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.
**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](http://www.spec.org).)

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

*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.

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

Figure 2: System configuration information for the two systems.

WHAT WE FOUND

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 3: Normalized SPECint_rate_base2006 performance/watt 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.

![SPECint_base_rate2006 results](image)

Figure 4: SPECint_rate_base2006 results for the two servers. Higher 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.

![SPECint_rate_base2006 power results](image)

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

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.

<table>
<thead>
<tr>
<th>Server</th>
<th>SPECint_rate_base 2006 results</th>
<th>Idle power</th>
<th>Peak power</th>
<th>User count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intel Xeon Processor X5570-based server</td>
<td>236</td>
<td>153.8</td>
<td>351.6</td>
<td>16</td>
</tr>
<tr>
<td>Intel Xeon Processor X5670-based server</td>
<td>319</td>
<td>157.7</td>
<td>368.6</td>
<td>24</td>
</tr>
</tbody>
</table>

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:

```bash
./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 "*****************************************************************************
Running rate with $a copies on a NHM system with a topology of $b
*****************************************************************************"
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.

<table>
<thead>
<tr>
<th>Servers</th>
<th>Intel Xeon Processor X5570-based server</th>
<th>Intel Xeon Processor X5670-based server</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Power supplies</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total number</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Wattage of each (W)</td>
<td>885</td>
<td>885</td>
</tr>
<tr>
<td><strong>Cooling fans</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total number</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Dimensions (h x w) of each</td>
<td>3” x 3”</td>
<td>3” x 3”</td>
</tr>
<tr>
<td><strong>General processor setup</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of processor packages</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Number of cores per processor package</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Number of hardware threads per core</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>CPU</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vendor</td>
<td>Intel</td>
<td>Intel</td>
</tr>
<tr>
<td>Name</td>
<td>Xeon X5570</td>
<td>Xeon X5670</td>
</tr>
<tr>
<td>Stepping</td>
<td>D0</td>
<td>C0</td>
</tr>
<tr>
<td>Socket type</td>
<td>LGA1366</td>
<td>LGA1366</td>
</tr>
<tr>
<td>Core frequency (GHz)</td>
<td>2.93</td>
<td>2.93</td>
</tr>
<tr>
<td>Bus frequency</td>
<td>6.4 GT/s</td>
<td>6.4 GT/s</td>
</tr>
<tr>
<td>L1 cache (KB)</td>
<td>32 + 32 (per core)</td>
<td>32 + 32 (per core)</td>
</tr>
<tr>
<td>L2 cache (KB)</td>
<td>256 KB (per core)</td>
<td>256 KB (per core)</td>
</tr>
<tr>
<td>L3 cache (MB)</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>Thermal design power (TDP, in watts)</td>
<td>95</td>
<td>95</td>
</tr>
<tr>
<td><strong>Platform</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vendor and model number</td>
<td>Supermicro SuperServer 6026T-NTR+</td>
<td>Supermicro SuperServer 6026T-NTR+</td>
</tr>
<tr>
<td>Motherboard model number</td>
<td>Super X8DTN+</td>
<td>Super X8DTN+</td>
</tr>
<tr>
<td>Motherboard chipset</td>
<td>Intel 5520</td>
<td>Intel 5520</td>
</tr>
<tr>
<td>BIOS name and version</td>
<td>American Megatrends 4.6.3.2 (01/06/2010)</td>
<td>American Megatrends 4.6.3.2 (01/06/2010)</td>
</tr>
<tr>
<td>BIOS settings</td>
<td>All default settings except Turbo mode disabled</td>
<td>All default settings except Turbo mode disabled</td>
</tr>
<tr>
<td><strong>Memory modules</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total RAM in system (GB)</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Intel Xeon Processor X5570-based server</td>
<td>Intel Xeon Processor X5670-based server</td>
</tr>
<tr>
<td>------------------</td>
<td>----------------------------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Number of types of memory modules</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Speed in the system currently running @ (MHz)</td>
<td>1,333</td>
<td>1,333</td>
</tr>
<tr>
<td>Timing/Latency (tCL-tRCD-iRP-tRASmin)</td>
<td>9-9-9-24</td>
<td>9-9-9-24</td>
</tr>
<tr>
<td>Vendor and model number</td>
<td>MT36JSZF51272PY</td>
<td>MT36JSZF51272PY</td>
</tr>
<tr>
<td>Type</td>
<td>PC3-10600R</td>
<td>PC3-10600R</td>
</tr>
<tr>
<td>Speed (MHz)</td>
<td>1,333</td>
<td>1,333</td>
</tr>
<tr>
<td>Speed in the system currently running @ (MHz)</td>
<td>1,333</td>
<td>1,333</td>
</tr>
<tr>
<td>Timing/Latency (tCL-tRCD-iRP-tRASmin)</td>
<td>9-9-9-24</td>
<td>9-9-9-24</td>
</tr>
<tr>
<td>Size (GB)</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Number of RAM modules</td>
<td>6 x 4GB</td>
<td>6 x 4GB</td>
</tr>
<tr>
<td>Chip organization</td>
<td>Double-sided</td>
<td>Double-sided</td>
</tr>
</tbody>
</table>

**Hard disk**

<table>
<thead>
<tr>
<th></th>
<th>Intel Xeon Processor X5570-based server</th>
<th>Intel Xeon Processor X5670-based server</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vendor and model number</td>
<td>Western Digital WD1600AAJS-00M0A0</td>
<td>Western Digital WD1600AAJS-00M0A0</td>
</tr>
<tr>
<td>Number of disks in system</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Size (GB)</td>
<td>160</td>
<td>160</td>
</tr>
<tr>
<td>Buffer size (MB)</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>RPM</td>
<td>7,200</td>
<td>7,200</td>
</tr>
<tr>
<td>Type</td>
<td>SATA</td>
<td>SATA</td>
</tr>
<tr>
<td>Controller</td>
<td>Intel Corporation ICH10R SATA 3.0Gbps Controller</td>
<td>Intel Corporation ICH10R SATA 3.0Gbps Controller</td>
</tr>
</tbody>
</table>

**Operating system**

<table>
<thead>
<tr>
<th></th>
<th>Intel Xeon Processor X5570-based server</th>
<th>Intel Xeon Processor X5670-based server</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>SUSE Linux Enterprise Server 11</td>
<td>SUSE Linux Enterprise Server 11</td>
</tr>
<tr>
<td>File system</td>
<td>ext3</td>
<td>ext3</td>
</tr>
<tr>
<td>Kernel</td>
<td>2.6.27.19-5</td>
<td>2.6.27.19-5</td>
</tr>
<tr>
<td>Language</td>
<td>English</td>
<td>English</td>
</tr>
</tbody>
</table>

**Network card/subsystem**

<table>
<thead>
<tr>
<th></th>
<th>Intel Xeon Processor X5570-based server</th>
<th>Intel Xeon Processor X5670-based server</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vendor and model number</td>
<td>Intel 82576EB Gigabit Ethernet</td>
<td>Intel 82576EB Gigabit Ethernet</td>
</tr>
<tr>
<td>Type</td>
<td>Integrated</td>
<td>Integrated</td>
</tr>
</tbody>
</table>

**USB ports**

<table>
<thead>
<tr>
<th></th>
<th>Intel Xeon Processor X5570-based server</th>
<th>Intel Xeon Processor X5670-based server</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Type</td>
<td>USB 2.0</td>
<td>USB 2.0</td>
</tr>
</tbody>
</table>

*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
# This is a sample config file. It was tested with:
# 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
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=SPECOPYNUM $command

%ifdef %{no-numa}
submit = taskset -c $SPECOPYNUM $command
%endif

# Invocation command line:
# Compiler options
# for Nehalem use -xSSE4.2
# for processors prior to dunnington, replace -xSSE4.1 with -xSSSE3
# Compiler options
default:
SSE = -xSSE4.2
FAST = $(SSE) -ipo -03 -no-prec-div -static
FASTNOSTATIC = $(SSE) -ipo -03 -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 = $(FAST) -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
%endif %{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}
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) -unroll12 -ansi-alias -auto-ilp32
feedback=no

458.sjeng=peak=default:
CC= icc -m64
CPORTABILITY= -DSPEC_CPU_LP64

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

Intel server processors: Performance-per-watt comparison
Intel server processors: Performance-per-watt comparison

A Principled Technologies Test Report 14
Intel server processors: Performance-per-watt comparison

A Principled Technologies Test Report
Intel server processors: Performance-per-watt comparison

A Principled Technologies Test Report 16
%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

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_nthreadsperecore =
hw_other =
hw_pcach =
hw_scach =
hw_tcach =
hw_ocach =
hw_vendor =
prepared_by =
sw_file =
sw_os =
sw_state =
notes_submit_000 = numactl was used to bind copies to the cores
%ifdef %{no-
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:

flagsur1000 = Intel-ic11.1-linux64-revE.xml
APPENDIX C – SPECint_rate_base2006 OUTPUT FILES

Intel Xeon Processor X5570-based server

Intel server processors: Performance-per-watt comparison

A Principled Technologies Test Report
SPEC CINT2006 Result

Supermicro Motherboard X8DTN+

SPECint_rate2006 = 236
SPECint_rate_base2006 = 236

Results Table

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Copies</th>
<th>Seconds</th>
<th>Ratio</th>
<th>Seconds</th>
<th>Ratio</th>
<th>Seconds</th>
<th>Ratio</th>
<th>Copies</th>
<th>Seconds</th>
<th>Ratio</th>
<th>Seconds</th>
<th>Ratio</th>
<th>Seconds</th>
<th>Ratio</th>
<th>Seconds</th>
<th>Ratio</th>
<th>Seconds</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>400.perfbench</td>
<td>16</td>
<td>810</td>
<td>100</td>
<td>796</td>
<td>100</td>
<td>796</td>
<td>100</td>
<td>16</td>
<td>810</td>
<td>100</td>
<td>796</td>
<td>100</td>
<td>796</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>403.gcc</td>
<td>16</td>
<td>640</td>
<td>100</td>
<td>640</td>
<td>100</td>
<td>640</td>
<td>100</td>
<td>16</td>
<td>640</td>
<td>100</td>
<td>640</td>
<td>100</td>
<td>640</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>429.nmcf</td>
<td>16</td>
<td>589</td>
<td>248</td>
<td>589</td>
<td>248</td>
<td>589</td>
<td>248</td>
<td>16</td>
<td>589</td>
<td>248</td>
<td>589</td>
<td>248</td>
<td>589</td>
<td>248</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>445.gobmk</td>
<td>16</td>
<td>726</td>
<td>237</td>
<td>726</td>
<td>237</td>
<td>726</td>
<td>237</td>
<td>16</td>
<td>726</td>
<td>237</td>
<td>726</td>
<td>237</td>
<td>726</td>
<td>237</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>456.hmmer</td>
<td>16</td>
<td>496</td>
<td>310</td>
<td>496</td>
<td>310</td>
<td>496</td>
<td>310</td>
<td>16</td>
<td>496</td>
<td>310</td>
<td>496</td>
<td>310</td>
<td>496</td>
<td>310</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>458.sjeng</td>
<td>16</td>
<td>915</td>
<td>212</td>
<td>915</td>
<td>212</td>
<td>915</td>
<td>212</td>
<td>16</td>
<td>915</td>
<td>212</td>
<td>915</td>
<td>212</td>
<td>915</td>
<td>212</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>462.libquantm</td>
<td>16</td>
<td>429</td>
<td>773</td>
<td>429</td>
<td>773</td>
<td>429</td>
<td>773</td>
<td>16</td>
<td>429</td>
<td>773</td>
<td>429</td>
<td>773</td>
<td>429</td>
<td>773</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>464.h264ref</td>
<td>16</td>
<td>1214</td>
<td>291</td>
<td>1214</td>
<td>291</td>
<td>1214</td>
<td>291</td>
<td>16</td>
<td>1214</td>
<td>291</td>
<td>1214</td>
<td>291</td>
<td>1214</td>
<td>291</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>471.omnetpp</td>
<td>16</td>
<td>582</td>
<td>172</td>
<td>582</td>
<td>172</td>
<td>582</td>
<td>172</td>
<td>16</td>
<td>582</td>
<td>172</td>
<td>582</td>
<td>172</td>
<td>582</td>
<td>172</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>483.xalanckm</td>
<td>16</td>
<td>453</td>
<td>223</td>
<td>453</td>
<td>223</td>
<td>453</td>
<td>223</td>
<td>16</td>
<td>453</td>
<td>223</td>
<td>453</td>
<td>223</td>
<td>453</td>
<td>223</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Submit Notes
The config file option ‘submit’ was used.
numacl was used to bind copies to the cores

Base Compiler Invocation

C benchmarks:
1cc -m32

C++ benchmarks:
1cpc -m32

Base Portability Flags

400.perfbench: -DSPEC_CPU_LINUX_IA32
402.libquantm: -DSPEC_CPU_LINUX
483.xalanckm: -DSPEC_CPU_LINUX

Base Optimization Flags

C benchmarks:
-xxSBSE4.2 -ipo -o3 -no-prec-div -static -opt-prefetch

Continued on next page

Standard Performance Evaluation Corporation
info@spec.org
http://www.spec.org/
## SPEC CINT2006 Result

<table>
<thead>
<tr>
<th>Supermicro Motherboard X8DTN+</th>
<th>SPECint_rate2006 = 236</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU2006 license: 3181</td>
<td>Test date: Mar-2010</td>
</tr>
<tr>
<td>Test sponsor: Intel Corporation</td>
<td>Hardware Availability: Mar-2010</td>
</tr>
<tr>
<td>Tested by: Principled Technologies</td>
<td>Software Availability: Mar-2010</td>
</tr>
</tbody>
</table>

### Base Optimization Flags (Continued)

C++ benchmarks:
- `xSSI84.2 -ipo -O3 -no-prec-div -opt-prefetch -Wl,-z,muldefs -L/home/cmplr/usr3/alrahate/cpu2006.1.1.1c11.1/libc11.1-32bit -lmsartheap`

### 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.xalanc.bmk: -DSPEC_CPU_LINUX`

### Peak Optimization Flags

C benchmarks:

---

Intel server processors: Performance-per-watt comparison

A Principled Technologies Test Report 23
### SPEC CINT2006 Result

<table>
<thead>
<tr>
<th>Motherboard X8DTN+</th>
<th>SPECint_rate2006 = 236</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SPECint_rate_base2006 = 236</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CPU2006 license: 3181</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test sponsor: Intel Corporation</td>
</tr>
<tr>
<td>Tested by: Principled Technologies</td>
</tr>
</tbody>
</table>

#### Peak Optimization Flags (Continued)

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Flag</th>
<th>Optimization</th>
</tr>
</thead>
<tbody>
<tr>
<td>400.perfbench</td>
<td>basepeak</td>
<td>yes</td>
</tr>
<tr>
<td>401.bzip2</td>
<td>basepeak</td>
<td>yes</td>
</tr>
<tr>
<td>403.gcc</td>
<td>basepeak</td>
<td>yes</td>
</tr>
<tr>
<td>429.mcf</td>
<td>basepeak</td>
<td>yes</td>
</tr>
<tr>
<td>445.gobmk</td>
<td>basepeak</td>
<td>yes</td>
</tr>
<tr>
<td>456.hmmer</td>
<td>basepeak</td>
<td>yes</td>
</tr>
<tr>
<td>458.sjeng</td>
<td>basepeak</td>
<td>yes</td>
</tr>
<tr>
<td>462.libquantum</td>
<td>basepeak</td>
<td>yes</td>
</tr>
<tr>
<td>464.hmmer64ref</td>
<td>basepeak</td>
<td>yes</td>
</tr>
</tbody>
</table>

**C++ benchmarks:**

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Flag</th>
<th>Optimization</th>
</tr>
</thead>
<tbody>
<tr>
<td>471.omnetpp</td>
<td>basepeak</td>
<td>yes</td>
</tr>
<tr>
<td>473.astir</td>
<td>basepeak</td>
<td>yes</td>
</tr>
<tr>
<td>483.xalancbmk</td>
<td>basepeak</td>
<td>yes</td>
</tr>
</tbody>
</table>

#### Peak Other Flags

Same as Base Other Flags

---

SPEC and SPECint are registered trademarks of the Standard Performance Evaluation Corporation. All other brand and product names appearing in this result are trademarks or registered trademarks of their respective holders.

For questions about this result, please contact the tester.

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

Tested with SPEC CPU2006 v1.1.

### Intel Xeon Processor X5670-based server

**SPEC® CINT2006 Result**

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Specint Rate2006</th>
<th>Specint Base2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>400.perlbench</td>
<td>291</td>
<td></td>
</tr>
<tr>
<td>401.bzip2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>403.gcc</td>
<td>225</td>
<td></td>
</tr>
<tr>
<td>429.mcf</td>
<td>306</td>
<td></td>
</tr>
<tr>
<td>445.gobmk</td>
<td>340</td>
<td></td>
</tr>
<tr>
<td>456.hmmer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>458.sjeng</td>
<td></td>
<td></td>
</tr>
<tr>
<td>462.libquantum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>461.h264ref</td>
<td></td>
<td></td>
</tr>
<tr>
<td>471.omnetpp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>473.astar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>483.xalancbmk</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Hardware**

- **CPU Name:** Intel Xeon X5670
- **CPU Characteristics:** Intel Turbo Boost Technology disabled
- **CPU MHz:** 2933
- **FPU:** Integrated
- **CPU(s) installed:** 12 cores, 24 hyperthreads
- **CPU(s) orderable:** 12 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 (8 x 4 GB DDR3-1333 RDIMM, CL9)
- **Disk Subsystem:** 1.160 GB SATA II, 7200 RPM
- **Other Hardware:** None

**Software**

- **Operating System:** SUSE Linux Enterprise Server 11 x86_64, kernel 2.6.27.10-5-default
- **Compiler:** Intel C++ Professional Compiler for IA32 and Intel 64, Version 11.1
- **Auto Parallel:** No
- **File System:** ext3
- **System State:** Run level 3 (multi-user)
- **Resource:** 32-bit
- **Peak Resource:** 264-bit
- **Other Software:** Microquilt SmartHeap V8.1
  - Binutils 2.18.50.0.7.20080502

---

Intel server processors: Performance-per-watt comparison

A Principled Technologies Test Report 25
SPEC CINT2006 Result

Supermicro
Motherboard X8DTN+

SPECint_rate2006 = Not Run
SPECint_rate_base2006 = 319

CPU2006 license: 3181
Test sponsor: Intel Corporation
Tested by: Principled Technologies

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Copies</th>
<th>Seconds</th>
<th>Ratio</th>
<th>Seconds</th>
<th>Ratio</th>
<th>Seconds</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>400.perbench</td>
<td>24</td>
<td>780</td>
<td>24</td>
<td>807</td>
<td>231</td>
<td>806</td>
<td>231</td>
</tr>
<tr>
<td>401.harpoon</td>
<td>24</td>
<td>1158</td>
<td>31</td>
<td>1187</td>
<td>311</td>
<td>1146</td>
<td>202</td>
</tr>
<tr>
<td>403.gcc</td>
<td>24</td>
<td>761</td>
<td>254</td>
<td>757</td>
<td>255</td>
<td>730</td>
<td>235</td>
</tr>
<tr>
<td>429.mcf</td>
<td>24</td>
<td>732</td>
<td>298</td>
<td>734</td>
<td>298</td>
<td>732</td>
<td>298</td>
</tr>
<tr>
<td>445.gobmk</td>
<td>24</td>
<td>739</td>
<td>341</td>
<td>740</td>
<td>340</td>
<td>729</td>
<td>340</td>
</tr>
<tr>
<td>456.hmmer</td>
<td>24</td>
<td>502</td>
<td>445</td>
<td>500</td>
<td>448</td>
<td>506</td>
<td>442</td>
</tr>
<tr>
<td>458.sjeng</td>
<td>24</td>
<td>922</td>
<td>315</td>
<td>921</td>
<td>313</td>
<td>902</td>
<td>316</td>
</tr>
<tr>
<td>462.libquantm</td>
<td>24</td>
<td>811</td>
<td>318</td>
<td>810</td>
<td>319</td>
<td>810</td>
<td>319</td>
</tr>
<tr>
<td>464.h264ref</td>
<td>24</td>
<td>1192</td>
<td>445</td>
<td>1188</td>
<td>447</td>
<td>1191</td>
<td>446</td>
</tr>
<tr>
<td>471.omnetpp</td>
<td>24</td>
<td>693</td>
<td>216</td>
<td>692</td>
<td>217</td>
<td>693</td>
<td>216</td>
</tr>
<tr>
<td>473.astar</td>
<td>24</td>
<td>844</td>
<td>200</td>
<td>845</td>
<td>196</td>
<td>845</td>
<td>199</td>
</tr>
<tr>
<td>483.xalanxmlk</td>
<td>24</td>
<td>490</td>
<td>338</td>
<td>488</td>
<td>339</td>
<td>490</td>
<td>339</td>
</tr>
</tbody>
</table>

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.perbench: -DSPEC_CPU_LINUX_IA32
462.libquantm: -DSPEC_CPU_LINUX
483.xalanxmlk: -DSPEC_CPU_LINUX

Base Optimization Flags
C benchmarks:
  -xSSE4.2 -ipo -O3 -no-prec-div -static -opt-prefetch

Continued on next page

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

Page 2
SPEC CINT2006 Result

Supermicro Motherboard X8DTN+

SPECint_rate2006 = Not Run
SPECint_rate_base2006 = 319

CPU2006 license: 3181
Test sponsor: Intel Corporation
Tested by: Principled Technologies

Hardware Availability: Mar-2010
Software Availability: Mar-2010

Base Optimization Flags (Continued)

C++ benchmarks:
-xSSE4.2 -ipo -03 -no-prec-div -opt-prefetch -Wl,-z,muldefs

Base Other Flags

C benchmarks:
403gcc: -Dalloca=alloca

SPEC and SPECint are registered trademarks of the Standard Performance Evaluation Corporation. All other brand and product names appearing in this result are trademarks or registered trademarks of their respective holders.

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

Tested with SPEC CPU2006 v1.1.

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

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.

---

Principled Technologies is a registered trademark of Principled Technologies, Inc.
All other product names are the trademarks of their respective owners.

Disclaimer of Warranties; Limitation of Liability:
PRINCIPLED TECHNOLOGIES, INC. HAS MADE REASONABLE EFFORTS TO ENSURE THE ACCURACY AND VALIDITY OF ITS TESTING, HOWEVER, PRINCIPLED TECHNOLOGIES, INC. SPECIFICALLY DISCLAIMS ANY WARRANTY, EXPRESSED OR IMPLIED, RELATING TO THE TEST RESULTS AND ANALYSIS, THEIR ACCURACY, COMPLETENESS OR QUALITY, INCLUDING ANY IMPLIED WARRANTY OF FITNESS FOR ANY PARTICULAR PURPOSE. ALL PERSONS OR ENTITIES RELYING ON THE RESULTS OF ANY TESTING DO SO AT THEIR OWN RISK, AND AGREE THAT PRINCIPLED TECHNOLOGIES, INC., ITS EMPLOYEES AND ITS SUBCONTRACTORS SHALL HAVE NO LIABILITY WHATSOEVER FROM ANY CLAIM OF LOSS OR DAMAGE ON ACCOUNT OF ANY ALLEGED ERROR OR DEFECT IN ANY TESTING PROCEDURE OR RESULT.

IN NO EVENT SHALL PRINCIPLED TECHNOLOGIES, INC. BE LIABLE FOR INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH ITS TESTING, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. IN NO EVENT SHALL PRINCIPLED TECHNOLOGIES, INC.’S LIABILITY, INCLUDING FOR DIRECT DAMAGES, EXCEED THE AMOUNTS PAID IN CONNECTION WITH PRINCIPLED TECHNOLOGIES, INC.’S TESTING. CUSTOMER’S SOLE AND EXCLUSIVE REMEDIES ARE AS SET FORTH HEREIN.