Business PC Performance: Built-To-Order Systems

For Intel Corporation

Executive summary

Intel Corporation (Intel) commissioned Principled Technologies (PT) to run a set of performance tests on the following two built-to-order Hewlett Packard (HP) Microtower Business PCs:

- HP Compaq dc5100 Microtower (with an Intel Pentium 4 640 with Hyper-Threading Technology (HT) processor)
- HP Business desktop dx5150 Microtower (with an AMD Athlon 64 4000+ processor)

The goal of the testing was to gauge the performance that PC buyers would experience on systems they purchased online from such well-known sites as www.hpshopping.com, using an industry standard benchmark and a wide array of additional custom performance tests. Intel identified the test systems, tests, test procedures, and test settings. PT purchased and set up the two PCs and executed all tests. We ran the following custom tests and benchmark:

Industry standard benchmark
- SYSmark 2004 SE

Custom Tests
- ABBYY Fine Reader 8.0 Professional Edition
- ABBYY Fine Reader 8.0 Professional Edition while scanning for viruses using McAfee VirusScan Enterprise 8.0i
- ABBYY Fine Reader 8.0 Professional Edition while scanning for viruses using McAfee VirusScan Enterprise 8.0i and scanning for spyware using Webroot Spy Sweeper 4.5
- Adobe Photoshop CS2
- Adobe Photoshop CS2 while scanning for viruses using McAfee VirusScan Enterprise 8.0i
- Adobe Photoshop CS2 while scanning for viruses using McAfee VirusScan Enterprise 8.0i and scanning for spyware using Webroot Spy Sweeper 4.5
- Microsoft Windows Media Encoder 9.0 with Advanced Profile
- Microsoft Windows Media Encoder 9.0 with Advanced Profile while scanning for viruses using McAfee VirusScan Enterprise 8.0i
- Microsoft Word 2003 and Adobe Acrobat 7.0.5 while scanning for viruses using McAfee VirusScan Enterprise 8.0i

Appendix A provides the purchase price of both systems, and Appendix B details their configurations. Whenever possible, we tested each system as it came out of the box. One change was necessary. The AMD-based HP dx5150 booted with a display resolution of 800x600x16-bit color depth, which SYSmark 2004 SE does not support. We changed that system's resolution to 1024x768x32-bit color depth, the out-of-box resolution of the Intel-based HP dc5100 and one that SYSmark 2004 SE supports.

Figure 1 summarizes the test results, each of which is the median result of three runs on each system. For SYSmark 2004 SE, higher scores are better. For all other performance tests, lower scores are better because they represent the time the system required to complete each workload. In the rightmost column, we compare the results of the systems. We calculate this comparison by dividing the Intel-based system's median score by the AMD-based system's median score for tests in which a higher score is better, and by dividing the AMD-based system's median score by the Intel-based system's median score for tests in which a lower score is better. Consequently, comparative results above 1.00 indicate tests the Intel-based system won, and those below 1.0 indicate tests the AMD-based system won. The Test results section provides the results of all the runs on each system.

Tests	HP dc5100 (Intel Pentium 4 640 w/HT)	HP dx5150 (AMD Athlon 64 4000+)	Comparative Result
Industry standard benchmark	Higher is better	Higher is better	Higher is better
BAPCo SYSmark 2004 SE – Overall score[1]	186	175	1.06
Custom tests – single task workloads	Lower is better	Lower is better	Higher is better
ABBYY Fine Reader 8.0 Professional	91	100	1.11
Adobe Photoshop CS2	235	242	1.03
Microsoft Windows Media Encoder 9.0 with Advanced Profile	140	142	1.01
Custom tests – multitasking workloads with two simultaneous tasks			
ABBYY Fine Reader 8.0 Professional with virus scanning			
Median average task time	170	198	1.16
ABBYY Fine Reader 8.0 Professional	131	211	1.61
McAfee VirusScan Enterprise 8.0i	209	184	0.88
Adobe Photoshop CS2 with virus scanning			
Median average task time	389	396	1.02
Adobe Photoshop CS2	278	269	0.97
McAfee VirusScan Enterprise 8.0i	499	523	1.05
Microsoft Windows Media Encoder 9.0 with Advanced Profile with virus scanning			
Median average task time	148	183	1.24
Microsoft Windows Media Encoder 9.0 with Advanced Profile	167	166	0.99
McAfee VirusScan Enterprise 8.0i	129	200	1.55
Microsoft Word 2003 & Adobe Acrobat 7.0.5 with virus scanning			
Median average task time	44	54	1.23
Microsoft Word 2003 & Adobe Acrobat 7.0.5	17	19	1.12
McAfee VirusScan Enterprise 8.0i	71	89	1.25
Custom tests – multitasking workloads with three simultaneous tasks			
ABBYY Fine Reader 8.0 Professional with virus and spyware scanning			
Median average task time	253	311	1.23
ABBYY Fine Reader 8.0 Professional	221	301	1.36
McAfee VirusScan Enterprise 8.0i	313	361	1.15
Webroot Spy Sweeper 4.5	225	270	1.20
Adobe Photoshop CS2 with virus and spyware scanning			
Median average task time	305	376	1.23
Adobe Photoshop CS2	286	314	1.10
McAfee VirusScan Enterprise 8.0i	249	379	1.52
Webroot Spy Sweeper 4.5	380	435	1.15
Overall comparison (geometric mean benchmark, single-task workload, and multitasking workload scores; higher is better)			1.13

Table 1: Results of performance tests on the two systems (in seconds for the custom tests and absolute ratings for the industry standard benchmark).

Notes:
[1] SYSmark 2004 SE would not run on the HP dx5150 at the resolution at which it came out of the box, so we changed this system's resolution to match the out-of-box resolution of the HP dc5100.

Test results

This section details the individual test results for the two systems.

Tests	HP dc5100 (Intel Pentium 4 640 w/HT)	HP dx5150 (AMD Athlon 64 4000+)
SYSmark 2004 SE – Absolute score (higher is better)		
Internet Content Creation Overall - Run 1	210	193
Internet Content Creation 3D Creation - Run 1	206	191
Internet Content Creation 2D Creation - Run 1	242	228
Internet Content Creation Web Publication - Run 1	185	164
Office Productivity Overall - Run 1	166	158
Office Productivity Communication - Run 1	135	126
Office Productivity Document Creation - Run 1	175	195
Office Productivity Data Analysis - Run 1	192	162
Internet Content Creation Overall - Run 2	210	195
Internet Content Creation 3D Creation - Run 2	206	196
Internet Content Creation 2D Creation - Run 2	240	227
Internet Content Creation Web Publication - Run 2	186	166
Office Productivity Overall - Run 2	164	157
Office Productivity Communication - Run 2	135	124
Office Productivity Document Creation - Run 2	171	195
Office Productivity Data Analysis - Run 2	192	161
Internet Content Creation Overall - Run 3	211	194
Internet Content Creation 3D Creation - Run 3	205	194
Internet Content Creation 2D Creation - Run 3	247	225
Internet Content Creation Web Publication - Run 3	186	166
Office Productivity Overall - Run 3	164	158
Office Productivity Communication - Run 3	134	124
Office Productivity Document Creation - Run 3	173	195
Office Productivity Data Analysis - Run 3	192	162
SYSmark 2004 SE Rating	186	175
Internet Content Creation Overall	210	194
Office Productivity Overall	165	158
ABBYY FineReader 8.0 Professional (in seconds; lower is better)		
Run 1	91	100
Run 2	91	100
Run 3	91	101
Adobe Photoshop CS2 (in seconds; lower is better)		
Run 1	235	243
Run 2	234	242
Run 3	235	242
Microsoft Windows Media Encoder 9.0 with Active Profile (in seconds; lower is better)		
Run 1	140	142
Run 2	140	142
Run 3	140	142
ABBYY Fine Reader 8.0 Professional Edition while scanning for viruses using McAfee VirusScan 8.0i (in seconds; lower is better)		
ABBYY FineReader 8.0 Professional - Run 1	132	211
McAfee VirusScan 8.0i - Run 1	208	184
ABBYY FineReader 8.0 Professional - Run 2	131	220
McAfee VirusScan 8.0i - Run 2	209	185

ABBYY FineReader 8.0 Professional - Run 3	131	211
McAfee VirusScan 8.0i - Run 3	212	181
Adobe Photoshop CS2 while scanning for viruses using McAfee VirusScan 8.0i (in seconds; lower is better)		
Adobe Photoshop CS2 - Run 1	277	269
McAfee VirusScan 8.0i - Run 1	503	523
Adobe Photoshop CS2 - Run 2	278	272
McAfee VirusScan 8.0i - Run 2	499	527
Adobe Photoshop CS2 - Run 3	272	261
McAfee VirusScan 8.0i - Run 3	490	520
Microsoft Windows Media Encoder 9.0 with Advanced Profile while scanning for viruses using McAfee VirusScan 8.0i (in seconds; lower is better)		
Windows Media Encoder 9.0 - Run 1	169	166
McAfee VirusScan 8.0i - Run 1	112	200
Windows Media Encoder 9.0 - Run 2	168	166
McAfee VirusScan 8.0i - Run 2	128	202
Windows Media Encoder 9.0 - Run 3	167	156
McAfee VirusScan 8.0i - Run 3	129	189
Microsoft Word 2003 and Adobe Acrobat 7.0.5 with McAfee VirusScan 8.0i (in seconds; lower is better)		
Adobe Acrobat PDF Creation from Word 2003 - Run 1	18	23
McAfee VirusScan 8.0 Virus Scan - Run 1	71	82
Adobe Acrobat PDF Creation from Word 2003 - Run 2	17	19
McAfee VirusScan 8.0 Virus Scan - Run 2	71	89
Adobe Acrobat PDF Creation from Word 2003 - Run 3	17	22
McAfee VirusScan 8.0 Virus Scan - Run 3	70	90
ABBYY Fine Reader 8.0 Professional Edition while scanning for viruses using McAfee VirusScan 8.0i and scanning for spyware using Spy Sweeper 4.5 (in seconds; lower is better)		
ABBYY FineReader 8.0 Professional - Run 1	221	280
McAfee VirusScan 8.0i - Run 1	303	367
Webroot Spy Sweeper Scan - Run 1	222	281
ABBYY FineReader 8.0 Professional - Run 2	221	301
McAfee VirusScan 8.0i - Run 2	313	361
Webroot Spy Sweeper Scan - Run 2	225	270
ABBYY FineReader 8.0 Professional - Run 3	241	322
McAfee VirusScan 8.0i - Run 3	313	354
Webroot Spy Sweeper Scan - Run 3	238	257
Adobe Photoshop CS2 while scanning for viruses using McAfee VirusScan 8.0i and scanning for spyware using Webroot (in seconds; lower is better)		
Adobe Photoshop CS2 - Run 1	306	293
McAfee VirusScan 8.0i - Run 1	258	381
Webroot Spy Sweeper Scan - Run 1	358	432
Adobe Photoshop CS2 - Run 2	286	290
McAfee VirusScan 8.0i - Run 2	249	409
Webroot Spy Sweeper Scan- Run 2	380	469
Adobe Photoshop CS2 - Run 3	300	314
McAfee VirusScan 8.0i - Run 3	194	379
Webroot Spy Sweeper Scan- Run 3	373	435

Table 2: Individual test results.

Test methodology

This section details the methodology we followed in testing the systems.

Configuration differences

When we configured the two systems on www.hpshopping.com, we made them as identical as possible. We could not avoid the following differences in the systems:

- The motherboard for the AMD-based dx5150 supports only DDR RAM, with the fastest RAM available on www.hpshopping.com being DDR400 (PC3200) dual channel SDRAM. The motherboard for the Intel-based dc5100, by contrast, supports DDR2-533MHz SDRAM, which was the only option available for our purchase.
- The hard drive controllers in the systems also differ. Though both are Serial ATAII (SATA-II) devices, the AMD-based dx5150 uses the ATI SB400 controller, while the Intel-based dc5100 uses the Intel 82801FB Ultra ATA Storage controller.
- The prices differ, with the $1,153.81 Intel-based dc5100 costing $202.23 less than the $1,356.04 AMD-based dx5150.[2]

Appendix A provides complete cost information for both systems, and Appendix B details their configurations.

Initial setup

When the systems arrived, we unpacked and set up each one. They came with identical keyboards. The AMD-based dx5150 shipped with a standard PS/2 mouse, while the Intel-based dc5100 shipped with a USB optical mouse. We do not believe the use of different mice should materially affect the performance of the systems on the tests we ran. We did not purchase monitors with the systems, so we used identical MAG Innovision 786N monitors from our test stock. We went through the following process with each PC the first time we booted it:

1. Selected Next > to set up Windows XP.
2. Selected United States, English and U.S. keyboard.
3. Selected Eastern Time.
4. Selected Yes to both the manufacturer (if present) and Microsoft End User License Agreements.
5. Selected No to automatic updates, because our goal was to test each PC as it came out of the box.
6. We named each computer with its model and processor vendor (dx5150_AMD and dc5100_INTEL).
7. We left each machine description blank.
8. Selected Skip during the How will this computer connect to the Internet? part of the setup process.
9. Selected No to registering with Microsoft.
10. Selected Finish.

We used Symantec's Ghost product to capture an exact image of the hard disk over our local network to a server. We then burned each Ghost image to a DVD. This Ghost image was our base test image.

Each time we ran a new benchmark or test on a machine, we used the Ghost image DVD to return that machine to the above out-of-box configuration. After re-imaging, we installed the software necessary to run the benchmark or test, standardized the two test systems to 1024x768x32-bit resolution, and rebooted.

We rebooted before running each time we ran a benchmark or test.

The following subsections summarize the steps we followed to obtain each of the benchmark or test results in this report.

Custom performance tests

How we determined the virus scan workload

Many of our tests are multitasking scenarios that involve either virus scanning as a background task or both virus scanning and spyware scanning as simultaneous background tasks. For these tests, we wanted to keep

the systems under continuous multitasking workloads, so we wanted a virus-scan workload that ran approximately as long as the longer of the foreground application and the spyware scan.

Intel provided the directory we used as the base workload for virus scanning. This directory has the following characteristics:

- Size: 598 MB
- Number of Files: 4731
- Number of Folders: 104

To meet our goal, we ran some experimental tests with virus-scanning workloads consisting of one, three, and five copies of the above directory. We then compared the three results and chose the workload whose duration best met our goal. We did not adjust the size of the workload at the file or subdirectory level but instead kept to complete copies of the test directory.

To create these workloads we created an empty folder on the root of the system partition (C:\Virus Scan Workload) and copied one or three of the above virus scan workload directories into this folder. The resulting workloads had the following characteristics:

- Single directory workload
  - Size: 598 MB
  - Number of Files: 4731
  - Number of Folders: 105
- Three directory workload
  - Size: 1.75 GB
  - Number of Files: 14193
  - Number of Folders: 315

We did not choose to scan the entire hard disk of each system both to keep test time reasonable and to ensure that we scanned exactly the same amount of data each time. (Scanning the full hard disk would have yielded different workloads depending on which applications were present on the system.)

How we calculated the average of the median results in the summary table and the overall comparison

In the multitasking test scenarios with two or three applications, we calculated the median results and the arithmetic average of those results with the following Intel-specified methodology.

To calculate the average of the task times for a run,

1. Sum the times of the applications in that run.
2. Divide that sum by the number of applications in the scenario. The result of this calculation is the arithmetic average task time.

The median run is the run with the median average of the task times. If two runs tie on this calculation (i.e., each has the median average task time), then use as the median run the run whose foreground task has the median result of the three foreground times.

For each of the custom multitasking tests in Figure 1, we report the median average task time and the individual application times for the median run of that test.

We calculated the overall comparison of the two systems with the following Intel-specified methodology: Take the geometric mean of the benchmark score, each of the single-task scenario scores, and each of the multitasking scenario average task times.

ABBYY FineReader 8.0 Professional Edition

We used this application to test the time each system takes to scan a PDF document using OCR (Optical Character Recognition) technology and produce an editable text document. Intel provided the PDF document this test uses. This document has the following key characteristics:

- Size: 779.77 KB (798,408 bytes)
- Number of pages: 46

This test requires a stopwatch.

We performed the following steps to run this test on each test system:

Setup
1. Reset the test systems with the base test image.
2. Download an evaluation copy of ABBYY FineReader 8.0 Professional Edition from http://download.abbyy.com/content/default.aspx.
3. Double-click the installation executable file.
4. On the self-extractor screen accept the temporary destination folder, and click Install.
5. Accept the License Agreement, and click Next >.
6. Choose the Typical installation, and click Next >.
7. Click Install to begin installation.
8. At the Installation completed screen, de-select Launch ABBYY FineReader now, and click Finish.
9. Download the PDF document from the URL above, and save a local copy in My Documents.
10. Close the application, and reboot the system.
11. Launch ABBYY FineReader 8.0 Professional Edition (Start→All Programs→ABBYY FineReader 8.0→ABBYY FineReader 8.0 Professional Edition).
12. Select Continue using Try&Buy version, if not already selected, and click OK.
13. If the Welcome! dialog below pops up, close it.

Figure 1: ABBYY FineReader 8.0 Welcome! screen.

14. The following dialog should appear:
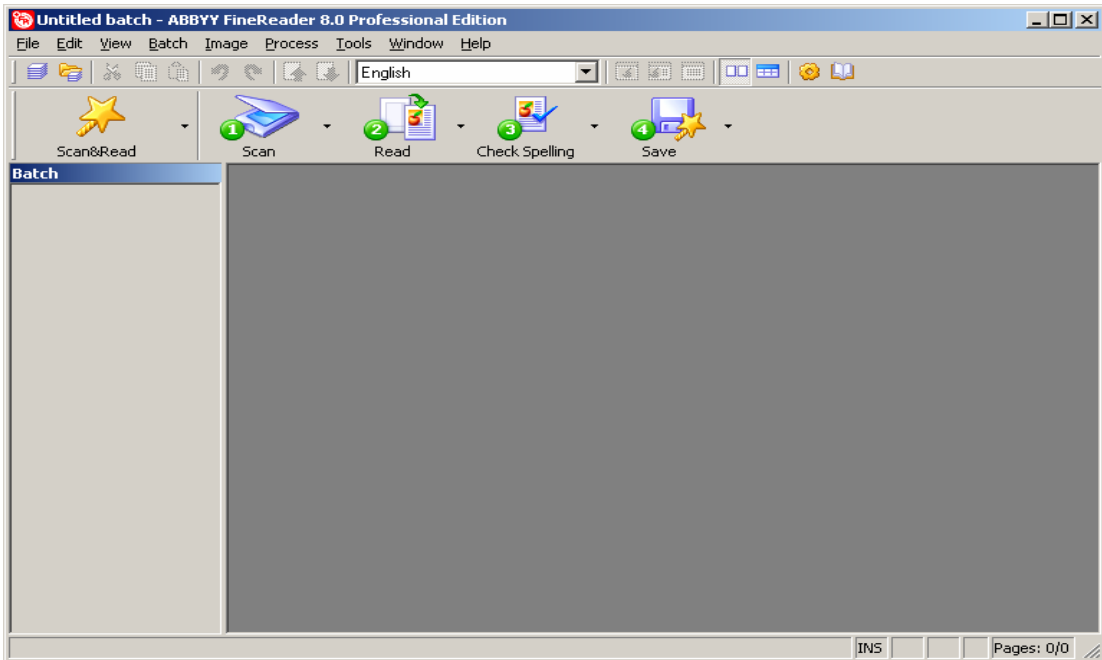
Figure 2: ABBYY FineReader 8.0 interface.

15. From the view menu, select Batch Window, and select Details View. Figure 3 indicates how ABBYY FineReader 8.0 should look with the test PDF loaded for processing:
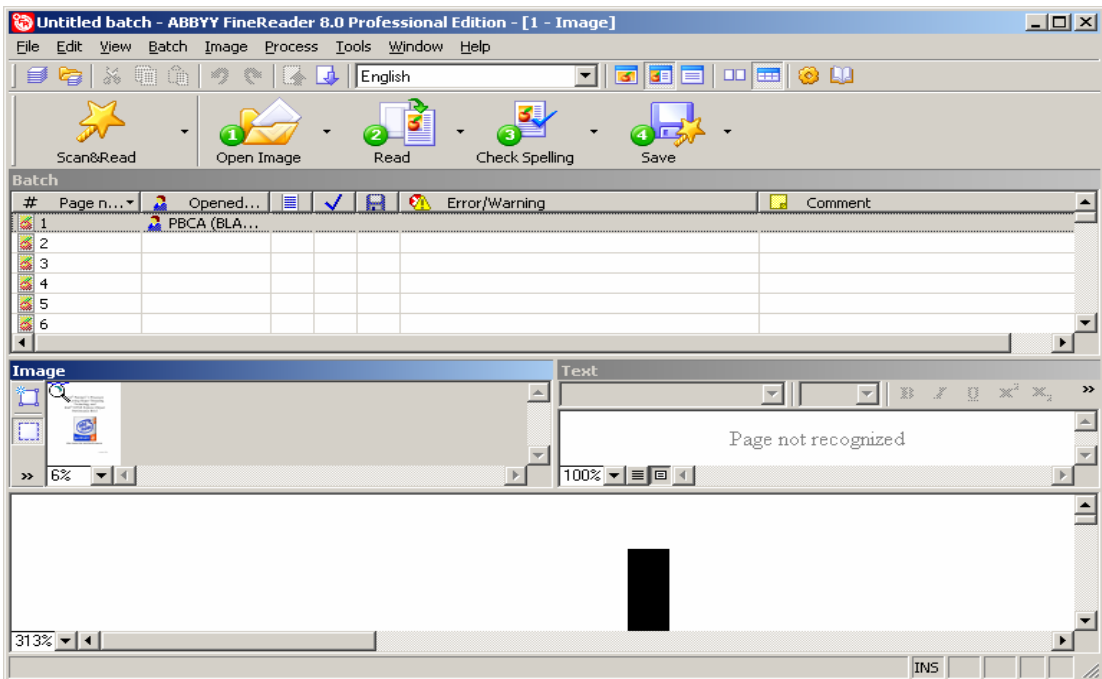
**Figure 3: ABBYY FineReader 8.0 with the test document loaded.**

16. Close the application.

Running the test

1. Reboot the test system, and reset the stopwatch.

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2. Launch ABBYY FineReader 8.0 Professional Edition (Start→All Programs→ABBYY FineReader 8.0→ABBYY FineReader 8.0 Professional Edition).
3. From the Process menu, select Start Background Recognition. Start the stopwatch at the same time.
4. As ABBYY FineReader 8.0 completes processing a page, an icon appears in the third column.
5. Stop the stopwatch when ABBYY FineReader completes processing all 46 pages; the application should look like Figure 4. Record the time, in seconds, from the stopwatch.
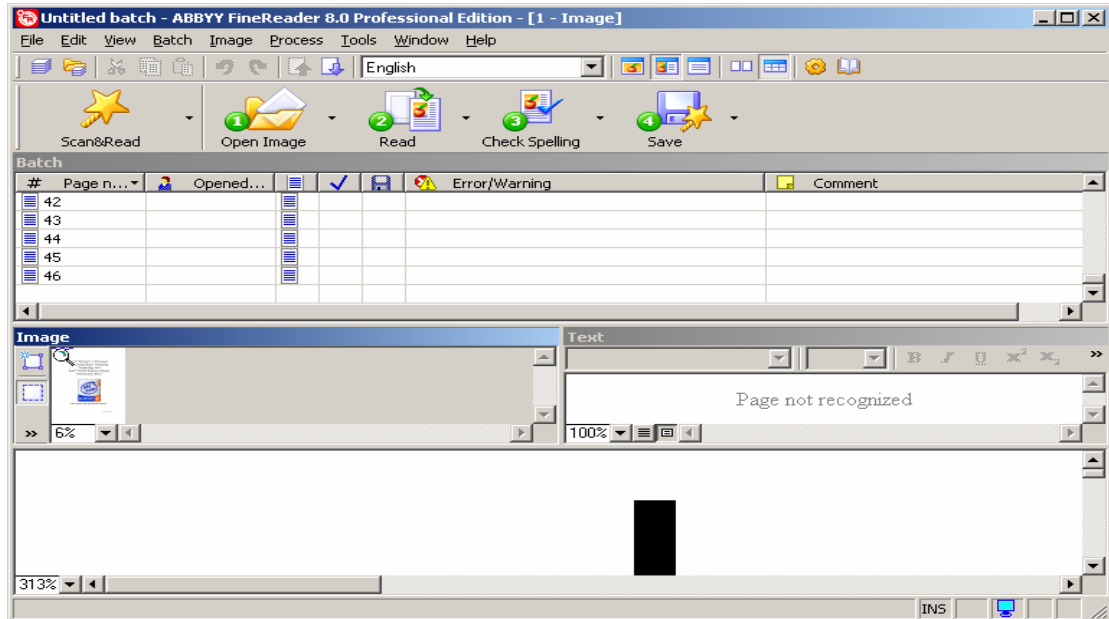
Figure 4: Document after ABBYY FineReader 8.0 processing completes.

6. Close ABBYY FineReader 8.0 Professional Edition.
7. Repeat these steps two times.

We report the time, in seconds, it took ABBYY FineReader 8.0 to process this 46 page PDF. The time we report is stopwatch time.

ABBYY FineReader 8.0 Professional Edition with virus scanning

We followed this procedure for evaluating PC performance using ABBYY FineReader 8.0 Professional Edition with McAfee VirusScan Enterprise 8.0i.

We used a three-directory workload for the virus-scan portion of this test. This test requires two stopwatches.

After resetting the systems with the base test image, install the applications in the following order:

1. ABBYY FineReader 8.0 Professional Edition. Follow the setup instructions for the previous FineReader test.
2. McAfee VirusScan Enterprise 8.0i. Follow the setup instructions below.

Setup—McAfee VirusScan Enterprise 8.0i
1. Copy the VirusScan test directory to the C drive (C:\Virus Scan Test).
2. Insert the McAfee VirusScan Enterprise 8.0i CD.
3. Install the application with default settings.
    a. Click Next > at Readme screen.
    b. Select I accept the terms in the license agreement, and click OK.
    c. Select Typical on the Select Setup Type screen.
    d. Click Install in the Ready to install screen.

e. Deselect Update Now.
f. Deselect Run On-Demand Scan
g. Click Finish.
h. Click OK at the dialog box telling you to reboot.
i. Reboot the system.
4. Launch McAfee VirusScan Enterprise 8.0i by navigating to it from the start menu (Start→All Programs→Network Associates→VirusScan Console). The following screen should appear.
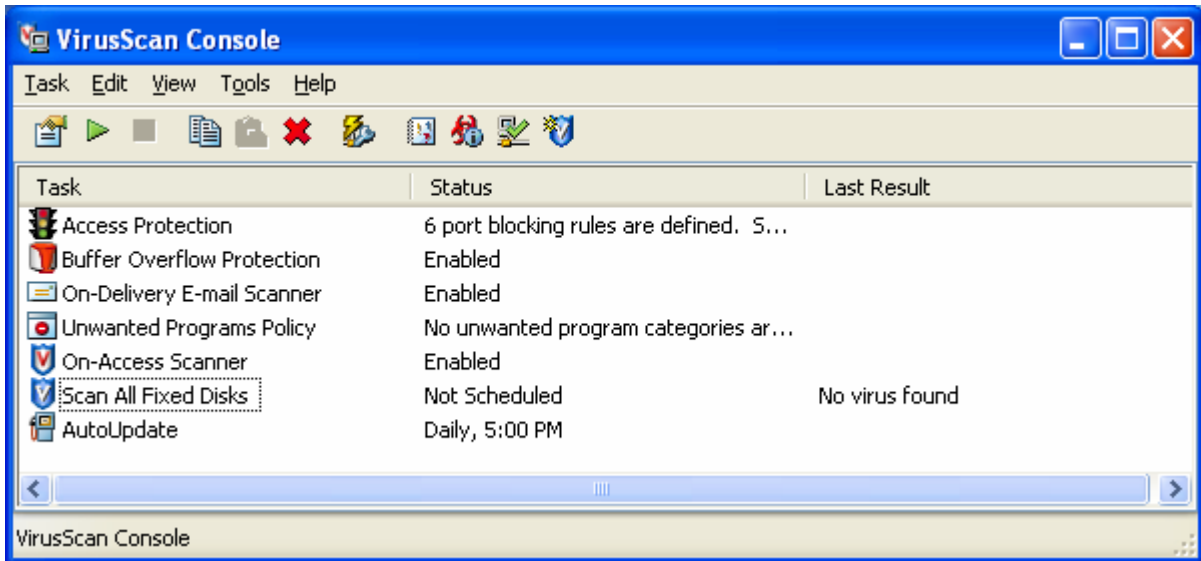
Figure 5: McAfee VirusScan Console

5. Create a custom scan:
   a. Double-click Scan All Fixed Disks.
   b. Select All fixed drives, and click remove.
   c. Select Running processes, and click remove.
   d. Click Add.
   e. Choose Drive or Folder from Add Scan Item dropdown menu.
   f. Click Browse button, and navigate to C:\Virus Scan Test.
   g. Click OK.
   h. Click OK.
   i. Select Detection Tab, and check the box next to Scan inside archives (for example, ZIP).
   j. Click OK.
6. Close the VirusScan Console.

Running the test
1. Reboot the system, and reset the stopwatches.
2. Launch McAfee VirusScan Enterprise 8.0i by navigating to it from the start menu (Start→All Programs→Network Associates→VirusScan Console).
3. Double-click Scan all fixed disks to open the necessary window.
4. Click the Virus Scan Workload folder in the left window pane.
5. Launch ABBYY FineReader 8.0 Professional Edition (Start→All Programs→ABBYY FineReader 8.0→ABBYY FineReader 8.0 Professional Edition).
6. With both applications open, click the Start button in McAfee VirusScan Enterprise 8.0i and start stopwatch #1.
7. From the Process menu in ABBYY FineReader 8.0, select Start Background Recognition. Start stopwatch #2 at the same time.
8. Stop stopwatch #2 when processing is complete. Record the time for PDF processing, in seconds, from the stopwatch.

9. The virus scan completes when the progress bar reaches 100%. Stop stopwatch #1. Record the time for the virus scan, in seconds, from the stopwatch.
10. Close the applications. Do not save the file in ABBYY FineReader 8.0.
11. Repeat two times.

We report the time, in seconds, it took ABBYY FineReader 8.0 to process this 46 page PDF and McAfee VirusScan Enterprise 8.0i to scan a directory for viruses. The times we report are stopwatch times.

ABBYY FineReader 8.0 Professional Edition with virus and spyware scanning

We followed this procedure for evaluating PC performance using ABBYY FineReader 8.0 Professional Edition while scanning for viruses with McAfee VirusScan Enterprise 8.0i and scanning for spyware with Webroot Spy Sweeper 4.5.

We used a three-directory workload for the virus-scan portion of this test. This test requires three stopwatches.

After resetting the systems with the base test images, install the applications in the following order:

1. ABBYY FineReader 8.0 Professional Edition. Follow the setup instructions for the previous two FineReader tests.
2. McAfee VirusScan Enterprise 8.0i. Follow the setup instructions for the previous VirusScan test.
3. Webroot Spy Sweeper 4.5 trial version. Follow the setup instructions below.

Setup—Webroot Spy Sweeper 4.5
NOTE: Install Webroot Spy Sweeper 4.5 on a system isolated from a network to ensure all testing occurs with the product's default definitions. This practice is necessary because Spy Sweeper 4.5 attempts to update its spyware definitions as one of the last steps of its installation.

1. Copy Spy Sweeper Trial version 4.5 ssfsetup1_1831229530.exe to the local system, and double-click it to install the application.
2. Install with default settings.
3. Click Run Spy Sweeper 4.5 at the end of the installation procedure.
4. Click Sweep on left panel.
5. Spyware Fingerprints Loaded should be 110,373. If not, the installation did not succeed, so reset the system to the base test image and begin again.
6. Assuming the installation succeeded, click Options on left panel. The options screen should look like this:
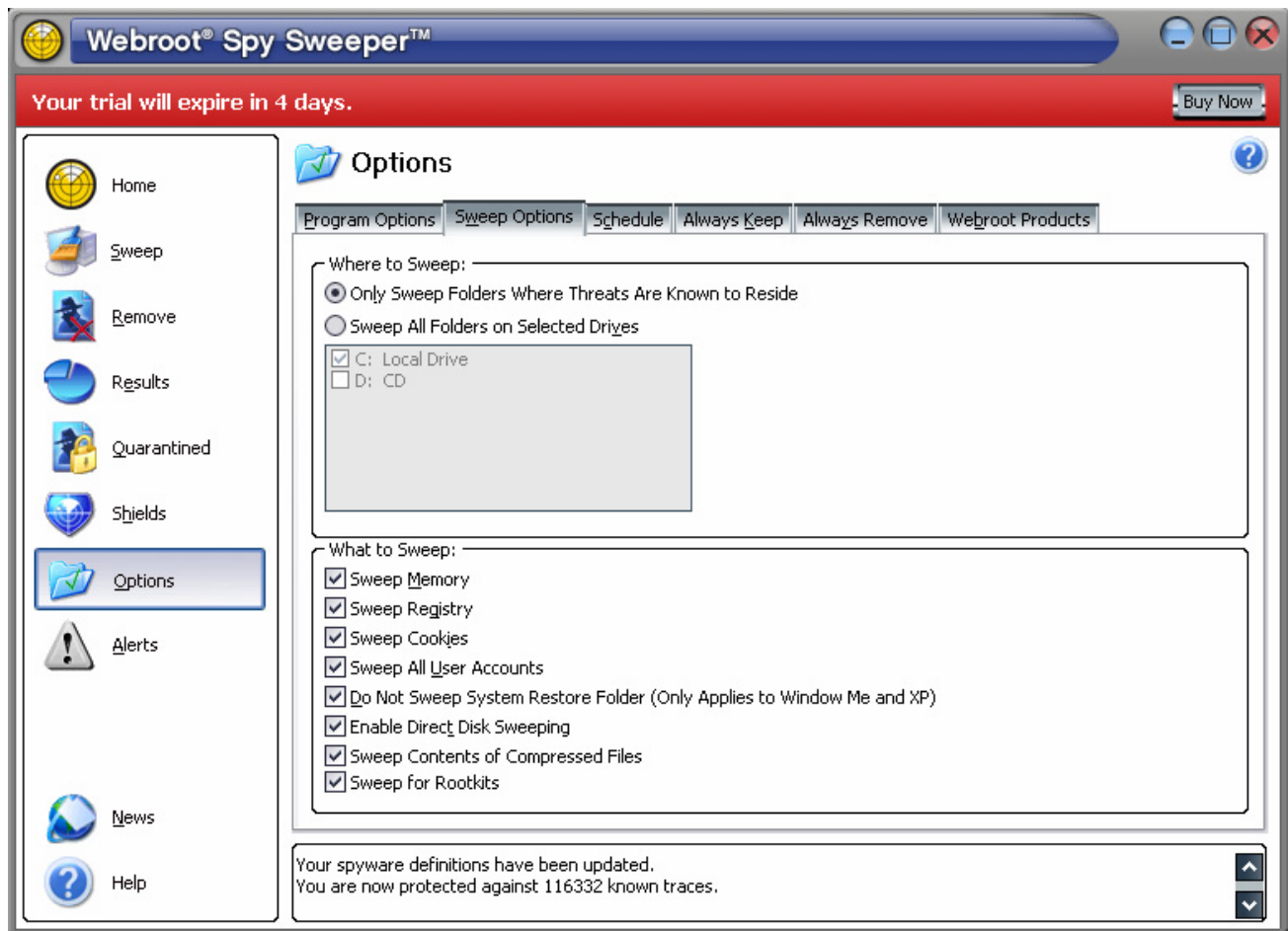
Figure 6: Webroot Spy Sweeper options.

      a. In the Where to Sweep: section of this screen, select Only Sweep Folders Where Threats Are Known to Reside.

      b. In the What to Sweep: section of this screen, select all options available.

7. Close Spy Sweeper 4.5.

Running the test

1. Reboot the system, and reset the three stopwatches.
2. Launch McAfee VirusScan Enterprise 8.0i by navigating to it from the start menu (Start→All Programs→Network Associates→VirusScan Console).
3. Launch ABBYY FineReader 8.0 Professional Edition (Start→All Programs→ABBYY FineReader 8.0→ABBYY FineReader 8.0 Professional Edition).
4. Launch Spy Sweeper 4.5 by double-clicking the desktop icon.
5. Click Sweep on the left panel.
6. With all three applications open, click the Start button in McAfee VirusScan Enterprise 8.0i, and start stopwatch #1.
7. As quickly as possible, click the Start button in Webroot Spy Sweeper 4.5. Start stopwatch #2.
8. Again, as quickly as possible, select Start Background Recognition from the Process menu in ABBYY FineReader 8.0. Start stopwatch #3 at the same time.
9. Stop stopwatch #3 when PDF processing is complete.
10. Stop stopwatch #2 when the virus scan is complete.
11. The sweep is complete when Spy Sweeper 4.5 presents a message stating, Congratulations! No spyware, adware or unwanted items were detected. Stop stopwatch #3.
12. Record the time, in seconds, for each task from the stopwatches.

13. Close the applications. Do not save the file in ABBYY FineReader 8.0.
14. Repeat two times.

We report the time, in seconds, it took ABBYY FineReader 8.0 to process this 46 page PDF, McAfee VirusScan Enterprise 8.0i to scan a directory for viruses, and Webroot Spy Sweeper 4.5 to sweep the system for spyware. All the times we report are stopwatch times.

Adobe Photoshop CS2

We followed this procedure for evaluating PC performance using Adobe's Photoshop 2 and a set of events that an IBM Rational Visual Test script controlled.

This test requires a stopwatch.

Intel provided both the Adobe Photoshop CS2 .psp file and the .tif file (Country Road.tif) this test uses. Intel also provided the IBM Rational Visual Test 6.5 client installation file (runtime.exe) and the IBM Rational Visual Test 6.5 script (Photoshop.pc6) for this test.

On our test configurations, the script Intel provided successfully ran with Adobe Photoshop CS2 running alone. It also ran with McAfee VirusScan Enterprise 8.0i scanning in the background. It did not, however, complete successfully on our test systems with both virus and spyware scanning running in the background. Intel then supplied the script's source, and we slightly modified it so it ran successfully with both background tasks. We used this modified script for all tests involving Adobe Photoshop CS2.

The script times the following operations:
1. Sizing the image, from the final Enter on the Image Size window until the main window menus are active.
2. Each of the filters from the last Enter until the main window menus are active, or, in the case of filters with progress bars, until the progress bar goes away.

The script performs but does not time the following operations:
1. Opening Photoshop.
2. Undo commands.
3. Closing the file.
4. Closing Photoshop.
5. The first application of the Film Grain filter.
6. The time it takes to display the filter previews for filters that display previews.

We installed Adobe Photoshop CS2 and the IBM Rational Visual Test runtime for this test.

Setup—Adobe Photoshop CS2
1. Reset the test systems with the base test images.
2. Copy the Adobe Photoshop CS2 .psp file and the .tif file (Country Road.tif) to C:\PhotoshopTest to in the C:\photoshopTest directory.
3. Insert the Adobe Photoshop CS2 CD.
4. Select North American English for the installation process, and Click OK.
5. Click Accept at the License Agreement screen.
6. Click Install Adobe Photoshop CS2.
7. At the Welcome screen, click Next >.
8. At the License Agreement screen, select English at the top, and click Accept.
9. At the Customer Information screen, enter the User Name, Organization, and Serial Number.
10. Accept the default installation folder, and click Next >.
11. Accept the default file types to associate with Photoshop CS2, and click Next >.
12. Click Install to start the installation process.
13. At the Activate Adobe Photoshop screen, click Activate.
14. Uncheck the box next to Show the readme file, and click Finish at the installation complete screen.

15. Reboot the system.
16. When the system is ready, start Adobe Photoshop CS2 by clicking Start→All Programs→Adobe Photoshop CS2.
17. At the Adobe Photoshop CS2—Registration screen, click Do Not Register.
18. At the Welcome Screen, uncheck the box next to Show this dialog at startup, and click Close.
19. At the Adobe Updater Preferences screen, uncheck the box next to Automatically check for updates every month, and click OK.
20. Exit the application.
21. Reboot the system.

Setup—Rational Visual Test
1. Store the IBM Rational Visual Test installation executable file, runtime.exe, in the C:\photoshopTest folder.
2. Put the IBM Rational Visual Test script file on the Desktop.
3. Open Windows Explorer, and install IBM's Rational Visual Test 6.5 runtime by double clicking the executable in the C:\PhotoshopTest directory.
4. At the Welcome screen, click Next >.
5. Accept the default installation folder, and click Next >.
6. After the installation completes, click Finish.
5. To associate the Visual Test application with the Visual Test script on the desktop (Photoshop.pc6), do the following:
    1. Right-click the file.
    2. Select Properties.
    3. On the General Tab, click the Change button.
    4. In the Open With dialog box, click the Browse button.
    5. Navigate to C:\Program Files\VT_Run.
    6. Double-click mtrun.exe.
    7. Click OK.
    8. Click OK.

Running the test
1. Reboot the system, and reset the stopwatch.
2. Double-click the Photoshop.pc6 file on the desktop to start the test script. Start the stopwatch.
3. The script completes when Adobe Photoshop CS2 closes and the system returns the user to the desktop. Stop the stopwatch. Record this time as the hand-timed result for the Photoshop test.
4. The script times certain aspects of the Photoshop processing. Open Windows Explorer, navigate to the C:\photoshopTest\results directory, and open the _temp.txt file with Notepad to retrieve those times.
5. The text file contains only one line. The number after Run time on that line is the amount of time, in milliseconds, the script ran. Divide this number by 1,000 to get the number of seconds the script ran, and record that time as the log-file time for the Photoshop test.
6. Repeat two times, recording each both hand times and logged times.

We report the time, in seconds, that the script took to run Photoshop CS2 through a series of events. The time we report is the script's log file time.

Adobe Photoshop CS2 with virus scanning

We followed this procedure for evaluating PC performance using Adobe's Photoshop 2 and a set of events that an IBM Rational Visual Test script controlled, while scanning for viruses with McAfee VirusScan Enterprise 8.0i.

We used a three-directory workload for the virus-scan portion of this test. This test requires two stopwatches.

We installed Adobe Photoshop CS2, the IBM Visual Test runtime, and McAfee VirusScan Enterprise 8.0i for this test. We used the same script from the previous Photoshop CS2 test.

After resetting the systems with the base test, install the applications in the following order:
1. Adobe Photoshop CS2. Follow the setup instructions from the previous Photoshop CS2 test.
2. IBM Rational Visual Test client application. Follow the setup instructions from the previous Photoshop CS2 test.
3. McAfee VirusScan Enterprise 8.0i. Follow the same setup instructions as in the other tests that include virus scanning.

Running the test
1. Reboot the system, and reset the stopwatches.
2. Open and prepare McAfee VirusScan Enterprise 8.0i using the same procedure as in the other tests that include virus scanning. Start stopwatch # 1.
3. Double-click Photoshop.pc6 on the desktop to launch the Photoshop CS2 test script. Start stopwatch #2.
4. Stop stopwatch #2 when Photoshop CS2 closes to reveal the desktop.
5. The virus scan completes when the progress bar reaches 100%. Stop stopwatch #1.
6. Record both times.
7. Repeat two times.

We report the time, in seconds, that the script took to run Photoshop CS2 through a series of events and that McAfee VirusScan Enterprise 8.0i took to scan a directory for viruses. The times we report are the script's log-file time for Adobe Photoshop CS2 and the stopwatch time for McAfee VirusScan Enterprise 8.0i.

Adobe Photoshop CS2 with virus and spyware scanning

We followed this procedure for evaluating PC performance using Adobe's Photoshop 2 and a set of events that an IBM Rational Visual Test script controlled, while scanning for viruses with McAfee VirusScan Enterprise 8.0i and scanning for spyware with Webroot Spy Sweeper 4.5.

We used a one-directory workload for the virus-scan portion of this test. This test requires three stopwatches.

We installed Adobe Photoshop CS2, the IBM Visual Test runtime, McAfee VirusScan Enterprise 8.0i, and Webroot Spy Sweeper 4.5 for this test. We used the same script from the previous Photoshop CS2 test.

After resetting the systems with the base test images, install the applications in the following order:

1. Adobe Photoshop CS2. Follow the setup instructions from the first Photoshop CS2 test.
2. IBM Rational Visual Test client application. Follow the setup instructions from the previous Photoshop CS2 test.
3. McAfee VirusScan Enterprise 8.0i. Follow the same setup instructions as in the other tests that include virus scanning.
4. Webroot Spy Sweeper 4.5. Follow the same setup instructions as in the other tests that include sypware scanning.

Running the test
1. Reboot the system, and reset the stopwatches.
2. Launch and prepare to run McAfee VirusScan Enterprise 8.0i using the same procedure as in the other tests that include virus scanning.
3. Launch and prepare to run Webroot Spy Sweeper 4.5 using the same procedure as in the other tests that include spyware scanning.
4. With both VirusScan Enterprise 8.0i and Spy Sweeper 4.5 applications open and the Photoshop script desktop icon visible, click the Start button in McAfee VirusScan Enterprise 8.0i, and start stopwatch #1.
5. Click Start in Webroot Spy Sweeper 4.5, and start stopwatch #2.
6. Double-click the Photoshop script icon on the desktop, and start stopwatch #3.
7. Stop stopwatch #3 when Photoshop closes and the desktop becomes visible.

8. The virus scan completes when the progress bar reaches 100%. Stop stopwatch #2 when the scan is complete.
9. The spyware sweep is complete when Spy Sweeper 4.5 presents a message stating, Congratulations! No spyware, adware or unwanted items were detected. Stop stopwatch #3.
10. Record the time for each task.
11. Close the applications.
12. Repeat two times.

We report the time, in seconds, that the script took to run Photoshop CS2 through a series of events, that McAfee VirusScan Enterprise 8.0i took to scan a directory for viruses, and that Webroot Spy Sweeper 4.5 took to sweep the system for spyware. The times we report are the script's log-file time for Adobe Photoshop CS2 and the stopwatch times for McAfee VirusScan Enterprise 8.0i. and Webroot Spy Sweeper 4.5.

Microsoft Windows Media Encoder 9.0 with Advanced Profile

The Microsoft Windows Media Encoder 9.0 performance test measures how quickly each system converts an .avi file into a Microsoft Windows Media Video 9.0 streaming media file.

Intel provided the file, kitesurfing.avi, this test uses. Copy this file to the My Videos directory. The file has the following key characteristics:

- Length (mm:ss): 2:01
- Size: 416 MB (436,644,352 bytes)
- Video resolution: 720x480

Setup—Microsoft Media Player 10
1. Reset the system to the base test image.
2. Download Microsoft Media Player 10 from Microsoft's Web site (http://www.microsoft.com/windows/windowsmedia/mp10/default.aspx).
3. Use this executable to upgrade the installed player from version 9 to version 10, which the test requires, accepting the following installation defaults.
   a. At the License Agreement screen, click I Accept.
   b. At the Confirm software download license agreement screen, click I Accept.
   c. At the Welcome screen, click Next >.
   d. At the Select Your Privacy Options, accept all default settings, and click Next >.
   e. Accept all default file associations, and click Finish.
   f. Answer No to the question Do you want to search your computer for files that have not been added to the library yet?
4. Close Windows Media Player 10.
5. Reboot the system.

Setup—Microsoft Windows Media Encoder 9.0
1. Download Microsoft Windows Media Encoder 9.0 from Microsoft's Web site (http://www.microsoft.com/windows/windowsmedia/9series/encoder/default.aspx), and store this file in the C:\ directory.
2. Using Windows Explorer, navigate to the downloaded Microsoft Windows Media Encoder 9.0 installation executable file, and double-click it.
3. At the Welcome screen, click Next >.
4. Accept the License Agreement, and click Next >.
5. Accept the default installation folder, and click Next >.
6. Click Install to begin the installation process.
7. When the installation completes, click Finish.
8. Reboot the system.
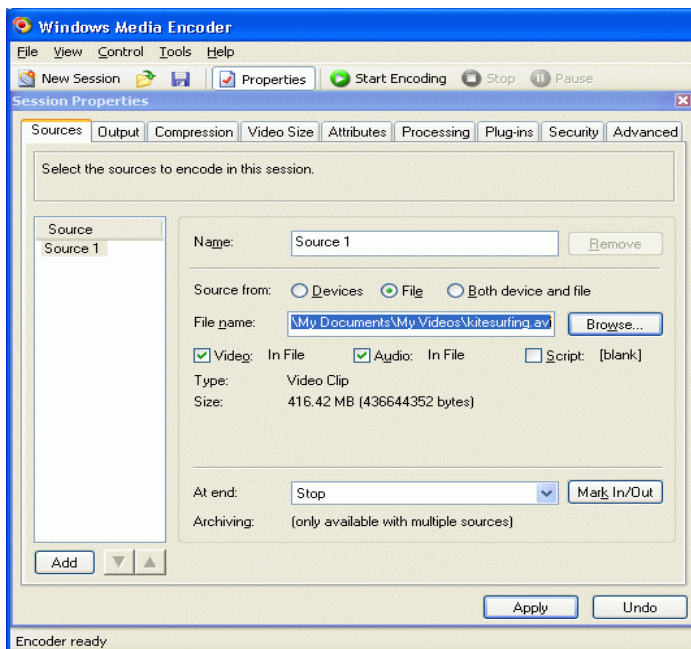
Running the test
1. Reboot the system.

2. Start Windows Media Encoder 9.0 by clicking Start→Programs→Windows Media→Windows Media Encoder. A New Session window like the one below will appear.
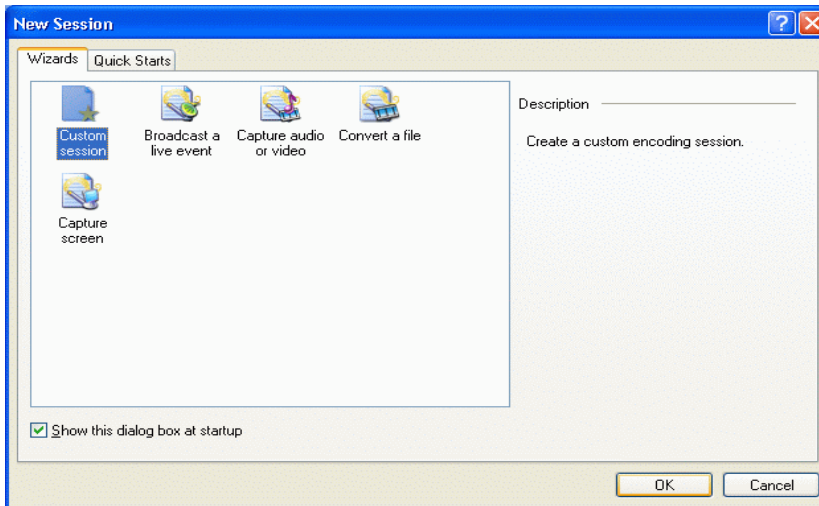

Figure 7: Windows Media Encoder 9.0 New Session window.

3. Highlight Custom Session, and click OK. A window like the one below will appear.

Figure 8: Windows Media Encoder 9.0 custom session dialog box.

4. In the Sources tab, click the File radio button from the choices for Source from. Click the Browse button, navigate to the My Videos directory, highlight the kitesurfing.avi file, and click OK.
5. Click the Output tab. A window like the one below will appear.
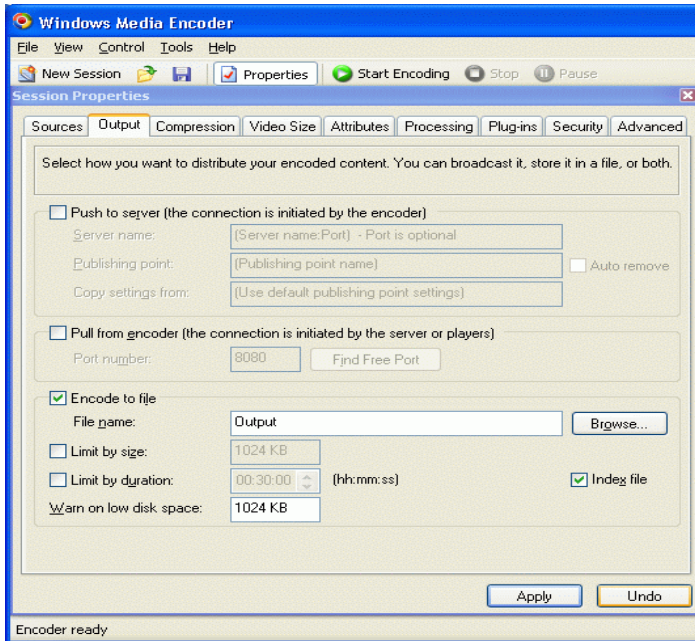
Figure 9: Output tab in Windows Media Encoder.

6. Uncheck the box next to Pull from encoder in the center of the screen.
7. Check the box next to Encode to file towards the bottom of the screen.
8. Type Output in the File name box.
9. Click the Compression tab. A window like the one below will appear.
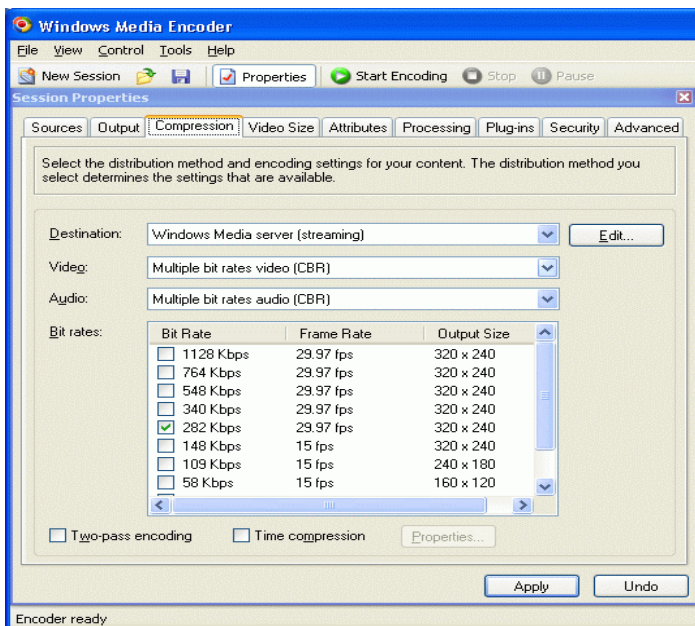
Figure 10: Compression tab in Windows Media Encoder.

10. Click Edit… towards the top right corner of the window. The Custom Encoding Settings dialog will open and show a window like the one below.
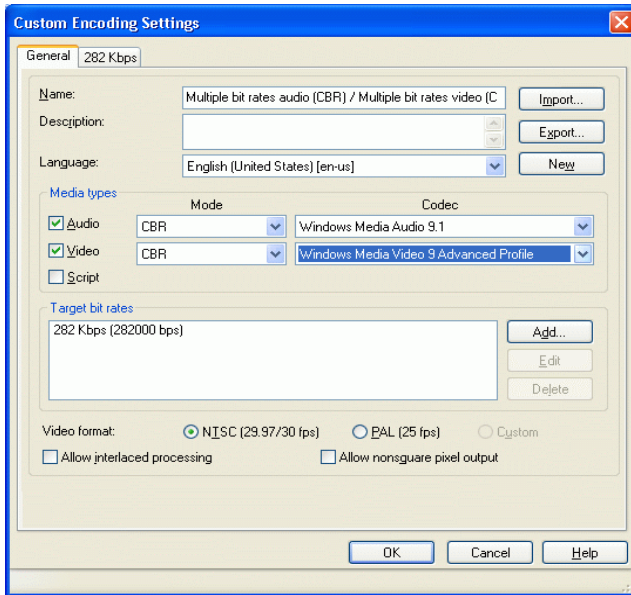
Figure 11: Custom Encoding Settings dialog box in Windows Media Encoder.

11. In the Media Types section, select Windows Media Video 9.0 Advanced Profile next to Video. Click OK.
12. Click Apply. A dialog like the one below will appear stating that the output file has been renamed with a new extension.
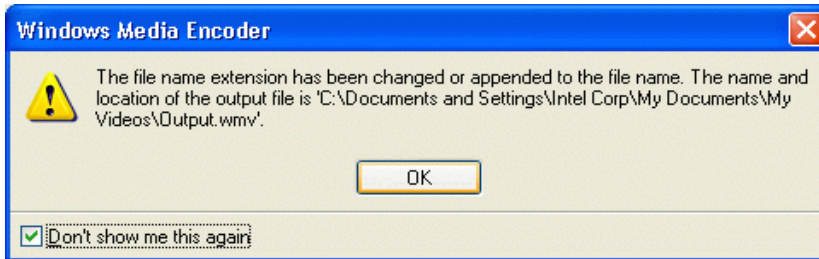
Figure 12: File rename warning message in Windows Media Encoder.

13. Click OK.
14. The main window will appear and look like the example below.
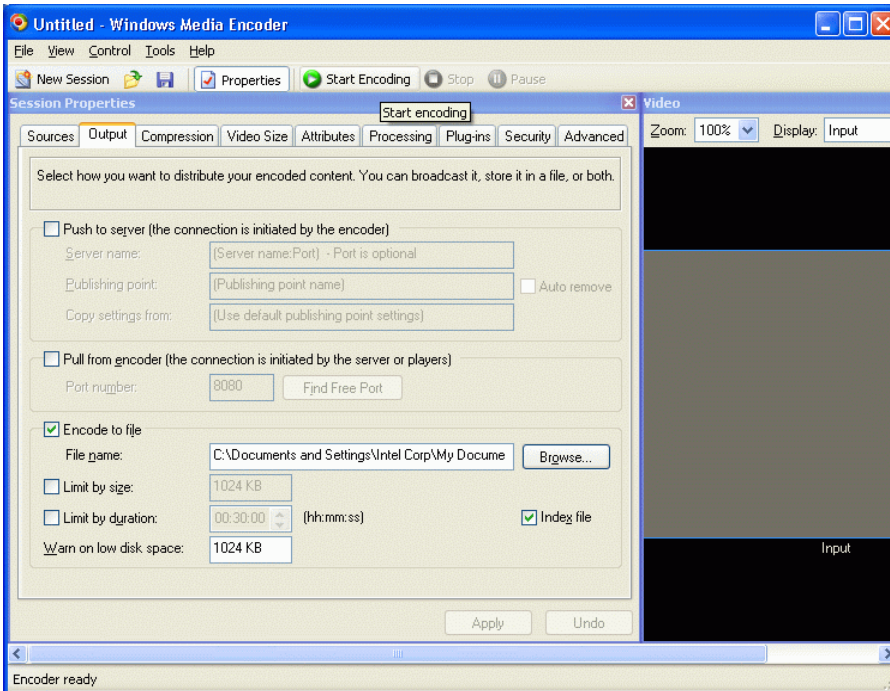
Figure 13: Main window prior to encoding takes place.

15. Click the green Start Encoding button at the top of the screen. A screen like the one below will appear. The green progress bar at the bottom right of the screen will show the status of the encoding process.
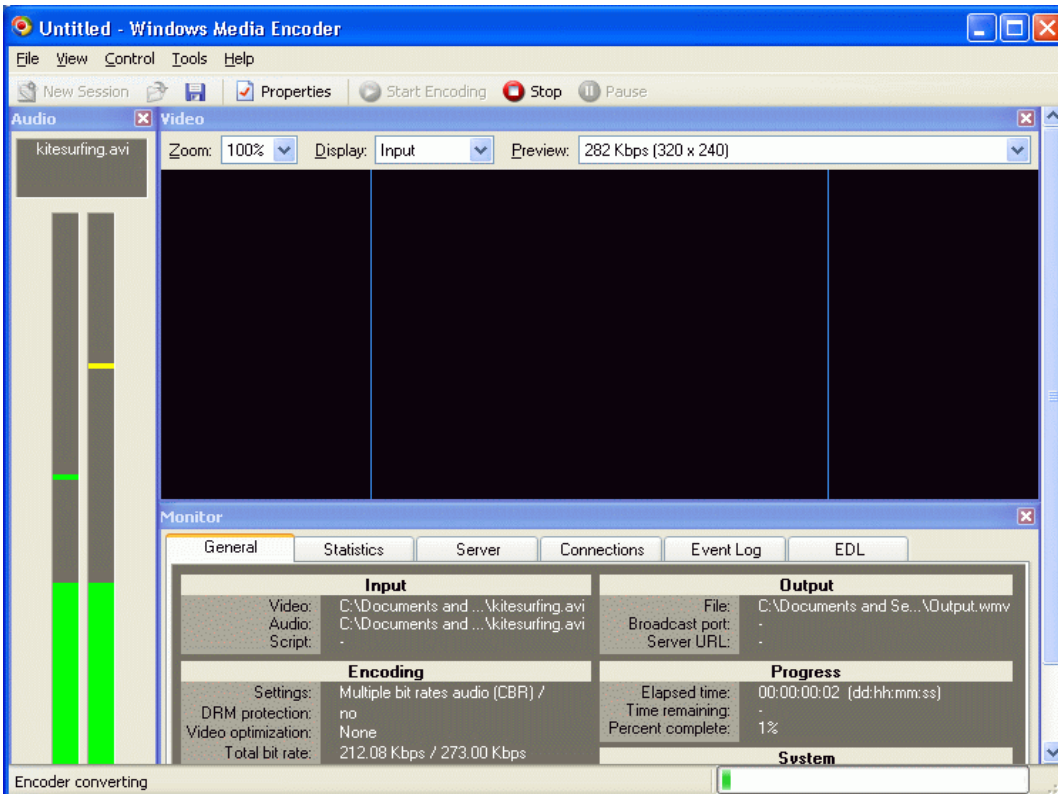
Figure 14: Windows Media Encoder during the encoding process.

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16. When the encoding process completes, an Encoding Results window like the one below will appear.
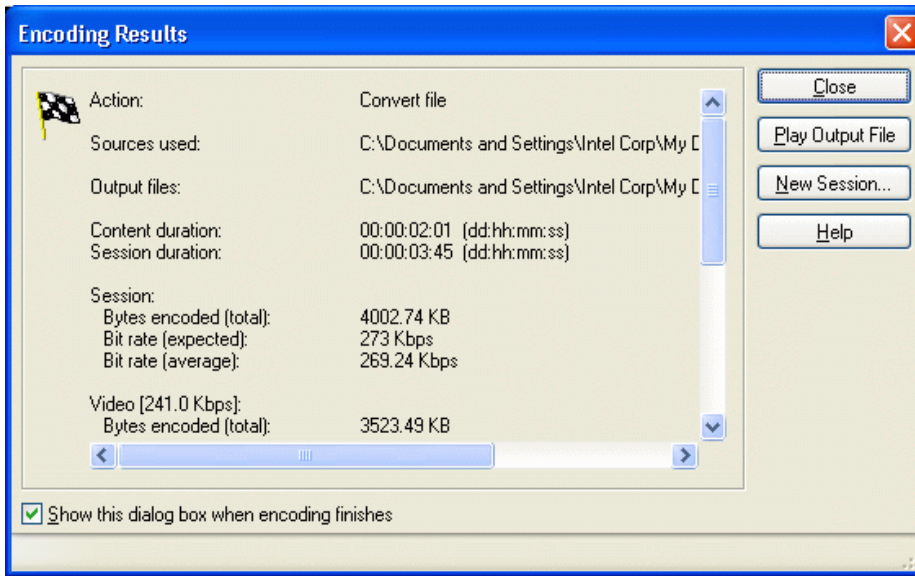
Figure 15: Encoding Results dialog box.

17. The fifth line shows the Session Duration, which is the time the application took to complete the conversion. Record this time as the test's result.
18. Click Close.
19. Close Windows Media Encoder. A window like the one below will appear.
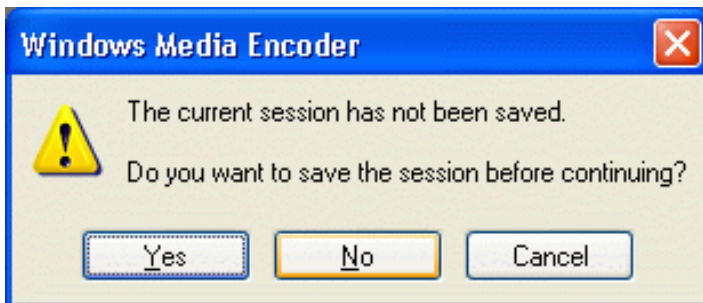
Figure 16: Save session warning.

20. Click No.
21. Using Windows Explorer, find and delete the output.wmv file.
22. Empty the Recycle Bin.
23. Repeat two times.

We report the time, in seconds, it took Windows Media Encoder to process an AVI file. The time we report is the session duration time that Windows Media Encoder displays.

Microsoft Windows Media Encoder 9.0 with Advanced Profile with virus scanning

We followed this procedure for evaluating PC performance using Microsoft Windows Media Encoder 9.0 to convert an .avi file into a Microsoft Windows Media Video 9.0 streaming media file while scanning for viruses with McAfee VirusScan Enterprise 8.0i.

We used a one-directory workload for the virus-scan portion of this test. This test requires a stopwatch. It uses the same test file as the previous Microsoft Windows Media Encoder 9.0 test.

After resetting the systems with the base test images, install the applications in the following order:

1. Microsoft Media Player 10. Follow the setup same instructions as in the previous test.
2. Microsoft Windows Media Encoder 9.0. Follow the same instructions as in the previous test.
3. McAfee VirusScan Enterprise 8.0i. Follow the same setup instructions as in the other tests that include virus scanning.

Running the test
1. Launch and prepare Windows Media Encoder 9.0 to run. Follow the same instructions as in the previous test.
2. Launch and prepare McAfee VirusScan Enterprise 8.0i to run. Follow the same instruction as in the previous test that included virus scanning.
3. With both VirusScan and Windows Media Encoder applications open, click the Start button in McAfee VirusScan Enterprise 8.0i, and start the stopwatch.
4. Click the green Start Encoding button at the top of the screen. The green progress bar at the bottom right of the screen will show the status of the encoding process.
5. When the encoding process completes, an Encoding Results window will appear.
6. The fifth line shows the Session Duration, which is the time the application took to complete the conversion. Record this time as one of the test's results.
7. The virus scan completes when the progress bar reaches 100%. Stop the stopwatch when the scan is complete. Record this time.
8. Close McAfee VirusScan Enterprise 8.0i.
9. Close Windows Media Encoder.
10. Using Windows Explorer, find and delete the output.wmv file from the My Videos directory.
11. Empty the Recycle Bin.
12. Repeat two times.

We report the time, in seconds, it took Windows Media Encoder to process an AVI file and McAfee VirusScan Enterprise 8.0i to scan a directory for viruses. The time we report for Windows Media Encoder is the session duration the application displays, and the time we report for McAfee VirusScan Enterprise 8.0i is the stopwatch time.

Microsoft Word 2003 and Adobe Acrobat 7.0.5 with virus scanning

We followed this procedure for evaluating PC performance using Adobe Acrobat 7.0.5 to convert a Microsoft Word 2003 file into a PDF file while scanning for viruses with McAfee VirusScan Enterprise 8.0i.

We used a one-directory workload for the virus-scan portion of this test. This test requires two stopwatches.

Intel provided the Word document this test uses. This document has the following key characteristics:

- Size: 314 KB (322,048 bytes)
- Number of pages: 68

After resetting the systems with the base test images, install the applications in the following order:

1. Microsoft Office 2003. Follow the setup instructions below.
2. Adobe Acrobat 7.0 Standard. Follow the setup instructions below.
3. McAfee VirusScan Enterprise 8.0i. Follow the same setup instructions as in the previous test that included virus scanning.

Setup—Microsoft Office 2003 Professional
1. Install Microsoft Office 2003 Professional with default settings.
   a. Insert the Microsoft Office 2003 Professional CD.
   b. Enter Product Key, and click Next >.

     c.   Enter User Information, and click Next >.
     d.   Click the check box next to I accept the terms in the License Agreement on the End-User License Agreement screen, and click Next >.
     e.   Select Typical Install, accepting the default install location, and click Next >.
     f.   Click Install.
     g.   Click Finish at the Setup Completed screen.
2. Reboot the system.

Setup—Adobe Acrobat 7.0 Standard
1. Install Acrobat 7.0 with default settings.
     a.   Insert the Adobe Acrobat 7.0 Standard CD.
     b.   Click Install Adobe Acrobat 7.0 Standard.
     c.   Click Next > at the Adobe Acrobat 7.0 screen.
     d.   Click Next > at the Adobe Acrobat 7.0 Standard – Setup screen.
     e.   Select US English, and select Next > at the Select EULA Language screen.
     f.   Click Accept > at the End User License Agreement screen.
     g.   Enter user information and Serial Number at the Customer Information screen, and click Next >.
     h.   Click Next > at the Caching the Installer screen.
     i.   Click Next > at the PDFMaker Installation and Integration Information.
     j.   Click Next > at the Setup Type screen. Leave Typical selected for Setup Type.
     k.   Accept the default Destination Folder, and click Next >.
     l.   Click Install.
2. Reboot the system
3. Upgrade Adobe Acrobat 7.0 to version 7.0.5 by launching the application, selecting Help from the menu, and choosing Check for updates now.
4. After the download is complete, select Install Now.
5. Select the Reboot Now option after installation completes.

Setup—Integrating Adobe Acrobat 7.0 with Microsoft Word
1. Copy the Word test document to the desktop.
2. Open Word.
3. When Word opens, go to the Adobe PDF menu.
4. Scroll down, and select Change Conversion Settings. The figure below shows an example of what you should see.
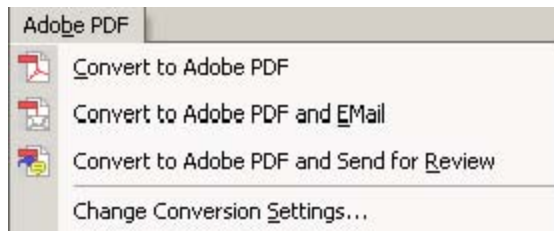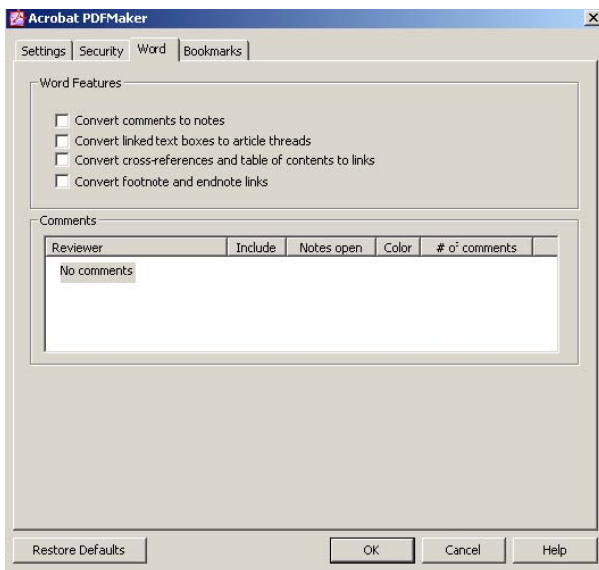

Figure 17: Adobe PDF menu in Word

5. Uncheck all the boxes on the Settings tab. The figure below illustrates what you should see.
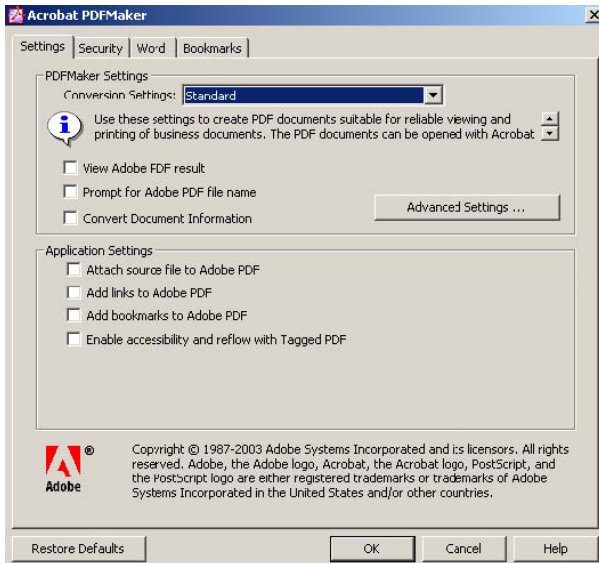
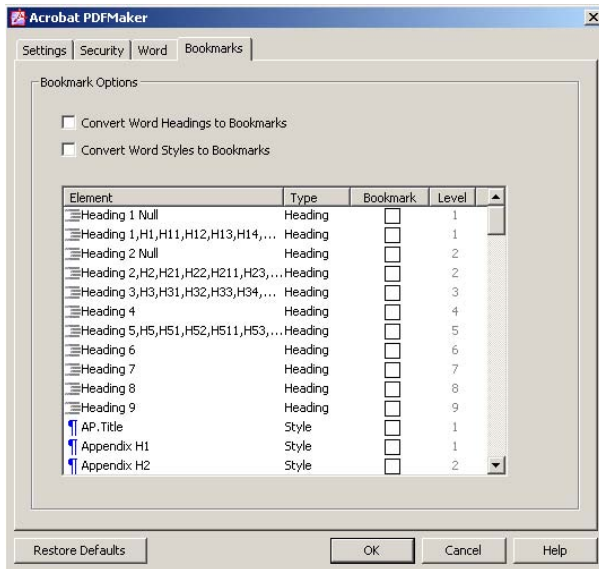**Figure 18: Adobe Acrobat PDFMaker dialog box—Settings tab**

6. Click the Word tab, and uncheck all the boxes. The figure below shows what you should see.

Figure 19: Adobe Acrobat PDFMaker dialog box—Word tab

7. Click the Bookmarks tab, and uncheck all the boxes. The figure below shows what you should see.

Figure 20: Adobe Acrobat PDFMaker dialog box—Bookmarks tab

8. Click OK.
9. Close Word.
10. Reboot the system.

Running the test
1. Reboot the system, and reset the stopwatches.
2. Launch Word, and open the test document (RoundTheMoon2.doc).
3. Launch and prepare to run McAfee VirusScan Enterprise 8.0i. Follow the same instructions as in the previous test that includes virus scanning.
4. Start stopwatch #1 and click the Start button in McAfee VirusScan Enterprise 8.0i at the same time.
5. Immediately go to Word, click the Acrobat conversion button , and start stopwatch #2.
6. When the Word presentation to Acrobat document conversion completes, the conversion status dialog closes. Stop stopwatch #2. Record this time.
7. The virus scan completes when the progress bar reaches 100%. Stop stopwatch #1 when the scan completes. Record this time.
8. Delete the output PDF file.

We report the time, in seconds, it took Adobe Acrobat 7.0 to convert a Word document to a PDF file and McAfee VirusScan Enterprise 8.0i to scan a directory for viruses. Both times we report are stopwatch times.

Industry benchmark

This benchmark produces, among other results, an overall score and a CPU score; higher scores are better.

BAPCo SYSmark 2004 SE

As we observed in the note below Table 1, SYSmark 2004 SE would not run successfully at the resolution at which the AMD-based HP dx5150 booted out-of-the-box. When we attempted to run the benchmark in the out-of-box configuration, SYSmark 2004 SE presented the following error:
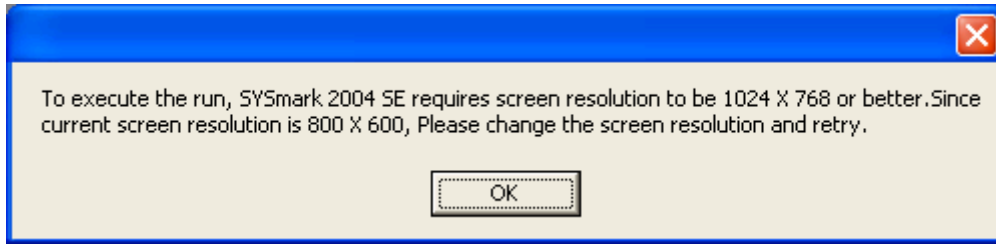
Figure 21: Error message when attempting to run BAPCo SYSmark 2004 SE at 800 x 600.

Consequently, as we also explained earlier we changed the AMD test system's screen resolution to 1024 x 768 x 32-bit color depth, the resolution at which the other test system booted. For consistency, we ran all tests in this report at this resolution. After making this modification, we performed the following steps to install the benchmark:

Setup—SYSmark 2004 SE
1. Insert the SYSmark 2004 SE DVD.
2. Click Next > at the SYSmark 2004 SE Setup dialog box.
3. Accept the license agreement, and click Next >.
4. Fill out the User Name, Company Name, and Serial Number fields in the Customer Information dialog box, and click Next >.
5. Click Next > at the Destination Directory dialog box.
6. Click Next > at the Select Program Folder dialog box.
7. Click Yes at the Question dialog box.
8. Click Finish at the Installation Complete dialog box, and let the system reboot.

Running the test
1. Reboot the system.
2. Launch SYSmark 2004 SE.
3. Click Run on the left-side menu.
4. Select Official Run, choose three iterations, and enter a name for that run.
5. When the benchmark completes, the main SYSmark 2004 SE menu appears. Select the Reports button, then Official Report, which produces the SYSmark 2004 SE test scores.
6. At the top, click Disclosure, enter all required information (which the benchmark designates with an asterisk), and click OK. When the report appears, click File→Export, and designate a location for the Full Disclosure Report.

We report the overall score that an official three-iteration run of BAPCo's SYSmark 2004 SE generated.

Appendix A: Test system price and purchase information

We purchased the two HP built-to-order systems on November 6, 2005 via www.hpshopping.com.

Figure 22 below presents the SKU and price information for the two PCs.

System	HP dc5100 system	HP dx5150 system
Processor	Intel Pentium 4 640	AMD Athlon64 4000+
Processor frequency (GHz)	3.2	2.4
Part number	995180	995185
Unit price ($)	1,027.00	1,216.00
Tax ($) [1]	71.89	85.12
Shipping ($) [2]	54.92	54.92
Total we paid ($)	1,153.81	1,356.04

Figure 22: Purchase information for the two test systems.

Notes:
[2] Tax reflects the North Carolina sales tax rate of seven percent.
 [2] www.hpshopping.com charged $109.84 shipping for the two systems. We divided this amount equally between the two systems.

Appendix B: Test system configuration information

This appendix provides detailed configuration information about the two test systems.

System	HP Compaq dc5100	HP Business desktop dx5150
General		
Processor and OS kernel: (physical, core, logical) / (UP, MP)	1P1C2L / MP	1P1C1L / UP
Number of physical processors	1	1
Single/Dual Core processors	Single core	Single core
Processor HT Status	Yes	No
System Power Management Policy (AC/AlwaysOn, AC/Adaptive, DC/AlwaysOn, DC/Adaptive, Other)	AC / AlwaysOn	AC / AlwaysOn
CPU		
Segment (S=Server, D=Desktop, M=Mobile)	D	D
Vendor	Intel	AMD
Name	Pentium 4	Athlon 64
Model number	Pentium 4 640	Athlon 64 4000+
Stepping	3	SH-CG
Socket type and number of pins	LGA775	Socket 939
Core frequency	3200	2400
Front-side bus frequency	800 MHz	HyperTransport 1000 MHz
L1 Cache	16 KB + 12 KB	64 KB + 64 KB
L2 Cache	2048 KB	1024 KB
Platform		
Vendor	Hewlett Packard	MSI
Motherboard model number	MT(PM213AV)	09AC
Motherboard chipset	Intel i915GV	ATI RS480/RX480
Motherboard revision number	10061574300273 v. A03	N/A
System/motherboard serial number	SP#376570-001 / P92C80CS5SBMVP	SP#380132-001 / P8C470DP1SD1W2
Bios name and version	Hewlett-Packard 786C2 v01.07 08/25/2005	Phoenix Technologies 1.06 09/07/2005
BIOS settings	Setup default	Setup default
Chipset INF driver	6.00.1013	5.10.1000.5
Memory module(s)		
Vendor and model number	Micron Tech. 4HTF3264AY-53EB2	Infineon 64D32300HU5C
Type	PC2-4200 DDR2-SDRAM	PC3200 DDR-SDRAM
Speed (MHz)	533	400
Speed running in the system (MHz)	266	200
Timing/Latency (tCL-tRCD-tRP-tRASmin)	4.0-4-4-12	3.0-3-3-8
Size	512 MB	512 MB
Number of sticks	2 x 256 MB	2 x 256 MB
Chip organization (Single-sided, Double-sided)	Single-sided	Single-sided
Channel (Single/Dual)	Dual	Dual
Hard disk		

Vendor and model number	Samsung HD080HJ	Samsung HD080HJ
Size	80 GB	80 GB
Buffer Size	8 MB	8 MB
RPM	7,200	7,200
Type	Serial ATA II	Serial ATA II
Controller	Intel(R) 82801FB Ultra ATA Storage Controllers - 2651	ATI IDE Controller
Driver	Intel 6.0.0.1011	Microsoft 5.1.2535.0
Operating system		
Name	Windows XP Professional	Windows XP Professional
Build number	2600	2600
Service pack	SP2	SP2
File system	NTFS	NTFS
Kernel	ACPI Multiprocessor PC	ACPI Uniprocessor PC
Language	English	English
Microsoft DirectX version	DirectX 9.0c	DirectX 9.0c
Graphics		
Vendor and model number	Intel 82910GL/915G/915GL/915GV Graphics	ATI Radeon Xpress 200
Chipset	Intel GMA 900	ATI Radeon Xpress 200 Chipset
BIOS version	Intel Video BIOS 3329	BK-ATI VER008.025I.004.000
Type (P=PCI Express, A=AGP 8X, I=Integrated)	I	I
Memory size	128 MB	64 MB
Resolution	1024 x 768 x 32-bit color	1024 x 768 x 32-bit color
Driver	ialmrnt5 (6.14.10.3924)	ati2dvag (6.14.10.6521)
Sound card/subsystem		
Vendor and model number	SoundMAX Digital Audio	Realtek AC97 Audio
Type (P=PCI, I=Integrated)	I	I
Driver	SoundMAX version 5.12.1.4070	Realtek version 5.10.0.5720
Network card/subsystem		
Vendor and model number	Broadcom NetXtreme Gigabit Ethernet	Broadcom NetXtreme Gigabit Ethernet
Type (P=PCI, I=Integrated)	I	I
Driver	Broadcom version 7.80.1.0	Broadcom version 8.22.1.0
Optical drive(s)		
Vendor and model number	LITE-ON DVD SOHD-16P9S	LITE-ON DVD SOHD-16P9S
Type (CDROM, CDRW, DVD-ROM, DVD-W)	DVD-ROM 16x	DVD-ROM 16x
Interface (I=Internal, E=External)	I	I
USB ports		
Number	8 (2 front, 6 back)	8 (2 front, 6 back)
Type	2.0	2.0
Monitor		
CRT/LCD type (P=Plug & Play, T=TFT, R=Reflective)	CRT / P	CRT/ P
CRT/LCD refresh rate	85 Hz	85 Hz
Other information	MAG Innovision Model 786N	MAG Innovision Model 786N

Figure 23: System configuration information for both test systems.
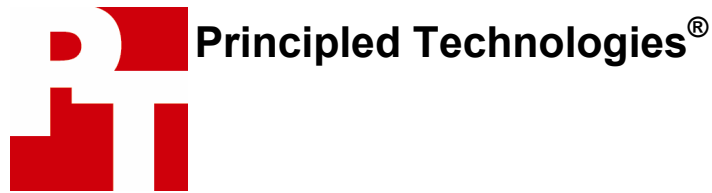
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