A PERFORMANCE COMPARISON OF DELL AND HP WORKSTATIONS

Dell™ workstations powered by the Intel® Xeon® processor family:

Better performance improves the user experience

versus comparable HP workstations with AMD workstation processors

Workers can be only as productive as their tools allow them to be. On a sluggish system, the most basic office tasks can become exercises in frustration, lowering user productivity and morale.

Principled Technologies ran a series of industry-standard benchmarks to measure system performance. We tested two Dell workstations powered by 2nd generation Intel Xeon processors, a mid-range Dell Precision™ T3500 and a high-end Dell Precision T7500, and two HP workstations powered by AMD processors, a mid-range HP Pavilion Elite HPE-500z and a high-end HP Pavilion Elite HPE-560z.

The Intel Xeon processor-based Dell systems consistently delivered higher benchmark scores—as much as 98.0 percent higher—than the corresponding HP Pavilion systems, making Dell a great choice for productivity in the workplace.

MAY 2011

A PRINCIPLED TECHNOLOGIES TEST REPORT

Commissioned by Dell Inc.

DELL AND INTEL DELIVER PERFORMANCE

Responsive performance enhances worker productivity. That's why, when choosing desktop systems for the workplace, it makes sense to purchase systems powerful enough to execute tasks quickly and efficiently.

In our tests, we found that the Intel Xeon processor-based Dell Precision T3500 and Dell OptiPlex 990 delivered considerably better performance than comparable AMD processor-based HP systems—enough to improve performance by up to 98.0 percent. (To learn more about the systems we tested, see Appendix A. To learn more about how we tested, see Appendix B.)

SYSmark 2007 Preview v1.06 measures system performance in four workload scenarios: e-learning, office productivity, video creation, and 3D modeling. Figure 1 shows the SYSmark 2007 Preview performance for four workstations. The Dell Precision T3500, with a score of 160, outperformed the HP Pavilion Elite HPE-500z (which had a score of 152) by 5.3 percent. The Dell Precision T7500's score of 282 was 45.4 percent higher than the HP Pavilion Elite HPE-560z score of 194.

MAXON CINEBENCH consists of two main components. The first test sequence targets the computer's main processor. CINEBENCH plays a scene that makes use of various CPU-intensive features. During the first run, the benchmark uses only one CPU or CPU core to determine a reference value. On computers that have multiple CPUs or cores, CINEBENCH runs a second test using all available CPU power. The benchmark produces a single-CPU score for all computers, and a multiple-CPU score for those computers with multiple cores.

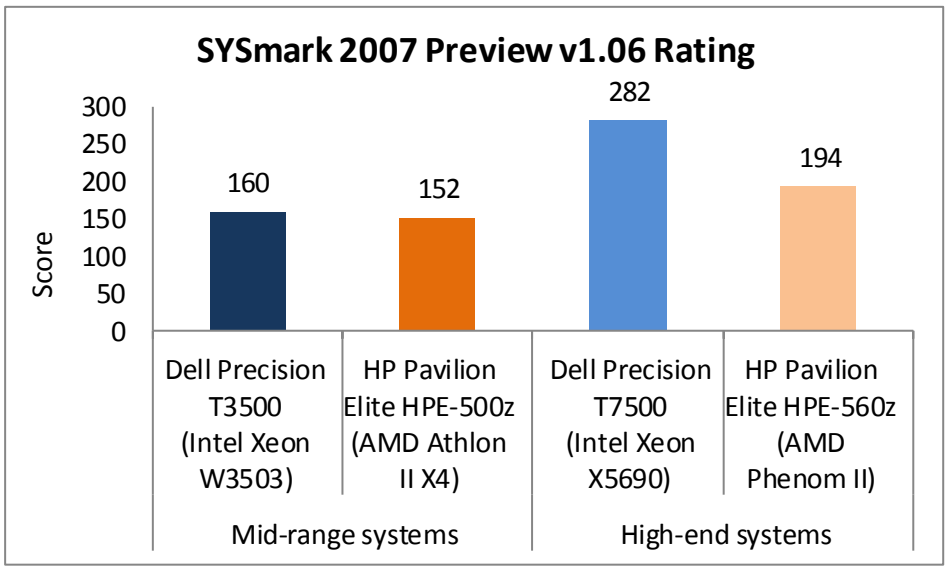


Figure 1: SYSmark 2007 Preview productivity results for our test systems. Higher numbers are better.

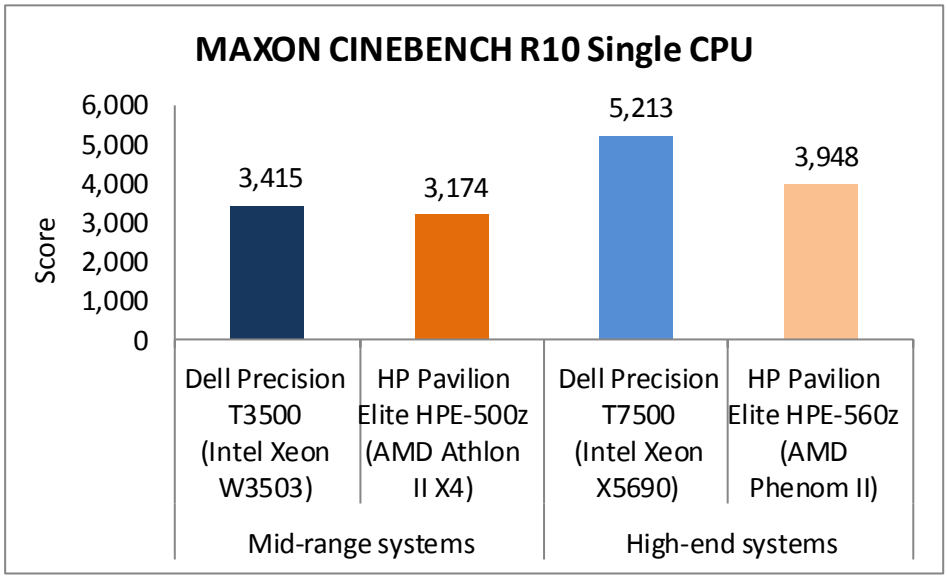


Figure 2: CINEBENCH R10 single-CPU test results for our test systems. Higher numbers are better.

As Figure 2 shows, the Dell Precision T3500, with a single-CPU score of 3,415, outperformed the HP Pavilion Elite HPE-500z (which had a score of 3,174) by 7.6 percent. The Dell Precision T7500's single-CPU score of 5,213 was 32.0 percent higher than the HP Pavilion Elite HPE-560z score of 3,948.

As Figure 3 shows, the dual-core Dell Precision T3500, with a multiple-CPU score of 6,686, underperformed the quad-core HP Pavilion Elite HPE-500z (which had a score of 10,879) by 38.5 percent. However, given that the Intel Xeon W3503 has half as many cores as the AMD Athlon II X4, the Dell Precision T3500 competes well with the AMD-based HP Pavilion Elite HPE-500z. The two systems' scores on the CINEBENCH single-CPU test also show this; the Dell Precision T3500 outperforms the HP Pavilion Elite HPE-500z by almost 8 percent in a core-to-core comparison. The six-core Dell Precision T7500's multiple-CPU score of 28,175 was 54.1 percent higher than the six-core HP Pavilion Elite HPE-560z score of 18,283.

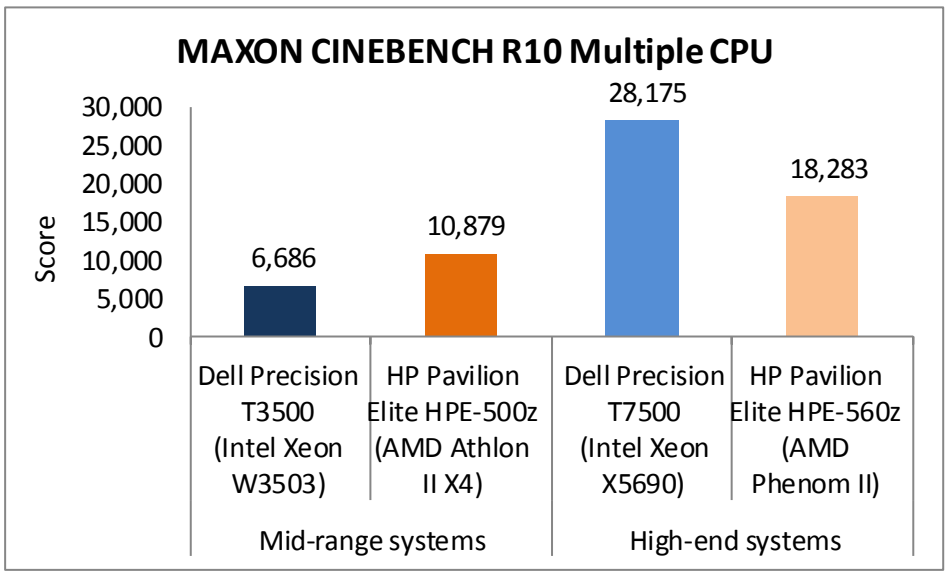


Figure 3: CINEBENCH R10 multiple-CPU test results for our test systems. Higher numbers are better.

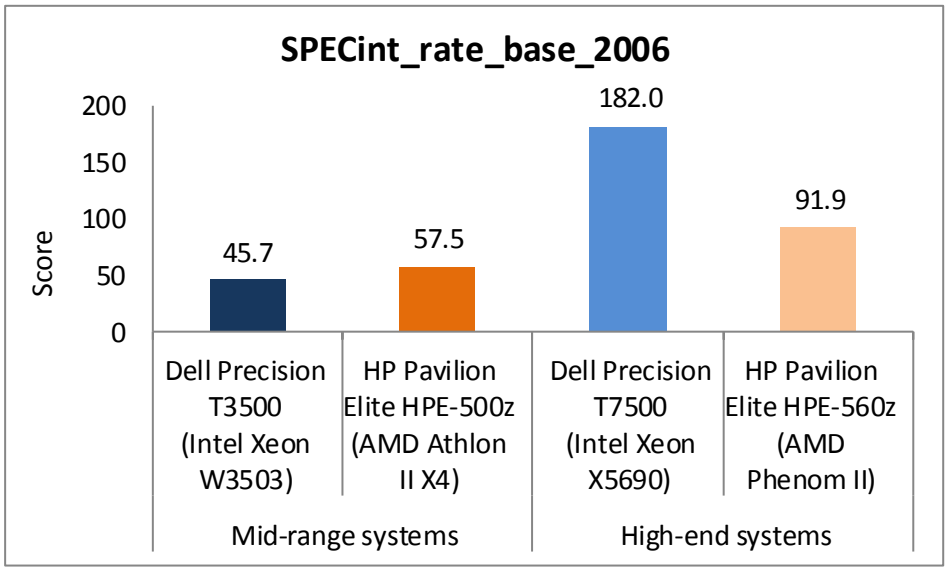


Figure 4: SPECint_rate_base_2006 test results for our test systems. Higher numbers are better.

As Figure 4 shows, the Dell Precision T3500, with a SPECint score of 45.7, underperformed the HP Pavilion Elite HPE-500z (which had a score of 57.5) by 20.5 percent. The Dell Precision T7500's SPECint score of 182.0 was 98.0 percent higher than the HP Pavilion Elite HPE-560z score of 91.9.

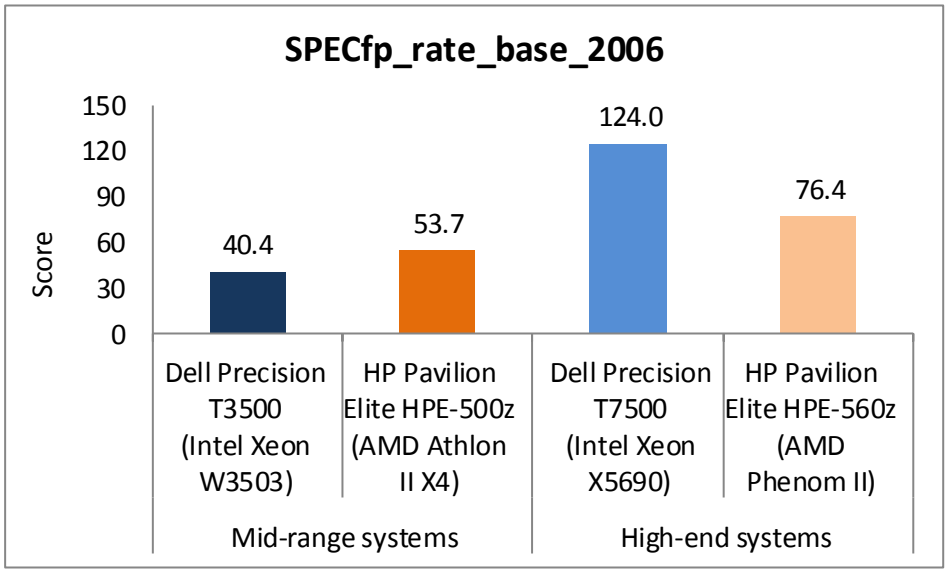


Figure 5: SPECfp_rate_base_2006 test results for our test systems. Higher numbers are better.

As Figure 5 shows, the Dell Precision T3500, with a SPECfp score of 40.4, underperformed the HP Pavilion Elite HPE-500z (which had a score of 53.7) by 24.8 percent. The Dell Precision T7500's SPECfp score of 124.0 was 62.3 percent higher than the HP Pavilion Elite HPE-560z score of 76.4.

TEST RESULTS

Figures 6 and 7 show a detailed breakdown of benchmark results for the four test systems. These results represent the median of three test runs. Appendix C presents the results from all three BAPCo SYSmark 2007 and MAXON CINEBENCH runs, and Appendix E presents detailed results for our SPEC CPU2006 testing.

Mid-range systems	Dell Precision T3500 (Intel Xeon W3503)	HP Pavilion Elite HPE-500z (AMD Athlon II X4)	Percentage improvement with Dell Precision T3500 (Intel Xeon W3503)
BAPCo SYSmark 2007 Preview v1.06	160.0	152.0	5.3%
MAXON CINEBENCH R10 Single CPU	3,415.0	3,174.0	7.6%
MAXON CINEBENCH R10 Multiple CPU	6,686.0	10,879.0	(38.5%)
SPEC CPU2006 SPECint_rate_base_2006	45.7	57.5	(20.5%)
SPEC CPU2006 SPECfp_rate_base_2006	40.4	53.7	98.0%

Figure 6: Benchmark score for the mid-range systems. Higher numbers are better.

High-end systems	Dell Precision T7500 (Intel Xeon X5690)	HP Pavilion Elite HPE-560z (AMD Phenom II)	Percentage improvement with Dell Precision T7500 (Intel Xeon X5690)
BAPCo SYSmark 2007 Preview v1.06	282.0	194.0	45.4%
MAXON CINEBENCH R10 Single CPU	5,213.0	3,948.0	32.0%
MAXON CINEBENCH R10 Multiple CPU	28,175.0	18,283.0	54.1%
SPEC CPU2006 SPECint_rate_base_2006	182.0	91.9	(24.8%)
SPEC CPU2006 SPECfp_rate_base_2006	124.0	76.4	62.3%

Figure 7: Benchmark score for the high-end systems. Higher numbers are better.

SUMMARY

Workers need workstations that allow them to do their jobs, in a timely manner and without the frustration and delays that underperforming systems cause. In our tests, we found that Dell workstations powered by the Intel Xeon processor family outperformed comparable HP workstations. With up to 98.0 percent increased performance over HP systems, Dell workstations are an excellent choice to meet workers' performance and productivity needs.

APPENDIX A – DETAILED SYSTEM CONFIGURATION INFORMATION

Figure 8 presents each test system and the details of its configuration.

System	Dell Precision T3500 (Intel Xeon W3503)	Dell Precision T7500 (Intel Xeon X5690)	HP Pavilion Elite HPE-500z (AMD Athlon II X4)	HP Pavilion Elite HPE-560z (AMD Phenom II)
General				
Number of processor packages	1	1	1	1
Number of cores per processor	2	6	4	6
Number of hardware threads per core	1	2	1	1
System power management policy	Dell	Dell	Balanced	Balanced
Processor power-saving option	Enhanced Intel SpeedStep® Technology	Enhanced Intel SpeedStep Technology	AMD PowerNow!™ Technology (Cool'n'Quiet™ Technology)	AMD PowerNow! Technology (Cool'n'Quiet Technology)
System dimensions (length x width x height)	17.5" x 6.5" x 17.5"	20.5" x 8.5" x 22.5"	16.5" x 7" x 15.75"	16.5" x 7" x 15.75"
System weight	39 lbs.	52 lbs.	12 lbs.	26 lbs.
CPU				
Vendor	Intel	Intel	AMD	AMD
Name	Xeon W3503	Xeon X5690	Athlon II X4	Phenom II X6
Model number	W3503	X5690	640	1090
Stepping	D0	B1	PH-EO	PH-EO
Socket type and number of pins	Socket 1366 LGA	Socket 1366 LGA	Socket AM3 (938)	Socket AM3 (938)
Core frequency (GHz)	2.40	3.46	3.00	3.20
Bus frequency	2,400 MHz	3,200 MHz	4,000 MHz HyperTransport Technology	4,000 MHz HyperTransport™ Technology
L1 cache	32 KB + 32 KB (per core)	32 KB + 32 KB (per core)	32 KB + 32 KB (per core)	64 KB + 64 KB (per core)
L2 cache	512 KB (256 KB per core)	1.5 MB (256 KB per core)	2 MB (512 KB per core)	3 MB (512 KB per core)
L3 cache	4 MB	12 MB	N/A	6 MB

System	Dell Precision T3500 (Intel Xeon W3503)	Dell Precision T7500 (Intel Xeon X5690)	HP Pavilion Elite HPE-500z (AMD Athlon II X4)	HP Pavilion Elite HPE-560z (AMD Phenom II)
Platform				
Vendor	Dell	Dell	FOXCONN	FOXCONN
Motherboard model number	09KPNV	06FW8P	2A92	2A92
Motherboard chipset	Intel X58	Intel 5520	AMD 785G	AMD 785G
BIOS name and version	Dell A10 (01/21/2011)	Dell A09 (01/21/2011)	American Megatrends Inc. 6.11 (03/21/2011)	American Megatrends Inc. 6.11 (03/21/2011)
Memory module(s)				
Vendor and model number	Hynix HMT125U6TFR8C-H9	Hynix HMT112R7BFR8C-H9	Hynix HMT125U6TFR8C-H9	Samsung M378B5773CH0-CH9
Type	PC3-10600E	PC3-10600R	PC3-10600U	PC3-10600U
Speed (MHz)	1,066	1,333	1,333	1,333
Speed running in the system (MHz)	1,066	1,333	1,333	1,333
Timing/Latency (tCL-tRCD-tRP-tRASmin)	7-7-7-20	9-9-9-24	9-9-9-24	9-9-9-24
Size (MB)	4,096	6,144	4,096	8,192
Number of memory module(s)	4 x 1,024 MB	6 x 1,024 MB	2 x 2,048 MB	4 x 2,048 MB
Chip organization (single-sided/double-sided)	Single	Double	Dual	Single
Channel (single/dual)	Triple	Triple	Dual	Dual
Hard disk				
Vendor and model number	Seagate® ST3500418AS	Samsung PM810	Hitachi HDS72107SCLA332	Seagate ST31000528AS
Number of disks in system	1	1	1	2
Size (GB)	500	256	750	1,000
Buffer size (MB)	16	128	32	32
RPM	7,200	N/A	7,200	7,200
Type	SATA 3.0 Gb/s	SATA II 3.0 Gb/s	SATA 3.0 Gb/s	SATA 3.0 Gb/s
Controller	Intel 82801JR (ICH10R)	Intel 82801JR (ICH10R)	AMD SB700	AMD AHCI Compatible RAID Controller

System	Dell Precision T3500 (Intel Xeon W3503)	Dell Precision T7500 (Intel Xeon X5690)	HP Pavilion Elite HPE-500z (AMD Athlon II X4)	HP Pavilion Elite HPE-560z (AMD Phenom II)
Driver	Intel 9.6.0.1014 (03/03/2010)	Intel 8.9.4.1004 (10/13/2009)	Advanced Micro Devices Inc. 3.2.1545.19 (08/27/2010)	Advanced Micro Devices Inc. 3.2.1545.19 (08/27/2010)
Operating system				
Name	Windows® 7 Ultimate	Windows 7 Ultimate	Windows 7 Ultimate	Windows 7 Ultimate
Build number	7600	7600	7600	7600
Service Pack	SP1 (for SPEC CPU2006 testing only)	SP1 (for SPEC CPU2006 testing only)	SP1 (for SPEC CPU2006 testing only)	SP1 (for SPEC CPU2006 testing only)
File system	NTFS	NTFS	NTFS	NTFS
Kernel	ACPI x64 – based PC	ACPI x64 – based PC	ACPI x64 – based PC	ACPI x64 – based PC
Language	English	English	English	English
Microsoft DirectX® version	DirectX 11	DirectX 11	DirectX 11	DirectX 11
Graphics				
Vendor and model number	NVIDIA® Quadro® FX580	NVIDIA Quadro 4000	AMD Radeon™ HD 6450	NVIDIA Geforce® GT 440
Type	Discrete	Discrete	Discrete	Discrete
Chipset	Quadro FX 580	Quadro 4000	ATI Radeon HD 6450	GeForce GT 440
BIOS version	62.94.96.0.5	70.0.2f.0.12	113-AC88800-103-PE	70.6.1d.0.2
Total available graphics memory (MB)	2,302	4,862	2,299	4,095
Dedicated video memory (MB)	512	2,048	512	3,072
System video memory (MB)	0	0	0	0
Shared system memory (MB)	1,790	2,814	1,787	1,023
Resolution	1,280 x 1,024 x 32-bit	1,280 x 1,024 x 32-bit	1,280 x 1,024 x 32-bit	1,280 x 1,024 x 32-bit
Driver	NVIDIA 8.16.11.9175 (12/04/2009)	NVIDIA 8.17.11.9810 (06/14/2010)	ATI Technologies Inc. 8.784.1.0 (11/23/2010)	NVIDIA 8.17.12.5935 (08/08/2010)

System	Dell Precision T3500 (Intel Xeon W3503)	Dell Precision T7500 (Intel Xeon X5690)	HP Pavilion Elite HPE-500z (AMD Athlon II X4)	HP Pavilion Elite HPE-560z (AMD Phenom II)
Sound card/subsystem				
Vendor and model number	SoundMAX Integrated Digital High Definition Audio	SoundMAX Integrated Digital High Definition Audio	Realtek High Definition Audio	Creative Sound Blaster X-fi
Driver	Analog Devices 6.10.2.7250 (04/23/2009)	Analog Devices 6.10.2.7250 (04/23/2009)	Realtek Semiconductor Corp. 6.0.1.6196 (09/07/2010)	Creative 6.0.1.1325 (03/05/2010)
Ethernet				
Vendor and model number	Broadcom® NetXtreme® 57xx Gigabit	Broadcom NetXtreme 57xx Gigabit	Realtek PCIe GBE Family	Realtek PCIe GBE Family
Driver	Broadcom 14.0.0.7 (02/09/2010)	Broadcom 14.0.0.7 (02/09/2010)	Realtek 7.26.902.2010 (09/02/2010)	Realtek 7.26.902.2010 (09/02/2010)
Optical drive(s)				
Vendor and model number	Samsung TS-H653G/DEWHW	PLDS DH-16ABS	HP DH16ABLH	HP BDDVDRW CH20L
Type	CD/DVD-RW	CD/DVD-RW	CD/DVD-RW	BD-ROM
USB ports				
Number	8	8	8	8
Type	2.0	2.0	2.0	2.0
Other	eSATA	eSATA, 2 x 1394	Media Card Reader, 1394	Media Card Reader, 1394
Monitor				
LCD type	Optiquest® Q7	Optiquest Q7	Optiquest Q7	Optiquest Q7
Screen size (inches)	17	17	17	17
Refresh rate (Hz)	60	60	60	60

Figure 8: Configuration information for the four test systems.

APPENDIX B – ABOUT OUR TESTING

SYSmark 2007 Preview v1.06

SYSmark 2007 Preview is a performance metric BAPCo created to measure system performance. SYSmark 2007 Preview determines its overall rating from the mean result from four workload scenarios: e-learning, office productivity, video creation, and 3D modeling. SYSmark 2007 Preview records the time the system takes to complete each individual operation in each scenario.

SYSmark 2007 Preview consists of the following applications and corresponding tasks: Adobe® After® Effects 7 (e-learning), Adobe Illustrator® CS2 (video creation), Adobe Photoshop® CS2 (video creation), AutoDesk® 3ds Max® 8 (3D modeling), Macromedia® Flash 8 (e-learning), Microsoft® Excel® 2003 (office productivity), Microsoft Outlook® 2003 (office productivity), Microsoft PowerPoint® 2003 (office productivity), Microsoft Word 2003 (office productivity), Microsoft Project 2003 (office productivity), Microsoft Windows Media™ Encoder 9 series (video creation), Sony® Vegas 7 (video creation), SketchUp 5 (3D modeling), and WinZip® 10.0 (office productivity).

To learn more, visit http://www.bapco.com/support/sysmark2007preview/Help/Help.html.

MAXON CINEBENCH R10

CINEBENCH is a free, real-world cross platform test suite designed to evaluate and compare the CPU and graphics performance across various systems and platforms. Based on MAXON CINEMA 4D software, which creates 3D content, the benchmark consists of two main components: the graphics-card performance test, and the CPU performance test.

CINEBENCH uses the processing power of a system to render 3D scenes that stress all available processor cores, and reports performance in points (pts). Higher scores are better, as they indicate a faster processor.

To learn more, visit http://www.maxon.net.

SPEC CPU2006

The SPEC CPU2006 workload includes two benchmark suites: CINT2006 and CFP2006. (Note: SPEC and SPECint are trademarks of the Standard Performance Evaluation Corporation.) The CINT2006 benchmark focuses on measuring and comparing compute-intensive integer performance, while CFP2006 measures and compares compute-intensive floating-point performance. We ran both benchmarks.

Figure 9 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.

Name	Application area
400.perlbench	Programming language
401.bzip2	Compression
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 9: The applications that make up the CINT2006 benchmark.

Figure 10 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++.

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.

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 10: The applications that make up the CFP2006 benchmark.

Measuring performance with BAPCo SYSmark 2007 Preview v1.06

Setting up the test

1. Reset the system to the base test image.
2. Disable the User Account Control.
    a. Click Start→Control Panel.
    b. At the User Accounts and Family Safety settings screen, click Add or remove user account.
    c. At the User Account Control screen, click Continue.
    d. Click Go to the main User Accounts page.
    e. At the Make changes to your user account screen, click Turn User Account Control on or off.
    f. At the User Account Control screen, click Continue.
    g. Uncheck Use User Account Control to help protect your computer, and click OK.
    h. At the You must restart your computer to apply these changes screen, click Restart Now.
3. Purchase and install SYSmark 2007 Preview v1.05 from https://www.bapcostore.com/store/product.php?productid=16165&cat=251&page=1.
4. At the Welcome to InstallShield Wizard screen, click Next.
5. At the License Agreement screen, select I accept the terms in the License Agreement, and click Next.
6. At the Choose Destination Location screen, click Next.
7. At the Ready to Install the Program screen, click Install.
8. When the installation is complete, click Finish.

Running the test

1. Launch SYSmark 2007 Preview by double-clicking the desktop icon.

2. Click Run.
3. Select Official Run, choose 3 Iterations, check the box beside run conditioning run, and enter a name for that run.
4. When the benchmark completes and the main SYSmark 2007 Preview menu appears, click Save FDR to create a report.

Record the results for each iteration.

Measuring performance with MAXON CINEBENCH R10

Setting up the test

1. Reset the system to the base test image.
2. Download CINEBENCHR10.zip from http://www.maxon.net/en/downloads/downloads/cinebench.html.
3. Right-click the CINEBENCH ZIP file, and choose Extract All.
4. Click Extract.

Running the test

1. Launch CINEBENCH R10 by double-clicking the CINEBENCH R10.exe file in the CINEBENCH R10 folder.
2. Enter the MHz frequency of the processor in the MHz (real freq.) field.
3. Enter a name in the Tester field.
4. Click the Start all tests button.
5. When the picture finishes rendering in multi-processor mode, save the results.
   a. Click the To Clipboard button.
   b. Launch notepad and paste the results into an empty notepad document.
   c. Save the results in the format system_run_N.txt.
6. Close CINEBENCH R10.
7. Reboot the system.
8. Repeat steps 1 through 7 two times, and report the median.

Measuring performance with SPEC CPU2006

SPEC CPU2006 configuration

For the Intel processor -based desktop workstations, we used the latest version of the Intel C/C++ and Fortran compiler. We followed SPEC's standard instructions for building the CINT2006 and 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 12.0.3.163
- Intel Fortran Compiler 12.0.3.163
- MicroQuill SmartHeap v10 (Multi-Core)

The benchmark requires configuration files. PT used a custom configuration file based on similar tests online. From the SPEC Web site, we chose the most recent (as of the testing for this report) SPEC CPU2006 results that used the above compiler. We used these configuration files, along with modifications to reflect the

appropriate system information about the system under test, in our testing. The configuration files we used appear in Appendix D.

To begin the benchmark, we performed the following steps:

- Open a command prompt.
- Change to the c:\cpu2006 directory.
- Type `shrc.bat` at the command prompt.
- Type the `runspec` command as recommended in the configuration file for the system you are testing.

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

Appendix E provides the SPECint_rate_base2006 and SPECfp_rate_base2006 output results for the test systems.

APPENDIX C – DETAILED RESULTS

Figures 11 and 12 present the detailed test results for the systems. For detailed SPEC CPU2006 results, see Appendix E.

Mid-range systems	Dell Precision T3500 (Intel Xeon W3503)			HP Pavilion Elite HPE-500z (AMD Athlon II X4)		
	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3
BAPCo SYSmark 2007 Preview v1.06						
SYSmark 2007 Preview v1.06 - E-Learning	151	154	153	123	124	124
SYSmark 2007 Preview v1.06 - Video Creation	176	185	183	219	226	217
SYSmark 2007 Preview v1.06 - Productivity	165	163	166	123	123	125
SYSmark 2007 Preview v1.06 - 3D	142	142	142	159	158	159
MAXON CINEBENCH R10						
CB Single	3,415	3,487	3,407	3,161	3,174	3,179
CB Dual	6,589	6,686	6,827	10,830	10,879	11,093
Open GL	4,362	4,744	4,323	4,916	4,931	4,909
Multiprocessor Speedup	1.93	1.92	2.00	3.43	3.43	3.49

Figure 11: Benchmark results for the two mid-range workstations. Higher numbers are better.

High-end systems	Dell Precision T7500 (Intel Xeon X5690)			HP Pavilion Elite HPE-560z (AMD Phenom II)		
	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3
BAPCo SYSmark 2007 Preview v1.06						
SYSmark 2007 Preview v1.06 - E-Learning	229	230	229	146	150	160
SYSmark 2007 Preview v1.06 - Video Creation	420	420	421	241	256	260
SYSmark 2007 Preview v1.06 - Productivity	241	240	240	190	189	189
SYSmark 2007 Preview v1.06 - 3D	271	272	272	189	198	198
MAXON CINEBENCH R10						
CB Single	5,260	5,213	5,195	3,943	3,961	3,948
CB Dual	28,621	28,074	28,175	17,754	18,283	18,385
Open GL	6,803	6,821	6,820	4,226	4,728	4,747
Multiprocessor Speedup	5.44	5.39	5.42	4.5	4.62	4.66

Figure 12: Benchmark results, for the two high-end workstations. Higher numbers are better.

APPENDIX D – SPEC CPU2006 CONFIGURATION FILE

Mid-range systems

Dell Precision T3500 (Intel Xeon W3503)

```
# Invocation command line:
# D:\cpu2006.v1.1_tst\bin\runspec -T base -c cpu2006.W3503.cfg -r 2 int
# output_root was not used for this run
############################################################################
############################################################################
# Dell Inc.
# CPU2006 - Windows (32-bit) Config file for Intel Processors
#
# Intel C++/FORTRAN Compiler 11.0
############################################################################
action        = validate
tune          = base

dell_icl_dir  = ic11.0.072
ext           = cpu2006.W3503.exe

PATHSEP       = /
check_md5     = 1
reportable    = 1
backup_config = 0
output_format = asc,html

flagsurl000   = http://www.spec.org/cpu2006/flags/dell.ic11.0.windows.flags.xml

mean_anyway   = 1

#include: dell.SUT.inc
#  ----- Begin inclusion of 'dell.SUT.inc'
############################################################################
############################################################################
# Include for SUT (System Under Test) Description
############################################################################

# --------------------------
#  Edit fields as necessary
# --------------------------
default:

hw_cpu_name        = Intel Xeon W3503
hw_cpu_char        = Intel Turbo Boost Technology up to 3.46 GHz
hw_cpu_mhz         = 2400
hw_disk            = 1 x 500 GB SATA 7200 RPM
hw_fpu             = Integrated
hw_memory          = 4 GB (4x1 GB DDR3-8500E)
hw_model           = Dell Precision T3500 (Intel Xeon W3503, 2.40 GHz)

hw_ncpuorder       = 1 chip
hw_ncores          = 2
hw_nthreadspercore = 1
hw_nchips          = 1
hw_ncoresperchip   = 2

hw_ocache          = None
hw_other           = None
hw_pcache          = 32 KB I + 32 KB D on chip per core

# Quad Core
```

```
hw_scache          = 256 KB I+D on chip per core
hw_tcache          = 4 MB I+D on chip per chip

sw_file            = NTFS
sw_os              = Windows 7 Ultimate w/ SP1 (64-bit)
sw_state           = Default

hw_avail           = Apr-2009
sw_avail           = Feb-2009

#
# This section only needed if there are non-default BIOS settings
#
#notes010 = BIOS Settings
#notes020 =   Snoop Filter set to OFF
#notes021 =    Snoop Filter preserves cache coherency while
#notes022 =    minimizing snoops to remote nodes.
#notes023 =
#notes030 =   Adjacent Cache Line Prefetch set to ON
#notes031 =     Prefetch data in order to shorten execution cycles
#notes032 =     and maximize data processing efficiency.
#notes033 =
#notes040 =   Optimization for high-frequency FSB applicatons set to ON
#notes049 =

#--------------------DO NOT EDIT BELOW THIS LINE----------------------------------

license_num   = 55
hw_vendor     = Dell Inc.
tester        = Dell Inc.
test_sponsor  = Dell Inc.


# ---- End inclusion of 'D:/cpu2006.v1.1_tst/config/dell.SUT.inc'

fast_opt      = -QxSSE4.2
#include: ${dell_icl_dir}\opts.NHLM.RAT.win32.inc
#  ----- Begin inclusion of 'ic11.0.072\opts.NHLM.RAT.win32.inc'
###############################################################################
#############################################
# Dell Inc.
# Optimizations - Windows  32-bit /RATE
#############################################

sh_lib = c:\cpu2006\sh1w32m.lib

sw_base_ptrsize = 32-bit
sw_peak_ptrsize = 32-bit

all_c,all_cpp=default:
EXTRA_LDFLAGS  = /F512000000

all_fortran,all_mixed=default:
EXTRA_LDFLAGS  = /F1000000000

# Compiler name
#include: ${dell_icl_dir}\name.win32.inc
#  ----- Begin inclusion of 'ic11.0.072\name.win32.inc'
###############################################################################
#####################################################################
# Dell Inc.
#
# Compiler Name/Description
```

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

# ====================================
#  Compiler description/information
# ====================================
default:

sw_compiler000 = Intel C++ Compiler for IA-32, Version 11.0
sw_compiler001 =    Build 20090131 Package ID: w_cproc_p_11.0.072

fp:
sw_compiler010 = Intel Visual FORTRAN Compiler for IA-32, Version 11.0
sw_compiler011 =    Build 20090131 Package ID: w_cprof_p_11.0.072

default:
sw_compiler002 = Microsoft Visual Studio 2008 SP1
sw_other       = MicroQuill SmartHeap Library 8.1

# ---- End inclusion of 'D:/cpu2006.v1.1_tst/config/ic11.0.072/name.win32.inc'

# Portability Flags
#include: ${dell_icl_dir}\port.win32.inc
#  ----- Begin inclusion of 'ic11.0.072\port.win32.inc'
##############################################################################
#####################################################################
# Dell Inc.
# CPU2006 - Include for Portability Flags - Windows XP (32-bit)
#
# Intel C++/FORTRAN Compiler 11.0
#
#####################################################################

# =================
#  Portability
# =================
default:

403.gcc=default=default=default:
CPORTABILITY      = -DSPEC_CPU_WIN32
EXTRA_CFLAGS      = -Dalloca=_alloca

436.cactusADM=default=default=default:
FPORTABILITY      = -Qlowercase /assume:underscore

444.namd=default=default=default:
CXXPORTABILITY    =  -TP

447.dealII=default=default=default:
PORTABILITY       = -DDEAL_II_MEMBER_VAR_SPECIALIZATION_BUG

453.povray=default=default=default:
CXXPORTABILITY    = -DSPEC_CPU_WINDOWS_ICL

454.calculix=default=default=default:
FPORTABILITY     = -Qlowercase
PORTABILITY      = -DSPEC_CPU_NOZMODIFIER

464.h264ref=default=default=default:
PORTABILITY       = -DSPEC_CPU_NO_INTTYPES -DWIN32

481.wrf=default:
CPORTABILITY     = -DSPEC_CPU_WINDOWS_ICL
```

```
483.xalancbmk=default=default=default:
CXXPORTABILITY    = -Qoption,cpp,--no_wchar_t_keyword
# ---- End inclusion of 'D:/cpu2006.v1.1_tst/config/ic11.0.072/port.win32.inc'

# Optimize
#include: ${dell_icl_dir}\opts.NHLM.RAT.windows.inc
#  ----- Begin inclusion of 'ic11.0.072\opts.NHLM.RAT.windows.inc'
################################################################################
############################################
# Dell Inc.
# Intel Nehalem
# RATE Optimizations for Windows
############################################

#################################################################
# Compiler Setup
#################################################################
default:

CC  = icl -Qvc9 -Qstd=c99
CXX = icl -Qvc9
FC  = ifort
OBJ = .obj

# Works only on Vista32, Server2003 and all x64 Windows operating systems.
# Does *not* work on Win XP32
# submit= specperl -e "system sprintf qq{start /b /wait /affinity %x %s}, (1<<$SPECCOPYNUM), q{
$command } "

# ================================================
# Library Tuning Flags
# ================================================
all_cpp=default:
EXTRA_LIBS = ${sh_lib}
LDOUT = -Fe$@ -link /FORCE:MULTIPLE

# ================================================
# Baseline Tuning Flags
# ================================================

int=base:
OPTIMIZE=       $[fast_opt] -Qipo -O3 -Qprec-div- -Qopt-prefetch
CXXOPTIMIZE=    -Qcxx_features

fp=base:
OPTIMIZE=       $[fast_opt] -Qipo -O3 -Qprec-div- -Qopt-prefetch
CXXOPTIMIZE=    -Qcxx_features

# ================================================
# Peak Tuning Flags
# ================================================

default=peak:
PASS1_CFLAGS=                -Qprof_gen
PASS2_CFLAGS=    $[fast_opt] -Qprof_use
PASS1_CXXFLAGS=              -Qprof_gen
PASS2_CXXFLAGS=  $[fast_opt] -Qprof_use
PASS1_FFLAGS=                -Qprof_gen
PASS2_FFLAGS=    $[fast_opt] -Qprof_use
PASS1_LDFLAGS=               -Qprof_gen
PASS2_LDFLAGS=   $[fast_opt] -Qprof_use

# ================================================
```

```
# Peak Tuning Flags int 2006 fast
# ================================================

int=peak:
OPTIMIZE=       $[fast_opt] -Qipo -O3 -Qprec-div- -Qopt-prefetch
#CXXOPTIMIZE=    -Qcxx_features

400.perlbench=peak=default:
OPTIMIZE   = -Qipo -O3 -Qprec-div- -Qansi-alias -Qopt-prefetch
EXTRA_LIBS = ${sh_lib}
LDOUT      = -Fe$@ -link /FORCE:MULTIPLE

401.bzip2=peak=default:
OPTIMIZE= -Qipo -O3 -Qprec-div- -Qansi-alias -Qopt-prefetch

#403.gcc=peak=default:

429.mcf=peak=default:
OPTIMIZE= $[fast_opt] -Qipo -O3 -Qprec-div- -Qopt-prefetch
feedback=no
#%ifdef %{1p4c8l}
#copies=4
#submit= specperl -e "system sprintf qq{start /b /wait /affinity %x %s}, (1<<(2*$SPECCOPYNUM)), q{
$command } "
#%endif

445.gobmk=peak=default:
OPTIMIZE= -Qipo -O2 -Qprec-div- -Qansi-alias

456.hmmer=peak=default:
OPTIMIZE= $[fast_opt] -Qipo -O3 -Qprec-div- -Qunroll2 -Qansi-alias
feedback=no

458.sjeng=peak=default:
OPTIMIZE= -Qipo -O3 -Qprec-div- -Qunroll4

462.libquantum=peak=default:
basepeak=yes

464.h264ref=peak=default:
OPTIMIZE= -Qipo -O3 -Qprec-div- -Qunroll2 -Qansi-alias

471.omnetpp=peak=default:
OPTIMIZE= -Qipo -O3 -Qprec-div- -Qansi-alias -Qopt-ra-region-strategy=block

473.astar=peak=default:
OPTIMIZE= -Qipo -O3 -Qprec-div- -Qansi-alias -Qopt-ra-region-strategy=routine

483.xalancbmk=peak=default:
basepeak=yes

# ================================================
# Peak Tuning Flags fp 2006 fast
# ================================================
fp=peak:
OPTIMIZE=       $[fast_opt] -Qipo -O3 -Qprec-div-
#CXXOPTIMIZE=    -Qcxx_features

410.bwaves=peak=default:
OPTIMIZE= $[fast_opt] -Qipo -O3 -Qprec-div- -Qopt-prefetch
feedback=0
#%ifdef %{1p4c8l}
#copies=4
```

```
#submit= specperl -e "system sprintf qq{start /b /wait /affinity %x %s}, (1<<(2*$SPECCOPYNUM)), q{
$command } "
#%endif

#%ifdef %{1p2c4l}
#copies=2
#submit= specperl -e "system sprintf qq{start /b /wait /affinity %x %s}, (1<<(2*$SPECCOPYNUM)), q{
$command } "
#%endif

416.gamess=peak=default:
OPTIMIZE= -Qipo -O3 -Qprec-div- -Qunroll2 -Ob0 -Qansi-alias -Qscalar-rep-

433.milc=peak=default:
basepeak=yes

435.gromacs=peak=default:
OPTIMIZE= -Qipo -O3 -Qprec-div- -Qopt-prefetch

436.cactusADM=peak=default:
basepeak=yes

437.leslie3d=peak=default:
basepeak=yes

444.namd=peak=default:
OPTIMIZE= -Qipo -O3 -Qprec-div- -Oa

447.dealII=peak=default:
OPTIMIZE= -Qipo -O3 -Qprec-div- -Qunroll2 -Qansi-alias -Qscalar-rep-

#450.soplex=peak=default:
#%ifdef %{1p4c8l}
#copies=4
#submit= specperl -e "system sprintf qq{start /b /wait /affinity %x %s}, (1<<(2*$SPECCOPYNUM)), q{
$command } "
#%endif

#%ifdef %{1p2c4l}
#copies=2
#submit= specperl -e "system sprintf qq{start /b /wait /affinity %x %s}, (1<<(2*$SPECCOPYNUM)), q{
$command } "
#%endif

453.povray=peak=default:
OPTIMIZE= -Qipo -O3 -Qprec-div- -Qunroll4 -Qansi-alias

454.calculix=peak=default:
OPTIMIZE= $[fast_opt] -Qipo -O3 -Qprec-div-
feedback=0

459.GemsFDTD=peak=default:
basepeak=yes

465.tonto=peak=default:
OPTIMIZE= -Qipo -O3 -Qprec-div- -Qunroll4 -Qauto

470.lbm=peak=default:
OPTIMIZE=  -QxSSE4.1  -Qipo -O3 -Qprec-div- -Qopt-prefetch
feedback=no

481.wrf=peak=default:
basepeak=yes
```

```
482.sphinx3=peak=default:
OPTIMIZE= $[fast_opt] -Qipo -O3 -Qprec-div- -Qunroll2
feedback=0
# ---- End inclusion of 'D:/cpu2006.v1.1_tst/config/ic11.0.072/opts.NHLM.RAT.windows.inc'
# ---- End inclusion of 'D:/cpu2006.v1.1_tst/config/ic11.0.072/opts.NHLM.RAT.win32.inc'
```

HP Pavilion Elite HPE-500 (AMD Athlon II X4)

```
# Invocation command line:
# C:\CPU200~1.IC1\bin\runspec --rate 4 -c cpu2006.phenom.cfg -T base --flagsurl=Intel-ic11.0-win32-
revA.xml,Intel-Win32-Platform.xml -o asc int
# output_root was not used for this run
############################################################################
############################################################################
# This is a sample config file. It was tested with:
#
#      Compiler name/version:       Intel Compiler 11.0 , MS VS 2008
#      Operating system version:    Windows Vista (32-bit and 64-bit)
#      Hardware:                    Intel processors supporting
#                                   Streaming SIMD Extensions 2
#
# If your platform uses different versions, different
# hardware or operates in a different mode (for
# example, 32- vs. 64-bit mode), there is the possibiliy
# that this configuration file may not work as-is.
#
# Note that issues with compilation should be directed
# to the compiler vendor. Information about SPEC technical
# support can be found in the techsupport document in the
# Docs directory of your benchmark installation.
#
# This config file uses the SmartHeap library and if you
# do not have a licensed copy, please remove all
# instances of shlW32M.lib from this config file.
#
# Also note that this is a sample configuration. It
# is expected to work for the environment in which
# it was tested; it is not guaranteed that this is
# the config file that will provide the best performance.
#
#
# Note that you might find a more recent config file for
# your platform with the posted results at
# http://www.spec.org/cpu2006
############################################################################
# SPEC CPU2006 Intel Windows XP/Vista32 config file
# Oct 03 2008. Intel Compiler 11.0 Visual Studio 2008
############################################################################
action      = validate
tune        = base
ext         = cpu2006.1.0.ic11.0.win32.sse2.rate.exe
PATHSEP     = /
check_md5=1
reportable=1
flagsurl000 = http://www.spec.org/cpu2006/flags/Intel-ic11.0-win32-revA.xml

# Works only on Vista32, Server2003 and all x64 Windows operating systems.
# Does *not* work on Win XP32
submit= specperl -e "system sprintf qq{start /b /wait /affinity %x %s}, (1<<$SPECCOPYNUM), q{
$command } "

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

```
# These are listed as benchmark-tuning-extension-machine
#
######################################################################
# Compiler section
######################################################################
CC  = icl -Qvc9 -Qc99
CXX = icl -Qvc9
FC  = ifort
OBJ = .obj

int=default:
EXTRA_LDFLAGS     = /F512000000

fp=default:
EXTRA_LDFLAGS     = /F1000000000

######################################################################
# Portability section
######################################################################
403.gcc=default=default=default:
CPORTABILITY      = -DSPEC_CPU_WIN32
EXTRA_CFLAGS      = -Dalloca=_alloca

436.cactusADM=default=default=default:
FPORTABILITY      = -Qlowercase /assume:underscore

444.namd=default=default=default:
CXXPORTABILITY    =  -TP

447.dealII=default=default=default:
PORTABILITY       = -DDEAL_II_MEMBER_VAR_SPECIALIZATION_BUG

453.povray=default=default=default:
CXXPORTABILITY    = -DSPEC_CPU_WINDOWS_ICL

454.calculix=default=default=default:
PORTABILITY      = -Qlowercase -DSPEC_CPU_NOZMODIFIER

464.h264ref=default=default=default:
PORTABILITY       = -DSPEC_CPU_NO_INTTYPES -DWIN32

481.wrf=default:
CPORTABILITY     = -DSPEC_CPU_WINDOWS_ICL

483.xalancbmk=default=default=default:
CXXPORTABILITY   = -Qoption,cpp,--no_wchar_t_keyword

######################################################################
# Library Tuning Flags
######################################################################
all_cpp=default:
EXTRA_LIBS=     c:\cpu2006\shlW32M.lib
LDOUT=          -Fe$@ -link /FORCE:MULTIPLE

######################################################################
# Baseline Tuning Flags
# default baseline for int and fp 2006
######################################################################
int=base=default=default:
OPTIMIZE=       /arch:SSE2 -Qipo -O3 -Qprec-div- -Qopt-prefetch
CXXOPTIMIZE=    -Qcxx-features
sw_base_ptrsize = 32-bit
```

```
fp=base=default=default:
OPTIMIZE=       /arch:SSE2 -Qipo -O3 -Qprec-div- -Qopt-prefetch
CXXOPTIMIZE=    -Qcxx-features

####################################################################
# Peak Tuning Flags
# default peak for int and fp 2006
####################################################################
```

High-end systems

Dell Precision T7500 (Intel Xeon X5690)

```
# Invocation command line:
# C:\cpu2006.v1.1\bin\runspec -c cpu2006.x5690.cfg -r 12 -T base int
# output_root was not used for this run
############################################################################
############################################################################
# Dell Inc.
# CPU2006 - Windows (32-bit) Config file for Intel Processors
#
# Intel C++/FORTRAN Compiler 11.1
############################################################################
action        = validate
tune          = base

dell_icl_dir  = ic11.1.054
ext           = cpu2006.x5690.exe

# Works only on Vista32, Server2003 and all x64 Windows operating systems.
# Does *not* work on Win XP32
# submit= specperl -e "system sprintf qq{start /b /wait /affinity %x %s}, (1<<$SPECCOPYNUM), q{
$command } "

PATHSEP       = /
check_md5     = 1
reportable    = 1
backup_config = 0
output_format = asc,html

flagsurl000   = http://www.spec.org/cpu2006/flags/dell.flags.ic11.1.win.xml

mean_anyway   = 1

#include: dell.SUT.inc
#  ----- Begin inclusion of 'dell.SUT.inc'
############################################################################
############################################################################
# Include for SUT (System Under Test) Description
############################################################################

# --------------------------
#  Edit fields as necessary
# --------------------------
default:

hw_cpu_name        = Intel Xeon X5690
hw_cpu_char        = Intel Turbo Boost Technology up to 3.73 GHz
hw_cpu_mhz         = 3460
hw_disk            = 1 x 256 GB SATA SSD
hw_fpu             = Integrated
hw_memory          = 6 GB (6x1 GB PC3-10600R)
hw_model           = Dell Precision T7500 (Intel Xeon X5680, 3.46 GHz)
```

```
hw_ncpuorder       = 1 chip
hw_ncores          = 6
hw_nthreadspercore = 2
hw_nchips          = 1
hw_ncoresperchip   = 6

hw_ocache          = None
hw_other           = None
hw_pcache          = 32 KB I + 32 KB D on chip per core

hw_scache          = 256 KB I+D on chip per core
hw_tcache          = 12 MB I+D on chip per chip

sw_file            = NTFS
sw_os              = Windows 7 Ultimate (64-bit)
sw_state           = Default

hw_avail           = Mar-2010
sw_avail           = Dec-2009

#
# This section only needed for non-default BIOS settings
#
notes_plat_000 = BIOS Settings
notes_plat_005 =      Hyper-Threading: ENABLE
#notes_plat_013 =                   Turbo Boost: ENABLE/DISABLE
#notes_plat_014 =  Adjacent Cache Line Prefetch: ENABLE/DISABLE
#notes_plat_015=              Hardware Prefetch: ENABLE/DISABLE
notes_plat_015 =

#--------------------DO NOT EDIT BELOW THIS LINE-----------------------------------

license_num   = 55
hw_vendor     = Dell Inc.
tester        = Dell Inc.
test_sponsor  = Dell Inc.


# ---- End inclusion of 'C:/cpu2006.v1.1/config/dell.SUT.inc'
#include: omp.inc
#  ----- Begin inclusion of 'omp.inc'
##############################################################################
#
# Auto Parallel(if applicable)
#
default:
# ---- End inclusion of 'C:/cpu2006.v1.1/config/omp.inc'

fast_opt      = -QxSSE4.2
#include: ${dell_icl_dir}\opts.NHLM.RAT.win32.inc
#  ----- Begin inclusion of 'ic11.1.054\opts.NHLM.RAT.win32.inc'
##############################################################################
##############################################
# Dell Inc.
# Optimizations - Windows  32-bit /RATE
##############################################

sh_lib = c:\cpu2006\shlw32m.lib

sw_base_ptrsize = 32-bit
sw_peak_ptrsize = 32-bit

all_c,all_cpp=default:
```

```
EXTRA_LDFLAGS  = /F512000000

all_fortran,all_mixed=default:
EXTRA_LDFLAGS  = /F1000000000

# Compiler name
#include: ${dell_icl_dir}\name.win32.inc
#  ----- Begin inclusion of 'ic11.1.054\name.win32.inc'
##############################################################################
##################################################################
# Dell Inc.
#
# Compiler Name/Description
##################################################################

# ================================
#  Compiler description/information
# ================================
default:

sw_compiler000 = Intel C++ Compiler Professional for IA-32,
sw_compiler001 = Version 11.1
sw_compiler002 =    Build 20091130 Package ID: w_cproc_p_11.1.054

fp:
sw_compiler010 = Intel Visual FORTRAN Compiler Professional for IA-32, Version 11.1
sw_compiler011 =    Build 20090130 Package ID: w_cprof_p_11.1.054

default:
sw_compiler003 = Microsoft Visual Studio 2008 SP1
sw_other       = MicroQuill SmartHeap Library 8.1

notes_000= Binaries were built on Windows Vista Business (64-bit)
# ---- End inclusion of 'C:/cpu2006.v1.1/config/ic11.1.054/name.win32.inc'

# Portability Flags
#include: ${dell_icl_dir}\port.win32.inc
#  ----- Begin inclusion of 'ic11.1.054\port.win32.inc'
##############################################################################
##################################################################
# Dell Inc.
# CPU2006 - Include for Portability Flags - Windows XP (32-bit)
#
# Intel C++/FORTRAN Compiler 11.0
#
##################################################################

# =================
#  Portability
# =================
default:

403.gcc=default=default=default:
CPORTABILITY      = -DSPEC_CPU_WIN32
EXTRA_CFLAGS      = -Dalloca=_alloca

436.cactusADM=default=default=default:
FPORTABILITY      = -Qlowercase /assume:underscore

444.namd=default=default=default:
CXXPORTABILITY    =  -TP

447.dealII=default=default=default:
```

```
PORTABILITY       = -DDEAL_II_MEMBER_VAR_SPECIALIZATION_BUG

453.povray=default=default=default:
CXXPORTABILITY    = -DSPEC_CPU_WINDOWS_ICL

454.calculix=default=default=default:
FPORTABILITY     = -Qlowercase
PORTABILITY      = -DSPEC_CPU_NOZMODIFIER

464.h264ref=default=default=default:
PORTABILITY       = -DSPEC_CPU_NO_INTTYPES -DWIN32

481.wrf=default:
CPORTABILITY     = -DSPEC_CPU_WINDOWS_ICL

483.xalancbmk=default=default=default:
CXXPORTABILITY    = -Qoption,cpp,--no_wchar_t_keyword
# ---- End inclusion of 'C:/cpu2006.v1.1/config/ic11.1.054/port.win32.inc'

# Optimize
#include: ${dell_icl_dir}\opts.NHLM.RAT.windows.inc
#  ----- Begin inclusion of 'ic11.1.054\opts.NHLM.RAT.windows.inc'
################################################################################
##############################################
# Dell Inc.
# Intel Nehalem
# RATE Optimizations for Windows
##############################################

#####################################################################
# Compiler Setup
#####################################################################
default:

CC  = icl -Qvc9 -Qstd=c99
CXX = icl -Qvc9
FC  = ifort
OBJ = .obj

# ================================================
# Library Tuning Flags
# ================================================
all_cpp=default:
EXTRA_LIBS = ${sh_lib}
LDOUT = -Fe$@ -link /FORCE:MULTIPLE

# ================================================
# Baseline Tuning Flags
# ================================================

int=base:
OPTIMIZE=       $[fast_opt] -Qipo -O3 -Qprec-div- -Qopt-prefetch
CXXOPTIMIZE=    -Qcxx_features

fp=base:
OPTIMIZE=       $[fast_opt] -Qipo -O3 -Qprec-div- -Qopt-prefetch
CXXOPTIMIZE=    -Qcxx_features

# ================================================
# Peak Tuning Flags
# ================================================

default=peak:
```

```
PASS1_CFLAGS=                -Qprof_gen
PASS2_CFLAGS=    $[fast_opt] -Qprof_use
PASS1_CXXFLAGS=              -Qprof_gen
PASS2_CXXFLAGS=  $[fast_opt] -Qprof_use
PASS1_FFLAGS=                -Qprof_gen
PASS2_FFLAGS=    $[fast_opt] -Qprof_use
PASS1_LDFLAGS=               -Qprof_gen
PASS2_LDFLAGS=   $[fast_opt] -Qprof_use

# ============================================
# Peak Tuning Flags int 2006 fast
# ============================================

int=peak:
OPTIMIZE=       $[fast_opt] -Qipo -O3 -Qprec-div- -Qopt-prefetch
#CXXOPTIMIZE=    -Qcxx_features

400.perlbench=peak=default:
OPTIMIZE   = -Qipo -O3 -Qprec-div- -Qansi-alias -Qopt-prefetch
EXTRA_LIBS = ${sh_lib}
LDOUT      = -Fe$@ -link /FORCE:MULTIPLE

401.bzip2=peak=default:
OPTIMIZE= -Qipo -O3 -Qprec-div- -Qansi-alias -Qopt-prefetch

#403.gcc=peak=default:

429.mcf=peak=default:
OPTIMIZE= $[fast_opt] -Qipo -O3 -Qprec-div- -Qopt-prefetch
feedback=no
#%ifdef %{1p4c8l}
#copies=4
#submit= specperl -e "system sprintf qq{start /b /wait /affinity %x %s}, (1<<(2*$SPECCOPYNUM)), q{
$command } "
#%endif

445.gobmk=peak=default:
OPTIMIZE= -Qipo -O2 -Qprec-div- -Qansi-alias

456.hmmer=peak=default:
OPTIMIZE= $[fast_opt] -Qipo -O3 -Qprec-div- -Qunroll2 -Qansi-alias
feedback=no

458.sjeng=peak=default:
OPTIMIZE= -Qipo -O3 -Qprec-div- -Qunroll4

462.libquantum=peak=default:
basepeak=yes

464.h264ref=peak=default:
OPTIMIZE= -Qipo -O3 -Qprec-div- -Qunroll2 -Qansi-alias

471.omnetpp=peak=default:
OPTIMIZE= -Qipo -O3 -Qprec-div- -Qansi-alias -Qopt-ra-region-strategy=block

473.astar=peak=default:
OPTIMIZE= -Qipo -O3 -Qprec-div- -Qansi-alias -Qopt-ra-region-strategy=routine

483.xalancbmk=peak=default:
basepeak=yes

# ============================================
# Peak Tuning Flags fp 2006 fast
```

```
# ================================================
fp=peak:
OPTIMIZE=       $[fast_opt] -Qipo -O3 -Qprec-div-
#CXXOPTIMIZE=    -Qcxx_features

410.bwaves=peak=default:
OPTIMIZE= $[fast_opt] -Qipo -O3 -Qprec-div- -Qopt-prefetch
feedback=0
#%ifdef %{1p4c8l}
#copies=4
#submit= specperl -e "system sprintf qq{start /b /wait /affinity %x %s}, (1<<(2*$SPECCOPYNUM)), q{
$command } "
#%endif

#%ifdef %{1p2c4l}
#copies=2
#submit= specperl -e "system sprintf qq{start /b /wait /affinity %x %s}, (1<<(2*$SPECCOPYNUM)), q{
$command } "
#%endif

416.gamess=peak=default:
OPTIMIZE= -Qipo -O3 -Qprec-div- -Qunroll2 -Ob0 -Qansi-alias -Qscalar-rep-

433.milc=peak=default:
basepeak=yes

435.gromacs=peak=default:
OPTIMIZE= -Qipo -O3 -Qprec-div- -Qopt-prefetch

436.cactusADM=peak=default:
basepeak=yes

437.leslie3d=peak=default:
basepeak=yes

444.namd=peak=default:
OPTIMIZE= -Qipo -O3 -Qprec-div- -Oa

447.dealII=peak=default:
OPTIMIZE= -Qipo -O3 -Qprec-div- -Qunroll2 -Qansi-alias -Qscalar-rep-

#450.soplex=peak=default:
#%ifdef %{1p4c8l}
#copies=4
#submit= specperl -e "system sprintf qq{start /b /wait /affinity %x %s}, (1<<(2*$SPECCOPYNUM)), q{
$command } "
#%endif

#%ifdef %{1p2c4l}
#copies=2
#submit= specperl -e "system sprintf qq{start /b /wait /affinity %x %s}, (1<<(2*$SPECCOPYNUM)), q{
$command } "
#%endif

453.povray=peak=default:
OPTIMIZE= -Qipo -O3 -Qprec-div- -Qunroll4 -Qansi-alias

454.calculix=peak=default:
OPTIMIZE= $[fast_opt] -Qipo -O3 -Qprec-div-
feedback=0

459.GemsFDTD=peak=default:
basepeak=yes
```

```
465.tonto=peak=default:
OPTIMIZE= -Qipo -O3 -Qprec-div- -Qunroll4 -Qauto

470.lbm=peak=default:
OPTIMIZE=  -QxSSE4.1  -Qipo -O3 -Qprec-div- -Qopt-prefetch
feedback=no

481.wrf=peak=default:
basepeak=yes

482.sphinx3=peak=default:
OPTIMIZE= $[fast_opt] -Qipo -O3 -Qprec-div- -Qunroll2
feedback=0
# ---- End inclusion of 'C:/cpu2006.v1.1/config/ic11.1.054/opts.NHLM.RAT.windows.inc'
# ---- End inclusion of 'C:/cpu2006.v1.1/config/ic11.1.054/opts.NHLM.RAT.win32.inc'
```

HP Pavilion Elite HPE-560Z (AMD Phenom II)

```
# Invocation command line:
# C:\CPU200~1.IC1\bin\runspec --rate 4 -c cpu2006.phenom.cfg -T base --flagsurl=Intel-ic11.0-win32-
revA.xml,Intel-Win32-Platform.xml -o asc int
# output_root was not used for this run
############################################################################
############################################################################
# This is a sample config file. It was tested with:
#
#      Compiler name/version:       Intel Compiler 11.0 , MS VS 2008
#      Operating system version:    Windows Vista (32-bit and 64-bit)
#      Hardware:                    Intel processors supporting
#                                   Streaming SIMD Extensions 2
#
# If your platform uses different versions, different
# hardware or operates in a different mode (for
# example, 32- vs. 64-bit mode), there is the possibiliy
# that this configuration file may not work as-is.
#
# Note that issues with compilation should be directed
# to the compiler vendor. Information about SPEC technical
# support can be found in the techsupport document in the
# Docs directory of your benchmark installation.
#
# This config file uses the SmartHeap library and if you
# do not have a licensed copy, please remove all
# instances of shlW32M.lib from this config file.
#
# Also note that this is a sample configuration. It
# is expected to work for the environment in which
# it was tested; it is not guaranteed that this is
# the config file that will provide the best performance.
#
#
# Note that you might find a more recent config file for
# your platform with the posted results at
# http://www.spec.org/cpu2006
############################################################################
# SPEC CPU2006 Intel Windows XP/Vista32 config file
# Oct 03 2008. Intel Compiler 11.0 Visual Studio 2008
############################################################################
action      = validate
tune        = base
ext         = cpu2006.1.0.ic11.0.win32.sse2.rate.exe
PATHSEP     = /
check_md5=1
```

```
reportable=1
flagsurl000 = http://www.spec.org/cpu2006/flags/Intel-ic11.0-win32-revA.xml

# Works only on Vista32, Server2003 and all x64 Windows operating systems.
# Does *not* work on Win XP32
submit= specperl -e "system sprintf qq{start /b /wait /affinity %x %s}, (1<<$SPECCOPYNUM), q{
$command } "

####################################################################
#
# These are listed as benchmark-tuning-extension-machine
#
####################################################################
# Compiler section
####################################################################
CC  = icl -Qvc9 -Qc99
CXX = icl -Qvc9
FC  = ifort
OBJ = .obj

int=default:
EXTRA_LDFLAGS     = /F512000000

fp=default:
EXTRA_LDFLAGS     = /F1000000000

####################################################################
# Portability section
####################################################################
403.gcc=default=default=default:
CPORTABILITY      = -DSPEC_CPU_WIN32
EXTRA_CFLAGS      = -Dalloca=_alloca

436.cactusADM=default=default=default:
FPORTABILITY      = -Qlowercase /assume:underscore

444.namd=default=default=default:
CXXPORTABILITY    =  -TP

447.dealII=default=default=default:
PORTABILITY       = -DDEAL_II_MEMBER_VAR_SPECIALIZATION_BUG

453.povray=default=default=default:
CXXPORTABILITY    = -DSPEC_CPU_WINDOWS_ICL

454.calculix=default=default=default:
PORTABILITY      = -Qlowercase -DSPEC_CPU_NOZMODIFIER

464.h264ref=default=default=default:
PORTABILITY       = -DSPEC_CPU_NO_INTTYPES -DWIN32

481.wrf=default:
CPORTABILITY     = -DSPEC_CPU_WINDOWS_ICL

483.xalancbmk=default=default=default:
CXXPORTABILITY   = -Qoption,cpp,--no_wchar_t_keyword

####################################################################
# Library Tuning Flags
####################################################################
all_cpp=default:
EXTRA_LIBS=     c:\cpu2006\shlW32M.lib
LDOUT=          -Fe$@ -link /FORCE:MULTIPLE
```

```
##########################################################################
# Baseline Tuning Flags
# default baseline for int and fp 2006
##########################################################################
int=base=default=default:
OPTIMIZE=       /arch:SSE2 -Qipo -O3 -Qprec-div- -Qopt-prefetch
CXXOPTIMIZE=    -Qcxx-features
sw_base_ptrsize = 32-bit

fp=base=default=default:
OPTIMIZE=       /arch:SSE2 -Qipo -O3 -Qprec-div- -Qopt-prefetch
CXXOPTIMIZE=    -Qcxx-features

##########################################################################
# Peak Tuning Flags
# default peak for int and fp 2006
##########################################################################
```

APPENDIX E – DETAILED SPEC CPU2006 RESULTS

Mid-range systems

Dell Precision T3500 (Intel Xeon W3503)

SPEC® CINT2006 Result

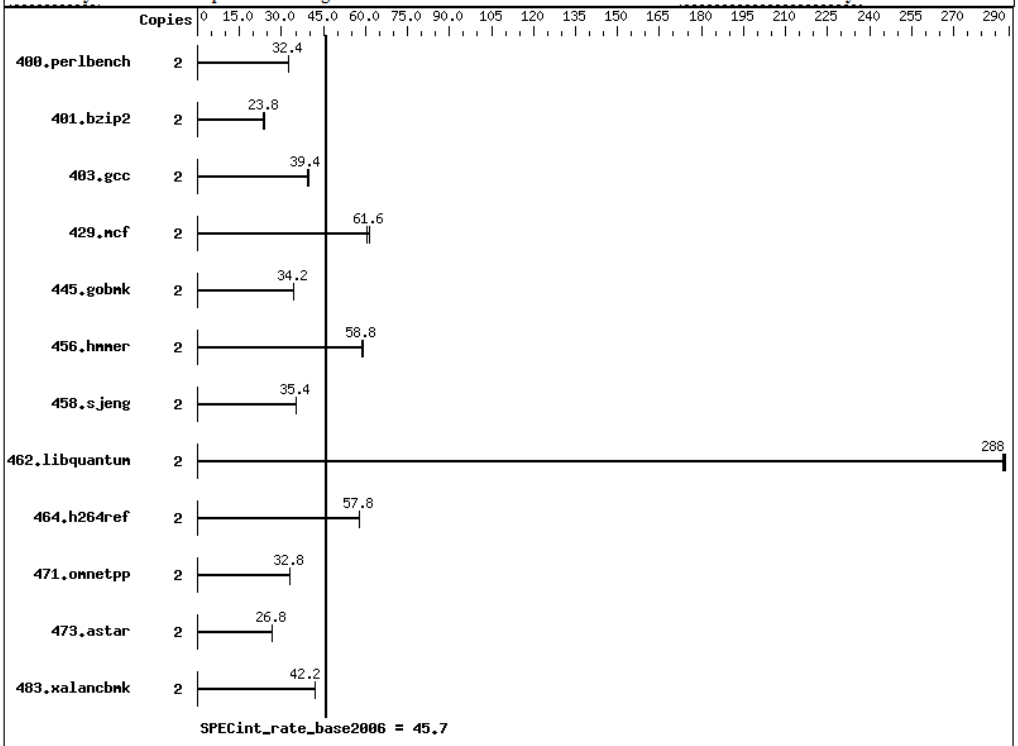
Copyright 2006-2008 Standard Performance Evaluation Corporation

Dell Inc.
Dell Precision T3500 (Intel Xeon W3503, 2.40 GHz)

SPECint® rate2006 = Not Run
SPECint rate base2006 = 45.7

CPU2006 license: 3184
Test sponsor: Dell Inc.
Tested by: Principled Technologies Inc.

Test date: May-2011
Hardware Availability: Apr-2009
Software Availability: Feb-2009



Hardware

CPU Name:	Intel Xeon W3503
CPU Characteristics:	
CPU MHz:	2400
FPU:	Integrated
CPU(s) enabled:	2 cores, 1 chip, 2 cores/chip
CPU(s) orderable:	1 chip
Primary Cache:	32 KB I + 32 KB D on chip per core
Secondary Cache:	256 KB I+D on chip per core
L3 Cache:	4 MB I+D on chip per chip
Other Cache:	None
Memory:	4 GB (4x1 GB DDR3-8500E)
Disk Subsystem:	1 x 500 GB SATA 7200 RPM
Other Hardware:	None

Software

Operating System:	Windows 7 Ultimate w/ SP1 (64-bit)
Compiler:	Intel C++ Compiler XE for IA-32 Version 12.0.4.196 Build 20110427 Microsoft Visual Studio Professional 2008 SP1 (for libraries)
Auto Parallel:	No
File System:	NTFS
System State:	Default
Base Pointers:	32-bit
Peak Pointers:	32-bit
Other Software:	MicroQuill SmartHeap Library 10 (Multi-Core) from http://www.microquill.com/

SPEC® CFP2006 Result

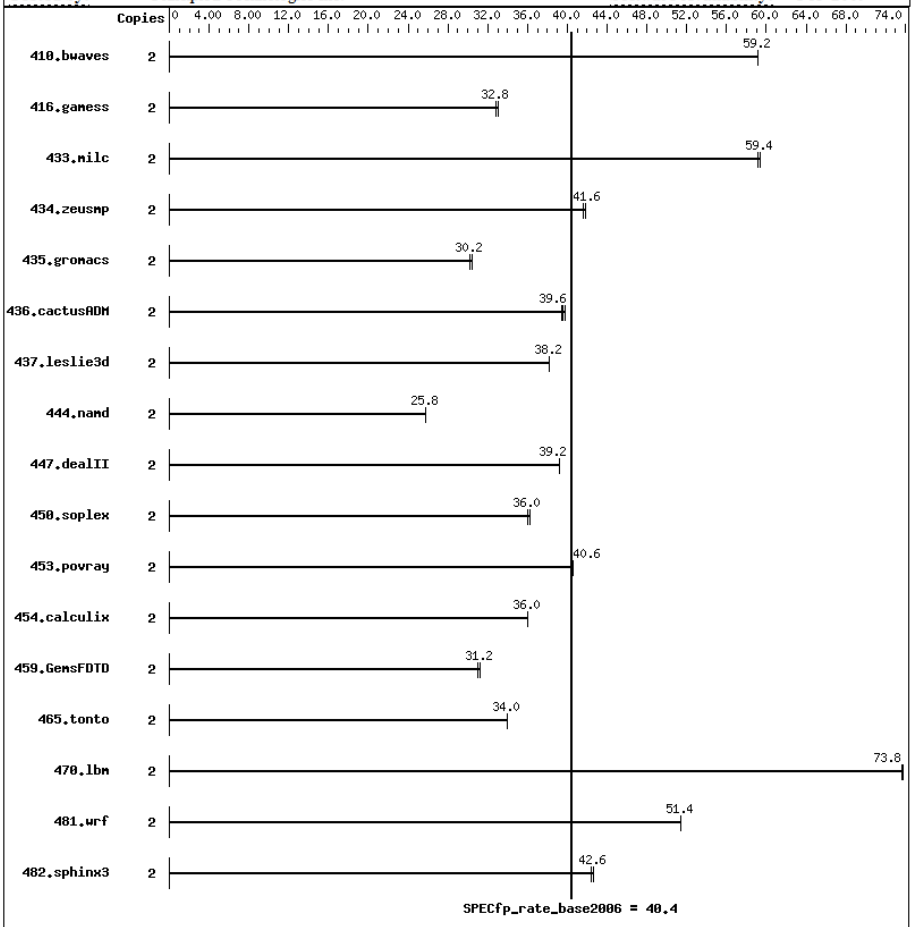
Copyright 2006-2008 Standard Performance Evaluation Corporation

Dell Inc.
Dell Precision T3500 (Intel Xeon W3503, 2.40 GHz)

SPECfp® rate2006 = Not Run
SPECfp_rate_base2006 = 40.4

CPU2006 license: 3184
Test sponsor: Dell Inc.
Tested by: Principled Technologies Inc.

Test date: May-2011
Hardware Availability: Apr-2009
Software Availability: Feb-2009



Hardware

CPU Name:	Intel Xeon W3503
CPU Characteristics:	
CPU MHz:	2400
FPU:	Integrated
CPU(s) enabled:	2 cores, 1 chip, 2 cores/chip
CPU(s) orderable:	1 chip
Primary Cache:	32 KB I + 32 KB D on chip per core
Secondary Cache:	256 KB I+D on chip per core
L3 Cache:	4 MB I+D on chip per chip
Other Cache:	None
Memory:	4 GB (4x1 GB DDR3-8500E)
Disk Subsystem:	1 x 500 GB SATA 7200 RPM
Other Hardware:	None

Software

Operating System:	Windows 7 Ultimate w/ SP1 (64-bit)
Compiler:	Intel C++ Compiler XE for IA-32 Version 12.0.4.196 Build 20110427 Intel Visual FORTRAN Compiler XE for IA-32 Version 12.0.4.196 Build 20110427 Microsoft Visual Studio 2008 Professional SP1 (for libraries)
Auto Parallel:	No
File System:	NTFS
System State:	Default
Base Pointers:	32-bit
Peak Pointers:	32-bit
Other Software:	MicroQuill SmartHeap Library 10 (Multi-Core) from http://www.microquill.com/

HP Pavilion Elite HPE-500 (AMD Athlon II X4)

SPEC® CINT2006 Result

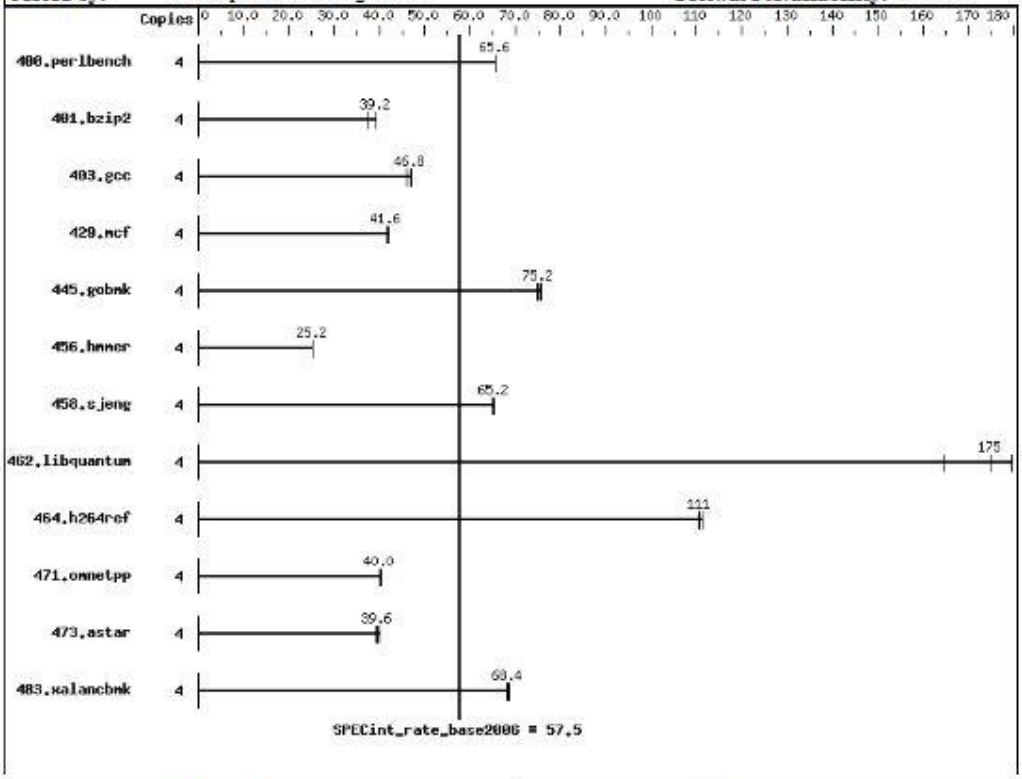
Copyright 2006-2008 Standard Performance Evaluation Corporation

Hewlett-Packard Company
HP Pavilion Elite HPE-500z (AMD Phenom II X4 640)

SPECint®_rate2006 =Not Run
SPECint_rate_base2006 = 57.5

CPU2006 license: 3184
Test sponsor: Dell Inc.
Tested by: Principled Technologies Inc.

Test date: May-2011
Hardware Availability: Apr-2009
Software Availability: Feb-2011



Hardware

CPU Name:	AMD Phenom II X4 640
CPU Characteristics:	
CPU MHz:	3000
FPU:	Integrated
CPU(s) enabled:	4 cores, 1 chip, 4 cores/chip
CPU(s) orderable:	1 chip
Primary Cache:	32 KB I + 32 KB D on chip per core
Secondary Cache:	512 KB I+D on chip per core
L3 Cache:	None
Other Cache:	None
Memory:	4 GB (2x2GB PC3-10600U)
Disk Subsystem:	Hitachi 750 GB SATA, 7200RPM
Other Hardware:	None

Software

Operating System:	Windows 7 Ultimate w/ SP1 (64-bit)
Compiler:	Intel C++ Compiler XE for IA32 Version 12.0.4.196 Build 20110427 Microsoft Visual Studio 2008 Professional SP1 (for libraries)
Auto Parallel:	No
File System:	NTFS
System State:	Default
Base Pointers:	32-bit
Peak Pointers:	32-bit
Other Software:	SmartHeap Library Version 10 (Multi-Core) from http://www.microquill.com/

SPEC® CFP2006 Result

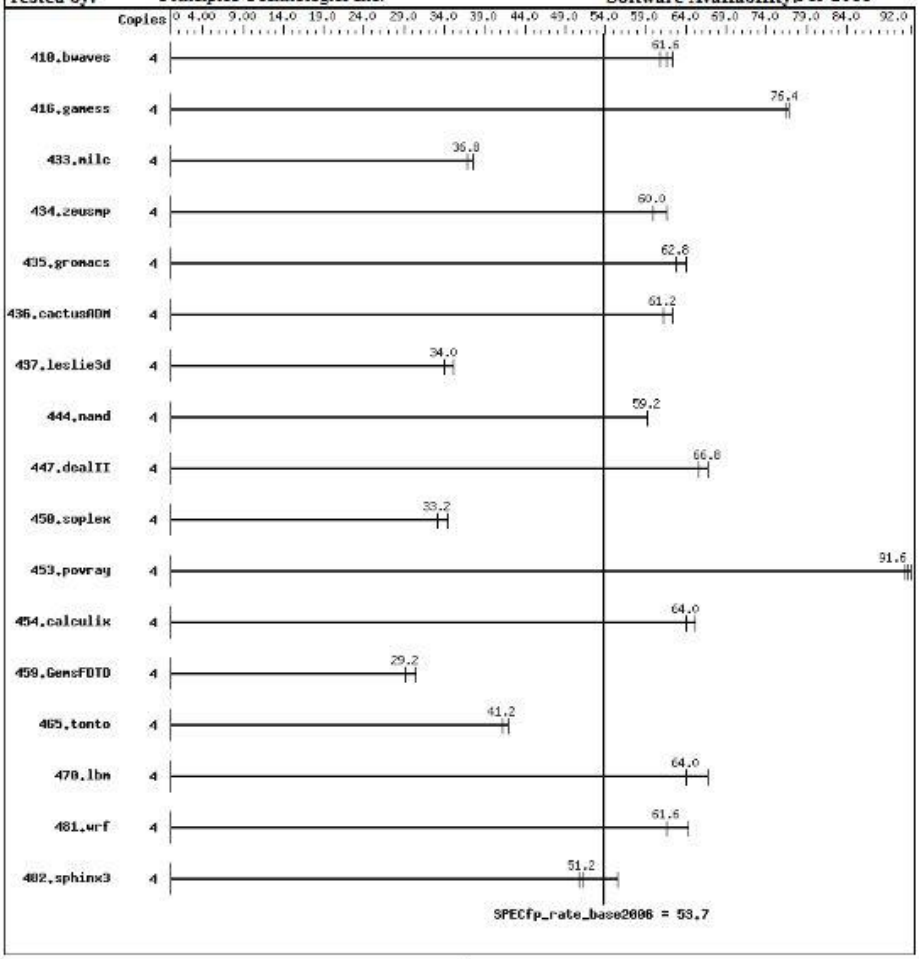
Copyright 2006-2008 Standard Performance Evaluation Corporation

Hewlett-Packard Company
HP Pavilion Elite HPE-500z (AMD Phenom II X4 640)

SPECfp®_rate2006 = Not Run
SPECfp_rate_base2006 = 53.7

CPU2006 license: 3184
Test sponsor: Dell Inc.
Tested by: Principled Technologies Inc.

Test date: May-2011
Hardware Availability: Apr-2009
Software Availability: Feb-2011



Hardware

CPU Name:	AMD Phenom II X4 640
CPU Characteristics:	
CPU MHz:	3000
FPU:	Integrated
CPU(s) enabled:	4 cores, 1 chip, 4 cores/chip
CPU(s) orderable:	1 chip
Primary Cache:	32 KB I + 32 KB D on chip per core
Secondary Cache:	512 KB I+D on chip per core
L3 Cache:	None
Other Cache:	None
Memory:	4 GB (2x2GB PC3-10600U)
Disk Subsystem:	Hitachi 750 GB SATA, 7200RPM
Other Hardware:	None

Software

Operating System:	Windows 7 Ultimate w/ SP1 (64-bit)
Compiler:	Intel C++ Compiler XE for IA32 Version 12.0.4.196 Build 20110427 Intel Visual Fortran Compiler XE for IA32 Version 12.0.4.196 Build 20110427 Microsoft Visual Studio 2008 Professional SP1 (for libraries)
Auto Parallel:	No
File System:	NTFS
System State:	Default
Base Pointers:	32-bit
Peak Pointers:	32-bit
Other Software:	SmartHeap Library Version 10 (Multi-Core) from http://www.microquill.com/

High-end systems

Dell Precision T7500 (Intel Xeon X5690)

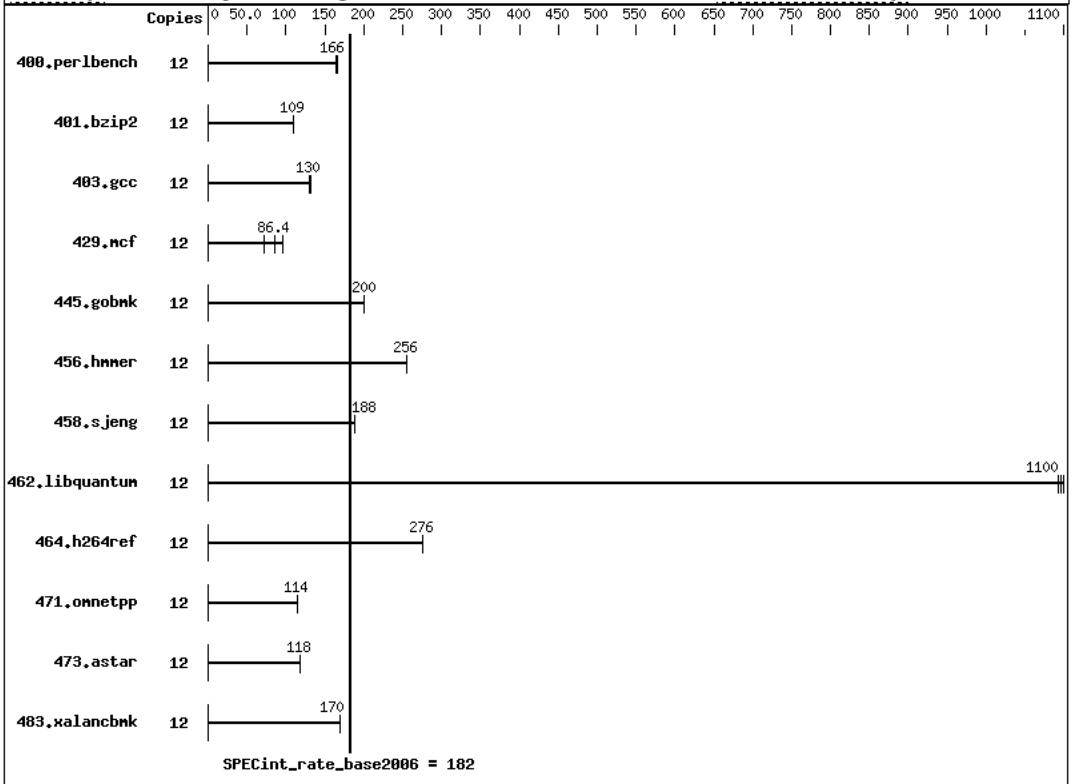
SPEC® CINT2006 Result

Copyright 2006-2008 Standard Performance Evaluation Corporation

Dell Inc.
Dell Precision T7500 (Intel Xeon X5690, 3.46 GHz)

SPECint®_rate2006 = Not Run
SPECint_rate_base2006 = 182

CPU2006 license:	3184	**Test date:**	May-2011
Test sponsor:	Dell Inc.	**Hardware Availability:**	Mar-2010
Tested by:	Principled Technologies Inc.	**Software Availability:**	Dec-2009



Hardware

CPU Name:	Intel Xeon X5690
CPU Characteristics:	Intel Turbo Boost Technology up to 3.73 GHz
CPU MHz:	3460
FPU:	Integrated
CPU(s) enabled:	6 cores, 1 chip, 6 cores/chip, 2 threads/core
CPU(s) orderable:	1 chip
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:	6 GB (6X1 GB PC3-10600R)
Disk Subsystem:	1 x 256 GB SATA SSD
Other Hardware:	None

Software

Operating System:	Windows 7 Ultimate w/ SP1 (64-bit)
Compiler:	Intel C++ Compiler XE for IA-32 Version 12.0.4.196 Build 20110427 Microsoft Visual Studio 2008 Professional SP1 (for libraries)
Auto Parallel:	No
File System:	NTFS
System State:	Default
Base Pointers:	32-bit
Peak Pointers:	32-bit
Other Software:	MicroQuill SmartHeap Library 10 (Multi-Core) from http://www.microquill.com/

SPEC® CFP2006 Result

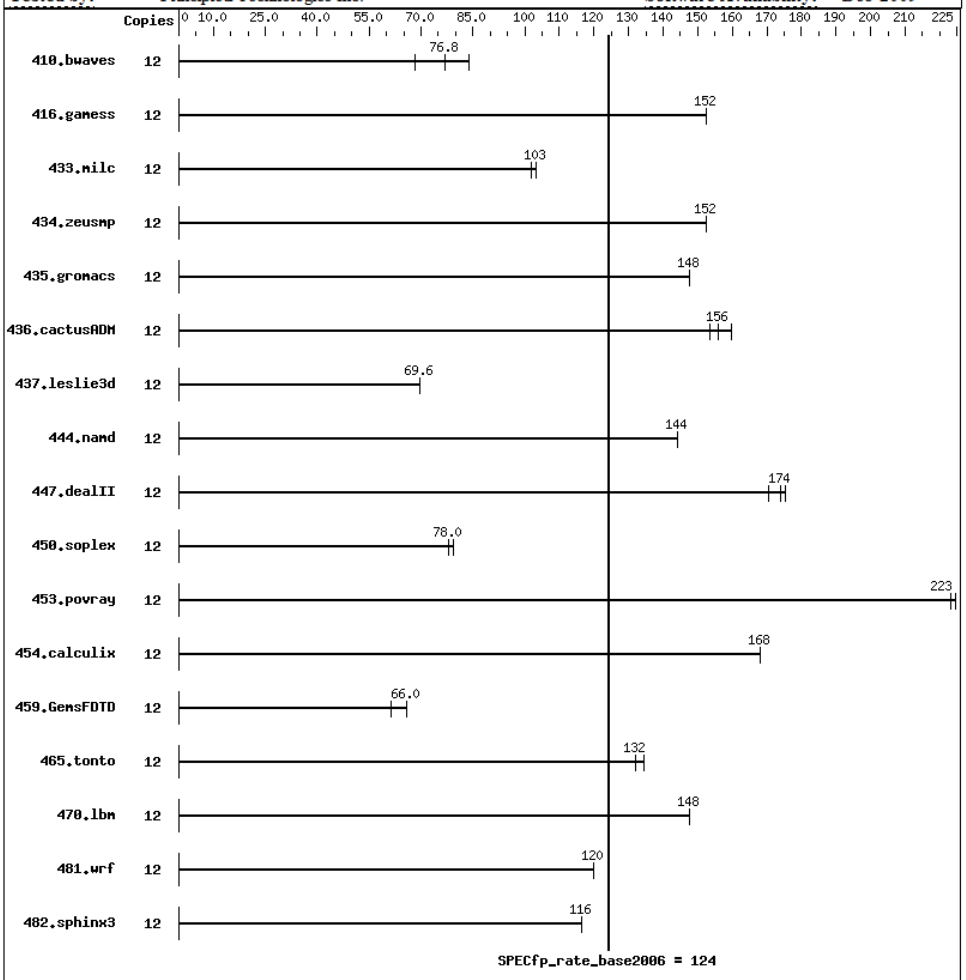
Copyright 2006-2008 Standard Performance Evaluation Corporation

Dell Inc.
Dell Precision T7500 (Intel Xeon X5690, 3.46 GHz)

SPECfp® rate2006 = Not Run
SPECfp_rate_base2006 = 124

CPU2006 license: 3184
Test sponsor: Dell Inc.
Tested by: Principled Technologies Inc.

Test date: May-2011
Hardware Availability: Mar-2010
Software Availability: Dec-2009



Hardware

CPU Name:	Intel Xeon X5690
CPU Characteristics:	Intel Turbo Boost Technology up to 3.73 GHz
CPU MHz:	3460
FPU:	Integrated
CPU(s) enabled:	6 cores, 1 chip, 6 cores/chip, 2 threads/core
CPU(s) orderable:	1 chip
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:	6 GB (6X1 GB PC3-10600R)
Disk Subsystem:	1 x 256 GB SATA SSD
Other Hardware:	None

Software

Operating System:	Windows 7 Ultimate w/ SP1 (64-bit)
Compiler:	Intel C++ Compiler XE for IA-32 Version 12.0.4.196 Build 20110427 Intel Visual FORTRAN Compiler for IA32 Version 12.0.4.196 Build 20110427 Microsoft Visual Studio 2008 Professional SP1 (for libraries)
Auto Parallel:	No
File System:	NTFS
System State:	Default
Base Pointers:	32-bit
Peak Pointers:	32-bit
Other Software:	MicroQuill SmartHeap Library 10 (Multi-Core) from http://www.microquill.com/

HP Pavilion Elite HPE-560z (AMD Phenom II)

SPEC® CINT2006 Result

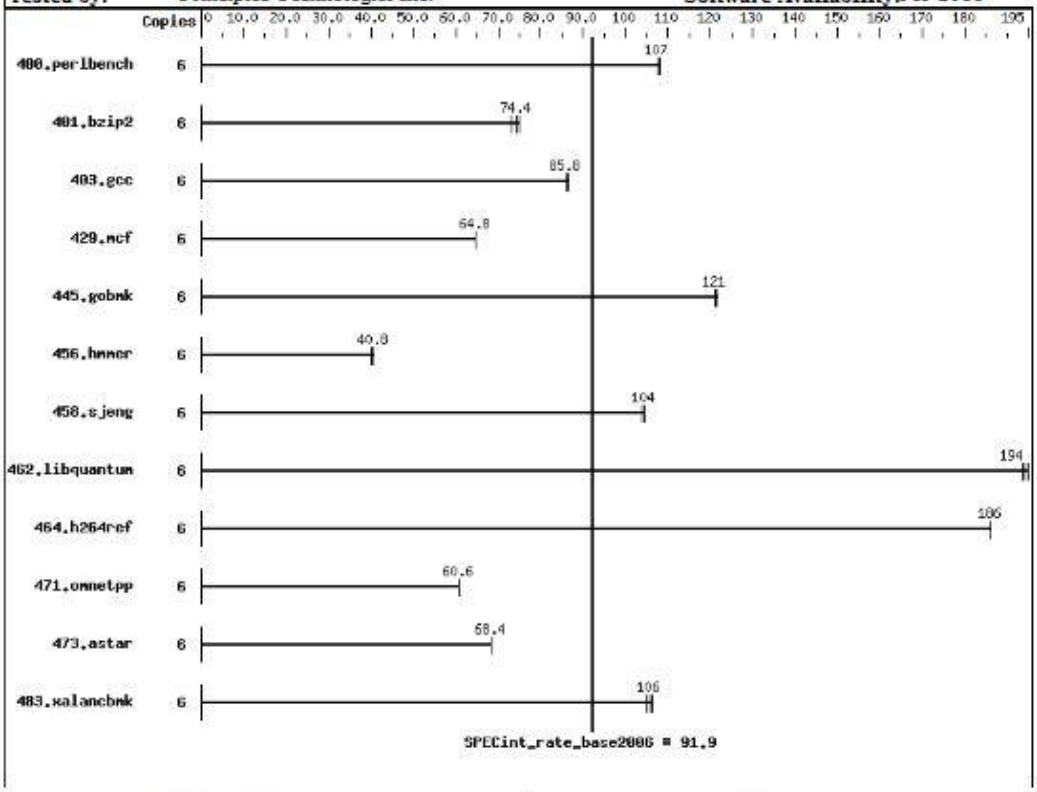
Copyright 2006-2008 Standard Performance Evaluation Corporation

Hewlett-Packard Company
HP Pavilion Elite HPE-560z (AMD Phenom II X4 1090)

SPECint® rate2006 =Not Run
SPECint_rate_base2006 = 91.9

CPU2006 license: 3184
Test sponsor: Dell Inc.
Tested by: Principled Technologies Inc.

Test date: May-2011
Hardware Availability: Jan-2011
Software Availability: Feb-2011



Hardware

CPU Name:	AMD Phenom II X4 1090
CPU Characteristics:	
CPU MHz:	3200
FPU:	Integrated
CPU(s) enabled:	6 cores, 1 chip, 6 cores/chip
CPU(s) orderable:	1 chip
Primary Cache:	64 KB I + 64 KB D on chip per core
Secondary Cache:	512 KB I+D on chip per core
L3 Cache:	6 MB I+D on chip per chip
Other Cache:	None
Memory:	8 GB (4x2GB PC3-10600)
Disk Subsystem:	2 x Seagate 1000 GB SATA, 7200RPM
Other Hardware:	None

Software

Operating System:	Windows 7 Ultimate w/ SP1 (64-bit)
Compiler:	Intel C++ Compiler XE for IA32 Version 12.0.4.196 Build 20110427 Microsoft Visual Studio 2008 Professional SP1 (for libraries)
Auto Parallel:	No
File System:	NTFS
System State:	Default
Base Pointers:	32-bit
Peak Pointers:	32-bit
Other Software:	SmartHeap Library Version 10 (Multi-Core) from http://www.microquill.com/

SPEC® CFP2006 Result

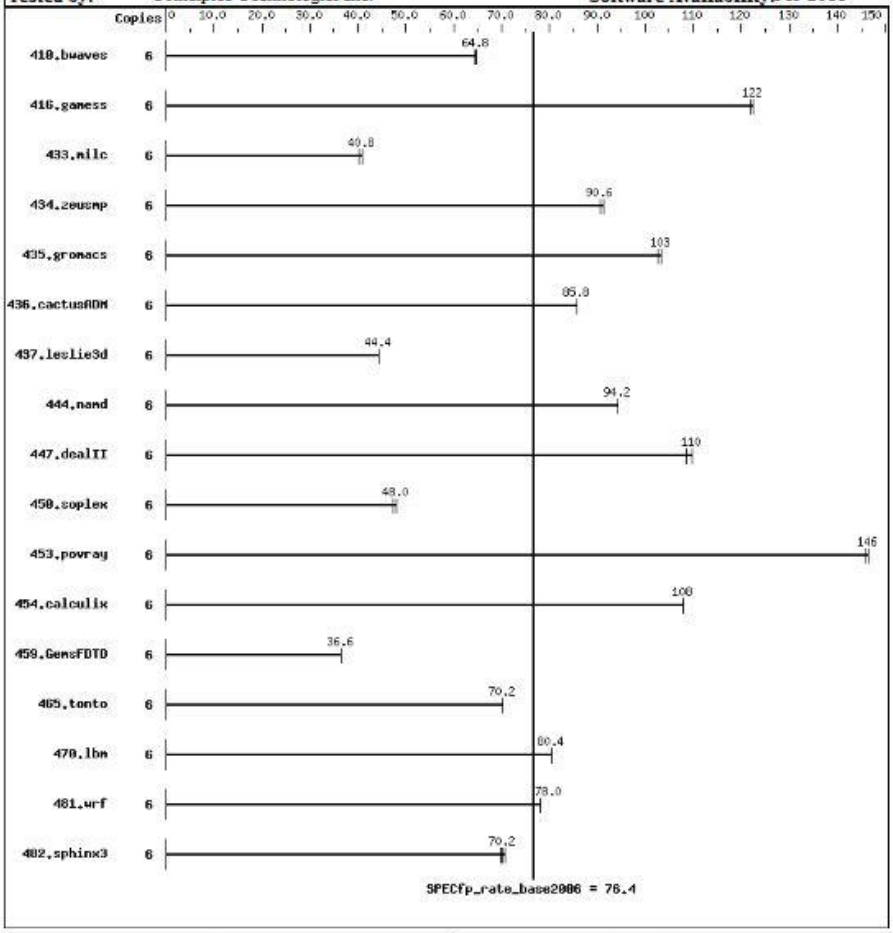
Copyright 2006-2008 Standard Performance Evaluation Corporation

Hewlett-Packard Company
HP Pavilion Elite HPE-560z (AMD Phenom II X4 1090)

SPECfp® _rate2006 = Not Run
SPECfp_rate_base2006 = 76.4

CPU2006 license: 3184
Test sponsor: Dell Inc.
Tested by: Principled Technologies Inc.

Test date: May-2011
Hardware Availability: Jan-2011
Software Availability: Feb-2011



Hardware

CPU Name:	AMD Phenom II X4 1090
CPU Characteristics:	
CPU MHz:	3200
FPU:	Integrated
CPU(s) enabled:	6 cores, 1 chip, 6 cores/chip
CPU(s) orderable:	1 chip
Primary Cache:	64 KB I + 64 KB D on chip per core
Secondary Cache:	512 KB I+D on chip per core
L3 Cache:	6 MB I+D on chip per chip
Other Cache:	None
Memory:	8 GB (4x2GB PC3-10600)
Disk Subsystem:	2 x Seagate 1000 GB SATA, 7200RPM
Other Hardware:	None

Software

Operating System:	Windows 7 Ultimate w/ SP1 (64-bit)
Compiler:	Intel C++ Compiler XE for IA32 Version 12.0.4.196 Build 20110427 Intel Visual Fortran Compiler XE for IA32 Version 12.0.4.196 Build 20110427 Microsoft Visual Studio 2008 Professional SP1 (for libraries)
Auto Parallel:	No
File System:	NTFS
System State:	Default
Base Pointers:	32-bit
Peak Pointers:	32-bit
Other Software:	SmartHeap Library Version 10 (Multi-Core) from http://www.microquill.com/

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1007 Slater Road, Suite 300
Durham, NC, 27703
www.principledtechnologies.com

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