

## Dell Latitude E6400 notebook competitive analysis

### Executive summary

Dell Inc. (Dell) commissioned Principled Technologies (PT) to test the battery life of two notebook systems and data protection after 29-inch drop of three notebook systems, which we list in alphabetical order:

- Dell™ Latitude™ E6400
- HP® EliteBook 6930p
- Lenovo® ThinkPad® T400

#### Maximum battery life

Figure 1 shows the battery life of the two systems with the maximum battery configuration available at the time of testing. We configured the maximum battery notebooks with as much battery as was available at the time of purchase. We also configured them with hardware that was as identical as possible. With the two notebooks configured as similarly as possible, the Dell Latitude E6400 achieved the longer battery life, 9.4 percent longer than the HP EliteBook 6930p. Note: We did not include the Lenovo T400 in this test as Lenovo offers no slice battery for the ThinkPad T400.

#### Physical data protection

We measured how well each system protected its data after sustaining a 29-inch flat drop onto commercial-grade carpet when open and while running Mobile Mark 2007. The Dell Latitude E6400 and the HP EliteBook 6930p both had zero data defects after three separate drops from this height. The Lenovo ThinkPad T400 had 0.2 percent data corruption after three drops.

### KEY FINDINGS

- The Dell Latitude E6400 achieved the longest battery life, 9.4 percent longer than the HP EliteBook 6930p when configured for maximum battery life. (See Figures 1 and 2.)
- After three drops from a height of 29 inches, both the Dell Latitude E6400 and the HP EliteBook 6930p showed zero data defects. The Lenovo ThinkPad T400 had 0.2 percent data corruption. (See Figure 3.)

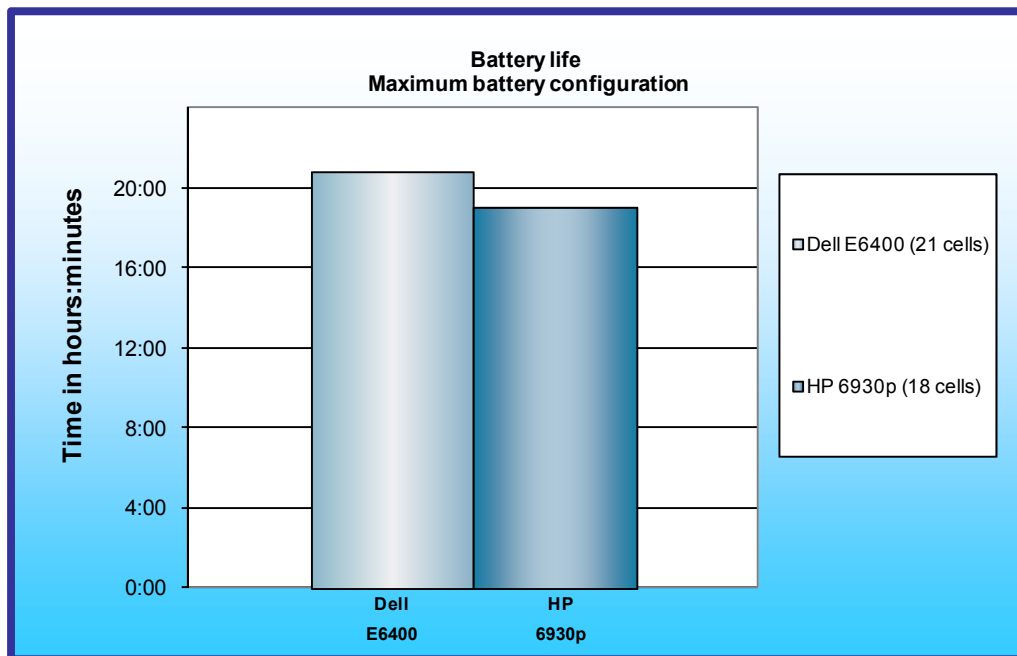


Figure 1: Battery life, in hours:minutes, for the maximum battery configuration for the two test systems. Higher numbers, indicating longer battery life, are better.

Figure 2 presents raw battery life scores and comparative ratings. Figure 3 presents the results of our drop testing. Appendix A provides detailed system configuration information and we detail our testing approach in the Test methodology section.

Test	Raw results		Comparative ratings	
	Dell Latitude E6400	HP EliteBook 6930p	Dell Latitude E6400	HP EliteBook 6930p
Maximum Battery Life Configuration	9-cell battery + 12-cell slice = 21 cells	6-cell battery + 12-cell slice = 18 cells	9-cell battery + 12-cell slice = 21 cells	6-cell battery + 12-cell slice = 18 cells
MobileMark 2007 v1.05 Battery Life rating (higher is better)	20 hours 51 minutes	19 hours 3 minutes	1.000	0.914
MobileMark 2007 v1.05 Performance rating (higher is better)	251	242	1.000	0.964

Figure 2: Results and comparative ratings for the two test systems.

Test	Drop test results		
	Dell Latitude E6400	HP EliteBook 6930p	Lenovo ThinkPad T400
Number of bad blocks before first drop (lower is better)	0	0	0
Number of bad blocks after one drop (lower is better)	0	0	4
Number of bad blocks after two drops (lower is better)	0	0	6
Number of bad blocks after three drops (lower is better)	0	0	6
Result	Pass	Pass	Fail

Figure 3: Drop test results for the three test systems.

## Test methodology

PT proposed and ordered the three test systems. We did not include the Lenovo T400 in the battery life test as Lenovo offers no slice battery for the ThinkPad T400.

We tested the battery life of the Dell and HP systems under the same conditions:

- Using the MobileMark 2007 Productivity test, the current industry-standard productivity battery life benchmark
- With the battery settings that MobileMark 2007 requires
- In adherence with BAPCo testing rules
- As close to the out-of-box configuration as possible

### Creating the base test image

With the exception of MobileMark 2007, which required us to remove conflicting applications, PT conducted all testing on the original factory image.

We powered on each notebook, and if a notebook vendor required us to respond to specific system preparation steps, we did so until the Windows desktop appeared. Once each installation was complete, PT ran Windows Update and installed all updates available as of 9/18/2008, including Service Pack 3 for Windows XP if that update was not already on the system. At that point, PT used Symantec's Ghost product to create an image of the disk with that out-of-box software setup. Those images facilitated repeatable testing and experimenting. We made them by following this process:

1. Insert a bootable Ghost CD.
2. Power down the computer.
3. Attach an external USB hard disk.
4. Power on the computer.
5. At the Symantec Ghost screen, click OK.
6. Select Local→Disk→To Image.

7. Click OK.
8. Select the Primary disk, and click OK.
9. Select the external hard disk in the copy image to drop-down box, name the file `BASE`, and click Save.
10. At the Compress Image dialog, select Fast.
11. At the Proceed dialog, select Yes.
12. When the ghost image is complete, click OK, and exit Ghost.
13. Power down the computer.
14. Disconnect the USB hard disk.
15. Reboot the computer.

### **Preparing to measure battery life with MobileMark 2007 v.1.05**

We conditioned the battery prior to testing. To do so, we performed two complete drains of the battery, starting from a battery at 100 percent charge. To expedite the draining process, we ran the MobileMark 2007 Productivity 2007 test until the battery completely discharged. We recorded the room temperature at the beginning of each official run.

### **Antivirus software conflicts**

MobileMark 2007 is not compatible with any virus-scanning software, so we uninstalled any such software that was present on the notebook PCs before we installed the benchmark.

### **Pre-installed software conflicts**

MobileMark 2007 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 these applications are already on the system under test, they will cause problems with the benchmark due to software conflicts. To avoid any such issues, before we installed the benchmark, we uninstalled all conflicting pre-installed software applications, including different versions of any of the programs MobileMark 2007 uses.

### **Installing MobileMark 2007 v.1.05**

1. Reset the notebook to the base image using Symantec's Ghost product.
2. Turn off the wireless network adapter by using the external toggle switch.
3. Insert the MobileMark 2007 Install DVD in the notebook PC's DVD drive.
4. At the Welcome screen, click Next.
5. Accept the license agreement, and click Next.
6. At the Ready to Install the Program screen, click Install.
7. Run the BAPCo Auto-configuration tool, v.1.3.2, to set the power options:
  - a. Insert the Auto-configuration tool in the notebook PC's DVD drive.
  - b. Double-click `BAPCo_AutoConfig.exe`.
  - c. Type `M` to choose MobileMark 2007.
  - d. Type `3` to choose the changes that produce the best possible scores, as follows:
    1. Set Critical battery alarm to 0%.
    2. Set Low battery alarm to 0%.
    3. Disable screen saver.
    4. Stop and disable Windows Update.
    5. Disable desktop cleanup wizard.
    6. Disable Windows Security Center warnings.
    7. Disable Windows Firewall.

8. Disable incoming Remote Desktop connections.
9. Disable Windows Error Reporting to Microsoft.
10. Disable Windows Defender.

### **Displaying brightness and power settings**

Because the brightness of a notebook's display affects its battery life, BAPCo required that, before we tested with MobileMark 2007, we made sure the brightness of the notebook's monitor was greater than or equal to 60 nits on a completely white screen while the notebook was 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](http://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 without going below that brightness level. We used the following procedure, which assumes we began with the notebook plugged into the power supply, 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 pressing 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. Press Ctrl+F to view the bitmap image and render the screen totally white.
6. Wait 45 minutes to allow the screen to warm.
7. Unplug the notebook from the power supply, and measure the display's brightness using a luminance meter in the center of the screen. (We use the Gossen Mavolux5032C.)
8. If the reading is below or significantly greater than 60 nits, use the notebook's keyboard screen-brightness-adjustment keys to bring the display as close to 60 nits as possible, then retest.
9. Allow the notebook to run on battery for 10 minutes, re-measure the display, and adjust the brightness up or down as necessary.
10. 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.

### **Conditioning the battery**

1. Plug the AC power adapter into the notebook PC, and completely charge the battery.
2. Install MobileMark 2007 v1.05, following the steps we outlined in the Installing MobileMark 2007 section earlier in this section.
3. Double-click the MobileMark 2007 icon on the desktop.
4. Highlight the Productivity 2007 item in the left panel.
5. Enter a name for this test in the Project Name field at the top-right panel, and click Next Step.
6. If MobileMark lists no problems or warnings, click Next Step. If it does list any problems or warnings, close MobileMark 2007, and correct the problem(s) before proceeding.
7. Unplug the AC power adapter. The Productivity 2007 test begins immediately.
8. The test is complete when the notebook PC has fully depleted its battery and is no longer operational when running on battery power.
9. Repeat steps 3 through 8 for the second conditioning run and for all official runs.
10. Plug the AC power adapter into the notebook PC, and completely charge the battery.

### **Measuring battery life with MobileMark 2007 v.1.05**

We performed the following steps to run the MobileMark Productivity 2007 benchmark:

1. Double-click the MobileMark 2007 icon on the desktop.
2. Select the Productivity 2007 test by highlighting it in the left panel.
3. Enter a name for this test in the Project Name field in the top right panel, and click Next Step.
4. If MobileMark lists no problems or warnings, click Next. If it does list any problems or warnings, close MobileMark 2007, and correct the problem(s) before proceeding.
5. Unplug the AC power adapter. The test begins immediately.

6. The Productivity 2007 test is complete when the notebook PC has fully depleted its battery and is no longer operational when running on battery power.

We executed the Productivity 2007 test three times on each system configuration and used the average result of each set of three as the representative score for that test.

1. Configure the notebook with the standard battery and the BAPCo recommendations for running MobileMark 2007.
2. Execute the Productivity 2007 test three times in this configuration.
3. Configure the notebook with the maximum-sized battery available at the time of purchase and the BAPCo recommendations for running MobileMark 2007.
4. Execute the Productivity 2007 test three times in this configuration.

### **Getting the MobileMark 2007 results**

After each MobileMark test completed, we plugged the AC power adapter into the notebook PC and turned on the system. MobileMark 2007 started automatically after the system booted, analyzed the test scores, and opened the Test Results Viewer with the results from the last test.

To submit these results to BAPCo, we saved the test results directory. To do so, we performed the following steps:

1. Browse to the C:\Program Files\BAPCo\MobileMark 2007\results directory:
  - a. Select My Computer.
  - b. Select Local Disk (C:).
  - c. Select the Program Files directory.
  - d. Select the BAPCo directory.
  - e. Select the MobileMark2007 directory.
  - f. Select the results directory. (Note: The name of the directory for the Productivity 2007 results is the name you gave the test in Step 6 of the MobileMark Productivity 2007 process.)

### **Measuring physical data protection**

This test measures the damage that the impact from a drop of 29 inches inflicted upon an open notebook running MobileMark 2007. We used a Lansmont PDT56ED Precision Drop Tester and dropped each notebook onto commercial carpet. We opened the notebook so that the screen and keyboard formed a 120-degree angle. We then placed the notebook flat on the platen. Orienting the notebook in this way resulted in a flat drop. (Figure 4 shows our test setup.)

We scanned the hard disk with PC-Doctor Service Center 6 and HD Tune Pro 3.00 and recorded the number of bad sectors and blocks before and after the drop test. We also recorded any other physical defects, such as cracks or breaks in the display, as well as hinges or displaced screws, which the impact of the drop caused. Refer to Appendix C for the drop test checklist. We videotaped the test and took still photographs of the notebooks at the conclusion of the test.

For obvious reasons, we conducted this test only after we completed all other testing. We dropped each notebook three times, if possible, using this process:

1. Reset the notebook to the base image using Symantec's Ghost product.
2. Install BAPCo's MobileMark 2007 v1.05 onto the test notebook as we described above.
3. Run PC-Doctor's Fixed Disk Tests to get baseline data on the state of the hard disk:
  - a. Insert the PC-Doctor Service Center 6 CD into the optical drive and the Multipurpose USB Device into a USB port, and reboot the notebook.
  - b. Choose C: as the log drive.
  - c. Type R to select PC-Doctor Standalone from the list of available tools.
  - d. Use the arrow keys to highlight Utility in the PC-Doctor menu, and press Enter.
  - e. Use the arrow keys to highlight Surface Scan Hard Disk in the Utility menu, and press Enter.
  - f. Use the arrow keys to highlight the Read Test, and press Enter.
  - g. Select Disk 1, and press Enter.
  - h. Press F3 to save the log to a file.
  - i. Enter a file name, and press Enter.

- j. Press Esc until you see the main menu, then select Quit to reboot.
4. Save the PC-Doctor results as pre-test disk status.
5. Install EFD Software's HD Tune Pro 3.00 onto the test notebook.
6. Run HD Tune Pro's Error Scan Test to get baseline data on the state of the hard disk.
7. Save the results as pre-test disk status.
8. Set the height of the platen on the Lansmont Precision Drop Tester to 29 inches above the surface of the 28 oz. commercial carpeting.
9. Start recording with the digital video camera.
10. Place the fully charged notebook on the platen of the drop tester, with the notebook's base flat on the platen and the screen facing forward, open at a 120-degree angle.
11. Launch MobileMark 2007's Productivity 2007 test.
12. Unplug the notebook, and drop the notebook onto the commercial carpeting.
13. Wait until the notebook is completely still.

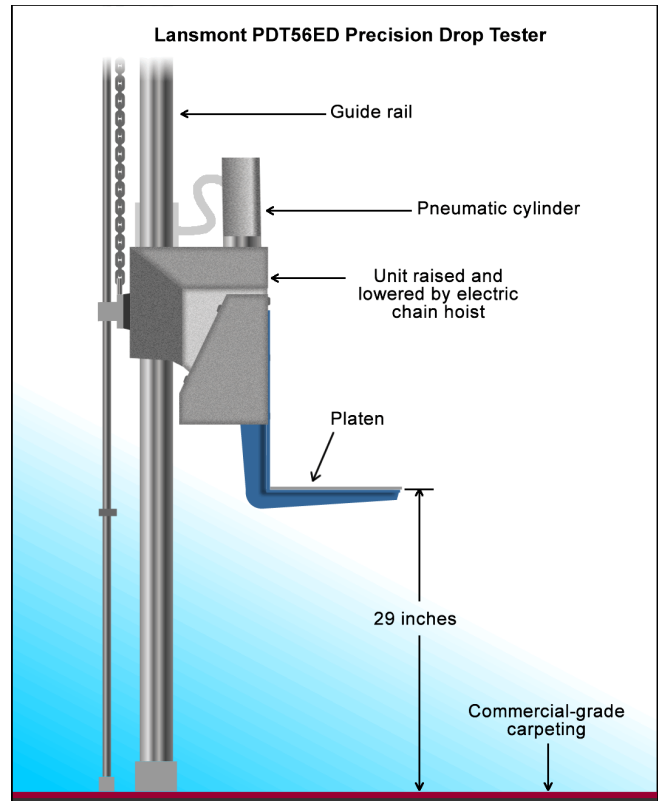



Figure 4: Our physical data protection test setup.

## Appendix A. Test system configuration information

As per Dell's request, PT purchased the notebook systems for this test. Figure 5 presents detailed configuration information for the systems configured for maximum battery life. Figure 6 presents detailed configuration information for the systems configured for drop testing.

System	Dell Latitude E6400 SSD	HP EliteBook 6930P SSD	Lenovo ThinkPad T400 SSD
			
<b>General</b>			
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	MobileMark 2007	MobileMark 2007	MobileMark 2007
Processor power-saving option	Enhanced Intel SpeedStep Technology	Enhanced Intel SpeedStep Technology	Enhanced Intel SpeedStep Technology
System dimensions (length x width x height)	9-1/2" x 13-1/4" x 1-1/4"	9 1/2" x 13" x 1-1/2"	13-1/4" x 11" x 1-1/2"
System weight—shipping battery	5 lbs. 6.5 oz.	5 lbs. 1.5 oz.	5 lbs. 5.5 oz.
System weight—maximum battery configuration	7 lbs. 8 oz.	6 lbs. 14 oz.	NA
<b>CPU</b>			
Vendor	Intel	Intel	Intel
Name	Core 2 Duo mobile	Core 2 Duo mobile	Core 2 Duo mobile
Model number	P8400	P8400	P8400
Stepping	M0	M0	R0
Socket type and number of pins	Socket P (478)	Socket P (478)	Socket P (478)
Core frequency (GHz)	2.26	2.26	2.26
Front-side bus frequency (MHz)	1,066	1,066	1,066
L1 cache	32 KB + 32 KB (per core)	32 KB + 32 KB (per core)	32 KB + 32 KB (per core)
L2 cache	3 MB (shared)	3 MB (shared)	3 MB (shared)
<b>Platform</b>			
Vendor	Dell Inc.	Hewlett-Packard	Lenovo
Motherboard model number	0H635N	30DB	7417CTO
Motherboard chipset	Intel GM45/GM47	Intel GM45/GM47	Intel GM45/GM47
Motherboard revision number	07	07	07

<b>System</b>	<b>Dell Latitude E6400 SSD</b>	<b>HP EliteBook 6930P SSD</b>	<b>Lenovo ThinkPad T400 SSD</b>
System/motherboard serial number	F7GWLJ1	2CE9091QLW	L3-C0396
BIOS name and version	Dell Inc A12 (2/13/2009)	Hewlett-Packard 68PCU Ver. F.0E (12/15/2008)	Lenovo 7UET61WW 2.07 (02/13/2009)
BIOS settings	Default	Default	Default
<b>Memory module(s)</b>			
Vendor and model number	Hyundai Electronics HYMP112S64CP6-S6	Hynix HYMP112S64CP6-S6	Samsung M471B2874DZ1-CF8
Type	PC2-6400	PC2-6400	PC3-8500
Speed (MHz)	800	800	1066
Speed running in the system (MHz)	800	800	1066
Timing/Latency (tCL-tRCD-tRP-tRASmin)	6-6-6-18	6-6-6-18	7-7-7-20
Size (MB)	1,024	1,024	1,024
Number of memory module(s)	1 x 1,024	1 x 1,024	1 x 1,024
Chip organization (single-sided, double-sided)	Double-sided	Double-sided	Double-sided
Channel (single/dual)	Single	Single	Single
<b>Hard disk</b>			
Vendor and model number	Intel SSDSA2MH080G1DL	Intel SSDSA2MH080G1HP	Samsung MMCRE64G8MPP-0VA
Size (GB)	80	80	64
Buffer size (MB)	NA	NA	NA
RPM	NA	NA	NA
Type	SATA	SATA	SATA
Controller	Intel ICH8M-E/ICH9M-E	Intel ICH9M-E/M	Intel ICH9M-E/M
Driver	Intel 8.7.0.1007 (12/4/2008)	Intel 8.7.0.1007 (12/4/2008)	Intel 8.6.3.1004 (11/3/2008)
<b>Operating system</b>			
Name	Windows XP Professional	Windows XP Professional	Windows XP Professional
Build number	2600	2600	2600
Service pack	Service Pack 3	Service Pack 3	Service Pack 3
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
<b>Graphics</b>			
Vendor and model number	Mobile Intel GMA 4500MHD	Mobile Intel GMA 4500MHD	Mobile Intel GMA 4500MHD
Type	Integrated	Integrated	Integrated
Chipset	Mobile Intel 4 Series Express Chipset	Mobile Intel 4 Series Express Chipset	Mobile Intel 4 Series Express Chipset
BIOS version	1659.0	1637.0	1654.1
Total available graphics memory (MB)	512	512	512
Resolution	1,280 x 800 x 32 bit	1,280 x 800 x 32 bit	1,280 x 800 x 16 bit



<b>System</b>	<b>Dell Latitude E6400 SSD</b>	<b>HP EliteBook 6930P SSD</b>	<b>Lenovo ThinkPad T400 SSD</b>
Driver	Intel 6.14.10.4980 (8/25/2008)	Intel 6.14.10.5016 (12/12/2008)	Intel 6.14.10.5002 (10/21/2008)
<b>Sound card/subsystem</b>			
Vendor and model number	IDT High Definition Audio, Intel High Definition Audio HDMI	SoundMAX Integrated Digital HD Audio	Conexant High Definition SmartAudio 221
Driver	IDT 5.10.0.6124 (11/13/2008), Intel 5.10.0.1046 (7/30/2008)	Analog Devices 5.10.1.5820 (4/11/2008)	Conexant 3.53.0.0 (5/28/2008)
<b>Ethernet</b>			
Vendor and model number	Intel 82567LM Gigabit	Intel 82567LM Gigabit	Intel 82567LM Gigabit
Driver	Intel 9.50.14.2 (4/4/2008)	Intel 9.50.14.0 (3/27/2008)	Intel 9.52.10.1003 (9/19/2008)
<b>Wireless</b>			
Vendor and model number	Intel Wireless WiFi Link 5300	Intel Wireless WiFi Link 5300	Intel Wireless WiFi Link 5300
Driver	Intel 12.0.0.82 (7/8/2008)	Intel 12.2.0.11 (11/17/2008)	Intel 12.2.1.2 (12/22/2008)
<b>Modem</b>			
Vendor and model number	NA	Agere Systems HDA Modem	ThinkPad Modem Adapter
Driver	NA	Agere 2.1.88.0 (3/21/2008)	Conexant 7.73.0.0 (3/28/2008)
<b>Optical drive(s)</b>			
Vendor and model number	LG MU10N	Optiarc CRX890S	LG MU10N
Type	DVD/CD RW	DVD/CD RW	DVD/CD RW
Interface	SATA	SATA	SATA
Dual/Single layer	Dual	Dual	Dual
<b>USB ports</b>			
Number	4	3	3
Type	2.0	2.0	2.0
Other	SD card reader	RICOH SmartCard Reader	NA
<b>eSATA port</b>			
Number	1	0	0
<b>IEEE 1394 ports</b>			
Number (4-pin)	1	1	1
<b>Monitor</b>			
LCD type	WXGA	WXGA	WXGA
Screen size (inches)	14.1	14.1	14.1
Refresh rate (Hz)	60	60	60
<b>Battery 1</b>			
Type	Dell KY265	Hewlett-Packard 463310-741	Lenovo 42T4644
Size (length x width x height)	8" x 3" x 3/4"	8" x 2-1/8" x 3/4"	8-3/4" x 3-1/4" x 1"

<b>System</b>	<b>Dell Latitude E6400 SSD</b>	<b>HP EliteBook 6930P SSD</b>	<b>Lenovo ThinkPad T400 SSD</b>
Rated capacity	7,700 mAh 11.1V = 85Wh	4,910 mAh x 10.8 V = 53 Wh	7,800 mAh x 10.8V = 84Wh
Cell count	9	6	9
Weight	1 lb. 1 oz.	11.5 oz.	1 lb. 2 oz.
<b>Battery 2</b>			
Type	Dell GN752	Hewlett-Packard 405389- 001	NA
Size (length x width x height)	12-3/4" x 8" x 1/2"	10-1/2" x 6" x 1"	NA
Rated capacity	5,700 mAh x 14.8 V = 84Wh	6,419 mAh x 14.8 V = 95 Wh	NA
Cell count	12	12	NA
Weight	2 lb. 1.5 oz.	1 lb. 12.5 oz.	NA
<b>AC adapter</b>			
Vendor	Dell	HP	Lenovo
Make/model	FA90PE1-00	PPP014L-SA	92P1156
Watts (W)	90	90	65

Figure 5: Detailed system configuration information for the test systems configured for maximum battery life.

System	Dell Latitude E6400 HDD	HP EliteBook 6930P HDD	Lenovo ThinkPad T400 HDD
			
<b>General</b>			
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	MobileMark 2007	MobileMark 2007	MobileMark 2007
Processor power-saving option	Enhanced Intel SpeedStep Technology	Enhanced Intel SpeedStep Technology	Enhanced Intel SpeedStep Technology
System dimensions (length x width x height)	9 1/2" x 13 1/4" x 1 1/3"	9 1/2" x 13" x 1 1/2"	13 1/4" x 11" x 1 1/2"
System weight with shipment battery	5 lbs. 1 oz.	5 lbs. 2 oz.	5 lbs. 1.5 oz.
System weight with extended battery	NA	NA	NA
<b>CPU</b>			
Vendor	Intel	Intel	Intel
Name	Core 2 Duo mobile	Core 2 Duo mobile	Core 2 Duo mobile
Model number	P8400	P8400	P8400
Stepping	M0	M0	R0
Socket type and number of pins	Socket P (478)	Socket P (478)	Socket P (478)
Core frequency (GHz)	2.26	2.26	2.26
Front-side bus frequency (MHz)	1,066	1,066	1,066
L1 cache	32 KB + 32 KB (per core)	32 KB + 32 KB (per core)	32 KB + 32 KB (per core)
L2 cache	3 MB (shared)	3 MB (shared)	3 MB (shared)
<b>Platform</b>			
Vendor	Dell Inc.	Hewlett-Packard	Lenovo
Motherboard model number	0RX493	30DB	7417CTO
Motherboard chipset	Intel GM45/GM47	Intel GM45/GM47	Intel GM45/GM47
Motherboard revision number	07	07	07
System / motherboard serial number	8Q7GGJ1	2CE9091QLX	L3-C0395
BIOS name and version	Dell Inc A12 (2/13/2009)	Hewlett-Packard 68PCU Ver. F.0E (12/15/2008)	Lenovo 7UET61WW 2.07 (02/13/2009)
BIOS settings	Default	Default	Default

<b>System</b>	<b>Dell Latitude E6400 HDD</b>	<b>HP EliteBook 6930P HDD</b>	<b>Lenovo ThinkPad T400 HDD</b>
<b>Memory module(s)</b>			
Vendor and model number	Hyundai Electronics HYMP112S64CP-S6	Hynix HYMP112S64CP6-S6	Samsung M471B2874DZ1-CF8
Type	PC2-6400	PC2-6400	PC3-8500
Speed (MHz)	800	800	1066
Speed running in the system (MHz)	800	800	1066
Timing/Latency (tCL-tRCD-tRP-tRASmin)	6-6-6-18	6-6-6-18	7-7-7-20
Size (MB)	1,024	1,024	1,024
Number of memory module(s)	1 x 1,024	1 x 1,024	1 x 1,024
Chip organization (single-sided, double-sided)	Double-sided	Double-sided	Double-sided
Channel (single/dual)	Single	Single	Single
<b>Hard disk</b>			
Vendor and model number	Hitachi HTS723216L9A362	Seagate ST9160411AS	Hitachi HTS723216L9SA60
Size (GB)	160	160	160
Buffer size (MB)	16	16	16
RPM	7200	7200	7200
Type	SATA	SATA	SATA
Controller	Intel ICH8M-E/ICH9M-E	Intel ICH9M-E/M	Intel ICH9M-E/M
Driver	Intel 8.7.0.1007 (12/4/2008)	Intel 8.7.0.1007 (12/4/2008)	Intel 8.6.3.1004 (11/3/2008)
<b>Operating system</b>			
Name	Windows XP Professional	Windows XP Professional	Windows XP Professional
Build number	2600	2600	2600
Service pack	Service Pack 3	Service Pack 3	Service Pack 3
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
<b>Graphics</b>			
Vendor and model number	Mobile Intel GMA 4500MHD	Mobile Intel GMA 4500MHD	Mobile Intel GMA 4500MHD
Type	Integrated	Integrated	Integrated
Chipset	Mobile Intel 4 Series Express Chipset	Mobile Intel 4 Series Express Chipset	Mobile Intel 4 Series Express Chipset
BIOS version	1659.0	1637.0	1654.1
Total available graphics memory (MB)	512	512	512
Resolution	1,280 x 800 x 32 bit	1,280 x 800 x 32 bit	1,280 x 800 x 16 bit
Driver	Intel 6.14.10.4980 (8/25/2008)	Intel 6.14.10.5016 (12/12/2008)	Intel 6.14.10.5002 (10/21/2008)
<b>Sound card/subsystem</b>			
Vendor and model number	IDT High Definition Audio, Intel High Definition Audio HDMI	SoundMAX Integrated Digital HD Audio	Conexant High Definition SmartAudio 221

<b>System</b>	<b>Dell Latitude E6400 HDD</b>	<b>HP EliteBook 6930P HDD</b>	<b>Lenovo ThinkPad T400 HDD</b>
Driver	IDT 5.10.0.6124 (11/13/2008), Intel 5.10.0.1046 (7/30/2008)	Analog Devices 5.10.1.5820 (4/11/2008)	Conexant 3.53.0.0 (5/28/2008)
<b>Ethernet</b>			
Vendor and model number	Intel 82567LM Gigabit	Intel 82567LM Gigabit	Intel 82567LM Gigabit
Driver	Intel 9.50.14.2 (4/4/2008)	Intel 9.50.14.0 (3/27/2008)	Intel 9.52.10.1003 (9/19/2008)
<b>Wireless</b>			
Vendor and model number	Intel Wireless WiFi Link 5300	Intel Wireless WiFi Link 5300	Intel Wireless WiFi Link 5300
Driver	Intel 12.0.0.82 (7/8/2008)	Intel 12.2.0.11 (11/17/2008)	Intel 12.2.1.2 (12/22/2008)
<b>Modem</b>			
Vendor and model number	NA	Agere Systems HDA Modem	ThinkPad Modem Adapter
Driver	NA	Agere 2.1.88.0 (3/21/2008)	Conexant 7.73.0.0 (3/28/2008)
<b>Optical drive(s)</b>			
Vendor and model number	LG MU10N	Optiarc CRX890S	LG MU10N
Type	DVD/CD RW	DVD/CD RW	DVD/CD RW
Interface	SATA	SATA	SATA
Dual/Single layer	Dual	Dual	Dual
<b>USB ports</b>			
Number	4	3	3
Type	2.0	2.0	2.0
Other	SD card reader	RICOH SmartCard Reader	NA
<b>eSATA port</b>			
Number	1	0	0
<b>IEEE 1394 ports</b>			
Number (4-pin)	1	1	1
<b>Monitor</b>			
LCD type	WXGA	WXGA	WXGA
Screen size (inches)	14.1	14.1	14.1
Refresh rate (Hz)	60	60	60
<b>Battery</b>			
Type	Dell PT434	Hewlett-Packard 463310-741	Lenovo 42T4678
Size (length x width x height)	8" x 2 1/8" x 3/4"	8" x 2 1/8" x 3/4"	8 3/4" x 2 1/2" x 3/4"
Rated capacity	5000 mAh x 11.1 V = 56 Wh	5,090 mAh x 10.8 V = 95 Wh	5200 mAh x 10.8V = 57 Wh
Cell count	6	6	6
Weight	11.1 oz.	1 lb. 12.5 oz.	11.3 oz.

Figure 6: Detailed system configuration information for the test systems configured for drop testing.

## About Principled Technologies

We provide industry-leading technology assessment and fact-based marketing services. We bring to every assignment extensive experience with and expertise in all aspects of technology testing and analysis, from researching new technologies, to developing new methodologies, to testing with existing and new tools.

When the assessment is complete, we know how to present the results to a broad range of target audiences. We provide our clients with the materials they need, from market-focused data to use in their own collateral to custom sales aids, such as test reports, performance assessments, and white papers. Every document reflects the results of our trusted independent analysis.

We provide customized services that focus on our clients' individual requirements. Whether the technology involves hardware, software, Web sites, or services, we offer the experience, expertise, and tools to help you assess how it will fare against its competition, its performance, whether it's ready to go to market, and its quality and reliability.

Our founders, Mark L. Van Name and Bill Catchings, have worked together in technology assessment for over 20 years. As journalists, they published over a thousand articles on a wide array of technology subjects. They created and led the Ziff-Davis Benchmark Operation, which developed such industry-standard benchmarks as Ziff Davis Media's Winstone and WebBench. They founded and led eTesting Labs, and after the acquisition of that company by Lionbridge Technologies were the head and CTO of VeriTest.



Principled Technologies, Inc.  
1007 Slater Road, Suite 250  
Durham, NC 27703  
[www.principledtechnologies.com](http://www.principledtechnologies.com)  
[info@principledtechnologies.com](mailto:info@principledtechnologies.com)

Principled Technologies is a registered trademark of Principled Technologies, Inc.  
All other product names are the trademarks of their respective owners

#### Disclaimer of Warranties; Limitation of Liability:

PRINCIPLED TECHNOLOGIES, INC. HAS MADE REASONABLE EFFORTS TO ENSURE THE ACCURACY AND VALIDITY OF ITS TESTING, HOWEVER, PRINCIPLED TECHNOLOGIES, INC. SPECIFICALLY DISCLAIMS ANY WARRANTY, EXPRESSED OR IMPLIED, RELATING TO THE TEST RESULTS AND ANALYSIS, THEIR ACCURACY, COMPLETENESS OR QUALITY, INCLUDING ANY IMPLIED WARRANTY OF FITNESS FOR ANY PARTICULAR PURPOSE. ALL PERSONS OR ENTITIES RELYING ON THE RESULTS OF ANY TESTING DO SO AT THEIR OWN RISK, AND AGREE THAT PRINCIPLED TECHNOLOGIES, INC., ITS EMPLOYEES AND ITS SUBCONTRACTORS SHALL HAVE NO LIABILITY WHATSOEVER FROM ANY CLAIM OF LOSS OR DAMAGE ON ACCOUNT OF ANY ALLEGED ERROR OR DEFECT IN ANY TESTING PROCEDURE OR RESULT.

IN NO EVENT SHALL PRINCIPLED TECHNOLOGIES, INC. BE LIABLE FOR INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH ITS TESTING, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. IN NO EVENT SHALL PRINCIPLED TECHNOLOGIES, INC.'S LIABILITY, INCLUDING FOR DIRECT DAMAGES, EXCEED THE AMOUNTS PAID IN CONNECTION WITH PRINCIPLED TECHNOLOGIES, INC.'S TESTING. CUSTOMER'S SOLE AND EXCLUSIVE REMEDIES ARE AS SET FORTH HEREIN.