



## Start faster and stay unplugged longer

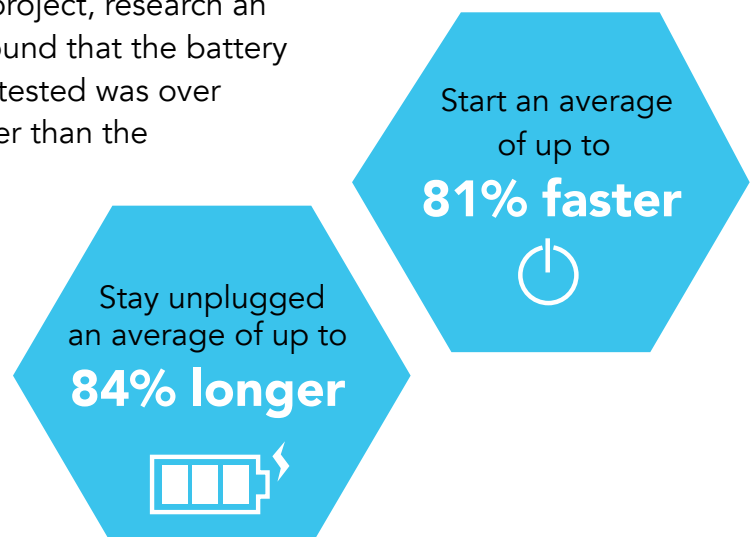
### Choose solid-state drives over hard disk drives when you move from a Windows 7 laptop to a new Windows 10 device

Change is hard. Especially when it comes to trading in your trusty old laptop for a new one. But there's good news for people considering the jump from their Microsoft® Windows® 7 laptop to a new Windows 10 device. And that good news is solid-state drive (SSD) storage. Most Windows 7 laptops came with hard disk drive (HDD) storage, which can't compete with the advantages SSD storage brings to the Windows 10 laptop.

To show you exactly how moving to a Microsoft Windows 10 laptop with SSD storage can improve your laptop experience, we compared start up times and battery life of two popular Windows 7 laptops with HDD storage and two Windows 10 laptops with SSD storage.<sup>†</sup>

We found that the Fast Startup feature available on Windows 10 laptops meant we didn't have to wait as long for the new laptops to start. In two of the scenarios on the following pages, that translates to over half a minute of "found time" every time you turn on your laptop to work on a project, research an assignment, or just surf the web. We also found that the battery life on both of the Windows 10 laptops we tested was over a full eight-hour workday. That's hours longer than the Windows 7 laptops we tested.

Read on to explore three scenarios where making the jump to a Windows 10 laptop with SSD storage can improve your experience.

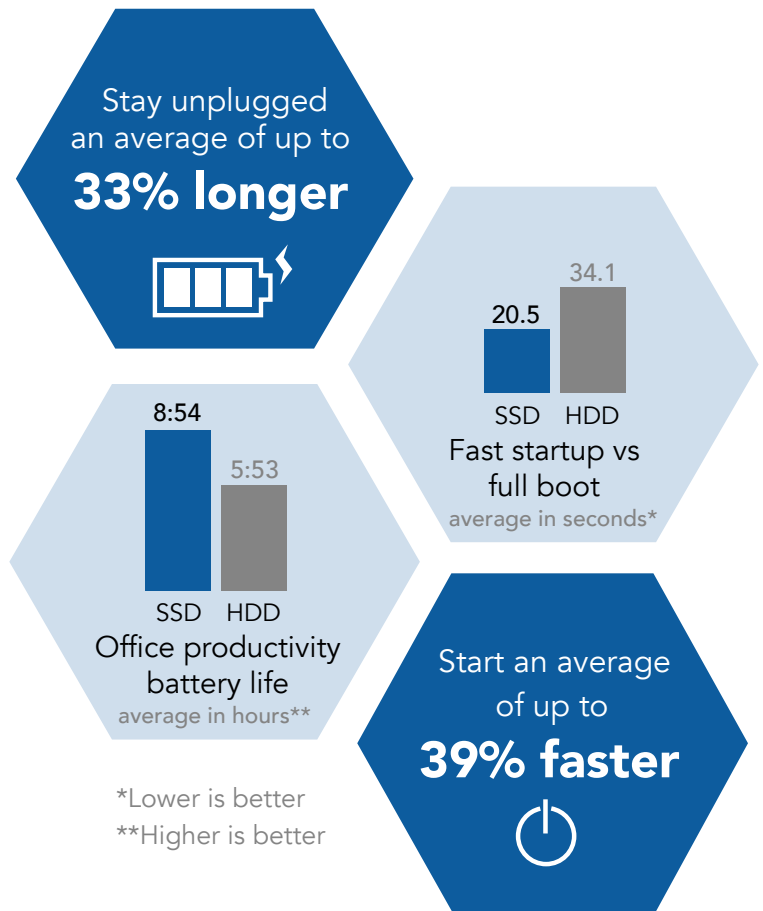
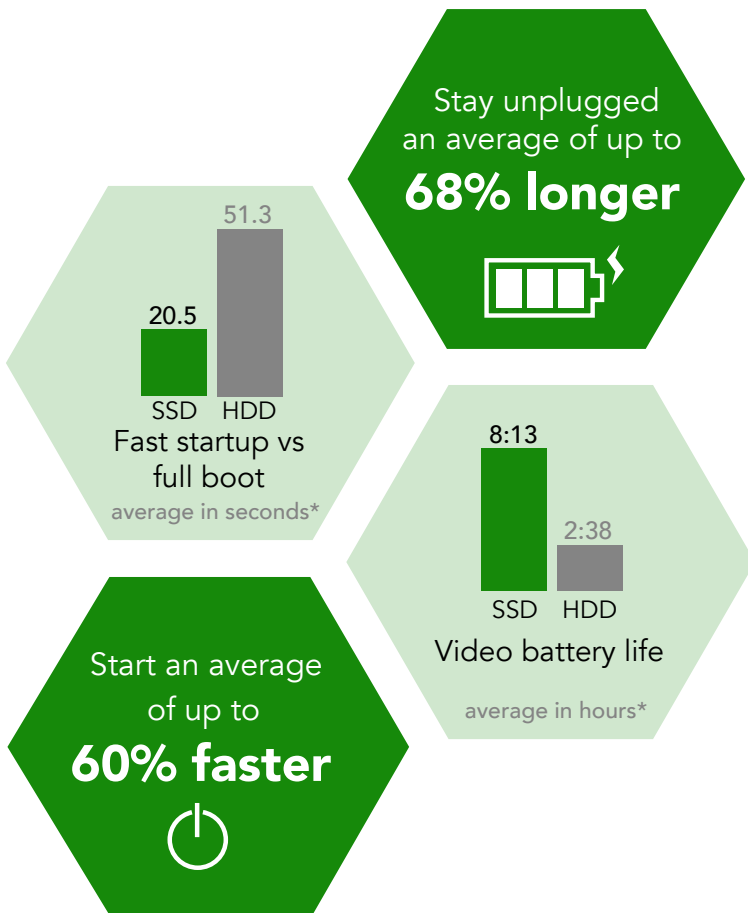


<sup>†</sup> See a list of laptops we tested on [page 4](#)

These scenarios are hypothetical, but the decisions the characters face are real. At Principled Technologies, we tested the performance of Microsoft Windows 7 and Windows 10 laptops. Read on to see how choosing Windows 10 laptops with SSDs can enhance your experience.

## Stick with what works—only better

Randi is an accountant, so she did her research when she bought her Windows 7 laptop six years ago. She chose a top-selling mainstream (MSRP between \$300 and \$800) laptop that she paid \$539 for. It's been a great computer over the years, but she's ready to get something new. Our test results show that if she chooses a mainstream Windows 10 laptop with the same processor and memory as before, with SSD storage instead of HDD storage, she can start her computer an average of almost 14 seconds faster and use her laptop unplugged for up to three hours longer when she's balancing the books for her clients.†



## Get more for less than before

Josh spent everything he had on his first computer. It was a top-selling premium (MSRP over \$800) Windows 7 laptop loaded with the most popular storage and processor options available at the time and cost him \$939. He's ready to upgrade to a Windows 10 laptop, but he's older and wiser now, so he wants something that does more and costs less. Our test results show that if Josh purchases a \$599.99 top-selling mainstream Windows 10 laptop with SSD storage, his new laptop will start up in half the time and he can watch videos for a full eight hours before he even thinks about plugging it in.‡ That's much longer than his Windows 7 laptop, which quit after a few 60-minute episodes of his favorite TV show. This gives him more time to do what he wants, where he wants, and stay unplugged for a full eight-hour workday. That's over five and a half hours longer than the battery life of his previous laptop, all with less of a hit to his wallet.

■ Mainstream laptops

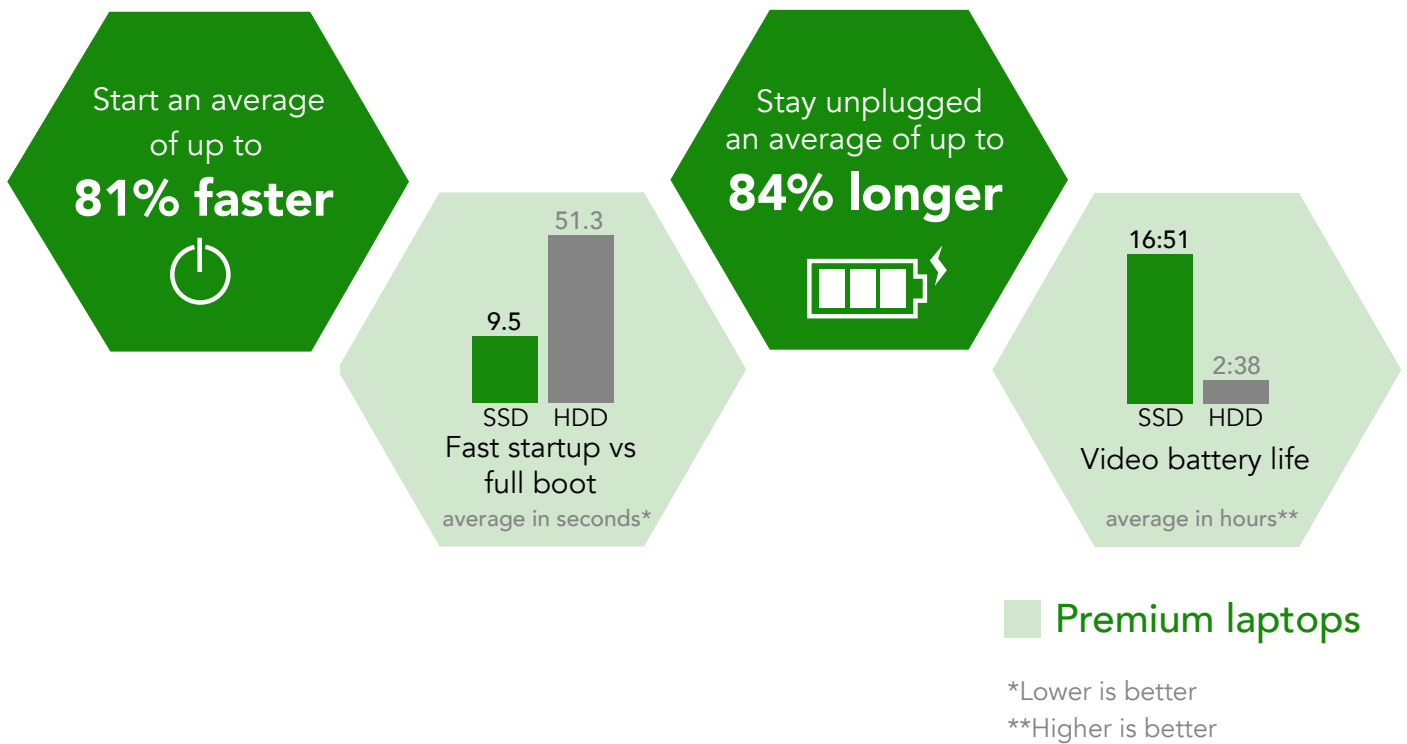
■ Premium laptops

† [Link to mainstream laptop results](#)

‡ [Link to premium laptop results](#)

## This cloud has a silver lining

Irving and Natasha are business consultants with clients around the world. Sadly, Irv accidentally destroyed their prized top-selling premium Windows 7 laptop when he left it on top of a cab in a mad dash to the airport. But, there's good news. Our test results show that if this dynamic duo springs for a new top-selling premium Windows 10 laptop with the same processor and similar memory as their Windows 7 machine and chooses SSD storage, instead of HDD storage, their new laptop would be up and running in under ten seconds. That's 40 seconds faster than their Windows 7 laptop. Another bonus is that they were constantly looking for an outlet with their Windows 7 laptop.<sup>†</sup> Switching to a Windows 10 laptop with SSD storage means they can watch movies longer together during an international flight without worrying about a dead battery.



## Conclusion

We understand it's hard to move from something that works for you to an unknown quantity. But our test results should help lay some of those concerns to rest. Moving from a Windows 7 laptop with HDD storage to a Windows 10 laptop with SSD storage can help you start faster and stay unplugged longer.

<sup>†</sup>[Link to premium laptop results](#)

On May 4, 2018, we finalized the hardware and software configurations we tested. Updates for current and recently released hardware and software appear often, so unavoidably these configurations may not represent the latest versions available when this report appears. We concluded hands-on testing on June 26, 2018.

## What we tested

Laptops with an MSRP between \$300 and \$800 are mainstream laptops and premium laptops start at an MSRP of \$800.

Mainstream laptop model	Operating system	MSRP	Processor	Memory	Drive
HP® Pavilion g6	Win 7	\$539.00	Intel® Core™ i3	4 GB	640GB HDD
Lenovo™ Yoga® 720	Win 10	\$629.99	Intel Core i3	4 GB	128GB SSD

Premium laptop model	Operating system	MSRP	Processor	Memory	Drive
Dell™ Inspiron™ 14R	Win 7	\$939.00	Intel Core i5	6 GB	640GB HDD
Lenovo Yoga 920	Win 10	\$1,329.99	Intel Core i5	8 GB	256GB SSD

## Results for “Stick with what works—only better” scenario

	Lenovo Yoga 720 Win 10 SSD	HP Pavilion g6 Win 7 HDD		
Windows ADK: Fast startup vs. full boot results			<b>Average time difference</b>	<b>Average percent difference</b>
Shutdown duration (seconds)	5.72	10.20	4.48	43.9%
BIOS initialization duration (seconds)	1.92	8.79	6.87	78.2%
Total boot (excluding BIOS) duration (seconds)	20.54	34.09	13.55	39.7%
Local full-screen video playback results				
Video battery life (minutes)	493	318	175	35.5%
MobileMark® 2014 v1.5 results				
Office productivity overall battery life (minutes)	534	353	181	33.9%

## Results for "Get more for less than before" scenario

	Lenovo Yoga 720 Win 10 SSD	Dell Inspiron 14R Win 7 HDD		
Windows ADK: Fast startup vs. full boot results			<b>Average time difference</b>	<b>Average percent difference</b>
Shutdown duration (seconds)	5.72	8.66	2.94	33.9%
BIOS initialization duration (seconds)	1.92	4.96	3.04	61.3%
Total boot (excluding BIOS) duration (seconds)	20.54	51.34	30.80	60.0%
Local full-screen video playback results				
Video battery life (minutes)	493	158	335	68.0%
MobileMark 2014 v1.5 results				
Office productivity overall battery life (minutes)	534	205	329	61.6%

## Results for "This cloud has a silver lining" scenario

	Lenovo Yoga 920 Win 10 SSD	Dell Inspiron 14R Win 7 HDD		
Windows ADK: Fast startup vs. full boot results			<b>Average time difference</b>	<b>Average percent difference</b>
Shutdown duration (seconds)	4.68	8.66	3.98	46.0%
BIOS initialization duration (seconds)	2.26	4.96	2.70	54.4%
Total boot (excluding BIOS) duration (seconds)	9.50	51.34	41.84	81.5%
Local full-screen video playback results				
Video battery life (minutes)	1,011	158	853	84.4%
MobileMark 2014 v1.5 results				
Office productivity overall battery life (minutes)	879	205	674	76.7%

## How we tested

This document details the methodologies we followed while testing the systems.

### Setting up the system

1. Complete the OOBE on each system.
2. Run Windows Updates.
3. Uninstall any vendor-provided applications. If anti-virus is on the system, leave it and update to latest version.
4. If no anti-virus is installed, install McAfee LiveSafe™.
5. Set the homepage to open to <https://www.amazon.com>, and install the following browsers:
  - a. Microsoft Edge®
  - b. Google Chrome™
  - c. Mozilla® FireFox®
  - d. Microsoft Internet Explorer®
6. Install and launch the following applications:
  - a. Adobe® Acrobat® Reader
  - b. RARLAB WinRAR x64
  - c. Microsoft Office 365® Word
  - d. Microsoft Office 365 Excel™
  - e. Microsoft Office 365 PowerPoint™
  - f. Microsoft Windows ADK Windows Assessment Toolkit
  - g. Microsoft Windows ADK Windows Performance Toolkit

### Running the tests

#### Windows ADK fast startup and full boot performance assessments

1. Launch the Windows Assessment Console.
2. Click Options→New Job.
3. Click Create Custom Job.
4. Click Add Assessments, and add the following assessments:
  - a. Boot performance (fast startup).
  - b. Full boot performance.
5. In the left-hand column, select each assessment, and uncheck the “Use recommended settings” box.
6. For each assessment, change the number of iterations to 10.
7. Click Run.
8. Click Start.
9. When the tests finish, record the results, and shutdown the system.

#### Local Full Screen Video Playback (FSVP) assessment

1. Copy the Microsoft-provided Performance Assessment Toolkit directory (Perf2.4) to the C drive.

#### Running the Local Full Screen Video Playback assessment

To play media clips locally, you will use the Movies & TV app, so verify that it is the default application to handle MP4 file extensions.

1. Press the Windows Key, and type Powershell.
2. To Run as Administrator, right-click the powershell.exe.
3. To access the Performance Assessment Toolkit directory, type `cd C:\Users\\Perf2.4`
4. To launch the script, type `.\performance_assessments.cmd`
5. To run the system preparation script, type P, and the system will reboot. (Note: Do this once per day or after making a configuration change.)
6. After the system reboots, repeat steps 1 through 4.
7. To execute the Battery Life assessment, type 5.
8. To analyze the performance result, after the Battery Life assessment is complete, type A, and record the result.
9. Repeat steps 1 through 8 two more times.

#### Measuring battery life with MobileMark 2014 v1.5

### Avoiding antivirus software conflicts

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

- Adobe Acrobat Pro XI
- Google Chrome 32.0
- Microsoft Excel 2013
- Microsoft Outlook 2013
- Microsoft PowerPoint 2013
- Microsoft Word 2013
- WinZip® Pro 17.5

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 2014 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 2014, you 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](http://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. Before we started each test, we used the following procedure (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. To open the Resize and Skew dialog, press Ctrl+W.
3. Under Horizontal and Vertical, enter 200, and click OK.
4. Click the View tab.
5. To view a white screen, click Full screen.
6. To allow the screen to warm, wait 45 minutes.
7. Unplug the notebook from the power supply, and using a luminance meter, measure the display's brightness 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 in the Windows Start Search box, type `power options`
  - 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 is using the correct 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. For the benchmark to run, only make required changes.
2. Additionally, make recommended changes 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
- Sets DPI Scaling to 100%

#### Level 2—recommended

- Creates BAPCo power scheme
- Sets 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

#### Setting up the test

1. Verify that the wireless adapter is enabled and connected to a wireless router that is not connected to the Internet.
2. Install MobileMark 2014 with the default options.

#### Measuring battery life with MobileMark 2014

To run the MobileMark 2014 Office Productivity benchmark, we performed the following steps:

1. Launch MobileMark 2014.
2. Click Configuration, and choose all the options except for the optional “Set Maximum Display Brightness.”
3. Click Save.
4. Select the Office Productivity test by clicking the Office Productivity icon.
5. Enter a name for this test in the Project Name field, and click Continue.
6. If MobileMark 2014 lists no problems or warnings, click Continue. If it does list any problems or warnings, close MobileMark 2014, and correct the problem(s) before proceeding.
7. When prompted, unplug the AC power adapter. The test begins immediately.
8. 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 2014 Office Productivity test three times on the system and took the average battery life run as the representative score for that test.

#### Getting the MobileMark 2014 results



After the completion of each MobileMark Productivity 2014 test, we plugged the AC power adapter into the notebook PC and turned on the system. After the system booted, MobileMark 2014 started automatically, analyzed the test scores, and displayed the results from the last test in the Test Results Viewer.

To submit these results to BAPCo, we saved the test results by performing the following steps:

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

This project was commissioned by Microsoft.



Facts matter.®

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.