise Linux Server release 5.2
sw_os001 = Kernel 2.6.18-92.el5xen x86_64
sw_state       = Run level 3 (multi-user)
sw_other000    = Microquill SmartHeap V8.1


int=default=default=default:
sw_compiler001   = Intel C++ Compiler 11.0 for Linux
sw_compiler002   = Build 20080730 Package ID: l_cc_b_11.0.042
sw_base_ptrsize  = 32-bit
sw_peak_ptrsize  = 32/64-bit
notes_020        = All benchmarks compiled in 32-bit mode except 401.bzip2 and 456.hmmer,
notes_025        = for peak, are compiled in 64-bit mode
notes_026        = taskset was used to bind processes to cores except
notes_027        = for 462.libquantum peak
notes_028        = OMP_NUM_THREADS set to number of processors
notes_029        = KMP_AFFINITY set to "physical,0"
notes_030        = KMP_STACKSIZE set to 64M


fp=default=default=default:
sw_compiler000   = Intel C++ and Fortran Compiler 11.0 for Linux
sw_compiler001   = Build 20080730 Package ID: l_cc_b_11.0.042,
sw_compiler002 = l_fc_b_11.0.042
sw_base_ptrsize  = 64-bit
sw_peak_ptrsize  = 32/64-bit
notes_000        = All benchmarks compiled in 64-bit mode except 437.leslie3d, 450.soplex
notes_005        = and 482.sphinx3, at peak, are compiled in 32-bit mode
notes_010        = taskset was used to bind processes to cores except
notes_015        = for 436.cactusADM peak
notes_020        = OMP_NUM_THREADS set to number of processors
notes_025        = KMP_AFFINITY set to "physical,0"
notes_030        = KMP_STACKSIZE set to 64M
notes_035 = 'ulimit -s unlimited' was used to set the stacksize to unlimited prior to run
notes_040 = Hardware Prefetcher: Disabled
notes_045 = Adjacent Cache Line Prefetcher: Disabled
notes_050 = High Bandwidth Option: Enabled




# The following section was added automatically, and contains settings that
# did not appear in the original configuration file, but were added to the
# raw file after the run.
default:
flagsurl000 = Intel-ic11.0-fp-linux64-revA.xml
flagsurl001 = Intel-Linux64-Platform.xml
```
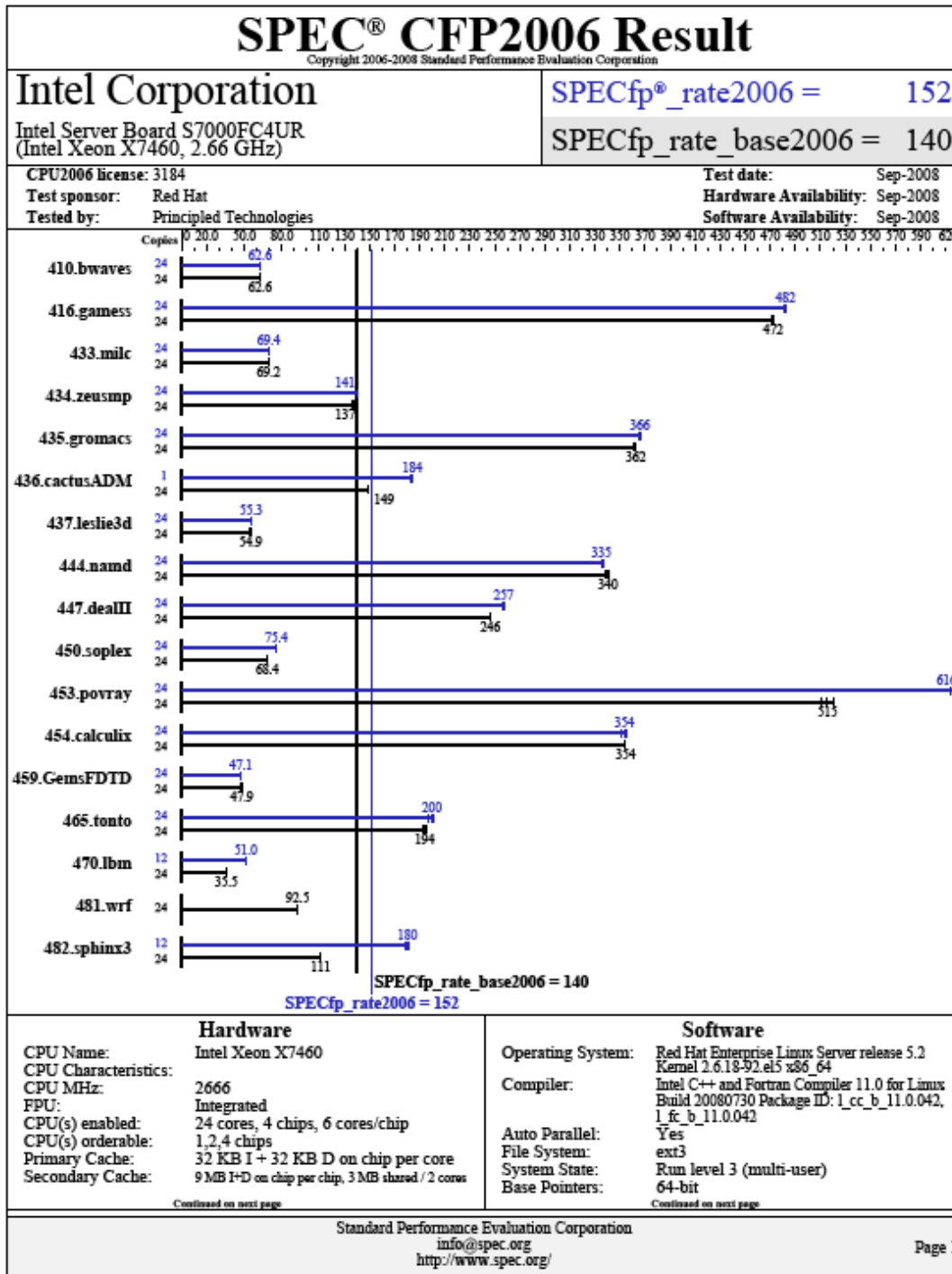
Appendix C – SPECfp_rate2006 output

This appendix provides the output of the benchmark for each of the test servers.

Red Hat Enterprise Linux 5.2 server: Intel Xeon X7460-based server

SPEC® CFP2006 Result
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Intel Corporation

Intel Server Board S7000FC4UR
(Intel Xeon X7460, 2.66 GHz)

SPECfp®_rate2006 = 152
SPECfp_rate_base2006 = 140

CPU2006 license: 3184	Test date: Sep-2008
Test sponsor: Red Hat	Hardware Availability: Sep-2008
Tested by: Principled Technologies	Software Availability: Sep-2008

Copies: 0 20.0 50.0 80.0 110 130 150 170 190 210 230 250 270 290 310 330 350 370 390 410 430 450 470 490 510 530 550 570 590 620

Benchmark	Copies	Value
410.bwaves	24 / 24	62.6 / 62.6
416.gamess	24 / 24	482 / 472
433.milc	24 / 24	69.4 / 69.2
434.zeusmp	24 / 24	141 / 137
435.gromacs	24 / 24	366 / 362
436.cactusADM	1 / 24	184 / 149
437.leslie3d	24 / 24	55.3 / 54.9
444.namd	24 / 24	335 / 340
447.dealII	24 / 24	257 / 246
450.soplex	24 / 24	75.4 / 68.4
453.povray	24 / 24	616 / 513
454.calculix	24 / 24	354 / 354
459.GemsFDTD	24 / 24	47.1 / 47.9
465.tonto	24 / 24	200 / 194
470.lbm	12 / 24	51.0 / 35.5
481.wrf	24	92.5
482.sphinx3	12 / 24	180 / 111

SPECfp_rate_base2006 = 140
SPECfp_rate2006 = 152

Hardware

CPU Name:	Intel Xeon X7460
CPU Characteristics:	
CPU MHz:	2666
FPU:	Integrated
CPU(s) enabled:	24 cores, 4 chips, 6 cores/chip
CPU(s) orderable:	1,2,4 chips
Primary Cache:	32 KB I + 32 KB D on chip per core
Secondary Cache:	9 MB I+D on chip per chip, 3 MB shared / 2 cores

Continued on next page

Software

Operating System:	Red Hat Enterprise Linux Server release 5.2 Kernel 2.6.18-92.el5 x86_64
Compiler:	Intel C++ and Fortran Compiler 11.0 for Linux Build 20080730 Package ID: l_cc_b_11.0.042, l_fc_b_11.0.042
Auto Parallel:	Yes
File System:	ext3
System State:	Run level 3 (multi-user)
Base Pointers:	64-bit

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Intel Corporation

Intel Server Board S7000FC4UR
(Intel Xeon X7460, 2.66 GHz)

SPECfp_rate2006 =	152
SPECfp_rate_base2006 =	140

CPU2006 license: 3184		Test date:	Sep-2008
Test sponsor:	Red Hat	Hardware Availability:	Sep-2008
Tested by:	Principled Technologies	Software Availability:	Sep-2008

Hardware (Continued)		Software (Continued)	
L3 Cache:	16 MB I+D on chip per chip	Peak Pointers:	32/64-bit
Other Cache:	None	Other Software:	Microquill SmartHeap V8.1
Memory:	64 GB (32 x 2GB)		
Disk Subsystem:	73.4 GB SATA, 10,000RPM		
Other Hardware:	None		

Results Table

Benchmark	Base						Peak						
	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio
410.bwaves	24	5210	62.6	5211	62.6	5211	62.6	24	5210	62.6	5212	62.6	5212	62.6
416.gamess	24	997	471	995	472	994	473	24	978	481	974	482	975	482
433.milc	24	3185	69.2	3184	69.2	3184	69.2	24	3173	69.4	3174	69.4	3174	69.4
434.zeusmp	24	1597	137	1598	137	1595	137	24	1553	141	1552	141	1555	140
435.gromacs	24	474	362	473	362	473	362	24	468	366	469	366	470	365
436.cactusADM	24	1931	149	1931	149	1931	149	1	65.0	184	65.0	184	65.2	183
437.leslie3d	24	4119	54.8	4109	54.9	4107	54.9	24	4078	55.3	4080	55.3	4080	55.3
444.namd	24	569	338	566	340	565	341	24	574	335	575	335	571	337
447.dealII	24	1115	246	1112	247	1115	246	24	1065	258	1070	257	1069	257
450.soplex	24	2929	68.3	2926	68.4	2926	68.4	24	2653	75.4	2652	75.5	2656	75.4
453.povray	24	245	521	248	515	250	510	24	208	614	207	618	207	616
454.calculix	24	559	354	559	355	559	354	24	558	355	560	354	563	352
459.GemsFDTD	24	5321	47.9	5320	47.9	5323	47.8	24	5409	47.1	5410	47.1	5406	47.1
465.tonto	24	1226	193	1217	194	1210	195	24	1201	197	1177	201	1183	200
470.lbm	24	9285	35.5	9283	35.5	9282	35.5	12	3225	51.1	3231	51.0	3231	51.0
481.wrf	24	2893	92.7	2899	92.5	2900	92.4	24	2893	92.7	2898	92.5	2900	92.4
482.sphinx3	24	4214	111	4232	111	4213	111	12	1299	180	1289	181	1313	178

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.

General Notes

All benchmarks compiled in 64-bit mode except 437.leslie3d, 450.soplex
and 482.sphinx3, at peak, are compiled in 32-bit mode
taskset was used to bind processes to cores except
for 436.cactusADM peak
OMP_NUM_THREADS set to number of processors
KMP_AFFINITY set to "physical,0"
KMP_STACKSIZE set to 64M
'ulimit -s unlimited' was used to set the stacksize to unlimited prior to run

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Intel Corporation

Intel Server Board S7000FC4UR
(Intel Xeon X7460, 2.66 GHz)

SPECfp_rate2006 =	152
SPECfp_rate_base2006 =	140

CPU2006 license: 3184	Test date:	Sep-2008
Test sponsor: Red Hat	Hardware Availability:	Sep-2008
Tested by: Principled Technologies	Software Availability:	Sep-2008

General Notes (Continued)

```
Hardware Prefetcher: Disabled
Adjacent Cache Line Prefetcher: Disabled
High Bandwidth Option: Enabled
```

Base Compiler Invocation

C benchmarks:
```
icc
```

C++ benchmarks:
```
icpc
```

Fortran benchmarks:
```
ifort
```

Benchmarks using both Fortran and C:
```
icc ifort
```

Base Portability Flags

```
  410.bwaves: -DSPEC_CPU_LP64
  416.gamess: -DSPEC_CPU_LP64
    433.milc: -DSPEC_CPU_LP64
  434.zeusmp: -DSPEC_CPU_LP64
  435.gromacs: -DSPEC_CPU_LP64  -nofor_main
436.cactusADM: -DSPEC_CPU_LP64  -nofor_main
  437.leslie3d: -DSPEC_CPU_LP64
    444.namd: -DSPEC_CPU_LP64
   447.dealII: -DSPEC_CPU_LP64
   450.soplex: -DSPEC_CPU_LP64
   453.povray: -DSPEC_CPU_LP64
  454.calculix: -DSPEC_CPU_LP64  -nofor_main
459.GemsFDTD: -DSPEC_CPU_LP64
    465.tonto: -DSPEC_CPU_LP64
     470.lbm: -DSPEC_CPU_LP64
     481.wrf: -DSPEC_CPU_LP64  -DSPEC_CPU_CASE_FLAG -DSPEC_CPU_LINUX
   482.sphinx3: -DSPEC_CPU_LP64
```

Base Optimization Flags

C benchmarks:
```
-xSSE4.1 -ipo -O3 -no-prec-div -static -opt-prefetch
```

C++ benchmarks:
```
-xSSE4.1 -ipo -O3 -no-prec-div -static -opt-prefetch
```

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SPEC CFP2006 Result
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Intel Corporation

Intel Server Board S7000FC4UR
(Intel Xeon X7460, 2.66 GHz)

SPECfp_rate2006 =	152
SPECfp_rate_base2006 =	140

CPU2006 license: 3184		Test date:	Sep-2008
Test sponsor:	Red Hat	Hardware Availability:	Sep-2008
Tested by:	Principled Technologies	Software Availability:	Sep-2008

Base Optimization Flags (Continued)

Fortran benchmarks:
    -xSSE4.1 -ipo -O3 -no-prec-div -static -opt-prefetch

Benchmarks using both Fortran and C:
    -xSSE4.1 -ipo -O3 -no-prec-div -static -opt-prefetch

Peak Compiler Invocation

C benchmarks (except as noted below):
    icc

    482.sphinx3: /opt/intel/Compiler/11.0/042/bin/ia32/icc
            -L/opt/intel/Compiler/11.0/042/ipp/ia32/lib
            -I/opt/intel/Compiler/11.0/042/ipp/ia32/include

C++ benchmarks (except as noted below):
    icpc

    450.soplex: /opt/intel/Compiler/11.0/042/bin/ia32/icpc
            -L/opt/intel/Compiler/11.0/042/ipp/ia32/lib
            -I/opt/intel/Compiler/11.0/042/ipp/ia32/include

Fortran benchmarks (except as noted below):
    ifort

    437.leslie3d: /opt/intel/Compiler/11.0/042/bin/ia32/ifort
            -L/opt/intel/Compiler/11.0/042/ipp/ia32/lib
            -I/opt/intel/Compiler/11.0/042/ipp/ia32/include

Benchmarks using both Fortran and C:
    icc ifort

Peak Portability Flags

       410.bwaves: -DSPEC_CPU_LP64
       416.gamess: -DSPEC_CPU_LP64
         433.milc: -DSPEC_CPU_LP64
       434.zeusmp: -DSPEC_CPU_LP64
      435.gromacs: -DSPEC_CPU_LP64 -nofor_main
     436.cactusADM: -DSPEC_CPU_LP64 -nofor_main
        444.namd: -DSPEC_CPU_LP64
       447.dealII: -DSPEC_CPU_LP64
       453.povray: -DSPEC_CPU_LP64
      454.calculix: -DSPEC_CPU_LP64 -nofor_main
     459.GemsFDTD: -DSPEC_CPU_LP64

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SPEC CFP2006 Result
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Intel Corporation	SPECfp_rate2006 =	152
Intel Server Board S7000FC4UR (Intel Xeon X7460, 2.66 GHz)	SPECfp_rate_base2006 =	140

CPU2006 license: 3184		Test date:	Sep-2008
Test sponsor:	Red Hat	Hardware Availability:	Sep-2008
Tested by:	Principled Technologies	Software Availability:	Sep-2008

Peak Portability Flags (Continued)

465.tonto: -DSPEC_CPU_LP64
470.lbm: -DSPEC_CPU_LP64
481.wrf: -DSPEC_CPU_LP64 -DSPEC_CPU_CASE_FLAG -DSPEC_CPU_LINUX

Peak Optimization Flags

C benchmarks:

433.milc: -prof-gen(pass 1) -prof-use(pass 2) -xSSE4.1 -ipo -O3
-no-prec-div -static -fno-alias

470.lbm: -xSSE4.1 -ipo -O3 -no-prec-div -static -opt-prefetch
-auto-ilp32

482.sphinx3: -xSSE4.1 -ipo -O3 -no-prec-div -static -unroll2

C++ benchmarks:

444.namd: -prof-gen(pass 1) -prof-use(pass 2) -xSSE4.1 -ipo -O3
-no-prec-div -static -fno-alias -auto-ilp32

447.dealII: -prof-gen(pass 1) -prof-use(pass 2) -xSSE4.1 -ipo -O3
-no-prec-div -static -unroll2 -ansi-alias -scalar-rep-

450.soplex: -prof-gen(pass 1) -prof-use(pass 2) -xSSE4.1 -ipo -O3
-no-prec-div -static -opt-malloc-options=3

453.povray: -prof-gen(pass 1) -prof-use(pass 2) -xSSE4.1 -ipo -O3
-no-prec-div -static -unroll4 -ansi-alias

Fortran benchmarks:

410.bwaves: -xSSE4.1 -ipo -O3 -no-prec-div -static -opt-prefetch

416.gamess: -prof-gen(pass 1) -prof-use(pass 2) -xSSE4.1 -ipo -O3
-no-prec-div -static -unroll2 -Ob0 -ansi-alias
-scalar-rep-

434.zeusmp: -prof-gen(pass 1) -prof-use(pass 2) -xSSE4.1 -ipo -O3
-no-prec-div -static

437.leslie3d: -prof-gen(pass 1) -prof-use(pass 2) -xSSE4.1 -ipo -O3
-no-prec-div -static -opt-malloc-options=3 -opt-prefetch

459.GemsFDTD: -prof-gen(pass 1) -prof-use(pass 2) -xSSE4.1 -ipo -O3
-no-prec-div -static -unroll2 -Ob0 -opt-prefetch

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SPEC CFP2006 Result
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Intel Corporation	SPECfp_rate2006 =	152
Intel Server Board S7000FC4UR (Intel Xeon X7460, 2.66 GHz)	SPECfp_rate_base2006 =	140

CPU2006 license: 3184		Test date:	Sep-2008
Test sponsor:	Red Hat	Hardware Availability:	Sep-2008
Tested by:	Principled Technologies	Software Availability:	Sep-2008

Peak Optimization Flags (Continued)

465.tonto: -prof-gen(pass 1) -prof-use(pass 2) -xSSE4.1 -ipo -O3
-no-prec-div -static -unroll4 -auto

Benchmarks using both Fortran and C:

435.gromacs: -prof-gen(pass 1) -prof-use(pass 2) -xSSE4.1 -ipo -O3
-no-prec-div -static -opt-prefetch -auto-ilp32

436.cactusADM: -prof-gen(pass 1) -prof-use(pass 2) -xSSE4.1 -ipo -O3
-no-prec-div -static -unroll2 -opt-prefetch -parallel
-auto-ilp32

454.calculix: -xSSE4.1 -ipo -O3 -no-prec-div -static -auto-ilp32

481.wrf: basepeak = yes

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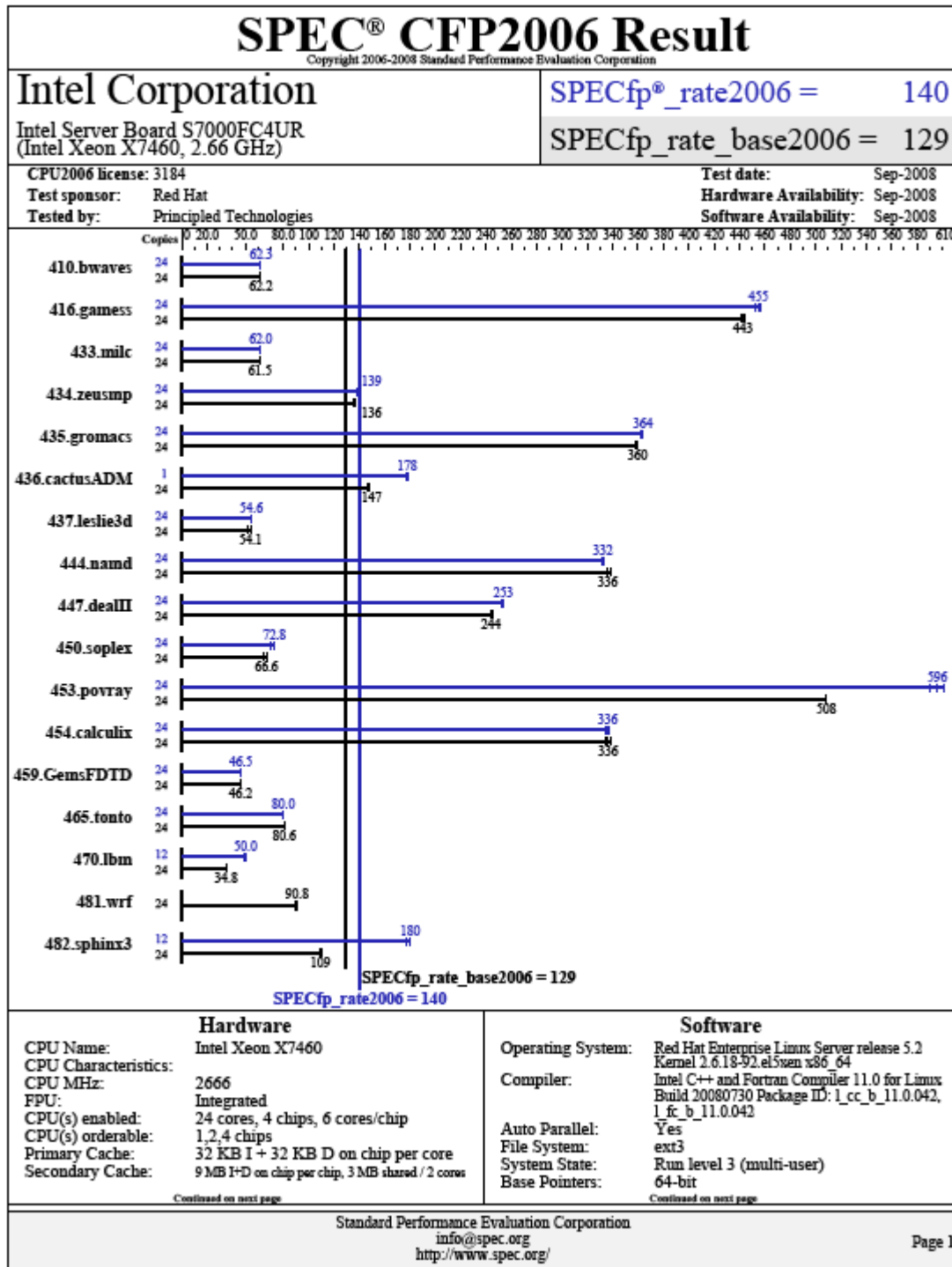For other inquiries, please contact webmaster@spec.org.

Tested with SPEC CPU2006 v1.1.
Report generated on Thu Oct 2 12:25:52 2008 by SPEC CPU2006 PS/PDF formatter v6128.

Red Hat Enterprise Linux 5.2 guest on Red Hat Enterprise Linux 5.2 server: Intel Xeon X7460-based server

SPEC® CFP2006 Result
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Intel Corporation	SPECfp®_rate2006 =	140
Intel Server Board S7000FC4UR (Intel Xeon X7460, 2.66 GHz)	SPECfp_rate_base2006 =	129

CPU2006 license: 3184	Test date:	Sep-2008
Test sponsor: Red Hat	Hardware Availability:	Sep-2008
Tested by: Principled Technologies	Software Availability:	Sep-2008

	Copies	
410.bwaves	24	62.3
	24	62.2
416.gamess	24	455
	24	443
433.milc	24	62.0
	24	61.5
434.zeusmp	24	139
	24	136
435.gromacs	24	364
	24	360
436.cactusADM	1	178
	24	147
437.leslie3d	24	54.6
	24	54.1
444.namd	24	332
	24	336
447.dealII	24	253
	24	244
450.soplex	24	72.8
	24	66.6
453.povray	24	596
	24	508
454.calculix	24	336
	24	336
459.GemsFDTD	24	46.5
	24	46.2
465.tonto	24	80.0
	24	80.6
470.lbm	12	50.0
	24	34.8
481.wrf	24	90.8
482.sphinx3	12	180
	24	109

SPECfp_rate_base2006 = 129
SPECfp_rate2006 = 140

Hardware		Software	
CPU Name:	Intel Xeon X7460	Operating System:	Red Hat Enterprise Linux Server release 5.2 Kernel 2.6.18-92.el5xen x86_64
CPU Characteristics:		Compiler:	Intel C++ and Fortran Compiler 11.0 for Linux Build 20080730 Package ID: l_cc_b_11.0.042, l_fc_b_11.0.042
CPU MHz:	2666		
FPU:	Integrated		
CPU(s) enabled:	24 cores, 4 chips, 6 cores/chip	Auto Parallel:	Yes
CPU(s) orderable:	1,2,4 chips	File System:	ext3
Primary Cache:	32 KB I + 32 KB D on chip per core	System State:	Run level 3 (multi-user)
Secondary Cache:	9 MB I+D on chip per chip, 3 MB shared / 2 cores	Base Pointers:	64-bit
Continued on next page		Continued on next page	

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SPEC CFP2006 Result
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Intel Corporation

Intel Server Board S7000FC4UR
(Intel Xeon X7460, 2.66 GHz)

SPECfp_rate2006 =	140
SPECfp_rate_base2006 =	129

CPU2006 license:	3184	Test date:	Sep-2008
Test sponsor:	Red Hat	Hardware Availability:	Sep-2008
Tested by:	Principled Technologies	Software Availability:	Sep-2008

Hardware (Continued)

L3 Cache:	16 MB I+D on chip per chip
Other Cache:	None
Memory:	64 GB (32 x 2GB)
Disk Subsystem:	73.4 GB SATA, 10,000RPM
Other Hardware:	None

Software (Continued)

Peak Pointers:	32/64-bit
Other Software:	Microquill SmartHeap V8.1

Results Table

Benchmark	Copies	Base Seconds	Ratio	Base Seconds	Ratio	Base Seconds	Ratio	Copies	Peak Seconds	Ratio	Peak Seconds	Ratio	Peak Seconds	Ratio
410.bwaves	24	5247	62.2	**5245**	**62.2**	5238	62.3	24	**5233**	**62.3**	5233	62.3	5237	62.3
416.gamess	24	1058	444	1066	441	**1062**	**443**	24	**1033**	**455**	1031	456	1038	453
433.milc	24	3582	61.5	3572	61.7	**3581**	**61.5**	24	**3556**	**62.0**	3554	62.0	3556	62.0
434.zeusmp	24	**1608**	**136**	1600	136	1616	135	24	1572	139	**1576**	**139**	1584	138
435.gromacs	24	478	358	476	360	**477**	**360**	24	473	363	**471**	**364**	471	364
436.cactusADM	24	1949	147	**1948**	**147**	1947	147	1	67.6	177	67.2	178	**67.2**	**178**
437.leslie3d	24	4305	52.4	4161	54.2	**4173**	**54.1**	24	**4132**	**54.6**	4126	54.7	4143	54.5
444.namd	24	**573**	**336**	573	336	569	338	24	**580**	**332**	580	332	579	332
447.dealII	24	1122	245	**1126**	**244**	1128	243	24	1086	253	1083	254	**1084**	**253**
450.soplex	24	3085	64.9	2999	66.7	**3004**	**66.6**	24	2837	70.6	2747	72.9	**2751**	**72.8**
453.povray	24	252	508	**251**	**508**	251	508	24	216	591	213	601	**214**	**596**
454.calculix	24	**589**	**336**	586	338	593	334	24	587	337	593	334	**589**	**336**
459.GemsFDTD	24	5529	46.1	**5508**	**46.2**	5495	46.3	24	5476	46.5	**5481**	**46.5**	5515	46.2
465.tonto	24	2933	80.5	**2929**	**80.6**	2922	80.8	24	2951	80.0	**2953**	**80.0**	2962	79.7
470.lbm	24	9485	34.8	9453	34.9	**9469**	**34.8**	12	3296	50.0	**3300**	**50.0**	3307	49.9
481.wrf	24	3018	88.8	**2953**	**90.8**	2940	91.2	24	3018	88.8	**2953**	**90.8**	2940	91.2
482.sphinx3	24	4300	109	**4290**	**109**	4251	110	12	1319	177	1298	180	**1299**	**180**

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.

General Notes

All benchmarks compiled in 64-bit mode except 437.leslie3d, 450.soplex
and 482.sphinx3, at peak, are compiled in 32-bit mode
taskset was used to bind processes to cores except
for 436.cactusADM peak
OMP_NUM_THREADS set to number of processors
KMP_AFFINITY set to "physical,0"
KMP_STACKSIZE set to 64M
'ulimit -s unlimited' was used to set the stacksize to unlimited prior to run

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SPEC CFP2006 Result

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Intel Corporation

Intel Server Board S7000FC4UR
(Intel Xeon X7460, 2.66 GHz)

SPECfp_rate2006 =	140
SPECfp_rate_base2006 =	**129**

CPU2006 license: 3184	Test date:	Sep-2008
Test sponsor: Red Hat	Hardware Availability:	Sep-2008
Tested by: Principled Technologies	Software Availability:	Sep-2008

General Notes (Continued)

```
Hardware Prefetcher: Disabled
Adjacent Cache Line Prefetcher: Disabled
High Bandwidth Option: Enabled
```

Base Compiler Invocation

C benchmarks:
```
icc
```

C++ benchmarks:
```
icpc
```

Fortran benchmarks:
```
ifort
```

Benchmarks using both Fortran and C:
```
icc ifort
```

Base Portability Flags

```
 410.bwaves: -DSPEC_CPU_LP64
 416.gamess: -DSPEC_CPU_LP64
   433.milc: -DSPEC_CPU_LP64
 434.zeusmp: -DSPEC_CPU_LP64
 435.gromacs: -DSPEC_CPU_LP64  -nofor_main
436.cactusADM: -DSPEC_CPU_LP64  -nofor_main
 437.leslie3d: -DSPEC_CPU_LP64
   444.namd: -DSPEC_CPU_LP64
  447.dealII: -DSPEC_CPU_LP64
  450.soplex: -DSPEC_CPU_LP64
  453.povray: -DSPEC_CPU_LP64
 454.calculix: -DSPEC_CPU_LP64  -nofor_main
459.GemsFDTD: -DSPEC_CPU_LP64
   465.tonto: -DSPEC_CPU_LP64
    470.lbm: -DSPEC_CPU_LP64
    481.wrf: -DSPEC_CPU_LP64  -DSPEC_CPU_CASE_FLAG -DSPEC_CPU_LINUX
  482.sphinx3: -DSPEC_CPU_LP64
```

Base Optimization Flags

C benchmarks:
```
-xSSE4.1 -ipo -O3 -no-prec-div -static -opt-prefetch
```

C++ benchmarks:
```
-xSSE4.1 -ipo -O3 -no-prec-div -static -opt-prefetch
```

SPEC CFP2006 Result

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Test sponsor:	Red Hat	Hardware Availability:	Sep-2008
Tested by:	Principled Technologies	Software Availability:	Sep-2008

Base Optimization Flags (Continued)

Fortran benchmarks:
```
-xSSE4.1 -ipo -O3 -no-prec-div -static -opt-prefetch
```

Benchmarks using both Fortran and C:
```
-xSSE4.1 -ipo -O3 -no-prec-div -static -opt-prefetch
```

Peak Compiler Invocation

C benchmarks (except as noted below):
```
icc
```
```
482.sphinx3: /opt/intel/Compiler/11.0/042/bin/ia32/icc
           -L/opt/intel/Compiler/11.0/042/ipp/ia32/lib
           -I/opt/intel/Compiler/11.0/042/ipp/ia32/include
```

C++ benchmarks (except as noted below):
```
icpc
```
```
450.soplex: /opt/intel/Compiler/11.0/042/bin/ia32/icpc
          -L/opt/intel/Compiler/11.0/042/ipp/ia32/lib
          -I/opt/intel/Compiler/11.0/042/ipp/ia32/include
```

Fortran benchmarks (except as noted below):
```
ifort
```
```
437.leslie3d: /opt/intel/Compiler/11.0/042/bin/ia32/ifort
            -L/opt/intel/Compiler/11.0/042/ipp/ia32/lib
            -I/opt/intel/Compiler/11.0/042/ipp/ia32/include
```

Benchmarks using both Fortran and C:
```
icc ifort
```

Peak Portability Flags

```
   410.bwaves: -DSPEC_CPU_LP64
   416.gamess: -DSPEC_CPU_LP64
     433.milc: -DSPEC_CPU_LP64
   434.zeusmp: -DSPEC_CPU_LP64
  435.gromacs: -DSPEC_CPU_LP64  -nofor_main
436.cactusADM: -DSPEC_CPU_LP64  -nofor_main
    444.namd: -DSPEC_CPU_LP64
   447.dealII: -DSPEC_CPU_LP64
   453.povray: -DSPEC_CPU_LP64
  454.calculix: -DSPEC_CPU_LP64  -nofor_main
 459.GemsFDTD: -DSPEC_CPU_LP64
```

Continued on next page

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Intel Server Board S7000FC4UR
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SPECfp_rate2006 =	140
SPECfp_rate_base2006 =	129

CPU2006 license: 3184	Test date:	Sep-2008
Test sponsor: Red Hat	Hardware Availability:	Sep-2008
Tested by: Principled Technologies	Software Availability:	Sep-2008

Peak Portability Flags (Continued)

465.tonto: -DSPEC_CPU_LP64
470.lbm: -DSPEC_CPU_LP64
481.wrf: -DSPEC_CPU_LP64 -DSPEC_CPU_CASE_FLAG -DSPEC_CPU_LINUX

Peak Optimization Flags

C benchmarks:

433.milc: -prof-gen(pass 1) -prof-use(pass 2) -xSSE4.1 -ipo -O3
-no-prec-div -static -fno-alias

470.lbm: -xSSE4.1 -ipo -O3 -no-prec-div -static -opt-prefetch
-auto-ilp32

482.sphinx3: -xSSE4.1 -ipo -O3 -no-prec-div -static -unroll2

C++ benchmarks:

444.namd: -prof-gen(pass 1) -prof-use(pass 2) -xSSE4.1 -ipo -O3
-no-prec-div -static -fno-alias -auto-ilp32

447.dealII: -prof-gen(pass 1) -prof-use(pass 2) -xSSE4.1 -ipo -O3
-no-prec-div -static -unroll2 -ansi-alias -scalar-rep-

450.soplex: -prof-gen(pass 1) -prof-use(pass 2) -xSSE4.1 -ipo -O3
-no-prec-div -static -opt-malloc-options=3

453.povray: -prof-gen(pass 1) -prof-use(pass 2) -xSSE4.1 -ipo -O3
-no-prec-div -static -unroll4 -ansi-alias

Fortran benchmarks:

410.bwaves: -xSSE4.1 -ipo -O3 -no-prec-div -static -opt-prefetch

416.gamess: -prof-gen(pass 1) -prof-use(pass 2) -xSSE4.1 -ipo -O3
-no-prec-div -static -unroll2 -Ob0 -ansi-alias
-scalar-rep-

434.zeusmp: -prof-gen(pass 1) -prof-use(pass 2) -xSSE4.1 -ipo -O3
-no-prec-div -static

437.leslie3d: -prof-gen(pass 1) -prof-use(pass 2) -xSSE4.1 -ipo -O3
-no-prec-div -static -opt-malloc-options=3 -opt-prefetch

459.GemsFDTD: -prof-gen(pass 1) -prof-use(pass 2) -xSSE4.1 -ipo -O3
-no-prec-div -static -unroll2 -Ob0 -opt-prefetch

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SPEC CFP2006 Result
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Intel Corporation

Intel Server Board S7000FC4UR
(Intel Xeon X7460, 2.66 GHz)

SPECfp_rate2006 =	140
SPECfp_rate_base2006 =	129

CPU2006 license: 3184		Test date:	Sep-2008
Test sponsor:	Red Hat	Hardware Availability:	Sep-2008
Tested by:	Principled Technologies	Software Availability:	Sep-2008

Peak Optimization Flags (Continued)

465.tonto: `-prof-gen(pass 1) -prof-use(pass 2) -xSSE4.1 -ipo -O3 -no-prec-div -static -unroll4 -auto`

Benchmarks using both Fortran and C:

435.gromacs: `-prof-gen(pass 1) -prof-use(pass 2) -xSSE4.1 -ipo -O3 -no-prec-div -static -opt-prefetch -auto-ilp32`

436.cactusADM: `-prof-gen(pass 1) -prof-use(pass 2) -xSSE4.1 -ipo -O3 -no-prec-div -static -unroll2 -opt-prefetch -parallel -auto-ilp32`

454.calculix: `-xSSE4.1 -ipo -O3 -no-prec-div -static -auto-ilp32`

481.wrf: `basepeak = yes`

For questions about this result, please contact the tester.
For other inquiries, please contact webmaster@spec.org.

Tested with SPEC CPU2006 v1.1.
Report generated on Thu Oct 2 12:28:46 2008 by SPEC CPU2006 PS/PDF formatter v6128.

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