

## Dell™ Latitude™ E6400 notebook competitive analysis

### Executive summary

Dell Inc. (Dell) commissioned Principled Technologies (PT) to test the performance and features of three notebook systems:

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

We performed tests to determine which of the three systems

- charged most quickly
- booted most quickly
- weighed the least
- arrived most quickly after ordering
- made upgrading hardware components the easiest
- had the longest-lasting battery

As our Key Findings state, the Dell Latitude E6400 beat the other two systems on every measure except for battery life, where results ranged depending on configuration. The Test Methodology section provides detail on our tests and Appendix A details the system configurations.

### KEY FINDINGS

- After one hour of charge time on a 6-cell battery, the Dell Latitude E6400 battery was 83 percent charged. Both the HP EliteBook 6930p and Lenovo ThinkPad T400 charged to 66 percent of capacity in the same period of time (see Figure 1).
- Boot time for the Dell Latitude E6400 was the fastest, coming in 11.8 percent faster than the HP EliteBook 6930p and 29.8 percent faster than the Lenovo ThinkPad T400 (see Figure 2).
- The Dell Latitude E6400 was the lightest of all three systems at 82.0 ounces (see Figure 3).
- The Dell Latitude E6400 arrived just 6 days after we ordered it. It took 17 days for the HP system to arrive, and 12 days for the Lenovo system (see Figure 4).
- Time needed to upgrade key components was 70.8 percent faster in the Dell Latitude E6400 vs. the HP EliteBook 6930p and 58 percent faster than the Lenovo ThinkPad T400 (see Figure 5).
- The Dell Latitude E6400 in its maximum battery life configuration lasted 20 hours and 9 minutes—5.7 percent longer than Dell's published claim of 19 hours. (Figure 6)

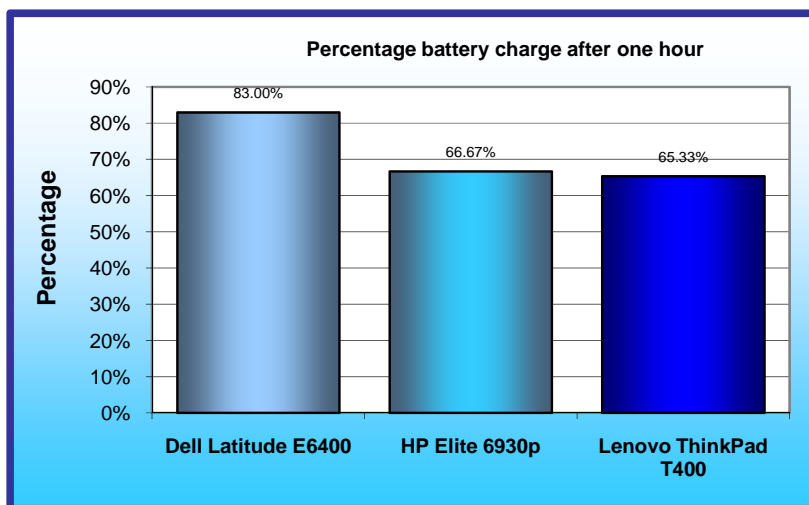


Figure 1: Percentage battery charge for the standard battery for the three test systems. Higher numbers are better.

### Percentage battery charge after one hour

To see how quickly the three systems with a 6-cell battery charged, we measured the percentage of battery charge after one hour with the system turned off. The Dell Latitude E6400 achieved 83.00 percent of total charge capacity; a 24.5 percent improvement over the HP EliteBook 6930p's charge capacity of 66.67 percent and a 27.0 percent improvement over the Lenovo ThinkPad T400's charge capacity of 65.33 percent (see Figure 1).

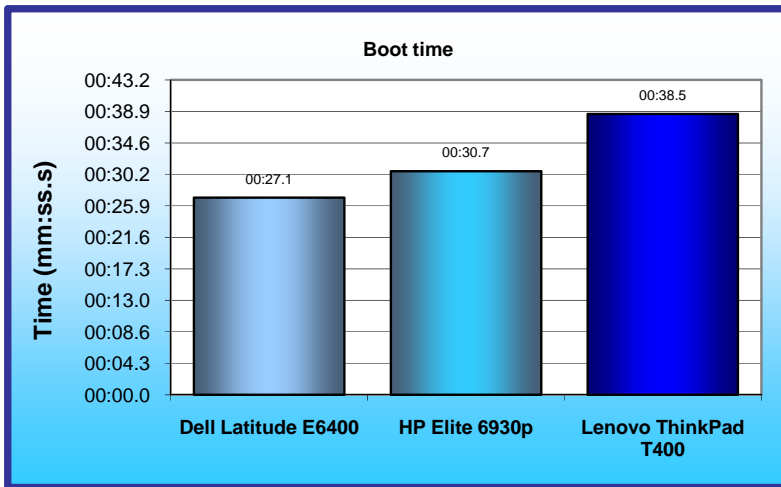


Figure 2: Time each system needed from pressing the power button to a login screen. Lower numbers are better.

### Boot time

We measured the time each system needed to boot to a login screen. The Dell Latitude E6400 took 27.1 seconds to boot, which was 11.8 percent faster than the HP EliteBook 6930p's boot time of 30.7 seconds, and 29.8 percent faster than the Lenovo ThinkPad T400's boot time of 38.5 seconds (see Figure 2).

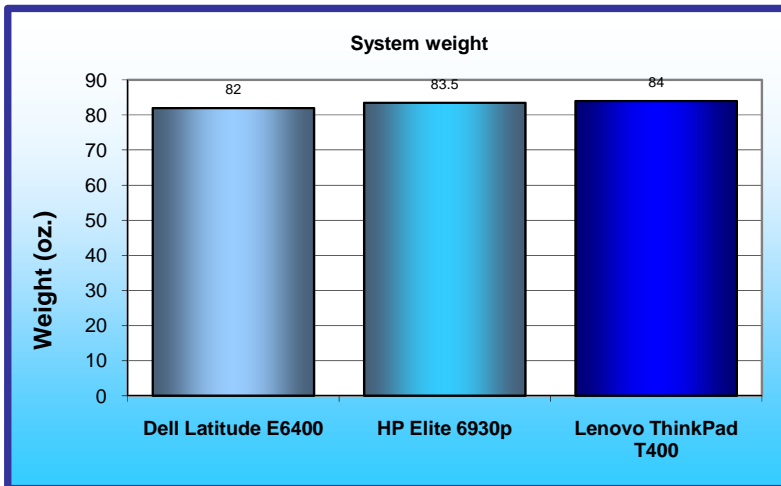


Figure 3: Weight, in ounces, of each system in its typical 6-cell battery configuration. Lower numbers are better.

### System weight

We compared typical 6-cell battery configurations for the three systems. The Dell Latitude E6400's weight of 82.0 ounces was 1.8 percent lighter than the HP EliteBook 6930p's 83.5 ounces and 2.4 percent lighter than the Lenovo ThinkPad T400's 84.0 ounces (see Figure 3).

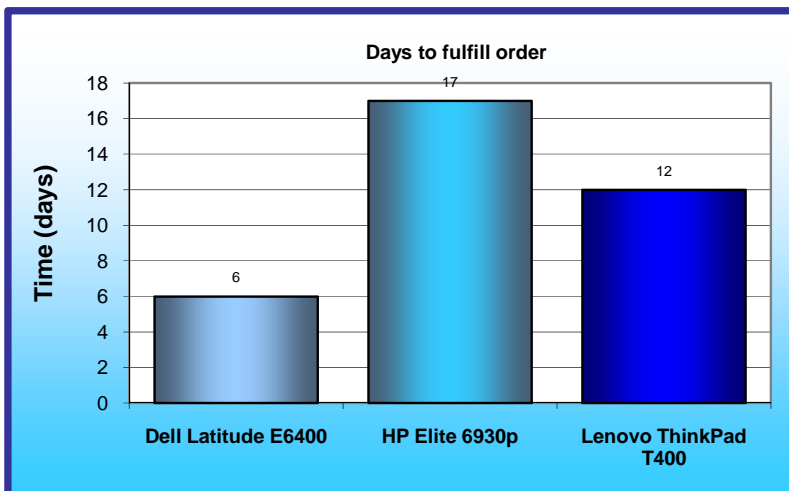
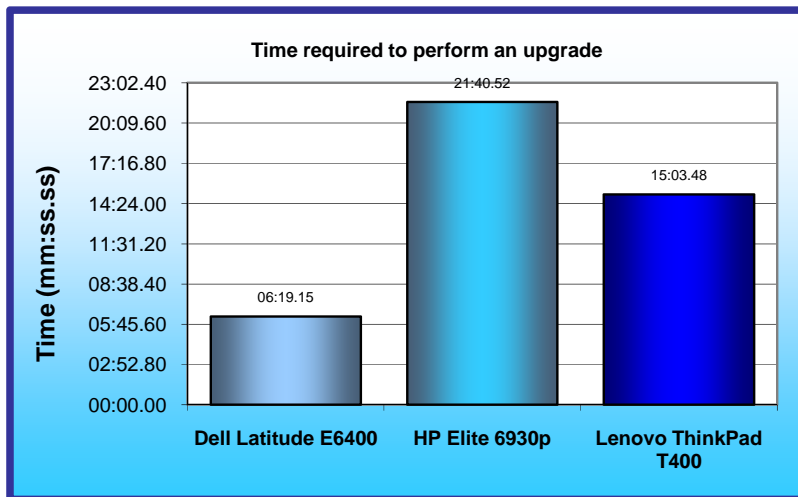


Figure 4: Number of days that elapsed from the time we ordered the system to the time it arrived. Lower numbers are better.

### Time for the system to arrive after we ordered it

Once we placed the order for the Dell Latitude E6400, 6 days elapsed until we received it, which was 50 to 65 percent faster than the time it took to receive both the HP and Lenovo notebooks. It took 17 days for the HP EliteBook 6930p to arrive and 12 days for the Lenovo ThinkPad T400 (see Figure 4).



**Figure 5: Time required to upgrade each notebook’s hard drive, RAM, and broadband wireless card. Lower numbers are better.**

### Time to upgrade hardware components

We measured the time required to upgrade each notebook’s hard drive and RAM.

The Dell Latitude E6400 took just over 6 minutes for the upgrades, which was 70.8 percent faster than the HP EliteBook 6930p, which took over 21 minutes. The Lenovo ThinkPad T400 took over 15 minutes to complete the upgrades (see Figure 5).

### Battery life

As more and more of the market shifts to notebook PCs, the importance of battery life is growing. Consequently, notebook vendors, including HP and Dell, have made claims about the maximum battery life of their systems; for example, see HP’s at <http://www.hp.com/hpinfo/newsroom/press/2008/080908a.html> and Dell’s at [http://www.dell.com/downloads/global/products/latit/en/latitude\\_landing\\_e6400\\_battery\\_life.pdf](http://www.dell.com/downloads/global/products/latit/en/latitude_landing_e6400_battery_life.pdf).

To bring an independent assessment to this discussion, we tested two separate hardware configuration scenarios:

- Typical configuration - represents the out-of-the-box system battery life for a configuration featuring a 6-cell battery and standard spindle hard drive
- Maximum battery life configuration – represents the out-of-the-box system battery life for a configuration featuring the maximum number of simultaneous battery cells, a solid state disk drive (SSD) and LED display

We tested the battery life of each system under the same conditions:

- Using 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 Figure 6 shows, the Dell, HP, and Lenovo systems with a 6-cell battery received virtually identical MobileMark 2007 v1.05 Battery Life scores of 5 hours and 18 or 19 minutes. We tested all three systems in states as close as possible to their out-of-box configurations; we made only MobileMark-required changes as we note in the Methodology section.

Dell and HP base their battery life claims on the maximum number of battery cells a consumer can use simultaneously; 9-cell plus high-capacity battery slice for the Dell Latitude E6400 and 6-cell plus ultra-capacity battery for the HP EliteBook 6930p. We tested with these same battery options. (Note: We did not include Lenovo in this test because they do not offer an optional slice battery.) As with the other configurations, we made only the MobileMark-required changes to the systems’ out-of-box configurations. The Dell Latitude E6400 lasted 20 hours 9 minutes, 5.7 percent longer than Dell’s published battery life claim. The HP EliteBook 6930p lasted 13.9 percent less time than HP’s published claim.

## Summary of results

Figure 6 summarizes our results.

Test	Raw results			Comparative ratings		
	Dell Latitude E6400	HP EliteBook 6930p	Lenovo ThinkPad T400	Dell Latitude E6400	HP EliteBook 6930p	Lenovo ThinkPad T400
<b>6-cell typical configuration</b>						
MobileMark 2007 v1.05 Battery Life rating for 6-cell typical configuration (higher is better)	5 hours 19 minutes	5 hours 18 minutes	5 hours 19 minutes	1.000	0.997	1.000
MobileMark 2007 v1.05 Performance rating for 6-cell typical configuration (higher is better)	224	217	224	1.000	0.969	1.000
Percentage charge after 1 hour (higher is better)	83.00%	66.67%	65.33%	1.270	1.021	1.000
Weight of system—6-cell typical configuration (lower is better)	82.0 ounces	83.5 ounces	84.0 ounces	0.976	0.994	1.000
Boot time (seconds; lower is better)	27.1	30.7	38.5	0.704	0.797	1.000
Days elapsed between our ordering and receiving the system (lower is better)	6	17	12	0.500	1.417	1.000
Time to upgrade hardware components (minutes: seconds; lower is better)	06:19.15	21:40.52	15:03.48	0.420	1.439	1.000
<b>Maximum battery life configuration</b>						
MobileMark 2007 v1.05 Battery Life rating for maximum battery life configuration (higher is better)	20 hours 9 minutes	21 hours 4 minutes	N/A	1.000	1.045	N/A

Figure 6: Performance results and comparative performance ratings for the three standard notebook systems we tested.

## Test methodology

### 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 and to measure charge time**

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 outlined in the Installing MobileMark 2007 section above.
3. Double-click the MobileMark 2007 icon on the desktop.
4. Highlight the Productivity 2007 item in the left panel.
5. Type 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 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. Type 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 battery charge time**

This test measures the amount of charge the 6-cell battery attains in 1 hour with the notebook powered off. This test requires a wall clock for marking the start and end points. This test also requires the battery meter icon present in the system tray.

We started each test at 5-minute intervals to allow us to collect percentage battery charge at the end of 1 hour for each of the notebooks in a sequence.

1. With the battery completely drained, note the time, and plug the AC power adapter into the notebook PC.
2. Wait 5 minutes.
3. Note the time, and plug the AC power adapter into the next notebook PC.
4. Repeat steps 2 and 3 until all notebook PCs are charging.
5. Allow the first notebook PC to charge for 1 hour.
6. After 1 hour, remove the battery from the first PC notebook, and power it on.
7. Allow 2 minutes for the operating system to load, and re-insert the battery.
8. Immediately move the mouse cursor over the battery meter icon in the system tray, and record the percentage battery charge.
9. Repeat steps 6, 7, and 8 for the remaining notebook PCs.
10. Discharge the batteries, and repeat steps 1 through 9.

We executed this test three times and used the average result of each set of three as the representative score for that test.

### **Measuring upgrade time**

This test measures the ease or difficulty and time required when upgrading a notebook's hard drive, and RAM.

To avoid the cost of purchasing a spare hard drive and RAM, we removed the notebook's existing hardware and then put that same hardware back in the notebook, thus simulating an upgrade. Because one upgrade may be more difficult than another, we timed each separately to more accurately report the level of difficulty with each hardware upgrade.

This test requires two people, a stopwatch, hand tools, a protractor, and a digital video camera.

As the technician performs the simulated upgrade, the proctor executes a number of tasks:

- Videotaping and timing each step of the process.
- Recording the number and name of parts removed and the number of steps the technician required to perform each upgrade.
- Recording anything out of the ordinary, not specifically attributable to the notebook, that happens during the test. (We noted any such incident that increased the duration of the upgrade process.)

Three PT technicians performed all upgrades on each system; we used the average result of each set of three as the representative score for that test on that system.

Because a technician was likely to become faster upgrading each subsequent notebook, the proctor delivered the notebooks to each technician in a different order. Though our three-person sample is too small to yield statistically significant results, this approach did reduce the amount of bias that the learning process induced.

Note: Because the process of upgrading a notebook's hard drive and RAM differs from system to system, this methodology uses generic terms.

1. The proctor starts the digital video camera, and states the name of the test and the make and model of the notebook.
2. The technician places the powered down notebook on the bench, right-side up with the lid closed.
3. The proctor prepares the stopwatch.
4. The proctor counts down to zero, and starts the stopwatch at zero.
5. The technician turns the notebook over, removes the hard drive from the notebook, and removes the hard drive from the drive holder, if present.
6. The proctor notes every step in this process, stops the stopwatch when the technician completes this process, and records the time the technician took to remove the hard drive.
7. The proctor prepares the stopwatch.
8. The proctor counts down to zero, and starts the stopwatch at zero.
9. The technician replaces the hard drive into the drive holder, if present, and re-installs the hard drive.
10. The proctor notes every step in this process, stops the stopwatch when the technician completes this process, and records the time the technician took to replace the hard drive.
11. Repeat steps 2 through 10 with the RAM.

We executed each test three times, using three people, and used the average result of each set of three as the representative score for that test.

## Measuring boot time

This test measures the time from a user's pressing the power button to the logon screen's appearing.

Notes: This test requires a stopwatch and a password-protected user account. Before running this test, we reset the notebook to the base image using Symantec's Ghost product.

## Verifying that a password exists

1. Click Start→Control Panel.
2. Click User Accounts, and click the Computer administrator account.
3. If the second choice in the User Accounts dialog box reads, "Change my password," a password exists.
4. If the first choice in the User Accounts dialog box reads, "Create my password," no password exists and you should create one:
  - a. Click Create a password.
  - b. In the Type a new password field, type `password`.
  - c. In the Type the new password again to confirm field, type `password`.
  - d. Click Create Password.



- e. Click Yes, Make Private.

### **Running the test**

1. Close all Windows Explorer windows and applications.
2. Turn the computer off for at least 2 minutes.
3. Prepare the stopwatch.
4. Simultaneously press the power button and start the stopwatch.
5. Stop the stopwatch when the logon screen appears.






### **Measuring system arrival time**

This test counts the number of elapsed days from our ordering a specific computer configuration to the time it arrives. We followed the steps below for all five systems.

1. Open a browser, go to the notebook vendor's Web site, and navigate to the Small & Medium Business section.
2. Move through the online ordering process, and place the order for the notebook system.
3. Note the date you placed the order.

## Appendix A. Test system configuration information

As per Dell's request, PT purchased the notebook systems for this test. Figure 4 presents detailed configuration information for the systems.

System	Dell Latitude E6400	Dell Latitude E6400 Configured for maximum battery life	HP EliteBook 6930p	HP EliteBook 6930p Configured for maximum battery life	Lenovo T400
					
<b>General</b>					
Processor and OS kernel: (physical, core, logical)/(UP, MP)	1P2C2L/MP	1P2C2L/MP	1P2C2L/MP	1P2C2L/MP	1P2C2L/MP
Number of physical processors	1	1	1	1	1
Single/dual-core processors	Dual	Dual	Dual	Dual	Dual
System power management policy	MobileMark 2007	MobileMark 2007	MobileMark 2007	MobileMark 2007	MobileMark 2007
Processor power-saving option	Enhanced Intel SpeedStep Technology	Enhanced Intel SpeedStep Technology	Enhanced Intel SpeedStep Technology	Enhanced Intel SpeedStep Technology	Enhanced Intel SpeedStep Technology
System dimensions (length x width x height)	13-1/4" x 9-3/4" x 1-1/4"	9-5/8" x 13-3/16" x 1-1/4"	9-1/2" x 13" x 1-1/2"	9-1/2" x 13" x 1-1/2"	13-1/4" x 9-1/4" x 1-1/4"
Weight of system—6-cell typical configuration	5 lb. 2 oz.	4 lb. 15.0 oz.	5 lb. 3.5 oz.	5 lb. 2 oz.	5 lb. 4 oz.
Weight of system—9-cell typical configuration	NA	5 lb. 4.0 oz.	NA	NA	NA
System weight with maximum battery—6-cell typical configuration with 12-cell slice	NA	NA	NA	6 lb. 14.5 oz.	NA
System weight with maximum battery—9-cell typical configuration with 12-cell slice	NA	7 lb. 5.5 oz.	NA	NA	NA
<b>CPU</b>					
Vendor	Intel	Intel	Intel	Intel	Intel
Name	Core 2 Duo mobile	Core 2 Duo mobile	Core 2 Duo mobile	Core 2 Duo mobile	Core 2 Duo mobile
Model number	P8400	P8400	P8400	P8400	P8400
Stepping	6	6	6	6	6

System	Dell Latitude E6400	Dell Latitude E6400 Configured for maximum battery life	HP EliteBook 6930p	HP EliteBook 6930p Configured for maximum battery life	Lenovo T400
Socket type and number of pins	Socket P (478)	Socket P (478)	Socket P (478)	Socket P (478)	Socket P (478)
Core frequency (GHz)	2.26	2.26	2.26	2.26	2.26
Front-side bus frequency (MHz)	1,066	1,066	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)	32 KB + 32 KB (per core)	32 KB + 32 KB (per core)
L2 cache	3 MB (shared)	3 MB (shared)	3 MB (shared)	3 MB (shared)	3 MB (shared)
<b>Platform</b>					
Vendor	Dell	Dell	Hewlett-Packard	Hewlett-Packard	Lenovo
Motherboard model number	0HT027	0HT027	30DB	30DB	7417CTO
Motherboard chipset	Intel GM45/GM47	Intel GL40/GM45/GS45/PM45	Intel GL40/GM45/GS45/PM45	Intel GL40/GM45/GS45/PM45	Intel GL40/GM45/GS45/PM45
Motherboard revision number	07	07	07	07	07
System/motherboard serial number	CQ0CGH1	G2D5LH1.CN129618A43126	2CE837551H	2CE844006Q	L3-B0519 08/09
BIOS name and version	Dell A03 (09/01/2008)	Dell A06 (10/10/2008)	Hewlett-Packard 68PCU Ver. F.06 (8/25/2008)	Hewlett-Packard 68PCU Ver. F.0C (10/17/2008)	Lenovo 7UET43WW(1.13) (08/19/2008)
BIOS settings	Default	Default	Default	Default	Default
<b>Memory module(s)</b>					
Vendor and model number	Nanya Technology NT1GT64UH8D 0FN-AD	Hyundai Electronics HYMP112S64C P6-S6	Micron MT16HTF25664 HY-800E1	Hynix HYMP112S64C P6-S6	Micron Technology MT8JSF12864H Y-1G1D1
Type	PC2-6400	PC2-6400	PC2-6400s	PC2-6400	PC3-8500
Speed (MHz)	800	800	800	800	1,066
Speed running in the system (MHz)	800	800	800	800	1,066
Timing/latency (tCL-tRCD-tRP-tRASmin)	6-6-6-18	6-6-6-18	6-6-6-18	6-6-6-18	7-7-7
Size (MB)	2,048	1,024	2,048	1,024	2,048
Number of memory module(s)	2 x 1,024 MB	1 x 1,024 MB	1 x 2,048	1 x 1,024	2 x 1,024
Chip organization (single-sided, double-sided)	Double-sided	Double-sided	Double-sided	Double-sided	Double-sided
Channel (single/dual)	Dual	Dual	Dual	Dual	Dual

System	Dell Latitude E6400	Dell Latitude E6400 Configured for maximum battery life	HP EliteBook 6930p	HP EliteBook 6930p Configured for maximum battery life	Lenovo T400
<b>Hard disk</b>					
Vendor and model number	Western Digital WD1600BEVT-75ZCT1	Samsung SSD RBX Series 6	Fujitsu MHZ2160BH G2	Intel SSDSA2MH080 G1HP	Seagate ST9160827AS
Size (GB)	160	64	160	80	160
Buffer size (MB)	8	NA	8	NA	8
RPM	5,400	NA	5,400	NA	5,400
Type	SATA 3.0 Gb/s	SATA	SATA 3.0 Gb/s	SATA	SATA 3.0 Gb/s
Controller	Intel ID2917	Intel ID2917	Intel ICH9M-E/M	Intel ID2917	Intel ID2917
Driver	Ricoh Company 6.0.2.3 (2/24/2007)	Ricoh Company 6.0.2.3 (2/24/2007)	Intel 8.2.3.1001 (6/11/2008)	Intel 8.2.3.1001 (6/11/2008)	Intel 8.2.4.1005 (7/22/2008)
Device type	Hard drive	Solid-state drive	Hard drive	Solid-state drive	Hard drive
<b>Operating system</b>					
Name	Windows XP Professional	Windows XP Professional	Windows XP Professional	Windows XP Professional	Windows XP Professional
Build number	2600	2600	2600	2600	2600
Service pack	Service Pack 3	Service Pack 3	Service Pack 3	Service Pack 3	Service Pack 3
File system	NTFS	NTFS	NTFS	NTFS	NTFS
Kernel	ACPI Multiprocessor PC	ACPI Multiprocessor PC	ACPI Multiprocessor PC	ACPI Multiprocessor PC	ACPI Multiprocessor PC
Language	English	English	English	English	English
Microsoft DirectX version	DirectX 9.0c	DirectX 9.0c	DirectX 9.0c	DirectX 9.0c	DirectX 9.0c
<b>Graphics</b>					
Vendor and model number	Mobile Intel GMA 4500MHD	Mobile Intel 4500MHD	Mobile Intel GMA 4500MHD	Mobile Intel GMA 4500MHD	Mobile Intel GMA 4500MHD
Type	Integrated	Integrated	Integrated	Integrated	Integrated
Chipset	Mobile Intel 4 Series Express Chipset	Mobile Intel 4 Series Express Chipset	Mobile Intel 4 Series Express Chipset	Mobile Intel 4 Series Express Chipset	Mobile Intel 4 Series Express Chipset
BIOS version	1659.0	1659.0	1637.0	1637.0	1654.1
Total available graphics memory (MB)	1,024	1,024	1,024	1,024	1,024
Resolution	1,440 x 900 x 32 bit	1,440 x 900 x 32 bit	1,280 x 800 x 32 bit	1,280 x 800 x 32 bit	1,280 x 800 x 32 bit
Driver	Intel 6.14.10.4964 (6/27/2008)	Intel 6.14.10.4980 (8/25/2008)	Intel 6.14.10.4953 (5/21/2008)	Intel 6.14.10.4953 (5/21/2008)	Intel 6.14.10.4957 (6/11/2008)
<b>Sound card/subsystem</b>					
Vendor and model number	Intel High Definition Audio HDMI Service	Intel High Definition Audio HDMI Service	SoundMAX Integrated Digital HD Audio	SoundMAX Integrated Digital HD Audio	Conexant High Definition Smart Audio 221

System	Dell Latitude E6400	Dell Latitude E6400 Configured for maximum battery life	HP EliteBook 6930p	HP EliteBook 6930p Configured for maximum battery life	Lenovo T400
Driver	Intel 5.10.0.1044 (6/13/2008)	Intel 5.10.0.1046 (7/30/2008)	Analog Devices 5.10.1.5820 (4/11/2008)	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 Network Connection	Intel 82567LM Gigabit Network Connection	Intel 82567LM Gigabit Network Connection	Intel 82567LM Gigabit Network Connection	Intel 82567LM Gigabit Network Connection
Driver	Intel 9.50.14.2 (4/4/2008)	Intel 9.50.14.2 (4/4/2008)	Intel 9.50.14.0 (3/27/2008)	Intel 9.50.14.0 (3/27/2008)	Intel 9.52.10.1001 (8/22/2008)
<b>Wireless</b>					
Vendor and model number	Intel WiFi Link 5300 AGN	Intel WiFi Link 5300 AGN	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 12.0.0.82 (7/8/2008)	Intel 12.0.0.82 (7/8/2008)	Intel 12.0.0.73 (4/27/2008)	Intel 12.0.0.75 (5/1/2008)
<b>Modem</b>					
Vendor and model number	NA	NA	Agere Systems HDA Modem	Agere Systems HDA Modem	Think Pad Modem Adapter
Driver	NA	NA	Agere 2.1.87.0 (2/29/2008)	Agere 2.1.88.0 (3/21/2008)	Conexant Systems 7.73.0.0 (3/28/2008)
<b>Optical drive(s)</b>					
Vendor and model number	HL-DT-ST MU10N	HL-DT-ST MU10N	Optiarc AD-7581S	Optiarc AD-7581S	HL-DT-ST MU10N
Type	CD-RW/DVD	CD-RW/DVD	CD-RW/DVD	CD-RW/DVD	CD-RW/DVD
Interface	SATA	SATA	SATA	SATA	SATA
Dual/single layer	Dual	Dual	Dual	Dual	Dual
<b>USB ports</b>					
Number	4	4	3	3	3
Type	2.0	2.0	2.0	2.0	2.0
Other	USB Smart Card reader	USB Smart Card reader	RICOH SmartCard Reader	RICOH SmartCard Reader	NA
<b>eSATA port</b>					
Number	1	1	0	0	0
<b>IEEE 1394 ports</b>					
Number (4-pin)	1	1	1	1	1
<b>Monitor</b>					
LCD type	WXGA	WXGA	WXGA	WXGA	WXGA
Screen size (inches)	14.1	14.1	14.1	14.1	14.1
Refresh rate (Hz)	60	60	60	60	60
<b>6-cell battery</b>					
Type	Dell PT434	NA	Hewlett-Packard 463310-741	Hewlett-Packard 463310-741	Lenovo 42T5264
Size (length x width x height)	8-1/8" x 1-3/4" x 5/8"	NA	8" x 2-1/8" x 3/4"	8" x 2-1/8" x 3/4"	8-3/4" x 3" x 1-1/4"

System	Dell Latitude E6400	Dell Latitude E6400 Configured for maximum battery life	HP EliteBook 6930p	HP EliteBook 6930p Configured for maximum battery life	Lenovo T400
Rated capacity	5 Ah x 11.1 V = 56 Wh	NA	5,090 mAh x 10.8 V = 55 Wh	5,090 mAh x 10.8 V = 55 Wh	5.2 Ah x 10.8 V = 56.16 Wh
Cell count	6	NA	6	6	6
Weight	11.1 oz.	NA	11 oz.	11 oz.	11.3 oz.
<b>9-cell battery</b>					
Type	NA	Dell KY265	NA	NA	NA
Size (length x width x height)	NA	8-1/8" x 2-1/8" x 7/8"	NA	NA	NA
Rated capacity	NA	7.7 Ah x 11.1 V = 85 Wh	NA	NA	NA
Cell count	NA	9	NA	NA	NA
Weight	NA	1 lb. 1 oz.	NA	NA	NA
<b>12-cell battery</b>					
Type	NA	Dell GN752	NA	Hewlett-Packard 405389-001	NA
Size (length x width x height)	NA	12-3/4" x 8" x 1/2"	NA	10-1/2" x 6" x 1"	NA
Rated capacity	NA	5.7 Ah x 14.8 V = 84Wh	NA	6,419 mAh x 14.8 V = 95 Wh	NA
Cell count	NA	12	NA	12	NA
Weight	NA	1 lb. 14.9 oz.	NA	1 lb. 12.5 oz.	NA
<b>AC adapter</b>					
Vendor	Dell	Dell	HP	HP	Lenovo
Make/model	Dell AC/DC Adapter	Dell AC/DC Adapter	HP AC Adapter	HP AC Adapter	Lenovo AC/DC Combo Adapter
Watts (W)	90	90	90	90	90

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

## 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.

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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.



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