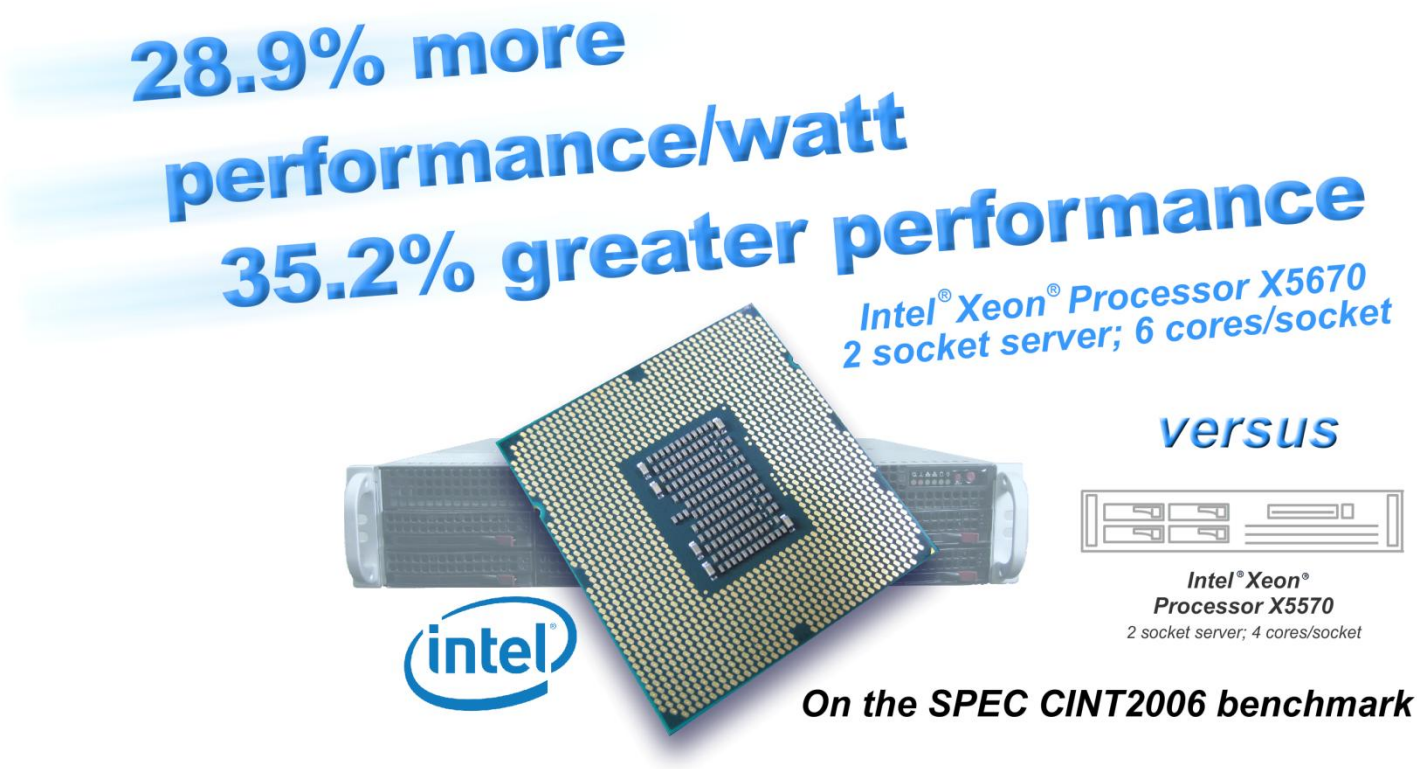
INTEL SERVER PROCESSORS: PERFORMANCE-PER-WATT COMPARISON



OUR FINDINGS

As data centers reach their power and cooling capacities, efficiency has become a key focus. The new Intel® Xeon® processor 5600 series delivers better performance per watt and higher performance than its predecessors. In Principled Technologies' tests in our labs, a two-socket server with the new Intel® Xeon® Processor X5670 demonstrated significant advantages over the previous-generation Intel Xeon Processor X5570-based server in both these areas.

OUR PROCESS

We used the industry-standard SPEC® CPU2006 benchmark to focus on and measure the processor performance of a pair of servers. While that benchmark was running, we captured the energy usage of each server. With this data, we computed both relative performance and performance per watt.

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Commissioned by Intel Corp.

WORKLOAD

The SPEC CPU2006 workload includes two benchmark suites: CINT2006 and CFP2006. (Note: SPEC and SPECint are trademarks of the Standard Performance Evaluation Corporation.) We ran only the CINT2006 benchmark, which focuses on measuring and comparing compute-intensive integer performance. Specifically, we measured the SPECint_rate_base2006 results for the test servers with 16 and 24 users.

Generally, the best SPECint_rate_base2006 score occurs using the same number of users as execution units for a given server. The optimum user count for our testing was 24 users on the Intel Xeon Processor X5670-based server and 16 users on the Intel Xeon Processor X5570-based server. The difference in user counts between the servers is due to the different number of execution units (logical or physical processors) on those servers.

Figure 1 lists the 12 applications that compose the CINT2006 benchmark. SPEC wrote nine of the applications in C and three (471.omnetpp, 473.astar, 483.xalancbmk) in C++.

A CINT2006 run performs each of the 12 applications three times and reports the median for each. It also calculates the geometric mean of those 12 results to produce an overall score. (For more information on SPEC CPU2006 and other SPEC benchmarks, see www.spec.org.)

Name	Application area
400.perlbench	Programming language
403.gcc	C compiler
429.mcf	Combinatorial optimization
445.gobmk	Artificial intelligence: Go
456.hmmer	Search gene sequence
458.sjeng	Artificial intelligence: chess
462.libquantum	Physics/quantum computing
464.h264ref	Video compression
471.omnetpp	Discrete event simulation
473.astar	Path-finding algorithms
483.xalancbmk	XML processing

Figure 1: The applications that make up the CINT2006 benchmark.

SYSTEM COMPARISON

Figure 2 shows a side-by-side comparison of the key hardware differences between the two systems. Appendix A provides detailed configuration information.

Hardware specifications	Intel Xeon Processor X5570-based system	Intel Xeon Processor X5670-based system
CPU	Intel Xeon Processor X5570	Intel Xeon Processor X5670
CPU speed (GHz)	2.93 GHz	2.93 GHz
Number of processor packages	2	2
Number of cores per processor package	4	6
Number of hardware threads per core	2	2
Memory type	PC3-10600R	PC3-10600R
Total memory (GB)	24 GB (6 x 4 GB)	24 GB (6 x 4 GB)
Hard drive	1 x Western Digital WD160	1 x Western Digital WD160

Figure 2: System configuration information for the two systems.

WHAT WE FOUND

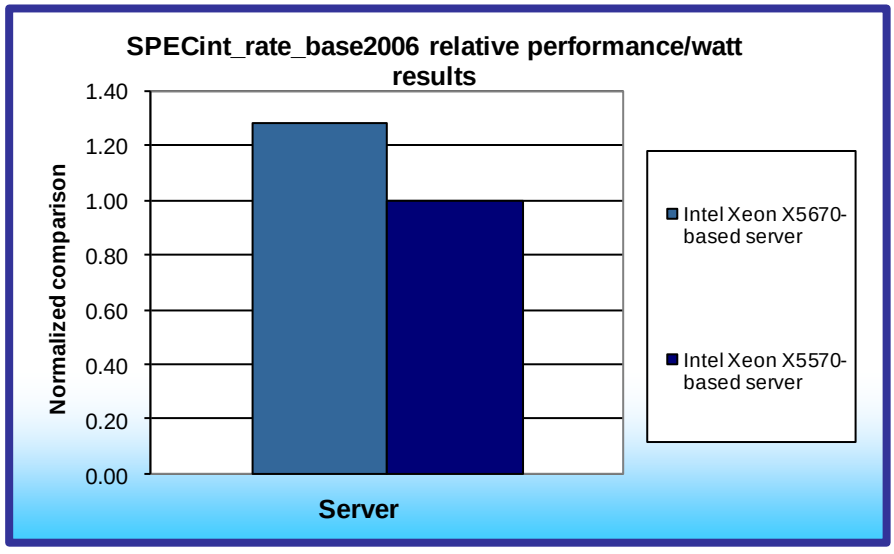


Figure 3: Normalized SPECint_rate_base2006 performance/watt results for the two servers. Higher numbers are better.

As Figure 3 shows, the Intel Xeon Processor X5670-based server delivers 28.9 percent more performance per watt than the Intel Xeon Processor X5570-based server.

To calculate the performance/watt, we used the following formula: benchmark score divided by average peak power consumption in watts. We normalized the results to the Intel Xeon X5570-based server.

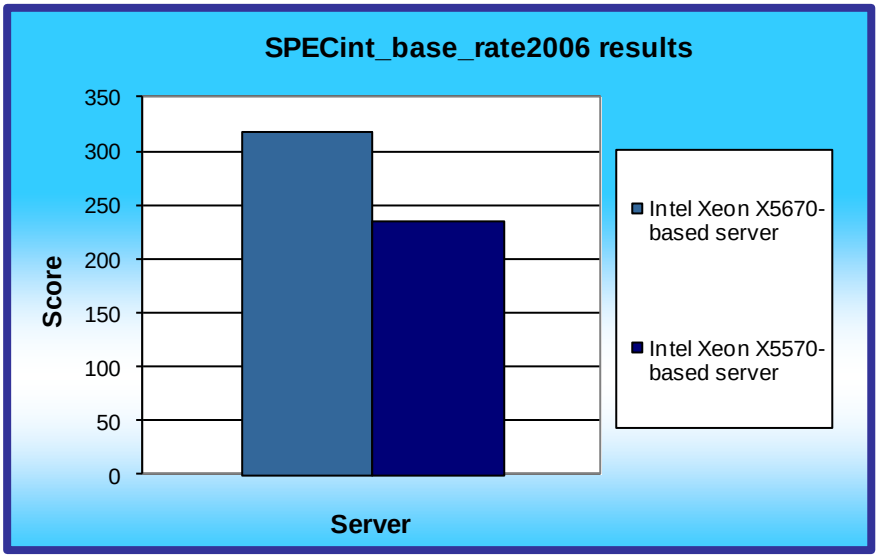


Figure 4: SPECint_rate_base2006 results for the two servers. Higher numbers are better.

As Figure 4 shows, the Intel Xeon Processor X5670-based server achieved a 35.2 percent greater SPECint_rate_base2006 score than the Intel Xeon Processor X5570-based server, with respective scores of 319 and 236.

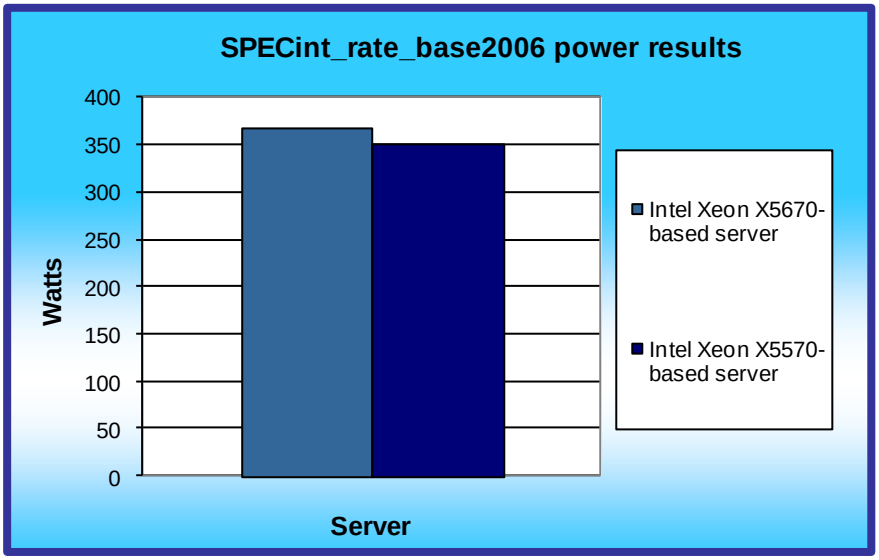


Figure 5: SPECint_rate_base2006 power results for the two servers. Lower numbers are better.

As Figure 5 shows, the Intel Xeon Processor X5670-based server used only 4.8 percent more power than the Intel Xeon Processor X5570-based server while running the SPECint_rate_base2006 benchmark, with respective scores of 368.6 watts and 351.6 watts.

Figure 6 details the results of our tests with the optimum number of users for SPECint_rate_base2006. We determined the number of users based on the number of execution units in a given server. We used the same number of SPECint_rate_base2006 users as processor execution units, so there is a one-to-one ratio. SPECint_rate_base2006 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.

Figure 6 also details the power consumption, in watts, of the test servers while idle and during the benchmark. Idle power is an average of a 2-minute power recording while the server was idle. Peak power represents the average power for the duration of the benchmark run.

Server	SPECint_rate_base 2006 results	Idle power	Peak power	User count
Intel Xeon Processor X5570-based server	236	153.8	351.6	16
Intel Xeon Processor X5670-based server	319	157.7	368.6	24

Figure 6: SPECint_rate_base2006 results; power consumption, in watts; and user count of the test servers while idle and during the benchmark.

HOW WE TESTED

Intel configured and provided the two Intel Xeon processor-based servers.

We began by installing a fresh copy of SUSE™ Linux Enterprise Server 11 Service Pack 2. We installed the default packages, the C/C++ Compilers and Tools, and disabled the firewall. To maximize performance per watt for each server, we adjusted the BIOS settings by disabling Turbo mode on both systems. We made no additional changes to the default installation options.

SPECCPU2006 configuration

Intel compiled and provided the SPEC CINT2006 executables, but followed SPEC's standard instructions for building the executables using the following software tools for both servers:

- Intel C++ Professional Compiler for IA32 and Intel 64, Version 11.1
- MicroQuill SmartHeap V8.1
- Binutils 2.18.50.0.7.20080502

The benchmark requires a configuration file. Intel provided the configuration file we used for the Intel Xeon Processor X5570-based server and the Intel Xeon Processor X5670-based server. The configuration file we used appears in Appendix B.

We report only the base metrics for the SPECint_rate test. SPEC requires the base metrics for all reported results and sets compilation guidelines that testers must follow in building the executables for such tests.

To begin the benchmark, we executed the following script on the Intel Xeon Processor X5570-based server:

```
. ./shrc
ulimit -s unlimited
export LD_LIBRARY_PATH=$SPEC/libic11.1-32bit/:$SPEC/libic11.1-
64bit/:$LD_LIBRARY_PATH
a=`cat /proc/cpuinfo | grep processor | wc -l`
rm -rf topo.txt
specperl nhmtopology.pl
b=`cat topo.txt`
echo "****************************************"
echo Running rate with $a copies on a NHM system with a topology of $b
echo "****************************************"
rm -rf benchspec/CPU2006/*/run
runspec --rate $a -c cpu2006.1.1.ic11.1.linux64.sse42.rate.jan182010.cfg --
flagsurl=Intel-ic11.1-linux64-revE.xml --define dp-nhm --define smt-on --
define $b -T base -o all int
```

We used the same script for the Intel Xeon Processor X5670, but changed the `--define dp-nhm` to `--define dp-wsm`. These commands tell the benchmark how many cores and define how it runs.

When the run completes, the benchmark puts the results in the directory /cpu2006/result. The result file names are of the form CINT2006.<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., CINT2006.002. asc and log.002.

Appendix C provides the SPECint_rate_base2006 output results for each of the two test servers.

Power measurement procedure

To record each server's power consumption during each test, we used an Extech Instruments (www.extech.com) 380803 Power Analyzer/Datalogger. We connected the power cord from the server under test to the Power Analyzer's output load power outlet. We then plugged the power cord from the Power Analyzer's input voltage connection into a power outlet.

We used the Power Analyzer's Data Acquisition Software (version 2.11) to capture all recordings. We installed the software on a separate Intel processor-based PC, which we connected to the Power Analyzer via an RS-232 cable. We captured power consumption at 1-second intervals.

To gauge the idle power usage, we recorded the power usage for 2 minutes while each server was running the operating system but otherwise idle.

We then recorded the power usage (in watts) for each server during the testing at 1-second intervals. To compute the average power usage, we averaged the power usage during the entire SPECint_rate_base2006 run. We call this time the power measurement interval. See Figure 6 for the results of these measurements.

APPENDIX A – SERVER CONFIGURATION INFORMATION

Figure 7 provides detailed configuration information about the test systems.

Servers	Intel Xeon Processor X5570-based server	Intel Xeon Processor X5670-based server
Power supplies		
Total number	2	2
Wattage of each (W)	885	885
Cooling fans		
Total number	3	3
Dimensions (h x w) of each	3” x 3”	3” x 3”
General processor setup		
Number of processor packages	2	2
Number of cores per processor package	4	6
Number of hardware threads per core	2	2
CPU		
Vendor	Intel	Intel
Name	Xeon X5570	Xeon X5670
Stepping	D0	C0
Socket type	LGA1366	LGA1366
Core frequency (GHz)	2.93	2.93
Bus frequency	6.4 GT/s	6.4 GT/s
L1 cache (KB)	32 + 32 (per core)	32 + 32 (per core)
L2 cache (KB)	256 KB (per core)	256 KB (per core)
L3 cache (MB)	8	12
Thermal design power (TDP, in watts)	95	95
Platform		
Vendor and model number	Supermicro SuperServer 6026T-NTR+	Supermicro SuperServer 6026T-NTR+
Motherboard model number	Super X8DTN+	Super X8DTN+
Motherboard chipset	Intel 5520	Intel 5520
BIOS name and version	American Megatrends 4.6.3.2 (01/06/2010)	American Megatrends 4.6.3.2 (01/06/2010)
BIOS settings	All default settings except Turbo mode disabled	All default settings except Turbo mode disabled
Memory modules		
Total RAM in system (GB)	24	24

Servers	Intel Xeon Processor X5570-based server	Intel Xeon Processor X5670-based server
Number of types of memory modules	1	1
Speed in the system currently running @ (MHz)	1,333	1,333
Timing/Latency (tCL-tRCD-iRP-tRASmin)	9-9-9-24	9-9-9-24
Vendor and model number	MT36JSZF51272PY	MT36JSZF51272PY
Type	PC3-10600R	PC3-10600R
Speed (MHz)	1,333	1,333
Speed in the system currently running @ (MHz)	1,333	1,333
Timing/Latency (tCL-tRCD-iRP-tRASmin)	9-9-9-24	9-9-9-24
Size (GB)	4	4
Number of RAM modules	6 x 4GB	6 x 4GB
Chip organization	Double-sided	Double-sided
Hard disk		
Vendor and model number	Western Digital WD1600AAJS-00M0A0	Western Digital WD1600AAJS-00M0A0
Number of disks in system	1	1
Size (GB)	160	160
Buffer size (MB)	8	8
RPM	7,200	7,200
Type	SATA	SATA
Controller	Intel Corporation ICH10R SATA 3.0Gbps Controller	Intel Corporation ICH10R SATA 3.0Gbps Controller
Operating system		
Name	SUSE Linux Enterprise Server 11	SUSE Linux Enterprise Server 11
File system	ext3	ext3
Kernel	2.6.27.19-5	2.6.27.19-5
Language	English	English
Network card/subsystem		
Vendor and model number	Intel 82576EB Gigabit Ethernet	Intel 82576EB Gigabit Ethernet
Type	Integrated	Integrated
USB ports		
Number	4	4
Type	USB 2.0	USB 2.0

Figure 7: Detailed configuration information about the test systems.

APPENDIX B – SPECint_rate_base2006 CONFIGURATION INFORMATION

```
# Invocation command line:
# /usr/cpu2006/bin/runspec --rate 16 -c
cpu2006.1.1.ic11.1.linux64.sse42.rate.jan182010.cfg --flagsurl=Intel-ic11.1-linux64-
revE.xml --define dp-nhm --define smt-on --define physicalfirst -T base -o all int
# output_root was not used for this run
############################################################################
############################################################################
# This is a sample config file. It was tested with:
#
#      Compiler name/version:       Intel Compiler 11.1
#      Operating system version:    64-Bit SUSE LINUX Enterprise Server 10 or later
#      Hardware:                    Intel processors supporting SSE4.2
#
############################################################################
# SPEC CPU2006 Intel Linux64 config file
# Sep 2009 IC 11.1 Linux64
############################################################################
action      = validate
tune        = base
ext         = cpu2006.1.1.ic11.1.linux64.sse42.rate.jan182010
PATHSEP     = /
check_md5=1
reportable=1
bench_post_setup=sync

#
# These are listed as benchmark-tuning-extension-machine
#
int=default=default=default:
CC=  icc  -m32
CXX= icpc -m32
OBJ = .o
SMARTHEAP32_DIR = /home/cmplr/usr3/alrahate/cpu2006.1.1.ic11.1/libic11.1-32bit
SMARTHEAP64_DIR = /home/cmplr/usr3/alrahate/cpu2006.1.1.ic11.1/libic11.1-64bit

fp=default=default=default:
CC=  icc   -m64
CXX= icpc  -m64
FC=  ifort -m64
OBJ = .o

# For UP systems, we need to know if the processors are ordered across cores first or in
order
# If across cores, processors 0, 1, 2 and 3 are on distinct physical cores
# Otherwise, processors 0, 2, 4 and 6 are on distinct physical cores

default:
submit       = numactl --localalloc --physcpubind=$SPECCOPYNUM $command

%ifdef %{no-numa)
submit       = taskset -c $SPECCOPYNUM $command
%endif

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

```
# Compiler options
# for Nehalem use -xSSE4.2
# for processors prior to dunnington, replace -xSSE4.1 with -xSSSE3
######################################################################
default:
SSE          = -xSSE4.2
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$(SMARTHEAP32_DIR) -lsmartheap
EXTRA_LDFLAGS= -Wl,-z,muldefs

int=base=default=default:
```

```
COPTIMIZE=    $(FAST) -opt-prefetch
CXXOPTIMIZE=  $(FASTNOSTATIC)  -opt-prefetch

fp=base=default=default:
OPTIMIZE=     $(FAST)

####################################################################
# Peak Tuning Flags int 2006 fast
####################################################################
int=peak=default:
COPTIMIZE=       -auto-ilp32 -ansi-alias
CXXOPTIMIZE=     -ansi-alias
PASS1_CFLAGS     = -prof-gen
PASS2_CFLAGS     = $(FAST) -prof-use
PASS1_CXXFLAGS   = -prof-gen
PASS2_CXXFLAGS   = $(FASTNOSTATIC) -prof-use
PASS1_LDCFLAGS   = -prof-gen
PASS2_LDCFLAGS   = $(FAST) -prof-use
PASS1_LDCXXFLAGS = -prof-gen
PASS2_LDCXXFLAGS = $(FASTNOSTATIC) -prof-use

400.perlbench=peak=default:
COPTIMIZE= -ansi-alias

401.bzip2=peak=default:
CC= icc -m64
CPORTABILITY= -DSPEC_CPU_LP64
COPTIMIZE= -opt-prefetch -ansi-alias -auto-ilp32

403.gcc=peak=default:
COPTIMIZE = $(FAST)
feedback=0

429.mcf=peak=default:
COPTIMIZE= $(FAST) -opt-prefetch
feedback=0
####################################################################################
########################################
%ifdef %{smt-on}
%ifdef %{physicallogical}
submit       = numactl --localalloc --physcpubind=`expr 2 \\* $SPECCOPYNUM` $command
%ifdef %{no-numa)
submit       = taskset -c `expr 2 \\* $SPECCOPYNUM` $command
%endif
%endif
%endif

%ifdef %{up-dale}
copies=2
%endif
%ifdef %{up-nhm}
copies=4
%endif
%ifdef %{dp-nhm}
copies=8
%endif
%ifdef %{up-wsm-6c}
```

```
copies=6
%endif
%ifdef %{dp-wsm-6c}
copies=12
%endif
##############################################################################################
##########################################

445.gobmk=peak=default:
COPTIMIZE= -O2 -ipo -no-prec-div -ansi-alias
PASS1_CFLAGS     = -prof-gen
PASS2_CFLAGS     = $(SSE) -prof-use
PASS1_LDCFLAGS   = -prof-gen
PASS2_LDCFLAGS   = $(SSE) -prof-use

456.hmmer=peak=default:
CC= icc -m64
CPORTABILITY= -DSPEC_CPU_LP64
COPTIMIZE=  $(FAST) -unroll2 -ansi-alias -auto-ilp32
feedback=no
##############################################################################################
##########################################
%ifdef %{smt-on}
%ifdef %{physicallogical}
submit       = numactl --localalloc --physcpubind=`expr 2 \\* $SPECCOPYNUM` $command
%ifdef %{no-numa)
submit       = taskset -c `expr 2 \\* $SPECCOPYNUM` $command
%endif
%endif
%endif

%ifdef %{up-dale}
copies=2
%endif
%ifdef %{up-nhm}
copies=4
%endif
%ifdef %{dp-nhm}
copies=8
%endif
%ifdef %{up-wsm-6c}
copies=6
%endif
%ifdef %{dp-wsm-6c}
copies=12
%endif
##############################################################################################
##########################################

458.sjeng=peak=default:
CC= icc -m64
CPORTABILITY= -DSPEC_CPU_LP64
COPTIMIZE= -unroll4 -auto-ilp32

462.libquantum=peak=default:
CC= icc -m64
CPORTABILITY= -DSPEC_CPU_LP64 -DSPEC_CPU_LINUX
```

```
COPTIMIZE=    $(FAST) -auto-ilp32 -opt-prefetch
feedback=no

464.h264ref=peak=default:
COPTIMIZE= -unroll2 -ansi-alias

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

473.astar=peak=default:
CXX= icpc -m64
CXXPORTABILITY= -DSPEC_CPU_LP64
EXTRA_LIBS=  -L$(SMARTHEAP64_DIR) -lsmartheap64
CXXOPTIMIZE= -ansi-alias -opt-ra-region-strategy=routine

483.xalancbmk=peak=default:
basepeak=yes

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

410.bwaves=peak=default:
OPTIMIZE=    $(FAST)  -opt-prefetch
feedback=0
#############################################################################################
#########################################
%ifdef %{smt-on}
%ifdef %{physicallogical}
submit       = numactl --localalloc --physcpubind=`expr 2 \\* $SPECCOPYNUM` $command
%ifdef %{no-numa)
submit       = taskset -c `expr 2 \\* $SPECCOPYNUM` $command
%endif
%endif
%endif

%ifdef %{up-dale}
copies=2
%endif
%ifdef %{up-nhm}
copies=4
%endif
%ifdef %{dp-nhm}
copies=8
%endif
%ifdef %{up-wsm-6c}
```

```
copies=6
%endif
%ifdef %{dp-wsm-6c}
copies=12
%endif
%ifdef %{1p-nhm-ex}
copies=8
%endif
%ifdef %{2p-nhm-ex}
copies=16
%endif
%ifdef %{4p-nhm-ex}
copies=32
%endif
################################################################################################
#########################################

416.gamess=peak=default:
OPTIMIZE= -unroll2 -Ob0 -ansi-alias -scalar-rep-
################################################################################################
#########################################
%ifdef %{smt-on}
%ifdef %{physicallogical}
submit       = numactl --localalloc --physcpubind=`expr 2 \\* $SPECCOPYNUM` $command
%ifdef %{no-numa)
submit       = taskset -c `expr 2 \\* $SPECCOPYNUM` $command
%endif
%endif
%endif

%ifdef %{up-dale}
copies=2
%endif
%ifdef %{up-nhm}
copies=4
%endif
%ifdef %{dp-nhm}
copies=8
%endif
%ifdef %{up-wsm-6c}
copies=6
%endif
%ifdef %{dp-wsm-6c}
copies=12
%endif
################################################################################################
#########################################

433.milc=peak=default:
OPTIMIZE= -fno-alias -opt-prefetch
COPTIMIZE=

434.zeusmp=peak=default:
basepeak=yes

435.gromacs=peak=default:
OPTIMIZE= -opt-prefetch
```

```
436.cactusADM=peak=default:
basepeak=yes

437.leslie3d=peak=default:
OPTIMIZE=     $(FAST)
feedback=no
################################################################################################
#########################################
%ifdef %{smt-on}
%ifdef %{physicallogical}
submit       = numactl --localalloc --physcpubind=`expr 2 \\* $SPECCOPYNUM` $command
%ifdef %{no-numa)
submit       = taskset -c `expr 2 \\* $SPECCOPYNUM` $command
%endif
%endif
%endif

%ifdef %{up-dale}
copies=2
%endif
%ifdef %{up-nhm}
copies=4
%endif
%ifdef %{dp-nhm}
copies=8
%endif
%ifdef %{up-wsm-6c}
copies=6
%endif
%ifdef %{dp-wsm-6c}
copies=12
%endif
%ifdef %{1p-nhm-ex}
copies=8
%endif
%ifdef %{2p-nhm-ex}
copies=16
%endif
%ifdef %{4p-nhm-ex}
copies=32
%endif
################################################################################################
#########################################

444.namd=peak=default:
CXXOPTIMIZE= -fno-alias -auto-ilp32

447.dealII=peak=default:
CXXOPTIMIZE= -unroll2 -ansi-alias -scalar-rep-

450.soplex=peak=default:
PORTABILITY =
CXX= icpc -m32
OPTIMIZE= -opt-malloc-options=3
CXXOPTIMIZE=
################################################################################################
#########################################
```

```
%ifdef %{smt-on}
%ifdef %{physicallogical}
submit       = numactl --localalloc --physcpubind=`expr 2 \\* $SPECCOPYNUM` $command
%ifdef %{no-numa)
submit       = taskset -c `expr 2 \\* $SPECCOPYNUM` $command
%endif
%endif
%endif

%ifdef %{up-dale}
copies=2
%endif
%ifdef %{up-nhm}
copies=4
%endif
%ifdef %{dp-nhm}
copies=8
%endif
%ifdef %{up-wsm-6c}
copies=6
%endif
%ifdef %{dp-wsm-6c}
copies=12
%endif
################################################################################################
#########################################

453.povray=peak=default:
CXXOPTIMIZE= -unroll4 -ansi-alias

454.calculix=peak=default:
basepeak=yes

459.GemsFDTD=peak=default:
OPTIMIZE= -unroll2 -Ob0
################################################################################################
#########################################
%ifdef %{smt-on}
%ifdef %{physicallogical}
submit       = numactl --localalloc --physcpubind=`expr 2 \\* $SPECCOPYNUM` $command
%ifdef %{no-numa)
submit       = taskset -c `expr 2 \\* $SPECCOPYNUM` $command
%endif
%endif
%endif

%ifdef %{up-dale}
copies=2
%endif
%ifdef %{up-nhm}
copies=4
%endif
%ifdef %{dp-nhm}
copies=8
%endif
%ifdef %{up-wsm-6c}
copies=6
```

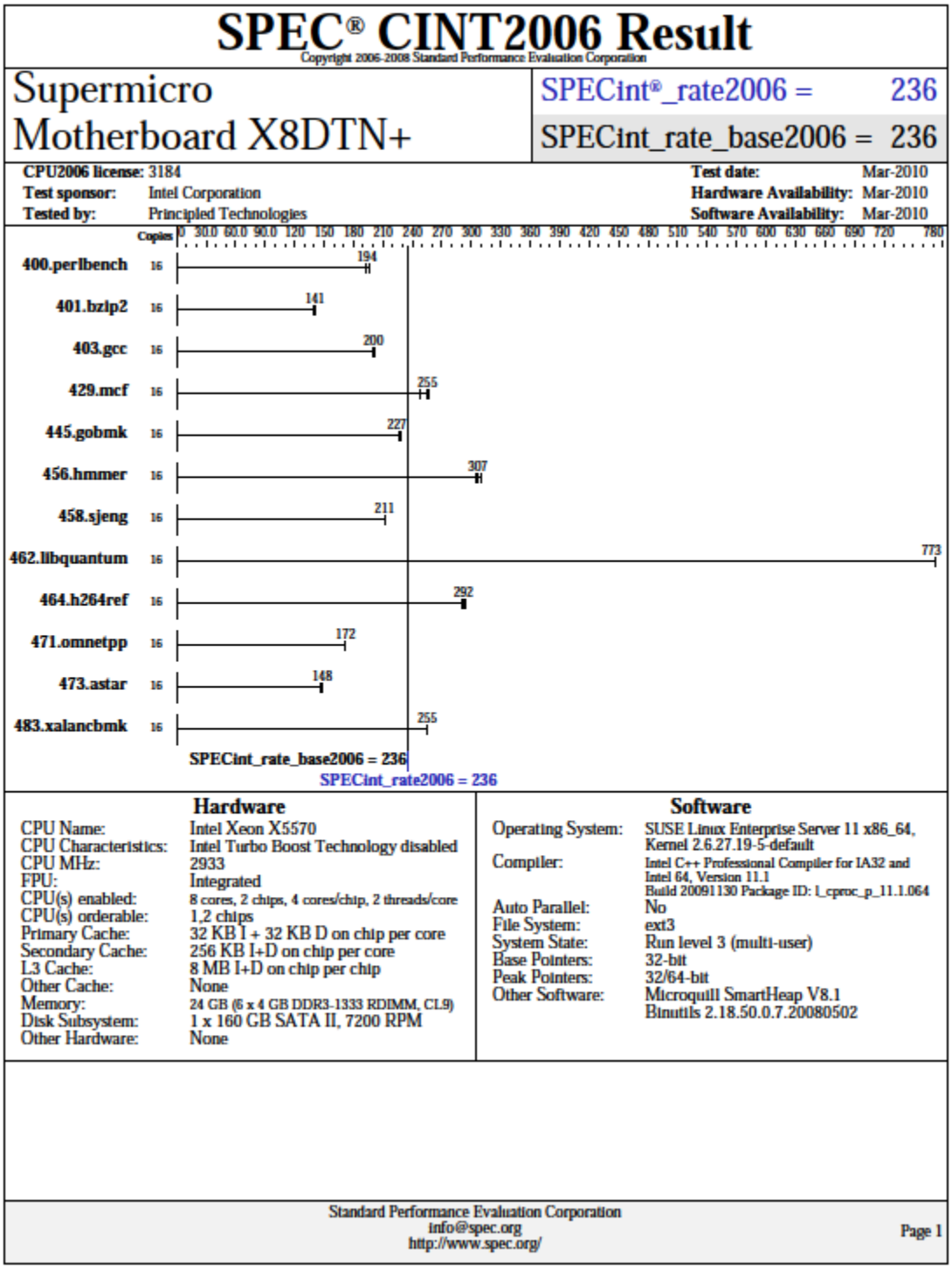
```
%endif
%ifdef %{dp-wsm-6c}
copies=12
%endif
################################################################################################
##########################################

465.tonto=peak=default:
OPTIMIZE= -unroll4 -auto -inline-calloc -opt-malloc-options=3

470.lbm=peak=default:
OPTIMIZE= -opt-malloc-options=3 -ansi-alias
################################################################################################
##########################################
%ifdef %{smt-on}
%ifdef %{physicallogical}
submit       = numactl --localalloc --physcpubind=`expr 2 \\* $SPECCOPYNUM` $command
%ifdef %{no-numa)
submit       = taskset -c `expr 2 \\* $SPECCOPYNUM` $command
%endif
%endif
%endif

%ifdef %{up-dale}
copies=2
%endif
%ifdef %{up-nhm}
copies=4
%endif
%ifdef %{dp-nhm}
copies=8
%endif
%ifdef %{up-wsm-6c}
copies=6
%endif
%ifdef %{dp-wsm-6c}
copies=12
%endif
%ifdef %{1p-nhm-ex}
copies=7
%endif
%ifdef %{2p-nhm-ex}
copies=14
%endif
%ifdef %{4p-nhm-ex}
copies=28
%endif
################################################################################################
##########################################

481.wrf=peak=default:
basepeak=yes

482.sphinx3=peak=default:
PORTABILITY=
CC= icc -m32
OPTIMIZE= $(FAST)
```

```
COPTIMIZE= -unroll2
feedback=no

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

default=default=default=default:
license_num      =
test_sponsor     =
hw_avail         =
sw_avail         =
tester           =
hw_cpu_name      =
hw_cpu_char      =
hw_cpu_mhz       =
hw_disk          =
hw_fpu           =
hw_memory        =
hw_model         =
hw_ncpuorder     =
hw_ncores        =
hw_nchips        =
hw_ncoresperchip =
hw_nthreadspercore =
hw_other         =
hw_pcache        =
hw_scache        =
hw_tcache        =
hw_ocache        =
hw_vendor        =
prepared_by      =
sw_file          =
sw_os            =
sw_state         =
notes_submit_000 = numactl was used to bind copies to the cores
%ifdef %{no-numa)
notes_submit_000 = taskset was used to bind copies to the cores
%endif

int=default=default=default:
sw_compiler000   = Intel C++ Professional Compiler for IA32 and
sw_compiler001 = Intel 64, Version 11.1
sw_compiler002   = Build 20091130 Package ID: l_cproc_p_11.1.064
sw_base_ptrsize  = 32-bit
sw_peak_ptrsize  = 32/64-bit
sw_other000      = Microquill SmartHeap V8.1
sw_other001      = Binutils 2.18.50.0.7.20080502

fp=default=default=default:
sw_compiler001   = Intel C++ and Fortran Professional Compiler for IA32 and Intel 64,
Version  11.1
sw_compiler002   = Build 20091130 Package ID: l_cproc_p_11.1.064, l_cprof_p_11.1.064
sw_base_ptrsize  = 64-bit
sw_peak_ptrsize  = 32/64-bit
sw_other001      = Binutils 2.18.50.0.7.20080502
```

```
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-ic11.1-linux64-revE.xml
```

APPENDIX C – SPECint_rate_base2006 OUTPUT FILES

Intel Xeon Processor X5570-based server



SPEC® CINT2006 Result

Copyright 2006-2008 Standard Performance Evaluation Corporation

Supermicro Motherboard X8DTN+

SPECint®_rate2006 = 236

SPECint_rate_base2006 = 236

CPU2006 license: 3184
Test sponsor: Intel Corporation
Tested by: Principled Technologies

Test date: Mar-2010
Hardware Availability: Mar-2010
Software Availability: Mar-2010

	Copies	0 30.0 60.0 90.0 120 150 180 210 240 270 300 330 360 390 420 450 480 510 540 570 600 630 660 690 720 780
400.perlbench	16	194
401.bzip2	16	141
403.gcc	16	200
429.mcf	16	255
445.gobmk	16	227
456.hmmer	16	307
458.sjeng	16	211
462.libquantum	16	773
464.h264ref	16	292
471.omnetpp	16	172
473.astar	16	148
483.xalancbmk	16	255

SPECint_rate_base2006 = 236

SPECint_rate2006 = 236

Hardware

CPU Name:	Intel Xeon X5570
CPU Characteristics:	Intel Turbo Boost Technology disabled
CPU MHz:	2933
FPU:	Integrated
CPU(s) enabled:	8 cores, 2 chips, 4 cores/chip, 2 threads/core
CPU(s) orderable:	1,2 chips
Primary Cache:	32 KB I + 32 KB D on chip per core
Secondary Cache:	256 KB I+D on chip per core
L3 Cache:	8 MB I+D on chip per chip
Other Cache:	None
Memory:	24 GB (6 x 4 GB DDR3-1333 RDIMM, CL9)
Disk Subsystem:	1 x 160 GB SATA II, 7200 RPM
Other Hardware:	None

Software

Operating System:	SUSE Linux Enterprise Server 11 x86_64, Kernel 2.6.27.19-5-default
Compiler:	Intel C++ Professional Compiler for IA32 and Intel 64, Version 11.1 Build 20091130 Package ID: l_cproc_p_11.1.064
Auto Parallel:	No
File System:	ext3
System State:	Run level 3 (multi-user)
Base Pointers:	32-bit
Peak Pointers:	32/64-bit
Other Software:	Microquill SmartHeap V8.1 Binutils 2.18.50.0.7.20080502

Standard Performance Evaluation Corporation
info@spec.org
http://www.spec.org/

Page 1

SPEC CINT2006 Result

Supermicro Motherboard X8DTN+

SPECint_rate2006 = 236

SPECint_rate_base2006 = 236

CPU2006 license: 3184
Test sponsor: Intel Corporation
Tested by: Principled Technologies

Test date: Mar-2010
Hardware Availability: Mar-2010
Software Availability: Mar-2010

Results Table

Benchmark	Base							Peak						
	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio
400.perlbench	16	810	193	**808**	**194**	796	196	16	810	193	**808**	**194**	796	196
401.bzip2	16	1108	139	**1098**	**141**	1098	141	16	1108	139	**1098**	**141**	1098	141
403.gcc	16	640	201	646	199	**644**	**200**	16	640	201	646	199	**644**	**200**
429.mcf	16	589	248	**572**	**255**	569	257	16	589	248	**572**	**255**	569	257
445.gobmk	16	**739**	**227**	742	226	737	228	16	**739**	**227**	742	226	737	228
456.hmmer	16	490	305	482	310	**487**	**307**	16	490	305	482	310	**487**	**307**
458.sjeng	16	915	212	**916**	**211**	916	211	16	915	212	**916**	**211**	916	211
462.libquantum	16	**429**	**773**	429	773	429	773	16	**429**	**773**	429	773	429	773
464.h264ref	16	1218	291	**1214**	**292**	1208	293	16	1218	291	**1214**	**292**	1208	293
471.omnetpp	16	582	172	582	172	**582**	**172**	16	582	172	582	172	**582**	**172**
473.astar	16	759	148	**759**	**148**	763	147	16	759	148	**759**	**148**	763	147
483.xalancbmk	16	**433**	**255**	434	254	433	255	16	**433**	**255**	434	254	433	255

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

Submit Notes

```
The config file option 'submit' was used.
 numactl was used to bind copies to the cores
```

Base Compiler Invocation

C benchmarks:
```
icc  -m32
```

C++ benchmarks:
```
icpc -m32
```

Base Portability Flags

```
400.perlbench: -DSPEC_CPU_LINUX_IA32
462.libquantum: -DSPEC_CPU_LINUX
483.xalancbmk: -DSPEC_CPU_LINUX
```

Base Optimization Flags

C benchmarks:
```
-xSSE4.2 -ipo -O3 -no-prec-div -static -opt-prefetch
```

Continued on next page

SPEC CINT2006 Result

Supermicro
Motherboard X8DTN+

SPECint_rate2006 = 236

SPECint_rate_base2006 = 236

CPU2006 license: 3184
Test sponsor: Intel Corporation
Tested by: Principled Technologies

Test date: Mar-2010
Hardware Availability: Mar-2010
Software Availability: Mar-2010

Base Optimization Flags (Continued)

C++ benchmarks:
-xSSE4.2 -ipo -O3 -no-prec-div -opt-prefetch -Wl,-z,muldefs
-L/home/cmplr/usr3/alrahate/cpu2006.1.1.ic11.1/libic11.1-32bit -lsmartheap

Base Other Flags

C benchmarks:

403.gcc: -Dalloca=_alloca

Peak Compiler Invocation

C benchmarks (except as noted below):
icc -m32

401.bzip2: icc -m64

456.hmmer: icc -m64

458.sjeng: icc -m64

462.libquantum: icc -m64

C++ benchmarks (except as noted below):
icpc -m32

473.astar: icpc -m64

Peak Portability Flags

400.perlbench: -DSPEC_CPU_LINUX_IA32
401.bzip2: -DSPEC_CPU_LP64
456.hmmer: -DSPEC_CPU_LP64
458.sjeng: -DSPEC_CPU_LP64
462.libquantum: -DSPEC_CPU_LP64 -DSPEC_CPU_LINUX
473.astar: -DSPEC_CPU_LP64
483.xalancbmk: -DSPEC_CPU_LINUX

Peak Optimization Flags

C benchmarks:

Continued on next page

SPEC CINT2006 Result

Supermicro Motherboard X8DTN+	SPECint_rate2006 = 236
	SPECint_rate_base2006 = 236

CPU2006 license: 3184
Test sponsor: Intel Corporation
Tested by: Principled Technologies

Test date: Mar-2010
Hardware Availability: Mar-2010
Software Availability: Mar-2010

Peak Optimization Flags (Continued)

400.perlbench: basepeak = yes
401.bzip2: basepeak = yes
403.gcc: basepeak = yes
429.mcf: basepeak = yes
445.gobmk: basepeak = yes
456.hmmer: basepeak = yes
458.sjeng: basepeak = yes
462.libquantum: basepeak = yes
464.h264ref: basepeak = yes

C++ benchmarks:

471.omnetpp: basepeak = yes
473.astar: basepeak = yes
483.xalancbmk: basepeak = yes

Peak Other Flags

Same as Base Other Flags

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 Mon Mar 15 11:03:11 2010 by SPEC CPU2006 PS/PDF formatter v6128.

Intel Xeon Processor X5670-based server

SPEC® CINT2006 Result

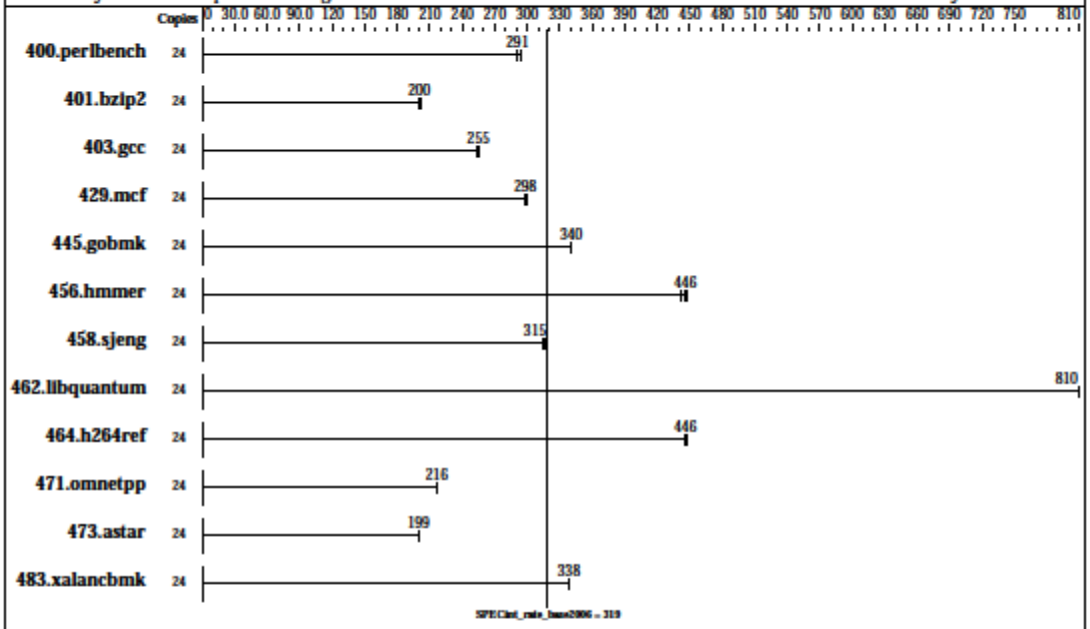
Supermicro Motherboard X8DTN+

SPECint®_rate2006 = Not Run

SPECint_rate_base2006 = 319

CPU2006 license: 3184
Test sponsor: Intel Corporation
Tested by: Principled Technologies

Test date: Mar-2010
Hardware Availability: Mar-2010
Software Availability: Mar-2010



Hardware

CPU Name:	Intel Xeon X5670
CPU Characteristics:	Intel Turbo Boost Technology disabled
CPU MHz:	2933
FPU:	Integrated
CPU(s) enabled:	12 cores, 2 chips, 6 cores/chip, 2 threads/core
CPU(s) orderable:	1,2 chips
Primary Cache:	32 KB I + 32 KB D on chip per core
Secondary Cache:	256 KB I+D on chip per core
L3 Cache:	12 MB I+D on chip per chip
Other Cache:	None
Memory:	24 GB (6 x 4 GB DDR3-1333 RDIMM, CL9)
Disk Subsystem:	1 x 160 GB SATA II, 7200 RPM
Other Hardware:	None

Software

Operating System:	SUSE Linux Enterprise Server 11 x86_64, Kernel 2.6.27.19-5-default
Compiler:	Intel C++ Professional Compiler for IA32 and Intel 64, Version 11.1 Build 20091130 Package ID: l_cproc_p_11.1.064
Auto Parallel:	No
File System:	ext3
System State:	Run level 3 (multi-user)
Base Pointers:	32-bit
Peak Pointers:	32/64-bit
Other Software:	Microquill SmartHeap V8.1 Binutils 2.18.50.0.7.20080502

SPEC CINT2006 Result

Supermicro Motherboard X8DTN+

SPECint_rate2006 = Not Run

SPECint_rate_base2006 = 319

CPU2006 license: 3184
Test sponsor: Intel Corporation
Tested by: Principled Technologies

Test date: Mar-2010
Hardware Availability: Mar-2010
Software Availability: Mar-2010

Results Table

Benchmark	Base							Peak						
	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio
400.perlbench	24	799	294	807	291	**806**	**291**							
401.bzip2	24	1158	200	**1157**	**200**	1146	202							
403.gcc	24	761	254	757	255	**758**	**255**							
429.mcf	24	732	299	**734**	**298**	735	298							
445.gobmk	24	739	341	740	340	**740**	**340**							
456.hmmer	24	**502**	**446**	500	448	506	442							
458.sjeng	24	922	315	**921**	**315**	920	316							
462.libquantum	24	**614**	**810**	614	810	614	809							
464.h264ref	24	1192	446	1188	447	**1191**	**446**							
471.omnetpp	24	693	216	692	217	**693**	**216**							
473.astar	24	844	200	**845**	**199**	845	199							
483.xalancbmk	24	490	338	488	339	**490**	**338**							

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

Submit Notes

```
The config file option 'submit' was used.
 numactl was used to bind copies to the cores
```

Base Compiler Invocation

C benchmarks:
```
icc  -m32
```

C++ benchmarks:
```
icpc -m32
```

Base Portability Flags

400.perlbench: -DSPEC_CPU_LINUX_IA32
462.libquantum: -DSPEC_CPU_LINUX
483.xalancbmk: -DSPEC_CPU_LINUX

Base Optimization Flags

C benchmarks:
```
-xSSE4.2 -ipo -O3 -no-prec-div -static -opt-prefetch
```

Continued on next page

SPEC CINT2006 Result

Supermicro
Motherboard X8DTN+

SPECint_rate2006 = Not Run

SPECint_rate_base2006 = 319

CPU2006 license: 3184
Test sponsor: Intel Corporation
Tested by: Principled Technologies

Test date: Mar-2010
Hardware Availability: Mar-2010
Software Availability: Mar-2010

Base Optimization Flags (Continued)

C++ benchmarks:
-xSSE4.2 -ipo -O3 -no-prec-div -opt-prefetch -Wl,-z,muldefs
-L/home/cmplr/usr3/alrahate/cpu2006.1.1.ic11.1/libic11.1-32bit -lsmartheap

Base Other Flags

C benchmarks:

403.gcc: -Dalloca=_alloca

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 Wed Mar 10 14:33:37 2010 by SPEC CPU2006 PS/PDF formatter v6128.

ABOUT PRINCIPLED TECHNOLOGIES

Principled Technologies, Inc.
1007 Slater Road, Suite 250
Durham, NC, 27703
www.principledtechnologies.com

We provide industry-leading fact-based marketing and technology assessment services that help technology vendors and buyers understand the real differences among products. We bring to every assignment extensive experience with and expertise in all aspects of technology marketing, testing, and analysis; from researching new technologies, to developing new methodologies, to testing with existing and new tools, to delivering the results in whatever form best communicates them.

When the assessment is complete, we know how to present the results to a broad range of target audiences. We provide our clients with the materials they need, from market-focused data to use in their own collateral to custom sales aids, such as test reports, performance assessments, white papers, PowerPoint presentations, and videos. Every piece of collateral reflects the results of our trusted independent analysis.

We customize our services to focus on each client's requirements. Whether the technology involves hardware, software, Web sites, or services, we offer the experience, expertise, and tools to assess how it will fare against its competition and to highlight its strengths.

Our founders, Mark L. Van Name and Bill Catchings, have worked together in technology assessment for 25 years. As journalists, they published over a thousand articles on a wide array of technology subjects. They created and led the Ziff-Davis Benchmark Operation, which developed such industry-standard benchmarks as Ziff Davis Media's Winstone and WebBench. They founded and led eTesting Labs, and after the acquisition of that company by Lionbridge Technologies were the head and CTO of VeriTest.