



Desktop system processors: Performance increase from upgrading to current Intel Core i5 Processor-based systems

Test report commissioned by Intel Corp. July 2010

Executive summary

Businesses upgrade their employees' desktop systems to maximize productivity. In Principled Technologies' tests in our labs, the current-generation Intel® Core™ i5-650 Processor-based desktop system delivered better performance than the current-generation, triple-core, AMD Phenom™ II X3 B75-based system and two previous generation Intel processor-based systems on a range of tests. Because better system performance—executing tasks more quickly—translates to increased user productivity, our results show that companies can benefit significantly from upgrading to an Intel Core i5-650 Processor-based system.

To gauge how well each desktop system would perform for typical business users, we used the SYSmark® 2007 Preview v1.06 (SYSmark) benchmark. We also used the following application-based tests, which Intel selected to represent realistic desktop system usage:

- Multitasking test in Microsoft® Office® Excel® 2007 (Excel) using Monte Carlo Black-Scholes, and WinZip® 14
- Big Number Crunch in Microsoft Office Excel 2007 using the Big Number Crunch XLSM file

KEY FINDINGS

- The Intel Core i5-650 Processor-based system performed better across all tests than the AMD Phenom II X3 B75-based system: 21.0% better SYSmark performance, 43.9% faster Excel and WinZip multitasking performance, and 50.0% faster Excel Big Number Crunch performance. (See Figure 1.)
- The Intel Core i5-650 Processor-based system performed better across all tests than the Intel Core 2 Duo Processor E8400-based system: 7.3 percent better SYSmark rating, 36.6 percent faster Excel and WinZip multitasking performance, and 25.0 percent faster Excel Big Number Crunch performance. (See Figure 2.)
- The Intel Core i5-650 Processor-based system performed better across all tests than the Intel Pentium Processor E6300-based system: 31.0% better SYSmark performance, 73.2% faster Excel and WinZip multitasking performance, and 113.0% faster Excel Big Number Crunch performance. (See Figure 3.)

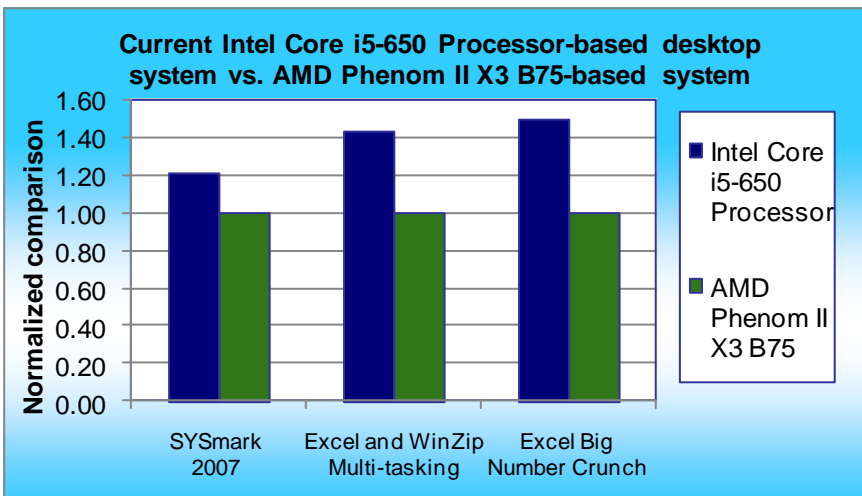


Figure 1: Normalized test results for the Intel Core i5-650 Processor-based system and the AMD Phenom II X3 B75-based system. Higher numbers are better.

In all three tests, the Intel Core i5-650 Processor-based system significantly outperformed the current-generation AMD Phenom II X3 B75-based system and the previous-generation Intel Core 2 Duo Processor E8400-based system and Intel Pentium Processor E6300-based system.

Figure 1 displays normalized test results, which show the Intel Core i5-650 Processor-based system performance increase over the AMD Phenom II X3 B75-based system: 21.0 percent greater SYSmark rating, 43.9 percent faster Excel and WinZip multitasking performance, and 50.0 percent faster Excel Big Number Crunch performance.

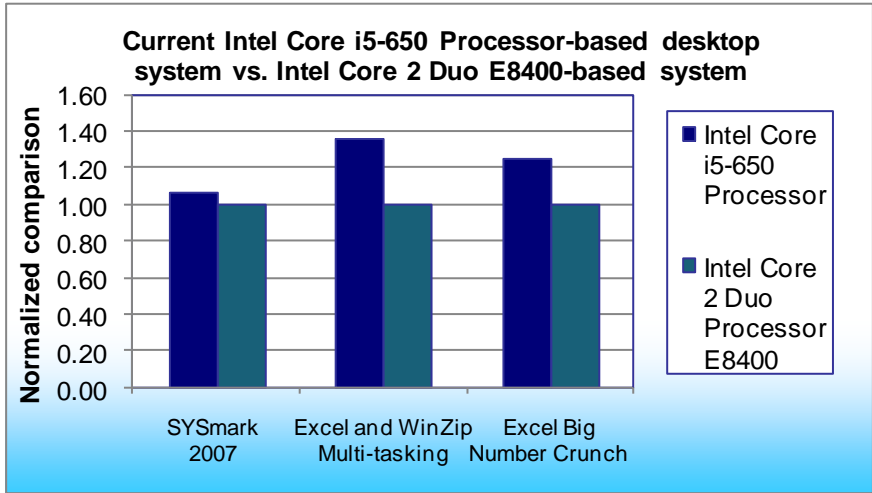


Figure 2: Normalized test results for the Intel Core i5-650 Processor-based system and the Intel Core 2 Duo Processor E8400-based system. Higher numbers are better.

Figure 2 displays normalized test results, which show the Intel Core i5-650 Processor-based system performance increase over the Intel Core 2 Duo Processor E8400-based system: 7.3 percent greater SYSmark rating, 36.6 percent faster Excel and WinZip multitasking performance, and 25.0 percent faster Excel Big Number Crunch performance.

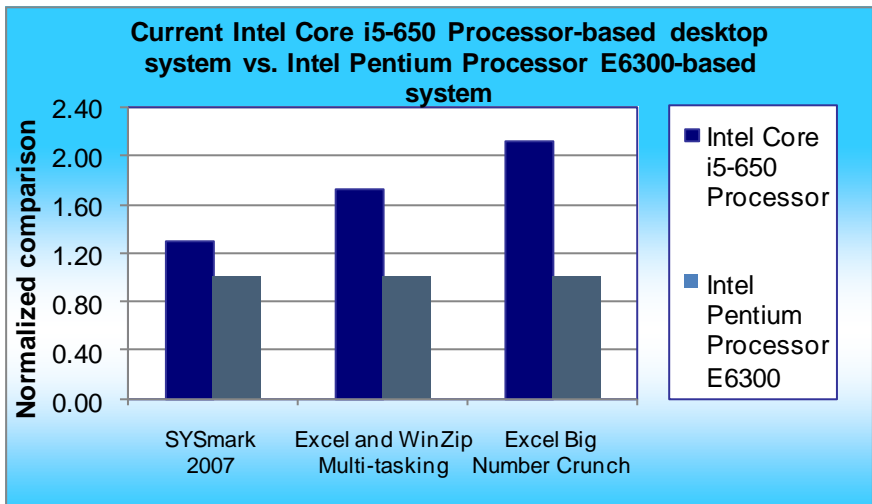


Figure 3: Normalized test results for the Intel Core i5-650 Processor-based system and the Intel Pentium Processor E6300-based system. Higher numbers are better.

Figure 3 displays the normalized test results, which show the Intel Core i5-650 Processor-based system performance increase over the Intel Pentium Processor E6300-based system: 31.0% better SYSmark performance, 73.2% faster Excel and WinZip multitasking performance, and 113.0% faster Excel Big Number Crunch performance.

In the following sections, we present the results of our tests (Test results), look more closely at our benchmark and application-based tests, and give detailed information about how we actually performed the tests (Test methodology). In Appendix A, we present the configurations of the test systems.

Test results

Figure 4 shows the SYSmark rating and the median time, in seconds, each desktop system took to complete each of the two custom application-based tests. We conducted each test five times and report the median time for each system. A higher SYSmark rating is better, while lower Excel application test times are better.

Desktop systems	Benchmark and application-based tests		
	SYSmark 2007 Preview v1.06 Rating	Microsoft Office 2007 Excel Monte Carlo & WinZip 14 multi-tasking (minutes:seconds)	Microsoft Office 2007 Excel Big Number Crunch (seconds)
Intel Core i5-650 Processor-based system	190	00:41	08
AMD Phenom II X3 B75-based system	157	00:59	12
Intel Core 2 Duo Processor E8400-based system	177	00:56	10
Intel Pentium Processor E6300-based system	145	01:11	17

Figure 4: Benchmark and application-based test results for the desktop systems. A higher SYSmark rating is better, while lower Excel application test times are better.

Benchmark and application-based tests

We selected the SYSmark benchmark, while Intel provided the two application-based tests, the results of which illustrate the benefits of a switching to a desktop system with an upgraded processor.

Each test involves one or more basic operations, such as copying a folder or opening files. The results for the test are the response times for each of these operations. We used realistic operations and content for all tests.

Performance measurement using BAPCo SYSmark 2007 Preview v1.06 benchmark

We used BAPCo's SYSmark 2007 Preview v1.06 to test processor performance in four office workloads: e-learning, office productivity, video creation, and 3D modeling. SYSmark 2007 determines its overall rating from the mean result of the workloads, recording the time the system takes to complete each individual operation for each workload.

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 about the SYSmark benchmark, visit <http://www.bapco.com/support/sysmark2007preview/Help/Help.html>.

Multitasking test in Microsoft Office Excel 2007 using Monte Carlo Black-Scholes and WinZip 14

For our multitasking test, we used the Monte Carlo Black-Scholes mathematical simulation running in Microsoft Office Excel 2007 while WinZip 14 decompresses an encrypted archive of 75 JPEG images. 300,000 instances of the Monte Carlo-Black Scholes mathematical simulation run in Excel, where they calculate hypothetical call and put prices, and use Excel's lookup functions to compare these prices against historical market prices.

Big Number Crunch test in Microsoft Office Excel 2007 using the Big Number Crunch XLSM file

We used the Excel Big Number Crunch workload to test processor performance while Excel performs common calculations like addition, subtraction, division, rounding, and square root. This workload runs approximately

28,000 sets of calculations. We determine processor performance by the task time Excel took to complete the Big Number Crunch workload.

Test methodology

We provide the methodology for two groups of tests: industry-standard benchmark tests (SYSmark 2007), and application-based tests (Microsoft Office Excel 2007 Monte Carlo Black-Scholes + WinZip 14 multitasking test and Microsoft Office Excel 2007 Big Number Crunch). We captured ghost images of factory OEM images as they arrived and used these images as the base for all systems in this study.

Using the base test image

With the exception of SYSmark 2007, which required us to remove conflicting applications, We conducted all testing on the original factory image. We used Symantec's Ghost solution to reset the system to the factory OEM image before we ran each test.

Industry-standard benchmarks

BAPCo SYSmark 2007 Preview v1.06

Setting up the SYSmark 2007

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 v1.06 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.
9. Run the BAPCo auto-configuration tool v1.3.2:
 - a. Click the BAPCo auto-configuration batch file.
 - b. Choose S to select SYSmark 2007.
 - c. Choose option 3 in order to produce the most consistent scores.
10. Reboot the system.

Running the SYSmark 2007

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.
5. Record the results.

Application-based tests

Microsoft Office Excel 2007 Monte Carlo Black-Scholes + WinZip 14 multitasking test

Intel provided the following files that this test uses:

- MonteCarloBlackScholesOptionPricing.xlsm. The file size is 70.1 MB (73,607,121 bytes)
- 75.zip. The file size is 375 MB (393,691,136 bytes)

We performed the following steps to set up and run this test:

Setting up the Excel and WinZip multitasking test

1. Reset the system to the base test image.
2. Copy the MonteCarloBlackScholesOptionPricing.xlsm test file to the Documents directory.
3. Copy the 75.zip test file to the Documents directory.
4. Install Microsoft Office 2007 Ultimate Edition with default settings:
 - a. At the Enter your Product Key screen, enter the product key, and click Continue.
 - b. At the License Agreement screen, select I accept the terms of this agreement, and click Continue.
 - c. At the Microsoft Office Ultimate 2007 has been successfully installed screen, click Close.
5. Launch Microsoft Office Excel 2007 by clicking Start→All Programs→Microsoft Office→Microsoft Office Excel 2007.
6. Select I want to activate the software over the Internet, and click Next.
7. Click Finish.
8. Uncheck Search Microsoft Office Online for Help content when I'm connected to the Internet, and click Next.
9. Select I don't want to use Microsoft Update, and click Finish.
10. Click the Microsoft Office button located in the top left.
11. Click Excel Options.
12. Click Trust Center, located in the left column.
13. Click the Trust Center Settings button.
14. Click Macro Settings located in the left column, and select Enable all macros.
15. Click OK.
16. Close Excel.
17. Purchase WinZip 14 from <http://www.winzip.com/index.htm>.
18. Install WinZip 14 with default settings.
19. Double-click the WinZip icon on your desktop to launch WinZip.
20. Enter the registration information, and click Register.
21. Select Never show tips at startup from the WinZip Tip of the Day dialog box, and click Close.
22. Close WinZip 14.
23. Reboot the system.
24. Run disk defragmenter by clicking Start→All Programs→Accessories→System Tools→Disk Defragmenter.
25. Delete the contents of C:\Windows\Prefetch.

Running the Excel and WinZip multitasking test

1. Launch Microsoft Office Excel 2007 by clicking Start→All Programs→Microsoft Office→Microsoft Office Excel 2007.
2. Press Ctrl+O.
3. Locate the MonteCarloBlackScholesOptionPricing.xlsm workload file, and click Open.
4. Double-click the WinZip icon on your desktop to launch WinZip.
5. Click the Open button to open an archive.
6. Navigate to the directory where the archive is located, and select the archive by pressing Enter.
7. Leave the password field blank, and click Cancel.
8. Select all the contents of the archive, and click Extract to extract the contents.
9. Select Documents as the target location for extraction, and click Extract.
10. When the application prompts you to do so, enter the password.
11. Type `rundll32.exe advapi32.dll,ProcessIdleTasks` in the Start Search command prompt.
12. Type `perfmon` in the Start Search command prompt.
13. Expand and watch the Disk Monitor. When there are no more disk requests, close Perfmon.
14. Bring Excel to the foreground, and press Ctrl+R to begin the Excel recalculation.
15. Press Alt+Tab to bring WinZip to the foreground.
16. Simultaneously start the stopwatch and press OK.
17. Stop the stopwatch when the progress bar dialog box closes.

18. Record this as the time to complete the decompression of the WinZip archive.
19. When the Excel recalculation completes, a dialog reports the execution time of the test.
Record this as the time it takes to complete the recalculation, and click OK to close Excel.
20. Repeat steps 1 through 19 four more times without rebooting between runs.

Microsoft Office Excel 2007 Big Number Crunch

Intel provided the file this test uses: BigNumberCrunch.xlsx. The file size is 6.24 MB (6,543,413 bytes).

We performed the following steps to set up and run this test:

Setting up Excel 2007 Big Number Crunch

1. Reset the system to the base test image.
2. Copy the BigNumberCrunch.xlsx test file to the My Documents directory.
3. Install Microsoft Office 2007 Ultimate Edition with default settings:
 - a. At the Enter your Product Key screen, enter the product key, and click Continue.
 - b. At the License Agreement screen, select I accept the terms of this agreement, and click Continue.
 - c. At the Microsoft Office Ultimate 2007 has been successfully installed screen, click Close.
4. Launch Microsoft Office Excel 2007 by clicking Start→All Programs→Microsoft Office→Microsoft Office Excel 2007.
5. Uncheck Search Microsoft Office Online for Help content when I'm connected to the Internet, and click Next.
6. Select I don't want to use Microsoft Update, and click Finish.
7. Click the Microsoft Office button located in the top left.
8. Click Excel Options.
9. Click Trust Center located in the left column.
10. Click the Trust Center Settings button.
11. Click Macro Settings located in the left column, and select Enable all macros.
12. Click OK.
13. Close Excel.
14. Reboot the system.
15. Run disk defragmenter by clicking Start→All Programs→Accessories→System Tools→Disk Defragmenter.
16. Delete the contents of C:\Windows\Prefetch.

Running Excel 2007 Big Number Crunch

1. Launch Microsoft Office Excel 2007 by clicking Start→All Programs→Microsoft Office→Microsoft Office Excel 2007.
2. Press Ctrl+O.
3. Locate the BigNumberCrunch.xlsx workload file, and click Open.
4. Type `rundll32.exe advapi32.dll,ProcessIdleTasks` in the Start Search command prompt.
5. Type `perfmon` in the Start Search command prompt.
6. Expand and watch the Disk Monitor. When there are no more disk requests, close Perfmon.
7. Press Ctrl+R on the keyboard to start the test.
8. Record the results, and click OK.
9. Close Excel. Click No to saving results made to file.
10. Repeat steps 1 through 9 four more times without rebooting between runs.

Appendix A – Test system information

Figures 5 and 6 provide detailed configuration for the desktop systems we tested.

System	Intel Core i5-650 Processor-based system	AMD Phenom II X3 B75-based system	Intel Core 2 Duo Processor E8400-based system	Intel Pentium Processor E6300-based system
General				
Make and model	HP Compaq 8100 Elite Convertible Minitower	HP Compaq 6005 Pro Microtower	HP Compaq 8000 Elite Convertible Minitower	HP Compaq 6000 Pro Microtower
Processor and OS kernel: (physical, core, logical)/(UP, MP)	1P2C4L/MP	1P3C3L/MP	1P2C2L/MP	1P2C2L/MP
Number of physical processors	1	1	1	1
Single/dual/quad-core processors	Dual-core with HyperThreading	Triple-core	Dual	Dual-core
System power management policy	Balanced	Balanced	Balanced	Balanced
CPU				
Vendor	Intel	AMD	Intel	Intel
Name	Core i5	Phenom II X3	Core 2 Duo	Pentium
Model number	650	B75	E8400	E6300
Stepping	C2	RB-C2	E0	R0
Socket type	Socket LGA1156	Socket AM3 (938)	Socket LGA775	Socket LGA775
Core frequency (GHz)	3.2	3.0	3.0	2.8
Front-side bus frequency	2.5 GT/s DMI	HT Link 2000	1,333 MHz	1,066 MHz
L1 cache	2 x 32 KB + 2 x 32 KB	3 x 64 KB + 3 x 64 KB	2 x 32 KB + 2 x 32 KB	2 x 32 KB + 2 x 32 KB
L2 cache	2 x 256 KB	3 x 512 KB	6 MB	2 MB
L3 cache	4 MB	6 MB	N/A	N/A
Platform				
Vendor and model number	Hewlett-Packard	Hewlett-Packard	Hewlett-Packard	Hewlett-Packard
Motherboard model number	304Bh	3047h	3647h	3048h
Motherboard chipset	Intel Q57	AMD 785GX	Intel Q45	Intel Q45
Motherboard revision number	02	00	03	03
Motherboard serial number	2UA011158N	2UA011158P	2UA0111595	2UA0111594
BIOS name and version	Hewlett-Packard 786H1 v01.02 (12/16/2009)	Hewlett Packard 786G6 v01.03 (08/25/2009)	Hewlett-Packard 786G7 v01.02 (10/22/2009)	Hewlett-Packard 786G2 v01.09 (08/25/2009)
BIOS settings	Default	Default	Default	Default
Memory module(s)				
Vendor and model number	Elpida EBJ21UE8BDF0-DJ-F	Elpida EBJ21UE8BDF0-DJ-F	Elpida EBJ21UE8BDF0-DJ-F	Elpida EBJ21UE8BDF0-DJ-F
Type	PC3-10600	PC3-10600	PC3-10600	PC3-10600
Speed (MHz)	1,333	1,333	1,333	1,333

System	Intel Core i5-650 Processor-based system	AMD Phenom II X3 B75-based system	Intel Core 2 Duo Processor E8400-based system	Intel Pentium Processor E6300-based system
Speed running in the system (MHz)	1,333	1,333	1,066	1,066
Timing/latency (tCL-tRCD-tRP-tRASmin)	9-9-9-24	9-9-9-24	7-7-7-20	7-7-7-20
Size (MB)	4,096	4,096	4,096	4,096
Number of memory module(s)	2 x 2GB	2 x 2GB	2 x 2GB	2 x 2GB
Chip organization	Double-sided	Double-sided	Double-sided	Double-sided
Channel	Dual	Dual	Dual	Dual
Hard disk				
Vendor and model number	Western Digital WD3200AAJS-60M0A1	Western Digital WD3200AAJS-60M0A1	Western Digital WD3200AAJS-60M0A1	Western Digital WD3200AAJS-60M0A1
Size (GB)	320	320	320	320
Buffer size (MB)	8	8	8	8
RPM	7,200	7,200	7,200	7,200
Type	SATA	SATA	SATA	SATA
Controller	Intel 5 Series/3400 Series SATA AHCI Controller	ATI Technologies SB700 SATA Controller (AHCI mode)	Intel ICH10D/DO SATA AHCI Controller	Intel ICH10D/DO SATA AHCI Controller
Controller driver	Intel 9.5.0.1037 (10/02/2009)	Microsoft 6.1.7600.16385 (6/21/2006)	Intel 8.9.0.1023 (06/04/2009)	Intel 8.9.0.1023 (06/04/2009)
Operating system				
Name	Microsoft Windows 7 Professional	Microsoft Windows 7 Professional	Microsoft Windows 7 Professional	Microsoft Windows 7 Professional
Build number	7600	7600	7600	7600
File system	NTFS	NTFS	NTFS	NTFS
Kernel	ACPI-x86 based PC	ACPI-x86 based PC	ACPI-x86 based PC	ACPI-x86 based PC
Language	English	English	English	English
Microsoft DirectX version	11.0	11.0	11.0	11.0
Graphics				
Vendor and model number	Intel Graphics Media Accelerator HD	ATI Radeon HD 4200	Intel Q45 Express Chipset	Intel Q45 Express Chipset
Type	Integrated	Integrated	Integrated	Integrated
Chipset	Intel Graphics Media Accelerator HD (Core i5)	HD 4200	Intel 4 Series Express Chipset Family	Intel 4 Series Express Chipset Family
BIOS version	1931.0	BK-ATI VER010.094.001.030.033760	1800.0	1800.0
Total available graphics memory (MB)	1,563	1,663	1,547	1,547
Dedicated graphics memory (MB)	64	384	32	32

System	Intel Core i5-650 Processor-based system	AMD Phenom II X3 B75-based system	Intel Core 2 Duo Processor E8400-based system	Intel Pentium Processor E6300-based system
System video memory (MB)	0	0	32	32
Shared system memory (MB)	1,499	1,279	1,483	1,483
Resolution	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024
Driver	Intel 8.15.10.1995 (11/6/2009)	ATI 8.632.0.0 (07/02/2009)	Intel 8.15.10.1855 (07/28/2009)	Intel 8.15.10.1855 (07/28/2009)
Sound card/subsystem				
Vendor and model number	Realtek High Definition	Realtek High Definition	Realtek High Definition	Realtek High Definition
Driver	Realtek Semiconductor 6.00.0001.5886 (07/02/2009)	Realtek Semiconductor 6.00.0001.5886 (07/02/2009)	Realtek Semiconductor 6.00.0001.5886 (07/02/2009)	Realtek Semiconductor 6.00.0001.5886 (07/02/2009)
Ethernet				
Vendor and model number	Intel 82578DM Gigabit	Broadcom NetXtreme Gigabit	Intel 82567LM-3 Gigabit	Intel 82567LM-3 Gigabit
Driver	Intel 11.5.10.0 (12/10/2009)	Broadcom 12.2.0.3 (05/28/2009)	Intel 11.2.19.250 (10/01/2009)	Intel 11.0.41.260 (08/26/2009)
Optical drive(s)				
Vendor and model number	HP DVD A DH16AAL	HP CDDCDW TS-H653R	HP CDDVDW TS-H653R	HP DVD-RAM GH40L
Type	DVDRW	DVDRW	DVDRW	DVDRW
Interface	Serial-ATA	Serial-ATA	Serial-ATA	Serial-ATA
Dual/single layer	Dual	Dual	Dual	Dual
USB ports				
Number	10	10	10	10
Type	2.0	2.0	2.0	2.0

Figure 5: Desktop test system configurations.¹

¹ Changing a system's hard drive or memory configuration can cause different benchmark results.

About Principled Technologies

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