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## PUBLICATION INFORMATION

You might know **Joshua**. He loves video games, and he owns enough to know they're not all meant for kids. That's why he reminds his friends (at least the ones that have kids) that they all have **big black letters on the box** to help parents find the ones that are best for their families.

You can learn about those ratings at **ESRB.org**

Los Angeles, CA

ESRB
**ENTERTAINMENT SOFTWARE RATING BOARD**

EARLY CHILDHOOD — CONTENT RATED BY ESRB

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EVERYONE 10+ — CONTENT RATED BY ESRB

TEEN — CONTENT RATED BY ESRB

MATURE 17+ — CONTENT RATED BY ESRB

ADULTS ONLY 18+ — CONTENT RATED BY ESRB

# NEWS

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# Shots fired as Blue Screen of Death pushes man over edge

Executing the troubled desktop was 'glorious,' but most definitely illegal.

**BY JARED NEWMAN**

**A** Colorado man says he has no regrets after unloading eight rounds into his dysfunctional Dell desktop, though he faces a fine for doing so. "I just had it," Lucas Hinch, 38, told *The Smoking Gun* (go.pcworld.com/gun) (via *Ars Technica*, go.pcworld.com/technica). Apparently the PC had thrown up one too many blue screens of death in recent months, so Hinch took it

```
A problem has been detected and Windows has been shut down to prevent damage to your computer.

The problem was caused by the following file: nope.avi

If this is the first time you've seen this Stop error screen, restart your computer. If this screen
appears again, follow these steps:

The device driver got stuck in an infinite loop. This usually indicates a problem with the device
itself or with the device driver programming the hardware incorrectly. Please check with your
hardware device vendor for any driver updates.

Technical information:

*** STOP: 0x000000EA (0x85178020, 0x859AB0D8, 0xF7C5acb4, 0x0000001)

nope.avi
Beginning dump of physical memory.
Physical memory dump.
Please contact your administrator for help.
```

into an alley, loaded up a 9mm Hi-Point pistol that he'd purchased on Craiglist, and let the bullets fly. "It was glorious," Hinch told the *Los Angeles Times* (go.pcworld.com/times). "Angels sung on high."

Hinch admitted that the murder was "premeditated, oh, definitely," and that he'd made sure there was nothing behind the desktop, and nothing from which the rounds could ricochet. The deed went down behind Hinch's home, where he and his girlfriend also run a homeopathic herb store.

Despite his precautions, Colorado Springs police issued Hinch a citation for discharging a firearm within city limits. (The local police blotter summarizes the incident as "Man Kills His Computer.") Hinch faces a possible fine, but jail time is highly unlikely according to the *Times*. While the cops confiscated the gun, they left the computer behind, letting it remain a tribute to frustrated PC users everywhere.

**The impact on you:** Hey, we've all felt the pain of dealing with an overly cranky desktop before. Kudos to this guy for letting us live vicariously through his act of retaliation—and absorbing the legal ramifications so we don't have to. ⏻

**Tragic last** words before an untimely demise.

# Skype's real-time Translator Preview now available to all

BY IAN PAUL

**YOUR STAR TREK-STYLE** universal communicator is ready for download.

Well, it's not exactly universal, but Microsoft's Skype Translator Preview (go.pcworld.com/skypetranslator-pre) is a step into the future. The company announced that the beta app is now available to all Windows 8.1 and Windows 10 Technical Preview users, no sign-up or wait list needed.

If you want to have a translated, spoken conversation with someone who speaks Italian, Mandarin, or Spanish, just download the free app from the Windows Store. Microsoft says Skype Translator works with almost any Skype client, meaning only you need to be the one with the Translator app enabled.

## Where no one has gone before

The app can also translate instant message conversations (go.pcworld.com/skypetranslator-faq) in more than 50 languages, including the oh-so-geeky favorite: Klingon.

bortaS bIr jablu'DI' reH QaQqu' nay' - Revenge is a dish best served cold. (old Klingon proverb)

Translator looks almost exactly the same as the standard metro UI Skype app. The most important difference is the Translation slider button that appears under the name of each contact when you are in conversation view.

Skype Translator does not distinguish between spoken languages on the fly. Instead, you have to pre-set the languages each person is speaking or writing in. Translator will prompt you to do this when you flip the Translation feature on, or you can click the language options underneath the slider.

During a Translator call, Microsoft advises you to use a headset with a microphone instead of a standalone mic. You should also use a wired connection rather than Wi-Fi. Translated calls also take longer to connect than a typical Skype call. You can find a complete list of Translator tips on Skype's site (go.pcworld.com/translator-support).

**Why this matters:** Translator is only in the preview stage, and it's limited in the number of spoken languages it can translate. Nevertheless, the fact that Skype Translator exists and is now available to the public is a huge advance for online communication. Live translation of spoken languages has long been a dream of technologists, futurists, and sci-fi writers. Now, it's becoming a reality. Perhaps even more surprising, it came from Microsoft first and not Google. ⏻

# Microsoft announces Windows 10 versions for consumer and business

BY MARK HACHMAN

**ON MAY 12,** Microsoft outlined the Windows 10 versions you'll know, love, and buy when the new operating system launches this summer. But the company withheld key details, such as how it will eventually make money on it.

As with Windows 7, 8, and now 10, Windows 10 will be sold in two versions for consumers: Windows 10 Pro, and Windows 10 Home. The Windows Phone brand, as Microsoft has indicated previously, is going away: It will be renamed Windows 10 Mobile, and will ship on phones

and small tablets. Businesses and enterprises will also receive their own versions: Windows 10 Enterprise, Windows 10 Mobile Enterprise and Windows 10 Education.

And yes, Windows 10 will be a free upgrade—at least for consumers: "As we announced earlier this year, for the first time ever, we are offering the full versions of Windows 10 Home, Windows 10 Mobile, and Windows 10 Pro as a free and easy upgrade for qualifying Windows 7, Windows 8.1, and Windows Phone 8.1 devices that upgrade in the first year after launch," Microsoft's Tony Prophet, the company's corporate vice president of Windows and search, wrote in a blog post (go.pcworld.com/tonyprophet-blog). "Once you upgrade, you have Windows 10 for free on that device."

Microsoft has said previously that Windows 10 beta testers, known as Insiders, will receive a free upgrade to the so-called "RTM" version of the software, the same version that will be shipped to stores and to hardware makers. Windows 7, Windows 8.1 and Windows Phone 8.1 users will be able to upgrade for free, as long as they do it within the first year that the OS ships.

**Windows 10's** lock screen will nudge people to install new apps.
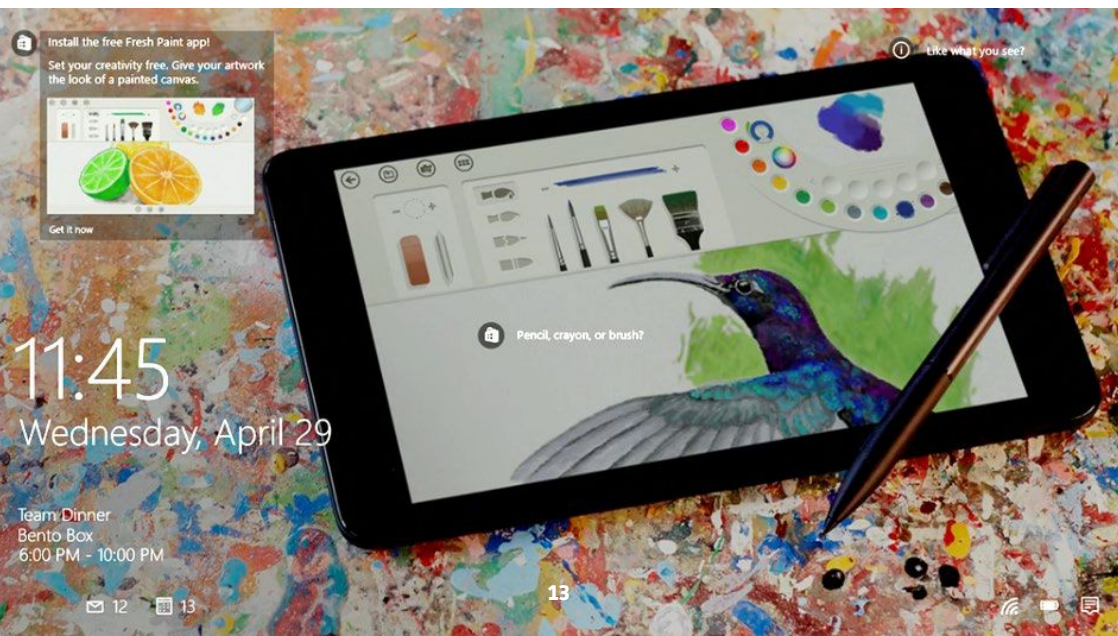
Microsoft did not say, however, what Windows 10's eventual price would be, nor did the company say whether it would be offered on a subscription model (or what that subscription cost would be).
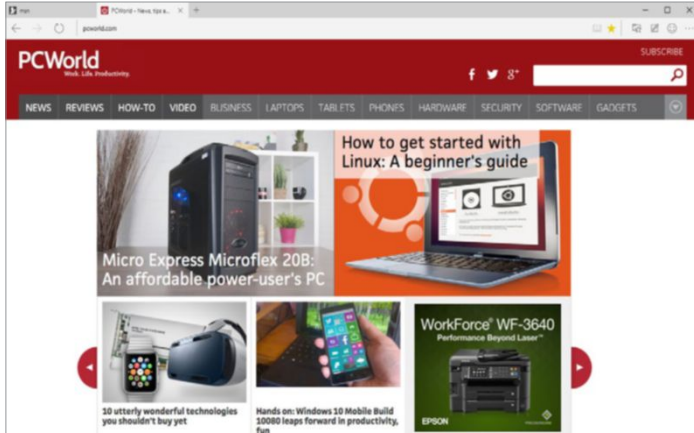
**Why this matters:** Because many consumers will receive a free upgrade to Windows 10 as part of their existing Windows 7 or Windows 8 license, the details of the different Windows 10 versions don't mean an awful lot—most people will likely end up on Windows 10 Home. What will be interesting to see, going forward, is whether the various versions of Windows will diverge, with Microsoft adding business-specific features to Windows 10 Pro, for example, and reserving consumer apps for Windows 10 Home.



**The Microsoft** Edge web browser will be one of the selling points of Windows 10.

## What's in each version

The differences among the versions of Windows 10 are easy to guess. In Windows 10 Home, Microsoft calls out Cortana, the new Microsoft Edge ("Project Spartan") Web browser, the Continuum tablet mode for touch devices like the Surface, Windows Hello face recognition, and universal apps like Maps and Calendar as its selling points. (Windows Hello will also require a specialized depth camera, possibly built into new PCs.)

It's not clear, however, why a consumer would want to upgrade to Windows 10 Pro, described as the OS for businesses allowing workers to bring their own devices, as well as "prosumer" customers.

"Windows 10 Pro helps to effectively and efficiently manage their devices and apps, protect their sensitive business data, support remote and mobile productivity scenarios, and take advantage of

cloud technologies," Prophet writes, without specifying which features they'll take advantage of. Windows 10 Pro will include Windows Update for Business, however, allowing business customers to "go slow" with new updates.

With Windows 10 Mobile, however, Microsoft confirmed that its once phone-centric operating system will now expand into "small tablets." They'll probably be smaller than 8 inches, although that detail wasn't specified.

> Windows 10 Enterprise will provide advanced capabilities to help protect against ever growing security threats.
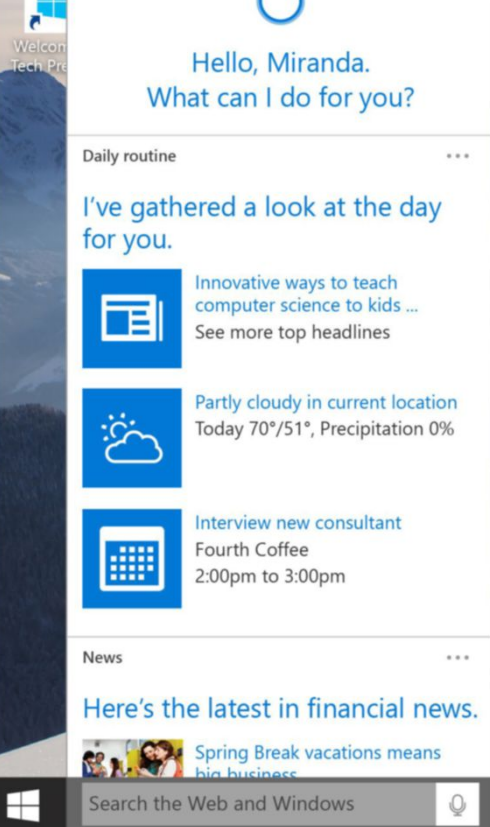
Finally, there will be the enterprise versions, designed for larger businesses. Windows 10 Enterprise "provides advanced capabilities to help protect against the ever-growing range of modern security threats targeted at devices, identities, applications, and sensitive company information," Microsoft says.

There's one hoop to jump through on the path to Windows 10: According to Prophet's blog post, Windows 8 users will need to upgrade to Windows 8.1 before upgrading to Windows 10. That's a small hitch for consumers, although businesses who carefully upgrade software for fear of breaking their proprietary applications may need to take care.

Microsoft also hasn't said which versions of Windows 7 will upgrade to Windows 10. A Microsoft spokeswoman said in an email that she couldn't comment beyond Prophet's blog post.

Still, Microsoft has been far more transparent than ever before about what to expect as consumers and businesses upgrade to Windows 10. Because the upgrade will be a free one, pricing issues aren't critical—yet. Eventually, however, Microsoft's going to have to answer the one question on everyone's mind: how exactly it plans to make money off Windows 10. ⏻

## Hello, Miranda.
## What can I do for you?

**Daily routine**  •••

## I've gathered a look at the day for you.

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Partly cloudy in current location
Today 70°/51°, Precipitation 0%

Interview new consultant
Fourth Coffee
2:00pm to 3:00pm

**News**  •••

## Here's the latest in financial news.

Spring Break vacations means
big business

Search the Web and Windows

# Cortana will only appear in select markets at Windows 10 launch

**BY MARK HACHMAN**

**MICROSOFT MAY HAVE** formally announced the various versions of
Windows 10, tailored for consumers, business, and mobile. But buried in
the fine print is an important detail: One of the key features, Cortana,
won't be immediately available everywhere Windows 10 is sold.

Microsoft outlined the six major versions of Windows 10 in a blog
post (go.pcworld.com/win10intro). They'll include Windows 10 Pro,
Windows 10 Home, and Windows 10 Mobile, plus the enterprise
versions: Windows 10 Enterprise, Windows 10 Mobile Enterprise, and
Windows 10 Education.

Under Windows 10 Home, the very first "new innovation" that
Microsoft corporate vice president Tony Prophet listed was the Cortana
digital assistant, along with the Edge browser and universal apps.
Windows 10 Pro will also incorporate Cortana, as will Windows 10 Mobile,
where the digital assistant first launched as a feature of Windows Phone.

But buried at the bottom of the blog post is a major caveat: "Cortana

will be available on Windows 10 at launch in select markets."

**What this means:** Windows 10 will launch in 190 countries and 111 languages, but it's one thing to translate dialog boxes and another thing to understand spoken language on the fly, as Cortana must. When the Windows Phone 8.1 Update launched last year, Cortana worked in Australia, Canada (English), France, Germany, India (English), Italy, and Spain, as well as the United States. Microsoft said that it was bringing the technology to China and the U.K. as well. But that list still excludes a number of major markets—Brazil, Russia, and Japan, to name just a few. Cortana's apparently going to need some time to catch up.

## Many questions for overseas users

Microsoft's Cortana rollout within the United States began with Windows Phone, then moved to Windows 10 phones and PCs. Over time, those platforms have begun to talk to one another. It's not clear whether those emerging regions will endure the same staggered rollout, or receive a holistic experience tying together Windows 10 Home, Business, and Mobile from day one. The odds seem to lean toward a staggered rollout, though.

Furthermore, while Cortana works well on Windows Phone, it's still not the quick, efficient digital assistant I expect in the desktop version of Windows 10. To be fair, Microsoft isn't alone in delaying spoken language support for specific regions. Wes Miller, an analyst with Directions on Microsoft, noted that Apple's Siri supported English in iOS 5.0, in 2011, while support for Brazil, Russia, and Sweden, among others arrived just this year in iOS 8.3.

"Teaching a digital system a new language is incredibly complicated," Miller said. For overseas users where Cortana isn't supported, Microsoft will simply sell Windows 10 on its other features, such as the Edge browser, he said.

For now, Microsoft's left customers with a number of questions. A Microsoft spokeswoman declined to comment further, noting that Microsoft would soon provide more details around Cortana and the features of each version of Windows 10.

# Latest Windows 10 phone build adds a variety of new features

**BY MARK HACHMAN**



**FOR WINDOWS PHONE** users, Microsoft's release of Build 10080 for Windows 10 phones is the big one, adding the Office apps, the Xbox app, the new Windows Store, and more.

As expected, Microsoft said the current build is being pushed to those users who have subscribed to the Fast ring of Windows 10 updates, including those who own a Lumia Icon and even the HTC One M8—the first time a Windows 10 preview has been made available to those who owned phones not sold by Microsoft.

In short, there's a boatload of new additions since Microsoft last released Build 10051 in April: the new Office apps, the new Store app, along with the Xbox app now appearing on Windows Phones. As in Windows 10 Build 10074 for PCs, there are also Music Preview and Video Preview apps, now for Windows phones. And there's even a new Camera app too.

**Why this matters:** As with all prior builds of Windows 10 for phones, Microsoft (and PCWorld) recommends that you either use a spare phone or one you've bought specifically for testing. As with all test builds, all of these new features come with a corresponding boatload of bugs. But the new features are still exciting, and definitely point the way toward a revamped Windows 10 experience for phones.

## The flagship apps: Office

Clearly, the most important element of the new build are the universal Office preview apps, now available for download through the new Windows Store app. Microsoft originally promised the new Office apps would be available at the end of April, but they slipped a bit. We're downloading the update now, so we'll have a chance to play with the Office Preview apps—Word, PowerPoint, Excel, and OneNote—a bit later. But while we had some concerns with Microsoft's overall Office experience, we're fairly confident in saying that you'll really like the look and feel of the new universal apps for Windows phones.

The Windows store app, now called Store (Beta), is also a universal app, meaning it should look more like the beta app available for
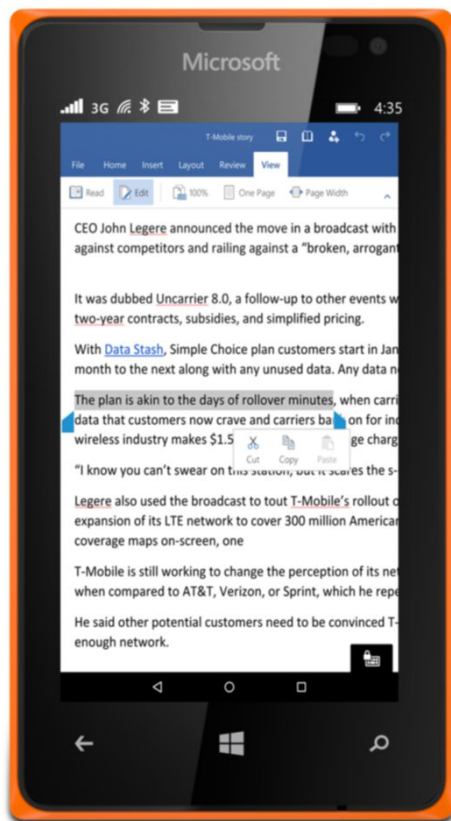
**Office preview** apps are now available for download through the new Windows Store app.

Windows 10 PCs. Users can browse and download apps, even pay for them, but not use carrier billing to do so, Microsoft said.

## Music and entertainment

Gamers will also appreciate the new Xbox app. Right now, the Xbox app is merely a portal into Microsoft's Xbox-specific social network for Xbox owners, allowing you to review your achievements, check in your friends, and more. But there's more to come: "Over the coming weeks, we'll update and add more Xbox features to the preview including OneGuide integration, Live TV Streaming, Game Hubs, and more," Microsoft said.

Microsoft's recent release of Build 10061 for Windows 10 desktops added Music Preview and Video Preview apps, and it looks like the universal versions of those have now arrived on Windows Phone, to boot. Music Preview allows you to download and play music stored to your Xbox subscription—including music you yourself have uploaded to the Music folder in OneDrive. And more features are on their way.

"We've got more improvements coming in future app updates that

"We've got more improvements coming in future app updates that will be delivered through the Store Beta..."



**Microsoft plans** to update the Xbox app to include Live TV Streaming.

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will be delivered through the Store Beta including a Live Tile showing what's currently playing, pinning favorites to your Start screen, exploring the full catalog and listening to Radio with an Xbox Music Pass, support for Kids Corner, the ability to shop for music in the Store Beta, and more," Microsoft promised.

Likewise, the Video Preview app allows you to play back videos from your phone, both your own—including MKV files—as well as those you've purchased. There's even syncing from the PC to the phone, so you can pick up from where you've left off, like you can with Netflix or other services.

In the future, Microsoft plans to add more manageability options. "In a future app update, we'll be adding the ability to download movies and TV shows for offline playback, new device management so you can manage your offline downloads on the devices you care about, improved search results, movie reviews and cast info, and more," Microsoft added.

Finally, there's a new Camera app—but Microsoft hasn't said too much about it yet. The company did say that high-end camera phones—the 1520, 1020, 930, and others—will have features that aren't totally supported by the app as yet.

You'll need to have your cellular data connection turned on at all times, or you may risk losing MMS messages sent with the connection turned off.

## Bugs, bugs, bugs

As usual, the new build brings with it some issues. Only one is really significant: You'll need to have your cellular data connection turned on at all times, or you may risk losing MMS messages that are sent to you with the data connection turned off.

Otherwise, you may need to reinstall apps that are saved to the SD card. There may be a duplicate tile or two, and Twitter may not work. Also, Microsoft recommends that you make sure your Cortana settings are correct, or the app may repeatedly crash. In many cases, reinstalling the affected apps should solve the problem. ⏻

# RAM for the rich and nerdy: 128GB DDR4 memory kits

BY GORDON MAH UNG

**SURE, YOU'LL HAVE** to sell both your kidneys to buy it, but at least now you can finally have 128GB of cutting-edge RAM in your PC.

Corsair is now selling two 128GB DDR4 RAM kits while Kingston touted that its upcoming big-ass set will hit speeds of 3000MHz.

**Why this matters:** The move from DDR3 to DDR4 last year (in high-end machines) promised lower voltage, higher-frequencies, and higher capacities—eventually. While the average consumer certainly doesn't need 128GB of RAM to run Microsoft Word or play a video game, some power users do indeed need seemingly crazy amounts of RAM. Also, can you say 100GB DDR4 RAM drive with 28GB left for system RAM?

Corsair's two kits fall into its premiere Dominator lineup. The "cheaper" of the two uses eight 16GB DIMMs running at DDR4/2400

speeds for just $1,980. Corsair also offers a kit running at DDR4/2400 speeds for $2,120. Sign me up for two!

Not to be outdone, Kingston announced its own 128GB DDR4 kit, coming at even higher speeds. The company said its eight 16GB DIMMs are rated to hit DDR4/3000 speeds. Kingston did the deed not with the pricey Core i7-5960X Haswell-E processor, but with the cheapie Core i7-5820K CPU.

If you're wondering what the fuss is about because you've seen 16GB DDR4 modules floating around for months, the Corsair and Kingston kits are unregistered RAM, which means there's no error correction support in the modules.

Most of the 16GB DDR4 modules available—such as this Crucial module (go.pcworld.com/crucialmodule)—have error-correcting code (ECC) support. ECC RAM can correct single-bit errors and detect multibit errors. It also generally runs at lower speeds. The Crucial RAM, for example, is a DDR4/2133 module. More importantly, ECC must be supported in the CPU.

For Intel, that means ECC DDR4 RAM can only be used with Xeon processors. Intel's enthusiast- and prosumer-focused Core i7 Haswell-E processors simply won't work with ECC RAM, so the Corsair and Kingston modules will be the first opportunity for those who don't want to pony up for a pricey Xeon to reach 128GB.



**Corsair is** now selling two 128GB kits of DDR4 RAM.

# Oculus Rift's recommended PC specs are surprisingly reasonable

BY HAYDEN DINGMAN

**VIRTUAL REALITY IS** starting to feel really real, for real. Sure, we're still months out from the proposed HTC Vive launch and even further out from Oculus's early 2016 consumer-ready Rift. But now we have recommended PC specs!

Oculus announced recommended specs for attaining "the full Rift experience," and they're surprisingly reasonable considering the horsepower VR requires—much more reasonable than the dual-GTX 980 rigs some

people have been building in anticipation.

According to Oculus, "The goal is for all Rift games and applications to deliver a great experience on this configuration. Ultimately, we believe this will be fundamental to VR's success, as developers can optimize and tune their game for a known specification, consistently achieving presence and simplifying development."

## VR eats graphics cards

The recommended specs seem about in line with the current Rift's specs. A GeForce GTX 970 or equivalent will easily run most demos currently on Oculus Share, as long as the demo is well-optimized. And while the GTX 970/R9 290 are definitely not bottom-of-the-barrel cards, it's definitely a lower barrier to entry for VR than a lot of people anticipated.

Why? Because VR is a graphics beast. Most normal (read: non-VR) games typically run (even in 2015) at 1080p, 60 frames per second. That's basically the standard most PC developers shoot for. And if a game drops to 30 frames per second intermittently, it's not a huge problem.

The Rift is, according to a supplemental spec post by Oculus Chief Architect Atman Binstock, running dual 2160×1200 displays at 90 frames per second in order to attain an optimal experience. In other words, it's doing far more than double the processing you'd need to run a game on a single monitor. That's a huge graphics sink. It also needs to stay at 90 frames per second, because intermittent lag is what causes many users to get sick when using VR headsets.

So with that in mind, a 970 or an R9 290 starts to look pretty damn reasonable. Surprisingly so, actually. Sure, you might not be able to run it on your laptop (yet) but the barrier to entry is definitely lower than I anticipated. Not that you won't see performance and graphics improvements with your fancy, schmancy dual-980 system. ⏻

**OCULUS RIFT RECOMMENDED PC SPECS**

- **Nvidia GTX 970 / AMD 290 equivalent or greater**
- **Intel i5-4590 equivalent or greater**
- **8GB+ RAM**
- **Compatible HDMI 1.3 video output**
- **2x USB 3.0 ports**
- **Windows 7 SP1 or newer**

# It's official: Windows 10 will not be free for pirates

Sorry, if you want to upgrade to Windows 10, you'll need an authentic, genuine version of either Windows 8.1 or Windows 7

**BY MARK HACHMAN**

**M**ICROSOFT EXECUTIVES said recently that the company will not offer Windows 10 for free to those without legitimate licenses to Microsoft's software, as the company had previously seemed to say.

## Attractive offers

Terry Myerson, executive vice president of operating systems for Microsoft, wrote recently that the company will provide "very attractive" offers to those who wish to upgrade from what he called a Windows operating system in a "non-genuine state" to Windows 10. But, he said, it will not be free.

"While our free offer to upgrade to Windows 10 will not apply to non-genuine Windows devices, and as we've always done, we will continue to offer Windows 10 to customers running devices in a non-genuine state," Myerson wrote (go.pcworld.com/myerson). "In addition, in partnership with some of our valued OEM partners, we are planning very attractive Windows 10 upgrade offers for their customers running one of their older devices in a non-genuine state."

If Windows thinks that the software isn't genuine, it will create a "watermark" on the machine, notifying customers that they're running an illegitimate copy of the software. If that happens, a customer will either need to upgrade or return the machine—assuming they just bought it—to the manufacturer itself.

"Non-genuine Windows has a high risk of malware, fraud, public exposure of your personal information, and a higher risk for poor performance or feature malfunctions," Myerson added. "Non-genuine Windows is not supported by Microsoft or a trusted partner."

**WHAT THIS MEANS:** This seemingly is the final act on a small drama that began in March, when Microsoft appeared to tell Reuters that it would offer free Windows 10 upgrades even to those who had pirated the software. Two days later, however, it began walking back on that statement, claiming that pirated copies would be "still illegitimate." Now we seem to have the final answer: If you pirate Windows, you'll have to pay—eventually. ⏻

# SSD: How much you really need to worry about data retention

**BY JON L. JACOBI**

**THE WORD IS OUT:** Your SSD won't retain your data forever (go. pcworld.com/unplugged) when you unplug it. Yup, you'll never be able to go on vacation again without toting your SSD along. It's incapable of surviving for two weeks without you, poor thing.

I kid, of course.

## Not archival, but not pathetic

The truth is, yes, under disastrously unfortunate environmental

conditions (we're talking biblical), your SSD could lose data retention just a few days after it's pulled from your PC. It could also lose it immediately if you pulverized it with a sledgehammer or threw it in a vat of sulfuric acid—almost-as-likely scenarios. To the point: I've re-tasked SSDs after a couple of years of sitting on the shelf, and annoyingly—I still had to secure-erase them to get rid of the old data.

This is not to belittle the underlying message that non-volatile memory media isn't forever, and in no way suitable for archiving. But panicking when you unplug the thing is unwarranted. SSDs are designed for speed and day-to-day use, but the amount of time they retain data when put on the shelf is measured in years, not days.

The current wave of concern is based on a table in a JEDEC presentation about general SSD specifications by Seagate's Alvin Cox (go. pcworld.com/cox). The table shows the expected data-retention characteristics of SSDs at both operational and non-operational temperatures, using data culled from Intel research. It highlights a non-operational, ambient temperature of 87 degrees Fahrenheit as the cause of failure in data retention in client-side (consumer) SSDs after only a year. Notice that's not a few days. If you store your SSD someplace that averages 72 degrees Fahrenheit, a far more likely scenario, you're talking two-years-plus according to this table. Notice again, that's not a few days.

What the table warns is that data retention drops precipitously as

**SSDs are built** for speed, not archiving, but the risk of data loss is low if the drive is stored at room temperature.

ambient and/or operational temperatures rise above the norm. For instance, you could lose data after only a few weeks if your SSD is stored in Death Valley, during the summer, with no AC. The table ends at one week's retention at 131 degrees. Put your SSD in an oven at 450, and you're on your own.

Several of the SSD vendors I talked to said they'd expect their consumer products to do better, as in several multiples better, than this chart would indicate. But even 10 years is hardly an archival time span, and SSDs simply shouldn't be relied upon for long-term storage.

## Digital doesn't mean forever

NAND can't retain data forever, or even as long as other types of media (hard drives, optical) because it stores data as tiny, trapped electrical charges. The cages that contain these charges aren't perfect—they leak, or de-trap in industry lingo. True, they leak extremely slowly, but they leak nonetheless.

Also, as shown in the JEDEC specifications, the warmer they get, the faster they leak, and the faster operations wear them out. Cell degradation occurs whether an SSD is in use (powered/operational) or stored (unpowered/non-operational). That's a simplified explanation. If you really want to dig into it, there's plenty of info online.

NAND and SSDs have never been touted as archival storage, but those degradation facts are rarely highlighted. That's why we have this discussion every couple of years. That and the persistent



**NAND storage** on SSDs retains data as tiny electrical charges, which can leak slowly—faster, if exposed to extreme conditions.

consumer misconception, aided by misleading advertising and the lack of visible deterioration, that digital somehow means forever.

In fact, no storage media has a warranty against data loss, only replacement. Seagate's hard drive warranty warns "This limited warranty does not cover data loss—back up the contents of your drive to a separate storage medium on a regular basis. Also, consequential damages; incidental damages; and costs related to data recovery, removal, and installation are not recoverable under this warranty."

Kingston's SSD warranty reads "Kingston is not liable for, and does not cover under warranty, any damages or losses of any kind what-soever resulting from loss of, damage to, or corruption of, content or data or any costs associated with determining the source of system problems or removing, servicing or installing Kingston products."

You can go down the list of vendors. Get the picture?

## Don't worry—after you back up

It's a good thing this story reopened the discussion that SSDs, and NAND in general, are not suitable for archiving data. But you absolutely do not have to rush back from vacation or hire someone to turn on your PC every few days to avoid losing the data on your SSD.

To archive data, store it online, store it to hard drives (write the data, unplug them, and store them in a safe place), or even use M-DISC write-once archival optical media. Yeah, and you thought optical was dead. Also, always follow the rule of three and keep a working copy of your data, a backup copy, and a copy of the backup.

Then, for goodness' sake, relax and enjoy the amazing speed of your SSD!

# Walmart's testing a $50 Amazon Prime competitor

BY IAN PAUL

**WALMART IS A DOMINANT** force among big box stores, but online the company is still playing catch-up with Amazon. Hoping to improve its position, Walmart will test an Amazon Prime-like service this summer, according to *Reuters* (go.pcworld.com/wmreuters).

Under the invite-only pilot program, customers pay $50 per year for the right to receive unlimited "free" delivery on select items in three days or less. Walmart's program is far cheaper than the $99 per year that Amazon Prime members pay, but you also get a slower delivery speed—Amazon offers two-day shipping.

Walmart was originally slated to offer the new delivery program, code-named 'Tahoe,' before the holidays, *The Information* (go.pcworld.com/info) reports. Technical issues apparently held the company back.

The impact on you at home: It's not clear when Walmart might lift the invite requirement and take Tahoe mainstream. However, a summer trial is most likely a warm-up for the holiday shopping season. Retailers depend on big sales both online and off during the end of the year gift-giving dash. Unlimited free delivery is a great way to keep customers coming back for more during that critical time.

## Not just delivery

The key thing about programs like Tahoe and Prime is to encourage customers to buy from you. If delivery is free anyway why not wait a few days to get your item in exchange for a cheaper price on USB sticks, DVDs, and laptops?

But Walmart would need to grow the program beyond delivery to truly compete with Amazon. Prime has become a big part of Amazon's retail business, growing by 50 percent in the United States in 2014.

Beyond unlimited delivery, Prime has all kinds of perks, including free movie and music streaming, unlimited photo storage, an ebook-lending library, and early access to online sale items.

Walmart could build up its digital offerings to offer at least some perks such as complimentary access to Vudu streaming on select titles. But Walmart isn't known for its digital chops. What it is known for is cheap prices and that may be its goal with Tahoe: to offer the bargain-basement version of Amazon's luxury membership. ⏻

# Amazon Echo update lets you shop without raising a finger

BY JARED NEWMAN

**AMAZON'S ECHO** connected speaker (go.pcworld.com/azecho) is an unusual product for the online retail giant, if only because it hasn't included a way to buy stuff.

That's changing with the latest update for Echo, which lets users bark out orders to restock anything they've previously bought through Amazon Prime. All that's required is the device's wake-up word ("Alexa" by default) followed by "re-order [item name]." Echo then finds the item and asks for confirmation to buy it, either with a "yes" or a voice code.

Shopping isn't restricted to past purchases. If Echo doesn't find the item in the user's order history, but can recommend something similar, it'll tell users the name and price before giving them the option to buy it. If it doesn't find anything, it'll add the item name to the user's shopping list. (You can also say "Alexa, cancel order" if you've bought

something by accident.)

When Echo arrived as an invite-only product in November 2014, it couldn't do much more than play streaming music, set reminders, and answer some Internet queries. But Amazon has been steadily expanding Echo's capabilities. The speaker has gained more music playback controls, smart home controls for Philips Hue light bulbs and Belkin switches, and IFTTT compatibility. And a software development kit is in the works for even more product tie-ins.

Echo is still only available by invitation only (pcworld.com/azinvite), at $149 for Prime members and $199 for non-Prime members.

Why this matters: Amazon hasn't said when it will make Echo widely available, but we've got to be getting close now that you can buy products directly through it. Even if Echo was useful before, the shopping tie-in brings it much more in line with Amazon's business of breezy online shopping. ⏻

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# REVIEWS & RATINGS

**TESTED IN PCWORLD LABS**
In this section, hardware & software
go through rigorous testing.

# REVIEWS
# & RATINGS

# Intel 750 series SSD: The future of storage is here

Featuring NVME and over-the-top performance, Intel's 750 series
SSD provides storage so fast, only the highest-end PCs can keep up.

**JON L. JACOBI**

**T**HEY'RE HERE: Intel's 750 series SSDs (go.pcworld.com/intel750SSD)—scintillatingly fast NVMe (Non-Volatile Memory express) storage for the masses. At least, the enthusiast subset of the masses—the infrastructure to support this advanced storage technology is found only in high-end PCs. But the 750's are fast, and that's with a capital *F* in certain benchmarks.

## Welcome to the cutting edge of storage

The 750 series SSDs are so cutting edge, the first people to enjoy this speed will have very special PCs, indeed. Do you have some paper and a pencil? Are you sitting down? Here's what it's gonna take.

The 750 series ships in two form factors: a half-height, half-length PCIe expansion card that uses a x4 PCIe slot, and a standard 2.5-inch model. While the latter may look like your typical 2.5-inch SSD, it actually uses the new SFF (Small Form Factor) 8639 connector designed especially for that technology, as well as SATA Express.

We expected the 750 to be fast, but we didn't expect it to be affordable.

Your PC undoubtedly lacks a SFF-8639 connector, but you can still use the 2.5-inch drive if you have a somewhat more common M.2 slot, albeit with a slight performance penalty. You'll need the SFF-8639–to–SFF-8643 (mini SAS) cable Intel provides, plus a SFF-8643 to M.2/SATA power connector adapter provided by your motherboard manufacturer. The SATA power connector must be used, because M.2 doesn't provide the 12-volt rail required by the 750 series. NVMe SSDs operating at higher frequencies require a lot more juice than 600MBps SATA SSDs.

You'll also need an M.2 connection with x4 PCIe 3.0 connections from the CPU to exploit the full potential of the Intel 750 series, or any NVMe drive. Most M.2 connections are Gen 2 PCIe from the chipset, including those wired to Intel's latest X99. Even if they were Gen 3, the DMI bus feeding the chipset is limited to 2GBps. That's a significant bottleneck, given that we saw 2.5GBps in certain benchmarks with the

expansion card model and have seen reports of 3.5GBps.

## To boot or not to boot

There's more: Though anyone with the proper connector can use the 750 series as secondary storage, in order to boot from it, you'll need a BIOS that supports NVMe. Motherboard vendors could add NVMe capability to an older BIOS, but it might be a financially unsound choice for their mainstream boards, whose users will probably never pine for NVMe. I'm not expecting it to happen with any but the most recent enthusiast systems. Also, while there's no technical barrier to running NVMe drives in RAID, Intel's Rapid Storage Technology, which is the RAID on most Intel motherboards, doesn't support it yet. You could use Windows RAID, but then you couldn't boot from your setup. And trust us, shorter boot times and Windows performance are a large part of the reason you'd want a 750 series SSD.

## Performance

Because of all the cabling kerfuffle involved with the 2.5-inch drive and the limits of many M.2 implementations, we figure most users will stick with the expansion card drive. Intel might have had the same thought when the company sent us that model to test.

Even before we installed the Intel NVMe drivers (Windows 8.1 has its own), we saw 1.3GBps reading and 900MBps sequential writing (4MB) scores in CrystalDiskMark 3. With the Intel drivers, that jumped to 1.6GBps reading and 1.4GBps writing. Small 4KB writes were rated at 229MBps for individual writes and significantly, 832MBps with the queue depth set at 32. Part of NVMe's magic is its multiple queues.
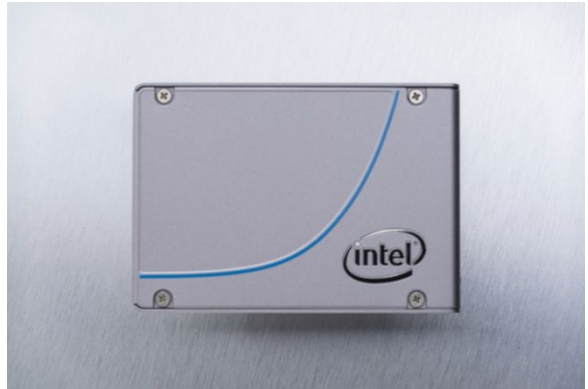
**The 2.5-inch** version of the 750 uses the new small form factor SFF-8639 connector, but may be attached to an M.2 slot using a SFF-8369–to–SFF-8643 (mini SAS) cable and an M.2 adapter.

Because Intel was throwing around numbers like 2.5GBps, however, we switched to Iometer. Using Intel's recommended 128KB file size, we saw just about that. Cool beans. Using a beta version of CrystalDiskMark, it displayed around 2.7GBps.

Things were looking 2.5GBps' worth of fantastic. Then we ditched the server scenarios and headed back down the client-desktop road, where things slowed down again.

Most users only pay attention to disk performance when they copy a large amount of data from one place to another. So to back up the artificial benchmarks we copy a large 20GB file, and a 20GB file and folder mix, back and forth. Because NVMe and SSDs are so fast, we generally do this with a RAM disk to eliminate the secondary drive as a bottleneck.

The best we saw in this ad-hoc testing when reading from the 750 series was 1.5GBps with the large 20GB archive and 1.2GBps with the files and folders. We copied manually, using XCOPY from the command line, and called the Windows file and folder copying routines from a Visual Basic script. Same basic results. Not bad, but not quite as fast as we were expecting.

We moved on to PC Mark to see how adding a 750 series would impact overall

## Intel 750 series SSD

**PROS:**
· Fast PCIe performance
· Affordable for its class

**CONS:**
· Requires NVMe-aware BIOS for use as a boot disk
· Minimally faster on client PCs than cheaper SATA RAID 0

**BOTTOM LINE:**
The industry's first consumer NVMe SSD shows what can happen when you leave the SATA and SAS busses behind. You can use it in any PC, but to boot from it requires an NVMe-aware BIOS which is currently a very rare thing outside of the enthusiast space.

$1,029

★★★★★
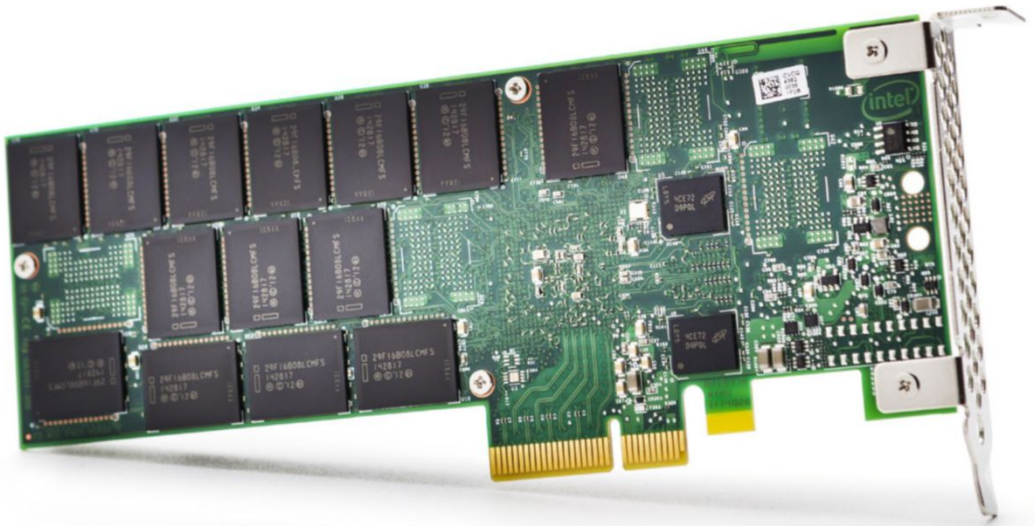
system performance. Here the 750 series scored quite a bit better than the system running on a single SATA SSD, but it actually lost to the RAID 0 SATA SSD array (two Samsung 840 Pros) that shipped with our Core i7-5960X/X99, 32GB Polywell X9900E4. The score difference of 3,493 to 3,503 is statistically meaningless, but it does show that you can get a lot of bang for your buck from SATA RAID.

What exactly was throttling the raw sequential throughput—Windows, the RAM disk, the NVMe drivers, or simply the drive itself—we were unable to ascertain in time for this review. We suspect that part of the story is that, while you'll see large gains over SATA simply because NVMe is using PCIe, most client usage is relatively straight-line and won't take advantage of everything NVMe has to offer. Multi-track audio and video editing, transcoding, and the like may see greater boosts than simply copying a single file.

On the other hand, while this next comment is subjective as subjective can be, it did seem that Windows operated more smoothly with the 750 series in place. Perhaps it was imagination. Perhaps it was the multiple queues that NVMe provides that make it more efficient when handling multiple I/O requests.

**Intel's new 750** series SSD is an enthusiast part and most will want the add-in board rather than the 2.5-inch version that uses a SFF-8639 connector few will have.

## Relatively low cost

We were expecting the 750 to be fast, but we were not expecting it to be affordable. It is, relatively speaking. The 400GB flavor (either type) is $389, and the 1.2TB version is $1,029. That's expensive by SATA SSD standards, but cheap when you compare it to the nearly $1,000, 480GB OCZ Revo Drive 350, the $500/256GB Plextor M6e, and the $750 MSRP of Kingston's 480GB Hyperx Predator PCIe SSD. The latter is actually available at a heavy discount, but expect the price of all the Intel 750 series competition to drop real soon.

Intel's warranty covers the 750 series drives for five years and for 0.3 drive writes a day. The latter is a new concept from Intel: It means the warranty allows you to write up to 30% of the drive's total capacity per day without voiding the whichever-comes-first warranty. That's 133GB per day on the 400GB model, and a whopping 400GB per day with the 1.2GB model—an extremely large amount of data for a non-enterprise drive.

## Conclusion

Because of the relatively tame performance in some tests and the lack of NVMe support in legacy PCs, we can recommend the 750 series only for the high-end crowd, and then with the caveat that you might get as much dash for less cash with a RAID 0 setup. But the 750 aces server-load scenarios, it's a single-drive solution, and it has a fantastic warranty. Plus, if you have an NVMe-aware BIOS you're golden.

For the average user with an average desktop, SATA RAID or a PCIe/M.2 solution, such as Kingston's HyperX Predator PCIe SSD, are the preferred, and generally the only practical, solutions for increasing storage performance. Not for long, though: Expect big inroads from NVMe in the very near future.

A final note: Not all SSDs handle RAID well. Intel's 735s and Samsung's 840s do, but it can be hit-and-miss with other drives. ⏻

*Because of the lack of NVMe support in legacy PCs, we can recommend the 750 series only for the high-end crowd.*

# Surface 3: This is the one worth recommending, though it's no bargain

BY MARK HACHMAN

**THE SURFACE 3'S** (go.pcworld.com/surface3) selling points can be summed up neatly: This is Microsoft's basic Office machine, a cheaper alternative to the Surface Pro 3. Thanks to the new Surface's Intel Atom chip and real Windows 8.1 (with an upgrade path to Windows 10), it offers decent battery life, with a processor sufficient to handle 1080p YouTube videos, Netflix streams, or basic games without batting an eye.

As with any junior member of a product line, there are compromises. The biggest are its price (it's not quite as inexpensive as it should be, for what you get) and the ergonomics, which make it less of a laptop replacement than the Surface Pro 3 clearly can be.

The Surface 3 is available in two different models: a $499 model with 64GB of storage and 2GB of RAM; and the upgraded version that we tested, a $599 version with 128GB of storage and 4GB of memory. Variants of both models with integrated LTE will also be available, although Microsoft hasn't said how much those will cost.

**The Surface 3** uses a charger with a micro-USB connector, the same connector found in your cell phone.

All of these prices, however, exclude the $130 Type Cover, a necessity that turns the advertised price into a bit of bait-and-switch. Microsoft will also sell a dedicated Surface 3 docking station for $200. Finally there's the Surface Pen, a $50 stylus that ships with the Surface Pro 3, but not the Surface 3. It works essentially the same on both machines.
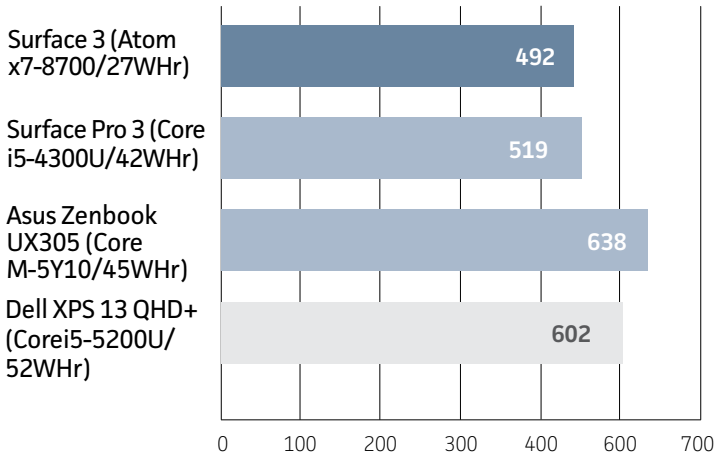
## A tablet upgraded with phone technology

Unbox the Surface 3, and one new feature stands out: the new 13-watt micro-USB charger, the same kind of connector used by your cell phone. In part, that's because the 1.6GHz Intel Atom x7-Z8700 used within the Surface 3 sips power, so it doesn't need a hulking wall wart. The extra-efficient chip also means the Surface 3 can have rather small 27Wh battery and yet still last 8.2 hours in our MobileMark 2014 battery rundown test—shorter than the Surface Pro 3's time, but still enough to get through a fair amount of the day. Your mileage may vary, of course.

Because the processor consumes so little power, Microsoft eliminated fans entirely, passively dissipating heat through the tablet chassis. The absence of fan noise is nice, although the Surface Pro 3's fans are so well designed that the tablet fan noise never climbs louder

## MobileMark 2014 Battery Life
### Office Productivity

| | |
|---|---|
| Surface 3 (Atom x7-8700/27WHr) | 492 |
| Surface Pro 3 (Core i5-4300U/42WHr) | 519 |
| Asus Zenbook UX305 (Core M-5Y10/45WHr) | 638 |
| Dell XPS 13 QHD+ (Corei5-5200U/52WHr) | 602 |

0    100    200    300    400    500    600    700

(LONGER BARS INDICATE HIGHER PERFORMANCE)

**The Surface 3's** battery life is about what you'd expect from its somewhat small battery.

than a hiss.

The new charger design also means your phone's charger could substitute in a pinch, or if you wanted to cut down on the number of cords you carry. You can even use an external battery charger. Unfortunately, like some modern phones, if you drain your Surface 3 completely you'll be forced to charge it for a minute or two before it boots—an annoyance when you need to use the tablet right away.

## Junior member of the Surface clan

Once on your desk, the new Surface 3 hardware looks nearly identical to the Surface Pro 3's. The Surface 3's superb, 1920x1280-pixel, 10.8-inch screen is slightly smaller than the 12-inch display on the Surface Pro 3, but it has the same 3:2 ratio. The space savings may translate into a bit more comfort on planes.

## Desktop use: smaller is only sometimes better

Physically, the new Surface 3 measures 10.52x7.36x0.34 inches and weighs 1.37 pounds, plus another 0.57 pounds for the Type Cover. That's virtually indistinguishable from the Surface Pro 3 in a satchel or backpack, but marginally heavier than a comparable Android tablet when you factor in the keyboard.

The Surface 3 offers three fixed positions for the kickstand. After living with the Surface Pro 3 and its variable-pitch kickstand, that's disappointing. I understand Microsoft made the choice for cost reasons, but I can't help but want more.

Like virtually every generation of Surface machines, the Surface 3 ships with its own backlit Type Pad keyboard. (No word from Microsoft on whether a Touch Pad keyboard is en route.) Like the Surface 3 itself, the associated keyboard is smaller, although Microsoft makes up for it by organizing the keys far closer to the side edges than on the SP3's keyboard. It also has a nicely redesigned top row of keys that includes frequently used functions.

The Surface 3's keyboard is sufficient, yet a little small for my tastes. Over time, my Surface Pro 3 Type Covers has become a bit mushy, so you may eventually need to invest in a replacement. And while you can use a Surface Pro 3 Type Cover with the Surface 3, you won't be able to fold back the edge of it, creating the slightly elevated angle that both keyboards otherwise allow—the magnet in the Surface Pro 3 keyboard

**Microsoft's
Surface Pro 3**
(left) and the
Surface 3 (right)

doesn't "grab" the Surface 3 correctly to do so.

The Surface 3's proprietary docking station provides ethernet, two USB 2.0 and two USB 3.0 ports, a miniDisplayPort, and a headphone jack. The dock doesn't recline, but it's a well-made piece of hardware that grasps the Surface 3 securely from both sides.

Unlike with the Surface Pro 3's dock, the Surface 3's dock completely encloses the tablet's own USB port, but it also eliminates the power brick that most other docks include. There's a slot hidden behind the kickstand that accepts up to 128GB SD cards, plus 802.11 a/b/g/n/ac and Bluetooth 4.0 tucked inside. While there's additional storage on the dock, you do get 1TB of OneDrive storage with your Office subscription.

**A Surface Pro 3** keyboard connected to a Surface 3 works, but the two won't create the secondary magnetic connection to tilt the keyboard.

The Surface 3's two cameras are designed to be used with its Office applications. The front-facing, 3.5MP camera is designed for Skype, while the rear-facing, 8MP camera is more designed for taking video of a lecture recorded as part of OneNote than anything else. The Surface 3 (like the SP3) lacks a flash, but you can now tap to focus and autoexpose a particular element of the scene, which you can't do on the SP3.

## Performance: basic, but that's the whole point

Think of the Surface 3 as a machine designed to run Office and other general day-to-day productivity and entertainment apps, and you'll be satisfied. Content creation in Word, OneNote, and other Office apps is

## PCMark 8
## Work Conventional

| | |
|---|---|
| Surface 3 (Atom x7-8700) | 1,717 |
| Lenovo Yoga 10 (Atom Z3745) | 1,371 |
| Surface Pro 3 (Core i5-4300U) | 2,810 |
| Asus Zenbook UX305 (Core M-5Y10) | 2,393 |
| Dell XPS 13 QHD+ (Corei5-5200U) | 2,824 |

0    500   1,000   1,500   2,000   2,500   3,000

(LONGER BARS INDICATE HIGHER PERFORMANCE)

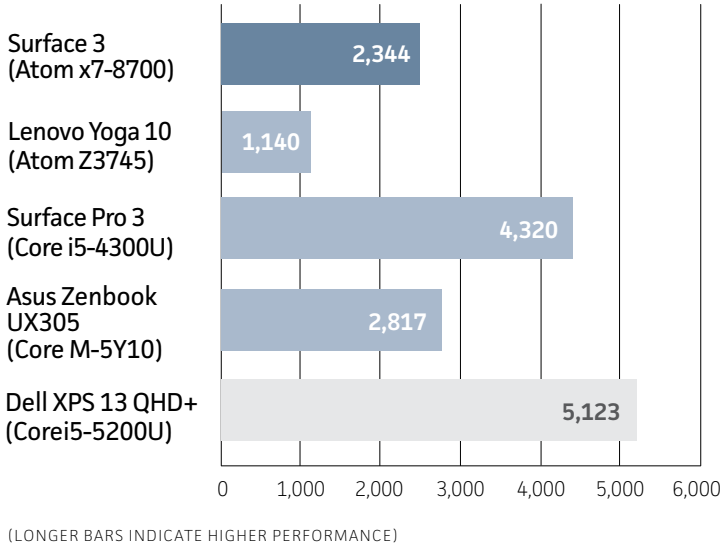**Here, the Surface 3** clearly fits within the Atom category. But how intensive is an Office workload, typically?
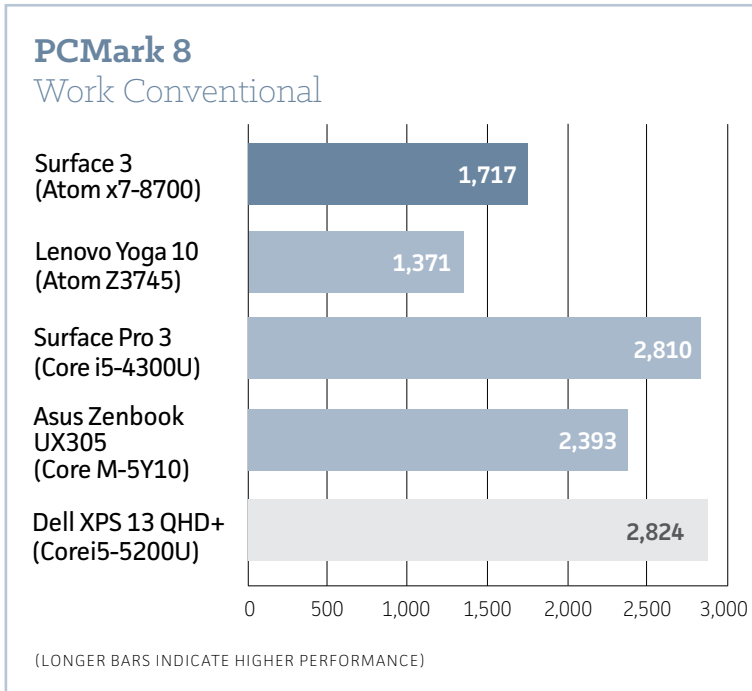
perfectly acceptable, although I did find myself squinting a bit at the small, high-resolution screen. I couldn't see any slowdown while running 1080p YouTube content or Netflix videos.

In our initial hands-on of the Surface 3, we compared it to older Atom-powered tablets. In this new group of benchmarks, we added the Surface Pro 3 and a few full-fledged laptops.

In general, the Surface 3 offers performance that's about 60 percent of what you'd get from the Surface Pro 3 in general Office work, but about 25 percent more than the older "Bay Trail"-class Atom-based tablets (as represented by the Lenovo Yoga Tablet 10). That difference becomes more profound when comparing the Surface 3 using conventional graphics benchmarks, as the table below shows.

The glaring weakness of the Surface 3 compared to the Surface Pro 3 is in disk access, which can mean slow app launches and other

## 3DMark
### Cloud Gate

| | |
|---|---|
| Surface 3 (Atom x7-8700) | 2,344 |
| Lenovo Yoga 10 (Atom Z3745) | 1,140 |
| Surface Pro 3 (Core i5-4300U) | 4,320 |
| Asus Zenbook UX305 (Core M-5Y10) | 2,817 |
| Dell XPS 13 QHD+ (Corei5-5200U) | 5,123 |

0    1,000    2,000    3,000    4,000    5,000    6,000

(LONGER BARS INDICATE HIGHER PERFORMANCE)

**The Surface 3** is almost on a par with a Core M, as far as graphics is concerned.

slowdowns. Using the CrystalDiskMark 3.0 benchmark, the Surface Pro 3 read and wrote 4GB blocks of data at 507.1 MB/s and 242.9 MB/s, respectively. The Surface 3 read and wrote the same data at 118.9 MB/s and 49.69 MB/s, respectively.

Gaming will be a mixed bag on the Surface 3. Pick a frantic 2D sprite-based game like *The Expendabros*, and it will run flawlessly. Move up to something that taxes the 3D hardware a bit more, like 2011's Serious Sam 3: BFE, and it runs acceptably at the very lowest settings.

It's possible that Microsoft has its eye on another gaming experience: game streaming. In the near future, Microsoft hopes to stream games over a wireless network from an Xbox One, letting the console do the heavy lifting. Microsoft sees the Surface 3 as the ideal tablet for basic Office productivity and casual use, so it'd seem natural to optimize that experience for the Surface 3.

**Note:** We ran early benchmarks while the Surface 3 was docked, and the tablet locked up twice—no dreaded Blue Screen of Death, just no response. Microsoft told us it hadn't had similar reports from other early Surface 3 users. When we ran the PCMark Creative Conventional test for this review, the tablet locked up again—only this time, it was sitting undocked on a bench. Because the Surface 3 is passively cooled, we speculated there might be conditions where it can't accommodate a thermal spike. We ran the PCMark Creative test a second time without issue, however, and we were unable to force the Surface 3 to crash by looping other benchmarks repeatedly.

## Stuck between premium and low-end

The Surface 3 is a much nicer tablet than its predecessors, and that alone makes it worth recommending. But it feels a bit expensive to be a "bargain" version of the Surface Pro 3. For a few dollars more, you could have the $699 Asus ZenBook UX305, an ultrabook that's actually a step up in terms of performance and battery life. Microsoft seemingly wants to establish the Surface 3 as a sort of premium low-end device, and that's a tricky proposition in this day and age. ⏻

## Microsoft Surface 3

**PROS:**
· Intel Atom processor performs better than expected
· One year of Office 365 Personal included
· Goodbye, Windows RT. Hello, Windows 8.1 (and 10!)

**CONS:**
· $499 advertised price is currently just for the tablet
· Battery life is actually less than the Surface Pro 3
· Limited to Microsoft Office, Web browsing, some basic games, and apps

**BOTTOM LINE:**

Think of the Surface 3 as a smaller, cheaper Surface Pro 3, with slightly disappointing battery life but surprisingly good performance.

$499

★★★★⯪

# LG G4 review: Killer camera and display, but not revolutionary

BY JON PHILLIPS

**IF YOU PLAN** to rock the LG G4 (go.pcworld.com/lgg4), please be prepared to account for your decisions. Samsung phones thoroughly dominate the Android space, so you have to share a veritable LG origin story whenever explaining an LG phone to non-nerd looky-loos. People are often suspicious of the rare and exotic. And that's a shame because the G4, LG's latest flagship phone, is a remarkable handset in many ways.

The G4 has the best manual camera package in the smartphone space. Its display looks great. You can swap out the G4's battery when juice runs low. You can upgrade storage with a microSD card. And LG doesn't muck up the basic Lollipop experience with excessive bloatware and customization.

▶ Watch the video at go.pcworld. com/lgg4vid
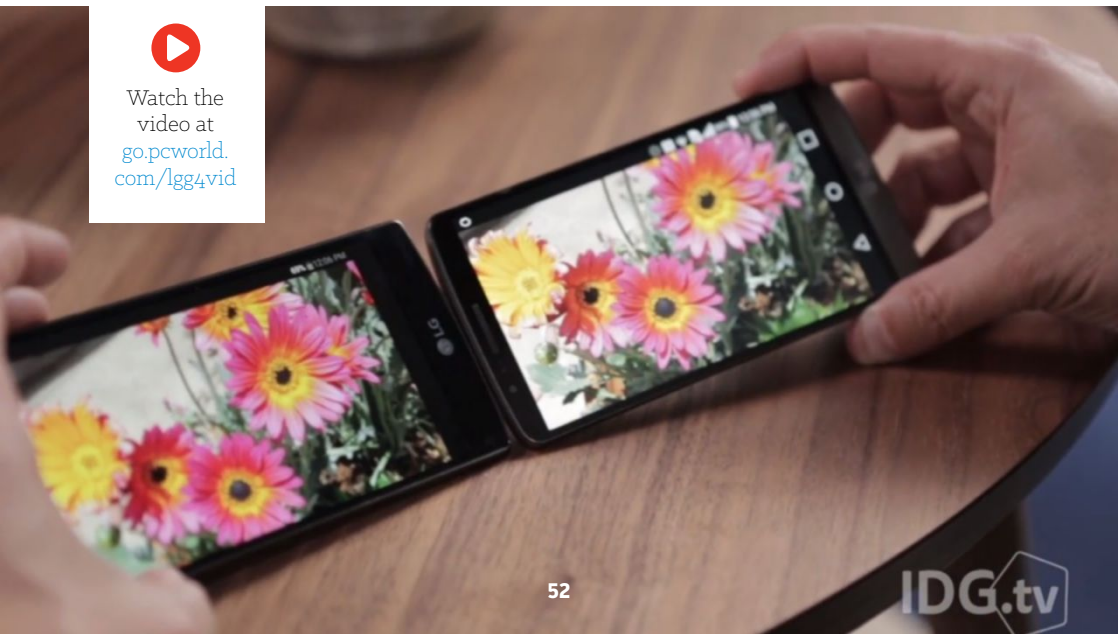
The G4 isn't perfect. And if you're already using last year's G3, you probably don't need to upgrade to the G4. But if your phone is two years old, you need to look very, very hard at the G4 before buying Samsung's Galaxy S6 in a hypnotic, hype-induced trance.

## Vaguely upgraded industrial design

I reviewed the international version of the phone. LG says it offers a slightly different software experience than the U.S. model, and my review unit didn't feature LG's ballyhooed leather backing, which we found to be as luxurious as a Mercedes-Benz steering wheel. I'm sorry I didn't get the leather package, as LG hasn't upgraded its basic plastic chassis in any material way.

Relative to the G3, the G4's rear plastic has a faint honeycomb pattern instead of faux brushed metal, and looks as downmarket as ever compared to fancy-pants iPhones and the finally-better-than-ever Samsung Galaxy S6. The G4's materials are bit too satin-slippery

**The G4's 5.5-inch display** is just a bit taller and wider than the 5.1-inch display of Samsung's GS6.

**Even a faux** metal finish can't hide chintzy materials. And some people still won't like that rear-mounted power button.



**Should you** prefer leather, well, LG does have that option.

for my tastes (leather would fix that), and aside from being a wee bit taller, it looks almost exactly like the G3.

This is a missed opportunity, LG. The leather version is a polarizing option, and the industrial design of the basic version now falls a distant third behind Samsung and HTC flagship phones.

On the upside, I've always found the G3 (and now the G4) to offer the perfect compromise between screen size and ergonomics. I can comfortably type and navigate the interface with a single hand, and like the G3, the G4 has a very thin bezel surrounding its 5.5-inch display. The end result is a phone that makes wonderfully efficient use of available space. The power and volume buttons are still located on the rear, and there's no physical home button. Neither decision bugs me, but if you think it will bug you, well, you've been warned.

## Now, that's a colorful display

LG has significantly improved its flagship display, and it's something you'll notice the moment you turn on the G4 if you've had any

**Here we see** the G4 (left) and G3 (right) displaying an identical photo. Notice the more-vibrant colors in the updated display.

## LG Electronics G4

**AT A GLANCE:**
With awesome manual camera settings and a gorgeous display, the LG G4 is one of the best phones of the year. And depending on your preferences, it might even be THE best phone.

**PROS:**
· Best manual still camera controls.
· Removable battery, upgradable storage.
· Androidy UI, light on bloatware.

**CONS:**
· No quick or wireless charging.
· Downmarket design, except for the polarizing leather option.
· Overall, a timid update to the G3.

★★★★⯪

experience with the G3. Using an "IPS Quantum" LCD that employs technology similar to quantum-dot TV tech (go.pcworld.com/quantumdot), LG says it has increased the color gamut by 20 percent and brightness by 50 percent.

Pixel density remains an ungodly 538 ppi across a 2560x1440 "Quad HD" resolution, but the real story here is gorgeous color reproduction. Comparing identical high-res photos on the G4 and G3, you can see richer, fuller tones on LG's updated display. It's a dazzling visual experience that doesn't bear that trademark oversaturation we've seen in so many AMOLED phones.

That said, the G4's pure white reproduction has a distinctly cool (bluish) cast to it, while Samsung's GS6 really is pure white when in its Basic white-point calibration mode. I don't plan on doing any mission-critical content creation on my smartphone, so the cool cast doesn't alarm me. But I can see how hard-core photographers might want a more accurate display, because the G4's camera is just that good.

## It's like a DSLR in your pocket

Samsung made a splash with manual camera controls in the GS6, but LG advances the ball even further. Both phones give you controls for



**Note the fine** level of manual controls for still images. A Histogram is in the top left corner. An ISO slider appears toward the right.



**Sharp foreground,** blurry background. Blurry foreground, sharp background. For this we thank manual focus and an f/1.8 aperture.

56

**All of these** long-exposure images were shot in a very dark room. For the most part, only a skylight overhead provided light. On the left, I have a 30-second exposure at ISO-150 (the lamp was actually dimmed to within an inch of its life). In the middle, I have a 30-second exposure at ISO-300. On the right, the skylight itself gave me plenty of moonlight for a 15-second exposure at ISO-800.

exposure compensation, focus, ISO and white balance, but the G4's 16-megapixel rear camera adds an all-critical shutter speed slider, along with a RAW file format option. The end result is a manual camera package that offers an unprecedented level of control—and it's super fun to use.

The G4's aperture is f/1.8, which delivers solid low-light image capture, and makes for artsy depth-of-field effects when playing with manual focus. Note the foreground and background detailing as I change focus in the images below.

I had even more fun with the shutter speed control. It ranges from 1/6000 to a full 30 seconds, and when you choose extremely long shutter speeds in near darkness, the camera sensor can collect an insane amount of light for breathtaking effects. If you end up buying the G4, place the phone on a tripod of some sort, and start playing with shutter speed and ISO in extremely dark environments.

All of these long-exposure images were shot in a very dark room.

For the most part, only a skylight overhead provided light. On the left, I have a 30-second exposure at ISO-150 (the lamp was actually dimmed to within an inch of its life). In the middle, I have a 30-second exposure at ISO-300. On the right, the skylight itself gave me plenty of moonlight for a 15-second exposure at ISO-800.

Besides simply yielding beautiful photos, the G4 serves as an excellent teaching tool. I'm a digital photography newbie, and while I understand the basic concepts behind white balance, ISO, and shutter speed, I've never mastered how they all work together on my Canon DSLR. But thanks to the G4's full-display preview, I can see how small adjustments to manual settings will affect my final image capture. There's even a teeny-tiny histogram in the upper left corner to see your photo's tonal range before you snap.
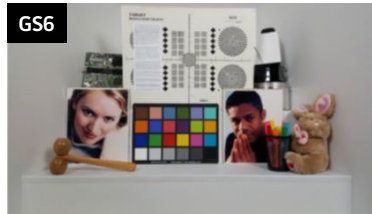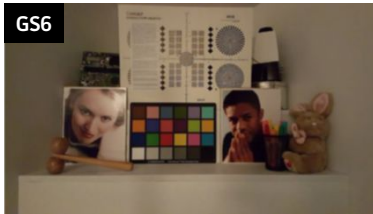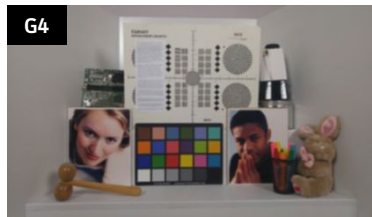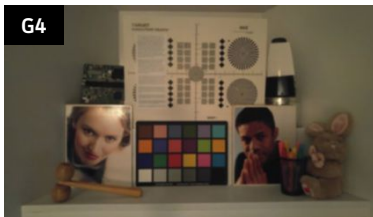


**Here's how** the G4's auto setting compares to the GS6 in low-light environments. Doing our best to re-create the atmosphere of a moody bar, we turn on a single floor lamp in a very dim room, and snap a photo without any flash.



**Despite having** a slightly wider aperture (f/1.8 versus f/1.9), the GS6 takes slightly better images—again, with auto settings enabled—under two bright studio lights.

**You can snap** a selfie with a simple hand gesture. It's a cool trick should you need to impress a Kardashian at some point in your life.

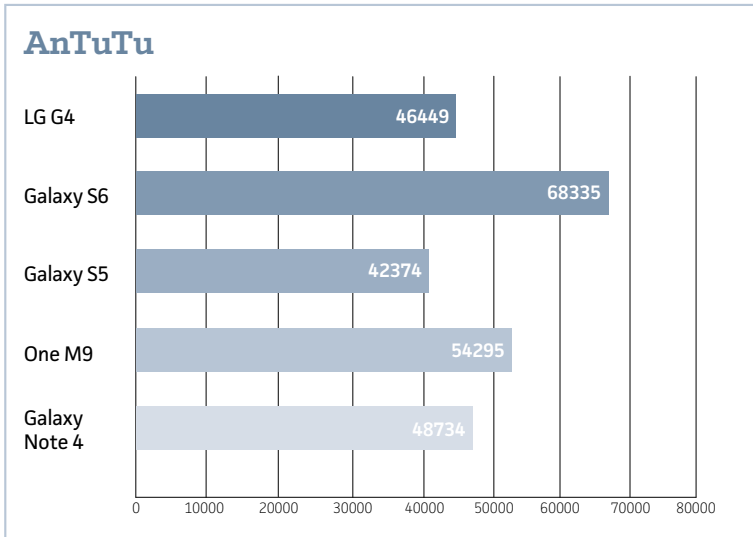## Shooting off shots like a machine gun

The G4's camera package is more of a mixed bag when you leave the still-photo manual settings. In auto mode, the rear camera's laser focus did a fantastic job of quickly adjusting focal length as I panned across objects at varying distances away. I was also super-impressed with the camera's burst mode: Hold down the shutter button in auto mode, and you'll snap multiple still shots like you're firing a machine gun.

I was also super-impressed with the camera's burst mode: Hold down the shutter button in auto mode, and you'll snap multiple still shots like you're firing a machine gun.

But in that same auto mode, the camera performed only admirably—not amazingly—in low-light situations. This despite LG's class-leading aperture spec. The upshot: The G4 will never be a miracle worker when you're shooting party shots in a darkened tavern, but remember that manual mode is available if you want to experiment with longer shutter speeds (just keep your phone very, very still).

At first, I was disappointed to discover that the video camera seemed almost bereft of controls. I could play with optical zoom and toggle autofocus on and off, but I couldn't find the slow-motion mode, let alone any of the advanced manual controls that are available to still images. But, it turns out LG hides settings for slo-mo and three video resolution options under the aspect ratio menu of its still camera. It's an unusual place to stow video settings, but they do exist.
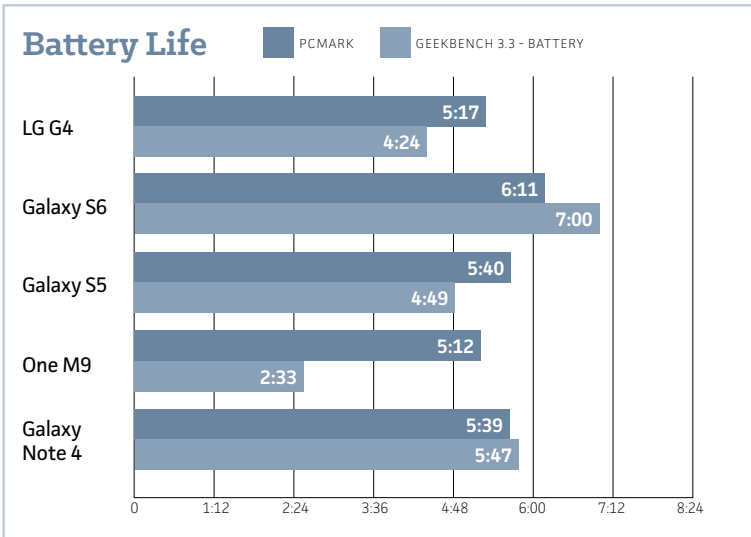
The G4's 8-megapixel front camera is entirely geared toward selfies. There's an 8-stage auto-beautify slider that lets you choose from zero digital air-brushing to more facial scrubbing than you'd wish on a South Korean plastic surgery addict. You can also trigger selfie shots with a hand gesture (it worked as expected) and a number of voice commands like "cheese" and "kimchi" (it didn't work at all on my particular early-build review unit).

## AnTuTu

| Device | Score |
|---|---|
| LG G4 | 46449 |
| Galaxy S6 | 68335 |
| Galaxy S5 | 42374 |
| One M9 | 54295 |
| Galaxy Note 4 | 48734 |

**AnTuTu is** an overall benchmarking suite. Here we see the G4's performance falls behind the Samsung and HTC flagships, but I didn't notice any performance issues whatsover during actual use.

## PCMark

| Device | Score |
|--------|-------|
| LG G4 | 4687 |
| Galaxy S6 | 5036 |
| Galaxy S5 | 3642 |
| One M9 | 4235 |
| Galaxy Note 4 | 3910 |

Scale: 0, 10000, 20000, 30000, 40000, 50000, 60000
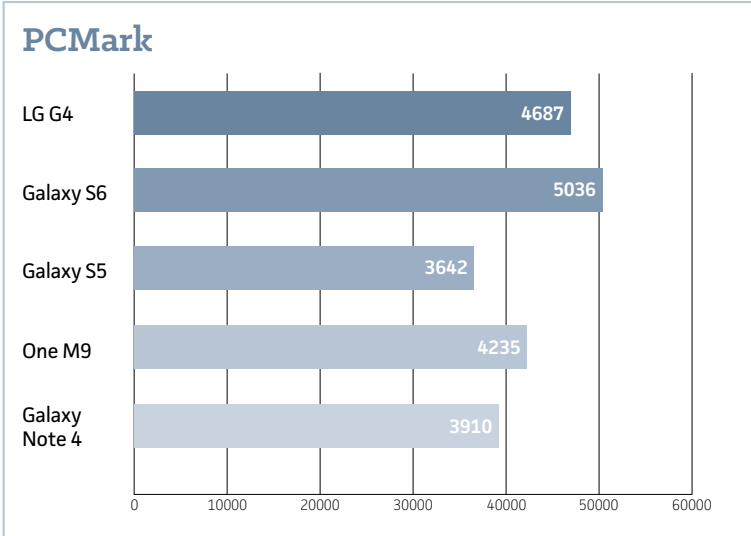
**The G4** closes up the gap in PCMark, and even bests the HTC One M9.

## Battery Life

PCMARK    GEEKBENCH 3.3 - BATTERY

| Device | PCMark | Geekbench 3.3 - Battery |
|--------|--------|-------------------------|
| LG G4 | 5:17 | 4:24 |
| Galaxy S6 | 6:11 | 7:00 |
| Galaxy S5 | 5:40 | 4:49 |
| One M9 | 5:12 | 2:33 |
| Galaxy Note 4 | 5:39 | 5:47 |

Scale: 0, 1:12, 2:24, 3:36, 4:48, 6:00, 7:12, 8:24

**And here we** see battery performance. But remember: These are only bench-marks, not real-world use.

**Ultimately,** this is the battery you'll be replacing.



**Somehow,** you'll need to pry this sucker off.

## Fast enough, long enough

LG outfitted the G4 with 3GB of RAM and a six-core 1.8GHz Snapdragon 808 processor instead of the eight-core Snapdragon 810 that it uses in the G Flex 2, and that HTC uses in the One M9. Conventional wisdom says the ostensibly higher-performing Snapdragon 810 overheats when you really hammer the processor for extended periods, and this causes its host phones to throttle down performance.

Well, overheating was certainly never an issue throughout five days of testing the G4. The phone never once got hot to the touch (I can't say the same for the G3), and basic interface performance never lagged to any noticeable degree, even during multitasking scenarios involving multi-megabyte file transfers. Our benchmarks show that the G4 doesn't have the raw processing power of the Galaxy S6 or even a non-throttling One M9. But during real-world use, I didn't feel the G4 was wanting for power.

Battery tests indicate the G4's longevity on a single charge lags behind the Samsung GS6's, but I never found myself desperate for a recharge before turning in for the night. In fact, while the G4 has the same 3000 mAh battery as the G3, I found the new phone's battery lasts noticeably longer, if only because the G3 took a palpable power-consumption hit when it received its Lollipop update.

At initial testing, the G4 didn't support quick-charging, which is a top-line feature of the GS6 and most other flagship phones. The G4 also lacks wireless charging support out of the box, despite the fact that its chipset supports this feature. But, LG later confirmed with us
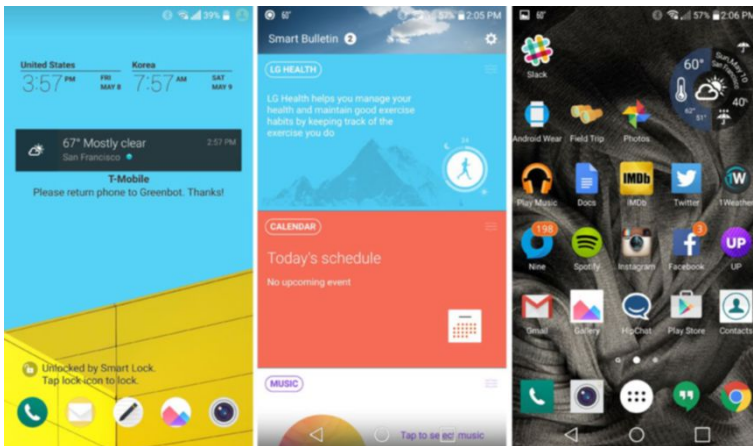
**You can** unlock the phone with a simple swipe if your "trusted agents" are set. Smart Bulletin (center) can be turned off entirely, and your home screen is, well, just a home screen.

that quick-charging is now supported. It turns out that LG needed more time to thoroughly test Quick Charge 2.0 on the phone's 808 processor, and LG's engineers were wary of promoting the feature before it was fully vetted.

## Travel with a second juice box

The G4 is still the only flagship smartphone to offer a removable/swappable battery. So if you're inclined to buy a second battery—and don't forget the wall charger—you can pop open your case in emergency situations to enjoy the best battery life around. There's just no denying the convenience of this feature, even despite the fact that LG's rear chassis is difficult to pry apart with fingernails alone.

Yep, you'll need a spudger tool (go.pcworld.com/spudger) if you want to avoid shucking the shell with a butter knife. That said, it remains to be seen whether the G4's rear panel pops off when you drop the phone on a hard surface. That's happened to me a number of times with the G3, leading to some frightening moments—especially that one time when the battery itself also popped out. (Luckily, the sudden loss of power didn't damage the phone.)

The first time you open your case for a battery swap, you should also take the time to locate your microSD card expansion slot: It directly integrates with the SIM card slot. The G4 comes with 32GB of internal storage standard, but you can add another 128GB.

Reading and writing to the expansion card won't be as fast as operations that tap built-in storage, but at least you'll have space for movie files and those 6MB images shot by the G4's camera. The Samsung GS6 comes in 32GB, 64GB and 128GB iterations, but its case is locked down, so adding storage via an SD card is out of the question.

## An inoffensive Android skin

Like LG's G3, the G4's Android skin employs a relatively flat, inoffensive design that's light on excessive customization. The G4 is also light on pre-installed bloatware, and overall I give LG kudos for letting its Android phone just be Android without a lot of OEM distractions. You can toggle off LG's Smart Bulletin (which gives you quick access to music controls, your calendar, and interface tips, among other things), and even LG's custom browser has been 86ed in favor of Chrome.

You can't wake the phone with an "always listening" feature à la the Nexus 6 or Moto X, and this really should be a standard trick for all Android phones. But like the G3, the G4 lets you set a "knock on" code to wake and unlock the phone with a particular fingertap pattern. Knock on is definitely my favorite OEM method for unlocking a phone, though Android's new Smart Lock (go.pcworld.com/androidsmartlock)

system (using trusted locations, trusted devices, etc.) is really the end-all, be-all solution.

The G4's rear-mounted speaker can't match the sound quality of HTC's One M9, but let's face reality here: This flagship battle is really between Samsung and LG, and when deciding between the Galaxy S6 and G4, you really need to look at the features that excite you the most versus the features you're willing to concede.

Deciding between one phone and the other comes down to personal preference. Indeed, for many people who are due for a phone upgrade, the LG G4 will be the clear choice. But in the final analysis, we have to separate the G4 and GS6 by half a verdict point and give the nod to the GS6.

Samsung dumped its cheapo plastic materials, dramatically upgraded its camera software, and added the blissful convenience of quick-charging and wireless charging. LG has done a lot with its flagship too, but the differences between the G3 and G4 just aren't that dramatic—that swanky (albeit polarizing) leather option notwithstanding. ⏻

# HELP KEEP THESE KIDS IN PLAY.

## 175,000 KIDS WILL BE DIAGNOSED WITH CANCER THIS YEAR.

Children are our greatest hope for the future. Let's be their greatest hope too.

Cancer strikes infants and children. For teens and young adults, survival can depend on treatment by a pediatric oncologist, designed specifically for them.

The St. Baldrick's Foundation and Stand Up To Cancer are funding groundbreaking collaborative research to bring the most effective therapies to kids fighting cancer. To learn how you can help keep these kids in play, go to stbaldricks.org/inplay and standup2cancer.org/pediatrics.

**Julia Hernandez**
Diagnosed at 16, in remission.

**Samuel L. Jackson**
Stand Up To Cancer and
St. Baldrick's Ambassador

**St. Baldrick's** FOUNDATION
*Conquer Childhood Cancers*

STAND UP TO CANCER

Photo by Nigel Parry

St. Baldrick's Foundation is a charitable 501(c)(3) organization funding childhood cancer research.
Stand Up To Cancer is a program of the Entertainment Industry Foundation, a 501(c)(3) charitable organization.

# Origin EON15-X: You'll find a desktop CPU in this laptop

**BY GORDON MAH UNG**

**IT'S TIME TO GO** *Glengarry Glen Ross* on dual-core processors in gaming laptops. As in, hey dual-core processor, I've got some bad news for you from downtown: Mitch and Murray said you're fired because gaming laptops should go to closers. And yes, dual-core, you can't close the deal on high-end gaming laptops anymore.

That's why we have Origin PC's EON15-X (go.pcworld.com/ EON15-X) here. It's a closer.

What makes it a closer? The desktop-grade Core i7-4790K CPU powering it. Yes, that's none other than Intel's Devil's Canyon CPU. While most mobile gaming quad cores struggle to crack the 3GHz barrier, the Core i7-4790K in the EON15-X cruises along at 4GHz and will Turbo up to 4.4GHz.

I don't want to totally bum out those still driving dual-core chips. Those chips have a place in more cost-conscious laptops and ultrabooks, but the era seems to be drawing to a close for burly gaming units. Origin PC's desktop chip in a laptop play isn't just about clock speeds though: It might also be about price.

## Price and specs

If you look at Intel's price sheet, its fastest quad-cores are $1,100—and even then, they still run at 75 percent the clock speeds of the CPU in the EON15-X. That translates into a hefty chunk of change that goes to Intel, compared to the $340 for the Core i7-4790K CPU in the EON15-X.

That doesn't make the EON15-X necessarily a cheap laptop, though. At $2,661, it's by no means an HP Streambook. That cost, though, gets you a quad-core ticking along at 4GHz at a minimum and Nvidia's top-dog GPU: the GeForce GTX 980M with 8GB of video RAM. You also get



**Origin's EON15-X** packs a desktop Devil's Canyon inside instead of the typical mobile chip.

8GB of DDR/1600 RAM, and a 1TB hybrid hard drive. Origin knows a hybrid hard drive won't impress, so it also includes an M.2 PCIe SSD inside—none other than a 240GB Samsung XP941.

I'll have to say, this is only the second time I've seen the XP941 in a laptop, but I wouldn't mind seeing more PCIe SSDs. The drive will cruise along at 1GB/s in read speeds. In M.2 SSD form, it's only eclipsed by its newer sibling, the Samsung SM951, which ups the speeds to around 1.5GB/s.

The EON15-X features two DisplayPorts along with an HDMI out. You get three USB 3.0, a Gigabit ethernet, and a combo USB and eSATA (remember those?) port, plus an SD card reader. There's also a full set of analog audio ports along with SPDIF. Wireless is an Intel combo 802.11ac and Bluetooth 4.0.

The keys have an odd sculpted shape to them that I'm not completely a fan of, but the trackpad isn't bad. The lid on the laptop and top keyboard deck has a light rubberized coating too. It makes the laptop a little less slippery when hefting.

The laptop weighs in at a hefty 7.7 pounds on your lap and pushes 10 with its power brick. You probably won't lug it with you every day, but it's manageable for hiking to your buddy's house for an ad-hoc LAN party or bringing it to your relatives' house to cut video.

## Performance

And that's the use case that will make you glad you have not just a quad-core but one that runs at high clock

### Origin PC EON15-X

**PROS:**
· Desktop CPU that cruises at 4GHz all day
· Nvidia's top-of-the-line GeForce GTX 980m gives you top flight gaming

**CONS:**
· Screen is apparently backlit with a single birthday candle
· Battery life, as expected, is dismal

$2,661

★★★★★

speeds too. With its 4GHz CPU, it makes quick work of encoding and video tasks.

I compared the EON15-X to MSI's monsterish GT80 Titan SLI with its mobile quad-core Haswell, as well as an older Eurocom P150EM with a quad-core Ivy Bridge CPU inside. The Devil's Canyon easily runs away from them. For more context, I also threw in the same encoding task on our zero-point, a quad-core Core i7-4770K desktop chip. If you were wondering whether the thermal limits of a laptop would make it slower than the desktop, it doesn't.

I also tossed in numbers from the budget-focused Alienware 15 with a dual-core Haswell CPU. You can see the impact of the two fewer cores on tasks that can truly use all of the CPU cores. See why dual-

## Handbrake Encode
(0.9.9)

| | |
|---|---|
| Origin EON15-X (Core i7-4790K) | 2,841 |
| Alienware 15 (Core i5-4210H) | 5,246 |
| Eurocom P150EM (Core i7-3740QM) | 3,570 |
| PCWorld Zero Point Desktop (Core i7-4770K) | 3,059 |
| MSI GT80 Titan SU (Core i7-4720HQ) | 3,522 |

SHORTER BARS INDICATE HIGHER PERFORMANCE
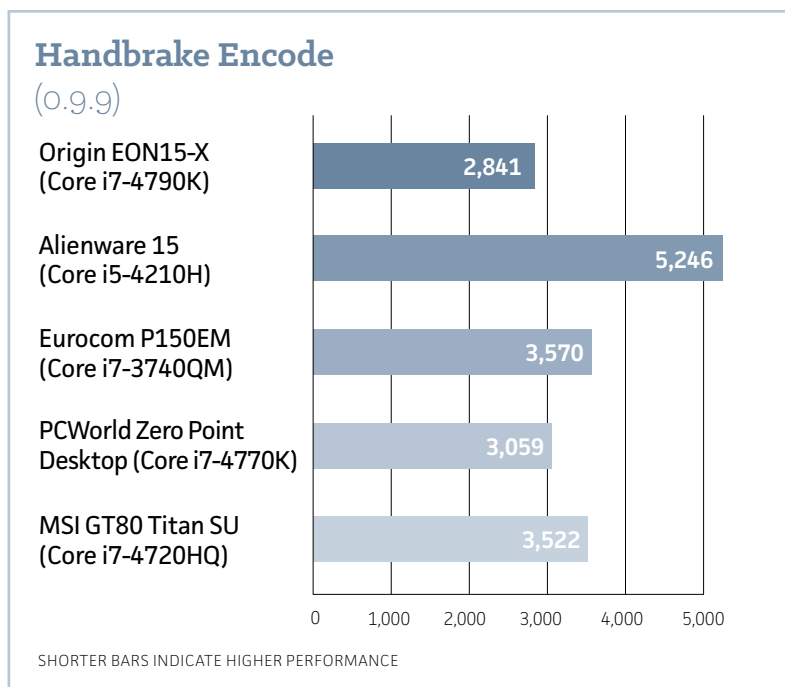
**The desktop Devil's Canyon** easily runs away from all of the mobile quad-cores including our desktop zero point with its Core i7-4770K too. That long bar, that's a dual-core.

## Tomb Raider Ultimate
19x10 (fps)

| | fps |
|---|---|
| Origin EON15-X (GeForce GTX 980M) | 76 |
| HP Omen (GeForce GTX 860M) | 39 |
| Alienware 15 (GeForce GTX 970) | 58 |
| MSI GT80 Titan SLI (GeForce GTX 980M SLI) | 128 |

LONGER BARS INDICATE HIGHER PERFORMANCE

**The GeForce GTX 980m** will play Tomb Raider set to Ultimate at 1920x1080 resolution above the magical 60 fps minimum.

cores aren't closers anymore?

Origin PC actually offers an overclocking option on the laptop, but I don't think I received it. For the most part the Core i7-4790K would operate at 4.2GHz during loads. It would start at 4.4GHz but within a few minutes would fall back to 4.2GHz. I suspect heat was the reason. I also compared it to PCWorld's zero-point desktop with its Core i7-4770K chip. That CPU has a stock clock of 3.5GHz with a Turbo Boost of 3.9GHz. But since it's not confined to a thin 7-pound chassis, it appears to run at top clock a lot longer.

Frankly, this makes the EON15-X probably the fastest laptop we've seen for chores that will use all of the CPU resources.

Gaming is the other story on the EON15-X, and the GeForce GTX 980M continues to show its prowess. For comparison, I ran Tomb Raider at 1920x1080 set to Ultimate quality: The EON15-X loses only

to the massive MSI GT80 Titan SLI, with its pair of 980M GPUs. The Alienware 15 is faster with its Amplifier (see page 76) option and appropriate card, but certainly not as portable.

   The upshot of the gaming performance on the EON15-X is that it will likely play all of today's games at 60 fps at its native resolution at max settings or with just a few tweaks to keep the frame rates up.

## Screen quality

One of my bigger issues with the EON15-X is its screen. I measured it at 200 nits when set on maximum—and yes, that's when plugged into the wall. It simply looks dim and dusty next to the other displays I've seen, and it's damn near a deal-breaker--and actually a bit of a heart-breaker, because the performance of the laptop is top-notch and can only be beat by SLI systems at this point.

## BioShock Infinite
### Diffusion DDOF 19x10 (fps)

| | fps |
|---|---|
| Origin EON15-X (GeForce GTX 980M) | 75 |
| HP Omen (GeForce GTX 860M) | 42 |
| Alienware 15 (GeForce GTX 970) | 67 |
| MSI GT80 Titan SLI (GeForce GTX 980M SLI) | 134 |

LONGER BARS INDICATE HIGHER PERFORMANCE
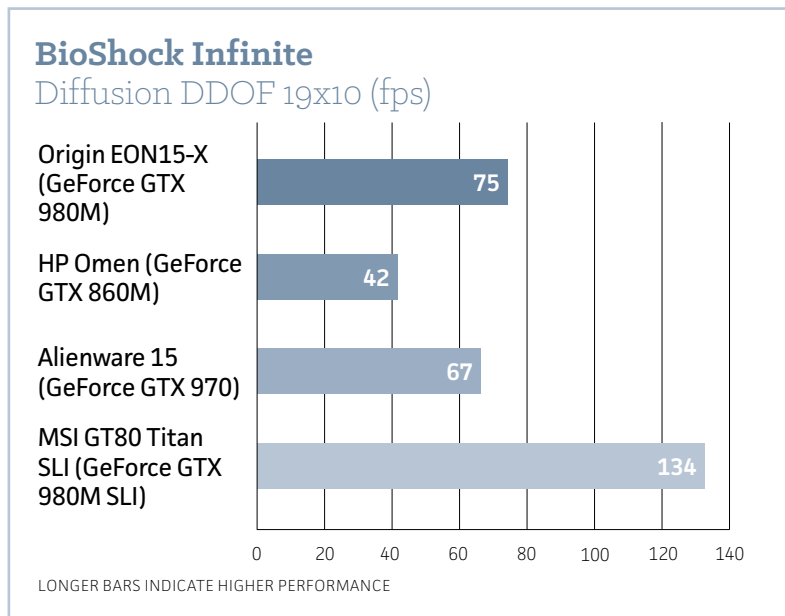
**Bioshock Infinite is** getting long in the tooth and not much work for either the GeForce GTX 980m or GeForce GTX 970m GPUs.

## MobileMark 2014
Office Battery Life (min)

| Laptop | Battery Life (min) |
|---|---|
| Origin EON15-X (82 Whr) | 147 |
| Surface Pro 3 (42 Whr) | 519 |
| Dell XPS QHD+ (52 Whr) | 602 |
| HP Spectre X360 (56 Whr) | 706 |
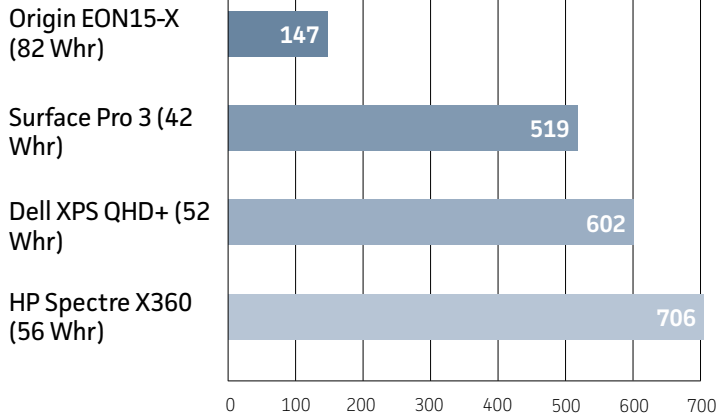
LONGER BARS INDICATE HIGHER PERFORMANCE

**Bring your power** brick: As you expected, this big gaming laptop with its desktop CPU chews through its battery fairly quickly doing common office tasks.

only be beat by SLI systems at this point.

Battery life, as expected, isn't great either. Because the EON15-X is almost light enough to use as a mobile unit on occasion, I wanted to see how it would do purely as an Office drone machine when off the grid, so I ran MobileMark 2014 on it. It's our standard run-down test for Ultrabooks and thin-and-light laptops. The laptop sucked its 82-Whr battery dry in 147 minutes doing boring work-related stuff. Crank up a game and put that GPU to work, or encode a large video, and expect to get even less run time. I really don't hold it against the EON15-X, as it is a performance-oriented gaming laptop, but you should definitely be aware of this liability.

## Upgrade options
Like all big laptops, it's a snap to get inside of the unit. The easy upgrade options are RAM. Our unit had 8GB installed, and there were

two additional SO-DIMM slots and room for one more 2.5-inch hard drive or SSD, and a second M.2 device. The CPU is socketed, of course, so there could potentially be a chip upgrade to the performance Broadwell quad-core down the road. The graphics card also rides in standard MXM slot so you



**Like all gaming** laptops, the Origin EON15-X features easy access to its guts.

could potentially upgrade that if you're willing to take the laptop apart further. (For those who don't know that some big gaming laptops can be upgraded, expect more on that topic very soon.)

## Conclusion

For a gaming laptop that's almost portable, the Origin EON15-X offers performance that's hard to beat. It doesn't offer "desktop-class" performance or any of that guff, it actually offers desktop performance in a laptop. Period. That makes the EON15-X a perfect laptop for someone who needs just that. But the costs are obvious. The battery life is pretty dismal (though no worse than what we've seen from other big gaming laptops, such as the MSI GT80 Titan SLI). The real snag for me is the screen. As I said, it's almost, almost a deal breaker in brightness. Because battery life is already subpar, why not put a little more juice into the screen?

# Alienware Amplifier review: It turbo-boosted a laptop with Titan X graphics

BY GORDON MAH UNG

**ALIENWARE'S GRAPHICS AMPLIFIER** has been described as the Holy Grail of mobile gaming. I think that's going too far. The Holy Grail of laptop gaming would be the ability to upgrade your laptop graphics like a desktop, using off-the-shelf parts.

Instead, the Amplifier (go.pcworld.com/alienwareamplifier) is the next best thing: a way to "upgrade" graphics on a gaming laptop, but using an external cabinet holding a standard graphics card and connected by cable.

That really makes the Amplifier more of the Ark of the Covenant of mobile gaming: a whole lot of gaming awesomeness, but without the Nazis melting at the end.



Watch the video at go.pcworld. com/awvid

## What it is and how you use it

In essence the $300 Amplifier is an external graphics box, connected by a proprietary six-foot PCIe cable to your laptop.

Getting the Amplifier up and running physically was a snap for me. You open up the Amplifier (although ours had a nasty snag problem, which Alienware says it has since corrected) and drop your GPU in to the single full-length PCIe slot. The Amplifier has two 8-pin/6-pin combo plugs for power. With 460 watts, it's enough juice to run any card you can physically fit. Alienware includes four USB 3.0 ports in back, so you can leave a mouse and keyboard plugged in, and it's wired so it kicks on when the laptop is turned on. This basically turns the Amplifier into a big docking station. Just come home, plug in, and boot up with the Amplifier under your desk.

When the Amplifier is installed, the discrete GPU in the laptop disappears and the one in the Amplifier takes over. When the Amplifier is disconnected, the internal discrete GPU takes over.

Note that switching GPUs requires a reboot, and it takes a few moments to reinitialize the internal GPU or the Amplifier graphics on power-up. Unplugging the Amplifier when the system is powered up will force Windows to shut down. Don't grumble too much: That's better than BSODs and a hard lock—you are, after all, pulling out your GPU while it's on.

You should also know that while the laptop is installed, there is no sleep mode. It's either on or off.

One more thing to clarify:

### Alienware Amplifier

**PROS:**
· Allows upgrade path for gaming
  laptops
· Reasonably priced

**CONS:**
· Rocky initial launch
· May need custom drivers for
  new GPU launches
· Turns your laptop into a desktop

$300

★★★★★

The Amplifier can be used with the laptop's internal monitor or an external one. You can also run your monitor to the laptop or directly to the GPU. Oddly, I experienced a small performance hit from running monitors off the Amplifier directly, though Alienware said I should experience the opposite.

**The Amplifier** lets you run most modern GPUs to power your laptop.

## Problems, we've had a few

The problem I initially had was with setting up the drivers. The first card I reached for was the mighty GeForce Titan X. With it installed, the first test I ran would only use the laptop's integrated graphic's card. After a few different attempts to fix it, I gave up and grabbed a GeForce GTX 980. It worked just fine. Using drivers directly from Nvidia's site, the Amplifier was up and running in minutes.

Alienware officials told me the issue was with how the Titan X was being identified by the current public drivers in the Amplifier. The fix was to use a tweaked driver directly from Alienware. The company said it expects to have that ironed out quickly and, in general, drivers will

come directly form AMD or Nvidia. The only time you might have to get tweaked drivers directly from Alienware is after a new graphics chip launch.

I wasn't alone in my troubles. No product is launched without problems, but given the volume of complaints from early customers you'd get the impression this was a public beta test. Most of the issues trace back to drivers. The good news is, the beta test appears to be over—my GeForce GTX 980's setup was exactly as expected.



**With the Amplifier** running, the internal GeForce GTX 970m disappears and the GeForce Titan X takes over.

## Bandwidth concerns

The cable itself carries



**Yup: It's standard** PCIe signals carried over the cable, but it's a proprietary cable.

data at x4 PCIe Gen 3 data rates. That's about 4GB/s. For comparison, a standard GPU connection on a desktop is a full x16 Gen 3 connection, which carries about 16GB/s. That's led to concerns over the bandwidth capability of the Amplifier and how much actual performance you give up by throttling the GPU. Alienware's competitor, MSI, has touted its GS30 Shadow's ability to give your GPU the full x16 connection in its graphics enclosure.

Alienware, however, feels 4GB/s is plenty. For the record, Thunderbolt 2 is about 2.5GB/s. There's some testing to support that "whatevs" approach. Puget Systems (go.pcworld.com/puget) found no appreciable difference between x16 and x8 and between Gen 2 and Gen 3. Puget didn't throttle it down to x4 Gen 3, but it did test x8 Gen 2, which is the same data rate. Likewise, Techpowerup.com (go.pcworld.com/techpu) tests also found no appreciable impact.

**A single x16** physical PCIe Gen 3 slot sits empty in the Amplifier.

## Performance

For my performance comparison I used a new $1,500 laptop from Alienware: the Alienware 15 with dual-core Core i5-4210H, 16GB of
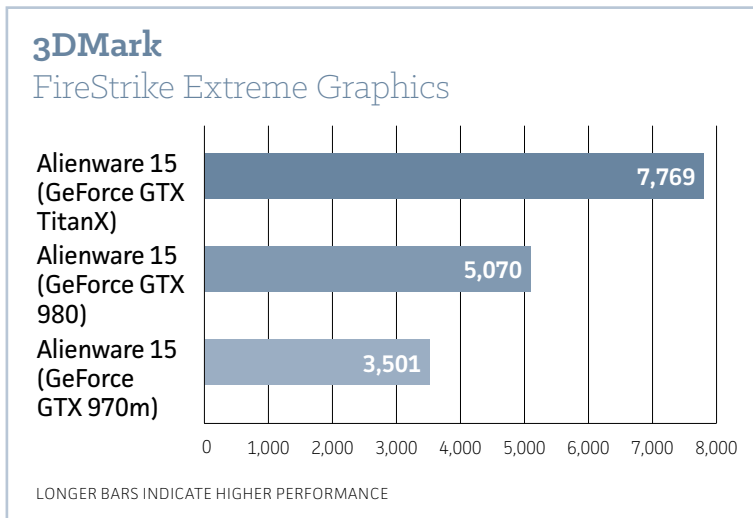
**The Amplifier** does indeed amplify the graphics of Alienware laptops.

### 3DMark
### FireStrike Extreme Graphics

| | |
|---|---|
| Alienware 15 (GeForce GTX TitanX) | 7,769 |
| Alienware 15 (GeForce GTX 980) | 5,070 |
| Alienware 15 (GeForce GTX 970m) | 3,501 |

0    1,000   2,000   3,000   4,000   5,000   6,000   7,000   8,000

LONGER BARS INDICATE HIGHER PERFORMANCE

DDR3L/1600, 128GB M.2 SSD, 1TB hard drive and a GeForce GTX 970m for graphics. I ran my tests with the internal graphics card as well as with a GeForce GTX 980 and a GeForce Titan X installed. These scores are actually the pure GPU scores rather than the overall 3DMark score. While this laptop is a pretty good deal at $1,500 with its GeForce GTX 970m, I fear its dual-core CPU could be a bottleneck in some gaming loads.

To see how the Amplifier could impact a real-world game, I also ran Tomb Raider on Ultimate quality, using an external 4K monitor. As you can see, we go from unplayable frame rates to a very playable 47 fps using the Amplifier and the Titan X.

## Conclusion

There are a couple of key takeaways from the Amplifier. The first is that despite its early teething issues, the problems appear to be mostly over. The second: This thing is freaking awesome.*

The asterisk is there because there are clearly limitations with the Amplifier. Despite my trouble-free use of the GeForce GTX 980, my initial GeForce Titan X problem gives me a little pause about future

### Tomb Raider
(4K on Ultimate)

| | |
|---|---|
| Alienware 15 (GeForce GTX TitanX) | 47 |
| Alienware 15 (GeForce GTX 970m) | 18 |

0    10    20    30    40    50

LONGER BARS INDICATE HIGHER PERFORMANCE
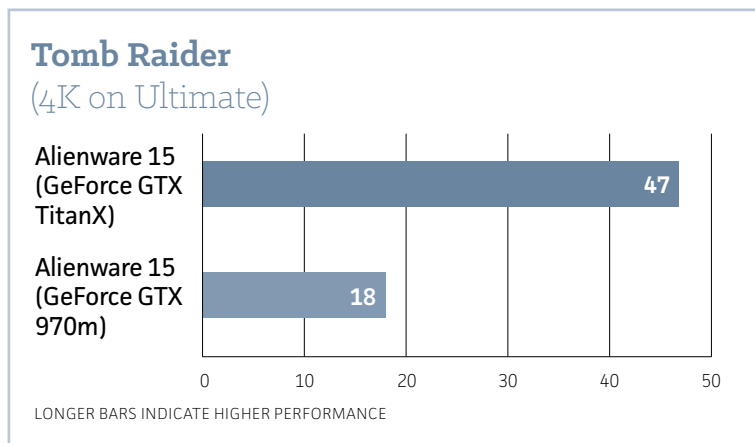
**You can't play** 4K with the GeForce 970m on Ultimate, but with a Titan X running the show, you can.

**Alienware** isn't counting sales of the Amplifier; it's expecting gamers who see the potential to buy its laptops because of the future upgrade potential.

potential driver issues. Oddities like the performance dip when running a monitor directly off the GPU make me wonder. I'll also point out that the sole 80mm cooling fan is just too loud.

Despite this, there's very little downside if you think about it. Unlike MSI's GS30 Shadow,  which requires you buy into the cabinet from the get-go, you don't have to buy the Amplifier now. Fast-forward a year or three, when you realize the internal graphics no longer cuts the mustard. Just pick up an Amplifier, buy the decent midrange card of 2020 and rock on.

The Amplifier really extends the lifespan of an Alienware laptop: You give up on portability, but the alternative is to buy a new one or stop using it for gaming. That's a pretty awesome alternative to have, and a pretty big competitive edge over competing laptop designs. ⏻

Aerodynamic Forces Overlay Enabled
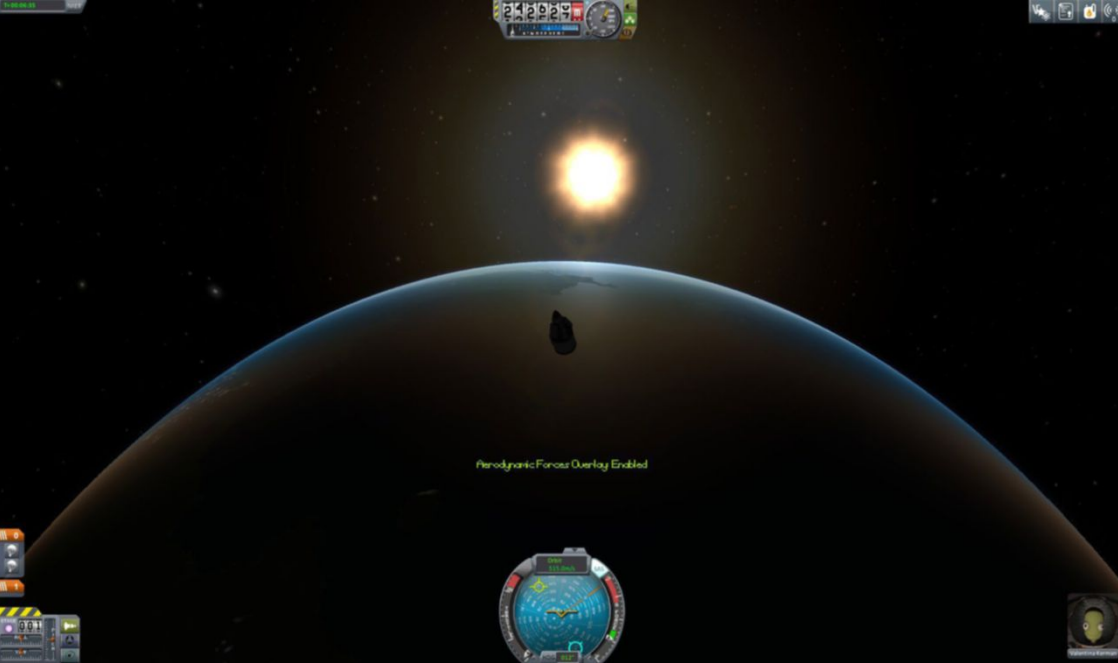
# Kerbal Space Program: PC gaming's new paragon reaches the heavens

BY HAYDEN DINGMAN

**IT'S FUNNY TO THINK** of Kerbal Space Program (kerbalspaceprogram. com) as a "new" game. Thanks to the magic of Steam Early Access, I've been playing the game on and off for about two years now (as have many of you, I'm sure).

But the game recently left Early Access for the fertile plains of an official 1.0 release, not only providing a reason for lapsed players to jump into the game but signaling the all-clear as far as official reviews go. So here it is, my official review: Kerbal Space Program is more than just an outstanding space sim. It's the embodiment of everything that's noteworthy and valuable about PC gaming.

## Get with the program

If you've never played Kerbal Space Program (KSP), it's sort of like the most advanced space-themed Lego set in the world. Or like baby's-first-NASA. Or a simulation of what your life might've been like had you gone to school for that aerospace engineering degree instead of…whatever you did instead.

You're in charge of the space program on the planet Kerbin, an Earthlike planet inhabited by adorable green aliens known as Kerbals. Don't get too attached. You will undoubtedly kill a lot of Kerbals over the course of your time with KSP.

While KSP now has a Story mode, the core of the game is still the same as it's ever been—build rockets, then fly those rockets. The only difference between the Story mode and the Sandbox modes is that in Story you'll have limited funds and will literally build up Kerbin's space program from scratch, researching more advanced parts as you get better.

It's a great way to introduce players to the game, because if you jump straight into the

## Kerbal Space Program

**AT A GLANCE:**
Kerbal Space Program isn't just a fantastic space game. It's one of those games that makes you glad you play on PC, because it could only come to exist on PC.

**PROS:**
· In-depth but fun simulation of rocketry
· All accomplishments are player-driven
· Fantastic mod community

**CONS:**
· In-game tutorials could still be more comprehensive

$40

★★★★★

sandbox you might find yourself drowning in quicksand. There are a ton of parts to experiment with in KSP, and the best way to understand what each does (in my opinion) is to have them introduced a bit at a time through the career. But if you like drowning, well, Sandbox mode is always available to you.

Regardless of whether you choose the Story or Sandbox path, make no mistake: Kerbal Space Program is hard. Why? Because real life is hard. You know how people say "It's not rocket science" in that annoying, pedantic tone? Well in this case, KSP really is rocket science.

Do you know how to nudge a throttle during takeoff so that you're not unnecessarily burning more fuel than drag necessitates? Do you know which thrusters to fire to increase your orbit around a planet? Do you know how to plot a course to the moon?

Yeah, I didn't either. But I learned—sometimes on my own, sometimes through KSP's built-in tutorials, sometimes through reading Wikipedia pages on, for instance, aerobraking (en.wikipedia. org/wiki/Aerobraking). I've spent many nights poring over forums, trying to better understand.

**This is the** tech tree in Story mode. It's… pretty complex.

Aerodynamic Forces Overlay Enabled
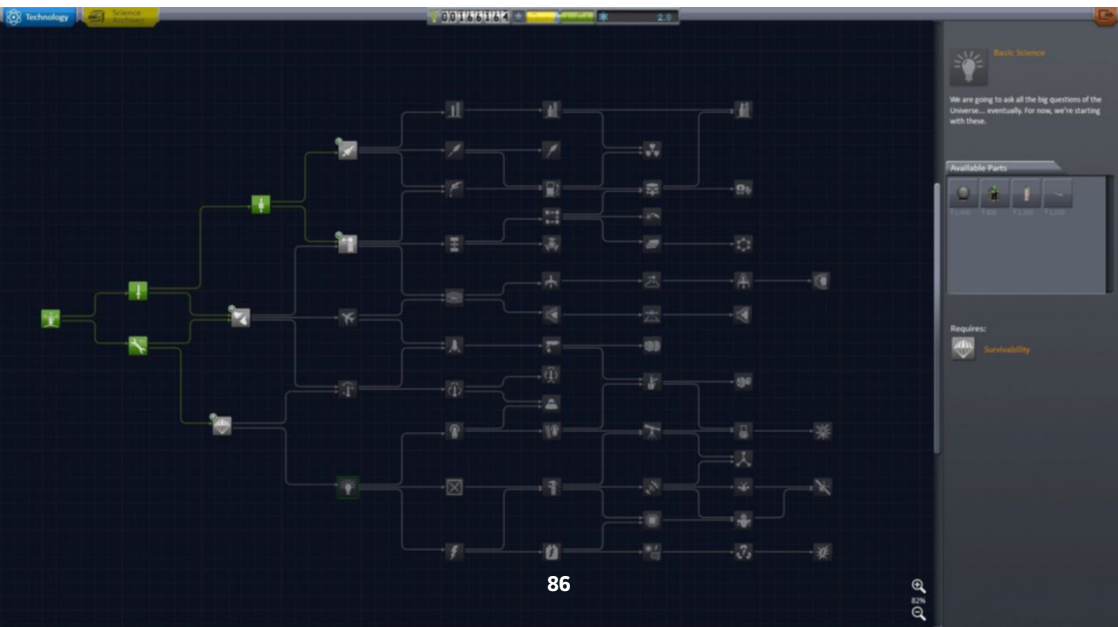
Kerbal Space Program is incredible for a number of reasons.

1. **Because complicated aerospace concepts are built into the game.**

2. **Because the game is engaging enough to make you want to learn about those concepts.**

3. **Because you could skip those concepts entirely and still have a ton of fun.**

The "edutainment" label is a bad word in the games industry, but that's exactly where KSP fits. It's more flight simulator than first-person shooter, if we're being honest, and yet it's friendly enough to rope in people who might never give Microsoft Flight Simulator X or X-Plane a second look.

You can play it as a serious rocketry simulator, putting satellites into orbit and heading to the moon or even further, to the edges of the solar system.

Or strap sixteen rockets in a helix pattern around a girder and see what happens when they all ignite. Or fly halfway to space and then force your Kerbals to jump out of the cockpit. Or. Or. Or.

There are so many possibilities for spaceflight when pesky real-life constraints like "Will people die?" and "How will we fund this?" go away. And if a few Kerbals need to suffocate in the vast vacuum of space so I can

**Your first rocket** will probably look something like this. Easy.

test out a new rocket design, well, so be it. Rest in peace, Jebediah Kerman.

Where the flight simulator genre is intrinsically "adult" and "boring," Kerbal Space Program somehow feels more like a game—even though it is, at heart, still a simulator. In that regard, KSP reminds me of another PC classic, The Incredible Machine. There, too, you had a physics simulator cleverly disguised as a sandbox game.

I'm not saying every game needs to be in this mold. Story-driven games certainly have a place in the industry, and I'm actually drawn toward narrative games more than purely mechanical games.

But Kerbal Space Program is one of the best of its kind. It's an adult Lego set (or K'Nex set) given life. It's creative, it's complicated, and when you succeed in KSP it's not because the game let you succeed— it's because you actually learned something new and applied those concepts appropriately.

That learning aspect's big. Games are at their best when they're teaching us something, even if that "something" is just how to shoot people more creatively. I feel like the games industry has, by and large, lost that "teaching new mechanics" feel in favor of a focus on driving players through stories using the same old rehashed game design.

You're still learning, in a way, but it's more like watching TV or reading a fictional book than anything intrinsic to games.



Games can teach. In many ways, games can teach better than any textbook. But to do so, those games need to exist. We need more Kerbal Space Programs to balance out the onslaught of Shootathon 20xx Editions—games that let us be better, let us experience and play with ideas we might not have a chance to otherwise.

And simultaneously, games like Kerbal Space Program that allow you to disengage with the learning aspect entirely if you so choose. In other words, games that are actually games and not just teaching tools. That's important too.

## Bottom line

For this and many more reasons (including a fantastic modding community), Kerbal Space Program is one of the most important games to hit the PC in years. Congratulations to Squad on a fantastic 1.0 release, and I look forward to many more updates in the future. ⏻

# Adobe Photoshop Lightroom CC 2015: New features and major performance gains

**BY JEFF CARLSON**

**SOMETIMES WINNING CAN BE** the worst outcome. With Aperture now effectively retired by Apple, and its successor Photos for OS X not up to the task of replacing it, the market for pro and enthusiast photo software is now led by Adobe Photoshop Lightroom. For the latest version, it would be easy for Adobe to add a few marketing-friendly features and coast into the future on its growing train of subscription revenue.

Fortunately for existing and incoming Lightroom customers, that doesn't seem to be the plan. The new Lightroom CC (go.pcworld.com/lrcc) does add some new

The **HDR preview** in Lightroom CC.
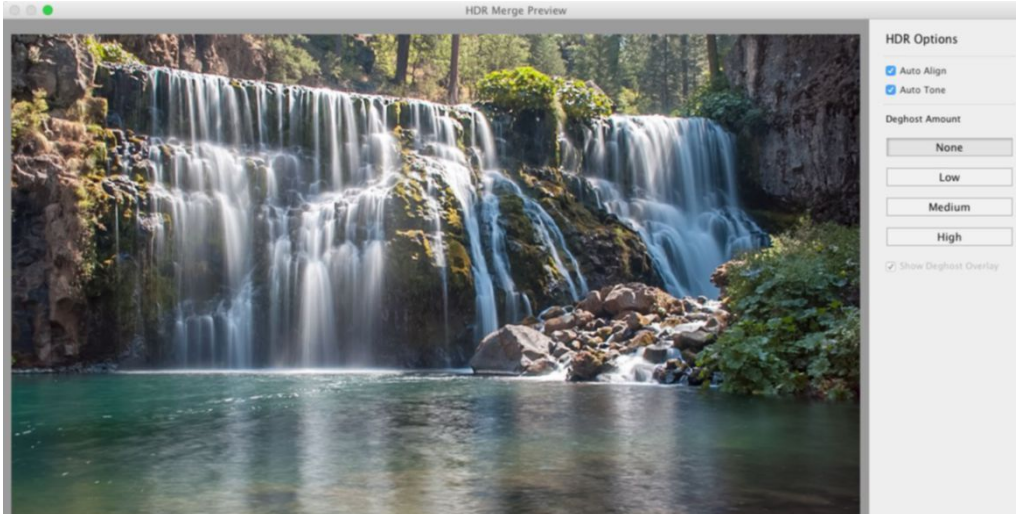
features, such as built-in HDR and panorama merge tools, facial recognition, a filter brush, and an improved slideshow builder. But more interesting is its performance: Lightroom CC takes advantage of your computer's graphics hardware to speed up the app in some welcome areas.

## Performance

Our computers will probably never feel as fast as we'd really like, but we sure notice when they start to bog down. It was that sluggish behavior that pushed me toward Lightroom in

**Lightroom CC takes advantage of your computer's GPU for image-intensive tasks, so the main processor isn't shouldering as much of the load.**

the first place: Aperture 3.0 was a dog on my old Mac at the time, but upgrading to a new MacBook Pro didn't improve the performance much. Lightroom was the oddly twee alternative, its curlicue design flourishes distracting from the fact that it was working hard to be a fast and nimble photo organizer and editor. But as libraries have expanded and image sizes ballooned, even Lightroom 5 started to feel

poky in areas.

Lightroom CC now takes advantage of your computer's GPU (graphics processing unit) for image-intensive tasks, so the main processor isn't shouldering as much of the load. Computers with discrete GPUs see the most improvement, but machines with integrated GPUs (soldered onto the motherboard, such as many Intel processors) also see improvements.

Performance does depend on hardware. As you might expect, the difference on the iMac with 5K Display is dramatic. For example, scrolling through the Grid (the thumbnail view) of a library containing more than 100,000 photos was a marked improvement on Lightroom 5—scrolling was fairly smooth, and there were only occasional empty thumbnails. Panning within large images was also an improvement.

But I also saw better performance on a 2010 MacBook Pro containing an Nvidia GeForce GT 330M GPU, as well as on a late-2013 Retina MacBook Pro with an integrated Intel GPU. The former isn't a race car (it meets the minimum OpenGL 3.3 cutoff for being able to use the GPU), but it's better than before.

> Lightroom merges the photos and creates a new DNG (digital negative) file that can then be adjusted using Lightroom's own Develop controls.

**Make an HDR** from two or more shots.



Open in Loupe
Open in Survey

Lock to Second Monitor          ⇧⌘↵

Show in Finder
Go to Folder in Library
Go to Collection                ▶

Edit In                          ▶
Photo Merge                      ▶      HDR...
                                        Panorama..
Set Flag                         ▶
Set Rating                       ▶
Set Color Label                  ▶
Add Shortcut Keyword

Remove from Quick Collection     B

Create Virtual Copies

Panorama Merge Preview

Panorama Options
Select a Projection

☑ Auto Select Projection

Spherical
Cylindrical
Perspective

☐ Auto Crop

(Want to see the difference yourself? In Lightroom's preferences, you can turn off the Use Graphics Processor option in the Performance screen, an option no doubt included in case compatibility issues arise with graphics cards.)

**This panorama** was created from eight stills.

## Built-in HDR and panorama

Speeding up performance doesn't happen just at the processor level. Lightroom 5 offered a way to create HDR (high dynamic range) photos by selecting two or more shots of the same scene captured at different exposures and shuttling them over to Photoshop CC's HDR Pro module. Instead of taking that round trip through Photoshop to merge the shots into one, Lightroom CC now includes its own HDR Merge feature.

Staying within Lightroom is not only more convenient, but processing is faster, too. The HDR Merge module is basic, with options to automatically align and tone the images and optionally remove ghosting caused by objects in the scene moving between shots. Lightroom merges the photos and creates a new DNG (digital negative) file that can then be adjusted using Lightroom's own
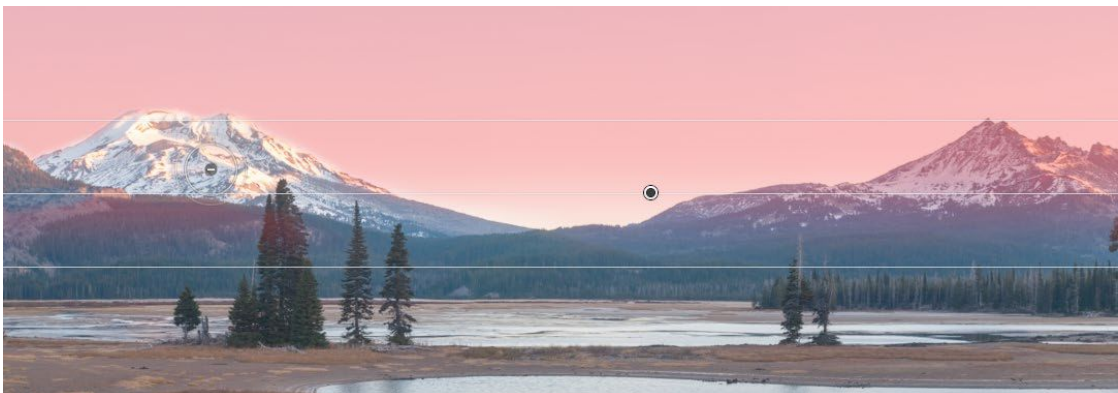
Develop controls. If you're merging raw files, you don't need to go through Photoshop's Adobe Camera Raw intermediate step, since Lightroom handles raw files natively. In my testing, the automatic adjustments also provided good starting points for editing.

Similarly, the Panorama Merge feature is simple but quickly stitches photos together into a single DNG image using one of three projections: spherical, cylindrical, and perspective. You can opt to let Lightroom automatically crop the merged image or do it yourself after the merge is complete.

## Filter brush

One new feature that may not get the recognition it deserves is the filter brush. When you apply an adjustment such as a graduated filter, you previously were not able to mask areas. So, using the panorama image above as an example, making the sky darker blue would also affect the snow on the mountains. The filter brush lets you paint areas to be included or excluded from the overall effect.

## Facial recognition

One reason I prefer Lightroom to other photo organizers is its extensive support for adding metadata that makes it easy to find photos later. The capability to identify and recognize faces has been part of iPhoto, Aperture, and Adobe's own Photoshop Elements for years, but if you

**The filter brush** keeps the mountains snow white (shown here with the mask visible in red).

wanted to identify people in Lightroom you'd have to do it by assigning your own keyword tags. Now Lightroom CC can help you out.



The feature shows up as just another view in the Library module—look for the People button just above the filmstrip—and operates as we've come to expect in other applications: Lightroom locates faces, and you identify a few to get started. The more photos you identify, the better Lightroom does in locating people in other photos.

**The People view** in Lightroom CC.

Initially I was surprised that the feature seems to be (forgive me) skin deep. Although it can locate and identify people, you won't find a People attribute or metadata category when performing a search or creating smart collections. However, it turns out Lightroom is doing something basic and clever: people are identified as keywords, so to find photos of someone in my library, all I need to do is a text search for their name. According to Adobe, the People keywords are treated separately under the hood—to help maintain privacy, those keywords are removed before exporting or sharing the photo. (You can choose to override that default in the Export dialog.)

## Slideshows

The last area to receive a sizable update is the Slideshow module, which adds a few ways to customize slideshows. A show can now include up to 10 songs (hopefully preventing countless earworms in the process), and the slide changes can be synced to the music; in my testing, Lightroom did a good job of making this seem natural. And an Audio Balance slider lets you choose which audio is dominant when you include video clips in the slideshow.

Adobe also added a Pan and Zoom slider to add motion to each slide. The setting applies to the entire slideshow, so you won't have the type of granular control you would get from dedicated slideshow applications, but the feature works fine.

## Bottom Line

Maybe Adobe has been too busy to realize they've won the market of photo organizational and editing software. More likely, the Lightroom developers understand that winning at software is an illusion as long as upstarts—like Lightroom when it started out—are out there. Lightroom CC is a welcome update that builds on its predecessor not only in terms of features but performance. That's a win in my book.

Lightroom CC is available through Adobe's Creative Cloud subscription service, the least expensive of which, the Creative Cloud Photography plan (go.pcworld.com/ccp), costs $10 per month and includes Lightroom CC, Photoshop CC, and the use of Creative Cloud–enabled mobile apps such as Lightroom mobile (go.pcworld.com/lrm)—which itself gains a small update and adds Android tablet support.

For some people, that "CC" may represent the crumbling of one of the last subscription plan holdouts, but Lightroom isn't exclusively subscription based: Adobe is also releasing a standalone version, Lightroom 6, for $149. It doesn't include any Creative Cloud features such as synchronization with Lightroom mobile (which is a free app for iOS and Android, but requires a Creative Cloud subscription to work). ⏻

### Photoshop Lightroom CC 2015

**PROS:**
· Improved performance due to GPU interaction.
· New filter brush.
· Built-in HDR and panorama merge features.
· Still a standalone product for customers who don't want a Creative Cloud subscription.

**CONS:**
· Older computers will see minimal or no performance increases, depending on the hardware.
· It would be nice to see People more specifically included in searches and smart collections.

**BOTTOM LINE:**
With facial recognition, easier editing tools like the great new filter brush, and better performance from using the GPU, the latest edition of Lightroom should appeal to former users of Aperture who might not be as well served by Photos for OS X.

$10/month with Creative Cloud Photography subscription. Up to $50/month as part of other Creative Cloud subscriptions. Available on its own as Lightroom 6 for $149

"I want to be a bench. Recycle me."

IWantToBeRecycled.org

Ad Council | KEEP AMERICA BEAUTIFUL

# How many light bulbs does it take to change an American?

It's no joke: climate change is a critical issue for all life on Earth. But can the actions of one individual really make a difference? Visit nature.org to calculate your impact on the world around you and learn about steps you can take to make the world a better place for us all.

**nature.org/calculate**

The Nature Conservancy

Protecting nature. Preserving life.℠

# Apple Watch: Beautiful form, frustrating function

**BY SUSIE OCHS**

**I'M ALL-IN ON** Apple products. At my house, I've got two Macs, an Apple TV, an iPad, two iPhones, and an Apple router. I've never owned an MP3 player that wasn't an iPod, or a tablet that wasn't an iPad. And now I've got an Apple Watch to converge my Apple universe right on my wrist.

I really do like my Apple Watch, even though it drives me crazy. It's slow. The navigation can be confusing. I like wearing it, but I'm still unsure if I want to wear it every day, forever (or at least until there's a new one). After a week and two weekends of nonstop use, it's yet to change my game in any profound or major way.

Apple calls the Apple Watch its most personal product ever, and as such, people's reactions to it and opinions about using it will be highly subjective. One person might be delighted by the gentle taps on the wrist every time she gets a text message, while another might find those same taps jarring, and rush to turn them off.

This review contains my subjective opinions on the Apple Watch, intending to serve as a reality check for anyone still on the fence. In a world of Macs, iPhones, and iPads—not to mention accessories, peripherals, apps and services for them—we have to prioritize our spending on technology, and $350 and up is a lot to ask. For a lot of people, I don't think this first-gen Apple Watch needs to make the cut.

## Fit and finish

That's not to say you shouldn't get one if you really want one, and I understand why you would. The Apple Watch is a beautiful object. It doesn't dominate my entire arm like a larger-screened Android Wear watch or even a Pebble. At 10.5 millimeters thick, it protrudes from my wrist enough that I do bang it on doorways and walls occasionally, but it doesn't seem clunky or unwieldy. (And I haven't yet picked up a single scratch, although your mileage may vary, of course.)

I'm wearing the 38mm stainless steel Apple Watch with the Milanese Loop band. I love that the metal band is comfortable and infinitely adjustable, and it goes with everything, casual to dressy. The magnetic clasp snaps shut and stays put, so I'm never worried about it falling off or loosening in the slightest as I wear it. One day I had it on from 8 a.m. straight through until 1 a.m. (and the battery was still at 13 percent when I took it off). By 1 a.m. the band was starting to feel itchy, and I couldn't wait to take it off, but usually it's fine. The Apple Watch Sport is a little bit lighter: My configuration weighs 73 grams (40 for the case, and 33 for the band), while my colleague Leah Yamshon's 38mm Apple Watch Sport with pink Sport Band weighs 67 grams (25 case, 42 band). But the Apple Watch doesn't feel heavy or cumbersome.

I've ordered a Sport band to wear when running, but I've done lighter

workouts on my stationary bike while wearing the Milanese Loop, and it was fine. Apple says the water resistance rating is IPX7 (not including leather bands). So you can wear it while exercising, while outside in the rain, and when washing your hands, but submerging it isn't recommended. IPX7 is technically rated as submergible in up to 1 meter of water for up to 30 minutes. So if you drop it in the toilet accidentally, or jump in the shower without taking it off, it should be fine. Tim Cook says he showers with his—I'm too nervous to try that myself, plus I wouldn't want soap gunking up my pretty Milanese Loop.

Battery life has been excellent. Using the Workout app hits the battery a little harder, so if you work out once (or more!) every day, you might just barely make it to bedtime with power left. But on days I don't use Workout (I'm typically up around 7 a.m. and go to sleep around midnight), it's rare for me to get below 20 percent charge remaining when it's time to plug it in.

This definitely feels like a high-end product, which shouldn't surprise Apple fans. But being pretty isn't enough to justify paying hundreds for the Apple Watch and keeping it charged up and strapped to your wrist every single day. It's got to be useful too.

**The Apple Watch** looks great, and the Milanese Loop goes with every outfit.

# What's the point?

The Apple Watch isn't designed to suck in your attention—you're supposed to use it in small bursts, so you aren't holding your arm up in the air interminably. For example, I used the Phone app to call for a pizza, tell someone I'd be late, and find out when the library opened, but I wouldn't use it for a sit-and-chat call with a friend. It's handy for checking the weather, periodically triaging incoming email (after you've skimmed a message, you can do a deep "force press" to flag it for follow-up or delete it), and looking over new notifications to decide if any of them are worth answering on your phone.

But most notifications do need to be dealt with on your phone. The Apple Watch has Handoff, so you can pick up on your iPhone and reply to the same email you just saw on your watch. (Just wake your phone and look for a Mail icon in the bottom left corner. Swipe that up to open the same message you're viewing on your watch.) You can reply to text messages directly on the watch, which is convenient as well as fun, but dealing with notifications for Facebook, Twitter, email, and most other apps happens back on your iPhone.

The Apple Watch did get me to rethink which notifications are important. I like being able to see the score of the Giants game from my wrist, but I don't need to know when new podcast episodes are available in Instacast. You can tweak which notifications go to the watch in the Apple Watch app for iPhone, and of course you can adjust which notifications go to your iPhone in the Settings app. But be prepared to spend a lot of time fiddling with both in your first week with the Apple Watch. I've said it before, and I'll say it again: I hope Apple overhauls the notifications system in iOS 9, because the Apple Watch just added another layer of complexity.
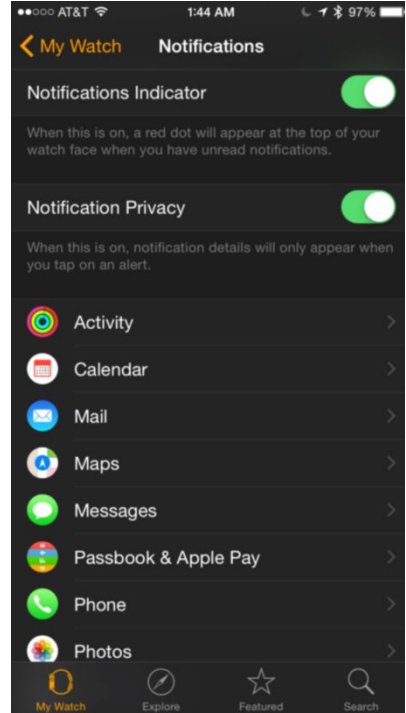
**Most of** the Apple Watch's settings are configured in the Apple Watch app for iPhone—expect to use it quite a bit in the early days.
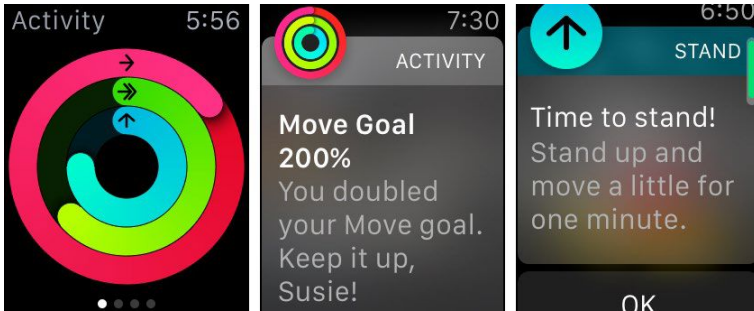
## Things I love about it

I've found Apple Watch's fitness features more motivational than using a Fitbit or a Jawbone UP2, since the progress goal is right on my wrist. I like how a workout isn't counted as Exercise minutes if your heart rate isn't high enough. But the prompts to stand up and get active aren't as smart as I'd like: for example, I hate when the Watch asks me to stand during my bus commute, especially because my phone can tell when it's in a vehicle. I would also love for the Watch to factor in what's on my calendar, perhaps prompting me to move for a few minutes right before I'm scheduled for a long meeting or call.

The Apple Watch excels as a remote control. The Remote app is great—I love being able to control my Apple TV without hunting for the actual remote. It's got all the features of that remote, and I can navigate menus and select items without even looking at the watch. The Now Playing glance is terrific too, providing play/pause, forward/back, and volume control for whatever app my iPhone is using to play music.

I'm really looking forward to when HomeKit finally launches (maybe with iOS 8.4?), and I'm finally able to access lights and security cameras on the watch, and use Siri to set scenes. It's a little frustrating that Apple didn't launch HomeKit before the watch, since the company started teasing it nearly a year ago as part of iOS 8, and we're at 8.3 now.

I'm glad that the Apple Watch opens Apple Pay to more users, too. (Apple Watch requires an iPhone 5, 5c, 5s, 6, and 6 Plus, and of those, Apple Pay only worked on the 6 and 6 Plus.) Once you set up your

cards using the Apple Watch app on your iPhone, you don't even need your iPhone present to use Apple Pay on the watch. It's just as easy as using your iPhone—two taps of the button is all it takes to call up your card.

But it's slightly more awkward, because with the iPhone the screen is pointed toward you, but with the watch, you typically have to point the screen to the reader. Still, you'll feel a buzz and hear a beep when your payment goes through. I do feel more self-conscious using my Apple Watch to pay for things than my phone (it gets noticed!), but that might fade over time, as the watch becomes less novel.



I love getting wrist-taps to signal turns when using the Maps app on the watch.

I love getting wrist-taps to signal turns when using the Maps app on the watch. When I'm in the car, I use the iPhone to navigate, but I also like to listen to podcasts, and it's a drag when the Maps app's voice prompts keep interrupting my podcast. But if I turn off the voice prompts, I'm liable to get too engrossed in the podcast, space out, and miss my turn. So having the watch tap me on the wrist—10 taps before a right turn, and 6 taps as 3 pairs for a left turn—is great. I tend to still glance at the iPhone's screen in my Tackform dashboard mount to confirm I'm turning onto the right street, but it's been great, and I'll be using Maps instead of Waze from now on, at least when I'm listening to podcasts on the road.

But the Maps app isn't all bliss: I quickly turned off its corresponding

glance because I don't need to pinpoint my position on a map very often (maybe I'll turn that back on when traveling), and the Maps glance loaded more slowly than any other besides Heart Rate . . . which has a reason to be slow!

## Things I hate about it

That brings me to my main complaint with the Apple Watch: its poky performance. Since the lion's share of the data it presents comes from your iPhone, be prepared for lags. Even scrolling around its face, the refresh rate seems slow compared with what I'm used to (and spoiled with) on the iPhone and iPad. Location-based apps, like Maps and Weather, seem the slowest, as well as third-party apps that pull data from apps I haven't used on my iPhone for a while. The lagginess isn't a deal-breaker, but it is a bummer. The watch is definitely the slowest Apple product I've used in years.

Speaking of apps, with such a small home screen, Apple should let users hide built-in apps they don't plan to use. You're stuck with each app that comes on your Apple Watch, and you can't even banish them to a folder like you can on your iPhone. I don't plan to use the Stocks app, but it's going to take up space on my home screen anyway.

The timekeeping functions of the watch are broken out into five

separate icons on your home screen: the watch face, plus World Clock, Timer, Alarm, and Stopwatch. I don't want to remote those functions from my Apple Watch entirely, but they really don't need to take up five icons—I would be happy to hide the icons and launch the apps with Siri, or just have Siri interface with the apps for me. (She's happy to tell me what time it is in Barcelona, or to set an alarm for 7 a.m.) Calling the un-delete-able, un-hide-able Stocks app "bloatware"



You can rearrange the app icons, but you can't delete or hide any of the built-in apps.

seems a little harsh, but it really does annoy me to no end that I don't have full control over my watch's icons.

I'm also annoyed that the watch keeps me so tethered to my iPhone. Just being on the same Wi-Fi network as your iPhone isn't enough to maintain a connection—you need to be in Bluetooth range as well. The Apple Watch has both Wi-Fi (b/g/n) and Bluetooth 4.0, but it seems to use Bluetooth to broadcast its presence, and only engages Wi-Fi to actually transfer data. (I've asked Apple to confirm this beyond what's in the user guide, but haven't gotten a definitive answer.) My house is pretty small (1100 square feet and cute as a button), so I'm almost always in Bluetooth range of my iPhone, even if it's charging in another room. But at the office, my Apple Watch will lose the connection to my iPhone on my desk once I get more than 30 feet away, even though the Wi-Fi network extends through the entire floor. This isn't a dealbreaker either, but I had assumed I'd need either Bluetooth or Wi-Fi, not both.

## Jury still out?

I have mixed feelings about some of the Apple Watch's other marquee features as well.

**Digital Touch:** The exclusive watch-to-watch communication feature is fun to play with—an author can tap my wrist from 3000 miles away if I don't notice that she submitted a story for editing, which is great. But drawing tiny images with your finger is more whimsical than useful, and sharing a heartbeat is almost too intimate to do with anyone you're not getting naked in front of on a regular basis. But I do think it'll be the biggest seller of his-and-hers Apple products since FaceTime.

**Handoff for so much:** I get that you can't—and shouldn't—do everything from the Apple Watch, and using Handoff to send some tasks, like answering email, back to the phone is really the best way. But when Siri hands me off for something I can do on the watch, it's frustrating. If I ask Siri to play an unheard voicemail, she hands me off to my iPhone instead of launching the Phone app on the watch, which has a button for playing that voicemail.

**Siri:** Raising your arm should wake your watch (if

## Apple Watch

### AT A GLANCE
The Apple Watch excels as a remote control and activity tracker, but it's slow and requires a Bluetooth connection to your iPhone, among other quirks.

### PROS
· Haptic feedback and force touch gesture work well.
· Supports Apple Pay even without an iPhone present.
· Well-designed Activity and Workout apps provide good tracking and motivation.

### CONS
· No way to hide built-in apps from the home screen.
· Many apps and glances are slow to load.

$549 and up

★★★★★

it doesn't, go to Settings on the watch and look for Activate On Wrist Raise), and then you can say, "Hey, Siri." But I've found this a little hit and miss. Sometimes nothing happens. Sometimes Siri comes up and waits for me to ask something. Sometimes Siri pops up but immediately jumps to processing what I said, but I didn't say anything, so I just have to wait until she realizes I didn't say anything and asks me for a command. Pressing and holding the Digital Crown has been more reliable. (Some righties are even reorienting the watch's display so the Digital Crown is on the bottom left instead of the top right, just to make it easier to press with the right thumb.)

## Bottom line: Who's it for?

The Apple Watch isn't an essential tool for most people. I can't say that "no one needs this" after reading Molly Watt's (go.pcworld.com/mollywatt) excellent piece about using the Apple Watch as someone with Usher's Syndrome. She's deaf and blind, and the haptic feedback and Digital Touch feature are already making a big difference for her.

It absolutely isn't perfect, but it does what it set out to do, and I don't necessarily agree that Apple is trying to make the watch do too much. Different people will find different killer uses for it, and those will change over time as people use it more and experiment with different apps. I could go on and on about how the watch is the perfect way to navigate in the car while listening to podcasts, but that's a specific use, and maybe only 10 percent of people who read this will care—and only 10 percent of those will care enough to spend $350 to solve that problem.

If you're the experimental, early-adopter type, well, you already know if you want it or not. If you're on the fence, I'd let the software mature and the hardware get faster before jumping in. It's a lovely piece of hardware, and the Apple Watch Sport is a decent value since it does everything the more expensive versions do, but I think the responsiveness needs to improve, and the process for adjusting notifications needs to be overhauled, before it's a mainstream must-have. ⏻

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# 10 Obscure, highly specialized browsers

## THAT WILL MAKE YOU FORGET ABOUT CHROME, FIREFOX, AND IE

**BY IAN PAUL**

# Give the Big Three browsers the boot

When it comes to web browsing, most Windows users are concerned with only three choices: Firefox, Google Chrome, and Internet Explorer. You'll occasionally run into someone running Opera, too. But those aren't the only options—far from it!

There's a wide world of alternative browsers out there, all fighting for your attention with unique features and specializations in gaming, privacy, media consumption, and more. There's even something to appeal to old-school Internet users. If you're looking to shake up your web-surfing experience, here's a look at 10 great browsers not named Firefox, Chrome, or Internet Explorer.
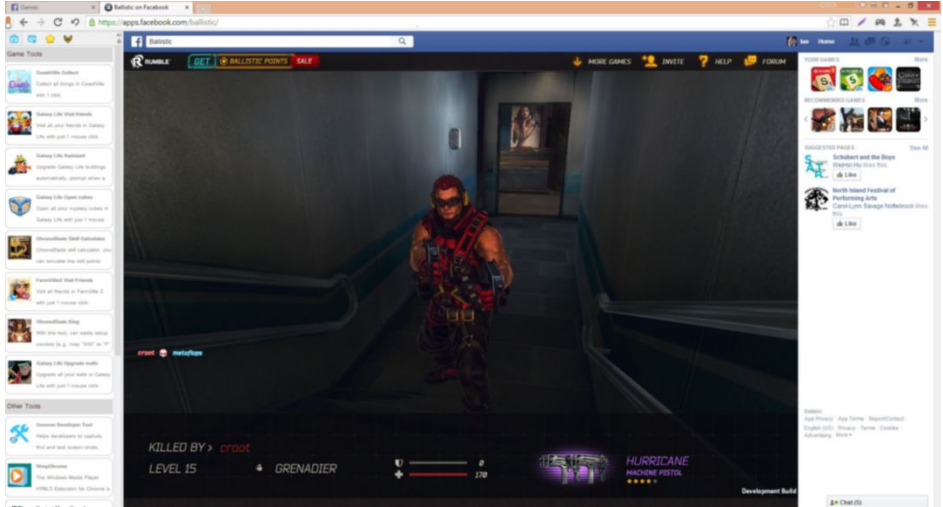
# 1  Coowon

UNDERPINNINGS: **Chromium**

FOCUS: **Gaming**

Coowon (coowon.com) is designed to be a browser for gamers. Not just any type of games, mind you, but the vast array of web-based games, from Ballistic to Farmville 2. Coowon has a sidebar with game-friendly features like the ability to record mouse clicks. You also get a built-in screenshot tool and an icon that lets you toggle between keyboard and gamepad controls. There's also a "boss" key (Alt + F1) to make it look like you're hard at work while you're really getting your game on.

In my test on Windows 8.1, the web-based installer didn't work very well, but Coowon has an offline installer that worked just fine.
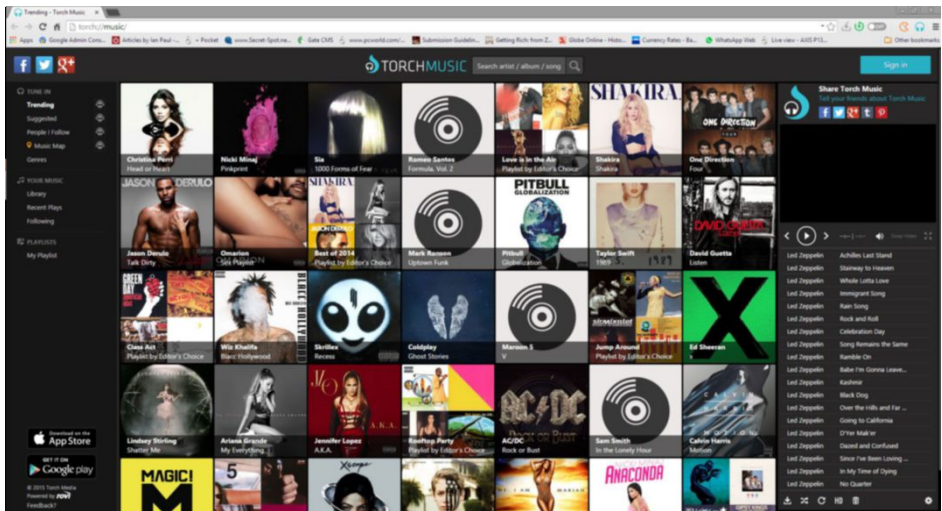
# 2 Torch

UNDERPINNINGS: **Chromium**
FOCUS: **Media**

Torch (torchbrowser.com) is a browser for media junkies with features for music and games. There's a built-in YouTube-based streaming service called
Torch Music. Torch Games gives you one-click access to a selection of web-based games. Torch also has some handy drag-and-drop sharing features: Drag web content to the left and you get a sidebar for sharing content on social networks, or drag content to the right to search for it.

Torch is also a media pirate's dream, with a built-in tool for downloading audio and video from sites like YouTube and Vimeo, as well as a built-in torrent client for… well, you know.

# 3  Lunascape

UNDERPINNINGS: **Trident, Gecko, or WebKit**
FOCUS: **Browser lovers**

Lunascape (lunascape.tv) is an interesting choice for those who can't decide which browser they like the best. It can run on one of three major browser engines, including Trident (Internet Explorer), Gecko (Firefox), or WebKit (Safari and formerly Chrome). And if you also love browser (small *c*) chrome then Lunascape is for you, because there is nothing minimalist about this browser. There are buttons everywhere, and Lunascape comes with a scrolling news feed that can be set to a variety of news sources, such as the BBC, CNN, or The New York Times. It also has a built-in RSS reader.

Lunascape ships with Trident as the default browser engine, and WebKit is also included. If you want to use Gecko, however, you'll have to download a plug-in.
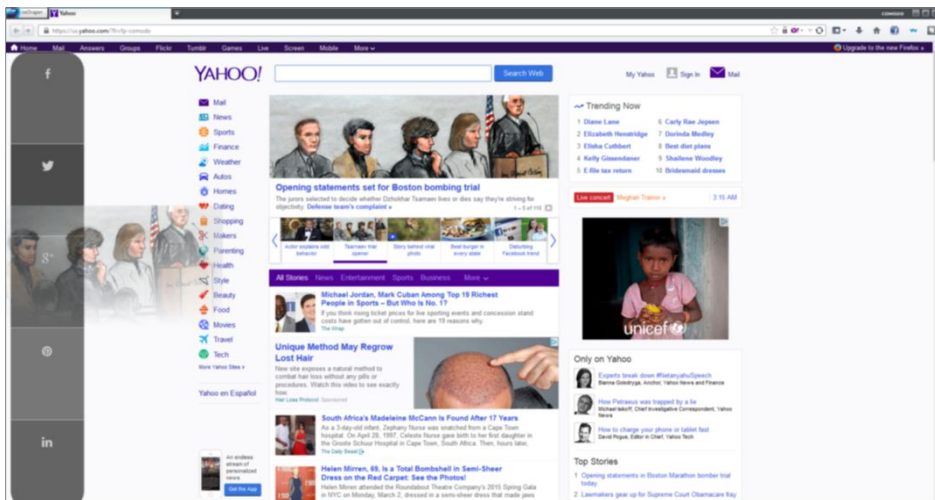
# 4  Comodo IceDragon

UNDERPINNINGS: **Gecko**
FOCUS: **Security**

From security firm Comodo, IceDragon (go.pcworld.com/comodo) is one of several browsers promising enhanced security. IceDragon's security props include webpage scanning for malware, the use of Comodo's Secure DNS service by default, and active blocking of known phishing and spyware sites. Similar to Torch, IceDragon lets you drag content from a webpage to the right to share it on social networks, and to the left to use that content as the basis of a web search.

You might be reluctant to try a Comodo product after PrivDog, a Comodo-associated piece of software, was found to be loaded with the dangerous Superfish adware. But fear not: IceDragon doesn't come with Superfish—at least the version we installed.
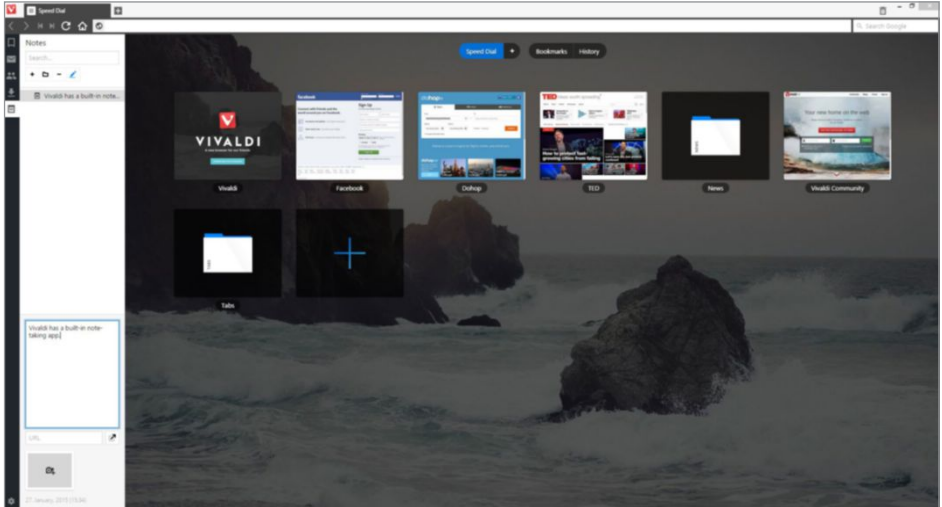
# 5 Vivaldi

UNDERPINNINGS: **Chromium**
FOCUS: **Power users**

Currently in its second technical preview, Vivaldi (vivaldi.com) is a Chromium-based browser that targets hard-core power users. It's a very simple browser at the moment, taking a lot of cues from current and former Opera features (Opera's former CEO is leading the Vivaldi effort).

Vivaldi has a speed-dial feature for quick access to favorite sites and a built-in note-taking app, while a built-in mail client is under development.

# 6 SeaMonkey

UNDERPINNINGS: **Gecko**

FOCUS: **old-school all-in-one Internet suite**

SeaMonkey (seamonkey-project.org) has been around for nearly ten years, and it's still going strong—but SeaMonkey is an ideal choice only for hard-core web users who want almost everything you could possibly think of in one package.

SeaMonkey integrates a browser, an email client, a RSS and newsgroup client, an HTML editor, and an IRC client. The only thing missing from this suite is the ability to download torrents… but you can get that as an add-on.
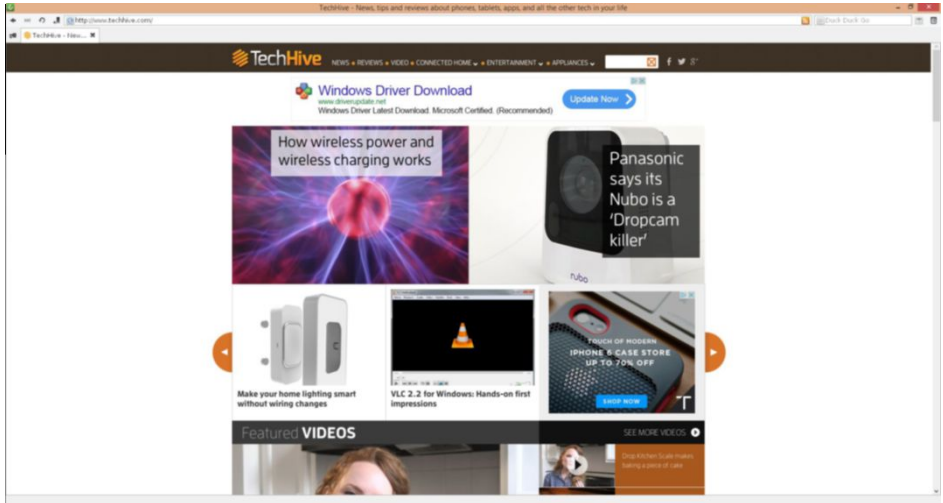
# 7 Midori

UNDERPINNINGS: **WebKit**
FOCUS: **Lightweight**

Midori (midori-browser.org) has long been a popular choice for underpowered Linux systems, but there's also a Windows version for anyone who needs a lightweight browser.

You'll find Midri to be pretty simple, lacking any major features and sporting an almost XP-like interface. On the upside, it's responsive and very simple to use. There's also a portable version if you want to run it from a USB stick.
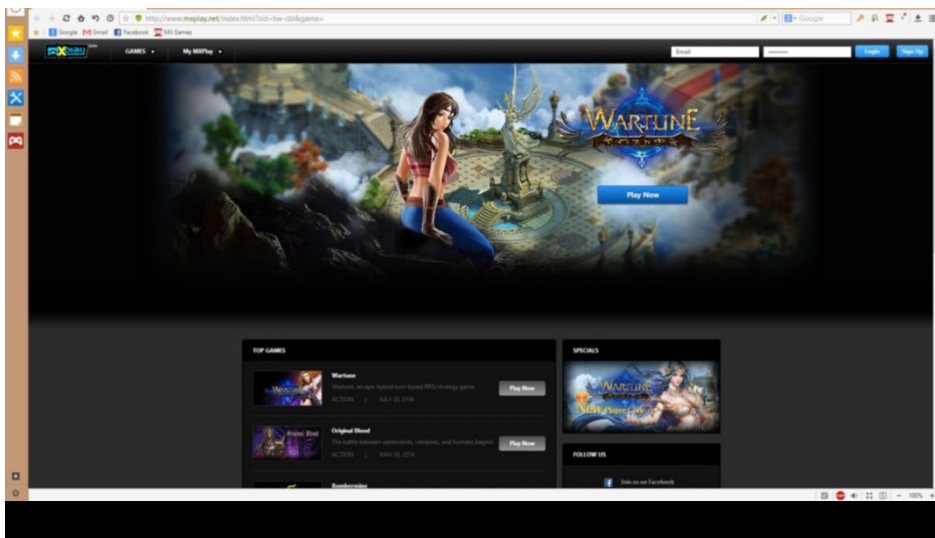
# 8 Maxthon Cloud Browser

UNDERPINNINGS: **Trident and WebKit**
FOCUS: **Multi-device browsing and social**

The biggest feature for Maxthon (maxthon.com) is its cloud-based account, called Passport, which syncs browsing data across your devices. That's a common feature among the major players, but not as common in the world of alternative browsers. Passport also has a feature called Cloud Push that lets you share content with your friends via email or text message.

Maxthon comes with its own RSS feed reader, a note pad, AdBlock Plus, and a link to Maxthon's games site. There's also a "reader mode" for when you want to read articles more easily without all the distractions of a typical website. Similar to Lunascape, Maxthon isn't a single-engine browser, instead relying on both Trident and WebKit. Unlike Lunascape, however, Maxthon determines which engine to use on the fly.
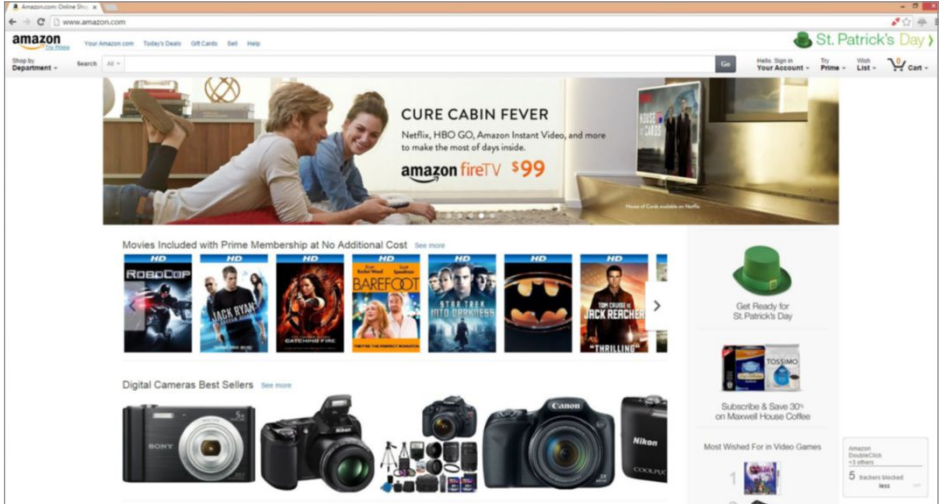
# 9 Epic Privacy Browser
UNDERPINNINGS: **Chromium**
FOCUS: **Privacy**

If you like Chrome but don't like forking over all your info to Google and other advertisers, then Epic Privacy Browser (epicbrowser.com) may be for you.

The browser doesn't deviate far from its Chrome-based roots, but it comes with a bunch of privacy-enhancing features like a built-in proxy, always-on private browsing, and built-in blockers for third-party cookies and trackers. Epic dumps Google account integration, so don't use this browser if you want to sync bookmarks and open browser tabs with Google's servers.
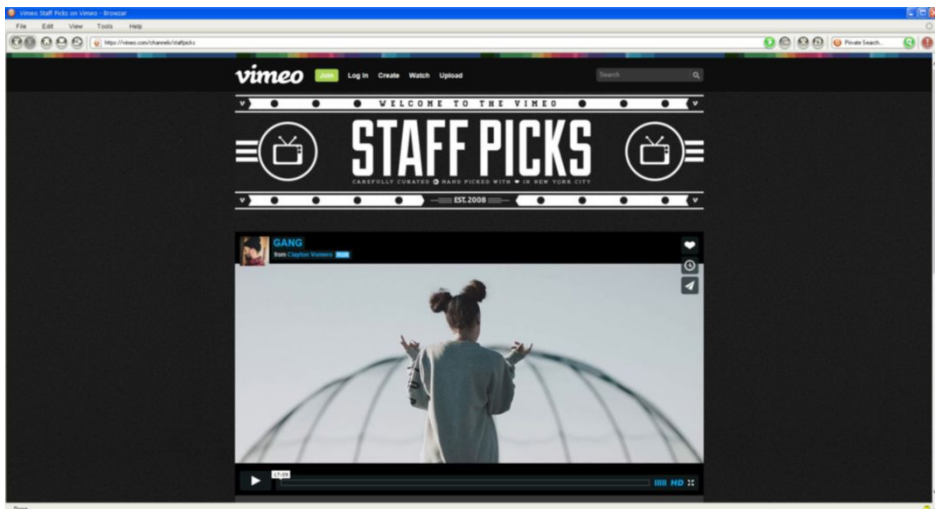
# 10 Browzar

UNDERPINNINGS: **Internet Explorer**
FOCUS: **Privacy**

Unlike Epic, Browzar (browzar.com) is billed as a throw-away browser that lets you get online on a PC without leaving any visible trace afterwards. The browser comes with several skin options and doesn't install itself on your system the way other browsers do. Just click the EXE file and it fires up in seconds. It's also crazy-small at just 222 kilobytes. That speediness and compact size is due to the fact that Browzar relies on your PC's built-in Internet Explorer files to run.

To keep your browsing private, Browzar deletes web, flash, and java caches on the fly, doesn't save your web history, and blocks autocompletion.

# SSDs HAVE A PROBLEM:

## *They're getting too fast, too soon*

**BY GORDON MAH UNG** • *ILLUSTRATION BY DANIEL DOWNEY*

**A**LL THE HAND-WRINGING over SSD reliability aside, the future of computing still belongs to solid-state drives. To be frank, no one who cares about performance is going back to mechanical drives as a primary boot device unless hell freezes over.

The problem performance junkies face going forward is just how all this storage performance will fit into their PCs. With SSDs literally getting faster than the interfaces they're supposed to go into every year, the path forward is murky.

The drive that puts the exclamation mark on this problem is Intel's glorious 750-series SSD, which we reviewed in this issue (See page 38).

This drive marks a major turning point for the PC. When these drives are powered down and thrown into the scrap heap in a few years, they will still be remembered for ushering in the era of Non-

123

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Volatile Memory Express. NVMe (go.pcworld.com/nvme) is the replacement for the Adaptive Host Control Interface that most hard drives and SSDs run on today. AHCI was designed for hard drives and the inherent latency they bring with them. As you can imagine, running an SSD on protocols, commands and queue depths designed for a head moving around a disc isn't great.

NVMe is designed for a greater magnitude of parallelism. Among its most impressive specs is the ability to manage almost 65,000 commands at a time, vs. 32 commands for AHCI. Today's SSD may not be able to push that many commands, but think of it as headroom for future memory technologies—and like always, the future will get here faster than we expect.

That brings us to how exactly we connect our storage down the road. Today it's the familiar Serial ATA, or SATA port.

SATA Express was supposed to be its replacement. Unfortunately, it underestimated today's storage needs. SATA Express as currently implemented in PCIe mode (it also supports plain SATA) has a maximum throughput of 10Gbps theoretical, using two lanes of PCIe Gen 2.0. That's better than the 6Gbps of SATA, but not by much, and we're well beyond that already.

I remember being shown the first Z97 motherboards with SATA

**Intel's celebrated** 750-series drive marks the beginning of a big change for PCs and many questions too.
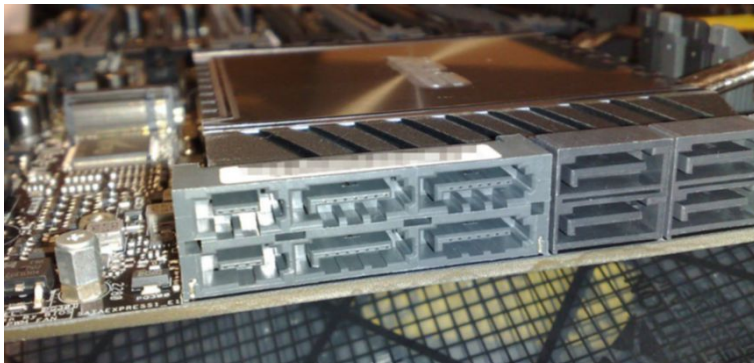
Express last year (and questioning its limits already) and being told the natural move would be to add more lanes or increase it to PCIe Gen 3.0 support.

Instead, these days, the talk positions SATA Express for future hard drives only, so clearly the industry doesn't think SATA Express is going to be where we plug our future SSDs.

The other option seems to be M.2, and why not? Originally called NGFF or next-gen form factor, M.2 today can support up to four lanes lanes of PCIe Gen 2.0 or Gen 3.0., running Gen 3.0 speeds. That's almost 4GBps, theoretically.

The problem with using M.2 alone is its limited capacity: It was always intended as a laptop storage option with the

**Originally called NGFF or next-gen form factor, M.2 today can support up to four lanes lanes of PCIe Gen 2.0 or Gen 3.0., running Gen 3.0 speeds.**

chips mounted to it. Today, that limits it to 512GB drives. I'm sure M.2's max will increase, but it won't keep pace with standard drives which already easily reach 6TB.

One option being explored, though it doesn't look pretty, is connecting to existing M.2 using a Mini-SAS connector. Intel even makes a version of its 750 drive in the SFF-8639 trim that's meant for

servers and workstations. To connect it to today's motherboards, you'd mount the Intel 750 drive in a standard drive bay and run a cable to the Mini-SAS connector into your motherboard's M.2 slot. The setup is ungainly and the cable length short.

The only path for us today and in the near future is occupying a PCIe slot. It's the easiest way to get to the

## The problem there is what happens when you run more than one graphics card.

most performance, and more bandwidth can be added by just adding lanes. The Intel 750 drive, for example, uses four PCIe lanes in PCIe Gen 3.0 mode.

The problem there is what happens when you run more than one graphics card. With a drive as fast as the Intel SSD installed, a typical consumer gaming box will cut the bandwidth to the video card in half. Granted, most games and most video cards don't really use all of that bandwidth. But what happens when that gamer wants to run the Intel drive with two video cards? To paraphrase Dana Carvey paraphrasing George HW Bush: "It's not gonna happen."

And if you think M.2 solves the problem it doesn't. Remember it needs PCIe in Gen 3.0 mode, too, and there just isn't enough to go around on consumer systems.

That means drives like Intel's will really only match up with the highest gaming systems, using the company's X99 chipset and Core i7-5960X CPU. Unlike the consumer-focused Haswell chips with support for but 16 PCIe lanes, the Core i7-5960X packs 40 lanes. Extreme

**M.2 would be** the natural place to turn for high-speed performance but right now, it tops out at 512GB.
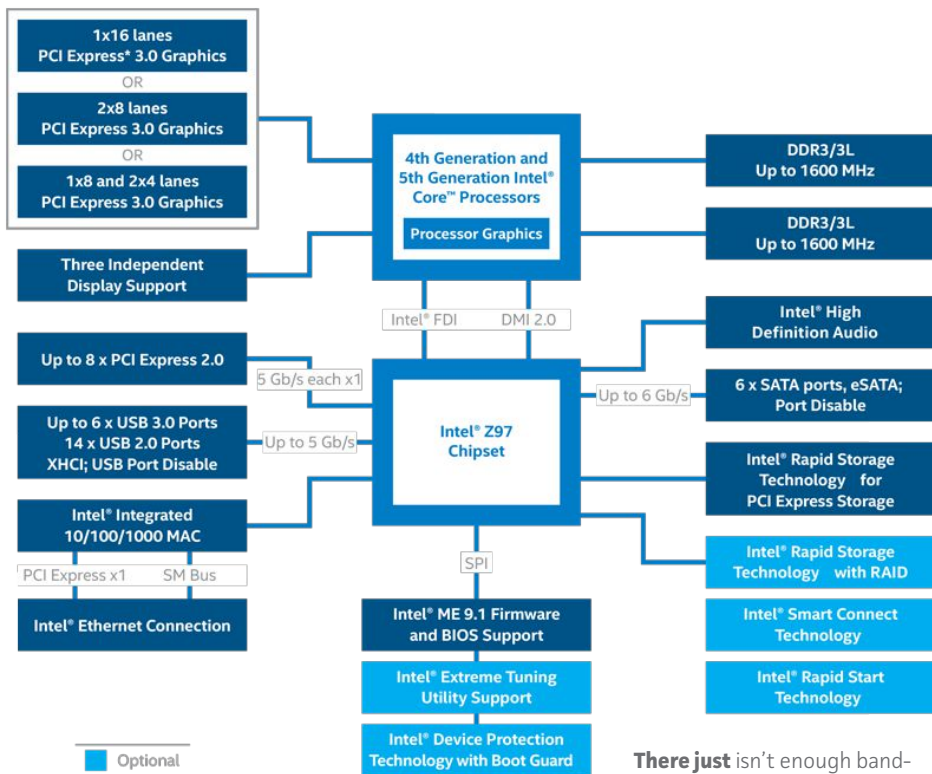
**There just** isn't enough band-width to go around on Intel's consumer-grade Z97 chipset.

gamers who like to run three or four video cards could still run into bottlenecks, but most other users won't feel the pinch quite yet.

The "easy" answer to all of this is PCIe Gen 4.0. That, spec, however, won't be available until 2016, and integration into CPUs and motherboards will certainly be far beyond that date. This is a good "problem" to have, but it's amazing to think it's a problem at all. ⏻

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# HERE'S HOW

## CONTENTS

# How to get started with Linux: A beginner's guide
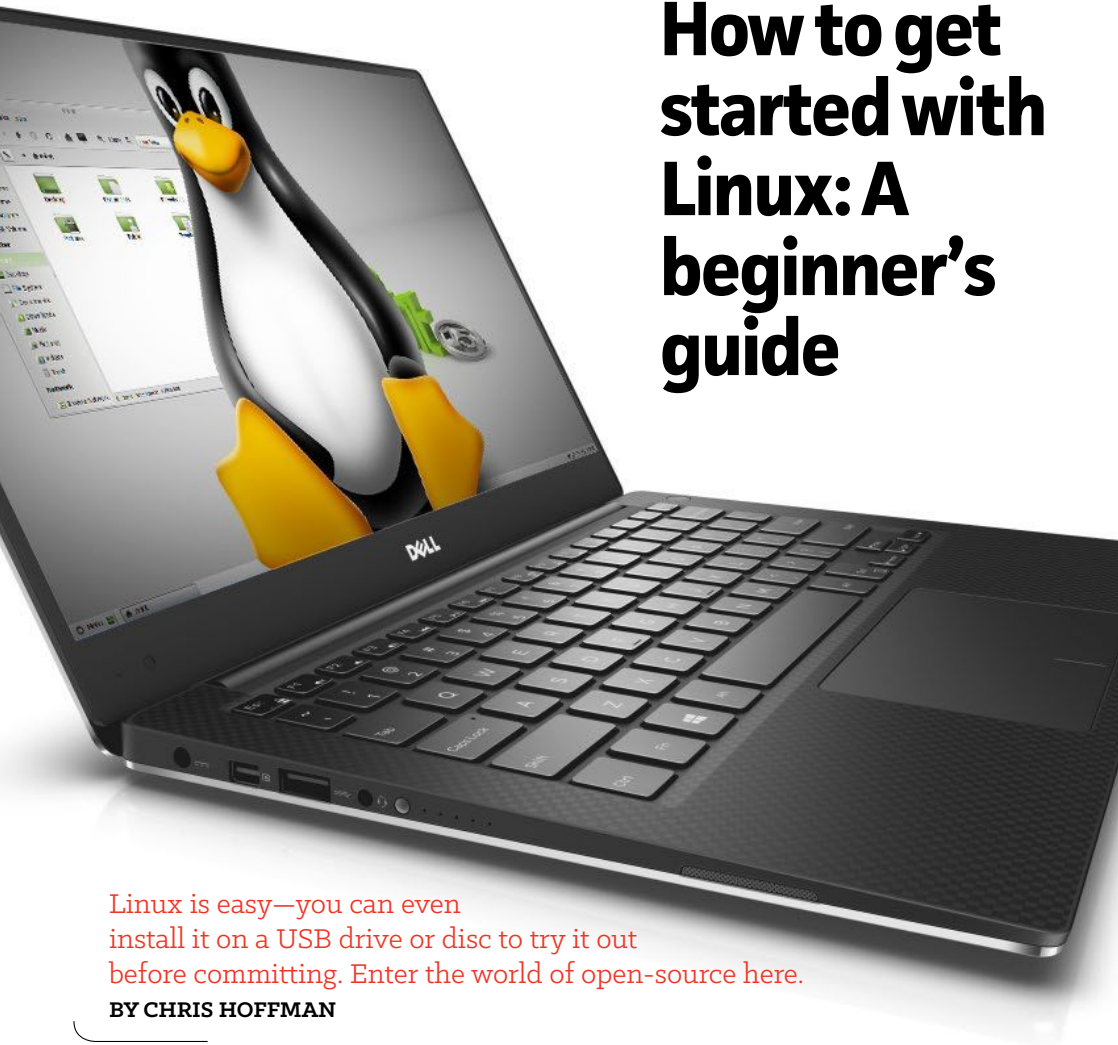
Linux is easy—you can even
install it on a USB drive or disc to try it out
before committing. Enter the world of open-source here.

**BY CHRIS HOFFMAN**

**T**HE WORLD of Linux is ready to welcome you, with a shower of free open-source software you can use on any PC: hundreds of active Linux distributions, and dozens of different desktop environments you could run on them. It's a far cry from the one-size-fits-all, this-is-just-what-comes-with-your-PC vision of Windows.

Everything from software installation to hardware drivers works differently on Linux, though, which can be daunting. Take heart—you don't even need to install Linux on your PC to get started. Here's everything you need to know.

## Choose and download a Linux distro

The first step is choosing the Linux distribution you'll want to use.

Unlike Windows, there's no single version of Linux. Linux distributions take the Linux kernel and combine it with other software like the GNU core utilities, X.org graphical server, a desktop environment, web browser, and more. Each distribution unites some combination of these elements into a single operating system you can install.

DistroWatch offers a good, in-depth summary (go.pcworld.com/distrowatch) of all the major Linux distributions you might want to try. Ubuntu is a fine place to start for former (or curious) Windows users. Ubuntu strives to eliminate many of Linux's rougher edges. Many Linux users now prefer Linux Mint, which ships with either the Cinnamon or MATE desktops—both are a bit more traditional than

**Fedora Linux** with the Gnome Shell desktop.

Ubuntu's Unity desktop.

Choosing the single best one isn't your first priority, though. Just choose a fairly popular one like Linux Mint, Ubuntu, Fedora, or openSUSE. Head to the Linux distribution's website and download the ISO disc image you'll need. Yes, it's free.
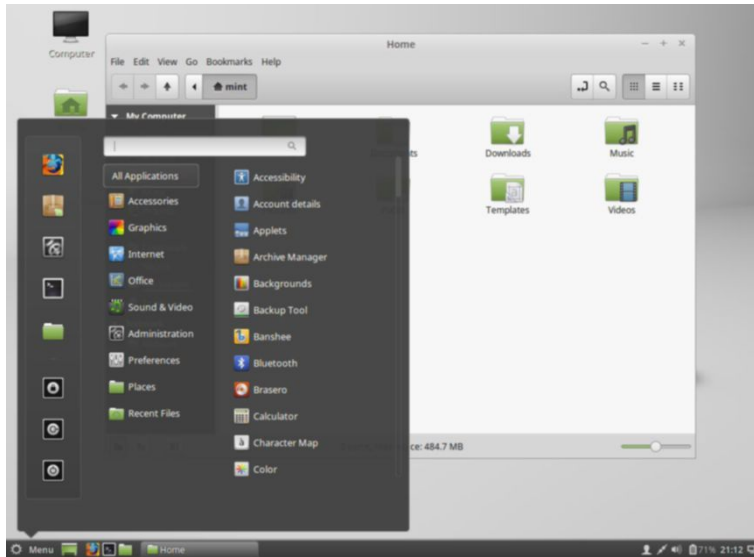
You can now either burn that ISO image to a DVD, or use a tool like the Universal USB Installer (go.pcworld.com/usbinstall) to copy that Linux system to a USB drive. Placing it on a USB drive is a better idea, if possible—the live system
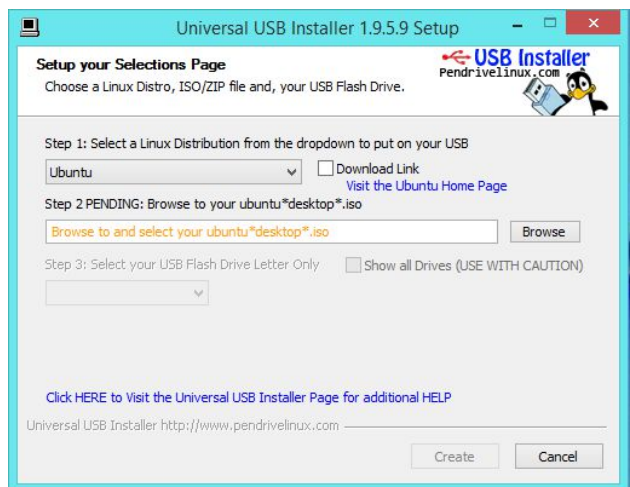
will boot and run faster. But if you plan on installing it immediately, a disc is also fine.

That's the way it'll work on a typical Windows PC, anyway. If you want to use Linux on a Chromebook (go.pcworld.com/cb), Raspberry Pi (go. pcworld.com/rpi), or another type of device, there are special instructions you'll need to follow.



**Fedora's Live** CD interface, like most Linux distributions, lets you choose to run the operating system from your bootable media or install it to your hard drive.

## We'll do it live!

Now you'll need to boot that Linux system. Restart your computer with the disc or USB drive inserted and it should automatically boot. If it doesn't, you may need to change your BIOS (go.pcworld.com/bios1) or UEFI firmware (go.pcworld.com/uefi1) boot order, or select a boot device during the boot process.

On modern Windows PCs that came with Windows 8, you may have to disable Secure Boot (go.pcworld.com/sboot) before booting Linux. Some Linux distributions will boot normally with Secure Boot enabled, while some won't. Most of the larger distributions will.

Your Linux distribution of choice probably allows you to use it in a "live" environment, meaning it runs entirely off the disc or USB drive and doesn't actually need to be installed to your computer's hard drive. Just use the Linux desktop normally and get a feel for it. You can even install software, and it'll remain installed in the live system until you reboot.

Even if you don't want to use Linux as your everyday operating system, having this Linux live DVD or USB drive around can be useful. You can insert it into any computer and boot Linux whenever you want. Use it to troubleshoot Windows problems, recover files from a corrupted system, scan an infected system for malware, or provide a secure environment for online banking and other important tasks. Another handy trick: If you enable the "persistence" option when putting Ubuntu on the USB drive, you can save files and settings to the drive and they'll remain accessible every time you boot it.

To leave the live Linux system, just reboot your computer and remove the disc or USB drive.



**Ubuntu Linux's** "Dash" applications list.

## Feel your way around

Depending on which Linux distribution and desktop environment you choose, your desktop environment and installed applications will vary—though most will cover your typical needs. Most Linux distributions ship with the Firefox web browser, for example, and Google's Chrome or the open-source Chromium browser are just a few clicks away.

Your desktop environment should have all the standard bits: an application menu, some sort of taskbar or dock, and a notification

area or "system tray." Click around to see what everything does. You should also find a collection of system configuration utilities, which will let you configure your hardware and make your desktop work the way you'll like it.

Ubuntu's Unity desktop can be quirky, but it's packed with useful features you'd never find on your own, like the HUD. Read my Ubuntu guide (go.pcworld.com/uguide) for displaced Windows users for more details. Be sure to enable virtual desktops (most modern Linux desktops have disabled them by default) and give them a shot, too. (Windows users are about to discover how useful they are in Windows 10.)

## Install Linux, or not

You have choices about when and how to install Linux. You can leave it on a disc or USB drive and boot it up whenever you want to play with it. Play with it several times until you're sure you want to install it. You can try several Linux distributions in this way—you can even reuse the

same USB drive.

The big reasons to install Linux instead of just running it from a USB drive or disc are productivity and convenience. Unlike running Linux live, installed Linux will remember your settings, keep your installed software, and maintain your files between reboots.

Once you're ready to take the plunge, installing Linux on your PC is easy—just launch the installer provided in the live Linux environment. You have yet another choice here, though: You could wipe away your existing Windows system (assuming that's your current OS) and replace it with Linux, but installing it in a "dual-boot" configuration, or "alongside Windows," in Ubuntu installer parlance, is the more flexible choice. The installer will resize your Windows partition to make room for Linux, and you can select which operating system you want to use every time you boot your computer.

## How to install more software

Software installation on Linux works very differently from software installation on Windows. You don't need to open your web browser



**OpenSUSE's YaST** software management tool.
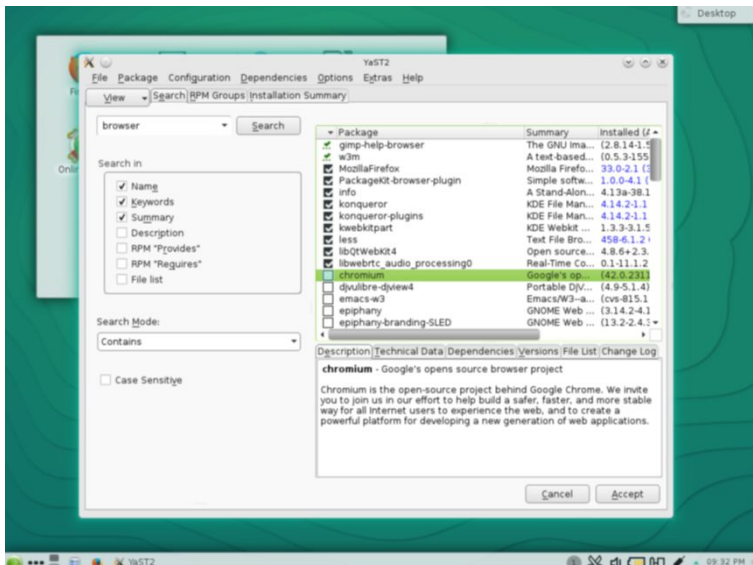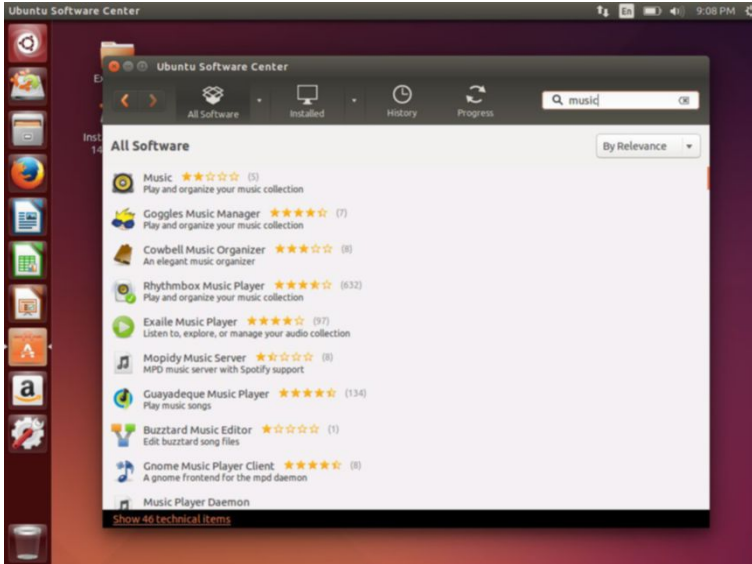
and search for applications. Instead, look for the software installer on your system. On Ubuntu, this is the Ubuntu Software Center. On Linux Mint, it's the Software Manager. On Fedora, it's just named Software.

This isn't just a fancy interface for downloading software from the web. Your Linux distribution hosts its own "software repositories," containing software compiled to work with it. This software is tested and provided by the Linux distribution. If security patches are necessary, your Linux distribution will provide them to you in a standard way.

Basically, it's like an app store full of free, open-source software—except Linux distributions were doing "app stores" like this long before Apple popularized the concept.

Some applications—particularly closed-source applications like Google Chrome, Steam, Skype, Minecraft, and others—must be installed from outside your Linux distribution's package manager. You can download these applications from their official websites, just as you would on Windows. Be sure to download the installer package
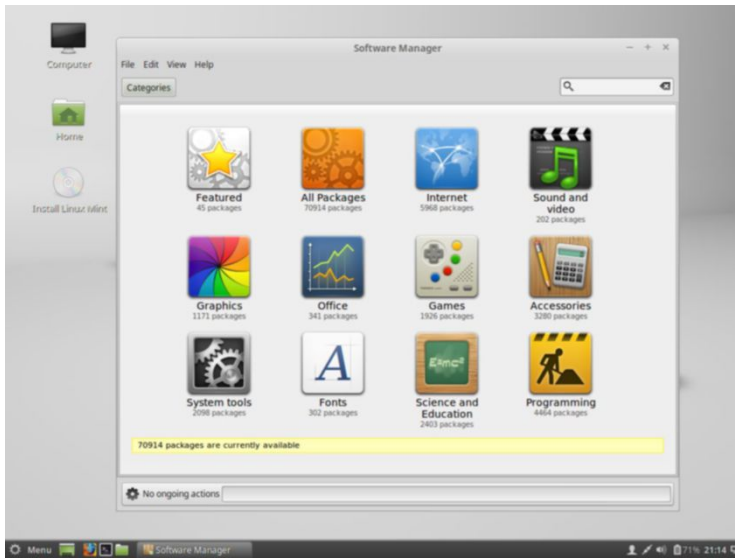
designed for the Linux distribution you're using.

Contrary to widespread belief, you probably don't need to install hardware drivers manually when you install the operating system. Most of the hardware drivers you'll need are built-in on Linux. There are a few closed-source drivers you might want—the Nvidia and AMD drivers for optimal 3D graphics performance, or Wi-Fi drivers to make your Wi-Fi hardware work right.

Ubuntu and Linux Mint will recommend these to you via their hardware driver tools, if necessary. Some Linux distributions may not help you install these at all. For example, Fedora doesn't want to endorse closed-source Linux drivers.

Despite the software installation differences, Linux should feel reasonably familiar for anyone who's used a Windows desktop before. You'll find windows, context menus, control panels, and more. Many of the applications you'll use on Linux are popular programs you may have already used on Windows, from Firefox to VLC and LibreOffice. And now you have the basic knowledge you need to get started using Linux. Happy exploring! ⏻

**SURE, AT FIRST I WAS A LITTLE TAKEN ABACK BY THE WHOLE PEEING STANDING UP THING. BUT I TAUGHT HIM TO THROW A STICK AND NOW HANGING OUT WITH HIM IS THE BEST PART OF MY DAY.**

—EINSTEIN
adopted 12-09-10

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# Excel cheat sheet: 15 tips for calculations and common tasks

BY JD SARTAIN

**MANY OF US** fell in love with Excel as we delved into its deep and sophisticated formula features. Because there are multiple ways to get results, you can decide which method works best for you. For example, there are several ways to enter formulas and calculate numbers in Excel.

# Five ways to enter formulas

### 1. Manually enter Excel formulas:

Long Lists: =SUM(B4:B13)

Short Lists: =SUM(B4,B5,B6,B7); =SUM(B4+B5+B6+B7).

Or, place your cursor in the first empty cell at the bottom of your list (or any cell, really) and press the plus sign, then click B4; press the plus

sign again and click B5; and so on to the end; then press Enter. Excel adds/totals this list you just "pointed to:" =+B4+B5+B6+B7.

## 2. Click the Insert Function button

Use the Insert Function button under the Formulas tab to select a function from Excel's menu list:

=COUNT(B4:B13) Counts the numbers in a range (ignores blank/ empty cells).

=COUNTA(B3:B13) Counts all characters in a range (also ignores blank/ empty cells).

## 3. Select a function from a group (Formulas tab)

Narrow your search a bit and choose a formula subset for Financial, Logical, or Date/Time, for example.

=TODAY() Inserts today's date.



**Use the AutoSum** button to calculate basic formulas such as SUM, AVERAGE, COUNT, etc.

**4. The Recently Used button**

Click the Recently Used button to show functions you've used recently. It's a welcome timesaver, especially when wrestling with an extra-hairy spreadsheet.

=AVERAGE(B4:B13) adds the list, divides by the number of values, then provides the average.

**5. Auto functions under the AutoSum button**

Auto functions are my editor's personal favorite, because they're so fast. Select a cell range and a function, and your result appears with no muss or fuss. Here are a few examples:

=MAX(B4:B13) returns the highest value in the list.

=MIN(B4:B13) returns the lowest value in the list.

Note: If your cursor is positioned in the empty cell just below your range of numbers, Excel determines that this is the range you want to calculate and automatically highlights the range, or enters the range cell addresses in the corresponding dialog boxes.

Bonus tip: With basic formulas, the AutoSum button is the top choice. It's faster to click AutoSum>SUM (notice that Excel highlights the range for you) and press Enter.

Another bonus tip: The quickest way to add/total a list of numbers is to position your cursor at the bottom of the list and press *Alt* and = (press the Alt key and hold, press the equal sign, release both keys), then press Enter. Excel highlights the range and totals the column.

# Five handy formulas for common tasks

The five formulas below may have somewhat inscrutable names, but their functions save time and data entry on a daily basis.

Note: Some formulas require you to input the single cell or range address of the values or text you want calculated. When Excel displays the various cell/range dialog boxes, you can either manually enter the cell/range address, or cursor and point to it. Pointing means you click the field box first, then click the corresponding cell over in the

worksheet. Repeat this process for formulas that calculate a range of cells (e.g., beginning date, ending date, etc.)

## 1. =DAYS

This is a handy formula to calculate the number of days between two dates (so there's no worries about how many days are in each month of the range).

   Example: End Date October 12, 2015 minus Start Date March 31, 2015 = 195 days

   Formula: =DAYS(A30,A29)

## 2. =NETWORKDAYS

This similar formula calculates the number of workdays (i.e., a five-day workweek) within a specified timeframe. It also includes an option to subtract the holidays from the total, but this must be entered as a range of dates.

   Example: Start Date March 31, 2015 minus End Date October 12, 2015 = 140 days

   Formula: =NETWORKDAYS(A33,A34)

## 3. =TRIM

TRIM is a lifesaver if you're always importing or pasting text into Excel (such as from a database, website, word processing software, or other text-based program). So often, the imported text is filled with extra
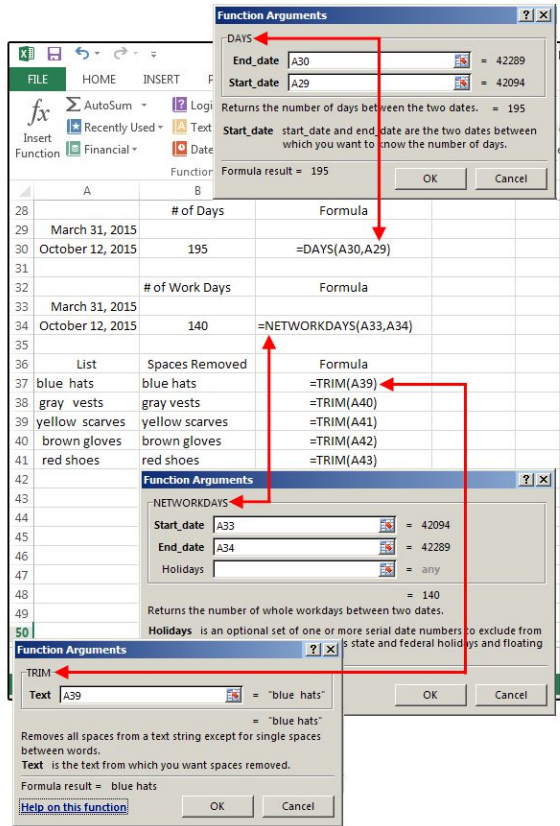
spaces scattered throughout the list. TRIM removes the extra spaces in seconds. In this case, just enter the formula once, then copy it down to the end of the list.

Example: =TRIM plus the cell address inside parenthesis.

Formula: =TRIM(A39)

## 4. =CONCATENATE

This is another keeper if you import a lot of data into Excel. This formula joins (or merges) the contents of two or more fields/cells into one. For example: In databases; dates, times, phone numbers, and other multiple data records are often entered in separate fields, which is a real inconvenience. To add spaces between words or punctuation between fields, just surround this data with quotation marks.

Example: =CONCATENATE plus (month,"space",day,"comma space",year) where month, day, and year are cell addresses and the info inside the quotation marks is actually a space and a comma.

Formula: For dates enter: =CONCATENATE(E33," ",F33,", ",G33)

Formula: For phone numbers enter: =CONCATENATE(E37,"-",F37,"-",G37)

## 5. =DATEVALUE

DATEVALUE converts the above formula into an Excel date, which is necessary if you plan to use this date for calculations. This one is easy: Select DATEVALUE from the formula list. Click the Date_Text field in the dialog box, click the corresponding cell on the spreadsheet, then click OK, and copy down. The results are Excel serial numbers, so you must choose Format>Format Cells>Number>Date, and then select a format from the list.

Formula: =DATEVALUE(H33)

# Three more formula tips

As you work with formulas more, keep these bonus tips in mind to avoid confusion:

**Tip 1:** You don't need another formula to convert formulas to text or numbers. Just copy the range of formulas and then paste as Special > Values. Why bother to convert the formulas to values? Because you can't move or manipulate the data until it's converted. Those cells may look like phone numbers, but they're actually formulas, which cannot be edited as numbers or text.

**Tip 2:** If you use Copy and Paste > Special > Values for dates, the result will be text and cannot be converted to a real date. Dates require the DATEVALUE formula to function as actual dates.

**Tip 3:** Formulas are always displayed in uppercase; however, if you type them in lowercase, Excel converts them to uppercase. Also notice there are no spaces in formulas. If your formula fails, check for spaces and remove them. ⏻

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# How to make Dropbox more secure without spending a cent

**BY MICHAEL ANSALDO**
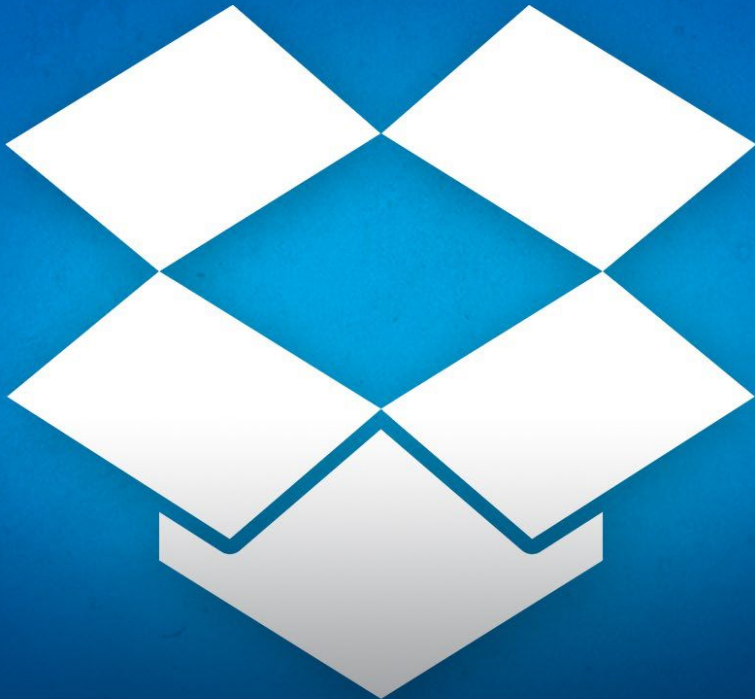


**DROPBOX HAS HAD** its share of security woes over the years. While the cloud storage provider has done much to beef up its defenses (go.pcworld.com/beef), there's still plenty you can do on your own to improve the safety of your files. Here are a few ways to get started.

**One of the** easiest ways to improve Dropbox security is to enable two-step verification.
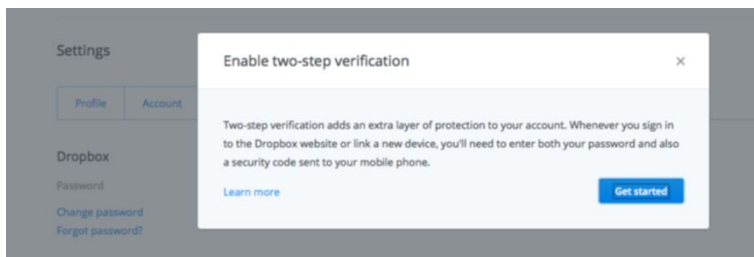
## Use two-step verification

Thanks to increasingly ambitious hackers and users' tendency to rely on comically weak passwords, one-factor authentication has become something of a joke. (Bonus tip: Get the last laugh by using a password manager on your computer or as a mobile app.) In light of this, most major services, including Dropbox, have implemented two-step verification. This system requires you to enter both your password and a security code sent to your mobile phone, and it's the easiest way to increase the security of your account.

To enable two-step verification, log into your Dropbox account, click your username in the upper right corner, and select Settings from the drop-down menu. Click the Security tab, then click Enable under Two-Step Verification. Follow the prompts to set up this feature.

## Unlink old devices

Much of Dropbox's power lies in the ability to use it across multiple



**Old or unused** devices still linked to your Dropbox account can compromise security.

devices. But considering most of us upgrade our smartphones, tablets, and computers every few years, you're likely you have some old devices still attached to your Dropbox account. That poses a security risk.

To unlink any devices you don't use or no longer have, follow the above steps to get to the Security tab and scroll down to "Devices." Here you'll find a list of devices that currently have access to your Dropbox account, along with the date of their most recent Dropbox activity. To unlink a device from your account, click the X at the far right of its name.

## Manage app access

A wealth of third-party apps integrate with Dropbox to extend its capabilities, most of which require full access to your account. An app retains its access even if you don't use it anymore, and if that app's developer stops supporting it or it otherwise becomes compromised, it may give hackers an easy entrée into your account. To prevent this, you need to revoke the access of any apps you don't regularly use.

Return again to the Security tab and scroll down to the Apps Linked section. You'll see a list of all the apps you've authorized to access your Dropbox account, along with the extent of access. To remove any app, click the X at the far right of its name.

## Monitor web sessions

In addition to devices and apps, Dropbox also tracks web browsers that are logged into your account. This is an easy way to monitor for any

unauthorized activity.

Go to the Security tab, and scroll down to Sessions. This is a list of all the browsers currently logged in to your account, along with their country of origin and the time of the activity. If you see any you don't recognize, you'll know your account has been breached. It's also a good idea to go in from time to time and remove any of your old activity—just click the X next to the entries you want to delete.

## Encrypt your files

While these measures will minimize any holes in your Dropbox security, none of them will safeguard your data if someone does break into your account. In that event, encryption remains the best protection for your files.

While Dropbox encrypts your data in transit and at rest, you can add an extra layer of protection with a third-party solution like Boxcryptor. This service encrypts your files before you upload them, then places them in a special Boxcryptor folder within your Dropbox. Boxcryptor offers free, Personal ($48/year) and Business ($96/year) licenses, as well as a selection of mobile apps for anywhere-access to your encrypted files. It's also "zero-knowledge" software—Boxcryptor doesn't have access to your encryption keys or passwords, so the security of your data remains in your hands, where it belongs. ⏻

# 3 surprisingly easy PC repairs you should do yourself

**PCS CAN BE** confusing, even scary at times, but the truth is they shouldn't be. That's especially true when it comes to simple hardware upgrades, repairs, or software fixes.

Sure, you could pay the overpriced techies at Geek Squad to fix your Windows system for you, but why bother? Tech support is often hiding a dirty secret: You could easily do most of this stuff on your own and save yourself some serious money in the process.

To get you started, here are three fixes you should almost never pay someone else to do.

## Swapping or adding RAM

Do you know how to swap out an old-school video game cartridge or load a DVD player? Great, then you've got the basic skills required to swap out RAM. Most PCs, especially laptops, allow for easy access to your RAM. On laptops, for example, they are typically accessible after you loosen a few screws on the underside of the chassis.

Once the screws are removed and your laptop is open, you just have to remove the old stick, slide the new RAM into place—they'll only fit one way—and you're done. (If you're upgrading a desktop PC, you'll also have to fiddle with latches at either end of the stick, which locks the memory into place.) Despite all the warnings, RAM is surprisingly robust and can survive a bit of moderate manhandling.

There are exceptions to this, such as MacBooks and Ultrabooks that solder their RAM to the motherboard, but those machines don't really count since you can't upgrade them anyway.

The hardest part of swapping RAM isn't the physical installation, but the purchasing process. You have to make sure you're buying the right kind of RAM for your system based on the type your motherboard supports such as DDR2 or DDR3 plus the speed, which is expressed in megahertz (MHz).

Once you've got those two facts down, you're good to go.

You can usually find out the information you need by consulting your PC manufacturer's website. There are also tools like Crucial System Scanner (crucial.com/systemscanner) and CPU-Z (go.pcworld.com/cpu-z) that can gather this data for you.

To learn more about swapping out RAM, check out our tutorial on How to Add RAM to your laptop (go.pcworld.com/laptopram). We've also got some tips and warnings about doing your research before upgrading your RAM (go.pcworld.com/upgrade-ram).

## A laptop keyboard

Similar to RAM, many laptop keyboards are dead easy to swap out. You may need to do this if your keyboard doesn't survive a close encounter with a soda can or because of component wear and tear.



A keyboard replacement usually requires undoing a few screws, gently sliding the keyboard unit out of your clamshell, and releasing the data cable connected to the motherboard. Then you just take the reverse steps to install the new unit. Check out our general overview on how to replace a laptop keyboard (go.pcworld.com/replacekeyboard) to get a better sense of the process.

Note that this is *generally* how laptop keyboards work, but there will be exceptions. The best way to research what your laptop requires is to search for a keyboard swap of your unit (or a similar unit) on YouTube. Google's video site has a ton of explanatory videos that show you the process first hand. iFixit.com is also a good source for this type of maintenance. After a little research, you can decide whether a keyboard swap is something you're up for.

If you're wondering where you can buy a replacement keyboard, one word: eBay.

## Re-installing Windows

You do not need someone to reinstall your operating system for you. Trust me on this one. And that goes doubly so if you're running Windows 8.1, which has tools for reinstallation built right in. If you're planning on upgrading to Windows 10,  the process will supposedly be even easier in the future.

The basic thing you need to know about doing a fresh install of Windows is that first you need to back up your personal files on (go. pcworld.com/freebackup) an external hard drive. Then throw in your system discs and start the fresh install process. You will also need to reinstall extra software such as Microsoft Office or accounting programs like Quicken. Depending on how you purchased that software, you will either download it from the manufacturer's website or install it from discs after Windows is up and running again.

Just make sure you have your product keys on hand when it's time to reinstall. If you don't have those physically available, run the superb Belarc Advisor (belarc.com/free_download) and jot down the key information found in the "Manage all your software licenses" portion of the results page *before* you reinstall Windows.

Here's our latest tutorial on how to reinstall Windows (go.pcworld. com/reinstallwin) whether you're running Windows 8 and 8.1, or Windows 7 and older.

PC repairs can be stressful to the uninitiated, but once you've successfully conquered even one of these tasks you'll be ready to take on the other two. ⏻

# Securely wipe your files, hard drive, or SSD

You delete a file, then empty the Recycle Bin. But the contents of that file remains on your drive. Here's what to do about that.

*STOQN TOCHEV ASKED about securely erasing sensitive files without destroying everything on his hard drive. I'll discuss SSDs, as well.*

When you delete a file conventionally, it goes into the Recycle Bin, where it can be easily restored. When you empty the Recycle Bin, Windows makes the space where the file once resided available for other files. But the data from the file remains until another file writes over it.

Things have changed since I last covered this topic in 2013. SSDs have become more popular, and they work differently. Also, as Windows 8 has gotten older and more mature, I felt I should discuss a tool built into that operating system. Finally, I've replaced one free tool I used to recommend with another, easier offering.

You can securely erase (or *wipe*) a hard drive's data by writing ones and zeros over it (I'll get to SSDs below). There are three approaches to the job:

**Ccleaner:** free all-around cleanup tool.

- You can wipe the entire drive or partition. This is theoretically the most secure approach, but it's slow, difficult, and dangerous. Wiping the C: partition will destroy your Windows installation, and wiping the entire drive may make a Windows reinstall impossible.

- You can wipe individual files that contain sensitive information. This is simple and relatively quick. If you know what needs to be destroyed, this is the best way.

- You can also wipe the free space that's available for new files. After all, that's where the security problem resides.

Here are three programs I recommend for this job:

## Ccleaner
Among Ccleaner's (piriform.com/ccleaner) many other capabilities, this free, all-around cleanup tool can wipe partitions or free space. Go to *Tools→Drive Wiper* and make your choices. The Entire Drive option won't let you wipe C:, but it will let you wipe a separate data partition.

## File Shredder

This small, light, free program does exactly what the name says. File Shredder (fileshredder. org) integrates with Windows Explorer, so you can right-click a file and wipe it off the drive. It also wipes (or, if you prefer, *shreds*) free space.
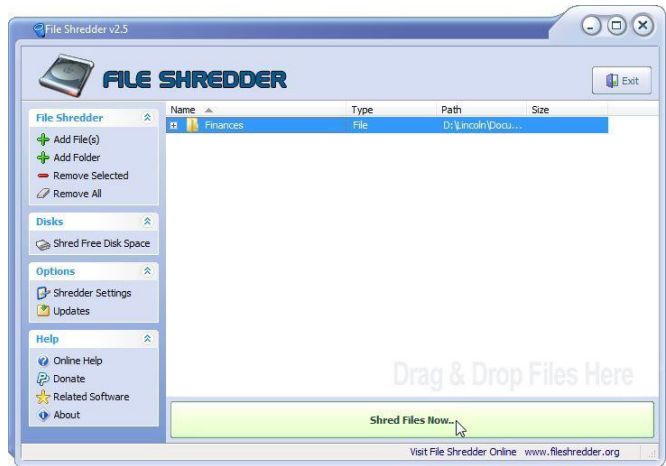


**File Shredder:** shreds free space.

## Windows 8(.1) Recovery Environment

This tool, built into Windows 8, allows you to reinstall Windows. When you go through the install wizard, you'll find an option to erase data "thoroughly." That means a wipe.

## The difference with SSDs

Now then, about SSDs: Wiping is all about massive writing to the drive, and as I've explained (go.pcworld.com/exp), that's not a good idea with flash memory. Besides, SSDs store files in an entirely different way than magnetic media, and wiping just won't work.

Fortunately, most SSDs have the ability to do a drive-wide secure erase. Go to the drive manufacturer's website for specific instructions. You'll probably have to download a program specific to that company. You can also just search on the manufacturer's name and this phrase:

`ssd secure erase utility`

One more piece of advice: If you keep your sensitive files properly encrypted (go.pcworld.com/proper), wipes are arguably unnecessary. ⏻

*Have a tech question? Ask PCWorld Contributing Editor Lincoln Spector. Send your query to answer@pcworld.com.*

# Tech Spotlight

▶ Watch the video at go.pcworld. com/fordgtvid

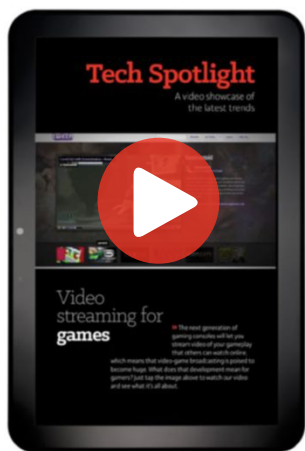## Ford GT: A high-tech exotic with a carbon-fiber chassis

» Ford's GT is lightweight to the extreme. This most American and old-school of car manufacturers wants to use the Ford GT as living, turbo-breathing demonstration of its forward-thinking tech chops, and plans to trickle down all the weight-saving tricks it developed for 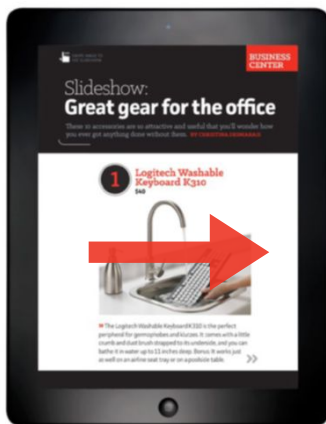the supercar into vehicles normal people might actually buy.