System performance in common business scenarios that utilize new user interface features in Microsoft Windows Vista

Executive summary

Intel Corporation (Intel) commissioned Principled Technologies (PT) to compare the performance in common business scenarios that utilize advanced user interface features in Microsoft Windows Vista of an Intel vPro technology based PC with that of three other platforms. We tested three scenarios that took advantage of various new features of Windows Vista. We made a combination of hard performance measurements and subjective quality assessments on the following systems:

- Intel Core 2 Duo processor E6700 on an Intel vPro 965 (DQ965GF) motherboard
- Intel® Pentium® D processor 930 on an Intel D945GTP motherboard
- Intel Pentium 4 processor 630 on an Intel D945GTP motherboard
- Intel Pentium 4 processor 2.8 GHz on an Intel D865GBF motherboard

As Figure 1 shows, the Intel vPro technology based PC with the Intel Core 2 Duo processor E6700 significantly outperformed the other PCs in the two scenarios in which we made hard performance measurements. The Intel vPro technology based PC with the Intel Core 2 Duo processor E6700 was from 1.30 times to 1.37 times faster on different applications and tasks and averaged 1.33 times faster across all the tasks than the Intel Pentium D processor 930 based PC. (In all comparisons in which we cite the average of task times, we use the geometric mean of the normalized times for each task.)

KEY FINDINGS

- The Intel® vPro™ technology based PC with the Intel® Core™ 2 Duo processor E6700 yielded significant performance advantages for users on our sample tests that take advantage of some of the new user-interface features in Windows Vista.
- For example, the Intel vPro technology based PC finished our tasks on average 2.72 times faster than the Intel® Pentium® 4 processor 2.8GHz based PC.
- These performance improvements translate into multi-second time savings that would be noticeable to users.
- The older system with the Intel Pentium 4 processor 2.8GHz on the Intel D865GBF motherboard did not have the capabilities necessary to support all of the new Windows Vista features the tests utilized.
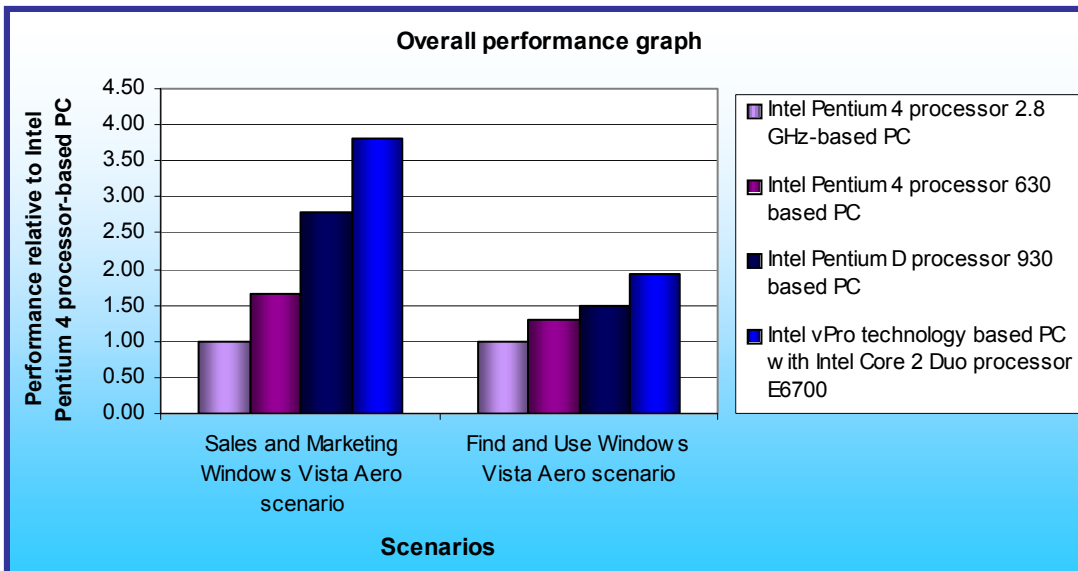
Figure 1: Normalized results for the test systems on the two scenarios that include hard performance measurements. Larger numbers indicate better performance.

Compared to the Intel Pentium 4 processor 2.8GHz based PC with the Intel D865GBF motherboard, the Intel vPro technology based PC was from 1.94 to 3.82 times faster on different applications and tasks and averaged 2.72 times faster.

In addition, while the Intel vPro technology based PC had no problems with any

of the user interface or video features we tested, the Intel Pentium 4 processor 2.8GHz based PC with the Intel D865GBF motherboard lacked the capabilities necessary to run all of the new Windows Vista tests.

So that we could make the test systems as similar as reasonably possible while varying the processors and motherboards, we built the systems rather than purchasing them from vendors. Intel specified the general system types. We purchased the processors and motherboards as well as such common components as RAM, hard disks, and optical drives. Each test system had the following basic components (see Appendix A for detailed configuration information):

- 1GB of the fastest RAM its motherboard supported
- 80GB hard disk with an 8MB buffer (SATA unless the motherboard did not support it)
- DVD-RW optical drive
- Microsoft Windows Vista Ultimate

The application scenarios we tested included such user new Window Vista interface capabilities as:

- Opening files
- Previewing digital photographs
- Viewing a slideshow
- Playing HD videos

We also used the following applications, which we list in alphabetical order:

- Adobe Acrobat 7.0.8
- Microsoft Windows Media Player 11
- Microsoft Windows Photo Gallery Slideshow
- Windows Vista file preview

In the following sections we look more closely at our test application scenarios (Application scenarios), examine the results of our tests (Test results and analysis), and give detailed information about how we actually performed the tests (Test methodology). In the appendices, we present the configurations of the test systems and explain how to manually execute the application functions in our scenarios.

Application scenarios

We focused on scenarios that illustrate the benefits of some of the features of the Windows Vista Aero user interface in business functions. We primarily used capabilities built into Windows Vista. We made both hard performance measurements and subjective quality assessments.

Sales and Marketing Windows Vista Aero scenario: Opening a PDF file to thumbnail view while an HD video plays

Charles Tanaka is a sales director at the Melcore Robotics Company. He is preparing for an upcoming teaching engagement in which he will be instructing his team on how to effectively deliver a presentation on the company's latest product lines. In this presentation, Charles wants to illustrate the type of visuals that are crucial to selling a product. The presentation includes a Microsoft demo HD video that Charles feels illustrates how much benefit HD can bring to his company's product presentations, a PDF file, and several supporting documents. He opens the video file that his co-worker Andy sent him, and he lets it play as he waits for a particular segment to appear. In the meantime, he opens the PDF file to study its contents. Adobe Reader opens the PDF file in its thumbnail view. Charles double-clicks the thumbnail of the last Adobe page, which jumps him to that page.

We timed:

- the PDF file open task from when Charles double-clicks the Melcore Robotics Marketing.pdf file to open it until Acrobat Reader has rendered all of the thumbnails

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Find and Use Windows Vista Aero scenario: Previewing digital photographs in Windows Vista

Jill Bancroft is an environmental engineer for the Clearspace Paper Company. Her manager has recently assigned Jill a large project: she is to write a bid for an environmental clean-up of sections of several cities. She will have to visit the cities before she can write the bid. To prepare for her trip, Jill studies photographs of some of the areas she will be inspecting.

We timed:

- a digital photo preview from when Jill chooses Open after right-clicking on the folder of photographs until a green progress bar indicates that the preview process is complete

Dual-monitor Windows Vista Aero scenario: Viewing a slideshow while an HD video plays

Andy Granton is a program manager at the Melcore Robotics Company. He has two monitors attached to his PC so he can multitask more efficiently. Andy has the job of developing a video to showcase his company's actuator arms. He's considering Web based HD video that looks very high-tech, so he visits Microsoft's Web site and checks out an HD video promo for HD WMV. He watches the windowed video on one monitor, while on the other he has open some photos for a candidate location for a video shoot. While the Microsoft demo video plays, he uses Windows Photo Gallery to open the folder of JPEG pictures into list view and then clicks slideshow to get a rotating show of the images.

We analyze the quality of the slideshow transitions, which use a fade effect between photographs, and note whether those transitions are smooth or choppy.

For more details on how we executed and assessed these scenarios, our specific test functions, and the files the scenarios use, see Appendix B.

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Test results and analysis

In this section we examine the results of each of our tests. Figure 2 shows the results of each of the test systems on each of the scenarios. For each task for which we measured elapsed time, we show the times, in seconds, that each test system needed to complete that task. The times we show for each platform for each scenario are from the median run of the five test runs of that scenario on that platform. For each task for which we made subjective assessments, we summarize those assessments.

Tests	Intel Pentium 4 processor 2.8 GHz on Intel D865GBF	Intel Pentium 4 processor 630 on Intel D945GTP	Intel Pentium D processor 930 on Intel D945GTP	Intel vPro with Core 2 Duo processor E6700 on Intel DQ965GF
Sales and Marketing Windows Vista Aero scenario				
Open a PDF file to thumbnail view	12.75	7.75	4.58	3.34
Play an HD video (results are subjective)	NA*	no issues	no issues	no issues
Find and Use Windows Vista Aero scenario				
Preview a digital photograph in Windows Vista	15.08	11.47	10.10	7.76
Dual-monitor Windows Vista Aero scenario				
View a slideshow while a video plays (results are subjective)	NA*	choppy	choppy	smooth
Play an HD video (results are subjective)	NA*	smooth	smooth	smooth

Figure 2: Results for all test systems on all scenarios. The test times are the medians and are in seconds; lower times are better. Comments summarize subjective assessments.

* Note: The PC with the Intel Pentium 4 processor 2.8 GHz on the Intel D865GBF motherboard did not support dual monitors. In addition, Windows Vista detected a lower-performance graphics capability on that system and defaulted to a limited-function version of the slideshow player that did not support slide transitions. Windows Media Player would also not play HD video on that system.

In the following sub-sections we explore these results in more detail. To make comparisons easier, we always show results normalized to those of the slowest system in the group, the Intel Pentium 4 processor 2.8GHz based PC with the Intel D865GBF motherboard. To compute those normalized results, we divided each system's time by the time it took the slowest system. The result for the Intel Pentium 4 processor 2.8GHz based PC with the Intel D865GBF motherboard is thus always 1.00, because it's the comparison basis. Results higher than 1.00 indicate how much faster a system is than that system. Because of the normalization, higher result numbers are better. For example, a result of 1.20 would mean the system in question was 20 percent faster than the Intel Pentium 4 processor 2.8GHz based PC. We also provide more information on our subjective assessments and the NA entries in Figure 2.

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Sales and Marketing Windows Vista Aero scenario: Opening a PDF file to thumbnail view while an HD video plays

Figures 3 and 4 present the results of this test. The Intel vPro technology based PC with the Intel Core 2 Duo processor E6700 was 1.37 times faster than the Intel Pentium D processor 930 based PC. Additionally, the Intel vPro technology based PC was 3.82 times faster than the PC with the Intel Pentium 4 processor 2.8 GHz on the Intel D865GBF motherboard.

Sales and Marketing Windows Vista Aero scenario

Legend:
- Intel Pentium 4 processor 2.8 GHz-based PC
- Intel Pentium 4 processor 630 based PC
- Intel Pentium D processor 930 based PC
- Intel vPro technology based PC w ith Intel Core 2 Duo processor E6700

Figure 3: Results for the Sales and Marketing Windows Vista Aero scenario for all test systems. Larger numbers indicate better performance.

As Figure 4 shows, these differences represent significant improvements in the time it takes to perform each task. Compared to the Intel Pentium 4 processor 2.8GHz based PC with the Intel D865GBF motherboard, the Intel vPro technology based PC with the Intel Core 2 Duo processor E6700 decreased the elapsed time from 12.75 to 3.34 seconds.
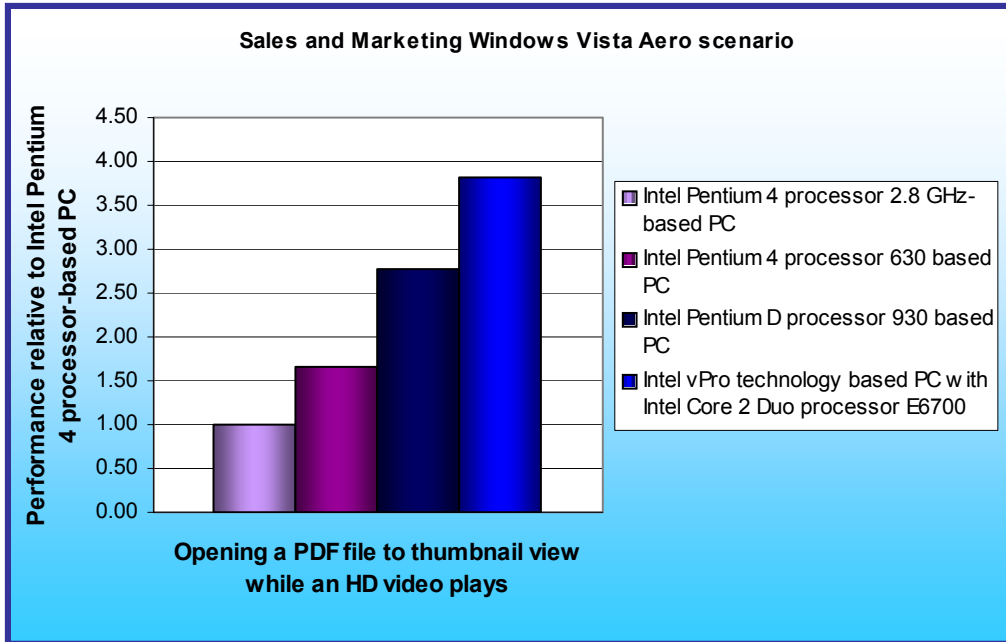
PERFORMANCE RESULTS (seconds)				TASKS	COMPARATIVE RATING			
Intel Pentium 4 processor 2.8 GHz on Intel D865GBF	Intel Pentium 4 processor 630 on Intel D945GTP	Intel Pentium D processor 930 on Intel D945GTP	Intel vPro with Core 2 Duo processor E6700 on Intel DQ965GF		Intel Pentium 4 processor 2.8 GHz on Intel D865GBF	Intel Pentium 4 processor 630 on Intel D945GTP	Intel Pentium D processor 930 on Intel D945GTP	Intel vPro with Core 2 Duo processor E6700 on Intel DQ965GF
12.75	7.75	4.58	3.34	Task: Opening a PDF file while an HD video is playing	1.00	1.65	2.78	3.82
NA*	no issues	no issues	no issues	Task: Playing a video	NA*	no issues	no issues	no issues

Figure 4: Results for the Sales and Marketing Windows Vista Aero scenario for all test systems. Lower performance results are better. Higher comparative ratings are better.

* Note: The PC with the Intel Pentium 4 processor 2.8 GHz on the Intel D865GBF motherboard did not support dual monitors. In addition, Windows Media Player would also not play HD video on that system. To get a reasonably comparable file-open time for that system, we played a less demanding video, the sample Windows Vista bear.wmv, during the file open.

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Find and Use Windows Vista Aero scenario: Previewing a digital photograph in Windows Vista

As Figures 5 and 6 show, the Intel vPro technology based PC with the Intel Core 2 Duo processor E6700 was 1.30 times faster than the Intel Pentium D processor 930 based PC on this test. Additionally, the Intel vPro technology based PC with the Intel Core 2 Duo processor E6700 was 1.94 times faster than the PC with the Intel Pentium 4 processor 2.8 GHz on the Intel D865GBF motherboard.

As Figure 6 shows, these differences represent significant improvements in the time it takes to perform each task. Compared to the PC with the Intel Pentium 4 processor 2.8 GHz on the Intel D865GBF motherboard, the Intel vPro technology based PC with the Intel Core 2 Duo processor E6700 decreased the elapsed time from 15.08 to 7.76 seconds.
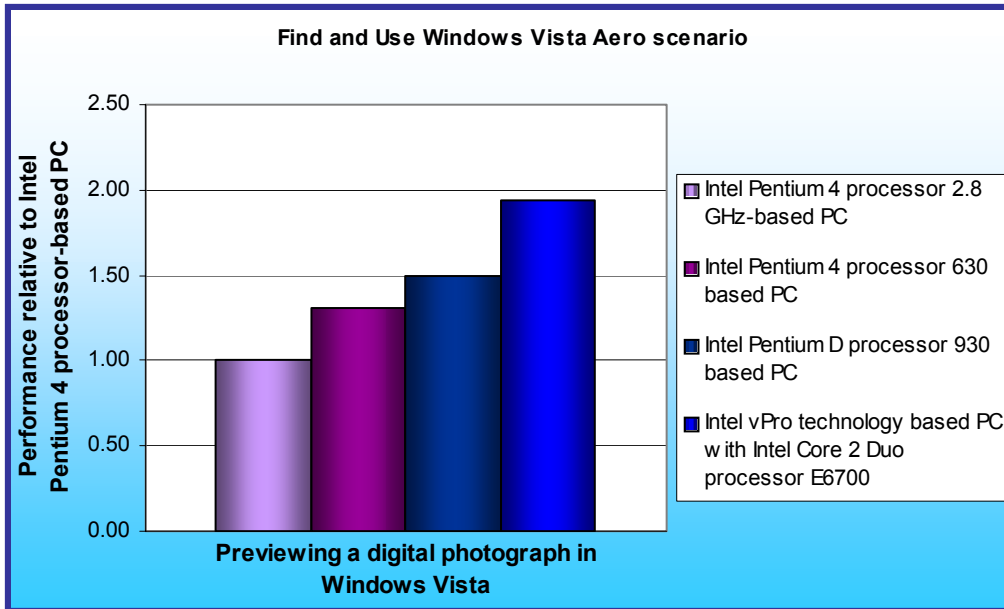

Figure 5: Results for the Find and Use Windows Vista Aero scenario for all test systems. Larger numbers indicate better performance.

PERFORMANCE RESULTS (seconds)				TASKS	COMPARATIVE RATING			
Intel Pentium 4 processor 2.8 GHz on Intel D865GBF	Intel Pentium 4 processor 630 on Intel D945GTP	Intel Pentium D processor 930 on Intel D945GTP	Intel vPro with Core 2 Duo processor E6700 on Intel DQ965GF		Intel Pentium 4 processor 2.8 GHz on Intel D865GBF	Intel Pentium 4 processor 630 on Intel D945GTP	Intel Pentium D processor 930 on Intel D945GTP	Intel vPro with Core 2 Duo processor E6700 on Intel DQ965GF
15.08	11.47	10.10	7.76	Task: Previewing digital photos	1.00	1.31	1.49	1.94

Figure 6: Results for the Find and Use Windows Vista Aero scenario for all test systems. Lower performance results are better. Higher comparative ratings are better.

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Dual-monitor Windows Vista Aero scenario: Viewing a slideshow while a video plays

This scenario utilizes two monitors to view a slideshow of 50 digital photographs. The results we present for this particular scenario indicate whether the slideshow transitions are smooth or choppy and whether each system had any problem playing the video. This test illustrates the ability of the Intel vPro technology based PC to deliver a smoother user experience.

As Figure 7 shows, the Intel vPro technology based PC with the Intel Core 2 Duo processor E6700 was able to handle the slide transitions smoothly and play the video with no problems. By contrast, on the Intel Pentium D processor 930 based PC the transitions between 37 of the 50 slides were not fluid. The frames repeatedly froze for a fraction of a second throughout the transition. The quality was clearly worse than that of the Intel vPro technology based PC with the Intel Core 2 Duo processor E6700.

On the Intel Pentium 4 processor 630 based system, the transitions between all slides were hesitant and not fluid. The frames repeatedly froze for a fraction of a second throughout the transition. The transition quality for all slides was clearly worse than that of the PC with the Intel Pentium D processor 930 and the Intel vPro technology based PC with the Intel Core 2 Duo processor E6700.

These differences represent significant improvements in how a user would experience the Windows Vista user interface in the increasingly common dual-monitor setup.

TASKS	PERFORMANCE RESULTS (subjective)			
	Intel Pentium 4 processor 2.8 GHz on Intel D865GBF	Intel Pentium 4 processor 630 on Intel D945GTP	Intel Pentium D processor 930 on Intel D945GTP	Intel vPro with Core 2 Duo processor E6700 on Intel DQ965GF
Task: Viewing a slideshow	NA*	Choppy: The transition between all slides showed pronounced stuttering. The quality was third out of the three systems that could do the transitions.	Choppy: The transition between 37 of the 50 slides showed some stuttering. The quality was second out of the three systems that could do the transitions.	smooth
Task: Playing a video	NA*	smooth	smooth	smooth

Figure 7: Results for the Dual-monitor Vista Aero scenario for all test systems. The results reflect the assessments of the testers.

*Note: The PC with the Intel Pentium 4 processor 2.8 GHz on the Intel D865GBF motherboard did not support dual monitors. In addition, Windows Vista detected a lower-performance graphics capability on that system and defaulted to a limited-function version of the slideshow player that did not support slide transitions. Windows Media Player would also not play HD video on that system.

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Test methodology

Setting up the test systems

To get the most accurate and repeatable results possible, you must set up all test systems carefully, starting with a clean hard disk.

Because one of the tests involves dual monitors, before installing Microsoft Windows Vista Ultimate, install the PixelView ADD2 (ADD-7307-DVI-N) card in the appropriate slot of the Intel DQ965GF motherboard and of both of the D945GTP motherboards.

Installing Microsoft Windows Vista Ultimate

Use the following process to install a clean version of Windows Vista Ultimate on each system under test:

1. Install Windows Vista Ultimate Build 6000.
    a. Boot to a Windows Vista Ultimate Build 6000 DVD.
    b. When prompted, press any key to boot from CD or DVD.
    c. At the language and preference screen, accept the default options, and click Next.
    d. Click Install now.
    e. Do not enter a Product key. Uncheck Automatically activate Windows when I'm online, and click Next.
    f. At the Do you want to enter your product key now screen, click No.
    g. Select Windows Vista Ultimate, and check I have selected the edition of Windows that I purchased.
    h. Click Next.
    i. Check I accept the license terms.
    j. Click Next.
    k. At the Which type of installation do you want screen, select Custom (advanced).
    l. Click Drive options (advanced).
    m. Select the destination Disk for the operating system.
    n. Click Format.
    o. Click OK at the all data stored will be permanently deleted dialog.
    p. Once the system finishes formatting the disk, click Next.
    q. Fill in the Username and Password fields, and click Next.
    r. Fill in the computer name field, and click Next.
    s. When presented with the option to enable Automatic Updates, click Ask me later.
    t. Select the correct time zone, date, and time, and click Next.
    u. At the Select your computer's current location screen, click Public location.
    v. Click Start at the Thank you screen.
    w. When the Windows Vista Ultimate installation completes, close the Welcome Center Dialog.
    x. At the Set network location screen, click Public location.
    y. Click Close.
2. Verify that Windows Automatic Updates are off.
    a. Click Start.
    b. Select Control Panel.
    c. Click Security.
    d. Under Security Center, select Turn automatic updating off.
    e. Select the Never check for updates radio button.
    f. Click OK.
3. Turn off System Restore. Doing so prevents such events from occurring during testing and affecting results.
    a. Click Start.
    b. Right-click Computer.
    c. Select Properties.
    d. Select System protection on the left.
    e. Click Continue.
    f. Uncheck each box under Automatic restore points.
    g. Select Turn System Restore Off at the System Protection pop-up window.

  h. Click OK.
4. Add the system to the test domain.
  a. Click Start.
  b. Right-click Computer
  c. Select Properties.
  d. Select Change settings.
  e. Click Continue.
  f. Click Change.
  g. Select the Domain radio button.
  h. Type the test domain name.
  i. Click OK.
  j. Type the administrator credentials in the User name and Password fields.
  k. Click OK.
  l. Click OK at the Computer Name/Domain Changes dialog box.
  m. Click OK again.
  n. Close the System Properties window.
  o. Close all other open windows before clicking Restart Now.
  p. Log in.
  q. Uncheck the Run at startup box on the Welcome Center before closing it.
5. Add the user to the Administrators group.
  a. Click Start.
  b. Right-click Computer.
  c. Select Manage.
  d. Click Continue.
  e. Select Local Users and Groups on the left.
  f. Double-click Groups in the center.
  g. Select Administrators.
  h. Click Add…, and type the domain test user account.
  i. Click OK.
  j. Type the administrator credentials in the User name and Password fields.
  k. Click Apply.
  l. Click OK.
  m. Close all windows.
  n. Click Start.
  o. Click the arrow→.
  p. Select Log Off.
  q. Press Ctrl + Alt + Delete at the prompt.
  r. Click Switch User, and select Other User.
  s. Type the test user's credential in the User name and Password fields.
  t. Press Enter.
6. Turn all Power Management settings to Performance.
  a. Click Start.
  b. Select Control Panel.
  c. Select Appearance and Personalization.
  d. Under Personalization, click Change screen saver.
  e. Select (None) from the Screen saver drop-down menu.
  f. Click the Change power settings link.
  g. Click the High performance radio button.
  h. Select Never for the Turn off the display and Put the computer to sleep drop-down menus.
  i. Click Change advanced power settings.
  j. Click Hard disk→Turn off hard disk after→Setting (Minutes), then type Never.
  k. Scroll down, and click Sleep→Sleep after→Setting (Minutes), and type Never.
  l. Click Sleep→Allow Hybrid Sleep→Setting.
  m. Select Off.
  n. Scroll down, and click Display→Turn off display after→Setting, then type Never.

   o. Click OK.
   p. Click Save changes.
   q. Close the Power Options window.
   r. Click OK on the Screen Saver Settings.
7. Windows Media Player 11 requires a Windows Experience Index score of 3.0 or higher for the graphics subsystem in order to run high-resolution videos. Before running any of the following test scenarios, to make sure the Windows Experience Index reflected the latest state of the system we manually updated the Windows Experience Index score by performing the following steps:
   a. Click Start.
   b. Right-click computer.
   c. Click Properties from the Windows pop-up.
   d. In the System section of the basic information screen, click the link to Windows Experience Index.
   e. Click Update my score.

Installing Adobe Acrobat Reader 7.0.8
Use the following process to install a clean version of Adobe Acrobat Reader 7.0.8:

1. Download Adobe Acrobat Reader 7.0.8 from: http://www.adobe.com/products/acrobat/readstep2.html.
2. Install Adobe Acrobat Reader 7.0.8 with default settings.
   a. Double-click the Adobe Acrobat Reader executable.
   b. Click Run at the Security Warning screen.
   c. Click Continue.
   d. Click Next at the Setup screen.
   e. Click Next at the Welcome screen.
   f. Accept the default installation path, and click Next.
   g. Click Install.
   h. Click Finish.

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Appendix A – Test system configuration information

This appendix provides detailed configuration information about each of the test systems.

System processor and motherboard	Intel vPro with Intel Core 2 Duo processor E6700 (2.66 GHz Dual-Core) on Intel DQ965GF motherboard	Intel Pentium D processor 930 (3.0 GHz Dual-Core) on Intel D945GTP motherboard	Intel Pentium 4 processor 630 (3.0 GHz) on Intel D945GTP motherboard	Intel Pentium 4 processor (2.8 GHz) on Intel D865GBF motherboard
General				
Processor and OS kernel: (physical, core, logical) / (UP, MP)	1P2C2L / MP	1P2C2L / MP	1P1C2L / MP	1P1C1L / UP
Number of physical processors	1	1	1	1
Single/Dual-Core processors	Dual	Dual	Single	Single
Processor HT status	NA	NA	Enabled	NA
System Power Management Policy	High Performance	High Performance	High Performance	High Performance
CPU				
Vendor	Intel	Intel	Intel	Intel
Name	Core 2 Duo	Pentium D	Pentium 4	Pentium 4
Model Number	E6700	930	630	NA
Stepping	6	2	3	7
Socket type	LGA775	LGA775	LGA775	Socket 478
Core frequency (GHz)	2.66	3.0	3.0	2.8
Front-side bus frequency	1066 MHz	800 MHz	800	533 MHz
L1 Cache	32 KB + 32 KB (per core)	16 KB + 12 Kµops (per core)	16 KB + 12 Kµops	8 KB + 12 Kµops
L2 Cache	4 MB (shared)	4 MB (2 MB per core)	2 MB	512 KB
Platform				
Vendor	Intel	Intel	Intel	Intel
Motherboard model number	DQ965GF	D945GTP	D945GTP	D865GBF
Motherboard chipset	Intel Q965	Intel i945G	Intel i945G	Intel i865G
Motherboard revision number	C1	A2	A2	A2
Motherboard serial number	BQGF63500GE9 / AAD41676-305	LATP61618159 / AAC97837-301	LATP61618114 / AAC97837-301	ABBF31715528 / AAC28142-401
BIOS name and version	Intel CO96510J.86A.5493.2006.1102.1728	Intel NT94510J.86A.3943.2006.0707.1405	Intel NT94510J.86A.3943.2006.0707.1405	Intel BF86510A.86A.0058.P15.04040500 12
BIOS settings	Setup default	Setup default	Setup default	Setup default
Memory module(s)				
Vendor and model number	Corsair CM2X512A-6400	Micron 8HTF6464AY-667D7	Micron 8HTF6464AY-667D7	Samsung M3 68L6423FTN-CCC
Type	PC2-6400	PC2-5300	PC2-5300	PC3200

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Speed (MHz)	800	667	667	400
Speed running in the system (MHz)	400	333	333	166
Timing/Latency (tCL-tRCD-tRP-tRASmin)	5-5-5-18	5-5-5-15	5-5-5-15	2.5-3-3-7
Size	1024 MB	1024 MB	1024 MB	1024 MB
Number of memory modules	2 x 512 MB	2 x 512 MB	2 x 512 MB	2 x 512 MB
Chip organization	Double-sided	Double-sided	Double-sided	Double-sided
Channel	Dual	Dual	Dual	Dual
Hard disk				
Vendor and model number	Seagate ST3808110AS	Seagate ST380811AS	Seagate ST380811AS	Seagate ST3802110A
Size	80 GB	80 GB	80 GB	80 GB
Buffer Size	8 MB	8 MB	8 MB	2 MB
RPM	7200	7200	7200	7200
Type	SATA 300 MB/s	SATA 150 MB/s	SATA 150 MB/s	ATA 100
Controller	Intel 82801HR (ICH8)	Intel 82801GB (ICH7)	Intel 82801GB (ICH7)	Intel 82801EB (ICH5)
Driver	Intel 6.2.0.2002	Microsoft 6.0.6000.16384	Microsoft 6.0.6000.16384	Microsoft 6.0.6000.16384
Operating system				
Name	Microsoft Windows Vista Ultimate RTM	Microsoft Windows Vista Ultimate RTM	Microsoft Windows Vista Ultimate RTM	Microsoft Windows Vista Ultimate RTM
Build number	6000	6000	6000	6000
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	DirectX 10	DirectX 10	DirectX 10	DirectX 10
Graphics				
Vendor and model number	Intel GMA 3000	Intel GMA 950	Intel GMA 950	Intel Extreme Graphics 2
Type	Integrated	Integrated	Integrated	Integrated
Chipset	Intel Q965 Express Chipset	Intel 945G Express Chipset	Intel 945G Express Chipset	Intel 865G
BIOS version	1377	1256	1256	1318
Memory size	256 MB Shared	128 MB Shared	128 MB Shared	224 MB
Resolution (for single-monitor tests)	1280 x 1024 x 32 @ 60Hz	1280 x 1024 x 32 @ 60Hz	1280 x 1024 x 32 @ 60Hz	1280 x 1024 x 32 @ 60Hz
Driver	Intel 7.14.10.1111	Intel 7.14.10.1111	Intel 7.14.10.1111	Intel 6.14.10.4656
Other for dual monitor tests	PixelView ADD-7307-DVI-N	PixelView ADD-7307-DVI-N	PixelView ADD-7307-DVI-N	NA
Sound card/subsystem				
Vendor and model number	SigmaTel 92XX High Definition Audio	SigmaTel 92XX High Definition Audio	SigmaTel 92XX High Definition Audio	SoundMAX Integrated Digital Audio Device
Driver	Microsoft 6.0.6000.16386	Microsoft 6.0.6000.16384	Microsoft 6.0.6000.16384	Analog Devices 5.12.1.5410
Ethernet				

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Vendor and model number	Intel 82566DM Gigabit	Intel PRO/1000 PM	Intel PRO/1000 PM	Intel PRO/1000 CT
Driver	Intel 9.6.8.0	Microsoft 9.6.8.0	Microsoft 9.6.8.0	Microsoft 8.1.37.2
Optical drive(s)				
Vendor and model number	Lite-On DVDRW SHW-160P6S	Lite-On DVDRW SHW-160P6S	Lite-On DVDRW SHW-160P6S	Lite-On DVDRW SHW-160P6S
Type	DVD-RW	DVD-RW	DVD-RW	DVD-RW
Dual/Single layer	Dual	Dual	Dual	Dual
USB ports				
# of ports	8	6	6	4
Type of ports (USB1.1, USB2.0)	USB 2.0	USB 2.0	USB 2.0	USB 2.0
IEEE 1394 ports				
# of ports	1	1	1	0
Monitor for single-monitor tests				
Model	Samsung SyncMaster 997DF	Samsung SyncMaster 997DF	Samsung SyncMaster 997DF	Samsung SyncMaster 997DF
Screen size	19"	19"	19"	19"
Secondary monitor for dual-monitor tests				
Model	Dell 2405FPW	Dell 2405FPW	Dell 2405FPW	NA
Screen size	24"	24"	24"	NA

Figure 8: Detailed system configuration information for each of the test systems.

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Appendix B – Instructions for running the application scenarios

We evaluated the performance of each of the test systems on each of the application scenarios (see the Application scenarios section for more information on them) by hand-timing the tasks in those scenarios.

We collected results for five runs of each scenario in each system configuration. We refer in this paper only to the median results of those runs on each system configuration. Lower times to complete a given function indicate better performance. We round those times to hundredths of seconds in this report.

In the following instructions, we assume you have already completed all of the setup work in the Test Methodology section.

Previewing a digital photograph in Windows Vista

The application involved
- Windows Vista file preview

The data file/folder involved
- Spain clean-up project, a 119MB folder with 50 JPEG images

The test process
First, prepare each system by following these steps once:

1. Set the screen resolution to 1600 by 1200.
2. Place the Spain clean-up project folder on the desktop.

To execute the test, follow these instructions. You will need one stopwatch.

1. Reboot the system under test.
2. Login.
3. Wait 2.5 minutes to be sure the system has completed booting and is in a consistent starting state.
4. Make a copy of the Spain clean-up folder on the desktop so we are creating new previews in each test:
   a. Right-click the folder.
   b. Drag and drop the folder to a new location on the desktop.
   c. Choose Copy Here.
5. Open the newly-created Spain clean-up-Copy folder by double-clicking its desktop icon.
6. Prepare the stopwatch.
7. Right-click the Spain clean-up folder in the Spain clean-up-Copy folder.
8. Simultaneously choose Open and start the stopwatch.
9. Immediately double-click the Title bar to maximize the window.
10. A green progress bar will indicate the progress of the system at rendering the 50 previews.
11. Stop the stopwatch at the completion of this process.
12. Record this time as the test's result.
13. Close each folder window.
14. Delete the Spain clean-up-Copy folder.
15. Repeat these steps four more times for a total of five runs.

We report the time, in seconds, that Windows Vista Preview took to perform preview rendering. Lower times indicate faster performance and so are better.

Opening a PDF file to thumbnail view while an HD video plays

The applications involved
- Adobe Acrobat 7.0.8
- Microsoft Windows Media Player 11

The data files involved
- Robotica_1080.wmv, a 102MB HD video file

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- Melcore Robotics marketing.pdf, a 4.7MB PDF file

The test process

First, prepare each system by following these steps once:

1. Set the screen resolution to 1600 by 1200.
2. Open Adobe Reader 7.08.
3. Click Edit Preferences.
4. Click Startup.
5. Select the drop-down box next to Reopen Documents to Last Viewed Page.
6. Select All Files.
7. Under Application Startup, select Display splash screen.
8. Click OK.
9. Click View→Page Layout.
10. Select Continuous-Facing.
11. Set the view to 50 percent by choosing this option from the drop-down menu.
12. Click and drag the Pages Navigation Tab, which is along the left side of the page, onto the Adobe Reader window.
13. Re-size the Pages Navigation Tab to cover 50 percent of the screen.
14. Double-click the Title bar to reduce Adobe Reader from full-screen size to a smaller window.
15. Click the Title bar, and drag the Adobe Reader window so its bottom lines up with the bottom right of the Windows Vista desktop. (The Adobe Reader window should take up 75 percent of the Windows Vista desktop in both the vertical and horizontal directions.)
16. Close Adobe Reader.
17. Double-click the Robotica_1080.wmv video file's desktop icon to open it in Windows Media Player 11.
18. Click the Title bar, and drag the Media Player Window to fit the top left quarter of the screen.
19. The window should take up half of the Windows Vista desktop in both the vertical and horizontal directions.
20. Click the Turn repeat on button.
21. Close Windows Media Player 11.

To execute the test, follow these instructions. You will need one stopwatch.

1. Reboot the system under test.
2. Login.
3. Wait 2.5 minutes to be sure the system has completed booting and is in a consistent starting state.
4. Double-click the Robotica_1080.wmv video to open it and play it in a loop with Windows Media Player 11. While following the rest of the instructions, also watch the video and note any problems the system has playing it.
5. Prepare the stopwatch.
6. Simultaneously double-click the Melcore Robotics Marketing.pdf file to open it and start the stopwatch.
7. Stop the timer when Acrobat Reader has rendered all the thumbnails.
8. Record this time as the test result for opening a PDF to thumbnail view.
9. Close Adobe Reader.
10. Repeat these steps four more times for a total of five runs.

We report the time, in seconds, that Adobe Reader 7.08 took to open a PDF to thumbnail view. Lower times indicate faster performance and so are better. We also report any problems the system has playing the video.

Viewing a slideshow while an HD video plays

The applications involved
- Microsoft Windows Media Player 11
- Microsoft Windows Photo Gallery Slideshow

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The data files involved
- Robotica_1080.wmv, a 102MB video file
- Possible shoot location, a 119MB folder with 50 JPEG images

The test process
First, prepare each system by following these steps once:

1. Set up the dual monitors.
    a. Connect a flat-screen analog monitor to the analog monitor output connector.
    b. Connect a flat-panel monitor to the DVI output monitor connector.
    c. Open the Graphics properties by right-clicking the desktop and choosing Graphics Properties.
    d. Set the digital monitor as primary.
    e. Set the digital monitor to 1600 by 900 resolution.
    f. Set the analog monitor as secondary.
    g. Set the analog monitor to 1280 by 1024 resolution.
    h. Click OK.

To execute the test, follow these instructions. You will need one stopwatch.

1. Reboot the system under test.
2. Login.
3. Wait 2.5 minutes to be sure the system has completed booting and is in a consistent starting state.
4. Double-click the Robotica_1080.wmv file to start the video on the analog monitor. While following the rest of the instructions, also watch the video and note any problems the system has playing it.
5. Right-click the video.
6. Select Full screen.
7. Open the 6MPelPhotos folder that contains the JPEG images.
8. Set the folder to List view.
9. Click slideshow.
10. Examine the slideshow transition for display problems, such as fade time, fade quality, and number of improper fades, and note all display issues.

Notes: The system with the Intel D865GBF motherboard does not support dual monitors, so we could not run this test on that system.

We report all problems the system has while playing the video and displaying the slideshow.

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