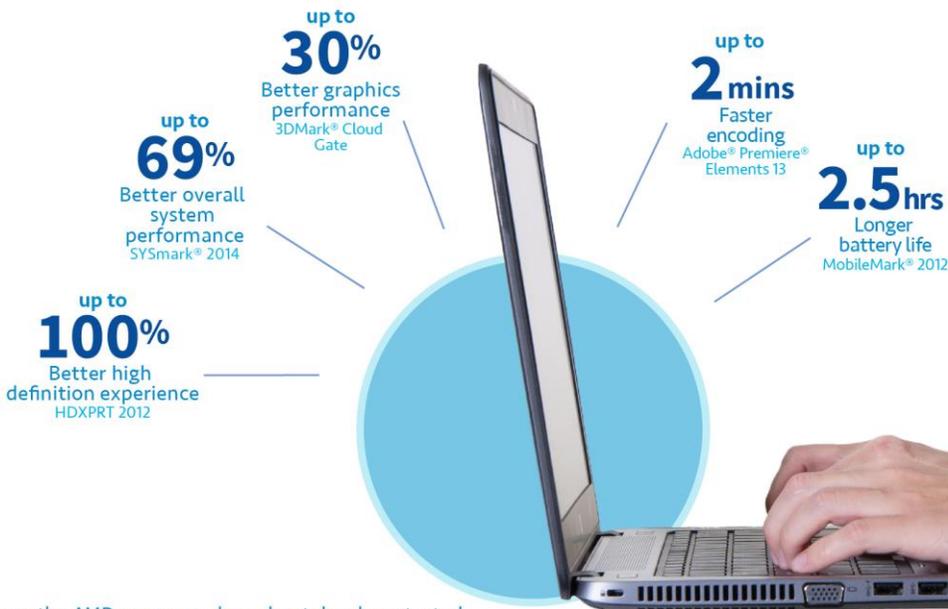


INTEL CORE i5 PROCESSOR-POWERED HP ELITEBOOKS: A BETTER EXPERIENCE FOR ENTERPRISES

GET A BETTER EXPERIENCE WITH AN INTEL® CORE™ PROCESSOR-POWERED HP ELITEBOOK*



*versus the AMD processor-based notebook we tested

Large enterprises depend on employees completing their work in a timely manner without sacrificing quality—work that includes graphic-intensive tasks such as media creation and compute-intensive ones such as numeric calculations. How do you choose which laptop will help your employees be more productive and get the job done?

In the Principled Technologies labs, we conducted hands-on testing to help with the buying decision. We compared an Intel Core i5 processor-powered HP EliteBook 740 G1 and an Intel Core i5 processor-powered HP EliteBook 840 G1 to a similarly configured AMD A10 processor-based HP EliteBook 745 G2. We put the three systems through tests that included industry-standard benchmarks and timed tasks.

We found that both Intel processor-powered HP EliteBooks provided a better experience across the board than the AMD processor-based HP notebook: up to 69 percent better performance in industry-standard benchmarks, up to 2 minutes faster in common tasks, and up to 2 hours and 31 minutes longer battery life. With better performance, application responsiveness, and battery life, our hands-on testing shows that Intel processor-powered HP EliteBooks are the better choice for large enterprises and their employees.



WHICH ELITEBOOK OFFERS A BETTER EXPERIENCE?

Does it matter what processor you choose in an EliteBook? Does the processor matter when employees use common productivity applications such as Microsoft® Excel® and PowerPoint® or graphic-intensive applications such as Adobe Photoshop® Elements 13 and Premiere Elements 13? Does the processor matter for battery life and how often employees will need to recharge?

We put three EliteBooks through a series of tests to help answer those questions:

- An Intel Core i5-4310U processor-powered HP EliteBook 740 G1
- An Intel Core i5-4300U processor-powered HP EliteBook 840 G1
- An AMD A10 Pro-7350B processor-based HP EliteBook 745 G2

We configured the systems as similarly as possible; the systems shared the same amount of memory and storage. In addition, all three systems we tested were configured with 3-cell batteries. For detailed specifications of our test systems, see [Appendix B](#).

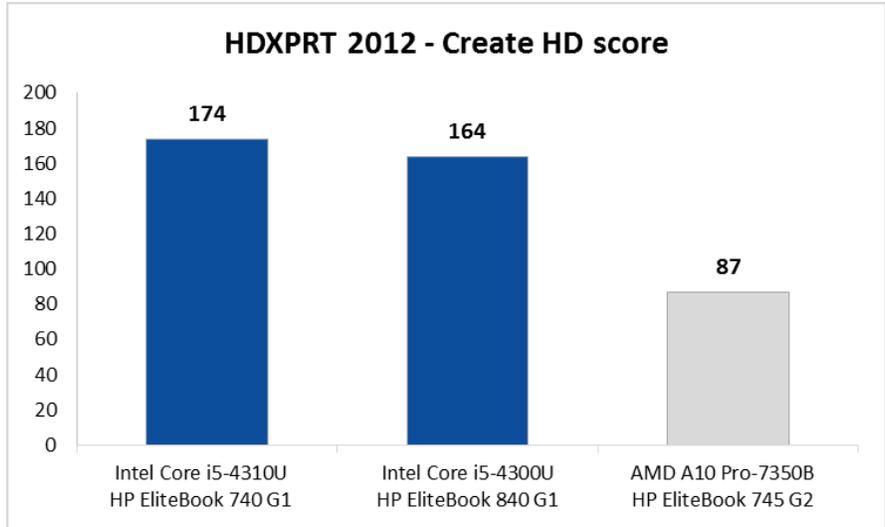
We put the three systems through a series of tests that included industry-standard benchmarks to measure performance and battery life. We also timed tasks to measure application responsiveness. For more information on the benchmarks we used, see [Appendix A](#). For detailed steps on how we conducted each test, see [Appendix C](#).

BENCHMARK PERFORMANCE

HDXPRT 2012

Other forms of digital media, in addition to graphics and video, require significant compute power as well. The benchmark HDXPRT, the High Definition Experience & Performance Ratings Test, assesses capabilities of Microsoft Windows®-based systems for handling real-world media scenarios while using common consumer applications. We used HDXPRT to see how well the three systems performed such tasks as organizing and editing photos, videos, and music. Figure 1 shows the overall HDXPRT Create HD Score for the three systems. The Intel processor-powered HP EliteBooks scored up to 100.0 percent better than the AMD processor-based HP EliteBook, indicating they would be better suited to handle media creation and manipulation demands.

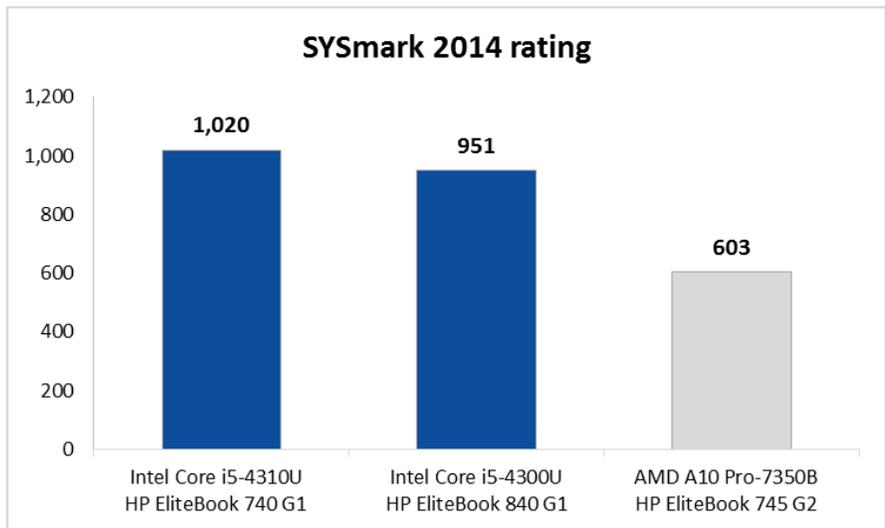
Figure 1: HDXPRT 2012 scores for the three test systems. Higher scores are better.



BAPCo SYSmark 2014

Users often employ a number of different applications to complete work-related tasks. BAPCo® SYSmark 2014 is an industry-standard benchmark that measures performance in areas such as productivity, media creation, and financial analysis. As Figure 2 shows, the Intel processor-powered HP EliteBooks outperformed the AMD processor-based HP EliteBook by up to 69.2 percent.

Figure 2: SYSmark 2014 scores for the three test systems. Higher scores are better.



Futuremark 3DMark

Those who work with graphics-intensive applications understandably need strong performance in this area. Graphics performance can also affect general responsiveness for users who do not use such applications. We used Futuremark® 3DMark v1.4.778 Cloud Gate to measure the graphics performance of the three test systems. Designed for Windows notebooks and home PCs, Cloud Gate includes graphics

and physics tests. As Figure 3 shows, we found that the Intel processor-powered HP EliteBooks outperformed the AMD processor-based HP EliteBook by up to 30.2 percent.

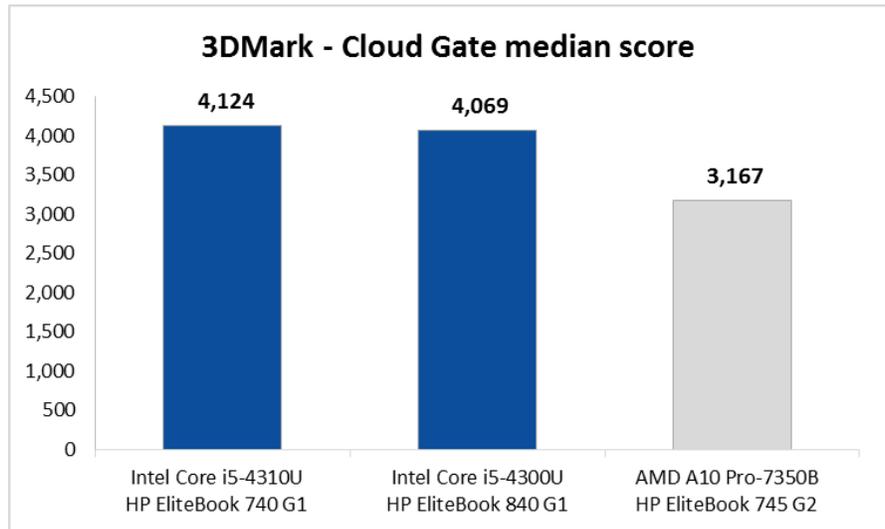


Figure 3: 3DMark Cloud Gate median scores for the three test systems. Higher numbers are better.

Futuremark PCMark 8

The latest version of this benchmark, Futuremark PCMark® 8 v2.2.282 measures various aspects of performance for a range of Windows-based devices. For our testing, we chose Home, Creative, Work, and Storage scenarios. Figure 4 shows the results from all four scenarios. The Intel Core i5 processor-powered HP EliteBook 740 G1 scored up to 44.7 percent higher than did the AMD processor-based HP EliteBook, while the Intel Core i5 processor-powered HP EliteBook 840 G1 scored up to 42.9 percent better than did the same AMD processor-based HP EliteBook.

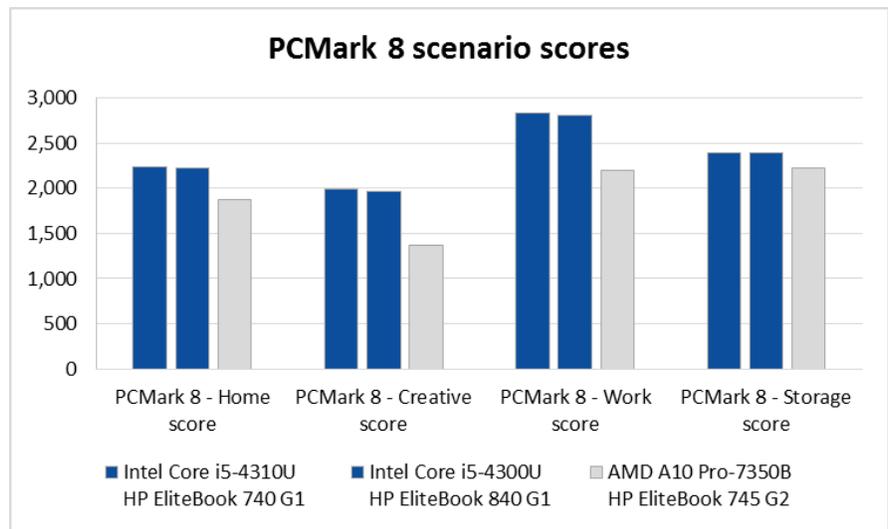
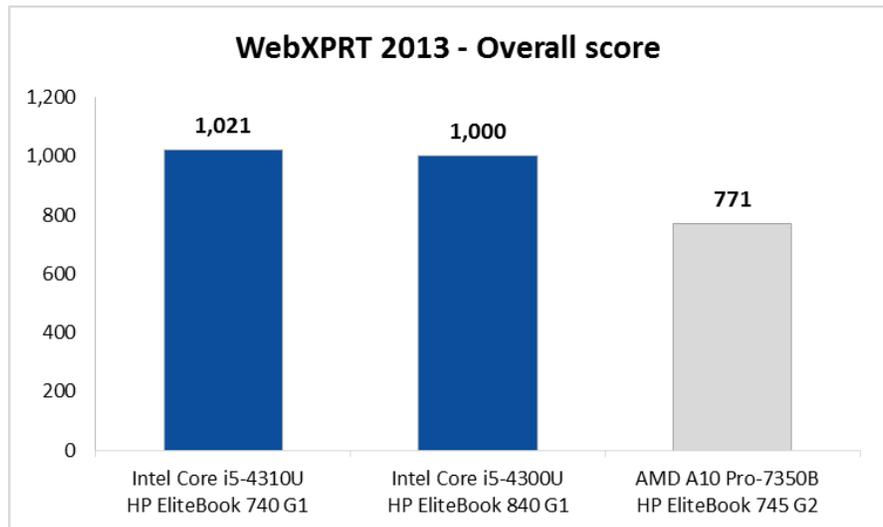


Figure 4: PCMark 8 Creative scenario scores for the three test systems. Higher scores are better.

WebXPRT 2013

WebXPRT 2013 measures Web-browsing performance of any Web-enabled device by simulating everyday usage scenarios. The benchmark calculates an overall score from the times the test system took to complete tasks from four workloads. As Figure 5 shows, the Intel processor-powered HP EliteBooks scored up to 32.4 percent higher than did the AMD processor-based HP EliteBook.

Figure 5: WebXPRT 2013 scores for the three test systems. Higher scores are better.

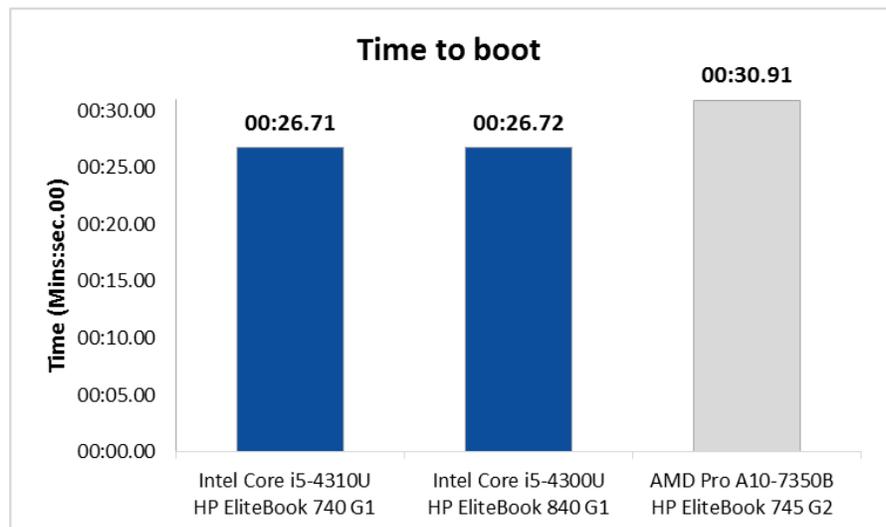


SYSTEM AND APPLICATION RESPONSIVENESS

Time to boot

A system that boots quickly helps users get to work quicker. In our tests, the Intel Core i5 processor-powered HP EliteBooks booted more quickly than the AMD processor-based HP EliteBook—up to 13.6 percent more quickly (see Figure 6).

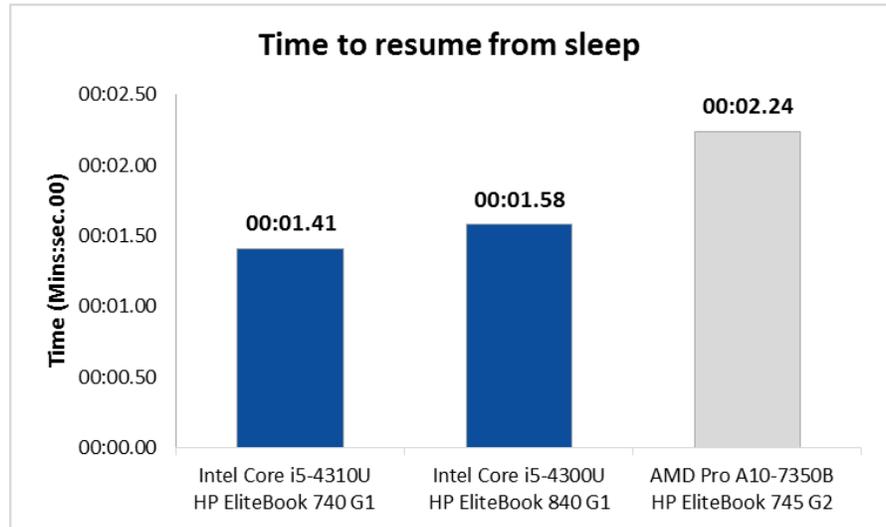
Figure 6: The times for each system to boot. Lower numbers are better.



Time to resume from sleep

To avoid a complete shutdown during productive hours, users often choose to put their notebooks to sleep. Figure 7 shows the times to resume from sleep—both Intel processor-powered HP EliteBooks did so in less time than did the AMD processor-based HP EliteBook.

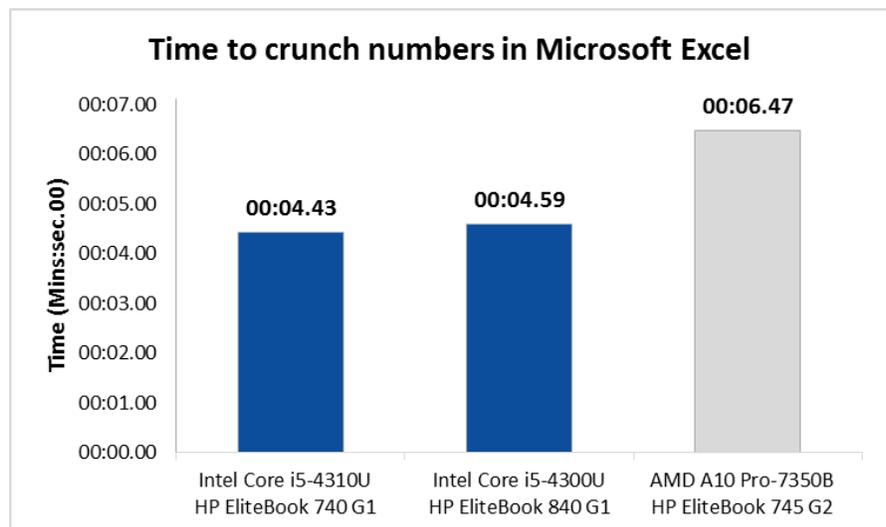
Figure 7: The times for each system to resume from a sleep state. Lower numbers are better.



Crunching numbers in Microsoft Excel

Tabulating numbers in a spreadsheet is a relatively common task for many users. However, computing large quantities of numbers can stress processors and slow performance. To test this capability in our notebooks, we performed a command that performed calculations in a Microsoft Excel spreadsheet full of numeric data. We found that the Intel processor-powered HP EliteBooks completed this task in up to 31.5 percent less time—just over two seconds faster. Figure 8 shows how long each system took to crunch numbers in Excel.

Figure 8: The times for each system to crunch numbers in Excel. Lower numbers are better.



Launching Microsoft PowerPoint

Launching productivity applications, such as PowerPoint, can provide insight into a system's responsiveness when a user would be getting work done on the notebook. We found that both Intel processor-powered HP EliteBooks launched PowerPoint in less time than did the AMD processor-based HP EliteBook. Figure 9 shows the times for the three EliteBooks to launch PowerPoint and the percentage wins for the Intel processor-powered HP EliteBooks.

	Intel Core i5-4310U HP EliteBook 740 G1	Percent win for Intel Core i5-4310U	Intel Core i5-4300U HP EliteBook 840 G1	Percent win for Intel Core i5-4300U	AMD A10 Pro-7350B HP EliteBook 745 G2
Launching PowerPoint (mins:secs.00)	00:01.93	4.5%	00:01.85	8.4%	00:02.02

Figure 9: Results and analysis for this responsiveness task. Lower numbers are better for times and higher numbers are better for percentages.

Adobe Photoshop Elements 13 – Opening a project & converting to JPEG

Adobe Photoshop Elements is a picture editor that can open and convert projects from one format to another. Due to file sizes and the nature of the application, these tasks can take longer than other productivity applications. As Figure 10 shows, we found that the two Intel processor-powered HP EliteBooks took less time to perform both of these tasks.

Figure 10: Time the three test systems needed to launch an Adobe Photoshop Elements 13 project and convert it to JPEG. Lower times are better.

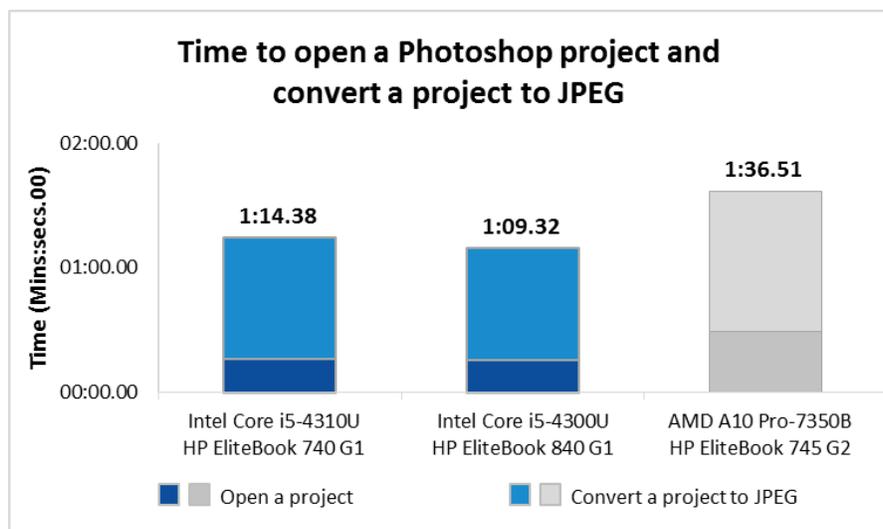


Figure 11 shows the times for the three notebooks to complete both tasks and the percentage wins for the Intel processor-powered HP EliteBooks.

	Intel Core i5-4310U HP EliteBook 740 G1	Percent win for Intel Core i5-4310U	Intel Core i5-4300U HP EliteBook 840 G1	Percent win for Intel Core i5-4300U	AMD A10 Pro-7350B HP EliteBook 745 G2
Time to open a project in Photoshop (mm:ss.00)	00:16.03	45.9%	00:15.87	46.4%	00:29.61
Time to convert a project to JPEG in Photoshop (mm:ss.00)	00:58.35	12.8%	00:53.45	20.1%	01:06.90

Figure 11: Results and analysis for these responsiveness tasks. Lower numbers are better for times and higher numbers are better for percentages.

Adobe Premiere Elements 13 – Opening a project & encoding to MPEG

Like Photoshop Elements 13, Adobe Premiere Elements 13 can take a while to open a project or encode projects from one format to another. Performing these actions many times in a day on a slower system can cut into productivity. As Figure 12 shows, we found that the two Intel processor-powered HP EliteBooks took less time to open a project and encode a project to MPEG than did the AMD processor-based HP EliteBook. An employee using an Intel processor-powered HP EliteBook would save valuable time—up to 2 minutes—when encoding a project to MPEG in Adobe Premiere Elements 13.

Figure 12: Time the three test systems needed to launch an Adobe Premiere Elements 13 project and encode it to MPEG. Lower times are better.

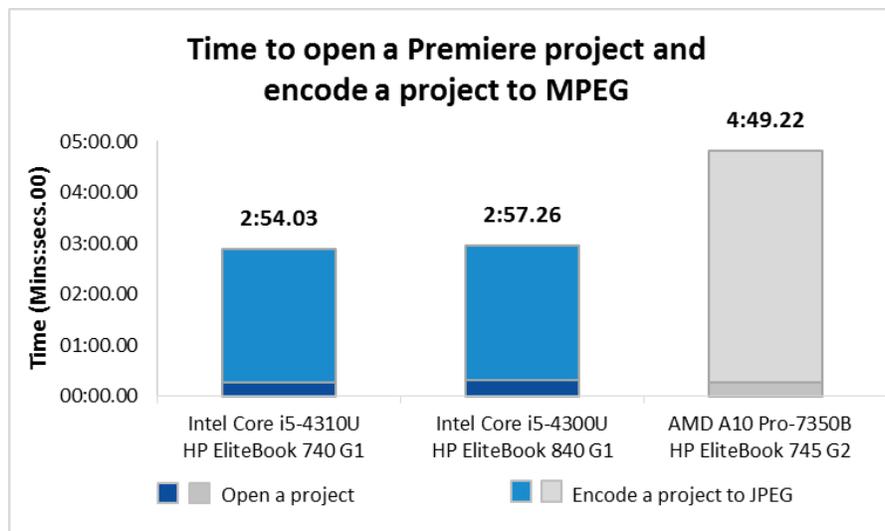


Figure 13 shows the times for the three notebooks to complete both tasks and the percentage wins for the Intel processor-powered HP EliteBooks. While it took slightly longer to open a project with the Intel processor-powered HP EliteBooks, it took significantly less time to convert a project to MPEG than with the AMD processor-based HP EliteBook.

	Intel Core i5-4310U HP EliteBook 740 G1	Percent win for Intel Core i5-4310U	Intel Core i5-4300U HP EliteBook 840 G1	Percent win for Intel Core i5-4300U	AMD A10 Pro-7350B HP EliteBook 745 G2
Time to open a project in Premiere (mm:ss.00)	00:16.34		00:18.06		00:16.09
Time to convert a project to MPEG in Premiere (mm:ss.00)	02:37.69	42.3%	02:39.20	41.7%	04:33.13

Figure 13: Results and analysis for these responsiveness tasks. Lower numbers are better for times and higher numbers are better for percentages.

BATTERY LIFE PERFORMANCE

BAPCo MobileMark 2012

Battery life depends on the performance of the processor as it runs applications in addition to battery capacity. The MobileMark benchmark creates a score for battery life from its tested applications. As Figure 14 shows, we found that the Intel Core i5-4310U processor-powered HP EliteBook 740 G1 lasted over two and a half hours longer on a single charge than did the AMD processor-based HP EliteBook. We also found that the Intel Core i5-4300U processor-powered HP EliteBook 840 G1 lasted over two hours longer than did the same AMD processor-based HP EliteBook. This means that the Intel processor-powered HP EliteBooks could be more convenient for today’s employees that are often on the go.

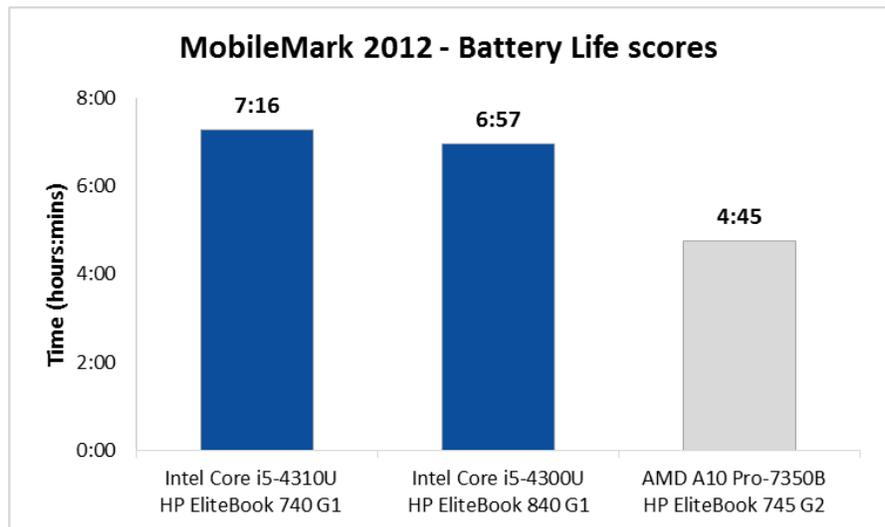


Figure 14: MobileMark 2012 Battery Life scores for the three test notebooks. Higher scores are better.

CONCLUSION

Workers have a range of tasks to complete and use a number of different applications. Laptops for these users, while providing advantages in mobility, are not always equal in terms of performance, experience, or battery life. We found that Intel Core i5 processor-powered HP EliteBooks provided a number of advantages in performance and application responsiveness over an AMD processor-based HP EliteBook, while also delivering longer battery life. When your organization needs notebooks for a broad range of users performing different yet vital tasks, our testing shows that an Intel processor-powered HP EliteBook could offer a better experience than an AMD processor-based HP EliteBook notebook.

APPENDIX A – ABOUT THE BENCHMARKS

About HDXPRT 2012

The High Definition Experience & Performance Ratings Test (HDXPRT) 2012 is a benchmark that evaluates the capabilities of PCs in consumer digital media uses, including

- Media Organizer
- Media Creator
- Photo Blogger
- Video Producer
- Music Maker

For more information on HDXPRT 2012, see www.hdxprt.com.

About BAPCo SYSmark 2014

According to BAPCo, “SYSmark 2014 is an application-based benchmark that reflects usage patterns of business users in the areas of office productivity, media creation, and data/financial analysis.” The benchmark features notable applications from these fields. SYSmark 2014 generates a score from the times the tested system takes to complete each individual operation in each scenario. For more information on this benchmark, see bapco.com/products/sysmark-2014.

About Futuremark 3DMark (2013) v1.4.778

Futuremark 3DMark v1.4.778 is a collection of benchmarks designed to rate the graphics performance of smartphones, tablets, notebooks, laptops, desktops, or high-performance gaming PCs. 3DMark includes benchmarks designed for Windows, Apple®, and Android™ devices.

Cloud Gate is for Windows notebooks and home PCs. This new test includes two graphics tests and a physics test and uses a DirectX® 11 engine limited to Direct3D® feature level 10, which makes it suitable for testing DirectX 10 compatible hardware. Cloud Gate is only available in the Windows editions of 3DMark at this time.

For more information on 3DMark, see www.futuremark.com/benchmarks/3dmark.

About Futuremark PCMark 8 v2.2.282

According to Futuremark, “PCMark 8 is the latest version in our series of industry standard PC-benchmarking tools.” PCMark 8 evaluates the performance of PCs from tablets to desktops by using real-world tasks and applications. Applications are divided into scenarios that reflect common usage in different capacities. For our testing, we used the following four parts of the benchmark:

- **Home** – workloads reflecting common tasks for a typical home user and that have low computational requirements, including workloads for Web-browsing, writing, gaming, photo editing, and video chat
- **Creative** – workloads typical of enthusiasts and professionals who work with media and entertainment content and that have more demanding requirements than the Home benchmark, including workloads for Web-browsing, photo editing, video editing, group video chat, media transcoding, and gaming
- **Work** – workloads that test a system's ability to perform basic office work tasks, such as writing documents, browsing Web sites, creating spreadsheets, and using video chat
- **Storage** – workloads that test the performance of SSDs, HDDs, and hybrid drives with traces recorded from Adobe Creative Suite®, Microsoft Office, and a selection of popular games

For more information on this benchmark, see www.futuremark.com/benchmarks/pcmark8.

About WebXPRT 2013

WebXPRT 2013 uses scenarios created to mirror the tasks you do every day to compare the performance of almost any Web-enabled device. It contains four HTML5- and JavaScript-based workloads: Photo Effects, Face Detect, Stocks Dashboard, and Offline Notes. From these workloads, the benchmark calculates a composite Overall Score for easy comparison. For more information about WebXPRT, visit www.webxpert.com.

About BAPCo MobileMark 2012

MobileMark 2012 is an industry-standard benchmark that provides a battery life rating and a performance rating based on common office scenarios. These include office activities like file and document management, data processing, and rich content creation. This module provides a score for battery life of the tested applications. In our tests, we focus solely on the battery life rating provided by MobileMark 2012.

MobileMark 2012 includes the following applications with their corresponding tasks:

- ABBYY® FineReader™ Pro 11
- Adobe Acrobat® Pro X
- Adobe Flash® Player 11
- Adobe Photoshop CS5 Extended 12.04
- Adobe Photoshop Elements 10
- Adobe Premiere Pro CS 5.5
- CyberLink® PowerDVD® Ultra 11
- Microsoft Excel 2010 SP1
- Microsoft Internet Explorer® 9
- Microsoft Outlook® 2010 SP1
- Microsoft PowerPoint 2010 SP1
- Microsoft Windows Media® Player
- Microsoft Word 2010 SP1
- Mozilla® Firefox® 10.0.2
- WinZip® Pro 16

MobileMark 2012 measures system battery life in minutes. It records system battery life at the start of the benchmark and repeats the workload until the system battery life is depleted, or until the system powers down due to low battery life.

MobileMark 2012 records a timestamp once per minute. At the end of the benchmark, it compares the beginning timestamp to the final (last recorded) timestamp. MobileMark 2012 derives its system battery life rating as the number of minutes between the start and end timestamps.

For more information on this benchmark, see www.bapco.com/products/mobilemark2012/index.php.

APPENDIX B – SYSTEM CONFIGURATION INFORMATION

Figure 15 provides detailed configuration information for the two Intel processor-powered HP EliteBooks.

System	HP EliteBook 740 G1	HP EliteBook 840 G1
General		
Number of processor packages	1	1
Number of cores per processor	2	2
Number of hardware threads per core	2	2
Total number of processor threads in system	4	4
System power management policy	HP Optimized	HP Optimized
Processor power-saving option	Enhanced Intel SpeedStep® Technology	Enhanced Intel SpeedStep Technology
System dimensions (length × width × height)	13.34" × 9.33" × 0.83"	13.35" × 9.33" × 0.83"
System weight	4 lbs.	4 lbs.
CPU		
Vendor	Intel	Intel
Name	Core	Core
Model number	i5-4310U	i5-4300U
Stepping	C0	C0
Socket type and number of pins	Socket 1168 BGA	Socket 1168 BGA
Core frequency (GHz)	2.0 / 3.0 Turbo	1.9 / 2.9 Turbo
L1 cache	2 × 32 KB + 2 × 32 KB	2 × 32 KB + 2 × 32 KB
L2 cache	2 × 256 KB	2 × 256 KB
L3 cache	3 MB	3 MB
Platform		
Vendor	Hewlett-Packard	Hewlett-Packard
Motherboard model number	198F	198F
Motherboard chipset	Haswell-ULT	Haswell-ULT
BIOS name and version	Hewlett-Packard L71 Ver. 01.21 (09/03/2014)	Hewlett-Packard L71 Ver. 01.20 (07/28/2014)

System	HP EliteBook 740 G1	HP EliteBook 840 G1
Memory module(s)		
Vendor and model number	Ramaxel Technology RMT3170EF68F9W1600	Samsung M471B5173DB0-YK0
Type	PC3-12800	PC3-12800
Speed (MHz)	1600	1600
Speed running in the system (MHz)	1600	1600
Timing/Latency (tCL-tRCD-tRP-tRASmin)	11-11-11-28	11-11-11-28
Size (MB)	4,096	4,096
Number of memory module(s)	1	1
Total amount of system RAM (GB)	4	4
Channel (single/dual)	Single	Single
Hard disk		
Vendor and model number	Hitachi HTS725050A7E630	Seagate ST500LM0 SSHD
Number of disks in system	1	1
Size (GB)	500	500
Buffer size (MB)	32	64
RPM	7,200	7,200
Type	SATA 6.0 Gb/s	SATA 6.0 Gb/s
Controller	Intel 8 Series Chipset Family SATA AHCI Controller	Intel 8 Series Chipset Family SATA AHCI Controller
Driver	Intel 12.8.0.1016 (08/01/2013)	Intel 12.8.0.1016 (08/01/2013)
Operating system		
Name	Microsoft Windows 7 Professional x64	Microsoft Windows 7 Professional x64
Build number	7601	7601
Service Pack	1	1
File system	NTFS	NTFS
Kernel	ACPI x64-based PC	ACPI x64-based PC
Language	English	English
Microsoft DirectX version	DirectX 11	DirectX 11

System	HP EliteBook 740 G1	HP EliteBook 840 G1
Graphics		
Vendor and model number	Intel HD Graphics 4400	Intel HD Graphics 4400
Type	Integrated	Integrated
Chipset	Intel HD Graphics Family	Intel HD Graphics Family
BIOS version	2175.1	2175.1
Total available graphics memory (MB)	1,696	1,696
Dedicated video memory (MB)	64	64
System video memory (MB)	0	0
Shared system memory (MB)	1,632	1,632
Resolution	1366 × 768	1366 × 768
Driver	Intel 9.18.10.3272 (08/08/2013)	Intel 9.18.10.3272 (08/08/2013)
Sound card/subsystem		
Vendor and model number	IDT High Definition Audio	IDT High Definition Audio
Driver	IDT 6.10.6496.0 (11/07/2013)	IDT 6.10.6496.0 (11/07/2013)
Ethernet		
Vendor and model number	Intel Ethernet I218-LM	Intel Ethernet I218-LM
Driver	Intel 12.12.50.401 (06/17/2014)	Intel 12.12.50.401 (06/17/2014)
Wireless		
Vendor and model number	Intel Dual Band Wireless-AC 7260	Intel Dual Band Wireless-N 7260
Driver	Intel 16.1.5.2 (08/29/2013)	Intel 16.1.5.2 (08/29/2013)
Optical drive(s)		
Vendor and model number	NA	NA
Type	NA	NA
USB ports		
Number	4	4
Type	USB 3.0	USB 3.0
Other	Media card reader, Display port	Media card reader, Display port
Monitor		
LCD type	HD LED	HD LED
Screen size	14"	14"
Refresh rate	60 Hz	60 Hz
Battery		
Type	3-cell Li-Polymer	3-cell Li-Polymer
Size (length × width × height)	7.82" × 4.04" × 0.31"	7.82" × 4.04" × 0.31"
Rated capacity	50 Whr	50 Whr
Weight	0.58 lb.	0.58 lb.

Figure 15: Detailed information of the Intel processor-based systems.

Figure 16 provides detailed configuration information for the AMD processor-based HP EliteBook.

System	HP EliteBook 745 G2
General	
Number of processor packages	1
Number of cores per processor	4
Number of hardware threads per core	4
Total number of processor threads in system	4 CPU + 6 GPU
System power management policy	HP Optimized
Processor power-saving option	AMD PowerNow!™ AMD Enduro™
System dimensions (length × width × height)	13.34" × 9.33" × 0.83"
System weight	3.97 lbs.
CPU	
Vendor	AMD
Name	PRO
Model number	A10-7350B
Stepping	KV-A1
Socket type and number of pins	Socket FP3 (906)
Core frequency (GHz)	2.1 / 3.3 Turbo
L1 cache	4 × 16 KB + 2 × 96 KB
L2 cache	2 × 2,048 MB
L3 cache	NA
Platform	
Vendor	Hewlett-Packard
Motherboard model number	221C
Motherboard chipset	AMD K15 IMC
BIOS name and version	Hewlett-Packard M84 Ver. 01.03 (07/04/2014)
Memory module(s)	
Vendor and model number	Samsung M471B5173DB0-YK0
Type	PC3-12800
Speed (MHz)	1600
Speed running in the system (MHz)	1600
Timing/Latency (tCL-tRCD-tRP-tRASmin)	11-11-11-28
Size (MB)	4,096
Number of memory module(s)	1
Total amount of system RAM (GB)	4
Channel (single/dual)	Single

System	HP EliteBook 745 G2
Hard disk	
Vendor and model number	Toshiba MQ01ACF050
Number of disks in system	1
Size (GB)	500
Buffer size (MB)	16
RPM	7,200
Type	SATA 3.0 Gb/s
Controller	AMD SATA Controller
Driver	AMD 1.2.1.359 (11/06/2013)
Operating system	
Name	Microsoft Windows 7 Professional x64
Build number	7601
Service Pack	1
File system	NTFS
Kernel	ACPI x64-based PC
Language	English
Microsoft DirectX version	DirectX 11
Graphics	
Vendor and model number	AMD Radeon™ R6 Graphics
Type	Integrated
Chipset	AMD Radeon R6 Graphics
BIOS version	BR45464.001
Total available graphics memory (MB)	2,020
Dedicated video memory (MB)	512
System video memory (MB)	0
Shared system memory (MB)	1,508
Resolution	1366 × 768
Driver	AMD 13.352.1004.1001 (04/20/2014)
Sound card/subsystem	
Vendor and model number	Realtek® High Definition Audio
Driver	Realtek 6.0.1.7255 (05/27/2014)
Ethernet	
Vendor and model number	Realtek PCIe® GBE
Driver	Realtek 7.83.328.2014 (03/28/2014)
Wireless	
Vendor and model number	Broadcom® BCM943228HMB 802.11abgn 2×2 Wi-Fi®
Driver	Broadcom 6.30.223.228 (02/05/2014)

System	HP EliteBook 745 G2
Optical drive(s)	
Vendor and model number	NA
Type	NA
USB ports	
Number	4
Type	USB 3.0
Other	Media card reader, Display port
Monitor	
LCD type	HD LED
Screen size	14.0"
Refresh rate	60 Hz
Battery	
Type	3-cell Li-Polymer
Size (length × width × height)	7.82" × 4.04" × 0.31"
Rated capacity	50 Whr
Weight	0.58 lb.

Figure 16: Detailed information of the AMD processor-based system.

APPENDIX C – HOW WE TESTED

HDXPRT 2012

Setting up the test

1. Insert the HDXPRT v1.1 DVD-ROM into your DVD drive.
2. At the HDXPRT Install screen, click Install HDXPRT.
3. Accept the HDXPRT end user license agreement.
4. After the setup is complete, select Yes, I want to restart my computer now, and click Finish.

Running the test

1. Click the HDXPRT 2012 shortcut on the desktop.
2. Click Run HDXPRT.
3. Enter a test name, choose 3 iterations, and click Run.
4. The Results Screen automatically appears at the end of a successful run. The test results files are found in the C:\Program Files\HDXPRT\Reports\<TestName> directory.

BAPCo SYSmark 2014 v1.0.1.21

Antivirus software conflicts

SYSmark 2014 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

SYSmark 2014 installs the following applications, which its test scripts employ:

- Adobe Acrobat XI Pro
- Adobe Photoshop CS6 Extended
- Adobe Premiere Pro CS6
- Google Chrome™
- Microsoft Excel 2013
- Microsoft OneNote® 2013
- Microsoft Outlook 2013
- Microsoft PowerPoint 2013
- Microsoft Word 2013
- Trimble® SketchUp® Pro 2013
- WinZip Pro 17.5

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 SYSmark 2014 uses.

Setting up the test

1. Disable the User Account Control.
 - a. Click Start→Control Panel.
 - b. At the User Accounts and Family Safety settings screen, click Add or remove user account.
 - c. At the User Account Control screen, click Continue.

- d. Click Go to the main User Accounts page.
 - e. At the Make changes to your user account screen, click Turn User Account Control on or off.
 - f. At the User Account Control screen, click Continue.
 - g. Uncheck Use User Account Control to help protect your computer, and click OK.
 - h. At the You must restart your computer to apply these changes screen, click Restart Now.
2. Purchase and install SYSmark 2014 v1.0.1.21 with default settings from www.bapco.com/products/sysmark-2014.
 3. To launch SYSmark 2014, double-click the desktop icon, and select Configuration.
 4. Select All Options, and click Save.

Running the test

1. Double-click the SYSmark 2014 desktop icon.
2. Make sure Office Productivity, Media Creation, and Data/Financial Analysis are selected.
3. Enter a Project name.
4. Select 3 Iterations, check the box beside Conditioning Run and beside Process Idle Tasks, and click Run Benchmark.
5. When the benchmark completes and the main SYSmark 2014 menu appears, click Save FDR to create a report.

3DMark

Installing 3DMark v1.4.778

1. Download the 3DMark benchmark from www.futuremark.com/benchmarks/3dmark/all.
2. Install 3DMark with the default options by double-clicking the 3DMark installer.exe file.
 - a. At the Welcome screen, click Next.
 - b. At the License Agreement screen, click I accept the terms of the license agreement, and click Next.
 - c. At the Setup Type screen, click Express, and click Next.
 - d. At the Ready to Install the Program screen, click Install.
3. At the Setup Complete screen, click Finish.
4. Launch 3DMark by double-clicking on the 3DMark desktop icon. Enter the registration code, and click Register.
5. Exit 3DMark.

Running 3DMark v1.4.778

1. Boot the system and bring up a command prompt:
 - a. Type `CMD`
 - b. Right-click the Command Prompt app to open App options.
 - c. Click the Run as administrator button.
2. Type `Cmd.exe /c start /wait Rundll32.exe advapi32.dll,ProcessIdleTasks`
3. Do not interact with the system until the command completes.
4. After the command completes, wait 5 minutes before running the test.
5. Double-click the 3DMark desktop icon to launch the benchmark.
6. At the 3DMark Welcome screen, click the Run primary tests button.
7. When the benchmark run completes, record the results.
8. Perform steps 1 through 7 two more times, and report the median of the three runs.

Futuremark PCMark 8 v2.2.282

Setting up the test

1. Download the PCMark 8 installer exe Windows package from www.futuremark.com/benchmarks/pcmark8.
2. Install PCMark 8 with the default options by double-clicking the PCMark installer exe file.
3. Launch PCMark 8 by clicking on the PCMark 8 desktop icon. Enter the registration code, click Register, and click OK.
4. Exit PCMark 8.

Running the test

1. Boot the system and bring up a command prompt:
 - a. Type `CMD`
 - b. Right-click the Command Prompt app to open App options.
 - c. Click the Run as administrator button.
2. Type `Cmd.exe /c start /wait Rundll32.exe advapi32.dll,ProcessIdleTasks`
3. Do not interact with the system until the command completes.
4. After the command completes, wait 5 minutes before running the test.
5. Double-click the PCMark 8 desktop icon to launch the benchmark.
6. Select the Home test suite.
7. Click Run Conventional.
8. When the benchmark run completes, record the results.
9. Shut down the system.
10. Perform steps 1 through 9 two more times for the Home test suite, and report the median of the three runs.
11. After completing the three runs of the Home test suite, perform steps 1 through 9 three times each for the Creative, Work, Storage, and Application suites. Report the median results.

WebXPRT 2012

Running the test

1. Open the default Web browser, and go to www.principledtechnologies.com/benchmarkxpvt/webxpvt/.
2. Click Run WebXPRT 2013.
3. At the Ready to test your browser screen, click Continue.
4. Click Start.
5. When the test completes, record the results.
6. Perform steps 1 through 5 two more times, and report the median of the three runs.

Timing boot

1. Simultaneously start the timer and boot the system.
2. Stop the timer when the word Start appears.
3. Record the result as the Boot time.
4. Open the Charm bar, and click Settings→Power.
5. Click Shut down.
6. Perform steps 1 through 5 two more times, and report the median of the three runs.

Timing resume from sleep

1. Boot the system and bring up an administrative command prompt:
 - a. Type `CMD`
 - b. Right-click the Command Prompt app to open App options.
 - c. Click the Run as administrator button.
2. Type `Cmd.exe /c start /wait Rundll32.exe advapi32.dll,ProcessIdleTasks`
Do not interact with the system until the command completes.
3. After the command completes, wait 5 minutes before running the test.
4. Open the Charm bar, and click Settings→Power.
5. Click Sleep.
6. Simultaneously start the timer and press the power button to resume from sleep mode.
7. Stop the timer when the Windows taskbar appears.
8. Record the result as the Resume from sleep time.
9. Shut down the system.
10. Repeat steps 1 through 9 two more times, and report the median of the three runs.

Setting up the Microsoft Office tests

1. Install Microsoft Office 365™ with default options. Copy the test files to the desktop.
2. Place the Microsoft Excel Number Crunch spreadsheet in the documents folder of each system under test. This Excel spreadsheet executes approximately 28,000 sets of calculations such as addition, subtraction, division, rounding, and square root. It also includes common statistical analysis functions such as Max, Min, Median, and Average. It generates a timed score on how long the calculations took to complete.

Crunching numbers in Microsoft Excel

1. Boot the system and bring up an administrative command prompt:
 - a. Type `CMD`
 - b. Right-click the Command Prompt app to open App options.
 - c. Click the Run as administrator button.
2. Type `Cmd.exe /c start /wait Rundll32.exe advapi32.dll,ProcessIdleTasks`
Do not interact with the system until the command completes.
3. After the command completes, wait 5 minutes before running the test.
4. Open the Microsoft Excel Number Crunch spreadsheet.
5. Press CTRL + R to start the calculation.
6. Record the output.
7. Close the Excel spreadsheet.
8. Shut down the system.
9. Perform steps 1 through 8 two more times, and report the median of the three runs.

Launching Microsoft PowerPoint

1. Boot the system and bring up an administrative command prompt:
 - a. Type `CMD`

- b. Right-click the Command Prompt app to open App options.
 - c. Click the Run as administrator button.
2. Type `Cmd.exe /c start /wait Rundll32.exe advapi32.dll,ProcessIdleTasks`
Do not interact with the system until the command completes.
3. After the command completes, wait 5 minutes before running the test.
4. Press the Windows key.
5. Simultaneously start the timer and select Microsoft Word.
6. Stop the timer when all the Microsoft Word templates are fully displayed.
7. Close Microsoft Word.
8. Shut down the system.
9. Repeat steps 1 through 8 two more times, and report the median of the three runs.

Launching Adobe Photoshop Elements 13 and encoding a file to JPEG

Setting up the test

1. Download and install Photoshop Elements with default options from www.adobe.com/cfusion/tdrc/index.cfm?product=photoshop_elements&loc=en.
2. Copy the test Photoshop Elements test file to the desktop.

Running the test

1. Boot the system and bring up an administrative command prompt:
 - a. Type `CMD`
 - b. Right-click the Command Prompt app to open App options.
 - c. Click the Run as administrator button.
2. Type `Cmd.exe /c start /wait Rundll32.exe advapi32.dll,ProcessIdleTasks`
Do not interact with the system until the command completes.
3. After the command completes, wait 5 minutes before running the test.
4. Simultaneously double-click the Adobe Photoshop Elements test file, and start the stopwatch.
5. Stop the stopwatch when the file is loaded into Photoshop Elements.
6. Click File→Save As.
7. Select JPEG from the drop-down format menu and enter a file name.
8. Click Save.
9. In JPEG Options, slide the file size bar all the way to the right for the largest file (12).
10. Simultaneously click OK and start the stopwatch.
11. Stop the stopwatch when the progress bar disappears and the cursor stops spinning.
12. Shut down the system.
13. Perform steps 1 through 12 two more times, and report the median of three runs.

Launching Adobe Premiere Elements 13 and encoding a file to MPEG

Setting up the test

1. Download and install Premiere Elements with default options from www.adobe.com/cfusion/tdrc/index.cfm?product=premiere_elements&loc=us.
2. Copy the Adobe Premiere Elements test file to the desktop.

Running the test

1. Boot the system and bring up an administrative command prompt:
 - a. Type `CMD`
 - b. Right-click the Command Prompt app to open App options.
 - c. Click the Run as administrator button.
2. Type `Cmd.exe /c start /wait Rundll32.exe advapi32.dll,ProcessIdleTasks`
Do not interact with the system until the command completes.
3. After the command completes, wait 5 minutes before running the test.
4. Simultaneously double-click the Adobe Premiere Elements test file, and start the stopwatch.
5. Stop the stopwatch when the project is loaded into Adobe Premiere Elements.
6. Click the Publish + Share tab, and select Computer.
7. Select MPEG, enter a file name, and simultaneously click Save and start the stopwatch.
8. Stop the stopwatch when the progress bar disappears and the Done button appears.
9. Shut down the system.
10. Perform steps 1 through 9 two more times, and report the median of three runs.

Measuring battery life with MobileMark 2012

Avoiding antivirus software conflicts

MobileMark 2012 is not compatible with any virus-scanning software, so we uninstalled any such software present on the notebook PCs before we installed the benchmark.

Avoiding pre-installed software conflicts

MobileMark 2012 installs the following applications, which its test scripts employ:

- ABBYY FineReader Pro 11
- Adobe Acrobat Pro X
- Adobe Flash Player 11
- Adobe Photoshop CS5 Extended 12.04
- Adobe Photoshop Elements 10
- Adobe Premiere Pro CS 5.5
- CyberLink PowerDVD Ultra 11
- Microsoft Excel 2010 SP1
- Microsoft Internet Explorer
- Microsoft Outlook 2010 SP1
- Microsoft PowerPoint 2010 SP1
- Microsoft Windows Media Player
- Microsoft Word 2010 SP1
- Mozilla Firefox 10.0.2
- WinZip Pro 16

If any of these applications are already on the system under test, they could 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 2012 uses.

Adjusting display brightness and power settings

The brightness of a notebook's display affects its battery life. Therefore, BAPCo requires that, before you test with MobileMark 2012, you do the following step: make sure the brightness of the notebook's monitor is greater than or equal to 150 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).

We complied with this standard for all the tests we ran by setting the notebook PC's brightness as close to 150 nits as we could without going below that brightness level. We used the following procedure before we started each test. Note: This procedure assumes we began with the notebook plugged into the power supply.

1. To create a completely blank, white screen, open Microsoft Paint by clicking Start→All Programs→Accessories→Paint.
2. Press Ctrl+W to open the Resize and Skew dialog.
3. Under Horizontal and Vertical enter 200, and click OK.
4. Click the View tab.
5. Click Full screen to view a white screen.
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 used the Gossen® Mavolux5032C.)
8. If the reading is below or significantly greater than 150 nits, adjust the screen brightness to as close to 150 nits, without going under, as possible. Then retest:
 - a. Click the Windows start button, and type `power options` in the Windows Start Search box.
 - b. Click Change plan settings.
 - c. Click Change advanced power settings.
 - d. Expand the Display option, and change the Display brightness on battery and plugged in to the correct percentage that produces no less than 150 nits.
9. Allow the notebook to run on battery power 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.

Using the MobileMark built-in Configuration Tool

This tool supports three levels of configuration:

1. Only makes changes that are REQUIRED in order for the benchmark to run.
2. Additionally, makes changes that are RECOMMENDED for repeatable results.
3. Additionally, makes OPTIONAL changes that help ensure best results.

The Configuration tool makes the following configuration changes at each of the three levels:

Level 1 - Required

- Disables User Account Control (UAC)
- Disables Windows Update
- Disables System Sleep and Hibernate
- Sets Screen Dimming Timeout (2 minutes)
- Disables Low Battery Actions

- Disables Network Proxies
- Disables Autorun for Optical Drive

Level 2 - Recommended

- Create BAPCo power scheme
- Set Power Plan Type to balanced
- Disables Windows Firewall
- Disables Windows Sidebar/Gadgets
- Disables Windows Pop-ups
- Disables Incoming Remote Desktop Connections
- Disables Windows Error Reporting
- Disables Screen Saver and Monitor Timeout
- Sets CPU Adaptive Mode
- Disables Desktop Slideshow
- Disables Disk Defrag

Level 3 - Optional

- Sets Hard Disk Timeout
- Disables Windows Defender
- Disables System Restore
- Ignores Laptop Lid Close
- Sets Maximum Display Brightness
- Disables Adaptive Brightness

We chose all options listed - Level 3 - in the Configuration tool.

Installing MobileMark 2012 and configuring the system for testing

1. Verify that the wireless adapter is enabled and connected to a wireless router that is not connected to the Internet.
2. Insert the MobileMark 2012 Install DVD into the notebook PC's DVD drive.
3. When the Autoplay menu appears, click Run MobileMark2012_Setup.exe.
4. At the Welcome screen, click Next.
5. Enter the serial number, and click Next.
6. Accept the license agreement, and click Next.
7. At the Choose Components screen, select Full, and click Next.
8. At the Choose Install Location screen, accept the default location of C:\Program Files (x86)\BAPCo\MobileMark2012, and click Next.
9. At the Choose Start Menu Folder screen, click Install.
10. Insert Disc 2 when prompted.
11. At the InstallShield Wizard Complete screen, click Finish.
12. Launch MobileMark 2012.
13. Click Configuration and choose only the Required options.
14. Click Apply, and restart the computer when prompted.
15. Adjust the screen brightness to no less than 150 nits:

- a. Click the Windows start button, and type `power options` in the Windows Start Search box.
- b. Click Change plan settings.
- c. Click Change advanced power settings.
- d. Expand the Display option, and change the Display brightness on battery and plugged in to the correct percentage that produces no less than 150 nits.

Conditioning the battery

1. Plug the AC power adapter into the notebook PC, and completely charge the battery.
2. Install MobileMark 2012, following the steps we outlined in the Installing MobileMark 2012 section earlier in this section.
3. Double-click the MobileMark 2012 icon on the desktop.
4. Click the Office Productivity icon.
5. Type `System Conditioning` as the name for this test in the Project Name, check the box next to conditioning, and click Continue.
6. If MobileMark 2012 lists no problems or warnings, click Continue. If it does list any problems or warnings, close MobileMark 2012, and correct the problem(s) before proceeding.
7. When prompted, unplug the AC power adapter. The Office Productivity 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. Plug the AC power adapter into the notebook PC, and completely charge the battery.

Measuring battery life with MobileMark 2012

We performed the following steps to run the MobileMark 2012 Office Productivity benchmark:

1. Double-click the MobileMark 2012 icon on the desktop.
2. Select the Office Productivity test by clicking the Office Productivity icon.
3. Enter a name for this test in the Project Name field, and click Continue.
4. If MobileMark 2012 lists no problems or warnings, click Continue. If it does list any problems or warnings, close MobileMark 2012, and correct the problem(s) before proceeding.
5. When prompted, unplug the AC power adapter. The test begins immediately.
6. The Office Productivity 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 MobileMark 2012 Office Productivity test three times on the system and took the median battery life run as the representative score for that test.

Getting the MobileMark 2012 results

After each MobileMark Productivity 2012 test completed, we plugged the AC power adapter into the notebook PC and turned on the system. MobileMark 2012 started automatically after the system booted, then 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 by performing the following steps:

1. Click Save.
2. Enter a name, and select FDR to save the results as an FDR file.
3. Click Save again, and select PDF to save the results as a PDF file.
4. Browse to the Documents directory where the result FDR and PDF files were saved.

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