

## Performance and battery life ratings of two notebook PCs with Intel processors

### Executive summary

Intel Corporation (Intel) commissioned Principled Technologies (PT) to run a set of performance tests on the following notebook systems in their out-of-the-box (OOB) configurations:

- Toshiba Satellite A200-03V, an Intel Pentium dual-core processor T2310-based system
- Toshiba Satellite A200-24V, an Intel Core 2 Duo processor T5250-based system

The goal of the testing was to gauge the performance and battery life that consumers would experience when performing common tasks. Intel provided the test systems, tests, test procedures, and test settings. PT set up the systems and executed all tests.

We measured system performance and battery life using the following industry-standard benchmark:

- **BAPCo MobileMark 2007 Productivity**, which provides a Performance Qualification score and a Battery Life score

We also measured system performance with the following three custom consumer application tests designed to simulate tasks that users commonly perform on notebook PCs:

- **Music ripping**, which uses Apple iTunes 7.5 to rip a .wma music file to mp3 format
- **Movie creation**, which uses different filters and effects to create an .avi movie file using Adobe After Effects CS3
- **Video encoding for YouTube use**, which encodes a .wmv file from four mpeg-4 video clips using Microsoft Windows Movie Maker

As Figure 1 illustrates, the Intel Core 2 Duo processor T5250-based notebook PC outperformed the Intel Pentium dual-core T2310-based notebook on the MobileMark 2007 Performance Qualification test by 37 percent while achieving a MobileMark 2007 Battery Life score only slightly lower (150 minutes versus 153 minutes). The Intel Core 2 Duo processor T5250-based notebook PC also outperformed the Intel Pentium dual-core T2310-based notebook on all three custom consumer application tests.

The Test results section shows these results in greater detail, while the Test methodology section explains how we ran those tests. Appendix A provides the configuration of the test systems.

### Test results

Figure 1 presents the medians of all test scores for the systems. (We ran MobileMark 2007 Productivity three times and each custom test five times on each system.) On the custom tests, lower scores are better, because each score is the time, in seconds, that the system required to complete the test. A lower time indicates that the system completed the work faster. The one exception is the MobileMark 2007 results; higher Performance Qualification and Battery Life scores indicate better system performance and battery life, respectively. The comparative ratings indicate how much better the T5250-based system is than T2310-based system on each test.

#### KEY FINDINGS

- The Intel Core 2 Duo processor T5250-based notebook PC outperformed the Intel Pentium dual-core T2310-based notebook on the MobileMark 2007 Performance Qualification test by 37 percent (see Figure 1).
- The Intel Core 2 Duo processor T5250-based notebook PC outperformed the Intel Pentium dual-core T2310-based notebook on all three custom consumer application tests (see Figure 1).

Benchmark or Test	Performance Results		Comparative Ratings	
	Toshiba Satellite A200-03V Intel Pentium dual-core mobile T2310 1.46 GHz (66 nits)	Toshiba Satellite A200-24V Intel Core 2 Duo mobile T5250 1.50 GHz (73 nits)	Toshiba Satellite A200-03V Intel Pentium dual-core mobile T2310 1.46 GHz (66 nits)	Toshiba Satellite A200-24V Intel Core 2 Duo mobile T5250 1.50 GHz (73 nits)
<b>Industry standard benchmarks</b>	<b>Score – higher is better</b>		<b>Comparative rating - higher is better</b>	
BAPCo MobileMark 2007 (Performance Qualification score)	91	125	1.00	1.37
BAPCo MobileMark 2007 (Battery Life score)	153	150	1.00	0.98
<b>Custom consumer application tests</b>	<b>Performance in seconds – lower is better</b>		<b>Comparative rating – higher is better</b>	
Adobe After Effects CS3	1,007	870	1.00	1.16
Apple iTunes 7.5	147	138	1.00	1.07
Microsoft Windows Movie Maker	161	151	1.00	1.07

**Figure 1: Performance results and comparative performance ratings for the test systems. In the performance results of the industry-standard benchmarks, higher numbers are better, while for custom consumer application tests, lower numbers are better. For comparative ratings, higher numbers are better.**

Because screen brightness can affect the amount of energy a system consumes, for each pair of comparison systems we set the brightness to be as close as we could make it to, but over, 60 nits. MobileMark 2007 requires systems be set to at least 60 nits to produce a valid result. Consequently, the Intel T5250-based system was actually slightly brighter than the Intel T2310-based comparison system. The nits measurements in parentheses below each system name gives the brightness at which we tested each system on battery power.

## Test methodology

This section discusses some differences in the configurations of the test systems and details the methodologies we followed in testing them. We ran MobileMark 2007 three times and each consumer custom test five times and reported the median of those runs.

### Configuration differences

The two systems have the following differences:

- The memory size and memory modules in the systems differ.
- The wireless network controllers in the systems differ.
- The optical drives in the systems differ.

For more details on the system configurations, see Appendix A.

### Initial setup

When the systems arrived, we unpacked and set up each one. We went through the following process with the Windows Vista Home Premium systems the first time we booted it:

1. At the Product Recovery Menu, select English and click Next.
2. At the Recovery of Factory Default Software screen, click Next.
3. At the Recovery Complete screen, click Finish.
4. At the Set up Windows screen, select United States, English and U.S. keyboard, and click Next.
5. At the Microsoft End User License Agreements, select Yes, I accept them, and click Next.
6. Type a user name.
7. Leave the password blank, and click Next.

8. Name the computer with its model, and click Next.
9. At the Help protect Windows automatically screen, click Ask me later (because our goal is to test each PC as it comes directly out of the box).
10. At the Review your time and date settings, select Eastern Time, and click Next.
11. At the Thank you screen, click Start.

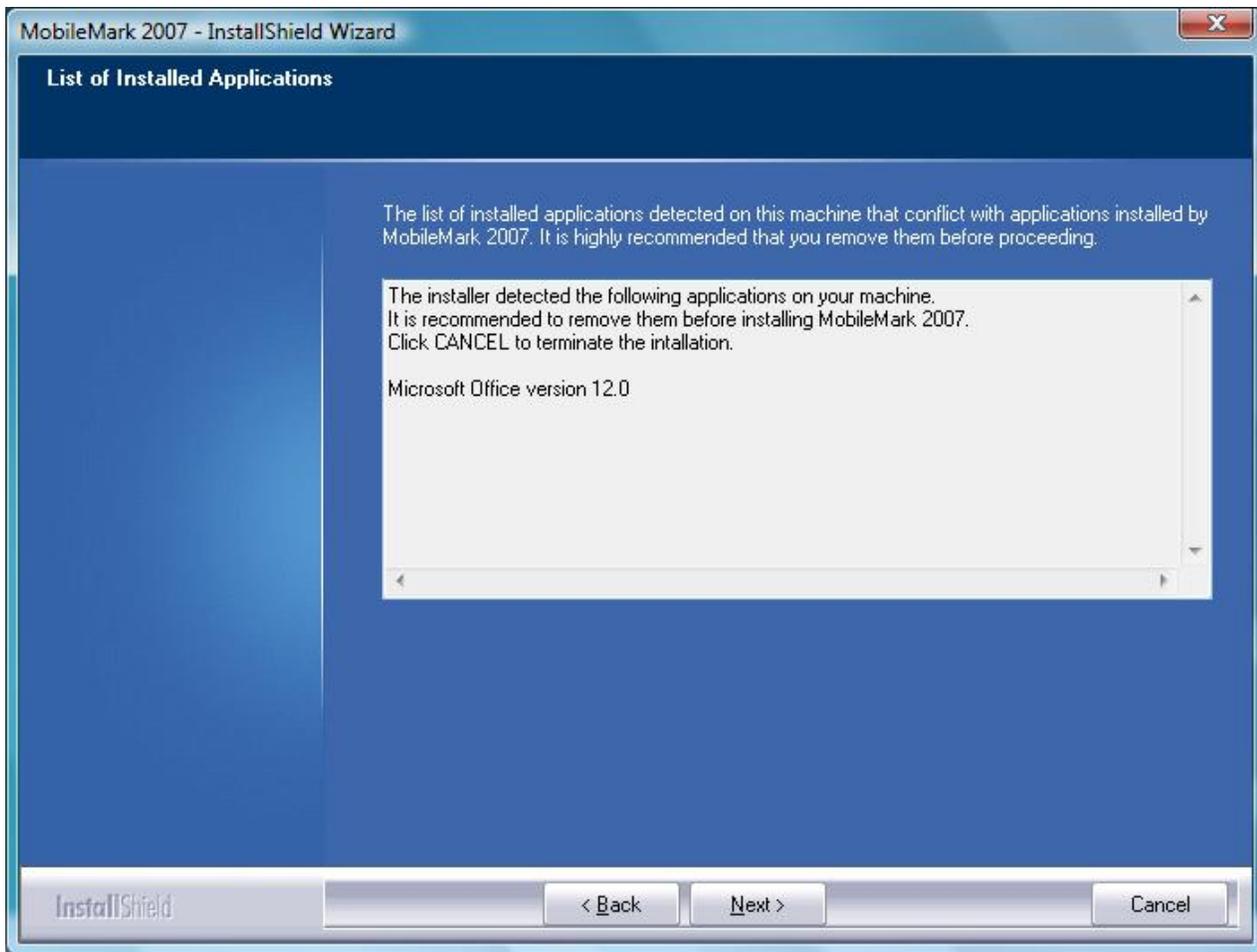
### **Capturing an image of the hard drive**

We used Symantec's Ghost product to capture an exact image of the hard disk. Each time we ran a new benchmark or test on a machine, we used the Ghost image to return that machine to its original configuration. After re-imaging, we installed the software necessary to run each test and rebooted. We followed this process to capture the image:

1. Restart the computer.
2. Insert a bootable network CD.
3. Press the Escape key, at the Current Configuration dialog screen, to accept the automatic network options.
4. At the DOS command prompt, use the net use command to map a network drive to the dedicated Ghost image server, i.e., type `net use z: \\ghostserver\ghost` and press Enter.
5. Type `z:` to change to the mapped drive.
6. Type `ghost`, and press Enter.
7. At the Symantec Ghost screen, click OK.
8. Select Local→Disk→To Image.
9. Click OK.
10. Select the Primary disk, and click OK.
11. Click Save.
12. At the Compress Image dialog, select Fast.
13. At the Proceed dialog, select Yes.
14. When the image is complete, click OK, and exit Ghost.
15. Reboot the computer.

### **BAPCo MobileMark 2007**

When we installed MobileMark 2007 on both systems in their out-of-box configurations, we received the following error:



**Figure 2: Error message we received during MobileMark 2007 installation on both systems in their out-of-box configurations.**

So we could install MobileMark, we removed the preinstalled trial version of Microsoft Office 2007.

MobileMark 2007 failed to run because of the Camera Assistant Software that came preinstalled on both systems. We received the following error:

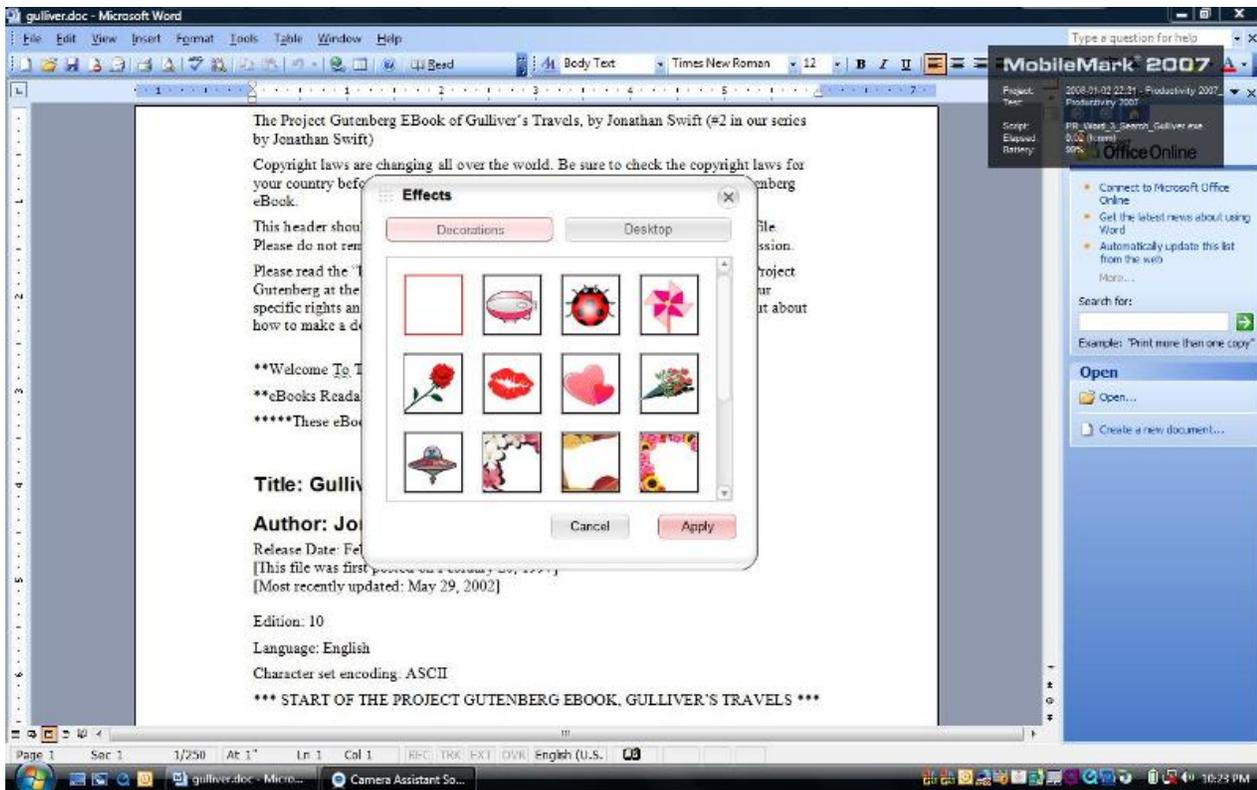


Figure 3: Camera Assistant Software error that appears during MobileMark 2007 test run.

So we could successfully complete MobileMark, we removed the Camera Assistant Software.

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

### Setting up the test

1. Reset the system to the base test image.
2. Turn off the wireless network adapter by using the external toggle switch.
3. Turn off User Account Control.
  - a. Click Start→type user accounts into the quick search field→Click Turn User Account Control on or off.
  - b. At the User Account Control dialog, click Continue.
  - c. Uncheck Use User Account Control to help protect your computer.
  - d. Click OK.
  - e. Click Restart Now.
4. Turn off Screen Saver and Power settings.
  - a. Right-click desktop→Personalize→Screen Saver.
  - b. Select None from drop-down menu, and click Apply.
  - c. Click Change power settings.
  - d. Click Change plan settings.
  - e. From the options for Turn off the display and Put the computer to sleep, select Never.
  - f. Click Change advanced power settings.
  - g. Set the battery options as follows:
    - i. Critical battery action to Shut down.
    - ii. Low battery level to 0%.
    - iii. Critical battery level to 0%.
    - iv. Low battery notification to Off.
    - v. Low battery action to Do nothing.
5. Purchase and install MobileMark 2007 with default settings from <https://www.bapcostore.com/store/product.php?productid=16173&cat=250&page=1>.

- a. At the Welcome to InstallShield Wizard screen, click Next.
  - b. At the License Agreement screen, select I accept the terms in the License Agreement, and click Next.
  - c. At the Destination Folder screen, leave the default, and click Next.
  - d. At the Ready to Install the Program screen, click Install. A screen appears indicating that the installation was successful.
  - e. Click Finish.
6. Reboot the system.

### Running the test

1. Launch MobileMark 2007 by clicking the MobileMark 2007 desktop icon.
2. Select Productivity on the left side.
3. Enter a name for that run, and click Next.
4. At the Benchmark check screen, click Next.
5. At the Hibernation Check screen click Yes to turn off Hibernation.
6. At the Preparing a new test screen, click Next.
7. When MobileMark 2007 instructs you to begin the benchmark, unplug the notebook.
8. When the notebook turns off, plug the notebook back in.
9. Record the Performance Qualification and Battery Life results MobileMark 2007 generates.

### Movie creation test using Adobe After Effects CS3

Intel provided the workload this test uses and specified the test methodology. The workload has the following key characteristic:

- Size: 135MB (141,566,877 bytes)

### Setting up the test

1. Reset the system to the base test image.
2. Copy the workload directory to the C:\ directory.
3. Download and install QuickTime 7.3.1. from <http://www.apple.com/quicktime>
  - a. At the Welcome to the QuickTime 7 Installer screen, click Next.
  - b. At the License Agreement screen, click Yes.
  - c. At the Destination folder screen, uncheck the Automatically update QuickTime and other Apple Software box, and click Install.
  - d. At the QuickTime Installer Completed screen, click Finish.
  - e. At the Upgrade from video watcher to video maker screen, click No Thanks.
4. Purchase and install Adobe After Effects CS3 Professional upgrade with default settings from <http://www.adobe.com>.
  - a. At the Adobe After Effects CS3 screen, click Install After Effects CS3.
  - b. At the License Agreement screen, click Accept.
  - c. At the Enter Serial Number screen, enter the serial number, and click Next.
  - d. At the Installation Options screen, click Next.
  - e. At the Installation Location screen, click Next.
  - f. At the Installation Summary screen, click Install.
  - g. At the Installation Completed screen, click Finish.
5. Run Adobe After Effects CS3 Software Setup:
  - a. Launch After Effects CS3, Start→All Programs→Adobe After Effects CS3.
  - b. At the Software Setup screen, enter the serial number, and click Next.
  - c. At the Upgrade Check screen, click Upgrade Later.
  - d. At the Activate screen, click Activate Later.
  - e. In the Tip of the Day window, uncheck Show Tips at Startup, and click OK.
  - f. Press Ctrl-Alt-0 to bring up the Render Queue window in the After Effects interface.
  - g. Close Adobe After Effects CS3.
6. Reboot the system.
7. Run disk defragmenter by clicking Start→All Programs→Accessories→System Tools→Disk Defragmenter.
8. Delete the contents of C:\Windows\Prefetch.
9. Double click the test\_all\_AECS3seg.aep file in C:\AECS3\Workloads to launch After Effects.
10. Select the Continue Trial radio button, and click Next.

11. Type `rundll32.exe advapi32.dll,ProcessIdleTasks` in the Start Search command prompt.
12. Type `perfmon` in the Start Search command prompt.
13. Expand and watch the Disk Monitor. When there are no more disk requests, close Perfmon.

### Running the test

1. Click Render.
2. Click OK for each of the 10 missing files dialog boxes that pop up. When all of the renderings are complete, the progress bar disappears.
3. At the Do you want to save changes? dialog, click No.
4. Browse to the log file in `c:\AECS3\Workloads\test_all_AECS3seg.aep Logs\`
5. Open the text file.
6. Record the total elapsed time.
7. Delete all files in the Output directory.
8. Repeat the steps four more times without rebooting between runs.

We report the time, in seconds, that After Effects took to complete the workload. Lower times indicate faster performance and are therefore better.

### Music ripping test using Apple iTunes 7.5

Intel provided the file this test uses, `newAudioTest.wma`, and specified the test methodology. The file has the following key characteristics:

- Length (hh:mm:ss): 01:01:24
- Size: 56.5 MB (59,287,245 bytes)

### Setting up the test

1. Reset the system to the base test image.
2. Copy the `newAudioTest.wma` file to the Music directory.
3. Download and install iTunes 7.5 with the following settings from <http://www.apple.com/itunes/download/>.
  - a. At the Welcome to the InstallShield Wizard screen, click Next.
  - b. At the License Agreement screen, select I accept the terms in the license agreement, and click Next.
  - c. At the Choose iTunes Installer Options screen, uncheck Automatically update iTunes, QuickTime, and other Apple software, and click Install.
  - d. At the Congratulations screen, click Finish.
  - e. At the License Agreement screen, click Agree.
  - f. At the Welcome to iTunes screen, click Next.
  - g. At the Find Music Files screen, uncheck both the Add MP3 and AAC files option and the Add WMA files option, and click Next.
  - h. At the Keep iTunes Music Folder Organized screen, select No, I'll change the file and folder names myself, and click Next.
  - i. At the Download Album Artwork screen, click Next.
  - j. At the iTunes Music Store screen, select No, take me to my iTunes Library, and click Finish.
  - k. From the top menu, click Edit→Preferences.
  - l. Click the Advanced tab.
  - m. Click the Importing tab.
  - n. From the Import Using drop-down menu, select MP3 Encoder.
  - o. Uncheck Play songs while importing or converting.
  - p. Uncheck Create filenames with track number.
  - q. Click OK.
  - r. Exit iTunes.
4. Reboot the system.
5. Run disk defragmenter by clicking Start→All Programs→Accessories→System Tools→Disk Defragmenter.
6. Delete the contents of `C:\Windows\Prefetch`.
7. Launch iTunes by double-clicking the desktop icon.
8. From the top menu, click File→Import.
9. Browse to the `newAudioTest.wma` test file, select it, and click Open.
10. Leave the iTunes Convert dialog open.

11. Type `rundll32.exe advapi32.dll,ProcessIdleTasks` in the Start Search command prompt.
12. Type `perfmon` in the Start Search command prompt.
13. Expand and watch the Disk Monitor. When there are no more disk requests, close Perfmon.

### Running the test

1. Click Convert.  
iTunes has finished encoding when the progress bar disappears.
2. Open a command prompt by clicking Start→All Programs→Accessories→Command Prompt.
3. Run the timestamps.exe by typing `C:\Users\User\Music\iTunes\iTunes Music\Unknown Artist\Unknown Album\timestamps.exe newAudioTest.mp3`.
4. Record the time in seconds.
5. Highlight the newAudioTest item in the iTunes Library.
6. Right-click, and select Delete.
7. Check the box that says Do not ask me again, and click Remove.
8. Click Move to Recycle Bin.
9. Empty the Recycle Bin.
10. Repeat the steps four more times without rebooting between runs.

We report the time, in seconds, that iTunes took to convert the file. Lower times indicate faster performance and are therefore better.

### Video encoding test for YouTube using Microsoft Windows Movie Maker

Intel provided the four video files this test uses and specified the test methodology. The files have the following key characteristics:

- Bridge.dvr-ms
  - Size: 177 MB (185,667,053 bytes)
  - Length (hh:mm:ss): 00:00:57
- Eiffel.dvr-ms
  - Size: 85.8 MB (90,051,134 bytes)
  - Length (hh:mm:ss): 00:00:28
- Food.dvr-ms
  - Size: 72.3 MB (75,829,985 bytes)
  - Length (hh:mm:ss): 00:00:23
- Indoors.dvr-ms
  - Size: 93.2 MB (97,784,288 bytes)
  - Length (hh:mm:ss): 00:00:30

Note: This test requires a stopwatch.

### Setting up the test

1. Reset the system to the base test image.
2. Copy the four video test files to the Documents directory.
3. Reboot the system.
4. Run Disk Defragmenter by clicking Start→All Programs→Accessories→System Tools→Disk Defragmenter.
5. Delete the contents of `C:\Windows\Prefetch`.
6. Launch Movie Maker by clicking Start→All Programs→Windows Movie Maker.
7. In the Movie Maker window, click the Import Media button.
8. Browse to the Bridge.dvr-ms test file, select it, and click the Import button.
9. Repeat steps 7 and 8 to import the other three test files.
10. Drag the four video scenes to the Storyboard time line at the bottom of the screen in the following order: Bridge, Eiffel, Food, and Indoors.
11. In the left column under Edit, click Titles and credits.
12. Click Title at the beginning.
13. Type `Our 2006 Summer Vacation - Trip to Europe`, and click Add Title.
14. Click Titles and credits again.
15. Click Credits at the end.

16. Type `Our fearless tourist`, and click Add Title.
17. In the left column under Edit, click Transitions.
18. Select the Dissolve transition and drag it between each video segment starting with Title and Bridge and ending with Indoors and Credits.
19. In the left column under publish, click This computer.
20. Name and select a location to save the file, and click Next.
21. Select Compress to 72 MB.
22. Leave the Publish dialog open.
23. Type `rundll32.exe advapi32.dll,ProcessIdleTasks` in the Start Search command prompt.
24. Type `perfmon` in the Start Search command prompt.
25. Expand and watch the Disk Monitor. When there are no more disk requests, close Perfmon.

Because this application is part of Windows Vista Ultimate, we did not need to install it.

### Running the test

1. Do the following two things simultaneously:
  - Click Publish
  - Start the stopwatchA progress dialog appears.
2. When Publish Movie finishes and the progress dialog disappears, stop the stopwatch.
3. Record the elapsed time on the stopwatch.
4. At the Your movie has been published screen, uncheck the box Play movie when I click Finish.
5. Click Finish.
6. Close Windows Movie Maker.
7. At the Do you want to save this project screen, click No.
8. Repeat the steps four more times without rebooting between runs.

We report the time, in seconds, that Windows Movie Maker took to publish a movie for YouTube. Lower times indicate faster performance and are therefore better.

## Appendix A – Test system configuration information

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

System	Toshiba Satellite A200-03V Intel Pentium dual-core mobile T2310	Toshiba Satellite A200-24V Intel Core 2 Duo mobile T5250
		
<b>General</b>		
Processor and OS kernel: (physical, core, logical)/(UP, MP)	1P2C2L / MP	1P2C2L / MP
Number of physical processors	1	1
Single/Dual Core processors	Dual	Dual
System power management policy	Balanced	Balanced
Processor power-saving option	Enhanced Intel SpeedStep Technology	Enhanced Intel SpeedStep Technology
System dimensions (length x width x height)	14 1/4" x 10 1/2" x 1 3/4"	14" x 10 1/2" x 1 3/4"
System weight	6 lbs. 1 oz.	5 lbs. 2 oz.
<b>CPU</b>		
Vendor	Intel	Intel
Name	Pentium dual-core mobile	Core 2 Duo mobile
Model number	T2310	T5250
Stepping	D	D
Socket type and number of pins	Socket P (478)	Socket P (478)
Core frequency (GHz)	1.46	1.50
Front-side bus frequency	533 MHz	667 MHz
L1 cache	32 KB + 32 KB (per core)	32 KB + 32 KB (per core)
L2 cache	1 MB (shared)	2 MB (shared)
<b>Platform</b>		
Vendor	Toshiba	Toshiba
Motherboard model number	ISKAA	ISKAA
Motherboard chipset	Intel GM965	Intel GM965
Motherboard revision number	C0	C0
System/motherboard serial number	Y7151077K	X7287675K
Bios name and version	Toshiba v1.70	Toshiba v1.70
BIOS settings	Default	Default
<b>Memory module(s)</b>		
Vendor and model number	Qimonda 64T64020HDL3SB	Samsung M470T2953EZ3-CE6
Type	PC2-5300	PC2-5300
Speed (MHz)	667	667
Speed running in the system (MHz)	533	667

<b>System</b>	<b>Toshiba Satellite A200-03V Intel Pentium dual-core mobile T2310</b>	<b>Toshiba Satellite A200-24V Intel Core 2 Duo mobile T5250</b>
Timing/Latency (tCL-tRCD-tRP-tRASmin)	4-4-4-12	5-5-5-15
Size	1,024 MB	2,048 MB
Number of memory module(s)	2 x 512 MB	2 x 1,024 MB
Chip organization (single-sided, double-sided)	Double-sided	Double-sided
Channel (single/dual)	Dual	Dual
<b>Hard disk 1</b>		
Vendor and model number	Toshiba MK1637GSX	Toshiba MK1637GSX
Size	160 GB	160 GB
Buffer size	8 MB	8 MB
RPM	5,400	5,400
Type	SATA 300 Mb/s	SATA 300 Mb/s
Controller	Intel 82801HBM (ICH8-ME)	Intel 82801HBM (ICH8-ME)
Driver	Intel 7.0.0.1020	Intel 7.0.0.1020
<b>Hard disk 2</b>		
Vendor and model number	NA	NA
Size	NA	NA
Buffer size	NA	NA
RPM	NA	NA
Type	NA	NA
Controller	NA	NA
Driver	NA	NA
<b>Operating system</b>		
Name	Windows Vista Home Premium	Windows Vista Home Premium
Build number	6000	6000
File system	NTFS	NTFS
Kernel	ACPI x86-based PC	ACPI x86-based PC
Language	English	English
Microsoft DirectX version	DirectX 10	DirectX 10
<b>Graphics</b>		
Vendor and model number	Mobile Intel GMA X3100	Mobile Intel GMA X3100
Type	Integrated	Integrated
Chipset	Mobile Intel 965 Express Chipset	Mobile Intel 965 Express Chipset
BIOS version	1436	1436
Total available graphics memory	251 MB	358 MB
Dedicated video memory	0 MB	0 MB
System video memory	128 MB	128 MB
Shared system memory	123 MB	230 MB
Resolution	1,280 x 800 x 32 bit	1,280 x 800 x 32 bit
Driver	Intel 7.14.10.1329	Intel 7.14.10.1329
<b>Sound card/subsystem</b>		
Vendor and model number	Realtek High Definition Audio	Realtek High Definition Audio
Driver	Realtek 6.0.1.5477	Realtek 6.0.1.5477
<b>Ethernet</b>		
Vendor and model number	Realtek RTL8101E PCI-E Fast Ethernet	Realtek RTL8101E PCI-E Fast Ethernet
Driver	Realtek 6.193.430.2007	Realtek 6.193.430.2007

System	Toshiba Satellite A200-03V Intel Pentium dual-core mobile T2310	Toshiba Satellite A200-24V Intel Core 2 Duo mobile T5250
<b>Wireless</b>		
Vendor and model number	Atheros AR5007EG	Intel Wireless 4965AGN
Driver	Atheros 7.3.1.42	Intel 11.1.0.100
<b>Modem</b>		
Vendor and model number	Toshiba Software Modem	Toshiba Software Modem
Driver	Agere 2.1.77.0	Agere 2.1.77.0
<b>Optical drive(s)</b>		
Vendor and model number	TssTcorp TS-L632D	Toshiba TS-L802A
Type	DVD-RW	DVDW/HD
<b>USB ports</b>		
Number	4	4
Type	2.0	2.0
Other	Media card reader	Media card reader
<b>IEEE 1394 ports</b>		
Number	0	0
<b>Monitor</b>		
LCD type	WXGA	WXGA
Screen size	15.4"	15.4"
Refresh rate	60 Hz	60 Hz
<b>Battery</b>		
Type	PA3534U-1BRS Lithium-ion	PA3534U-1BRS Lithium-ion
Size (length x width x height)	8 1/4" x 2" x 3/4"	8 1/4" x 2" x 3/4"
Rated capacity	4,000mAh / 10.8V (43Wh)	4,000mAh / 10.8V (43Wh)
Weight	10 oz.	10 oz.

**Figure 4: Detailed system configuration information for the two test systems.**



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