Battery life of three Gateway notebook PCs

Executive summary

Gateway, Inc. (Gateway) commissioned Principled Technologies (PT) to run three different battery-life tests on the following three notebook PCs:

- **Gateway MX6930** with an Intel Core 2 Duo T5200 1.60GHz processor
- **Gateway MX6931** with an Intel Core 2 Duo T5500 1.66GHz processor
- **Gateway MP8708** with an Intel Core 2 Duo T7200 2.00GHz processor

We measured battery life with three tests that simulate tasks users commonly perform on notebook PCs:

- **Watching movies.** We played a move on DVD continuously until the notebook PC fully depleted its battery. (To do this, we used the DVD playback test from MobileMark 2005, an industry-standard benchmark from the Business Applications Performance Corp. (BAPCo)).
- **Playing music.** We played music continuously until the notebook PC fully depleted its battery. (To do this, we created a custom test using Apple iTunes 7.0.0.70 to play mp3 files on the notebook's hard disk.)
- **Running productivity applications.** We ran a set of common business tasks involving a broad range of applications until the notebook PC fully depleted its battery. (To do this, we used the Productivity test from MobileMark 2005.)

> **THE BOTTOM LINE**
>
> - The Gateway MP8708 notebook PC lasted over 5 hours while performing common tasks using leading productivity applications, and both other Gateway notebook PCs lasted over 4 hours on the same test.
> - All three Gateway notebook PCs lasted over 3 ½ hours while playing MP3 music.
> - All three Gateway notebook PCs lasted over 3 ½ hours while watching DVD video, more than enough time for a typical full-length movie.

As Figure 1 shows, all three notebook PCs lasted from over 3 hours to almost 5 hours on our tests. The results here are the number of hours and minutes each system lasted before its battery died. Larger numbers are better, because they represent longer battery life.

Battery-life test	Gateway MX6930	Gateway MX6931	Gateway MP8708
Watching movies	3:25	3:18	4:01
Playing music	3:59	3:40	4:49
Running productivity applications	4:10	4:06	5:03

Figure 1: Results of the battery-life tests in hours and minutes.

Test methodology

This section discusses the methodology we followed for each of the tests we ran. We ran each test three times and report the median result of the three runs.

Display brightness and power settings

Because the brightness of a notebook's display affects its battery life, BAPCo requires that before you test with MobileMark 2005 you make sure the brightness of the notebook's monitor is greater than or equal to 60 nits on a completely white screen while the notebook is unplugged and running on battery power. The measurement follows the standards from the Video Electronics Standards Association (www.vesa.org/Standards/summary/2001_6a.htm).

We complied with this standard for all the tests we ran by setting each notebook PC's brightness as close to 60 nits as we could. (The Gateway MX6930's display was at 69 nits, the Gateway MX6931's display was at 63 nits, and the Gateway MP8708's display was at 66 nits.) We used the following procedure to meet this requirement before we started each test:

1. To create a completely blank, white screen, open Microsoft Paint by clicking Start → All Programs → Accessories → Paint.
2. Open the Attributes by typing Ctrl-E.
3. Enter dimensions that are larger than the current screen resolution. For example, if the screen resolution is 1280 x 800, enter 1600 for Width and 1200 for Height.
4. Click OK.
5. Type Ctrl-F to view the bitmap image, which completely blanks the screen.
6. Unplug the notebook from the power supply.
7. Measure the display's brightness using a luminance meter. (We used the Gossen Mavolux5032C.) Test the screen brightness three times to confirm consistency.
8. If the reading is below or significantly greater than 60, use the notebook's keyboard screen-brightness-adjustment keys to bring the display as close to 60 as possible, then retest.
9. Verify that the notebook saved the brightness setting by plugging in the system, unplugging it, and taking another reading. If the notebook did not save this setting, use its power-management application(s) to set the brightness appropriately and save that setting.

The brightness level must not fall below the initial setting during the test. To ensure this, we configured the power management options not to lower this setting when the battery life is near depletion:

1. Open Control Panel by clicking Start → Control Panel.
2. Select Power Options.
   a. Select Max Battery from the Power schemes pull-down menu.
   b. Under the Running on Batteries settings section, select the Never option for the following: Turn off monitor and System standby. Set Turn off hard disks to 3 minutes.
3. Select the Alarms tab.
   a. Uncheck Activate low battery alarm when power level reaches:
   b. Uncheck Activate critical battery alarm when power level reaches:
4. Select the Hibernate tab.
   a. Uncheck Enable hibernation.
   b. Click OK.
5. Select Display.
   a. Select the Screen Saver tab.
   b. Select None from the Screen saver pull down menu.
   c. Click OK.
6. Close Control Panel.

Audio

BAPCO recommends using a set of headphones during the tests and adjusting the audio level "so that it is comfortably audible through the headphones." To comply with this recommendation, we set the Master Volume level to 50 percent for all the tests we ran.

Installing the Rational Visual Test runtime

We developed the iTunes music-playing test script using Rational Visual Test version 6.5 (http://www-306.ibm.com/software/rational/). Consequently, to run the test we had to install that product's run-time as follows:

1. Copy the file runtime.exe from Rational Visual Test to the notebook PC.
2. Double-click the runtime executable to start the installation process.
   a. Click Next at the Welcome screen.

b. Accept the default option, and click Next at the Choose Destination Location screen.
c. Click Finish at the Setup Complete screen.

The movie playing and productivity tests (MobileMark 2005)

Setting up MobileMark 2005

We followed BAPCo's MobileMark 2005 requirements and recommendations before we began testing.

Antivirus software conflicts

MobileMark 2005 is not compatible with any virus-scanning software, so we made sure none was present on the notebook PCs.

Pre-installed software conflicts

MobileMark 2005 installs the following applications, which its test scripts employ:

- Adobe Photoshop 6.0.1
- InterVideo WinDVD 6.0
- Macromedia Flash 5.0
- Microsoft Excel 2002
- Microsoft Outlook 2002
- Microsoft PowerPoint 2002
- Microsoft Word 2002
- Netscape Communicator 6.01
- Network Associates McAfee VirusScan 5.13
- WinZip Computing WinZip 8.0

If any of those applications are already on the system under test, the benchmark may experience problems due to software conflicts. To avoid any such issues, we uninstalled all conflicting pre-installed software applications, including different versions of any of the programs MobileMark uses.

Installing MobileMark 2005

We performed the following steps to install MobileMark 2005 on each notebook PC:

1. Insert the "MobileMark 2005 Install DVD" in the notebook PC's DVD drive.
    a. Click Next at the Welcome screen.
    b. Accept the license agreement, and click Next.
    c. Click Install at the Ready to Install the Program screen.
    d. Accept the default option at the MobileMark Wireless Workload Configuration dialog, and click OK.
    e. Select Yes, I want to restart my computer now, and click Finish.
2. Install MobileMark 2005 Patch 1
    a. Download the MobileMark2005 Patch 1 from BAPCo's Web site (www.bapco.com/updates/MobileMark2005-Patch1.msi).
    b. Double-click the MobileMark2005-Patch 1.msi file to run the installation process.
    c. Click Next at the Welcome screen.
    d. Click Next at the Ready to Install the Application screen.
    e. Click Finish and reboot the system.

Running MobileMark 2005

BAPCo recommends that testers perform a System Conditioning trial test run before executing any of the MobileMark tests. The first step is to fully charge the battery. The System Conditioning test then drains the battery completely. "Cycling" the battery from fully charged to fully depleted will, according to BAPCo, lead to more reliable battery-life test results. We consequently did a System Conditioning run on each notebook PC.

We performed the following steps one time on each notebook PC to run the System Conditioning trial test:

1. Plug the AC power adapter into the notebook PC, and completely charge the battery.
2. Boot the system.
3. Disable the wireless network adapter by using the external wireless toggle button.
4. Double-click the MobileMark 2005 icon on the desktop.
5. Highlight the System Conditioning item in the left panel.
6. Type a name for this test in the Project Name field at the top right panel, and click Next Step.
7. If MobileMark lists no problems or warnings, click Next Step. If it does list any problems or warnings, close MobileMark 2005 and correct the problem(s) before proceeding.
8. Unplug the AC power adapter. The System Conditioning test will begin immediately.
9. The test is complete when the notebook PC has fully depleted its battery and is no longer operational when running on battery power.

We performed the following steps to run the MobileMark DVD Playback 2005 test:

1. Plug the AC power adapter into the notebook PC, and completely charge the battery.
2. Boot the system.
3. Disable the wireless network adapter by using the external wireless toggle button.
4. Place the MobileMark Playback Media DVD in the notebook PC's DVD drive.
5. Double-click the MobileMark 2005 icon on the desktop.
6. Select the DVD Playback 2005 test by highlighting it in the left panel.
7. Type a name for this test in the Project Name field at the top right panel, and click Next Step.
8. If MobileMark lists no problems or warnings, click Next Step. If it does list any problems or warnings, close MobileMark 2005 and correct the problem(s) before proceeding.
9. Unplug the AC power adapter. The test will begin immediately.
10. The DVD Playback test is complete when the notebook PC has fully depleted its battery and is no longer operational when running on battery power.

We performed the following steps to run the MobileMark Productivity 2002SE benchmark:

1. Plug the AC power adapter into the notebook, and completely charge the battery.
2. Boot the system.
3. Disable the wireless network adapter by using the external wireless toggle button.
4. Double-click the MobileMark 2005 icon on the desktop.
5. Select the Productivity 2002SE test by highlighting it in the left panel.
6. Type a name for this test in the Project Name field at the top right panel, and click Next Step.
7. If MobileMark lists no problems or warnings, click Next Step. If it does list any problems or warnings, close MobileMark 2005 and correct the problem(s) before proceeding.
8. Unplug the AC power adapter. The test will begin immediately.
9. The Productivity 2002SE test is complete when the notebook PC has fully depleted its battery and is no longer operational when running on battery power.

Getting the MobileMark 2005 results

After each MobileMark test completes, plug the AC power adapter into the notebook PC, and turn on the system. MobileMark 2005 starts automatically after the system boots, analyzes the test scores, and opens the Test Results Viewer with the results from the last test.

To submit these results to BAPCo, you must save the test results directory. To do that, we did the following:

1. Browse to the C:\ Program Files\BAPCo\MobileMark2005\results directory.
   a. Select My Computer.
   b. Select Local Disk (C:).
   c. Select the Program Files directory.

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d. Select the BAPCo directory.
e. Select the MobileMark2005 directory.
f. Select the results directory.
2. The name of the directory for the DVD Playback or Productivity 2002SE results is the name you gave the test in Step 7 of the MobileMark DVD Playback 2005 process or Step 6 of the MobileMark Productivity 2002SE process.

The music-playing test (iTunes 7.0.0.70)

We created a script that emulated playing MP3 files from a previously ripped two-CD set using Apple's iTunes, version 7.0.0.70 (http://www.apple.com/itunes/) while running on battery power. The script launches iTunes and plays the MP3s in the current library continuously until it completely depletes the notebook's battery. As the notebook shuts down due to lack of battery power, the script generates a results file that shows the amount of time in milliseconds the battery lasted.

The script also produces screenshots in the final minutes of battery life that illustrate the status of the battery as it depletes. Once the battery reaches 5 percent charge remaining, the script takes a screenshot every 60 seconds until the notebook shuts down.

Setting up iTunes

So we would have music to play for the test, we created a set MP3 files from the two-CD Pearl Jam set, rearviewmirror.

1. Insert CD 1 into the DVD-RW drive.
2. Select Rip music from CD using Windows Media Player at the Windows auto-launch dialog box.
3. If it is the first time the system has launched Windows Media Player:
    a. Click Next at the Welcome to Windows Media Player 10.
    b. Accept the default options, and click Next at the Select your Privacy Options screen.
    c. Accept the default options, and click Finish at the Customize the Installation Options screen.
4. At the Rip Options screen, select Change my current format settings, and click OK.
5. Under the Rip music to this location section, click Change.
    a. Select My Computer
    b. Select Local Disk (C:)
    c. Click Make New Folder
    d. Name the New Folder Music, and click OK.
6. Under the Rip settings section, select mp3 from the pull-down menu, and adjust the Audio quality to 128 Kbps. Click OK.
7. Windows Media Player will start ripping the CD.
8. When Windows Media Player finishes ripping CD 1, eject the CD.
9. Insert CD 2.
10. Click Cancel at the Windows auto-launch dialog box.
11. In the top right corner of Windows Media Player, click Rip Music.
12. When Windows Media Player finishes ripping CD 2, eject the CD, and close Windows Media Player.

Installing iTunes

We performed the following steps to install iTunes 7.0.0.70 on each notebook PC:

1. Download the iTunesSetup executable file from Apple's Web site (http://www.apple.com/itunes/download/).
2. Double-click the iTunesSetup executable file to run the installation process.
    a. If a Windows Security Warning dialog appears, select Run.
    b. Click Next at the Welcome to iTunes 7 Installer screen.
    c. Accept the license agreement, and click Next.
    d. Accept the default options, and click Install at the Choose iTunes Installer Options screen.

     e.   If an iTunes dialog appears that says AutoRun is turned off, choose No.
     f.   Check Open iTunes after the installer exits, and click Finish.
     g.   Click Agree at the iTunes Software License Agreement screen.
     h.   Click Next at the iTunes Setup Assistant screen.
     i.   Uncheck the options beside Add MP3 and AAC files and Add WMA files, and click Next.
     j.   Accept the default option, and click Next at the Keep iTunes Music Folder Organized screen.
     k.   Click Next at the Download Album Artwork screen.
     l.   Select No, take me to my iTunes Library, and click Finish.
3. Close iTunes.

Setting up the iTunes script
We performed the following steps to prepare the system for the test script:

1. Create a C:\Scripts directory:
     a.   Open My Computer.
     b.   Open Local Disk (C:).
     c.   Select File → New → Folder from the top menu.
     d.   Name the New Folder Scripts, and press the Enter key.
2. Copy the iTunes script into C:\Scripts.
3. Create a desktop shortcut to the Itunesbatterytest.pc6 file:
     a.   Browse to the C:\Scripts\iTunes directory.
     b.   Right-click Itunesbatterytest.pc6.
     c.   Select Send To → Desktop (create shortcut).
     d.   Close any open windows.
4. Associated the .pc6 file type with the Rational Visual Test Runtime:
     a.   Double-click the desktop shortcut for the Itunesbatterytest.pc6 file.
     b.   Choose Select the program from a list, and click OK.
     c.   Click Browse.
     d.   Highlight the VT_Run directory, and click Open.
     e.   Highlight the mtrun file, and click Open.
     f.   Click OK. The test should start running; stop it.

Setting up iTunes to play the mp3 files
We performed the following steps to prepare iTunes to play the test MP3 files:

1. Open iTunes by double-clicking the iTunes icon on the desktop.
2. Select File → Add Folder to Library from the top menu.
3. Browse to the C:\Music\Pearl Jam directory.
     a.   Select My Computer.
     b.   Select Local Disk (C:).
     c.   Select the Music directory.
     d.   Select the Pearl Jam directory.
     e.   Select Rearviewmirror – Greatest Hits 1991-2003 Disc 1, and click OK.
     f.   Repeat steps a through e to add Rearviewmirror – Greatest Hits 1991-2003 Disc 2.
4. The main window now displays all 33 songs.
5. In the bottom left corner of the main window, click the button with the two arrows forming a circle so the two arrows turn blue. This setting causes iTunes to repeat the playlist continually.
6. Close iTunes.
7. Reboot the system.

Running the music-playing (iTunes) test
We performed the following steps to run this test:

1. Plug the AC power adapter into the notebook PC, and completely charge the battery.

2. Boot the system.
3. Disable the wireless network adapter by using the external wireless toggle button.
4. Double-click the desktop shortcut for the Itunesbatterytest.pc6 file.
5. Make sure iTunes begins playing the first mp3 file.
6. Immediately unplug the power adapter.
7. The music-playing test is complete when the notebook PC has fully depleted its battery and is no longer operational when running on battery power.

Getting the results of the iTunes test

To get the test's results after it finishes, plug the AC power adapter into the notebook, turn on the system, and do the following:

1. Browse to the C:\Scripts\iTunes\Results directory.
   a. Select My Computer.
   b. Select Local Disk (C:).
   c. Select the Scripts directory.
   d. Select the iTunes directory.
   e. Select the Results directory.
2. The script generates two log files, Odd.txt and Even.txt. Open the one with the most recent Date Modified timestamp.
3. Record the milliseconds that appear after the heading, Lapsed ms.
4. Convert the test time to minutes and seconds.

Appendix A: Test system configuration information

This appendix provides detailed configuration information about the test notebook PCs, which we list in alphabetical order.

System	Gateway MP8708	Gateway MX6930	Gateway MX6931
General			
Processor and OS kernel: (physical, core, logical) / (UP, MP)	1P2C2L / MP	1P2C2L / MP	1P2C2L / MP
Number of physical processors	1	1	1
Single/Dual Core processors	Dual	Dual	Dual
System power management policy	Windows Power Management-Max Battery	Windows Power Management-Max Battery	Windows Power Management-Max Battery
Processor power-saving option	Enhanced Intel SpeedStep Technology	Enhanced Intel SpeedStep Technology	Enhanced Intel SpeedStep Technology
System dimensions (length x width x height)	15 ¾" x 11" x 1 ¾"	14" x 10 ½" x 1 ½"	14" x 10 ½" x 1 ½"
System weight	7 lbs. 9 oz.	6 lbs. 3 oz.	6 lbs. 3 oz.
CPU			
Vendor	Intel	Intel	Intel
Name	Core 2 Duo	Core 2 Duo	Core 2 Duo
Model number	T7200	T5200	T5500
Stepping	6	6	6
Socket type and number of pins	mPGA-479M	mPGA-479M	mPGA-479M
Core frequency (GHz)	2.00	1.60	1.66
Front-side bus frequency	667 MHz	533 MHz	667 MHz
L1 Cache	32 KB + 32 KB per core	32 KB + 32 KB per core	32 KB + 32 KB per core
L2 Cache	4 MB (Shared)	2 MB (Shared)	2 MB (Shared)
Platform			
Vendor	Gateway	Gateway	Gateway
Motherboard model number	MP8708 72.09	77.05	77.05
Motherboard chipset	Intel i945GM	Intel i945GM	Intel i945GM
Motherboard revision number	03	03	03
System/motherboard serial number	T236941011504	0036961598	0036961600
Bios name and version	Phoenix Technologies LTD 72.09	Phoenix Technologies LTD 77.06	Phoenix Technologies LTD 77.06
BIOS settings	Setup default	Setup default	Setup default
Memory module(s)			
Vendor and model number	Samsung M470T2953CZ3-CD5	Hyundai Electronics HYMP532S64BP6-C4	Hyundai Electronics HYMP532S64BP6-C4
Type	PC2-4200	PC2-4200	PC2-4200
Speed (MHz)	533	533	533
Speed running in the system (MHz)	266	266	266

Timing/Latency (tCL-tRCD-tRP-tRASmin)	4-4-4-11	4-4-4-12	4-4-4-12
Size	2048 MB	512 MB	512 MB
Number of memory module(s)	2 x 1024 MB	2 x 256 MB	2 x 256 MB
Chip organization (Single-sided, Double-sided)	Double-sided	Double-sided	Double-sided
Channel (Single/Dual)	Dual	Dual	Dual
Hard disk			
Vendor and model number	Hitachi HTS541616J9SA00	Fujitsu MHV2080BH PL	Fujitsu MHV2080BH PL
Size	160 GB	80 GB	80 GB
Buffer Size	8 MB	8 MB	8 MB
RPM	5400	5400	5400
Type	SATA 150 Mb/s	SATA 150 Mb/s	SATA 150 Mb/s
Controller	Intel 82801GHM (ICH7-M)	Intel 82801GHM (ICH7-M)	Intel 82801GHM (ICH7-M)
Driver	Intel 5.5.0.1035	Intel 5.5.0.1035	Intel 5.5.0.1035
Operating system			
Name	Microsoft Windows XP Media Center 2005	Microsoft Windows XP Media Center 2005	Microsoft Windows XP Media Center 2005
Build number	2600	2600	2600
Service pack	2	2	2
File system	NTFS	NTFS	NTFS
Kernel	ACPI Multiprocessor PC	ACPI Multiprocessor PC	ACPI Multiprocessor PC
Language	English	English	English
Microsoft DirectX version	DirectX 9.0c	DirectX 9.0c	DirectX 9.0c
Graphics			
Vendor and model number	Intel Mobile 945GM Express Chipset Family	Intel Mobile 945GM Express Chipset Family	Intel Mobile 945GM Express Chipset Family
Type	Integrated	Integrated	Integrated
Chipset	Intel GMA 950	Intel GMA 950	Intel GMA 950
BIOS version	1313	1237	1237
Memory size	128 MB (shared)	128 MB (shared)	128 MB (shared)
Resolution	1440 x 900 x 32 bit color @ 60 Hz	1280 x 800 x 32 bit color @ 60 Hz	1280 x 800 x 32 bit color @ 60 Hz
Driver	Intel 6.14.10.4543	Intel 6.14.10.4543	Intel 6.14.10.4543
Sound card/subsystem			
Vendor and model number	SigmaTel High Definition Audio	SigmaTel High Definition Audio	SigmaTel High Definition Audio
Driver	SigmaTel 5.10.5082.0	SigmaTel 5.10.5082.0	SigmaTel 5.10.5082.0
Ethernet			
Vendor and model number	Intel PRO/100 VE	Marvel Yukon 88E8038	Marvel Yukon 88E8038
Driver	Intel 8.0.27.0	Marvell 8.50.1.3	Marvell 8.50.1.3
Wireless			
Vendor and model number	Intel PRO/Wireless 3945ABG	Broadcom 802.11 Multiband Network Adapter	Broadcom 802.11 Multiband Network Adapter
Driver	Intel 10.1.0.13	Broadcom 4.10.40.0	Broadcom 4.10.40.0

Modem			
Vendor and model number	Motorola SM56 Data Fax Modem	Motorola SM56 Data Fax Modem	Motorola SM56 Data Fax Modem
Driver	Motorola Inc. 6.11.11.3	Motorola Inc. 6.11.11.3	Motorola Inc. 6.11.11.3
Optical drive(s)			
Vendor and model number	LG GWA-4082N	Philips SCB5265	Philips SCB5265
Type (CD-ROM, CD-RW, DVD-ROM, DVD-W)	DVD-RW	DVD-ROM / CD-RW	DVD-ROM / CD-RW
USB ports			
Number	4	4	4
Type	2.0	2.0	2.0
Other	Memory Stick Card Reader	Memory Stick Card Reader	Memory Stick Card Reader
IEEE 1394 ports			
Number	1	1	1
Monitor			
LCD type	WXGA	WXGA	WXGA
Screen size	17"	15.4"	15.4"
Battery			
Type	Gateway 8MSBG 4UR18650F-2-QC223 Lithium-Ion	Sanyo 3UR18650F-2-QC-MA6 Lithium-Ion	Sanyo 3UR18650F-2-QC-MA6 Lithium-Ion
Size (length x width x height)	10 ¾" x 2" x ¾"	10 ¾" x 2" x ¾"	10 ¾" x 2" x ¾"
Rated capacity	5200mAh / 14.8V (77Wh)	5200mAh / 11.1V (58Wh)	5200mAh / 11.1V (58Wh)
Weight	12 oz.	12 oz.	12 oz.

Figure 2: System configuration information for the test notebook PCs.

Principled Technologies®