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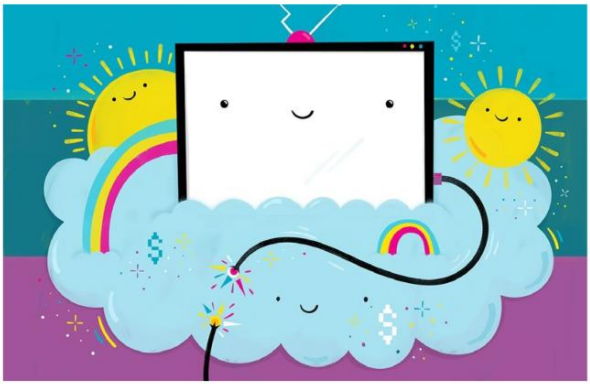

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DESIGN

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ADVERTISING SALES

SALES MANAGER Duane Hampson (415/978-3133)

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FOUNDERS

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CONTACT

PHONE 415/243-0500; **FAX** 415/442-1891

MAIL Editorial: 501 Second Street #600, San Francisco, CA 94107

STAFF ADDRESS To contact any *PCWorld* staff member, simply format the address as follows: *firstinitiallastname@idgcsmb.com*

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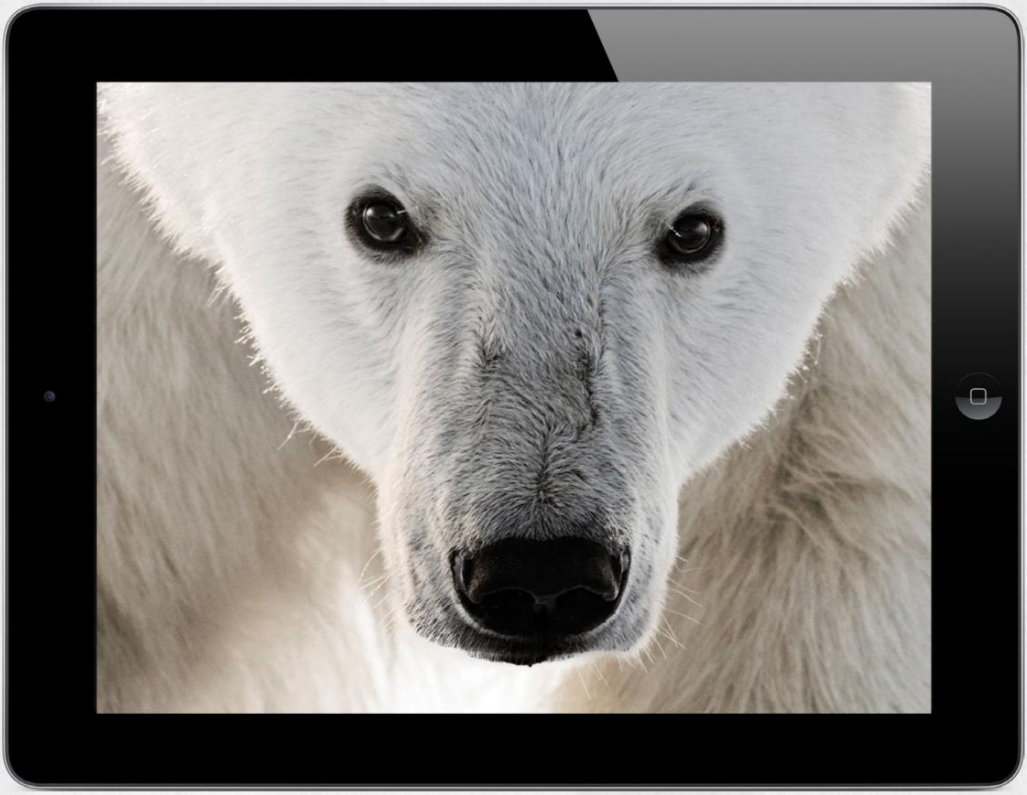

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NEWS

CONTENTS

iPhone 7 and 7 Plus FAQ: Everything you need to know about Apple's new phones

BY CAITLIN McGARRY

APPLE'S ANNUAL iPHONE event was jam-packed with information, but between the lingering look at the new jet black finish and all the business about AirPods, you may have missed some important details about the iPhone 7 and 7 Plus.

But we've got you covered. Here's everything you may have missed during Apple marketing VP Phil Schiller's presentation, plus some facts he didn't mention, in case you're thinking of upgrading to a 7 but

can't quite decide. For more information, take a look at our iPhone 7 hands-on (go.pcworld.com/ip7ho).

The basics

When can I get the new iPhones?

The iPhone 7 and iPhone 7 Plus went on sale Friday, Sept. 16 in more than 25 countries: Australia, Austria, Belgium, Canada, China, Denmark, Finland, France, Germany, Hong Kong, Ireland, Italy, Japan, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Portugal, Puerto Rico, Singapore, Spain, Sweden, Switzerland, Taiwan, United Arab Emirates, the United Kingdom, the Unites States, and the U.S. Virgin Islands. Preorders began Friday, Sept. 9.

The following Friday, Sept. 23, the new iPhones went on sale in Andorra, Bahrain, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Greece, Greenland, Guernsey, Hungary, Iceland, Isle of Man, Jersey, Kosovo, Kuwait, Latvia, Liechtenstein, Lithuania, Maldives, Malta, Monaco, Poland, Qatar, Romania, Russia, Saudi Arabia, Slovakia and Slovenia.

In India, the iPhone 7 and 7 Plus will be available Friday, Oct. 7.

How much do the new phones cost?

In the U.S., the unsubsidized iPhone 7 starts at $649 for a 32GB base

model and the 7 Plus starts at $769. Apple has phased out the 16GB storage option for all but the iPhone SE.

Both the iPhone 7 and 7 Plus will offer 32GB, 128GB, and 256GB of storage.

Apple's iPhone Upgrade Program (go.pcworld.com/iphoneupg), available to buyers in the U.S., U.K., and China, gives you the option to buy an unlocked iPhone 7 or 7 Plus with AppleCare+ through your carrier of choice for $32 a month and up. (Prices vary based on country, iPhone model, and storage size.) The upgrade program also lets you trade in your iPhone next year for the latest model.

Which carriers are offering the iPhone 7 and 7 Plus?

You can buy phones directly from AT&T, Verizon, T-Mobile, and Sprint in the U.S., or you can buy an unlocked phone from Apple to use on any network you'd like through the iPhone Upgrade Program.

What colors can I buy?

The new iPhones come in silver, gold, and rose gold, plus two brand-new colors—black and jet black.

What's the difference? The black model has an anodized matte

finish, while the jet black version is a high-gloss, inky black. Apple showed off the jet black model's engineering process in a Jony Ive–narrated video during the September 7 iPhone launch event. The new finish was crafted from bead-blasted aluminum (or, as Ive charmingly puts it, "aluminium") that then goes through a nine-step anodization and polishing process. The finished product is so glossy that you can't tell the difference between the glass display and the aluminum body. The down side: The jet black is also more prone to fingerprint smudges and scratches, so you might want to snag a case for that model.

The big changes

From a distance, the iPhone 7 and 7 Plus don't look all that different from the 6 or 6s models—same design, same shape, same size. But up close and under the hood, the 7 and 7 Plus are radically different from their 4.7-inch and 5.5-inch predecessors. Let's start with the most talked about feature (or the lack thereof).

Did Apple really kill the 3.5mm headphone jack?

Yes. The audio jack, a staple of consumer electronics devices for decades, is no more—at least when it comes to iPhones. Apple sacrificed

the port to free up space (go.pcworld.com/nojackreasons) for a larger camera system, bigger battery, and Taptic Engine for providing feedback in response to the redesigned Force Touch Home button.

So how will I listen to music, videos, and podcasts on my iPhone?

Apple is including a pair of Lightning EarPods (go.pcworld.com/lightningearpods) with every new iPhone, so you can still plug into an iPhone port for private listening sessions—just not the port you were used to. You won't be able to listen with the new Lightning EarPods and charge your phone with a Lightning cable simultaneously, if that's a problem you run into regularly. Third-party adapters will appear to fill the gap—Belkin just announced a $40 Lightning Audio + Charge RockStar (go.pcworld.com/belkinlightningsplitter) that splits the iPhone's Lightning port into two, one for charging and one for your Lightning EarPods.

Apple must have anticipated outraged responses to the eliminated audio jack, because it's also bundling a Lightning-to-headphone jack adapter with every iPhone. (You can buy an adapter (go.pcworld.com/hpjackadapter) separately for the low, low cost of $9.) Your expensive wired headphones will still work, now you'll just need an extra dongle.

Lightning EarPods and adapters are just interim solutions, though. Apple envisions a world in which all audio is enjoyed wirelessly, which is why the company created a new set of Bluetooth headphones called AirPods (go.pcworld.com/airpods). Those will retail for $159 when

they debut in October. (We tried them out [go.pcworld.com/airpodshandson]. They are very, very cool.)

Do the new phones have better cameras?

The new sensor corrects any shakiness and reduces blur for up to three times longer exposure from the 6s.

Every year, Apple makes the iPhone's camera a little bit better. This year, both iPhone models are getting a huge camera overhaul. The A10 Fusion (go.pcworld.com/ip7a10fusion) chip built into both the iPhone 7 and 7 Plus features a new image signal processor that uses machine learning to make your photos look amazing. Here's what you need to know:

Both new iPhones have 12-megapixel rear-facing iSight cameras and 7-megapixel front-facing FaceTime HD cameras (a bump up from the 5-megapixel FaceTime camera in the 6s models). The 4.7-inch model gains optical image stabilization, a huge improvement on the digital image stabilization in the 6s. Last year, only the 6s Plus offered OIS. The new sensor corrects any shakiness and reduces blur for up to three times longer exposure from the 6s.

Both the 7 and 7 Plus have an f/1.8 aperture that allows up to 50 percent more light than the 6s, and a six-element lens that will shoot better low-light images. A quad-LED True Tone flash is 50 percent brighter than the 6s, and a new sensor compensates for flickering lights. Both the front-facing and iSight cameras use wide color capture for brighter, more detailed shots.

Doesn't the iPhone 7 Plus have two cameras?

It does. The 5.5-inch model has the same wide-angle lens that the 4.7-inch phone does, but right next to it is a 12-megapixel telephoto lens with f/2.8 aperture that can capture zoomed-in details without losing image quality. The telephoto lens gives you 2x optical zoom, and 10x digital zoom for photos (6x for video).

In a software update coming later this year, the 7 Plus will gain a depth-of-field feature called Portrait, which uses both cameras to

sharpen the subject of your image while softening the background (an effect called bokeh). The new feature will be accessible in the iOS Camera app—just tap the new Portrait option—and you can see the effect as a live preview in the app before you start shooting.

So is the iPhone finally waterproof?

Not waterproof, exactly, but water-resistant. That's partly why Apple took out the headphone jack—and to make room for things like the supersized camera system, the stereo speaker on the bottom, and the new Taptic Engine, which I'll get to in a minute.

The iPhone 7 is rated IP67, which means it can withstand about 1 meter of water for up to 30 minutes. That means an accidental bath in the toilet or swimming pool no longer requires an emergency time-out in a bag of rice (oh, come on, you know you've tried it). It's also resistant to dust, which should please desert-dwellers and outdoorsy types.

Tell me more about that new speaker.

You know when you're watching a video in landscape mode but sound is only coming from one side of your phone? Apple fixed that. Now you'll get a stereo effect thanks to speakers at the bottom and top of the phone. Apple says the sound experience is 2x louder than the iPhone 6s, with an increased dynamic range.

Did Apple bring Force Touch to the iPhone?

The iPhone 7 Home button redesign may turn out to be the new model's sleeper hit feature. Why? It's now a solid state, pressure-sensitive button instead of a mechanical one. That could mean fewer

Home button failures, which means fewer repairs.

The Home button belies an internal feature, the new Taptic Engine, which responds with physical feedback—vibration at varying levels of intensity that you can customize—when you perform a function on your phone. Apple is opening up the Taptic Engine to developers with an API, so imagine what the possibilities could be for games and other apps.

OK that's all great, but what about battery life?

One of the benefits to removing the headphone jack was a bigger battery (we're not yet sure how big, but we're sure our pals at iFixIt will find out soon enough). Apple says the iPhone 7 lasts up to two hours longer than the 6s, and the 7 Plus lasts up to one more hour longer than the 6s Plus. Not too shabby. Some of the gains could be from the more efficient four-core A10 Fusion processor rather than just a higher-capacity battery, but as long as we can squeeze out more time between charges, that's what really matters.

Will my iPhone 6s or 6s Plus case fit the iPhone 7 or 7 Plus?

Nope, sorry. The 7 Plus's dual lenses make 6s Plus cases incompatible. And while the 4.7-inch iPhone 7 is the same size as last year's 6s, the camera is much larger, so the chances of your old case fitting this phone aren't great. It's possible a bumper-style case would fit, but for the most part you'll want a new case for your new iPhone 7.

A Surface all-in-one PC may lead a Microsoft hardware refresh in October

BY MARK HACHMAN

TALK OF A Microsoft Surface all-in-one has…resurfaced, with claims the device, code-named "Cardinal," could launch at the end of October.

ZDNet's Mary Jo Foley reported that October 26 might be the date Microsoft has scheduled for a fall refresh of some of its more popular devices, including newer, faster processors. That suggests Microsoft may upgrade a device like the Surface Pro 4 with a Kaby Lake chip, though Foley also reports that a more formal launch of a Surface Book 2 and possibly a Surface Pro 5 will wait until next spring.

In the meantime, Microsoft still appears to be preparing to launch a

Intel's AIO reference design, from June 2014, shows off what a Surface AIO might look like.

A larger version of Intel's AIO design shows the device used in tabletop mode, just like Microsoft's original Surface concept.

possible trio of stand-alone PCs—possibly from 21 inches to 27 inches, according to a Windows Central report. Though Microsoft has already entered the PC category with the Surface line of tablets and the Surface Book, this would be Microsoft's first entry into the desktop class of devices. (This isn't the first time a Surface AIO has been pegged for an October launch, either.)

Unlike the Surface tablet, which popularized the concept of Windows slates, desktop all-in-ones are a fairly mature concept. However, analyst group IDC last December identified them as one of a category of PC devices, along with Windows tablets and ultraslim notebooks (also known as ultrabooks), that would continue to grow in the face of a declining PC market.

Why this matters: Unquestionably, Microsoft's Surface tablets have been a hit. Windows phones? A miss. The Surface Book has fallen somewhere in between. Is the PC market crying out for a Windows desktop in a world seemingly ruled by a "cloud first, mobile first" focus? Remember that Microsoft's device ambitions are to break trail

on new, category-defining market segments that its hardware partners can follow up on.

A new kind of desktop

It's hard to see how Microsoft might accomplish this with a desktop. Sure, it might be aiming toward the concept of a modular PC, as Foley points out. But Microsoft has punted on modularity before: recall the Surface Music Cover (aka the Remix Cover), a customized interface device that turned the original Surface into a DJ console. It never shipped. I'd be intrigued by a monitor into which a Windows phone could be slipped, but the lack of Windows phones, plus the complexity of accounting for phones of varying shapes and sizes, would likely leave this idea dead in the water, too.

The Surface Remix Cover never shipped, and Microsoft abandoned most of its other Surface peripherals at about the same time.

Sounds like we'll find out pretty soon, though.

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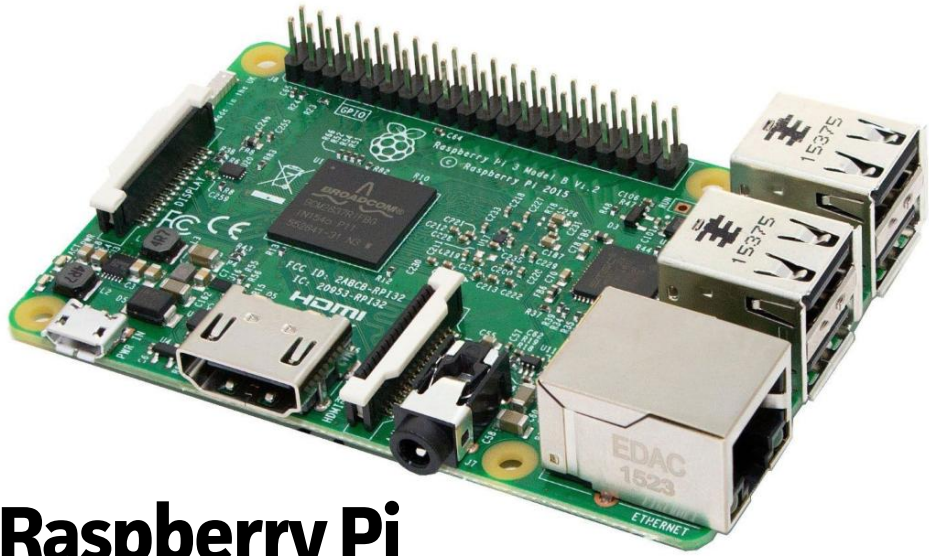

Raspberry Pi launches official starter kit to celebrate 10 million sales

BY IAN PAUL

THE RASPBERRY PI Foundation is celebrating a milestone. The organization recently announced it has sold ten million Raspberry Pi devices since the first versions debuted in 2012.

"Thanks to you, we've beaten our wildest dreams by three orders of magnitude," Raspberry Pi founder Eben Upton said in a blog post. To commemorate the milestone, Upton announced the very first official Raspberry Pi Starter Kit.

Why this matters: With its original mini-computers, the Raspberry Pi Foundation kicked off a revolution in low-priced computing for

students and enthusiasts. Hobbyists have used the Raspberry Pi (go.pcworld.com/coolraspberrypi) for everything from autonomous drones to smart mirrors to high-altitude balloons—not to mention its popularity as an everyday HTPC or the power behind a retro-gaming setup. The Raspberry Pi hobbyist trend is so popular it even prompted Microsoft to roll out a version of Windows 10 (go.pcworld.com/raspiw10update) tuned for developing Internet of Things devices. Microsoft also rolled out a Raspberry Pi development kit (go.pcworld.com/msiotgrovekit) of its own in early September.

Nice piece of kit

Unlike buying the plain old $35 Raspberry Pi 3 Model B board (go.pcworld.com/raspi3rev), the Starter Kit is a little on the pricey side.

The kit is on sale for £99 in the UK, meaning that when it rolls out to the U.S. in the coming weeks the kit will probably sell for about $140. For that money you'll receive everything you need to use the Raspberry Pi for basic coding.

The Starter Kit includes a Raspberry Pi 3 Model B, a case for the board, and an 8GB SD card with the NOOBS operating system pre-loaded. For peripherals, you'll get a mouse and a keyboard with scissor-switches—the keyboard looks similar to Apple's wireless keyboard. There's also an "official" 2.5 Amp power supply with multi-region adapters, an "official" three-foot HDMI cable, and a copy of the book *Adventures in Raspberry Pi, 2nd Edition* by Carrie Anne Philbin, who is Director of Education at the Raspberry Pi Foundation.

Google's Fuchsia OS is out in the open and shrouded in mystery

BY CHRIS HOFFMAN

GOOGLE IS DEVELOPING a new operating system named Fuchsia, and the early source code is already public. Google itself and Fuchsia's developers haven't explained what the OS is for—but we can dig into the source code to learn more.

Pink + Purple == Fuchsia

Fuchsia is a new, open-source operating system being worked on by Google employees. "Pink + Purple == Fuchsia (a new Operating System)," reads the cryptic description on the project's GitHub page (github.com/fuchsia-mirror). The source code is also available on GitHub, as well as on Google Source (fuchsia.googlesource.com).

That's it, though. While the project's source code is available and we can see who specifically is working on it, there's been no official announcement from Google or explanation from the individual developers as to Fuchsia's purpose.

While the project's source code is available and we can see who specifically is working on it, there's been no official announcement from Google or explanation from the individual developers as to Fuchsia's purpose.

If no one's ready to comment on it, why is it already public? As Google's Brian Swetland reportedly explained on the project's IRC channel: "The decision was made to build it open source, so might as well start there from the beginning." From the same conversations, the developers report that the Fuchsia operating system is "currently booting reasonably well on Broadwell and Skylake NUCs and the Acer Switch Alpha 12, though driver support is still a work in progress." Raspberry Pi 3 support is also coming soon.

Magenta, Escher, and Mojo

While there hasn't been much news officially announced, here's what we can glean from the available source code.

The Fuchsia operating system is based on Magenta (github.com/fuchsia-mirror/magenta). Magenta is a combination microkernel and a set of user-space services and hardware drivers. This is a big departure from Google's use of the Linux kernel across both Android and Chrome OS.

Fuchsia includes Escher (github.com/fuchsia-mirror/escher), a

"physically based renderer" that provides volumetric soft shadows, color bleeding, light diffusion, and a lens effect. This suggests that Fuchsia won't be just a bare-bones embedded operating system, but will be capable of providing graphical user interfaces.

It appears that Mojo (github.com/fuchsia-mirror/mojo) is the application framework and runtime for applications. The primary programming language for Fuchsia seems to be Google's own Dart (go.pcworld.com/githubfuchsiadart).

What's it for?

While Fuchsia is an extremely interesting project, any speculation that Google is on the verge of replacing Android and Chrome OS (go.pcworld.com/asusflipandapp) with Fuchsia is unfounded and way too early. Even if this was the long-term goal for the project, it will likely take quite a few years before anything is ready for a consumer release. We should be hearing a lot more about Fuchsia from Google in the future, and it'll be interesting to see what plans Google has up its sleeve.

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Sunrise calendar is dead, and only some features live on in Outlook

BY MARK HACHMAN

THE SUN HAS finally set on Sunrise, Microsoft's popular calendar app. Microsoft recently discontinued the service after bringing many of its features to its iOS and Android apps, both of which have been updated.

The Sunrise team wrote in a farewell post that your Sunrise calendar will stop updating. The day after the announcement, Sunrise users were logged out of their accounts. However, all of the information is still available on the original platform—iOS, Android, Outlook—that Sunrise ran on top of.

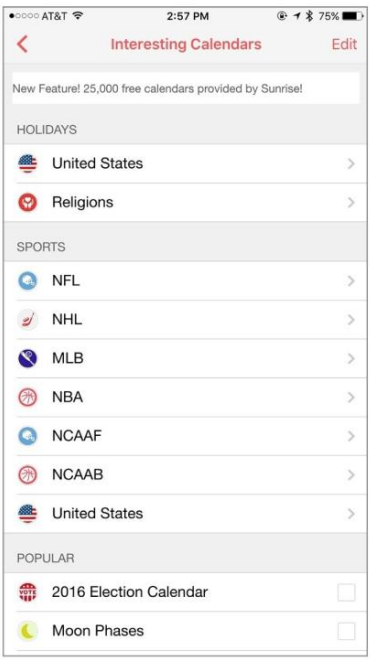
"This is definitely the end of an era," the Sunrise team wrote. "But more importantly, it's the beginning of a new one. We're excited by what's

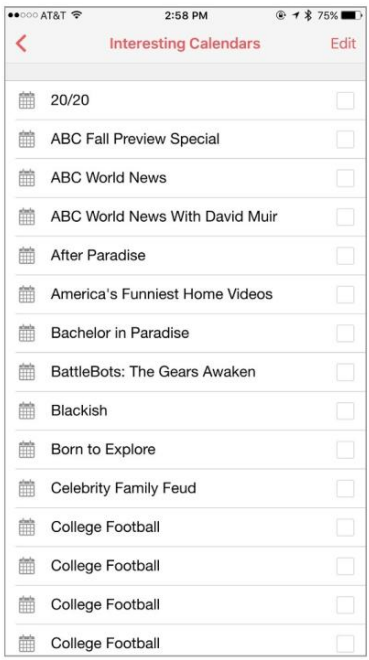
ahead and we'd love for you to come and join us in our latest adventure."

That next adventure is Outlook, Microsoft's own email app. Microsoft had originally promised that it would shut down Sunrise only when its features were "fully integrated" into Outlook, then delayed its decision when *PCWorld* pointed out (go.pcworld.com/outlooknosunrise) that hadn't happened. In his blog post (go.pcworld.com/outlookiosandimprov) announcing the updated Outlook apps, former Acompli chief Javier Soltero went point by point, describing how each feature was (mostly) integrated into the Outlook mobile apps.

Feature parity? Close, but not quite.

A closer examination of the new features for Outlook for Android (go.pcworld.com/outlookandroid) and Outlook for iOS (go.pcworld.com/outlookios) reveals, however, that the new apps still don't quite provide what Sunrise offered. (It's also worth noting that Microsoft has





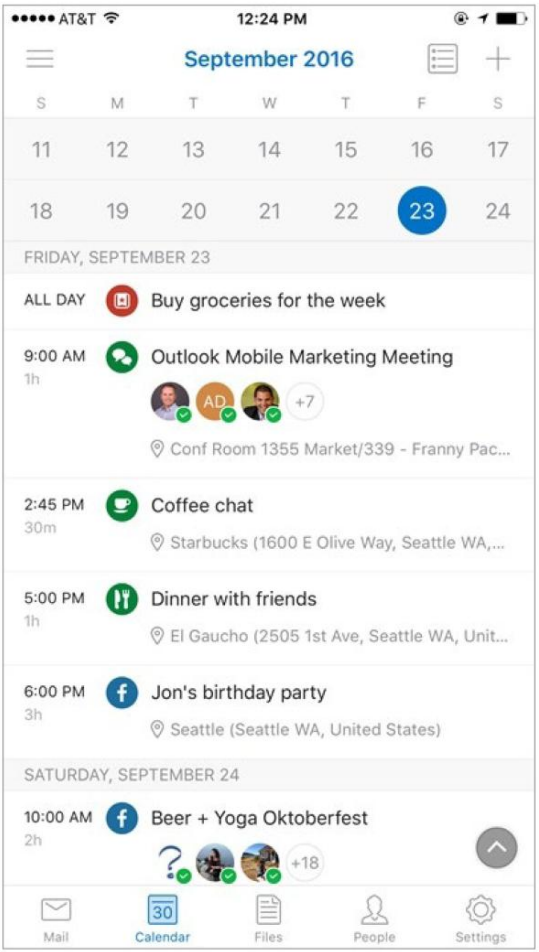
Neither Outlook's Web app nor the iOS/Android apps offer the full breadth of calendars that Sunrise still does.

completely ignored the Calendar app for Windows 10 Mobile in the new updates.)

Interesting calendars: In addition to normal work appointments, users have typically been able to integrate their personal calendars (for dentist appointments and the like) as well as so-called "interesting calendars," such as international holidays. This feature, previously excluded from the Outlook mobile apps, will now optionally add the times and dates of your hometown sports team's schedule to your calendar. TV shows are coming soon, Microsoft promised.

For now, the feature is available only to iOS users with an Office 365 email address. That feature will soon come to Android. Outlook.com users on both platforms will see the Interesting Calendar feature arrive later this year, then Gmail users.

Sunrise still offers a wealth of interesting calendars that Outlook doesn't, however: religious holidays in multiple faiths, a surprising variety of sports (the Pacific Rugby Premiership?!), and even "name days" from say, Hungary.



Outlook has taken the popular icon shortcuts from Sunrise and added them to its own calendar.

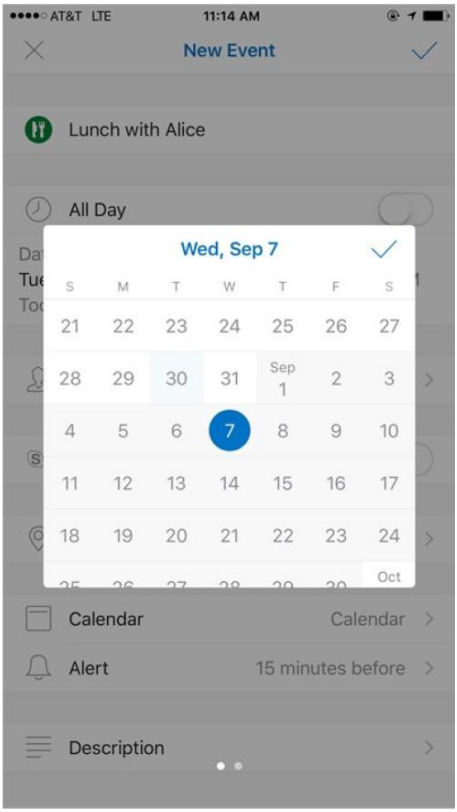
Event icons: To quickly allow users to find, say, a coffee meeting, Outlook will incorporate the icons used by Sunrise into its own user interface:

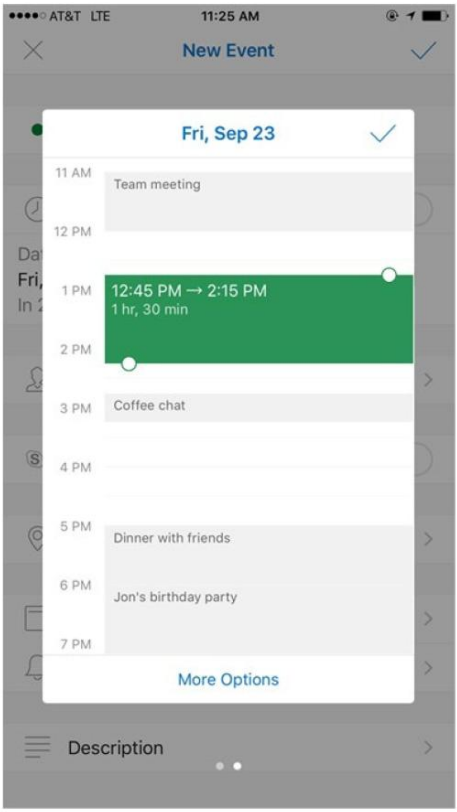
You'll see a coffee mug icon, for example, next to a proposed meetup at Peet's Coffee. This seems to be consistent with what Sunrise offered.

Map integration: Like Sunrise, Outlook now includes a smart lookup of any location you set for an offsite meeting and includes a small map of the venue inside your appointment. Outlook uses Bing to set this up, while Sunrise used Google. This is noteworthy only because Bing inexplicably failed to recognize San Francisco's famous landmark The Cliff House, while Google did recognize it.

Both Outlook and Sunrise only offer reminders that are keyed by time (15 minutes before, for example), however, rather than offering

Outlook has tried to incorporate Sunrise's improved calendar view, too.





an option to let Cortana/Google Now/Siri decide when you need to leave to avoid being late.

Recurring meetings: Sunrise offered the ability to create a recurring meeting on, say, every Tuesday at 11 am. For some reason, Outlook still can't manage that, though the new app updates allow you to edit the appointment or even delete the event. (Recurring event creation is on the way, Microsoft says.)

Skype for Business: Finally, you can now quickly set up a Skype call with just a tap, something you could do on Sunrise (as well as the Outlook Web App) and in Outlook. When the call begins, Microsoft says you can launch the call by tapping the icon. Unfortunately, Microsoft has rolled out the one-tap Skype for Business capability only to about 75 percent of users who use the mobile Outlook apps, Microsoft said.

> You'd think, for example, that "interesting calendars" would be prominently included within Outlook 2016. They're not.

App integration: Unfortunately, Microsoft's still not saying anything about whether it will integrate Outlook with the breadth of apps that Sunrise offered: Trello, Todoist, Songkick, and more. For now, Microsoft Outlook integrates with just three: Facebook, Evernote, and Wunderlist.

"The team is in the process of bringing the best features from Sunrise into Outlook," the Microsoft representative said via email. "Today marks an important milestone, with a majority of these features wrapped in the product. Over the coming months, we'll continue adding new Interesting Calendars and integrating with other services via Calendar Apps based on user feedback."

Platform parity: an issue Microsoft can't ignore

Sunrise users have a right to be concerned that Microsoft will simply cherry-pick some of the features that made Sunrise so useful, without transferring over the whole of the app experience. There's another issue that Microsoft will have to address eventually, however: platform

parity. Too many features remain scattered willy-nilly between apps.

You'd think, for example, that "interesting calendars" would be prominently included within Outlook 2016. They're not. Instead, you have to use the Outlook Web App (with an Office 365 account attached) to take advantage of this feature.

"Bringing feature parity across all Outlook end points—web, desktop and mobile—is a key goal for the Outlook team," the Microsoft representative added. "For example, we've gotten strong feedback about how useful Focused Inbox is, so we started rolling this out in Outlook for Windows, Mac and the web in July."

All of those features made Sunrise attractive. With Sunrise's demise, Microsoft obviously would like you to transition back to Outlook. But if that simply won't work for you, you'll probably want to check out these alternatives to Sunrise (go.pcworld.com/sunrisealts)—or simply wait for something better to come along.

For comprehensive coverage of the Android ecosystem, visit Greenbot.com.

GeForce GTX 970 settlement website opens, Nvidia will pay graphics card owners $30

BY BRAD CHACOS

NVIDIA'S PAYING THE price for the GeForce GTX 970's memory controversy—literally. The GTX 970 refund website (gtx970settlement.com) is now live after Nvidia agreed to pay GTX 970 owners $30 each (go.pcworld.com/gtx970settlement) to settle a class action lawsuit.

The false advertising lawsuit stemmed from a pair of hardware inconsistencies that prompted a not-quite-apology (go.pcworld.com/gtx970flaw) from Nvidia's CEO. The most obvious is the GeForce GTX 970's notorious 4GB RAM allotment, which Nvidia split into a full-speed 3.5GB segment as well as a drastically slower 512MB segment without telling customers. The company also erroneously claimed the card had 64 render output units while in reality it had just 56.

Both of those could affect performance—though the GTX 970 was

still a kick-ass graphics card with an incredibly compelling price tag. That combo led to the GTX 970 being dubbed the people's champion, and it's far and away the most popular card with Steam users. Now all those users are eligible for a $30 settlement, which makes the GTX 970 seem like an even better buy in retrospect.

Well, *some* of those users. You're eligible only if you purchased a GeForce GTX 970 graphics card from Nvidia, its add-in card partners (like EVGA and Asus), or an authorized retailer between September 1, 2014 and August 24, 2016, and only in the U.S. You might also be eligible if you purchased a desktop computer with a GTX 970 from an authorized retailer in that time frame.

Don't dilly-dally if you're eligible. You must file a claim by November 8 if you plan on cashing in. The court is expected to approve the settlement in December.

Don't dilly-dally if you're eligible. You must file a claim by November 8 if you plan on cashing in.

The impact on you at home: As always, you'll need to prove that you actually bought a GTX 970 before Nvidia sends you a check. You can do so in the usual ways—with a receipt, a credit card statement, a purchase order, etc.—but the settlement also supports an easier verification method: Your device ID. Between that and the ability to file a claim online, you could register for a refund in no time.

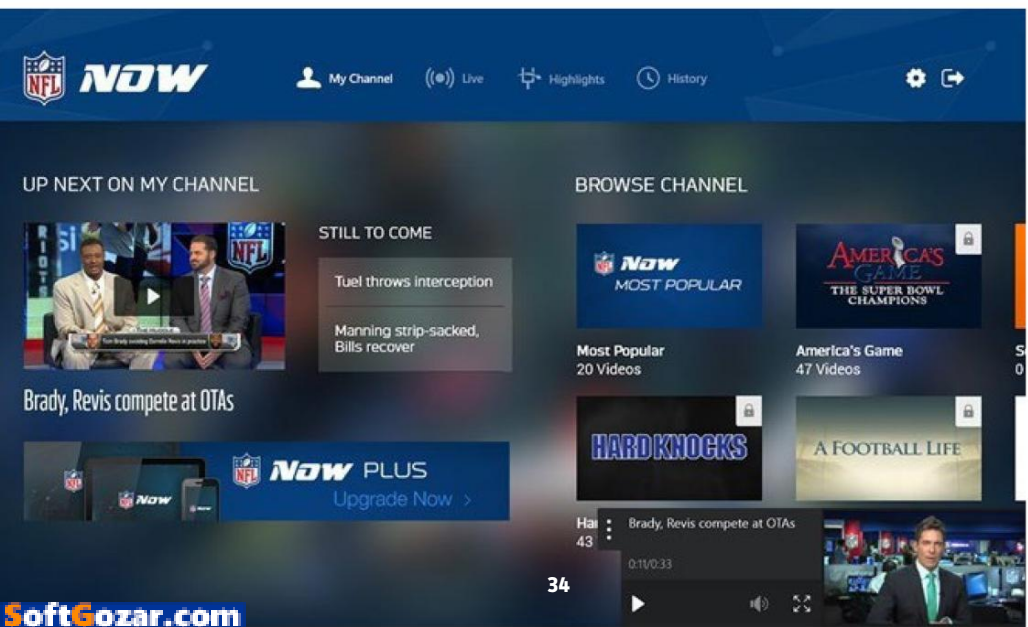
To find your GTX 970's device ID, simply fire up the Nvidia Control Panel, click System Information in the lower left corner, and look for the Device ID listing in the default Display tab. It should be the second from the bottom.

It's football season! These second-screen apps make NFL games even more fun

BY MICHAEL ANSALDO

ACCORDING TO THE NFL, 70 percent of fans use a second screen while watching football. It's easy to understand why: mobile devices—and the apps that run on them—give us easy access to player stats and analysis, provide interactive features to supplement the big-screen experience, and offer a convenient way to communicate with other fans watching the game.

We've rounded up six of the best second-screen apps to enhance your football viewing. Take them for a spin this season, and we're sure you'll be reaching for them along with your remote every week until the end of Super Bowl LI.



NFL Mobile

(iOS, Android, Windows Phone)

A year ago, the NFL seemed as determined to conquer the second screen as effectively as it has the TV screen, offering a dizzying array of official apps. It has pared down and consolidated its offerings since then, but NFL Mobile (nfl.com/apps) remains the league's digital flagship.

This free app gives you everything you'd expect: news, real-time scoring, video highlights, radio broadcasts, customizable team alerts, and push notifications. You also get access to Game Pass (nfl.com/gamepass), the league's on-demand video subscription service. If you're willing to pay $100 and don't mind watching games after they've aired, you can replay any of the season's 256 match-ups on your mobile device.

NFL Mobile offers Verizon customers (go.pcworld.com/verizonnflmobile) a few extra perks with a More Everything plan. You get 24/7 access to the NFL Network on your phone, and you can live-stream all nationally broadcast games on that channel as well as those on CBS, NBC, Fox, and ESPN.

If you miss a game for whatever reason, NFL Mobile's at-a-glance recap is indispensable for catching up.

Verizon has a lock on showing NFL games on mobile phones.

NFL app for Xbox One

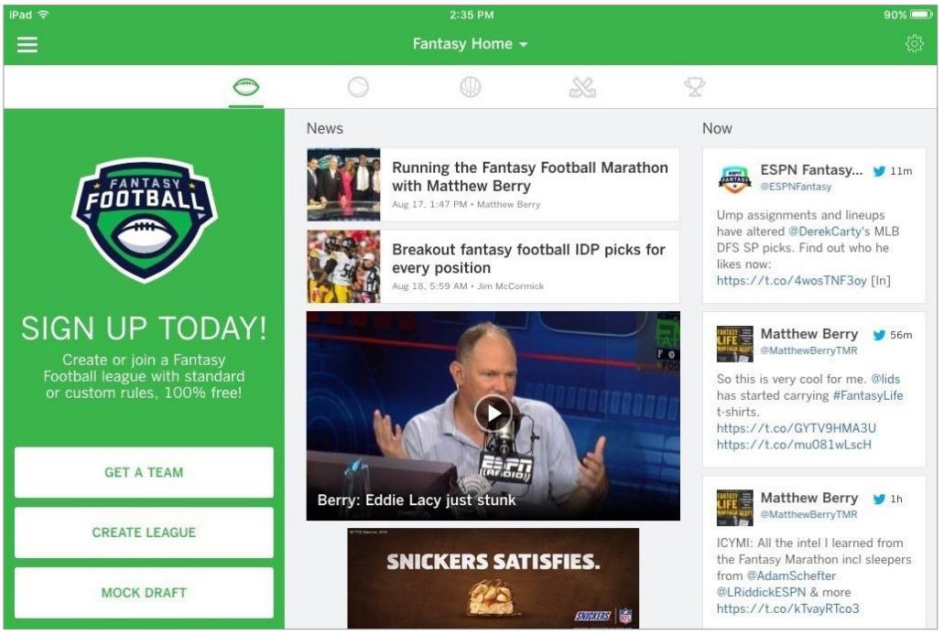
(Xbox One)

Xbox has more to offer football fans than endless hours playing Madden. Thanks to Microsoft's partnership with the NFL, your console will give you the best possible field position to follow the upcoming season.

Subscribers to the NFL Network and NFL Sunday Ticket can watch commentary programs and live games respectively, directly through the app. But the app also includes a wealth of features for fantasy owners and armchair quarterbacks alike, including game-day notifications, multi-angle replays, and real-time player tracking.

Most impressive is its Next Gen Stats feature—similar to what's been used in actual NFL broadcasts (go.pcworld.com/nflnetxgenstats)—which delivers player data such as distance traveled, top speed, and routes run. The elegant integration of live games with instant data and analysis makes this the next best thing to being in the broadcast booth.

The NFL app for the Xbox One has a Next Gen Stats feature that is similar to what's been used in actual NFL broadcasts.



ESPN Fantasy Sports

(iOS, Android)

If you're an ESPN fantasy football owner, you have more than bragging rights on the line with each game. The ESPN Fantasy app (go.pcworld.com/espnfantasyapp) provides every tool you need to stay on top of your squad all season long.

This free app gives you full access to your ESPN fantasy team, letting you start, bench, add, drop, trade, and waive players and otherwise manage your roster in the lead-up to game day. It also provides the most comprehensive collection of stats and analysis you'll find outside of an NFL war room.

While you're glued to the tube during games, Fantasycast keeps you updated on all your fantasy players' scoring in real time, while push notifications alert you to injuries, trades, and other player news.

Even if you've never stepped foot on a football field, this app could make you the Bill Belichick of your office league.

ESPN's Fantasy Sports app gives you everything you need to manage your team all season long.

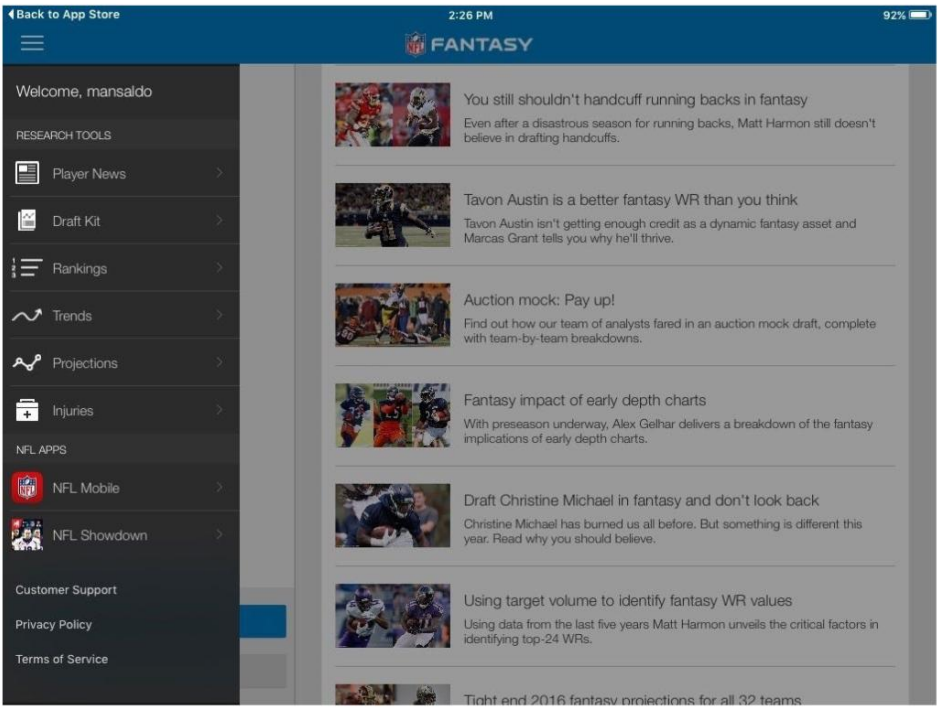
NFL Fantasy Football

(iOS, Android, Windows, Windows Phone, Kindle Fire, Kindle Fire Phone)

If you want to keep your fantasy focus strictly on football, check out the league's official fantasy app. It puts everything you need to manage your NFL fantasy team right in the palm of your hands.

Draft from anywhere, then make week-to-week adjustments with the help of live scoring, expert analysis, and news and stats straight from the NFL. You'll also get video highlights of all your team's key plays. Keep the chat feature handy to talk trash to your opponents while you're watching the real-life games.

The league's official fantasy app provides news and stats straight from the NFL.



FanCred

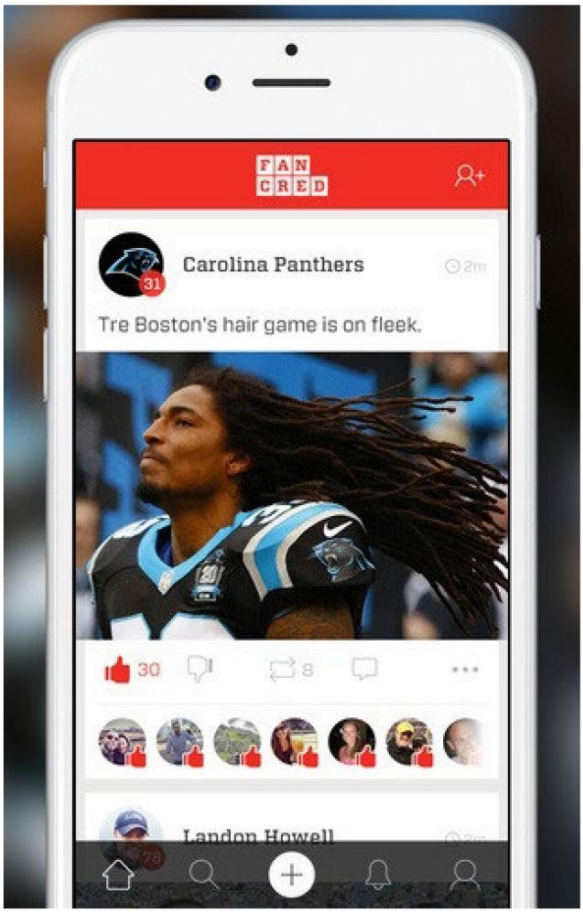
(iOS and Android)

From the Washington Redskins' Hogettes to the denizens of the Oakland Raiders' Black Hole (theblackholefans.com), football fans have unique ways of showing their devotion to their team. FanCred (fancred.com) is a free app that helps you harness that passion and share it with other fans.

FanCred is a social network that works like any other, but because it's designed for sports fans, your followers are genuinely interested in your check-ins to Soldier Field and your latest fantasy football trades.

Create a profile and select your favorite team and you'll receive a feed containing news, scores, and comments from other fans. If the prospect of socializing with your sports tribe isn't enough, you can even play broadcaster by posting Periscope-style streams from your sofa or the stadium.

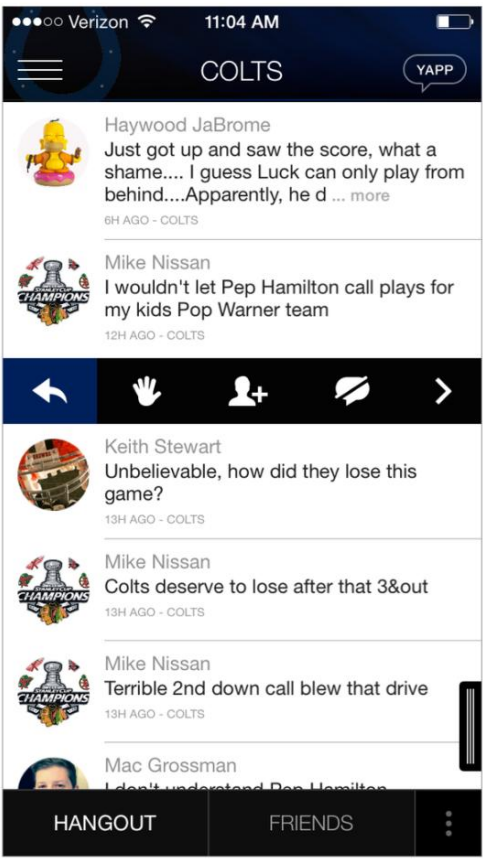
This network is not for lurkers: You'll also receive a FanCred Score, ranking you from 1 to 100 based on how much you post and interact with other users, so make sure you get in the game.



FanCred lets you show off your team spirit to other passionate fans during the game.

SportsYapper

Venting your football frustrations to the general population on Facebook or Twitter is unsatisfying for you and downright annoying for your friends and followers. SportsYapper (sportsyapper.com) offers a more welcoming forum where your opinions and rants will always find a sympathetic ear.



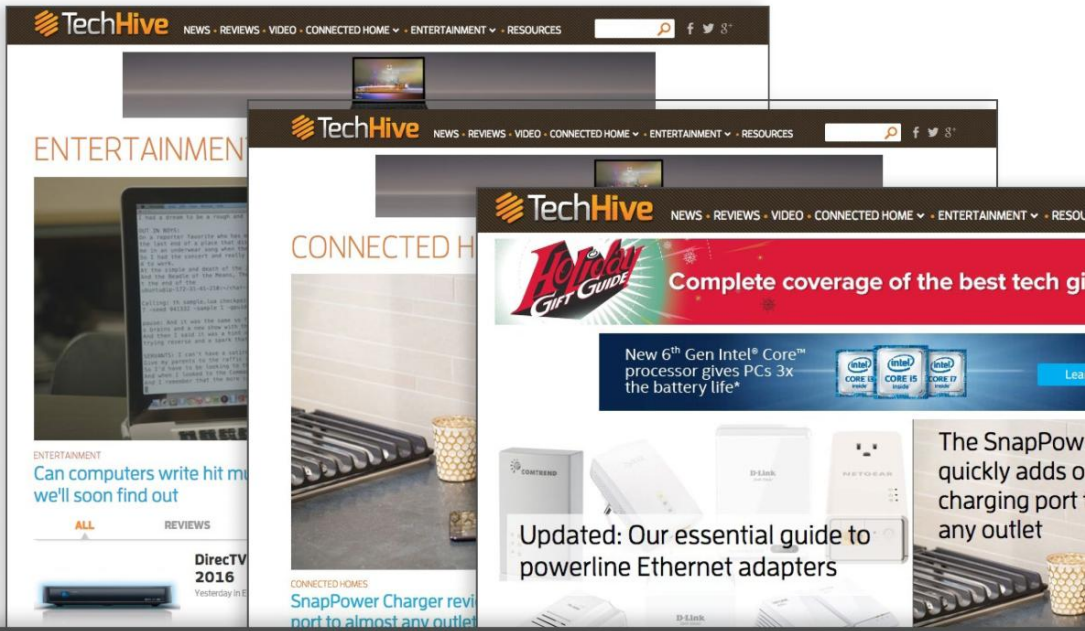
SportsYapper lets you talk about the game with other viewers in real time.

Essentially, SportsYapper creates chat rooms around specific teams and live games where you can hang out and "yap" with other fans. You get 300 characters to comment, which should be plenty to express your joy over your team's last-second win or to debate a ref's controversial call. When you have a meeting of the minds with another fan, you can give them a "high five," the SportsYapper equivalent of a Facebook "like."

Beyond sports chatter, the free app lets you upload and search photos of game gatherings, and it will alert you when a game is about to start or when a friend logs in.

TechHive

News, tips, and reviews about smart homes, home security, and home entertainment.



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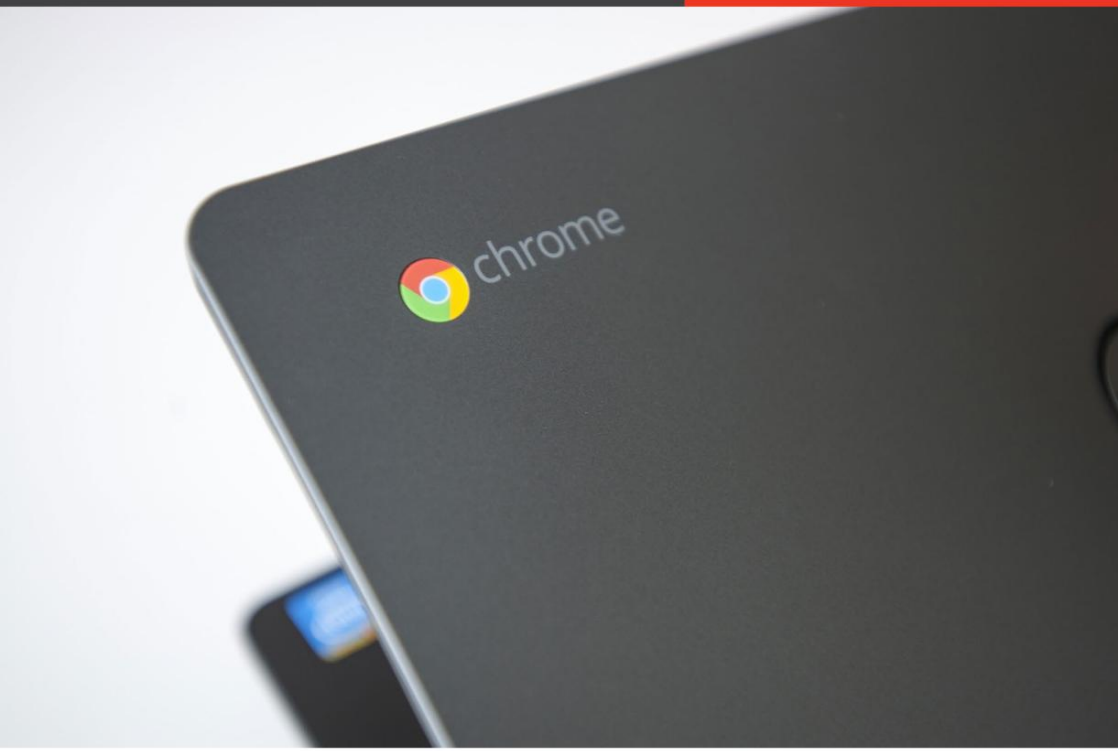


Why Google plans to stop supporting your Chromebook after five years

Google's End of Life Policy sets a schedule for retiring older Chromebooks, but the details are murky.

BY JARED NEWMAN

ONE OF THE BEST things about Chromebooks is that they're built to last. Thanks to automatic security and feature updates from Google, along with a lightweight browser-based operating system, longtime users may find that their laptops run as well, if not better, than they did on day one.

But despite Chromebooks' theoretical longevity, it's possible for Google to cut their lives short. Per the company's End of Life policy (go.pcworld.com/cbeolpolicy), Chromebooks and other Chrome OS devices are only entitled to five years of feature and security updates. After that, Google doesn't guarantee that these systems will run safely or properly.

Obsolescence seems nigh for the first wave of browser-based laptops, including Samsung's Series 5 and Acer's AC700, which arrived in 2011. Still, the policy isn't as cut-and-dry as Google's Chromebook end-of-life chart (go.pcworld.com/cbeolchart) makes it seem. Google has left itself some wiggle room to keep updating Chromebooks in the future, and is continuing to update Chromebooks that have officially lost support.

Google's CR-48, the first Chromebook, was also the first to lose guaranteed support.

Read on for details on how the Chromebook end-of-life policy really works.

Chromebook End of Life: What it means for you

According to Google, each Chromebook is guaranteed a minimum of five years of updates after the product's original release date (not to be confused with the time of purchase). Every six weeks during that time, Google provides automatic security and feature updates.

Right now, two Chromebooks—Samsung's Series 5 and the CR-48 prototype from 2010—have received an 'official' end-of-life date.

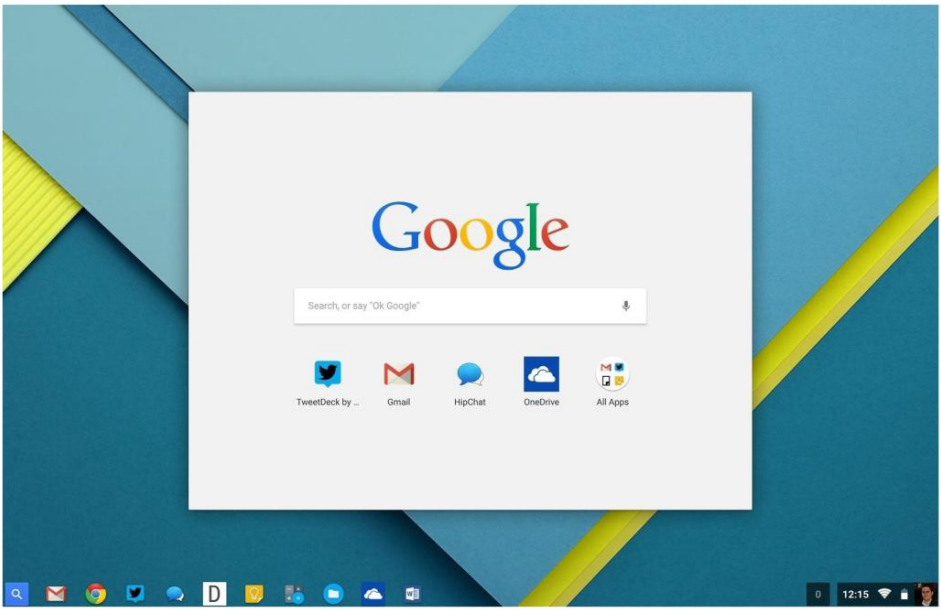
Beyond five years, though, things get murky. Right now, two Chromebooks—Samsung's Series 5 and the CR-48 prototype from 2010—have received an "official" end-of-life date. Another Chromebook, Acer's AC700, is unofficially slated for obsolescence very soon. However, only devices with official end-of-life dates are liable to stop receiving updates.

Not that it matters at the moment. A Google spokesperson told *PCWorld* that the end-of-life date is not a firm cutoff, and that all Chrome OS devices (including Google's CR-48 and Samsung's Series 5) are continuing to receive updates. As we said, murky situation.

When will the update situation change? It's unclear, but users should get a notification on their Chromebooks once the updates stop. At that point, devices may continue to function, but they could become less reliable over time. More importantly, they won't receive any more security updates, potentially leaving them vulnerable to unpatched exploits.

According to the Google spokesperson, the company recommends dumping your old Chromebook and getting a new one at that point.

There is, however, one more wrinkle to this story: Given that security is "one of the key tenets of Chrome OS," Google says it's "working with our partners to update our policies so that we're able to extend security patches and updates beyond a device's EOL date."



Google isn't making any guarantees at this point, but it sounds like the company wants to extend updates—at least on the security side—beyond five years. It also sounds like device makers such as Acer and Samsung would be partially responsible for making that happen.

Why this matters

Whether you're upset or satisfied with Google's Chromebook support policy depends on your point of view.

Compared to a typical PC, Chromebooks are designed to be more secure, thanks to verified boot mechanisms, built-in data encryption, and "sandboxing" that contains threats within apps and webpages. Even in an unpatched state, Chromebooks are somewhat safe. (They're arguably a lot safer than Android devices, which routinely go unpatched by device makers and are much bigger targets for malware overall.)

Still, Chrome OS exploits (go.pcworld.com/chromeossecurity) do happen, and Google itself has noted that the "most effective way to

protect against malware is to make sure all software is up to date and has the latest security fixes." For people with older hardware, those updates may not be guaranteed.

It's worth noting that end-of-life doesn't have to mean the end of useful hardware.

Five years may seem like a long time, but Microsoft has typically offered Windows security updates for at least 10 years after an operating system's release. That's a big deal given that more than 600 million PCs in use today are more than five years old. For enterprises and schools with slow device replacement cycles, it's essential.

Ultimately, what really matters is that users (and IT managers) can make informed decisions, and that's the biggest issue here. Google didn't publish an end-of-life policy for Chromebooks until late 2013, long after the company wooed users with the promise of automatic updates. And right now, the company's policy page remains ambiguous, so users can't be sure what to expect.

It's worth noting that end-of-life doesn't have to mean the end of useful hardware. If you have the know-how, you can install Linux (go.pcworld.com/cblinux) on your Chromebook to extend its lifespan. Otherwise, users whose Chromebooks are still in fine working order just have to hope that end-of-life notification never comes.

Yahoo data breach affects at least 500 million users, company says

BY MICHAEL KAN

A MASSIVE BREACH at Yahoo compromised account details from at least 500 million users, and the company is blaming the attack on state-sponsored hackers.

Names, email addresses, telephone numbers, and hashed passwords may have been stolen as part of the hack, which occurred in late 2014, Yahoo said.

The company reported the breach on September 22, after a stolen

database from the company went on sale (go.pcworld.com/yahooacctsblkmarket) on the black market in August.

However, the hacker behind the sale claimed that the stolen database involved only 200 million users and was likely obtained in 2012.

It's unclear if this breach is connected. But Yahoo has been notifying affected users and asking them to change their passwords.

"We are recommending that all users who haven't changed their passwords since 2014 do so," the company said in a statement. It's also asking that users review any suspicious activity related to their accounts.

Yahoo's investigation suggests that no payment card data or banking details were stolen in the breach.

The vast majority of the stolen passwords were hashed with the security tool bcrypt, making them more difficult to crack, Yahoo said. But some security questions and answers from the accounts may have also been taken.

However, Yahoo's investigation suggests that no payment card data or banking details were stolen in the breach, the company added. Yahoo has found no evidence showing that the hackers are still inside its network.

Yahoo has published an FAQ (yahooacctsecurityfaq) for affected users. The company is also working with law enforcement to investigate the incident.

The Windows 10 Anniversary Update is breaking webcams

BY IAN PAUL

MICROSOFT'S GOT ANOTHER Windows 10 Anniversary Update problem to fix following the login freeze issue (go.pcworld.com/w10loginfreeze) that came to light in mid-August.

Many users are now complaining that they can no longer use their USB-based webcams since updating to the latest version of Windows 10. The source of the problem is that Microsoft decided to filter out two common video compression formats for connected webcams in the Anniversary Update, as first reported by Thurrott.com.

Microsoft's reasons for restricting the formats—MJPEG and H.264—were reasonable enough, as explained by Windows Camera Team member Mike M. on Microsoft's developer forums.

In the Anniversary Update, Microsoft allows multiple apps to access a single webcam at the same time. The problem with MJPEG is that multiple apps could then decode the stream at the same time, which would reduce system performance unnecessarily. Mike M. said H.264's problem was a little different and could basically result in apps interfering with each other.

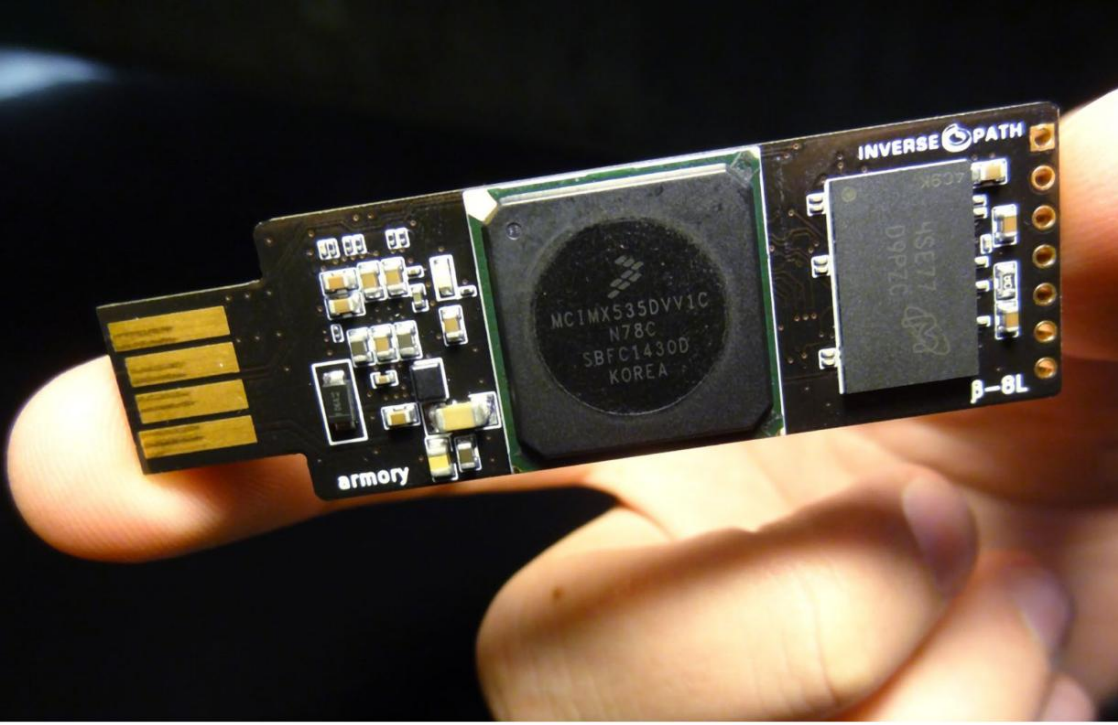
It appears Microsoft's simple solution of disallowing compression formats led to a much bigger problem. Potentially millions of webcams were suddenly broken, since they would freeze after failing to enable the blacklisted formats.

The impact on you at home: If your webcam has had problems after updating to the Anniversary Update, this may very well be the reason. Mike M. says Microsoft hopes to distribute a fix for the MJPEG issue in September, but solving H.264 will take a little longer. Unfortunately, until there's a fix there's not much you can do other than wait.

It appears Microsoft's simple solution of disallowing compression formats led to a much bigger problem.

If your webcam is a mission-critical peripheral then you may want to try and roll back to pre-Anniversary Update Windows 10. However, remember you only have 10 days to revert your system (go.pcworld.com/w10revert) after you upgrade—another change bundled with the Anniversary Update. For early adopters, that means it's already too late.

For those who haven't updated their systems yet, it might be a good idea to wait until later in order to save yourself any webcam hassles.



A USB device is all it takes to steal credentials from locked PCs

BY LUCIAN CONSTANTIN

MOST USERS LOCK their computer screens when they temporarily step away from them. While this seems like a good security measure, it isn't good enough, a researcher demonstrated recently.

Rob Fuller, principal security engineer at R5 Industries, found out (go.pcworld.com/lockedmachsnagcreds) that all it takes to copy an OS account password hash from a locked Windows computer is to plug in a special USB device for a few seconds. The hash can later be cracked or used directly in some network attacks.

For his attack, Fuller used a flash-drive-size computer called USB

Armory that costs $155, but the same attack can be pulled off with cheaper devices, like the Hak5 LAN Turtle, which costs $50.

The device needs to masquerade as a USB-to-ethernet LAN adapter in such a way that it becomes the primary network interface on the target computer. This shouldn't be difficult because: 1) operating systems automatically start installing newly connected USB devices, including ethernet cards, even when they are in a locked state and 2) they automatically configure wired or fast ethernet cards as the default gateways.

For example, if an attacker plugs in a rogue USB-to-Gigabit-ethernet adapter into a locked Windows laptop that normally uses a wireless connection, the adapter will get installed and will become the preferred network interface.

Furthermore, when a new network card gets installed, the OS configures it to automatically detect the network settings through the Dynamic Host Configuration Protocol (DHCP). This means that an attacker can have a rogue computer at the other end of the ethernet cable that acts as a DHCP server. USB Armory is a computer on a stick that's powered via USB and can run Linux, so no separate machine is required.

According to Fuller, computers in a locked state still generate network traffic, allowing for the account name and hashed password to be extracted.

Once an attacker controls a target computer's network settings via DHCP, he also controls DNS (Domain Name System) responses, can configure a rogue internet proxy through the WPAD (Web Proxy Autodiscovery) protocol and more. He essentially gains a privileged man-in-the-middle position that can be used to intercept and tamper with the computer's network traffic.

According to Fuller, computers in a locked state still generate network traffic, allowing for the account name and hashed password to be extracted. The time it takes for a rogue USB device to capture credentials from a system using this attack is around 13 seconds, he said.

He tested the attack successfully on Windows and OS X. However, he's still working on confirming if OS X is vulnerable by default or if it was his Mac's particular configuration that was vulnerable.

"First off, this is dead simple and shouldn't work, but it does," the researcher said in a blog post. "Also, there is no possible way that I'm the first one who has identified this, but here it is."

'Don't leave your workstation logged in, especially overnight, unattended, even if you lock the screen.'

Depending on the Windows version installed on the computer and its configuration, the password hashes will be in NT LAN Manager (NTLM) version 2 or NTLMv1 format. NTLMv2 hashes are harder to crack, but not impossible, especially if the password is not very complex and the attacker has access to a powerful password cracking rig.

There are also some relay attacks against network services where NTLM hashes can be used directly without having to know the user's plain-text password.

The lesson from all this is, as Fuller noted on Twitter: "Don't leave your workstation logged in, especially overnight, unattended, even if you lock the screen."

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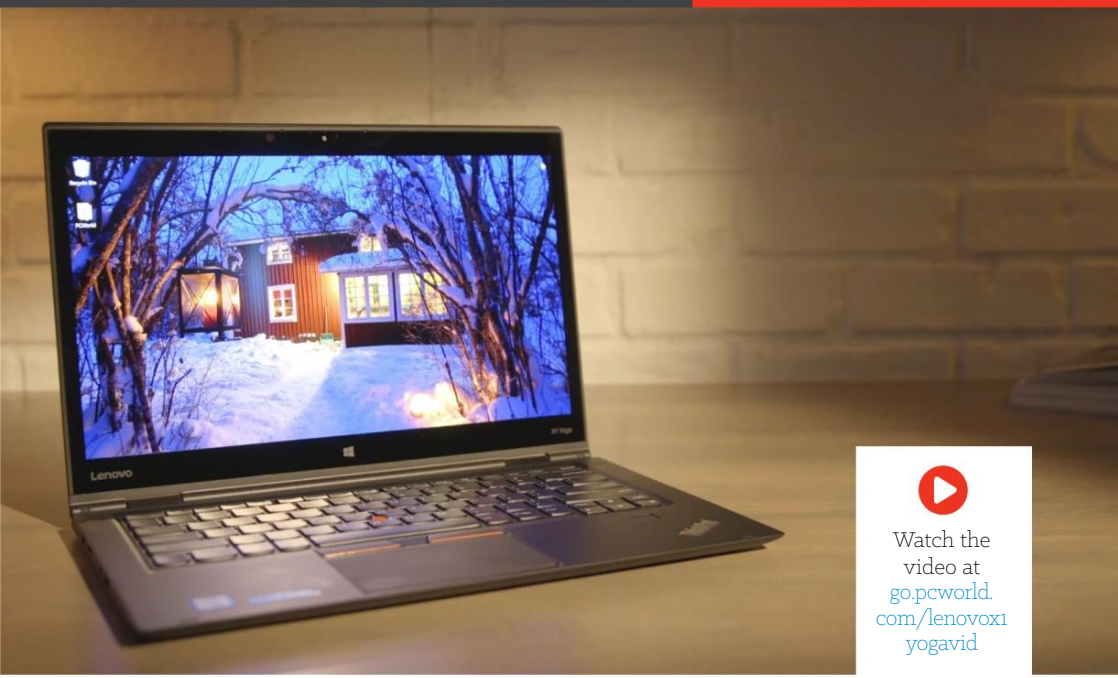


Watch the video at go.pcworld.com/lenovox1yogavid

Lenovo ThinkPad X1 Yoga: This 2-in-1's OLED screen will color your computing world

BY JON L. JACOBI

Rich, vibrant color. Real black. You don't realize how much you've missed them until they pop up again, as they do on Lenovo's new X1 Yoga. I can't overstate just how much nicer its OLED display looks compared to the cold LCD screens we've grown accustomed to. The images Lenovo sent us don't come close to doing it justice, so you'll have to trust us—or take a look yourself at a live unit.

Design and specs

The vehicle for this excellent technology, the X1 Yoga, is a riff on the X1 Carbon, and it sports several notable improvements. It has an active pen/stylus on board, a larger array of ports, and you can fully rotate the display to use the laptop in orientations from tablet to tent to traditional clamshell. Lenovo refers to all this as being Yoga-ized, which definitely sounds more appealing than a Yoga being carbonized.

The X1 Yoga in tent mode, with an invisible hand using the stylus to input text.

The X1 Yoga open as a normal laptop.

If you're familiar with the Carbon and Yoga series, or Lenovo in general, the X1 Yoga's won't surprise you. It comes dressed in black, with the usual hints of red on the eraserhead cursor control and the top set of touchpad buttons. Splashes of silver distinguish the display hinges and the logo.

The X1 Yoga weighs about 2.8 pounds, and measures approximately 13 x 9 x 0.66 inches. The display is that fantastic 14-inch, 2560x1440 RGB OLED that I've already gushed over. The fact that it's RGB is a nice feature: It means there are no white sub-pixels used to brighten the display. You get just red, green and blue. It's the best and most expensive type of OLED.

Inside our $2,544 review model (go.pcworld.com/lenovox1yoga) is a Intel Core i7-6600U CPU, 16GB of LPDDR3/1866MHz RAM, and a 256GB Samsung SM951 PCIe-NVMe SSD. An Intel 8260 wireless card provides 802.11ac Wi-Fi and Bluetooth 4.1.

The port selection is probably the only area of disappointment with the X1 Yoga. It does have three

HP Spectre X360 15T

PROS

- Sexy, thin, and a tiny power brick
- Big screen with a dual-core price

CONS

- Still very large footprint despite not having performance of competing laptops
- Dual-core gets smacked around by quad-core competitors

$1,150

★★★★½

USB 3.0 ports (one always-on for charging), full-sized HDMI, mini DisplayPort 1.3, microSD and SIM slots on the back, plus Lenovo's OneLink+ docking connector. But we were also hoping to see USB 3.1 (either Type A or Type C) or Thunderbolt. These modern additions would've taken the X1 Yoga from fantastic to awesome.

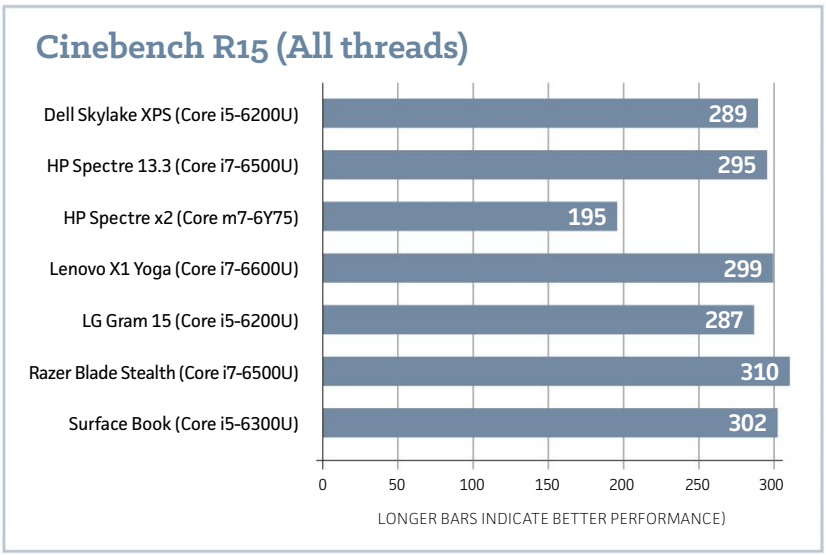
Input ergonomics

The X1 Yoga's keyboard, clickpad, and Trackpoint run smoothly. Very smoothly.

Despite the short amount of travel in its sculpted keys, the keyboard feels fantastic to type on. Each key press delivers a firm, decisive finish, as does the clickpad, and the latter's surface feels velvety when you slide your fingers across it.

For its part, the eraserhead-like TrackPoint responds well. Its companion set of left- and right-click buttons found just below the keyboard function smoothly, though the clickpad offers slightly sharper tactile feedback.)

An overhead shot of the X1 Yoga's fantastic sculpted-key keyboard.



Performance

The X1 Yoga performed about as we expected for a machine with its specs and slim profile. In short CPU-based tasks, like our Cinebench R15 benchmark, its Core i7-6600U part can give a small boost in performance over Core i5 parts. Its score of 299 marks a roughly 3-percent gain over ultraportables with a Core i5-6200U processor (currently one of the more common parts in ultrabooks). That said, the Surface Book (go.pcworld.com/surfacebook) still manages to hold its own running a Core i5-6300U CPU.

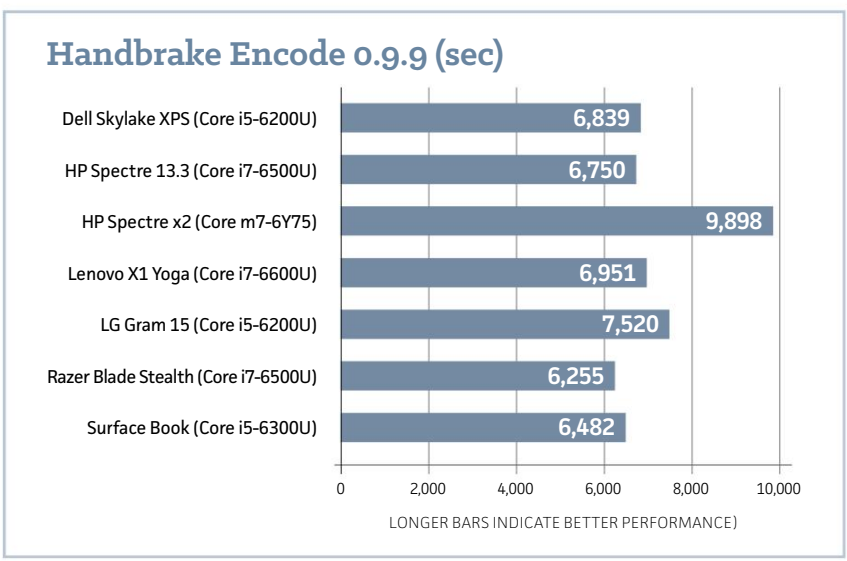
The thinner the machine, the more challenging it is to keep the processor cool—particularly if fan noise is a concern. Many thin laptops stay quiet by throttling CPU performance under heavy prolonged use, and our Handbrake test tells the tale.

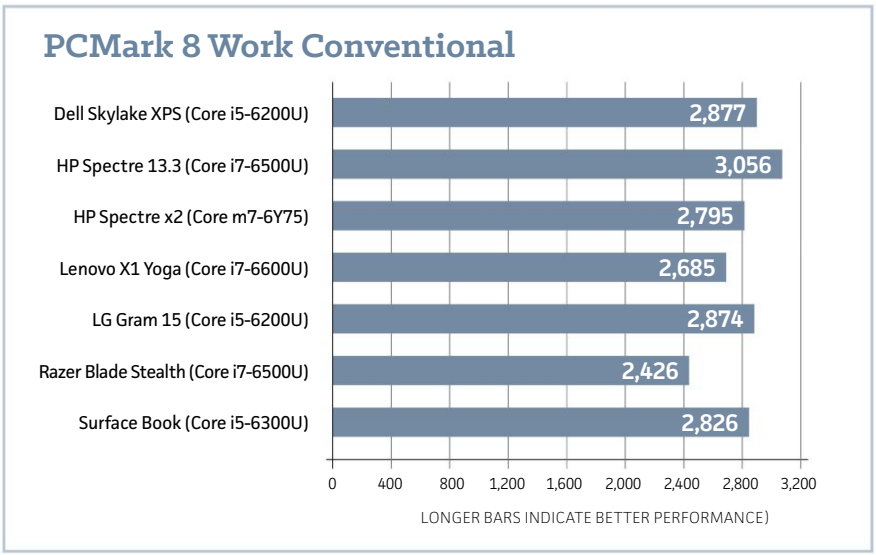
This benchmark, which involves converting a 30GB MKV into a MP4 on the Android Tablet preset, is a torture test for ultraportable systems like the X1 Yoga. Lenovo's OLED beauty dropped from a clock speed of 3.18GHz to a steady 2.78GHz after core temperatures rose and stayed at 72°C for several minutes. Still, it didn't throttle as heavily

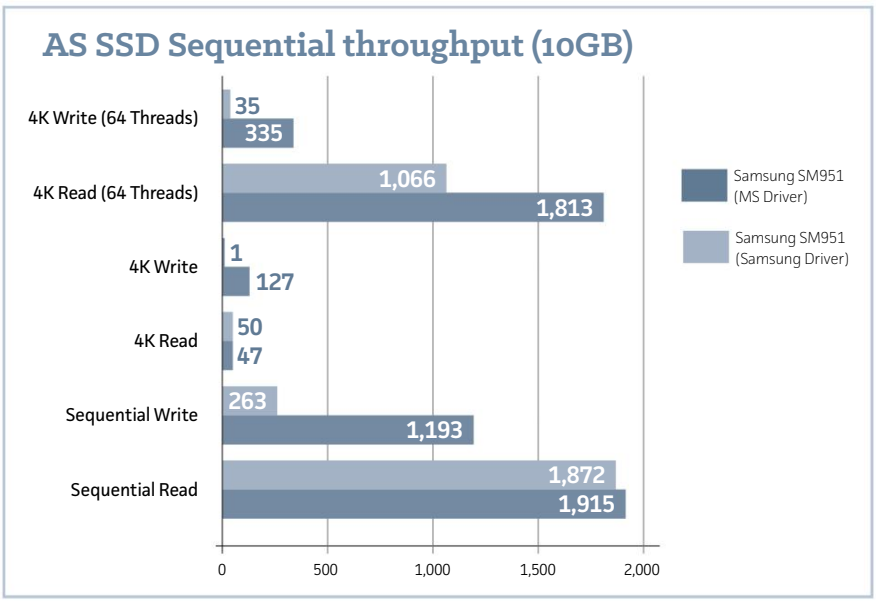
as some systems with even greater thermal constraints (like the LG Gram 15) do—it still performed roughly in the same range as the Dell XPS 13 (go.pcworld.com/dellxps13rev) and HP Spectre 13.3 (go.pcworld.com/hpspectre133rev).

Of course, the X1 Yoga isn't what you buy for content creation. Most people in the market for a thin-and-light just want to surf the web or watch a movie. In our PCMark8 Work Conventional benchmark, which simulates simple office work—document creation and editing, web browsing, and video conferencing—the X1 Yoga scored 2,685. That's actually slightly lower than some Core i5 systems, like the XPS 13, but in actual use, most people won't notice much of a difference when writing an email, adding some basic data to a spreadsheet, or browsing a website for office supplies.

In fact, what influences how fast a system will subjectively feel is more so the type of storage drive. Happily, the X1 Yoga comes equipped with the fastest you can currently get: a PCIe-NVMe SSD (go.pcworld.com/everythingnvme)—but the experience puzzled us at first. Windows and







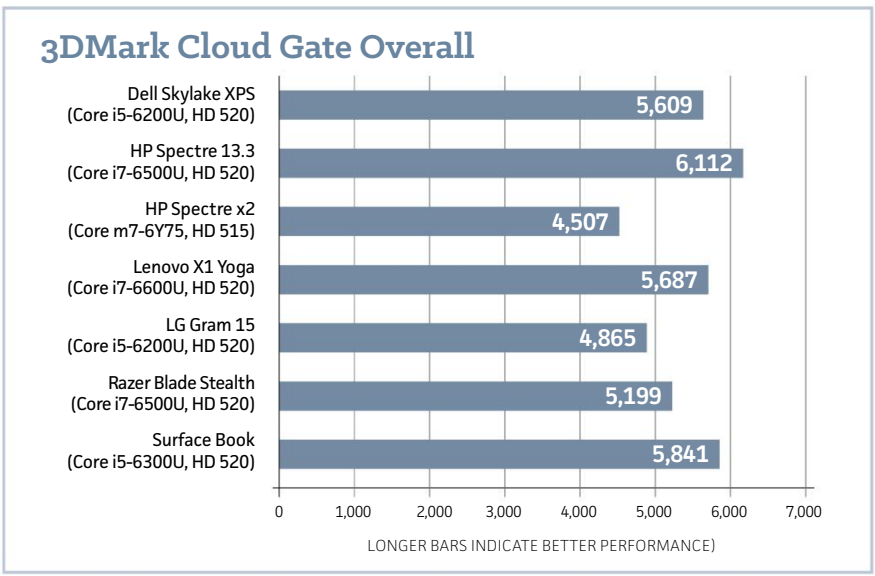
Before and after installing Samsung's NVMe driver on the X1 Yoga. Note that the 4K writes (unthreaded) were so slow before the install, they don't even tick the chart.

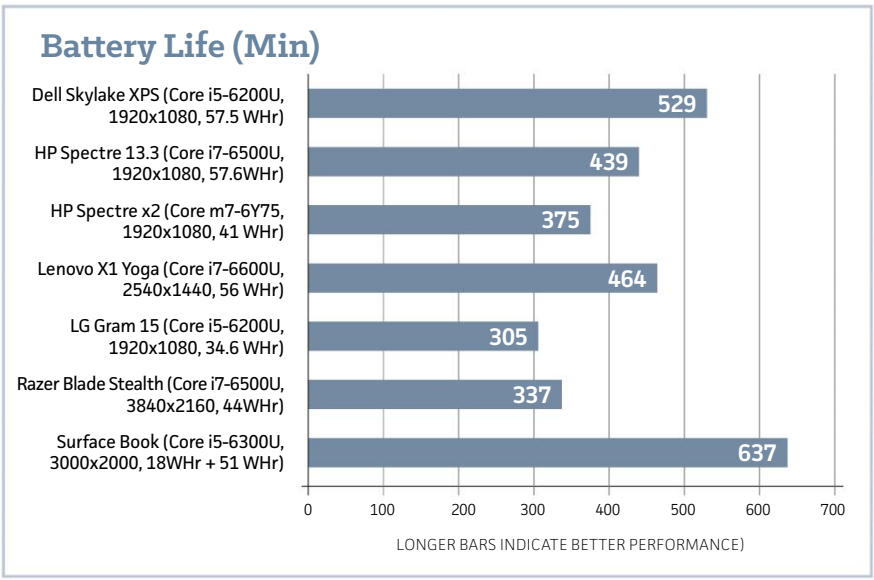
applications didn't pop open the way they should with an NVMe SSD. For some reason, Lenovo didn't install Samsung's NVMe driver, instead relying on Microsoft's. As a result, the SSD read great, but wrote like an inebriated hog.

Installing the proper driver (downloaded from Samsung's website go.pcworld.com/samsungdrivers) worked miracles. The feel of the unit perked up dramatically, as you can see in the AS SSD benchmark results on the previous page. If you see reviews complaining that the X1 Yoga doesn't feel as fast as it should, the generic driver is probably why.

As for gaming performance, the X1 Yoga performed about equal to its ultraportable peers in 3DMark's Cloud Gate test. That said, the whole lot of ultrabooks can't do much to begin with on their integrated GPUs. At best, you can play games with light system demands.

Of more importance for a machine like this is battery life. The X1 Yoga's 56-watt-hour battery lasted 7 hours and 44 minutes during our video playback test, in which we played a 4K movie file on continuous loop in Windows 10's Movie & TV app with the screen brightness set





between 250 and 260 nits. That's about a transatlantic flight. One note, though: In order to get that screen to 250 nits, we had to crank the brightness up all the way to 100 percent.

Strangely, though, the panel's OLED nature seems subjectively brighter at 250 nits compared to other machines set to the same level. That's possibly due to the fact that the display type seems to induce a bit of a home-brew HDR effect even in standard-definition material. OLED screens already possess that kind of dynamic range, thanks to the rich black they render. Fire, laser shots, and such really pop compared to the same type of elements on an LCD display.

Without a doubt, OLED makes just about everything more compelling (especially movies), at least visually. Sadly, it can't do anything for poor writing, directing, or acting.

Models, options, software and warranty

The X1 Yoga starts at $1,549 with an IPS LED backlit LCD touchscreen, and tops out at a little over $2,500. The cheapest OLED version—and

you want the OLED—is $1,869. That comes equipped with Windows 10 Home, a Core i5-6200U processor, 8GB of LPDDR3/1866MHz RAM, and a 128GB SATA SSD. Our configuration, which has Windows 10 Pro, an upgraded CPU, additional RAM, and a larger (and faster) storage drive, jacks up the price to $2,544 as mentioned above. You can opt for a 512GB SATA, 512GB PCIe-NVMe, or 1TB PCIe-NVMe SSD instead, but prepare to shell out up to another $250 more.

As of press time, Lenovo was offering a discount on these list prices—our review configuration cost $2,289.60—but you can save money in other ways, too. For example, you could easily cut the amount of RAM down to 8GB, and opt for a Core i5 CPU. If you're not crunching lots of numbers or editing high-def media, you won't notice the difference between the processors much, particularly since you'll be keeping that NVMe SSD. Fast storage will have far more of an effect on perceived performance than the CPU.

You could also downgrade to Windows 10 Home and save $30, but I'd advise against that. The Pro version allows you to ditch some intrusive stuff using the group policy editor, and also brings the ability to join a domain and other perks. Our configuration shipped with relatively little software clutter, but Lenovo does tend to brand things, so a little time culling the app herd won't hurt.

One included utility that we'd never call clutter is WRITEit, which lets you enter and edit text in any application with the active stylus. It

even does a good job with my handwriting, which is some of the ugliest ever to disgrace a page.

The X1 Yoga comes with a one-year, carry-in warranty. Adding a single year to the standard warranty is $69, with each additional year about $50. Other warranty/service packages are available, too, with the most expensive package offering five years of next business day on-site service and accidental damage coverage for $649.

Conclusion

The X1 Yoga belongs on anyone's list for the latest and greatest. Sure, we'd have liked to see the inclusion of USB 3.1 or Thunderbolt 3, but the combination of the X1 Yoga's OLED display and NVMe SSD (plus excellent keyboard, clickpad, and eraserhead) make this laptop one of the best. We can't stress enough that you shouldn't judge this machine by its photographs. You're viewing them through an LCD screen—go out and see that screen yourself.

iPhone 7: Its speed and camera are crazy-good, but it still drives me crazy

BY SUSIE OCHS

EVERY YEAR, APPLE releases the best iPhone ever, but the iPhone 7 feels different somehow. All of its major details leaked ahead of time, not to mention a good handful of rumors about *next* fall's iPhone, which could be a major redesign with an OLED screen and no Home button. For now, the iPhone 7 makes minor changes to the phone's form and bigger improvements to its function. But it adds a couple new annoyances at the same time, which makes the iPhone 7 feel a bit like a beta version of what's to come.

A10 Fusion

The biggest advancement is under the hood. At the September event, Apple explained that the A10

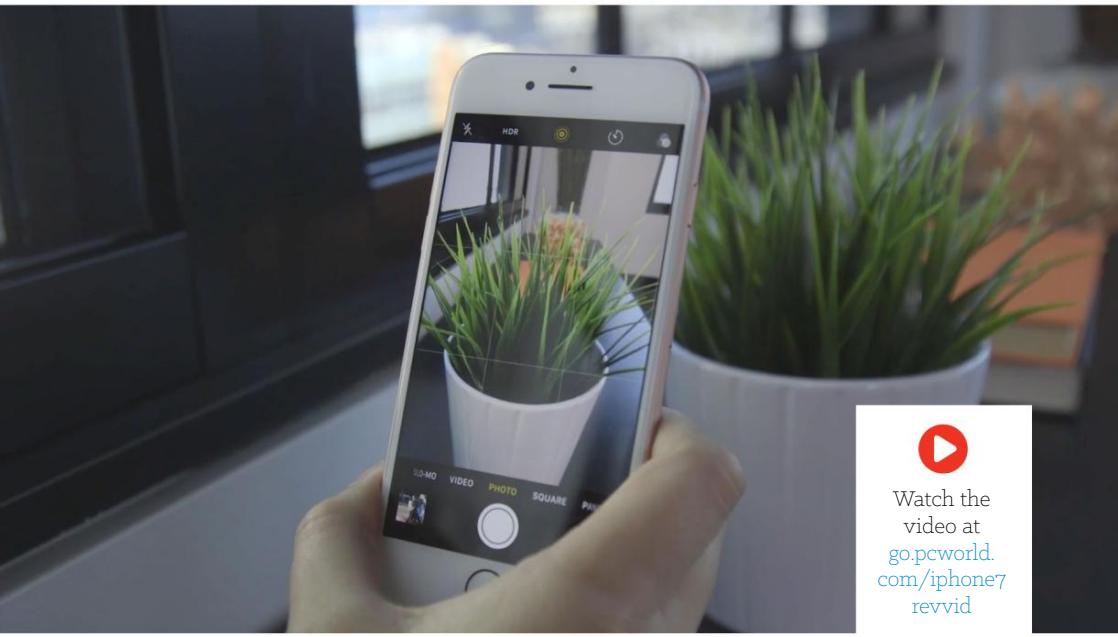
Fusion chip powering the iPhone 7 has four cores: two high-performance cores for the most intense tasks, and two low-energy cores to handle easier jobs while saving power. All I noticed when testing the iPhone 7—we bought a 128GB rose gold model on launch day—was speed.

Apps launch quickly, updates install quickly, and the camera is ready to shoot seemingly the very instant I swipe to it from the lock screen. I didn't notice any difference in performance in a resource-hungry app like Pixelmator as in a lighter app like Mail. Everything is just faster. Geekbench scores are 3440 for the single-core CPU test, and 5273 for the multi-core. That's nuts—my iPhone 6s scored 1437 and 2411, respectively, on the same tests, while my 2013 MacBook Air (1.7GHz Intel Core i7, 8GB of RAM) scored 2935 and 6200.

However, despite the A10's power management features, I didn't notice dramatic battery life savings. My iPhone 7 still gives me warnings in the early evening (usually between 5 and 8pm) that I'm down to 20 percent power, and even if I go into Low Power Mode at that point, I usually need to top off a little bit to make it to bedtime. I'm a pretty heavy user, so your mileage may vary, but I doubt your charging habits will change much.

Bigger is better. The f1.8 aperture lens on the back of the iPhone 7 (right) takes much better photos in low light than the iPhone 6s.

The iPhone 7 (on the left) looks nicer with the relocated antenna bars.



Watch the video at go.pcworld.com/iphone7revvid

Better screen, storage, and speakers

The screen is also improved. It's brighter, which makes it easier to read in bright sunlight. Where my iPhone SE is almost unreadable while standing in line at a food truck in the harsh midday glare, the iPhone 7 is legible enough that I can read an article in Instapaper or play another level of Two Dots. The screen also supports a wider color gamut, which makes photos and videos really pop with vibrant, saturated color—Dr. Raymond Soneira of DisplayMate recently proclaimed it "virtually indistinguishable from perfect (go.pcworld.com/iphone7sdisplay)." It's one of those things you kind of need to see in person to appreciate, though, with an older iPhone on hand to compare side-by-side.

While Apple did remove the analog headphone port (and trust me, I'll get way into that a little later), it did add a second speaker for stereo sound when you hold the phone in landscape mode. The extra

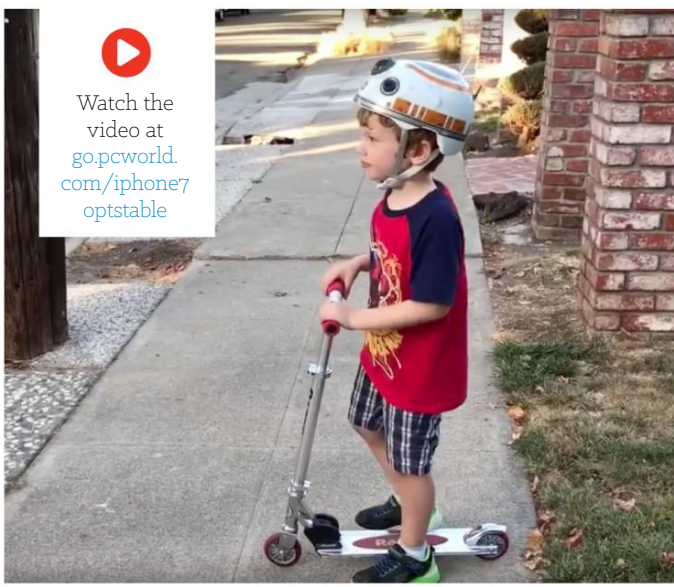
speaker is up near the FaceTime camera, and I could hear a bit of stereo separation when streaming *The Force Awakens* in the Videos app. Watching the same passage on an iPhone 6s, it was more obvious the sound was only coming from one speaker, and the iPhone 7 was louder too.

Another nice addition is the doubling of storage sizes. The entry-level iPhone 7 is now 32GB instead of 16GB. The middle tier is 128GB, and the high-end 256GB. That's a pretty big deal if you're always having to manage your available storage by deleting photos and videos. The iPhone SE tops out at 64GB, and the iPhone 6s at 128GB, so if you need a huge amount of storage, the iPhone 7 is the way to go.

Camera

This review only covers the iPhone 7—we'll follow up with a separate review of the iPhone 7 Plus, which has two cameras. The iPhone 7 has one 12-megapixel iSight camera, but its performance is much improved on the iPhone 6s's. It's got a wider aperture lens, f/1.8, which lets in more light for better photos in low-light conditions than the iPhone 6s's f/2.2 lens. The iPhone 7 also has optical image stabilization, which used to be confined to the larger Plus models. The TrueTone flash is also 50 percent brighter thanks to four LEDs, and Apple says it can even compensate for the subtle flickering of indoor lighting.

None of that changes how you actually use the Camera app—it's just easier to get a



A video I took while walking my son home from school really benefitted from the optical image stabilization, greatly reducing the bounce in my step as I tried to keep up with him.

good photo without any extra effort. Colors look amazing on the screen, and the iPhone 7 captures the wider P3 color gamut. (iOS 10 even lets third-party apps capture RAW data from the camera, but the stock Camera app still saves images as JPEGs.) My low-light photos show more detail, and daytime photos look better thanks to the vibrant color and the optical image stabilization.

I also loved how quickly the camera can refocus itself when you're composing a photo or shooting a video. I loved getting close up on, say, a flower, and watching how the background of the image got soft as the camera focused on the subject. Then I'd pull back until the focus snapped to the entire plant. A video I took while walking my son home from school really benefitted from the optical image stabilization, greatly reducing the bounce in my step as I tried to keep up

The image on the left, taken with an iPhone 6s, has lens flare, while the iPhone 7 image (on the right) has better color on the car as well as in the sky.

The biggest difference is in low light, where the iPhone 7 (right) captured way more detail than the iPhone 6s (left).

The iPhone 7 (right) better captured this fire truck's bright colors, and found more detail in the shadowy areas.

with him.

On the front, the FaceTime camera went from 5 megapixels in the iPhone 6s to 7 megapixels here, although it keeps the same f/2.2 aperture. It can now record video in 1080p, and its low-light performance is improved too. All in all, it just works more like the rear camera, so your selfies always look their best.

No, I have not yet tried this at home.

Water resistance

I've dropped two iPhones into toilets—I'm not proud, but it happens. Luckily, both of them came back to life, but that required a whole day of keeping the phone powered down and sitting in a Ziploc bag of uncooked rice, then a vigorous cleaning with antibacterial wipes that Apple advises against using anyhow. (But come on, I just had to!)

So the iPhone 7's IP67 rating will save a lot of people a lot time and heartbreak, even if the convenience store near my office sells fewer bags of rice to panicked iPhone owners. Apple recommends (go.pcworld.com/iphone7h20rec) you don't get the iPhone wet on purpose, and if you do, disconnect all cables and be sure to dry it out completely (they even suggest aiming a fan at the Lightning port) before you try to charge it again.

These warnings got me just paranoid enough to not want to test the water resistance of my brand-new phone, but I do appreciate how achieving this rating didn't necessitate any awkward design choices. I reviewed a water-resistant Sony Xperia Z (go.pcworld.com/xperiazrev) a couple years back, for example, that had little rubber plugs

shoved into the charging and headphone ports, which worked but wasn't the best experience. Today, Apple and Samsung (go.pcworld.com/samsungstudiosxsw16) are able to make their phones water resistant by protecting components inside the case, so there's no inconvenience to the end user. Water resistance probably isn't reason enough on its own to upgrade, but it's a great bonus.

The new Home button

Unfortunately, not everything about the iPhone 7 is better. The new Home button is easier for me to get behind, assuming it helped Apple waterproof the phone. Still, so far I'm not really a fan.

In past iPhones, the Home button was a real separate button that provided a physical click when pressed. Of course, that meant it was subject to physical failure, although I never had an issue with any of mine. The iPhone 7's new Home button is completely fused with the rest of the iPhone's chin, although you can still find it easily with your thumb thanks to the button's slight indentation, surrounded by the Touch ID's slightly raised metal ring.

The Home button isn't a traditional button, and I suspect it'll go away completely at some point.

So while the new Home button doesn't physically click, it does kind of buzz when you press it, thanks to a taptic engine that Apple added to provide haptic feedback. The effect is similar to the MacBook's Force Touch trackpad (go.pcworld.com/2015mbook12) and the Magic Trackpad (go.pcworld.com/trackpad2rev), which also don't physically click but provide a subtle vibration when you press down to simulate the feeling of a click.

Developers can already use those vibrations in their Mac apps, so for example, if you're editing a photo, you could "feel" on the Force Touch

trackpad when a selection box snaps to the exact center. Now on the iPhone 7, Apple and third-party iOS developers can use the taptic engine to provide feedback in their apps too. To test it out, open the Clock app, and spin the dials in the Timer app to feel a little buzz with every click of the dial. If you hate the effect, you can turn it off in Settings > Sounds & Haptics > System Haptics.

And the Home button is now capacitive, meaning you can't press it through cloth or through sports armbands that physically cover the button.

While the system haptics don't bother me, the new Home button just feels odd. You get three "click feels" to choose from in Settings > General > Home Button, so you can customize the amount of feedback somewhat. And I'm sure I'll get fully used to it at some point. But after five days, it still feels weird. If the iPhone is ever powered off (I know, it's rare, but stick with me), the Home button doesn't provide any feedback, so you feel like you're pressing a solid wall expecting to find a hidden button. Open sesame?

And the Home button is now capacitive, meaning you can't press it through cloth or through sports armbands that physically cover the button. Based on reports, some touchscreen-friendly gloves work (go.pcworld.com/capacitivegloves) on the Home button, while others work on the iPhone 7's touchscreen but not the Home button (go.pcworld.com/ip7gloveprob). A workaround to exit an app in that

My two biggest problems with the iPhone 7 are below the screen.

case is to 3D Touch the very left edge of the phone's screen to bring up the app switcher, then swipe left-to-right to get back to the home screen. Or just buy new gloves.)

I didn't have touchscreen gloves on hand to test—hey, it's California—but we'll follow up with a separate article later. If you live somewhere cold and rely on touchscreen gloves in the winter, you might want to bring your favorite pair to the Apple Store, if possible, to test them out on the iPhone 7 in person.

No more headphone jack

The lack of a headphone jack is more annoying than anything else. But it sucks when you just spent $649-plus on a piece of technology and then have to deal with new annoyances that previous editions didn't have. Quality Bluetooth headphones are still expensive, all Bluetooth headphones need to be charged, and they require a trip to the Settings app to pair them—and sometimes to re-pair them when they drop the connection with no warning.

Apple claims it's solved these problems with the AirPods, but those aren't available yet. Thanks to a W1 chip, Apple's AirPods, and Beats' Solo3, Powerbeats3, and BeatsX should pair more seamlessly and use less power, but only the Solo3 were available at launch. (AirPods are expected in late October, and the Beats just in "fall.") If you already

Now you see it, now you don't. The iPhone 6s has a headphone jack. The iPhone 7 does not.

have Bluetooth headphones you like, this isn't a problem. But if you don't, you'll find yourself in limbo with me, having to choose between what's out now from Jaybird or Bose, settling for last year's Beats, or waiting for Apple's AirPods or the new Beats to show up in stores.

Until then, Apple does provide two wired solutions in the box. I've been mostly using the Lightning EarPods, which fit and sound exactly like the old EarPods, but have a Lightning plug on the end instead of a 3.5mm plug. As Jason Snell pointed out (go.pcworld.com/nojackreasons), if most people use whatever headphones came in the box, having these in the box just might be good enough. I don't love the EarPods, but it turns out I don't hate them as much as I remembered.

As a bonus, you also get a Lightning-to–3.5mm adapter, to plug in whatever analog headphones you already have. (Spare adapters are $9 at the Apple Store go.pcworld.com/hpjackadapter.) The adapter is fine, although it's a little awkward if your headphones have a 90-degree plug instead of a straight one. We'll perform some tests a little later to see if there's much difference in sound quality between using the adapter (which must have a DAC built in) with the iPhone 7, versus plugging the same headphones directly into an iPhone 6s.

My hands-on time with the AirPods (go.pcworld.

The Lightning EarPods can tide me over until the AirPods ship, but I'm salty I can't charge my phone while I'm using them.

Apple iPhone 7

AT A GLANCE

The iPhone 7 has more speed, a better camera, double the storage, and a more vibrant screen. But some people might be turned off by little annoyances that previous iPhones didn't have.

PROS

- A10 Fusion chip is crazy fast, approaching laptop speeds
- Great camera performance

CONS

- No headphone port, so you can't charge and listen to wired headphones at the same time

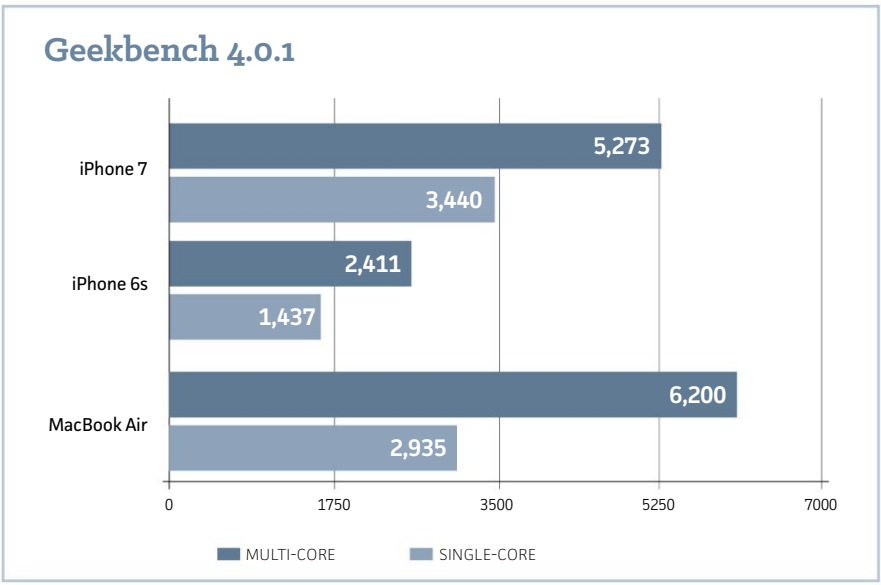
$749

★★★★½

com/airpodshandson) at their unveiling was promising enough that I'd like to hold out for those, and so I don't currently have a set of Bluetooth headphones that I like. So my biggest problem with the iPhone 7 is that I can't listen to wired headphones and charge the phone at the same time, since both of those require the Lightning port. Depending on your daily routine, you might not find yourself ever needing to do that. But I find myself needing to charge while wanting to listen fairly often, typically a few times a week.

So my biggest problem with the iPhone 7 is that I can't listen to wired headphones and charge the phone at the same time, since both of those require the Lightning port

Just yesterday I found myself on a commuter bus stuck in traffic, watching my iPhone 7, which was already in Low Power Mode, slip down below 10 percent. If I wanted to connect it to one of the USB



The new iPhone 7 benchmarked more like my 2013 MacBook Air than my iPhone 6s. (Longer bars are better.)

battery packs I keep in my bag, I'd have to stop listening to podcasts while it charged. Instead, I popped it into Airplane Mode to squeeze as much battery life as I could. I got home with 2 percent charge left, but I missed a text message from my husband in the process—pretty annoying. I also tend to work out in the evenings, so sometimes I'll top up my iPhone with a USB battery pack while I'm also using it to stream music over Spotify while I ride my exercise bike—wearing headphones. With the iPhone 7, I have to choose: charge the phone while blasting music over the speakers, or wait to exercise with my headphones until the phone has a chance to top off? (Or get yet another adapter, like this big ol' Lightning splitter go.pcworld.com/belkinlightningsplitter from Belkin.)

The moral of this story is that I really need some Bluetooth headphones, I realize. But I can't help feeling a little resentful when a piece of technology, in this case the iPhone 7, introduces a new problem that requires me to buy *more* technology to solve it.

I wouldn't call this Lightning to 3.5mm adapter an elegant solution. But it works and it's relatively cheap.

Bottom line

The things that are great about the iPhone 7—primarily its speed and the camera—are likely to be even better in the next generation. On the other hand, the things that aggravate me about this iPhone—namely, the weird Home button and the aggravation of switching to wireless headphones—are likely to be improved.

If you're excited enough about the camera to upgrade, or your current iPhone is old enough that you want to upgrade, this is the best iPhone for you. But if the drawbacks make you want to sit out a year, I think that's really smart.

EVGA GTX 1060 3GB: A compelling $200 graphics card with a questionable future

BY BRAD CHACOS

IN JUNE, AMD released the $200 Radeon RX 480 (go.pcworld.com/radeonrx480rev), the crown jewel in the company's oft-trumpeted campaign to bring high-performance graphics to the masses. While Nvidia was busy releasing powerful, yet pricey cards like the GeForce GTX 1070 (go.pcworld.com/geforcegtx1070rev) and GTX 1080 (go.pcworld.com/geforcegtx1080), AMD said its focus was squarely on

everyday gamers. VR isn't just for the 1 percent, a revolution-themed ad campaign barked.

A mere week after the Radeon RX 480 launched, Nvidia surprised everyone by announcing (go.pcworld.com/geforcegtx1060-980) its own affordable GeForce GTX 1060.

The GTX 1060 delivered (go.pcworld.com/geforcegtx1060rev) a similar, yet slightly better experience than the RX 480: It was slightly faster at gaming, slightly faster in VR, slightly quieter, and a hell of a lot more power-efficient. But Nvidia's card is also not-so-slightly more expensive, starting at $250. Between the extreme price sensitivity in the $200 segment and the fact that the RX 480 already delivers no-compromises 1080p gaming, we actually recommend (go.pcworld.com/pcgamingcards) most people pick up the Radeon instead of Nvidia's card—even though the 6GB GeForce GTX 1060 is technically superior on paper.

SPECIFICATIONS

Base Clock: 1506 MHz
Boost Clock: 1708 MHz
Memory Clock: 8008 MHz Effective
CUDA Cores: 1152
Bus Type: PCI-E 3.0
Memory Detail: 3072MB GDDR5
Memory Bit Width: 192 Bit
Memory Speed: 0.28ns
Memory Bandwidth: 192 GB/s

DIMENSIONS

Height: 4.376in - 111.15mm
Length: 6.8in - 172.72mm
Width: Dual Slot

GTX 1060 3GB Gaming

AT A GLANCE

EVGA's $200 GTX 1060 3GB Gaming would be a no-brainer over AMD's Radeon RX 470 if it had a bit more memory.

PROS

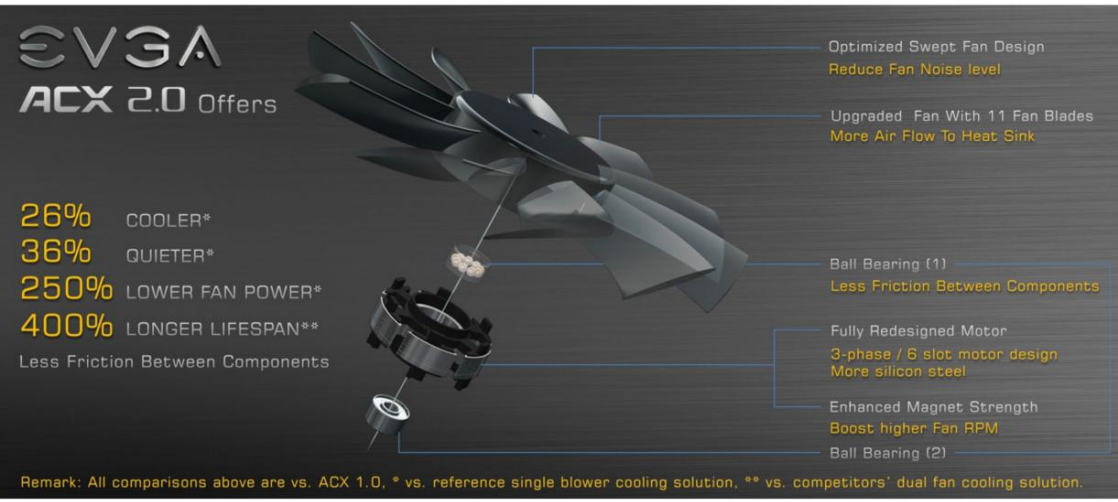
- High-quality 1080p gaming
- Incredibly power efficient
- Affordable and available

CONS

- 3GB of RAM isn't very future-proof
- Limited RAM already requires texture compromises in some games

$200

★★★★½



An overview of EVGA's ACX 2.0 cooling system.

There's a hiccup in all of this, though. The cheaper 4GB versions of the Radeon RX 480 have been extremely difficult to find, and $200 models based on the reference design are virtually nonexistent. People looking to buy an RX 480 for the $200 price point AMD trumpeted have been sorely disappointed, as the enthusiasts on the r/amd subreddit are quick (go.pcworld.com/200rx480) to point out (go.pcworld.com/200rx480question).

Enter Nvidia's 3GB GeForce GTX 1060—a cut-down variant that also starts at $200. It's on.

Meet the 3GB EVGA GTX 1060

The 3GB version of the GTX 1060 is mostly the same as the full-fat 6GB version, but with a couple of key differences.

Obviously, the memory's been halved. But more insidiously, the 3GB GTX 1060 actually disables one of the GP106 GPU's ten streaming multiprocessors. That reduces the graphics card's CUDA cores to 1152, down from the full-fat 6GB model's 1280. Add some other under-the-hood changes, and the 3GB GTX 1060 becomes a subtly—yet materially—different GPU than the 6GB GTX 1060. All this may have

been necessary to hit the $200 price point, but calling this card a “GTX 1060” seems destined to confuse buyers who don’t dig into 10-page performance reviews. Calling it a “GTX 1050 Ti” or “GTX 1060 LE” could’ve avoided all that.

Alas. On the plus side, Nvidia says it won’t mix and match the differing GPU’s memory capacities. A 6GB GTX 1060 will always have the full 14nm GP106 Pascal GPU, while any 3GB versions you see will always pack the pared-down version of the processor.

To test the new configuration’s capabilities, EVGA sent us an EVGA GTX 1060 3GB Gaming ($200 on Amazon, go.pcworld.com/evgagtx1060amz) for review. You couldn’t ask for a more ideal paragon: The card sticks to the GTX 1060 3GB’s reference speeds, feeds, and pricing. Port-wise, the EVGA GTX 1060 3GB Gaming packs the stock DVI-D, HDMI 2.0b, and trio of DisplayPort 1.4 connections. It doesn’t include an SLI connector, as Nvidia decided not to bake multicard setup support into the GTX 1060, presumably because a pair of GTX 1060s in SLI would likely outperform the $600-plus GTX 1080, but for just $500, and Nvidia doesn’t want that happening.

Nvidia didn’t create a Founders Edition “reference” version of the GTX 1060 3GB, and EVGA equipped this diminutive 6.8-inch-long graphics card with a single-fan version of the company’s ACX 2.0 custom cooler (go.pcworld.com/acx2cooler)

. Pricier options upgrade to a more efficient ACX 3.0 model, but hey—ACX 2.0 excelled on EVGA’s GTX 970 and GTX 980, albeit in dual-fan setups. This cooling solution is nothing to sneeze at. The card pulls its 120-watt TDP through a single 6-pin power connector.

Of course, the Pascal architecture-based GPU in the heart of the EVGA GTX 1060 3GB Gaming enables all sorts of fancy features found throughout the GTX 10-series lineup. That includes key additions (go.pcworld.com/geforcegtx1080p2) like simultaneous multi-projection and async compute improvements, as well as handy extras (go.pcworld.com/geforcegtx1080p3) like Ansel screenshots, Fast Sync, GPU Boost 3.0, and more. Importantly for this particular model, Pascal-based video cards also pack Nvidia's superb fourth-generation delta color compression to ease memory demands. Hit those links for details on all the goodies, which we covered in-depth in our GTX 1080 review.

And now to answer the most important question about the GTX 1060 3GB: How does it stack up against AMD's RX 400-series cards?

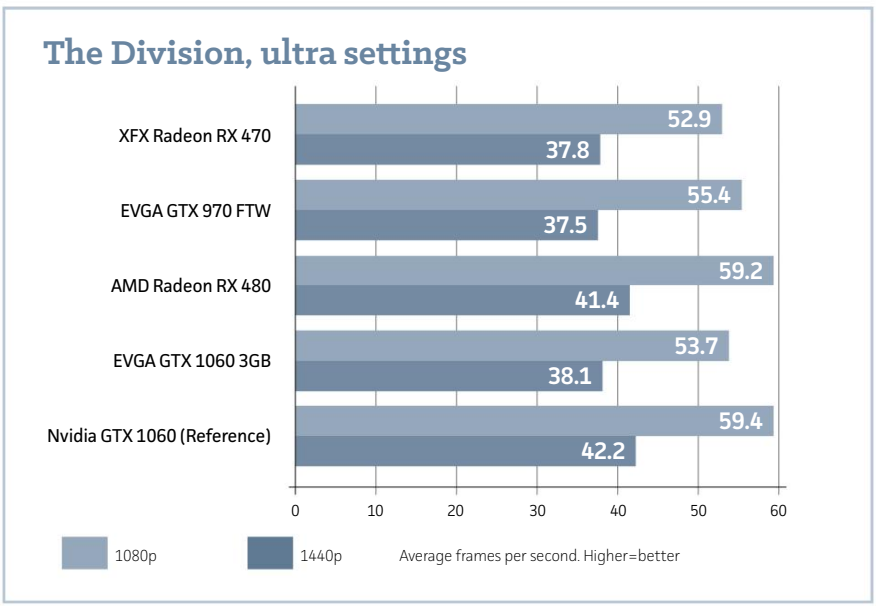
Our test system

We tested the EVGA GTX 1060 3GB Gaming on *PCWorld*'s dedicated graphics card benchmark system (go.pcworld.com/pcwbenchmark). Our testbed's loaded with high-end components to avoid bottlenecks in other parts of the system and show unfettered graphics performance. Key highlights:

- Intel's Core i7-5960X ($1,016 on Amazon, go.pcworld.com/intel i75960xamz) with a Corsair Hydro Series H100i closed-loop water cooler ($97 on Amazon, go.pcworld.com/corsairh100iamz).
- An Asus X99 Deluxe motherboard ($360 on Amazon, go.pcworld.com/asusx99amz).
- Corsair's Vengeance LPX DDR4 memory ($65 on Newegg, go.pcworld.com/vengeancelpxamz), Obsidian 750D full-tower case ($155 on Amazon, go.pcworld.com/obsidian750damz), and 1,200-watt AX1200i power supply ($308 on Amazon, go.pcworld.com/corsairaz1200iamz).

- A 480GB Intel 730 series SSD ($248 on Amazon, go.pcworld.com/intel730amz).
- Windows 10 Pro (go.pcworld.com/win10pro) ($199 on Amazon, go.pcworld.com/win10proamz).

We're comparing the $200 EVGA GTX 1060 3GB Gaming against its direct competitors: AMD's RX 480 and the XFX Radeon RX 470 RS Black Edition True OC (go.pcworld.com/radeonrx470rev) ($210 on Amazon, go.pcworld.com/xfx1226mhzamz), as well as the original 6GB GTX 1060. (We're testing the $240 8GB version of AMD's RX 480 card, though the 4GB model offers virtually identical performance, go.pcworld.com/radeonrx480-4gb8gb.) As the full-fat GTX 1060 offers performance that falls somewhere between the older GTX 980 and GTX 970, we've also tossed in results from EVGA GTX 970 FTW, a highly overclocked GTX 970 custom card. We're not including results from AMD and Nvidia's last-gen $200-ish graphics cards, as our original GTX 1060 review established that this new generation blows those older models away.

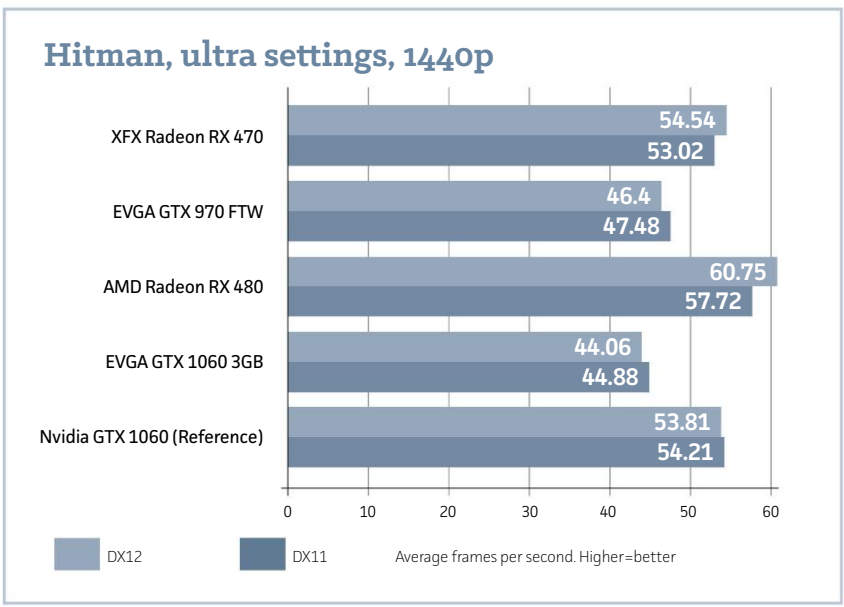


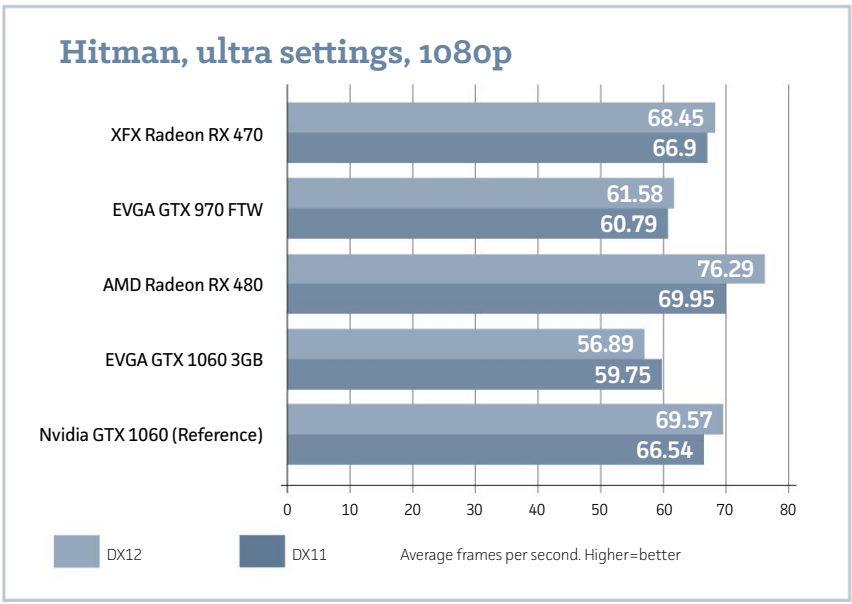
We benchmark every game using the default graphics settings unless otherwise noted, with all vendor-specific special features—such as Nvidia's GameWorks effects, AMD's TressFX, and FreeSync/G-Sync—disabled. Based on the GTX 1060 3GB's target performance we're looking at 1080p and 1440p results.

Test 1: The Division

The Division (go.pcworld.com/thedivision), a third-person shooter/RPG that mixes elements of *Destiny* and *Gears of War*, kicks things off with Ubisoft's new Snowdrop engine.

The effects of the cut-down GPU start to show themselves immediately, as the EVGA GTX 1060 3GB Gaming pumps out about nine percent fewer frames than its full-fledged cousin. That makes sense, considering one of the GP106 GPU's ten streaming multiprocessors is disabled in this model. That pulls the 3GB GTX 1060 away from the 6GB model's no-compromises 1080p performance at 60fps. It's a smidge faster than AMD's Radeon RX 470, though.





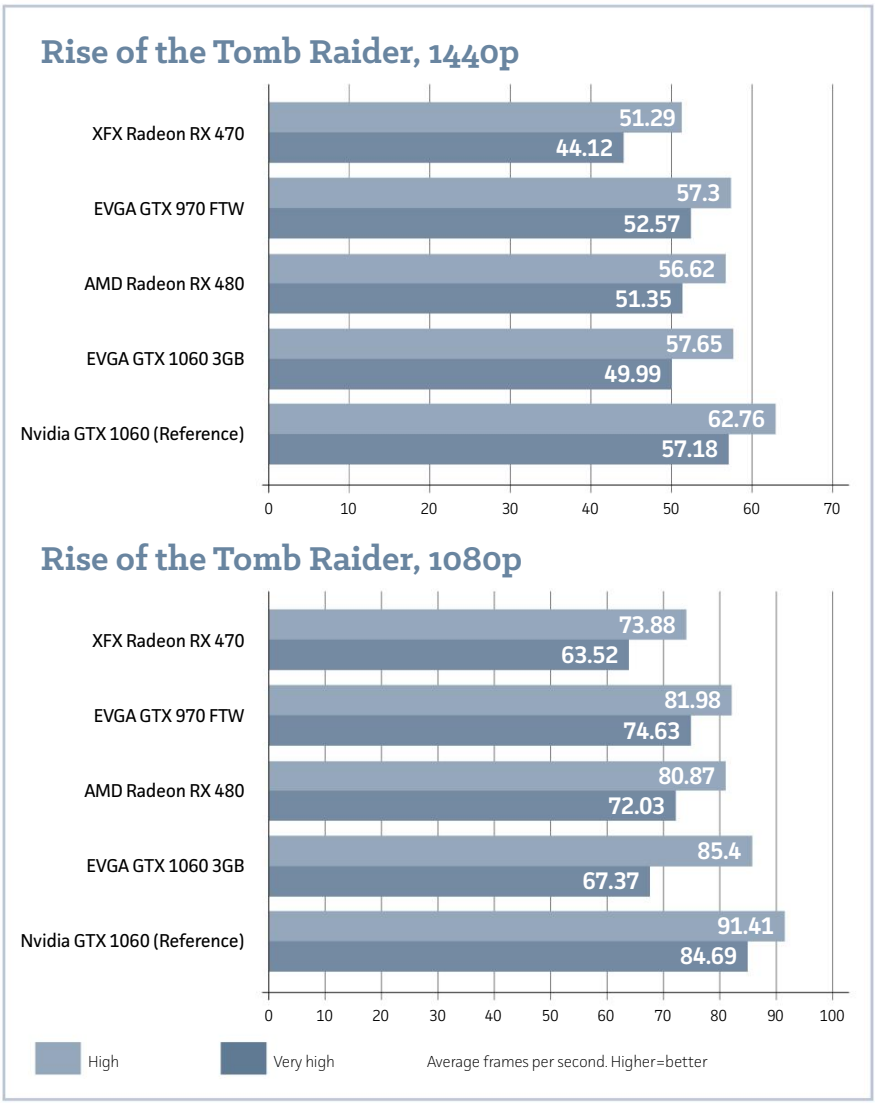
Test 2: Hitman

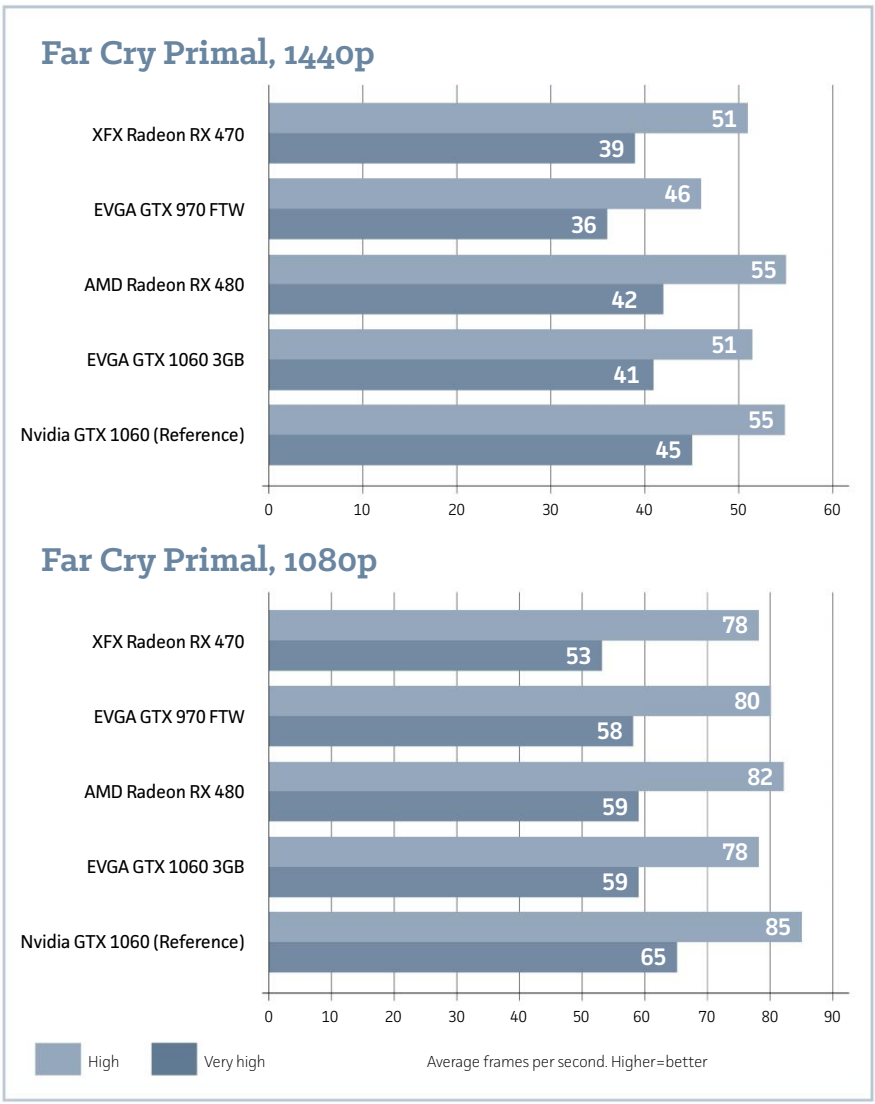
Hitman's (go.pcworld.com/hitmanrev) Glacier engine heavily favors AMD hardware. It's no surprise; *Hitman*'s a flagship AMD Gaming Evolved title, complete with a DirectX 12 mode that was patched in after the game's launch.

Important note: *Hitman* automatically caps the game's Texture Quality, Shadow Maps, and Shadow Resolution at Medium on cards with less than 4GB of onboard memory, meaning the EVGA GTX 1060 3GB is limited to those settings out-of-the-box. We overrode the memory safeguard to run the benchmark with those features set to the highest possible setting, to match the legion of 4GB graphics cards we're comparing against this new GeForce variant. That said, the benchmark didn't exhibit excessive stuttering or any other frame rate concerns.

As expected given the game's hearty Radeon tendencies, both of the GTX 1060s are outpunched by the RX 480 and even the RX 470. The GTX 1060 3GB also loses a few scant frames in DX12 mode. That's

likely due to the limited memory, especially since the GTX 970 and its 4GB of RAM fails to see a similar dip moving from DX11 to DX12. DirectX 12 loves RAM.





That said, the EVGA GTX 1060 3GB Gaming still hovers around the 60-fps gold standard with all the graphical settings cranked at 1080p.

Test 3: Rise of the Tomb Raider

Whereas *Hitman* adores Radeon GPUs, *Rise of the Tomb Raider* performs much better on GeForce cards. It's also the single most drop-dead gorgeous PC game I've ever laid my eyes on. We only tested the game's DirectX 11 mode.

The shaved-down SMPs create a sizeable performance difference between the two GTX 1060 models here. The EVGA GTX 1060 3GB nevertheless opens a sizeable lead over the RX 470, and even manages to outpunch the 8GB Radeon RX 480 when you reduce the graphics options to High—at least in raw frames per second.

The minimum frame times tell a different story when you bump things up to Very High settings. *Rise of the Tomb Raider* warns that the game needs 4GB+ of memory when you do so, and indeed, the EVGA GTX 1060 3GB Gaming saw minimum frame rates plunge to sub-10fps rates at the highest detail settings. That's probably why the card fails to topple the Radeon RX 480—or the older GTX 970—at Very High.

Test 4: Far Cry Primal

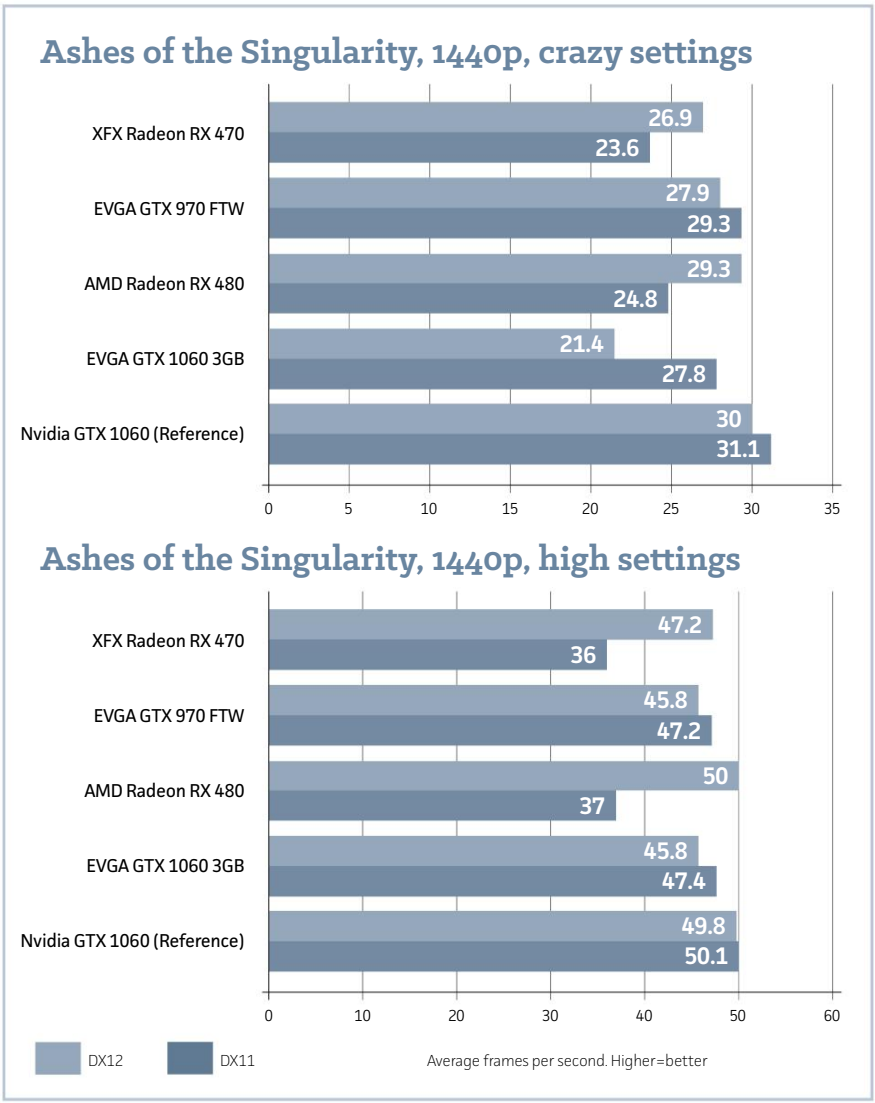
Far Cry Primal is yet another Ubisoft game, but it's powered by a different engine than *The Division*—the latest version of the long-running and well-respected Dunia engine.

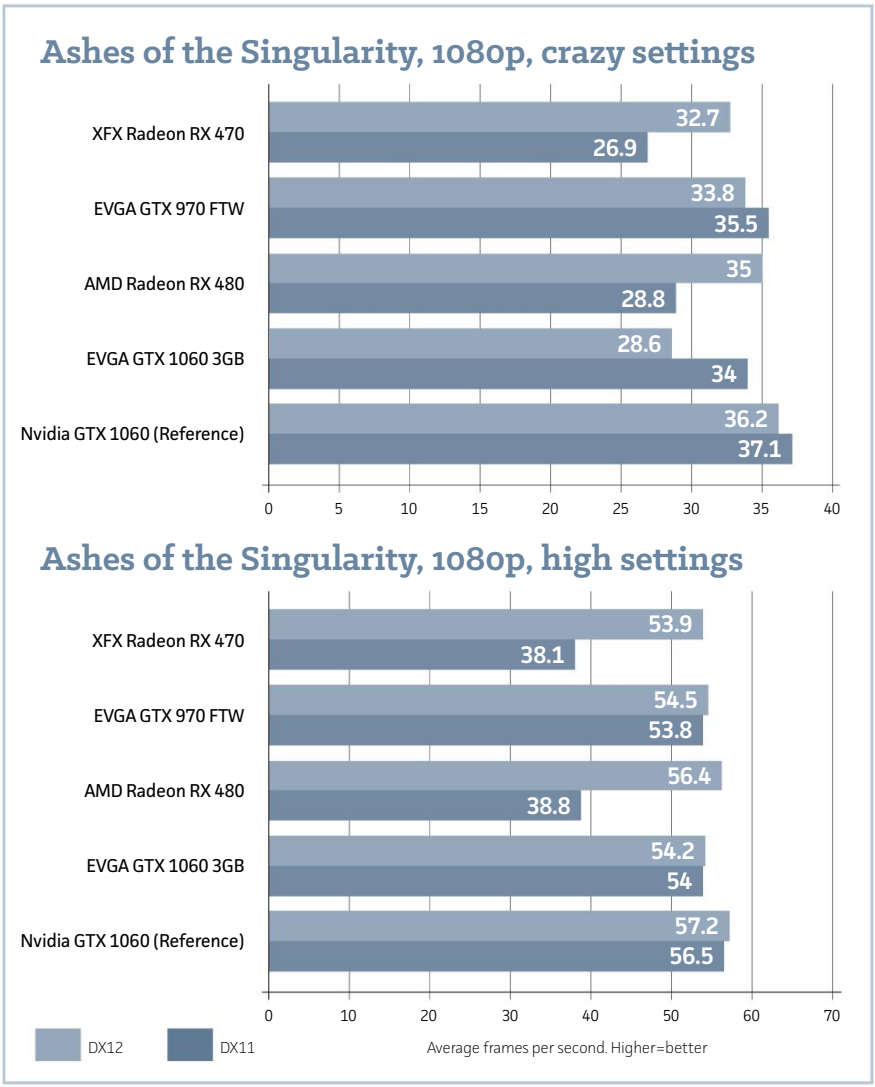
Here, we see the opposite behavior compared to *Rise of the Tomb Raider*. While the EVGA GTX 1060 3GB Gaming's in a dead heat with the RX 470 at High settings, it pulls ahead to match the RX 480 at Ultra.

Next: Ashes of the Singularity

Test 5: Ashes of the Singularity

Ashes of the Singularity (store.steampowered.com/app/228880), running on Oxide's custom Nitrous engine, was an early standard-



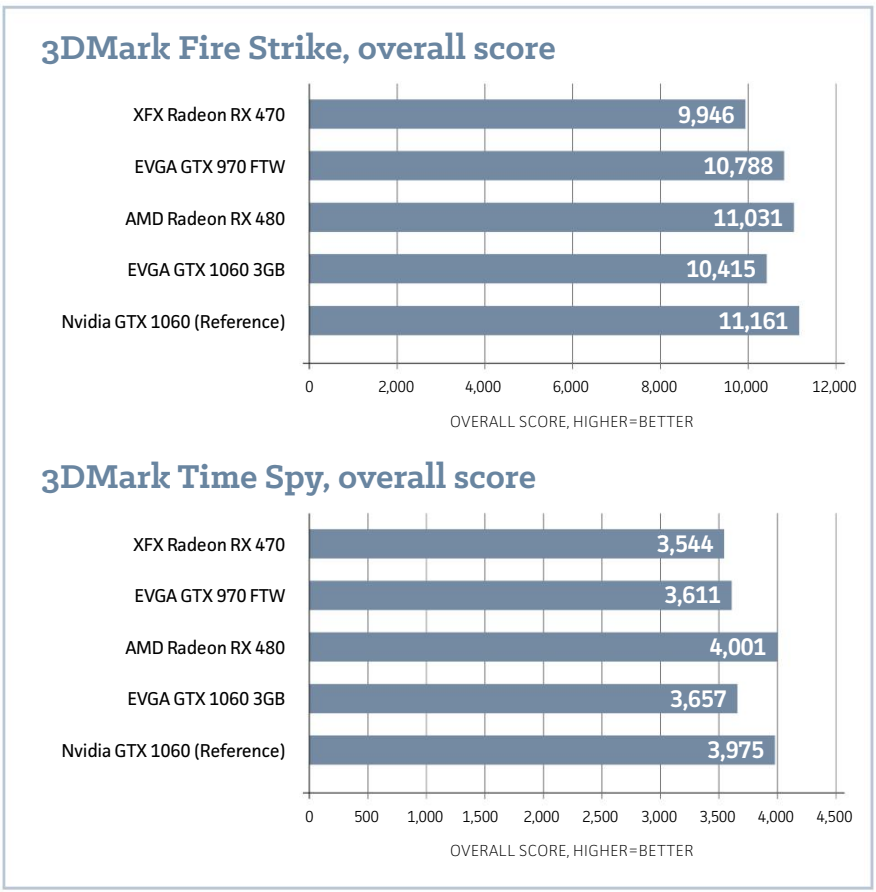


bearer for DirectX 12 (DX12). Many months later, it's still the premier game for seeing what next-gen graphics technologies have to offer. (It's a fun real-time strategy game, too!) The performance gains it

offers with DX12 over DirectX 11 (DX11) are eye-opening—especially when running on Radeon cards.

The EVGA GTX 1060 3GB Gaming's average frame rate drops when you activate DX12, especially at the high-end Crazy graphics preset (and likely because of its limited memory). Conversely, the average frame rate for Radeon cards skyrockets—though its DX11 results are downright poor at best.

That said, when you look solely at the peak performance for comparable cards—DX11 for the GTX 1060 3GB, and DX12 for the



Radeon RX 470—then the GeForce offerings actually come out very slightly ahead, in a way you'd never be able to actually see on screen.

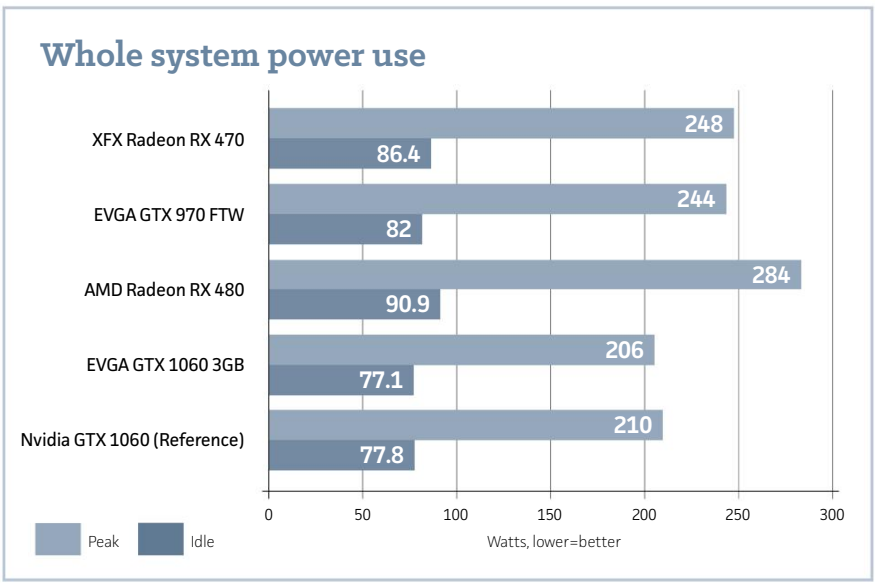
Test 6: Synthetic benchmarks

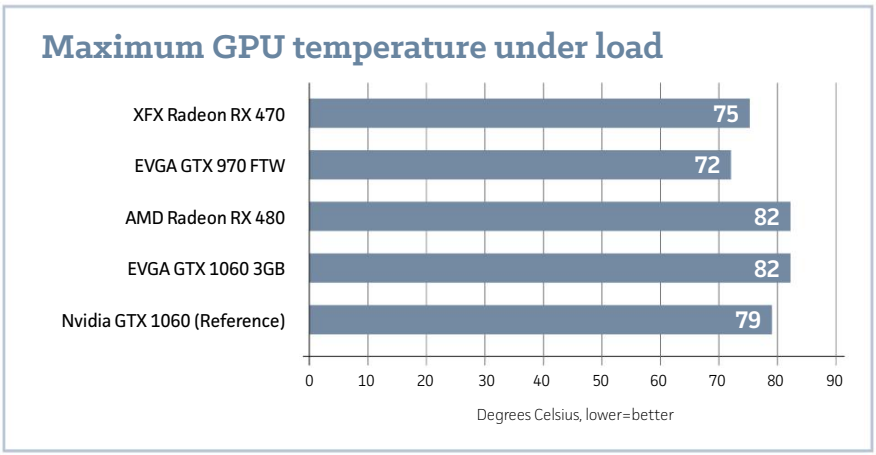
We also tested the RX 470 and its rivals using 3DMark's highly respected DX11 Fire Strike synthetic benchmark, which runs at 1080p, as well as its brand-new Time Spy benchmark (go.pcworld.com/timespybenchmark), which tests DX12 performance at 2560x1440 resolution.

Everything falls about where you'd expect. The Radeon cards perform better in Time Spy's DX12 test due to their dedicated asynchronous shader hardware.

Test 7: Power

We test power under load by plugging the entire system into a Watts Up meter, running the intensive Division benchmark at 4K resolution, and noting the peak power draw. Idle power is measured after sitting on the Windows desktop for three minutes with no extra programs or processes running.





The 6GB GeForce GTX 1060 was already a model of power efficiency. This version, with a cut-down GPU and 3GB less RAM, is just as much of a marvel. AMD's Polaris architecture made great strides forward in power efficiency, but Nvidia's Pascal design is still head-and-shoulders better in that regard.

Test 8: Heat

We test heat during the same intensive Division benchmark, by running SpeedFan in the background and noting the maximum GPU temperature once the run is over.

The EVGA GTX 1060 3GB Gaming runs hotter than the 6GB GTX 1060 Founders Edition, but that's no surprise. This particular design opted for a shorter length, so it only has a single fan compared to the usual pair on full-length cards. That's neither good nor bad; it's just different. On the plus side, the card runs quiet enough while you're gaming—that single fan isn't blaring to compensate for its lack of a buddy.

Bottom line

The $200 EVGA GTX 1060 3GB Gaming is an interesting graphics card being released into an interesting market.

In theory, there's no reason to buy one over a $200 4GB Radeon RX

480, period. But in reality (go.pcworld.com/inreality) , $200 reference versions of the RX 480 have been nonexistent since the card's initial launch in June. Heck, any 4GB RX 480s are borderline mythical. The MSI Radeon RX 480 Gaming X is the only 4GB model available on Newegg (go.pcworld.com/rx480nweg) right now, and it costs $250. AMD's partners have focused almost exclusively on pricier 8GB versions.

Instead, the Radeon RX 470 has assumed the 4GB RX 480's place. While its theoretical starting price is $180, you'll find a handful of models starting at $200 in reality, with most in-stock custom-cooled models going for $230 or more. Most 3GB GTX 1060 cards, meanwhile, sell for less than that (go.pcworld.com/lessthanthat).

If you can find an affordable 4GB Radeon RX 480, buy it. AMD's card offers superior performance and more memory than Nvidia's $200 challenger, which makes it a viable option for more intensive 1440p resolution and VR gaming. Don't hold your breath, though.

The 3GB GTX 1060's true rival is AMD's Radeon RX 470. Both deliver damned fine 1080p gaming experiences—though not quite the same no-compromises, 60-fps 1080p gaming as the RX 480 or 6GB GTX 1060 (go.pcworld.com/geforcegtx1060rev).

At first blush, the 3GB GTX 1060's slightly higher performance, incredible power efficiency, and lower street pricing should make it the easy pick. And it would be a no-brainer—if Nvidia's cut-down card

had 4GB of RAM like the RX 470.

Memory demands are only rising in this age of DX12 and modern consoles. While Nvidia's stellar memory compression helps, this new GTX 1060's 3GB of RAM doesn't feel very future-proof. It's enough for top-tier 1080p gaming at 60 fps in the here and now, but the limited capacity may force you to dial down textures and avoid memory-hogging features like MSAA anti-aliasing going forward. You can already see the limits of the 3GB capacity in our most grueling *Rise of the Tomb Raider* and *Hitman* tests. (Though to be fair, Ultra textures and extreme MSAA are better suited for higher resolutions than 1080p.)

For anyone stuck as close to a $200 budget as possible, the GeForce GTX 1060 3GB is the best option available today because RX 480s at AMD's trumpeted $200 don't exist (I'm going to keep saying that whenever I get the opportunity!). EVGA's GTX 1060 3GB Gaming hits that price right on the nose, and offers all the advantages listed earlier. It runs a little warm on account of its itty-bitty length, but not uncomfortably so, and the card isn't loud.

EVGA's GTX 1060 3GB Gaming hits that price right on the nose, and offers all the advantages listed earlier.

If you plan to hold on to your card for several years and are worried about long-term viability, you may want to opt for a Radeon RX 470 over the GTX 1060 3GB. With most 470s selling for over $200 when they're available, however, another option is to save your pennies for another month to snag a 6GB GTX 1060. It's a lot more future-proof, opens the door to better gameplay experiences, and several models can actually be found for the card's $250 MSRP.

Seagate Barracuda Pro 10TB hard drive: Vast and amazingly fast (for a hard drive)

BY JON L. JACOBI

I'VE USED THE term *vast and fast* to describe previous hard drives I've reviewed, but I'm not sure that it's ever been this spectacularly well-deserved. Seagate's 3.5-inch, 7,200rpm, SATA 6Gbps Barracuda Pro (go.pcworld.com/barracudaproamz) not only delivers a stunning 10TB of storage, it laid down some rather astounding transfer rates: 240MBps in both directions of our 20GB copy tests. At first, we didn't quite believe what we were seeing, but several repeats and throwing even larger data sets at the drive convinced us.

The Barracuda Pro is still a hard drive, so seek times aren't close to SSD-like, but if we had to build a system around a hard drive, this would be it.

Performance

By the numbers, AS SSD rated the drive at 243MBps reading and 229MBps writing. In our 20GB copy tests, which are subject to the vagaries of the Windows 8.1 operating system, that was closer to 250MBps each way with a single large file. Even with a 20GB mix of smaller files and folders, reads and writes, which were nearly identical in pace, dropped only to about 145MBps. (Ah, those seek times.)

How did Seagate do it? We're not sure, but the CMR (conventional magnetic recording) drive is extremely high-density, and has a whopping 14 platters and 7 read-write heads. Perhaps the company has leveraged some of the algorithms developed over the last few years for SSD controllers and is scattering data equally about the platters. Combined with 7,200rpm and its 256MB cache, that could do the trick. Whatever Seagate's done, we like it.

We also brought HD Tach out of retirement, and it seemed to say that the Barracuda Pro retains its speed across the entirety of its capacity. That's unusual; hard drives tend to write faster on the outside of the platters where sectors whip by at a faster pace than on the inner portions of the disc. More fodder for speculation.

The Barracuda Pro also draws a mere (in HDD terms) 6.8 watts when operating. That's very low for a hard drive, and far lower than, say, the five 2TB drives you'd need to get the same amount of capacity.

The ramifications of capacity

10TB is a lot of data. I have a hard time filling up my lone WD 4TB drive and there is a lot of multimedia on there. A lot. The Barracuda Pro is the equal of two of those, plus a 2TB drive. Unless you download a lot of stuff and never dump any of it, 10TB is massive overkill.

Not that you wouldn't take a 10TB drive over a 4TB

Seagate Barracuda Pro 10TB

AT A GLANCE

This 10TB drive is truly vast and stupendously fast (for a hard drive), and is also miserly on the power consumption. All in all, it's the best consumer 3.5-inch internal hard drive we've ever tested by a long shot.

PROS

- 10TB of capacity
- Reads and writes at over 200MBps
- 5-year, 900TB write warranty

CONS

- Nothing to speak of—keep it backed up

$580

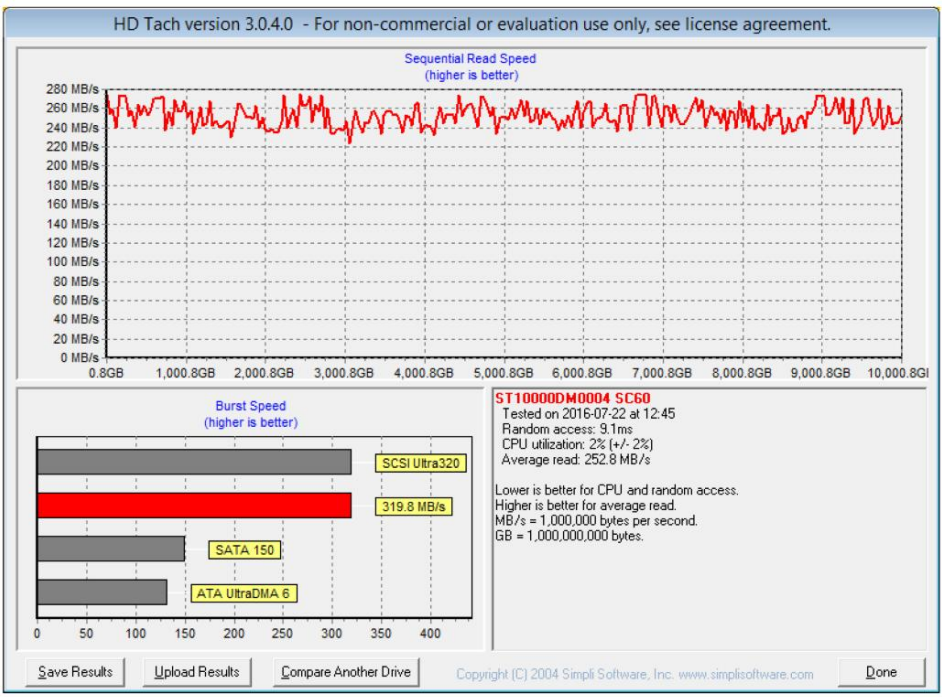
★★★★★

While not as fast as an SSD, the Barracuda Pro is closer than anything we've seen to date. Note the relative slothfullness of the other internal Barracuda.

drive if they were handed out for free. But you do need to consider that you're putting all your eggs in one basket. If the drive goes bad, still a very common occurrence, you're SOL (surely outta luck). Unless, of course, you back up regularly, or are willing to pony up a substantial amount of coin for a pair of the $500 Barracuda Pros to mirror each other. Mirroring has saved my bacon many a time when backup schemes go wrong.

Seagate's new Barracuda Pro 10TB hard drive.

All this adds up to a warning not to overbuy, especially if you're already running an SSD, which you should be if you like fast data transfers. The Barracuda Pro's speed is seductive, but a pair of 2TB drives (rather slow ones) can be had for $100 and a pair of average 4TB drives, around $250. That's a lot more affordable. You can also mimic some of the performance (and increased vulnerability) of the Barracuda Pro by running two drives in RAID 0 (striped) rather than a mirrored RAID 1.



Could it be true? HD Tach is old-school, but it seemed fine with the Barracuda Pro 10TB and indicates that unlike most hard drives, it's a consistent performer across the entirety of the drive.

Warranty

The 10TB Barracuda Pro is warrantied for five years at 220TB worth of writes per year, or 1100TB over the warranted lifespan. The SSD folks call this TBW (terabytes written), and Seagate's promise far outstrips the amount of data likely to be written to the drive. Then again, there are moving parts here. The warranty is limited, and includes only replacement, not data recovery. You'll need to purchase Seagate's Rescue service for that, at $10 for one year or $15 for two years. Why not the full five years? I can't say, but most of my drives that have gone bad have lasted more than two years. Just saying.

Seagate's new Barracuda Pro 10TB hard drive.

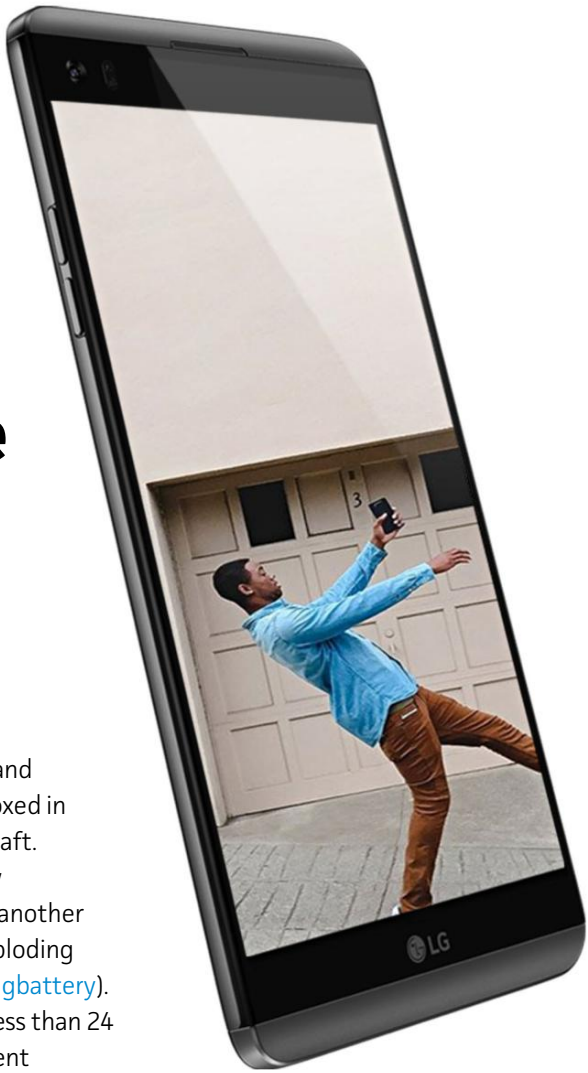
Conclusion

This is an absolutely fantastic hard drive. But 10TB is massive overkill for the average consumer. And data redundancy in the form of a $1,000 mirrored RAID pair is very pricey.

Warnings aside. To heck with it—if the powers that be let me keep this drive, I'd replace my 4TB with it in a heartbeat. Keeping it routinely backed up, of course.

LG V20 hands-on: A 5.7-inch phablet for smartphone content creators

BY JON PHILLIPS



LG'S NEW V20 phablet—5.7 inches and ready to make video magic—was boxed in by smartphone hullabaloo, fore and aft.

In its rear-view mirror, the V20 saw Samsung's humbled Galaxy Note 7, another 5.7-inch phone that still reeks of exploding batteries (go.pcworld.com/explodingbattery). And in its view out the windshield, less than 24 hours away, the V20 saw the imminent announcement of the iPhone 7 Plus, Apple's 5.5-inch phone that has made the earth's magnetic poles flip, and every other conversation in the

smartphone universe come to a grinding halt. Dual rear cameras, y'all.

It's a shame that LG didn't get a chance to reveal the V20 in a less crowded news cycle, because the phone looks like it really does have something fresh to add to the super-sized smartphone category. The V20 is also the first phone in the entire Android universe—Nexus phones included—to come with Android 7.0 Nougat right out of the box.

But forget about the OS for a moment, because LG is pinning the entire premise of the V20 on content creation: audio recording and especially video capture. The idea that a mere smartphone could be someone's one and only video production camera may seem like folly to serious auteurs, but legions of YouTubers may be interested in LG's vision.

Recently, I spent about an hour playing with a pre-production version of the V20, and I'm ready to share my first impressions. You can jump to the end of the article if you only want details on content creation. And if you want all the details on specs and features in one place, go.pcworld.com/v20grnbot.

LG's V20 comes with a 5.7-inch display, Snapdragon 820 processor, and Android 7.0 Nougat baked inside.

In with sophistication, out with grip

When I first picked up the V20, my immediate reaction was disappointment. LG dropped the grippy, textured-plastic surfacing on the back plate of the V10 (a phone with the same content-creation premise), and replaced it with a solid sheet of metal. In fact, save for polycarb bumpers on the top and bottom of the phone, the V20's case is made of aluminum 6013. Finishes include Silver, Pink, and the Titan color shown above.

Ian Hwang, head of product planning for LG Mobile, said the company wanted to give the V20 a more up-market, less "rugged" look, adding, "If we had applied that type of finish on [the V20], it may look like a barbell or something." The new phone does indeed look more expensive than the V10, but I still miss that plastic backing, which provided some reassuring grip when using the phone with only one hand. LG also dropped the vaguely lozenge-like shape of the V10, and now the V series design aligns much more closely to the company's G5 flagship phone.

Is the V20 a sophisticated-looking phone? Sure. But its design is also rather anonymous-looking, whereas the V10 had its own loveable oddball character.

Like all recent LG phones, the power button is on the rear and integrates a fingerprint sensor.

Flipping the phone over, I'm impressed by LG's new "second screen," which sits above the main 5.7-inch, 2560x1440 display. This thin, always-on screen can display notifications, music controls, a camera quick-launch button, and other shortcuts—and now it's noticeably, palpably brighter in the V20, jumping from a claimed 35 nits to 68 nits. The second screen text renders in a larger font as well.

A new approach to battery swaps

Like any proud LG superphone, the V20 has a removable battery, and LG is now on its third battery extraction scheme since the V10 was released last year.

With the V10, you stuck a fingernail in the charging port, and pried off the back case to get to the battery. It was a fumbly, inelegant solution. Then, in its 5.3-inch G5 flagship, LG introduced an entirely new extraction system that stuffs the battery into an end-cap, or

The V20 (left) drops the textured plastic surfacing and bowed edges of the V10.

The V20 second screen is noticeably brighter than the V10's.

"chin." In this scheme, you press a button on the edge of the phone to release the chin, and then you basically snap the battery off its mooring. Easier? Yes. But the G5's scheme is still flawed, for a number of reasons, as I describe in my review (go.pcworld.com/lgg5rev).

Now, with the V20, LG has introduced an updated version of the V10 scheme. Instead of poking around in the charging port, you press a button on the side of the chassis to disconnect the back panel from the rest of the phone. It's easier than the V10's approach, but I still found removing the 3,200 mAh battery to be a bit finicky, as it was difficult to tell when the two halves of the phone had disengaged. What's more, the panel didn't snap back in with absolute confidence. I heard only one barely audible click to signal the phone was whole again, but who knows, maybe this is an operation that becomes second-nature with practice.

During the demo, I asked Hwang if the new battery extraction approach in the V20 will be carried over to an evitable G6 flagship. His answer was most noteworthy because he didn't categorically say the G5's chin was a success and will continue for another generation: "I cannot comment about future products, but yeah, we'll see, we'll see," Hwang said.

If nothing else, playing with the new extraction method gave me a

great opportunity to test the strength and durability of the aluminum 6013 back panel. I didn't try to bend the panel with all my strength, but I did torque the panel with way more pressure than I'd ever exert on a component that I personally paid for. And bend it did not.

High-definition audio recording

The V20 is powered by a Qualcomm Snapdragon 820 processor, just like all the other flagship-caliber Android phones shipping today. The processor is mated to 4GB of memory, and 64GB of storage comes standard. You can also add up to 2TB of storage via a MicroSD slot. There's a rear fingerprint scanner for security and authentication, and the V20 supports QuickCharge 3.0 for fast-charging. Add in Android 7.0 Nougat, and you have a phone that should interest any Android enthusiast who just can't live with a display smaller than 5.7 inches.

But what if you actually want to record music and make videos to quasi-pro standards? For the content-creation enthusiast, LG has a bunch of answers.

Let's start with audio recording. LG is pimping a high-def,

The V20 opens up like a make-up compact. That rear panel is super-strong.

The V20 comes with a 3200 mAh battery.

24-bit/192kHz audio recorder that promises 6.5x more accurate sound than 16-bit alternatives. To prove the claim, Hwang played two audio clips of bizarre forest sounds, one recorded at 16-bit, the other at 24-bit. The higher-def clip was definitely louder and more detailed. So there's that.

LG also notes the V20 has three microphones that provide better capture of loud sounds in the 120dB to 132dB range. The upshot is that when you're shooting video at concerts, your audio track should be higher-def with less clipping.

Fancy new video tricks

On the video front, the V20 introduces a number of interesting technical solutions, starting with Steady Record 2.0, a video stabilization technique that leverages new EIS (electronic image stabilization) technology from Qualcomm. LG says Qualcomm's improved EIS is exclusive to the phone, and reduces latency in the interface between the phone's gyroscope and the video image, helping to smooth out shaky video. The V20 also uses DIS (digital image stabilization) to improve smoothness further.

After you've shot your video, DIS analyzes every frame, comparing it to some 15 to 20 neighboring frames, both forward and back. Then the algorithm adjusts the frames to make objects appear in the same position. Frankly, I was impressed by just how well Steady Record 2.0 performed. Shooting a video in LG's demo room, I rocked and swayed the V20 like a man possessed, but the resulting video was remarkably smooth with minimal "jello" effects. It was just a quick little experiment, and I only got to see the video output on the phone, but the results were impressive.

And there's more. In addition to laser-detection autofocus (which helps the camera quickly find focus in low light conditions) and phase-

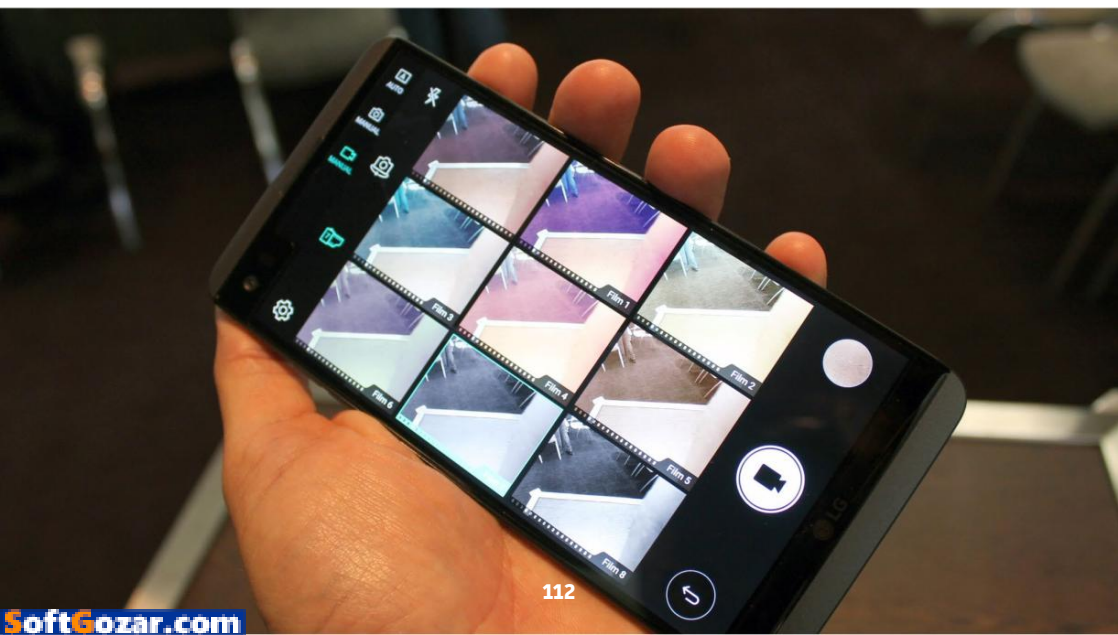
You can set your lock screen's wallpaper to mirror the first letter of the name you put in the second screen's signature. Nice to meet you. My name is Jon.

detection autofocus (which helps speed up focus on moving objects), the V20 also features tracking focus. If I understand LG correctly, you can select a specific object when you're shooting a video, and the camera will stay locked on that target as you record the action.

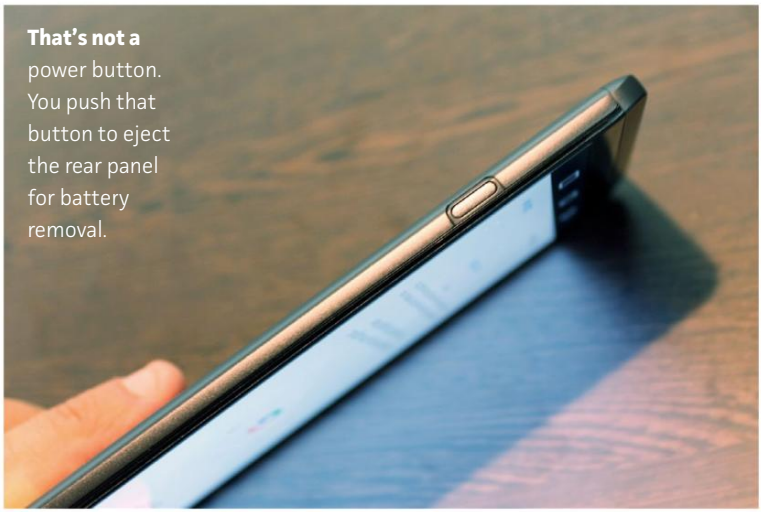
Finally, LG has added eight "film effects" to the V series' already fine set of manual video controls. LG is quick to point out these aren't mere filters. No, they're effects that specifically mimic the look of various film stocks, like Fuji and Agfa. In the V10 they were only available for still images, but now you can apply them to moving pictures. In real-time. This feature is easy to use, and will certainly give smartphone videographers a rather subtle collection of effects to play with.

LG V20, Pixel XL or Galaxy Note 7?

I didn't get a chance to test the audio output quality of the V20's Quad DAC. It offers 32-bit fidelity, 75 individual volume increments, and support for a slew of lossless formats. Nor did I test still image capture with LG's dual cameras, which now offer wide-angle support front and back.



Besides offering manual video controls, you can choose various video filters that mimic the appearance of specific film stock.



That's not a power button. You push that button to eject the rear panel for battery removal.

For now, I'll just kick back and wait, pondering which phablet will become my new daily driver. My ideal display size is 5.7 inches, so I'm looking forward to fully vetting the V20, as well as waiting for Samsung's Note 7 smoke to clear, and seeing what Google has in store via its update to the Nexus 6P (presumably called the Pixel XL, go.pcworld.com/pixelxl). Google has never done a lot with its Nexus camera experiences, so with Nougat already installed, the V20 could be a very compelling choice.

For comprehensive coverage of the Android ecosystem, visit Greenbot.com.

Moto Z Play: Long-lasting, affordable, and modular too

BY JASON CROSS

WE LIKE THE Moto Z (go.pcworld.com/motozrev) and it's bigger, bulkier cousin the Moto Z Force (go.pcworld.com/motozforcerev). They're speedy, elegant phones with a good approach to modular add-ons—as opposed to the LG G5 (go.pcworld.com/lgg5rev), whose "take the whole phone apart" approach to modules doesn't sit well with us.

Those other two Moto Z phones are expensive, high-end, premium devices. The Moto Z Play takes the same general concepts, and compatibility with the same Moto Mods, and brings it down to an affordable price point: about $450. And really, unless you simply need to have a phone with screaming-fast benchmark scores, this more affordable model is a better phone. Really!

Finding the sweet spot

The Moto Z aims to be so thin that you can slap a Moto Mod on the back and still have a "regular phone" thickness, and the Moto Z Force adds a shatterproof display and bigger battery. The Moto Z Play doesn't push the envelope. It is concerned with finding the sweet spot between price and performance.

Structurally, it's nearly identical to the Moto Z Force. It's almost exactly the same size and thickness, with a metal band around the rim where the Force has a heavily beveled edge. I'd prefer a little more separation between the power and volume buttons on the right side, and the plastic bit surrounding the USB-C port looks a little cheap, but for a phone in this price range it looks and feels good.

Motorola gets the price down by downgrading the system-on-chip (SoC) from a top-end Snapdragon 820 to a mid-range Snapdragon 625, with 3 gigs of RAM and 32GB of storage. The 5.5-inch display resolution is reduced from quad HD (2560x1440) to full HD (1920x1080). Frankly, at this size, full HD is just fine and probably the smarter choice. Higher resolutions are primarily only useful for VR. The display is otherwise bright and colorful with good viewing angles and excellent visibility in bright sunlight. By default it's a little oversaturated with slightly blue white balance, but choosing "standard" color mode in the settings helped alleviate both problems.

You'll notice a headphone jack next to that USB-C port on the bottom. You know, that important core technology stupidly missing from the Moto Z and Z Force. The square fingerprint sensor beneath the display is quite fast and accurate, but is sadly not a home button. I would prefer that it was, with capacitive Recent and Back buttons to either side, instead of on-screen controls. Or at least give me the option to use physical buttons and reclaim that screen real estate.

Motorola Moto Z Play

AT A GLANCE

It won't win any speed contests, but nice design, epic battery life, and an affordable price make this phone a winner.

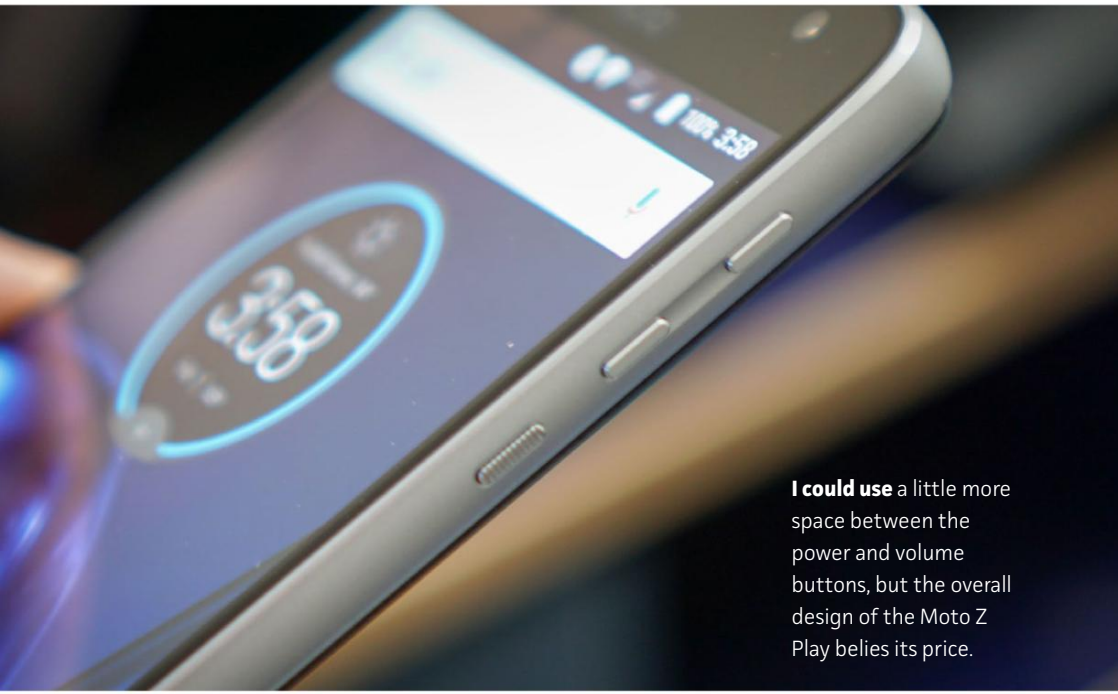
PROS

- Priced well
- Fantastic battery life
- Smooth performance

CONS

- Verizon exclusive version loaded with bloatware
- Camera software interface could use some work

★★★★½



I could use a little more space between the power and volume buttons, but the overall design of the Moto Z Play belies its price.

A smooth experience

With a Snapdragon 625, the Moto Z Play isn't going to win any benchmark charts. Even among other mid-priced phones; the OnePlus 3 manages to slap a Snapdragon 820 into a $400 phone. But Motorola's version of Android is smooth and highly optimized. It looks nearly identical to stock Android 6.0.1, with a few extras added on. It's the same stuff Motorola has added to its phones for the last year or so: Moto Voice (extensions to the usual suite of Google voice commands which work with the phone asleep), Moto Actions (gestures to launch specific functions, like a double-chop to turn on the flashlight), and Moto Display (time and notifications on the lock screen, that display when you wave your hand over it or when a new notification comes in).

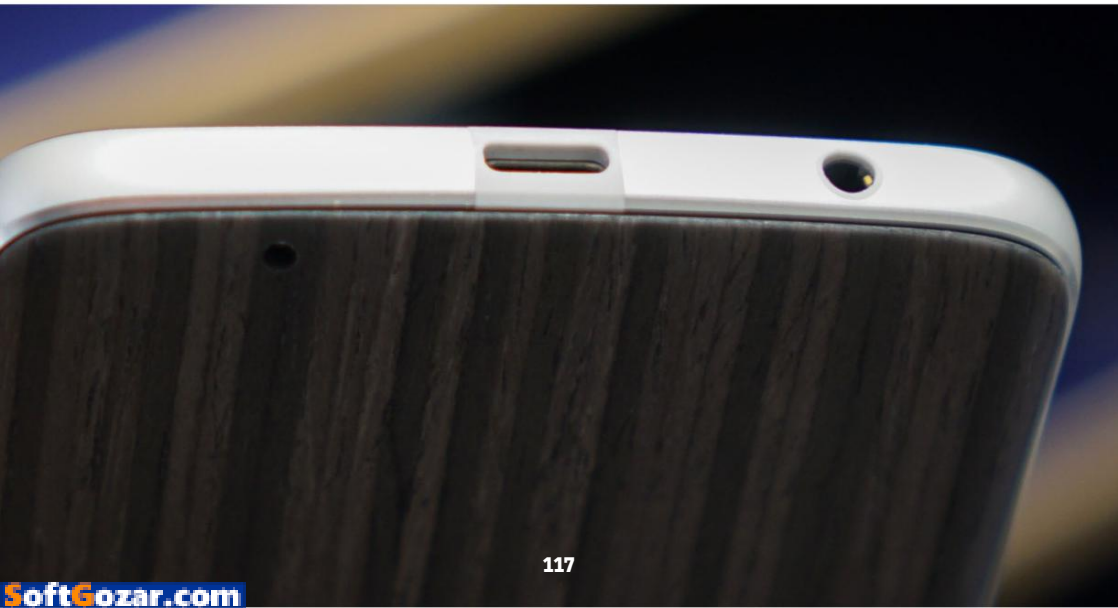
It's a good software experience, and one I'd love to see more Android

makers emulate. Rather than make Android look and feel entirely different (I'm looking at you, Samsung), Motorola stuck with the general design, layout, look, and feel of standard Android and simply extended it with smart, useful features. Perhaps more importantly, it's all very fast and fluid. The mid-range Snapdragon 625 has no trouble keeping the interface quick and responsive. Unless you play a lot of high-end 3D games or do lots of photo or video editing on your phone, you're unlikely to run into a scenario where the Moto Z Play feels slower than most phones with high-end processors.

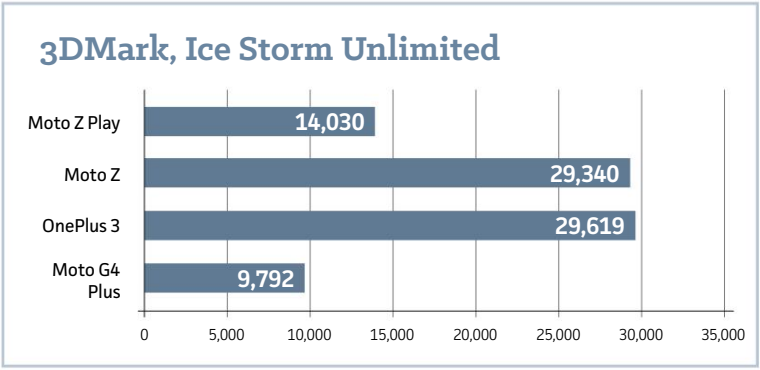
Crazy good battery life

The Moto Z Play has a 3510 mAh battery—about the same as that in the Moto Z Force. That's big by any measure. And with a less power-hungry SoC and a 1080p display, this phone places fewer demands on it than do those high-end phones.

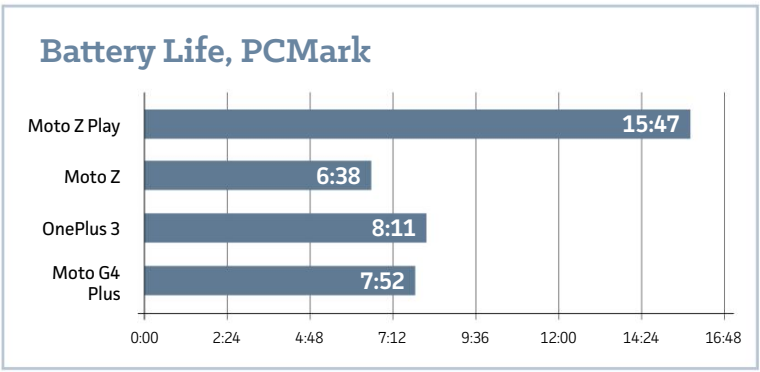
The result is truly epic battery life. With the display calibrated to 200 cd/m^2, this phone lasted 15 hours 47 minutes in the PCMark battery test. That's nearly twice as long as the OnePlus 3 or Galaxy S7 edge!



USB-C and a headphone jack? The mid-range Moto Z one-ups its more expensive pals.



Particularly in 3D graphics, the Moto Z Play falls behind its competitors with top-end processors.



One chart says it all. If only all those $700 phones had battery life this good.

It's not just in benchmarks, either. I used the phone for two days, on and off, without charging it. I left it sitting idle for nearly 3 days and the battery only dropped from 100 percent to 80 percent. A big battery, efficient display and processor, and Motorola's highly optimized software all combine to give you a phone with some of the best battery life I've ever seen.

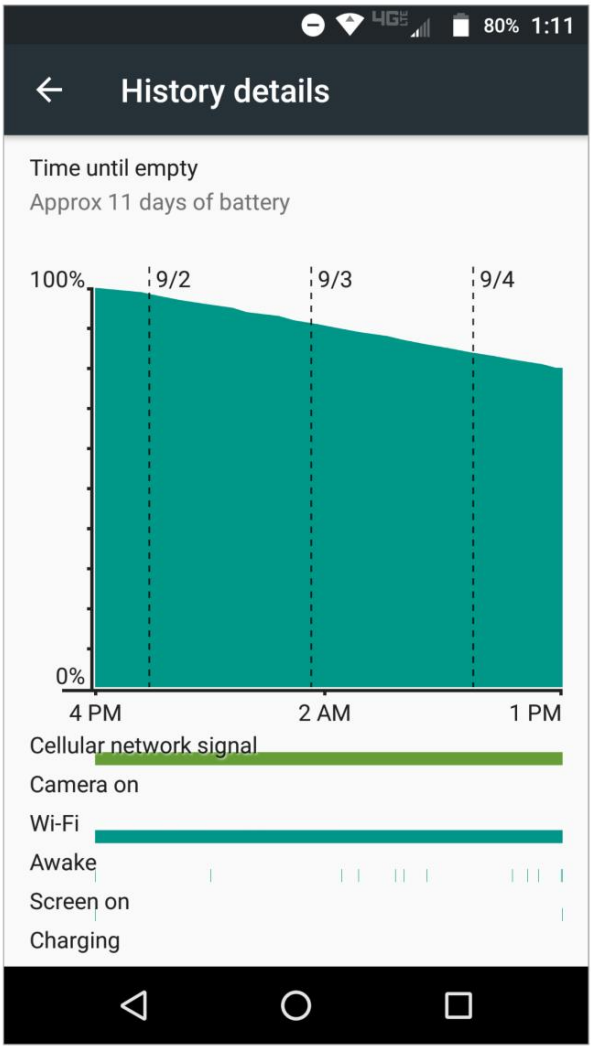
A respectable camera

It's not very exciting to say it, but the Moto Z Play has a pretty good camera. That's it: pretty good. It doesn't hold a candle to Samsung's best or the newest iPhones, but it's not the slow, grainy disappointment Motorola buyers were stuck with in years past. You

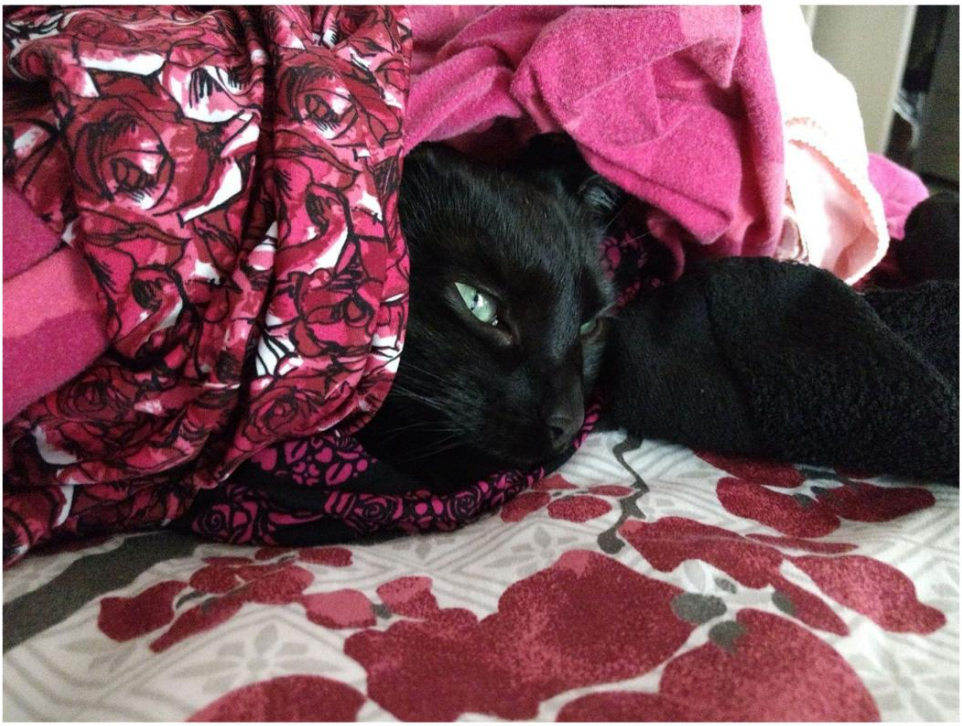
get a 16 megapixel sensor with fairly large 1.3 micron pixels, f/2.0 aperture lens, both phase detect and laser autofocus, and dual-tone LED flash. The front camera takes "good enough" selfies with its 5 megapixel sensor, wide-angle lens, and front-facing flash.

Low-light performance is above par for this price class, though there is some room for improvement. You get a decent pro mode that lets you adjust focus, white balance, shutter speed, and ISO, but you can't save RAW images. Serious video shooters may be disappointed to find that you're limited to 30 frames per second at all resolutions up to 4K, save for a single 720p/120fps slow motion mode.

Despite the occasional grainyness and limited dynamic range common to more affordable phones, you can get some really nice shots with the Moto Z Play, and it focuses very quickly with minimal shutter lag. The "pocket to photo" experience could be a touch faster, but doesn't disappoint.



Nearly 3 days on standby and the battery has only dropped 20 percent.



Low-light shots can be a touch grainy, but you can get a great shot if your subject cooperates.

It's a testament to how far smartphone cameras have come to think that this would be industry-leading camera performance as little as two years ago.

A great buy, but not from Verizon

At $450, the Moto Z Play is a great buy. Yes, you can get the OnePlus 3 with more storage and a bigger processor for the same price. But the Moto Z's incredible battery life, excellent display, lean software with useful enhancements, and compatibility with Moto Mods make a great case for it. With a price more than $200 less than the Moto Z or Moto Z Force, not to mention vastly superior battery life and an actual headphone jack, this Moto Z Play is a better choice for most consumers.

But this phone will spend about a month or so as a Verizon exclusive,

and you don't want that version. Verizon adds a whole slew of obnoxious bloatware apps including its own messenger app, NFL Mobile, it's own map app, and more. You can disable most of these, but can't delete them. What's more, Verizon has a terrible record of updating Motorola phones with the latest version of Android.

I recommend you wait until the direct, carrier-unlocked version goes on sale in October and grab one of those, even if you're on Verizon's network. If you're on AT&T or T-Mobile, you might consider the international variant, which doesn't support CDMA (Sprint and Verizon) but does work with more GSM frequencies and LTE bands. You can avoid the carrier bloat and stand a better chance of getting more timely OS and security updates by buying the unlocked versions.

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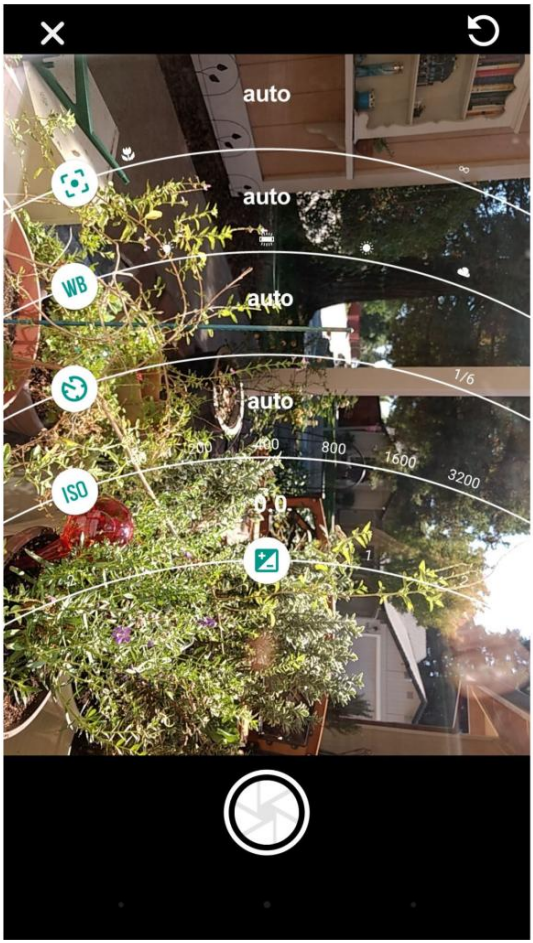

Pro photo mode gives you plenty of controls, but lacks the ability to save RAW image files.


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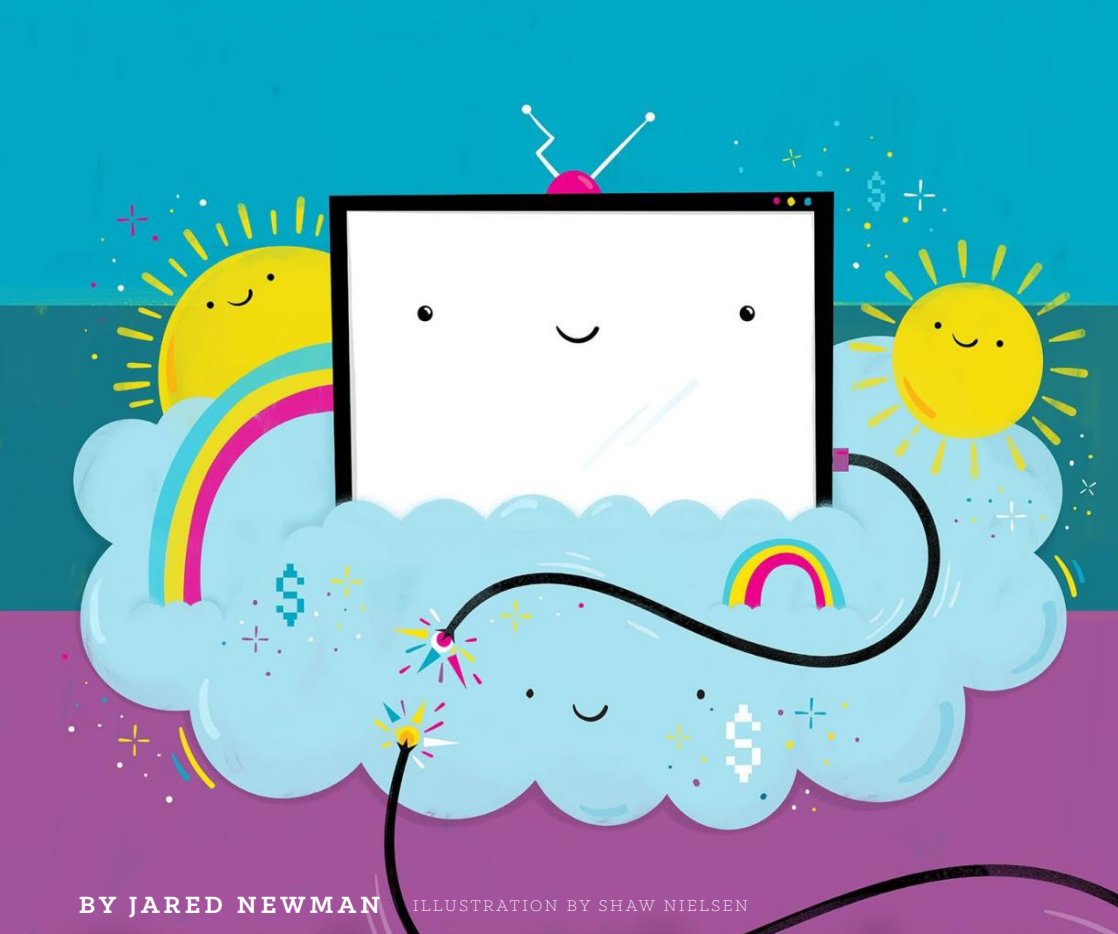


BY JARED NEWMAN ILLUSTRATION BY SHAW NIELSEN

Cord cutting is a bigger bargain than ever

Cable-TV apologists keep offering the same tired defense. When will they learn?

> About 18 months ago, I tried to dispense with the notion that it's hard to save money by cutting the cable TV cord.

You'll have to forgive me for essentially writing that column all over again, but cable-TV cheerleaders still haven't listened to reason. They continue to argue that the costs of streaming-video services add up, to the point that cable TV remains the more economical choice.

I call it the gee whiz argument, because its purveyors all seem to have the same obvious epiphany: If you subscribe to every available streaming service, you'll end up paying a lot of money. It never seems to occur to these naysayers that the ability to pick and choose is the entire point of quitting cable.

An article recently by Gizmodo's Matt Novak, titled "Cordcutting isn't a Bargain Anymore," (go.pcworld.com/cordcuttingnobargain) is the latest in a long line of offenders:

> *So, let's see, if you pay for Hulu Plus (which is now just Hulu, since they're dropping their free tier) that sets you back about $8 per month. And if you go subscription free [sic; he meant ad-free] that's $12 per month. And Netflix is another $10. And HBO Now is another $15. And obviously you're going to get the new commercial free CBS, so that's $10 per month. What are we up to? About $47 before tax? And then you toss on your high-speed internet bill, which you're probably paying to the cable company anyway. Yeah, this whole cordcutter thing sounds like it liberated consumers alright, doesn't it?*

If this argument sounds familiar, it's because plenty of other pundits have attempted the same back-of-the-napkin math. Here's Don

Reisinger of Fortune back in October:

> *The issue, however, is that the costs can very easily pile up. An entertainment-loving consumer, for instance, may dole out large amounts of cash to get his or her hand on content. If Netflix costs $9 per month, but the person also wants TV programming from Hulu and music streaming from Apple, they're paying what amounts to a tank of gas each month for relatively little content. If Amazon's wildly popular series Transparent catches his or her eye and the person happens to be a fan of professional wrestling and wants access to WWE content, the costs go up again. And now that YouTube is dangling an ad-free service that would be complemented with original programming, it's well within the realm of possibility that this theoretical consumer is paying $50 to $100 per month for all of the services he or she desires.*

And here's Klint Finley, writing for Wired last December:

> *So you cancel your cable TV and sign up for that $20 a month Sling TV package. But then the new season of American Horror Story starts. So you grab that on iTunes for $29.99 a season. You also need a $10-a-month HBO Now subscription for Game of Thrones. You already have an $8-a-month Netflix account, so you can keep watching House of Cards and Jessica Jones, but then you hear that The Man in the High Castle is really good, so you get an Amazon Prime subscription for $99 a year. Before you know it you're also subscribing to ad-free Hulu for $12 a month because, you know, who needs ads? Now all that HD content is burning through your Comcast data limit. Or maybe didn't but your internet bill still goes up by $10 and suddenly you're spending about what you were for cable TV in the first place.*

There are plenty more examples, but there's no need to quote them all. Each one consists of the same unoriginal thought about whether you can save money through cord cutting. And they're all demonstrably, empirically wrong.

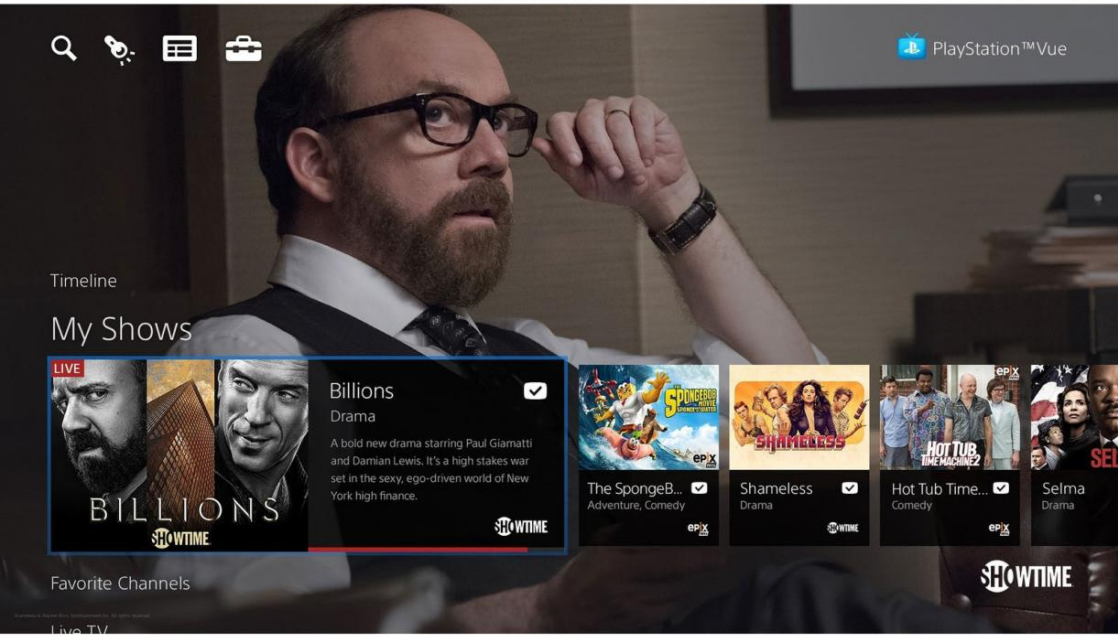
Streaming devices like the $50 Roku Streaming Stick are much cheaper than renting a cable box in the long run.

The real cost of cable TV

The thrust of all these arguments is that once you've subscribed to three or four streaming services, you might as well just get a cable subscription instead. But the math doesn't work out that way if you examine the numbers instead of just making them up.

Cable TV might seem cheap when you first sign up, but that's only because you're getting a short-term promotional deal, and the advertised price rarely factors in hardware rental and other hidden costs, such as regional sports fees and broadcast retransmission fees. Keeping your payments down requires constant vigilance (go.pcworld.com/cutcordreasons), and you'll never actually pay the advertised rate anyway.

Clear away the smoke and mirrors, and the cost of cable or satellite



TV service is pretty steep. As of 2014, a standard channel bundle cost $71.45 on average according to the Federal Communications Commission. Based on historical and ongoing rate increases, we can conservatively assume that prices have climbed by 3 percent per year since then, to an average of $76 today.

Still, that figure doesn't necessarily include cable boxes and DVR service. (Equipment is included in the average only if the cable provider doesn't charge extra for it, which is rare.) A separate survey tells us that the average U.S. home spends $19.25 per month on hardware rental fees.

In total, then, a cable TV package with equipment costs about $95 per month today. And that's before you add premium channels such as HBO and Showtime, or upgrade to a more expensive tier. Gee whiz, those costs sure add up!

The real savings of cord cutting

Alternatively, you could subscribe to a few streaming services for much less. PlayStation Vue, for instance, starts at $30 per month for more than 50 channels, including ESPN, and an extra $5 per month gets you regional sports networks. There are no ongoing equipment fees, so once you've bought a supporting device (such as Amazon's Fire TV or a PlayStation 4), you save up to $65 per month compared to the average cable TV bill. Add Netflix for $10 per month, and HBO Now for $15 per month, and you still come out $40 per month ahead of a typical cable package, which doesn't include those services.

The more important point, however, is that you don't have to spend a lot on streaming subscriptions. Instead, you could limit yourself to a few services such as Hulu and Showtime ($17 when purchased together) plus Netflix. Round it out with free over-the-air antenna broadcasts (go.pcworld.com/antennatricks), and you're paying $27 per month, which is $68 per month less than a standard cable bundle. Cord cutting is as much of a bargain as you make it.

These aren't just hypothetical scenarios. One friend of mine just dropped cable TV and phone service in favor of internet and streaming. Before, he was paying $220 per month for a triple-play bundle, plus $10 per month for Netflix. Now, he's paying $80 per month for internet, plus $65 per month for streaming services (including Netflix, Hulu, and Sling TV Orange and Blue, go.pcworld.com/slingchannelguide). That leaves him $85 in the bank every month.

There's also my father, who hasn't dropped Verizon Fios TV but is considering it. Right now he's paying about $220 per month for TV, phone, and internet. If he cut out TV, and replaced it with PlayStation Vue and HBO Now, he'd save about $50 per month.

Need more anecdotes? Just look to this Reddit thread (go.pcworld.com/cordcutsavingreddit)—a response to the aforementioned Gizmodo article—which is filled with stories of significant monthly savings. While cable apologists scoff at cord cutting in theory, people are saving real money in practice.

Is cord cutting for you?

I'm not saying everyone would be better off without cable TV. There are numerous legitimate reasons to stick with a traditional TV package, including reliability of service, the simplicity of having one TV bill, the familiarity of the cable-box interface (for long-time subscribers, at least), the convenience of DVR (go.pcworld.com/rokufeed), and the ability to get every channel you could possibly want. Cord cutting is not some magic shortcut to a smaller bill without trade-offs—not yet (go.pcworld.com/skinnybundles), anyway.

Instead, cord cutting is an alternative to the ever-escalating costs of cable, one that might involve some sacrifice, but gives you much greater control over how much you spend on TV entertainment every month. The fundamental flaw in the *gee whiz* argument is the assumption that people have no self-control to begin with.

9 REASONS WHY PC GAMING IS A BETTER VALUE THAN CONSOLES

The PlayStation 4 Pro and Xbox Scorpio drive the point home.

BY HAYDEN DINGMAN

PC GAMING IS A BETTER VALUE

This may come as some surprise to you, but we here at *PCWorld* are pretty big fans of PC gaming. Shocking, I know. And so please, all ye console believers, factor in whatever amount of bias you'd like to the following statement:

PC gaming is the most affordable it's ever been—and for a lot of people it's also the best value, for a multitude of reasons. The announcement of Sony's PlayStation 4 Pro just drove that point home.

Here's why.

PRICE

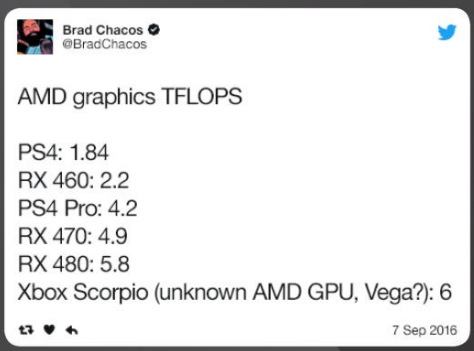
First let's talk about the elephant in the room: raw initial dollars. That's normally where the PC's fallen behind in the past, compared to consoles. "Yeah, I could spend thousands of dollars on a PC or $300 to $400 on a console."

PC gaming is still more expensive, at least up front. That hasn't changed. If you can build a desktop for $400, you're either a wizard or extremely good at snagging discount parts and waiting for sales. More power to you.

But the PC isn't that much more expensive at this point. Head to PC Part Picker or Reddit's /r/buildapc and you'll find plenty of entry-level builds in the $550 range and some jaw-dropping high-end builds in the $800 to $900 range.

Prices have come down a lot—video card prices especially. AMD's Polaris GPUs are an especially great bargain for those looking to game on the cheap. A Radeon RX 480 will only run you $200, which is incredible. You can take a look at my colleague Brad Chacos's in-depth review for explicit benchmarks, but the gist? Max out graphics at 1080p resolution and you'll still hit 60-plus frames per second in basically every modern game. For only $200.

Now, finding an RX 480 at its recommended list price is hard as hell, but the point is that companies want PC gaming to be accessible. They want enthusiasts buying GPUs. Competition has made the PC more affordable than ever before.



And that $200 graphics card is better than whatever's inside the newly announced PlayStation 4 Pro. Above is a comparison of raw TFLOPS power, again courtesy of Brad.

It's a bit misleading because consoles and PCs take advantage of their hardware in different ways, but serves well enough as a raw comparison. Two hundred bucks gets you a graphics card that's (on

paper at least) better than what you'll see in the PS4 Pro. Grab the rest of your parts and you're all set, especially if you already have a keyboard, mouse, and monitor handy, as many people do.

Hell, you can go lower than that if you're only looking to match the performance of the original PS4 and Xbox One. A $110 graphics card like the GeForce GTX 950 or Radeon RX 460 paired with AMD's affordable FX-6350 ($118 on Amazon) will get you over that extremely low bar.

BUT WAIT, THERE'S MORE

"Okay, sure: PC gaming is more affordable than ever before. But it's still expensive compared to consoles. I don't see how you can also say it's the best value for most gamers." We're getting to that part, fictional Mr./Ms. Rhetorical Device.

BETTER UPGRADE PATH

This is the big change, and the inspiration for this article.

A lot of people are going to be frustrated come November. A few years ago they bought a PlayStation 4—at the time the most powerful console ever made. And they expected it to last them for years. Years.

We can talk all we want about expectations around consoles, about why people are willing to spend $600+ on a phone every two years but expect a $400 console to last them for ten. But I'm not talking about that here. I don't really care—this is *PCWorld,* after all. Besides, it's a tangential argument.

Sony's PlayStation 4 Pro console.

The difference, this time, is that consoles are now using a faux-PC upgrade strategy. If the recent PlayStation event is any indication, we can now expect consoles to transfer into "platforms"—tiers of hardware, with more powerful boxes released every three to four years. It's not just Sony doing this. Microsoft has its own Project Scorpio upgrade planned for the Xbox One in Q4 2017.

Consoles are bad at upgrades though. As in you can't actually upgrade them. It's a misnomer. You don't crack open the PlayStation 4, shove a new GPU in it, then fire it back up. You throw your old PS4 on Craigslist and buy a new one.

The PC is admittedly more expensive up front, but your upgrade path later is markedly easier. If you're a budget gamer, you can probably run the same processor for up to six years, and the same graphics card for four to five years. Case? RAM? Power supply? Fans? Hard drives? All surprisingly cheap stuff you'll carry in perpetuity, build to build, replacing only when absolutely necessary.

You could easily stick to a budget build with as-needed upgrades and be totally fine for a long, long time, especially if your goal is only to stay ahead of consoles. Stagger them and you'll end up spending the same or less than if you bought a new console every three or four years.

You can't just plop Microsoft's powerful new Scorpio processor into your Xbox One.

Again, I'm not sure whether we'll see another iteration of the PS4/Xbox One in a few years. Maybe this is a one-time thing. I doubt it, though. I think these incremental box upgrades are the new norm.

CONSOLE EXCLUSIVES ARE OVER

Tonight I could pop open Steam and play *Street Fighter V*. I could also play *Dead Rising 3*, *Rise of the Tomb Raider*, *Axiom Verge*, *Talos Principle*, *Killing Floor 2*, *Darkest Dungeon*, *No Man's Sky*, *Downwell*, *SOMA*, *Everybody's Gone to the Rapture*, *Transistor*, *Grow Home*, *Hotline Miami 2*, *N++*, *Volume*, and so many others.

All of those games are exclusive to either the Xbox One or the PlayStation 4. Or rather, they're marketed as "Console Exclusive" for those consoles—meaning they also came to the PC. Both Microsoft and Sony seem to consider the PC neutral territory.

Sony's more cautious, keeping its first-person titles all to itself. You won't find *Uncharted 4* on the PC yet. But there's signs that might change, given that Sony recently released PlayStation Now—its subscription-based game-streaming service—on the PC.

Microsoft's gone further and wholesale embraced its involvement in both the Xbox and Windows 10, creating the Xbox Play Anywhere program. Nearly every "Xbox Exclusive" is coming to Windows 10 day-and-date nowadays, including *Gears of War 4*, *ReCore*, *Quantum Break*, *Forza Horizon 3*, and more. The only Xbox series we haven't heard plans for yet is *Halo*.

Point being: Buying a PC rarely means missing out on console games these days. Sure, you won't be able to play a handful of first-party titles on Sony's end, but everything else makes it over—and often (barring edge cases like *Arkham Knight*) in better condition than the console versions.

PC EXCLUSIVES **AREN'T**

Maybe you have that friend who asserts, vehemently, "The PC has no exclusives." We've all run into that person before—if not in person, at least on forums.

It's a weird argument, and one that belies an ignorance about the PC as a platform. Maybe it's shorthand for "The PC has no exclusives [that I want to play]," but there are far more PC-only games these days than console-only.

The entire strategy genre, for one. With the exception of *Halo Wars* and a handful of less-successful others, both turn-based and real-time strategy games are mostly found on the PC—and there are a ton.

It's not all plodding strategy games though. There are hundreds of games each year that make a name for themselves on PCs and never make it onto consoles. These span genres, from shooters (*Unreal Tournament*, *Quake Champions*) to RPGs (*Tyranny, Mount & Blade II*) to…I don't even know (*Duskers, Factorio*).

Civilization VI: Only on PCs.

Yup, you can still play this 24-year-old game on PCs.

BACKWARDS COMPATIBILITY

Oh yeah, and once you own a game on the PC, you own it forever. (Unless you're one of those people who's preternaturally paranoid that Valve's Steam will fold and take your games down, too. In which case there's always GOG.com.)

The PC's gaming heritage stretches back something like forty years at this point. Thanks to the enthusiasm of the PC community, most of that forty years is immediately accessible to you. Text adventures? The Interactive Fiction Database has you covered. DOS? Thanks, DOSBox. The more complicated environments of fifteen or twenty years ago? Again, there's GOG.com, plus (if the game you're looking for is popular) probably dozens of mods to improve the experience.

And I won't even mention the PC's more legally-gray console emulators. Not in this article, at least.

Buy a PC, and all that history is open to you. Just recently, Steam added a bunch of classic Sierra games—everything from *Gabriel Knight* to *Phantasmagoria* to *Caesar III*. Some of the best the '90s had to offer,

still accessible to today's players.

Sure, it can be finicky. Installing mods can be a hassle, or intimidating if you have no idea what you're doing. But I'll put in the work if it means having the ability to replay *Planescape: Torment* on my current hardware instead of scrounging up a PC from 1999 or relying on some publisher to fund a remaster. Heck, PlayStation 4 owners can only play PlayStation 3 games if they pony up $20 per month for PlayStation Now.

SALES AND **FREE-TO-PLAY** GAMES

"Okay, but I don't like classic games and/or I played all those games before." Well good news! It's also cheaper to be a PC gamer when it comes to new titles. Our prices fall faster, go lower, and stay that way.

The vaunted Steam Sales comes to mind first, but it's far from the only sale in town. GOG.com, Amazon, Green Man Gaming, Gamersgate, Humble—all of them run sales on the regular. You can easily amass a huge library of games on the cheap, more than making up for the cost of your hardware.

It's not unusual to see pre-orders for big games go for 10 or even 20 percent off on Steam, and by six months post-release many big games will fall to $20 or $15 during a sale. Or lower. Great indie games often go for under $10 or even $5 on sale if you're patient. Consoles? Even on sale, many AAA games seem to bottom out around $30 for years on end.

And then there's free-to-play. Often a dirty word, the fact is that some of the world's biggest (and most-loved) games are free. Maybe you've heard of *Dota 2* and *League of Legends*? *Team Fortress 2*? *Path of Exile*? *Evolve*? You can spend hundreds (or thousands) of hours playing some of the PC's best games and never spend another cent.

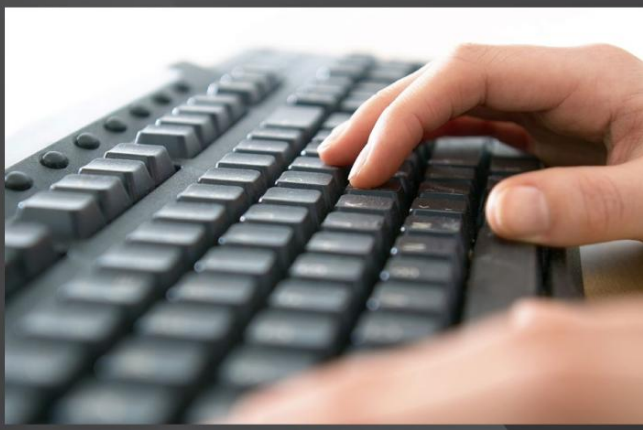
MISCELLANEA

Get motion-sick? Gaming on the PC allows you to change your field of view, or FOV, potentially mitigating that issue. Personally I run all my PC games at an FOV around 100 degrees. Consoles, being played on a screen farther away, are usually around 60 degrees. That's not an issue in itself. The bigger problem is that console games are typically locked to a certain FOV, meaning if it's making you sick you can't change it. (Disabling motion blur also falls in this category.)

Played a game and hated it? Steam, Origin, GOG.com, and many other retailers now allow you to get a refund on any game you purchase, as long as you meet certain parameters. Not only does can you get your money back when developers don't deliver on a game, but you can test whether a game runs on your machine—thereby removing much of the guesswork from PC gaming.

And don't get me started about the idea of paying for online multiplayer. Ugh. Still none of that here.

CONTROL FLEXIBILITY



We could also talk at length about the mouse and keyboard, but we won't. Suffice it to say: It's more precise, more approachable (for new gamers), and more responsive than a controller.

But there are so many console games on PCs nowadays, it's only natural you want to play some of them with the original control scheme. *Dark Souls* comes to mind, as does *Assassin's Creed*. These games just play better on a gamepad.

Luckily, it's easier than ever to connect an Xbox One controller or a DualShock 4 to your PC, either wired or (in the case of the Xbox One S and DS4) with Bluetooth. And most games support controllers on the PC these days, especially the big multi-platform releases.

YOU PROBABLY NEED A PC ANYWAY

And here's where we end. The be-all-end-all argument.

It's easy to discuss the price of a gaming PC in a vacuum. There are good reasons to do so: Maybe you prefer laptops for your day-to-day computing. Maybe you get all your work done on a tablet.

But for many people, a desktop computer is still a necessity (or at least a preference). People doing photo or film or audio work, or working on games of their own, or typing for long hours every day need a PC. Others simply like sitting at a desk and having a large screen and a meaty keyboard.

Why not use your PC for work and play?

In other words, there are ways to subsidize the cost of a gaming PC in your own head. "Well, I need a desktop PC anyway to use Ableton and Word and Premiere, so why not tack on $200 for a Radeon RX 480 and make it a gaming machine at the same time?"

A console? That's a one-use machine—especially in the age of the $35 Chromecast. There are so many ways to get Netflix, HBO Go, and

the like onto your TV, you don't really need a console to do those things anymore.

BOTTOM LINE

PC gaming still has issues it needs to overcome. Streaming to Twitch is overly convoluted for the layperson. Prepare to spend a bit of time on Google or Steam forums if a game breaks. Updating graphics drivers? A hassle for sure. Even the sheer act of building a PC can be stressful, at first.

The PC is in a good spot—probably the best it's ever been, and getting better all the time.

It's not for everyone. Not yet.

But PC gaming is miles more accessible than it was in the past. There are practically infinite resources on the Internet for any question you might encounter, for any error code a game might spit back at you. Driver updates are done with the push of a button now and take far less time than any console firmware update.

The PC is in a good spot—probably the best it's ever been, and getting better all the time. If you watched Sony's PlayStation 4 Pro announcement with disappointment, or bemusement, maybe it's time to think about moving to a more open platform.

We'd be more than happy to have you.

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HERE'S HOW

CONTENTS

How to repair Windows' master boot record and fix your bricked PC

Your PC won't work if Windows' MBR is corrupted or erased. Luckily, it can be fixed.

BY IAN PAUL

A NASTY NEW form of ransomware is wreaking havoc on computers. Hackers that encrypt your files and demand money from you in the form of bitcoin is bad enough, but a few versions also overwrite your Windows PC's master boot record (MBR).

The master boot record is a key part of your PC's startup system. It contains information about the computer's disk partitions and helps load the operating system. Without a properly functioning MBR, your PC simply won't work.

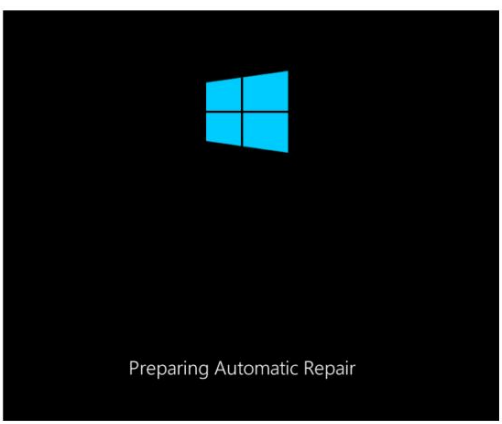
Ransomware that overwrites the MBR isn't all that new, with examples of it dating back to at least 2012. More recently, the Petya variant of ransomware (go.pcworld.com/petyaransomware) has been causing MBR problems. Then in August, a pesky bit of malware (go.pcworld.com/fosshubmalware) popped up on FossHub that overwrote the MBR, which caused headaches for affected users. And the master boot record can sometimes be damaged via less hostile actions, as well.

Luckily, destroying the MBR usually isn't irreversible. But it's still problematic since overwriting the MBR renders your PC inoperative until it's repaired. On top of that, the method for fixing it is far from obvious.

Here's how to make everything right if your master boot record was erased.

How to fix the MBR

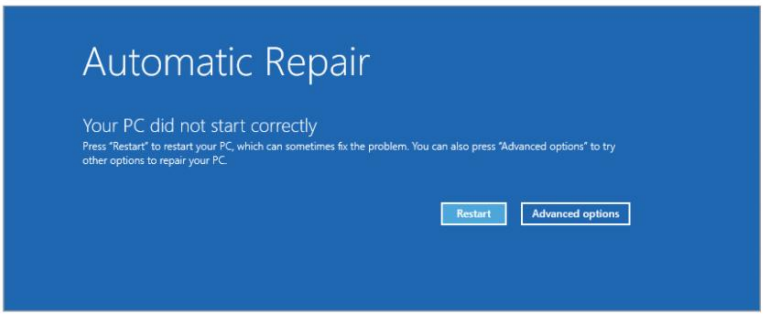
The main way to fix the MBR is to use a command prompt and run the **`bootrec.exe`** command. In versions of Windows prior to Windows 8 and 10, you usually accessed the command prompt through recovery media like a DVD disc or USB drive. That still works in Windows 10, and we'll discuss that method at the end of this tutorial. But the latest versions of Windows offer an easier method for running recovery commands without external media.



When you first boot up a Windows 10 PC it should recognize that

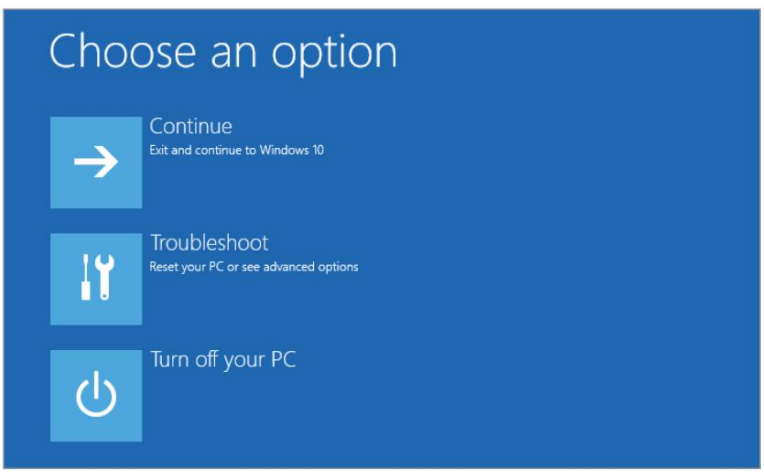
there's a problem and enter "automatic repair" mode. When it does, you'll see the words Preparing Automatic Repair appear below the blue Windows logo.

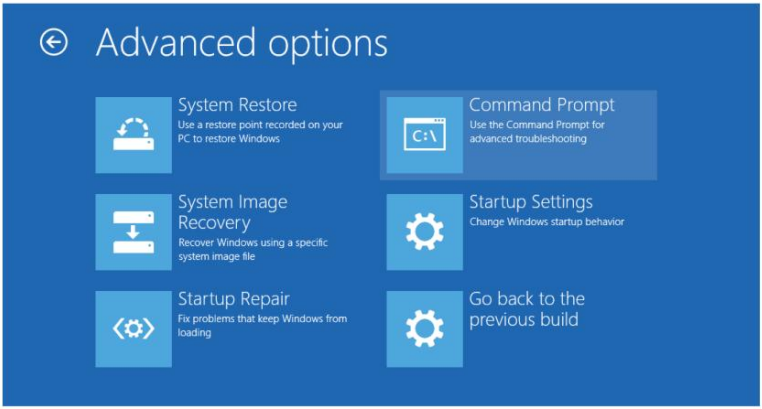
If that doesn't happen, but you do see the blue Windows logo, turn off your computer using the hard reset/power button. Keep turning the computer on and off until you see your PC booting into automatic repair. It should only take a few reboots.



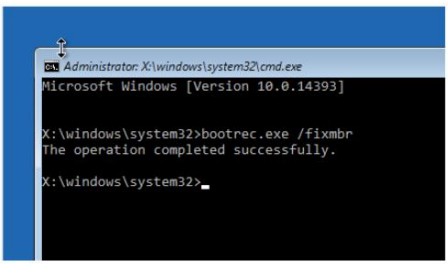
Once automatic repair mode is ready, you'll see the Automatic Repair screen. From here select Advanced Options.

On the next screen, click Troubleshoot and then Advanced Options once again.





You'll see a screen with six options. If you want, you can select Startup Repair before turning to the command prompt and Bootrec. Startup Repair is an automated program that will try to fix any problems it finds on the computer disk without any intervention from the user.



It's a good utility that may fix your problem, but Startup Repair will take far more time to complete its task than simply running Bootrec.

To use the Bootrec option, click the *Command Prompt* tile. This may prompt your computer to reboot yet again and then ask you to login with your password. If that happens, do so.

Once the command line appears, all you have to do is type the following, then press Enter:

```
bootrec.exe /fixmbr
```

Note the space between *exe* and */fixmbr*—it's critical to include this space for the command to run properly. The first part tells the PC to run the Bootrec program, while the */fixmbr* option tells Bootrec exactly what we want it to recover.

If all goes well, the command prompt should print out, "The operation

completed successfully." When you see that you can reboot your PC.

If you're trying to recover from ransomware or some other form of malware, be sure to boot into Safe Mode and then run an antimalware program. For more details on these steps, check out our earlier tutorials on how to remove malware from a Windows PC (go.pcworld.com/removemalware) and how to boot into Safe Mode in Windows 10 (go.pcworld.com/w10safemode).

Bootrec from a system repair drive

If you're running an older version of Windows, or if your Windows 10 PC isn't launching the repair options, you'll need to use a recovery drive to fix your MBR. Start by inserting the system repair media into the PC. This will be either one you created, or a purchased version of the Windows install discs.

Creating a recovery drive for Windows will give you peace of mind in case the worst happens.

Next, boot your system. If you're using a USB drive, your system's BIOS needs to be set to boot from USB before falling back to any internal drives. If you don't have your BIOS correctly configured, the system recovery drive will be of no use. Adding to the complication, the way you enter the BIOS (and how you set it up) is not universal.

Lincoln Spector has a tutorial on how to handle setting up your BIOS to boot (go.pcworld.com/bootusbflash) from USB.

Once you've booted into the recovery drive, you should be asked to select a keyboard layout in your language—US English in this case. Next, you'll land on the troubleshooting screen we saw earlier.

At this point you can continue to the command prompt as we discussed earlier and run Bootrec.

If you're on Windows 7, you'll need to follow slightly different steps once you launch into the recovery mode. After you've selected the input method, select Repair Your Computer, followed by the operating system name. Then click Next > System Recovery Options > Command Prompt and start Bootrec by typing the same **`bootrec.exe /fixmbr`** as shown earlier.

Next steps

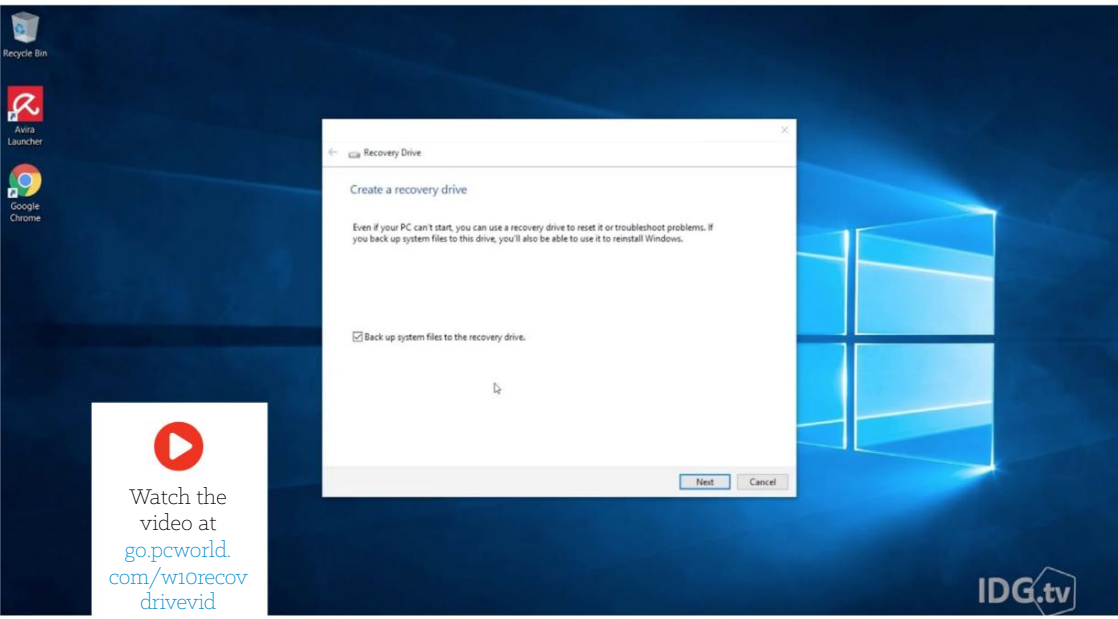
Although the MBR problem is relatively easy to repair, it's still best to be prepared for the worst in case this problem ever strikes again.

The most important thing you can do to protect against MBR erasure and most other catastrophic PC malfunctions: Back up your personal files. That means keeping a local daily backup on an external

hard drive or using a third-party program for daily backups. It's also a good idea to have a secondary backup that lives offsite, such as an online backup service like Backblaze, Carbon, or CrashPlan. *PCWorld*'s guide to backing up your PC for free (go.pcworld.com/diybackup) can help you out.

You'll also want to create a system recovery drive. This is an especially important measure in the age of Windows 10, since many early Windows 10 users upgraded to the new operating system via a digital download—and thus don't have a physical copy of the operating system. If the automatic repair method ever fails, you'll need a system repair drive in order to use Bootrec or any other system recovery tools.

Check out our other tutorial to learn how to create a system recovery drive (go.pcworld.com/w10recoveryfix), and the important information (see page 153) Microsoft won't tell you about recovery drives.



Watch the video at go.pcworld.com/w10recovdrivevid

What Microsoft won't tell you about your Windows 10 recovery drive size

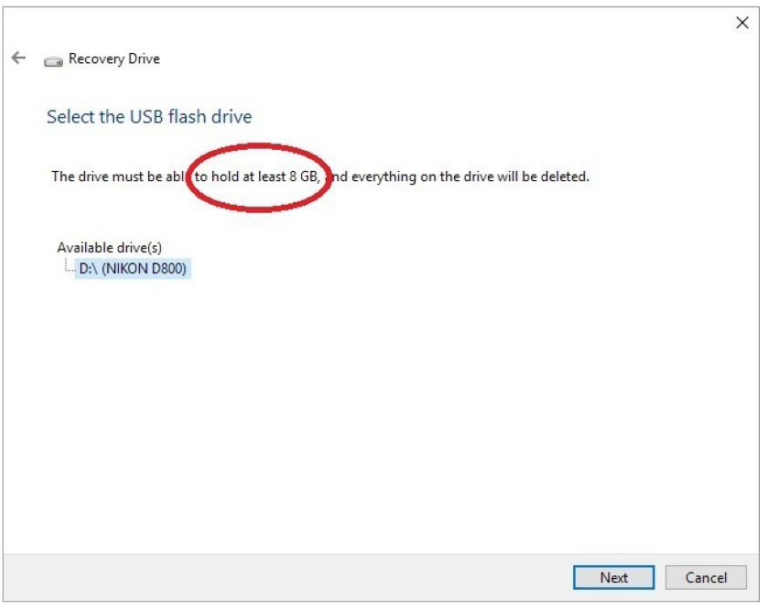
BY JOSH NOREM

READER ATTILA BALATON bought an 8GB USB key to create a Windows 10 Recovery Drive only to find out 16GB was required.

Mea culpa: *Answer Line* was partly to blame, as my former colleague wrote that Microsoft suggests (go.pcworld.com/w10recoveryfix) "at least a 4GB USB key." It's not his fault, though, as on this support page (go.pcworld.com/w10recoverydrive) Microsoft says in order to create

a Windows 10 Recovery Drive you will need a, "USB thumbdrive with 4GB of space or more." Confusing things further is this page from Microsoft (go.pcworld.com/wdwsrecoverydrive), where the company doesn't even mention how much space you'll need. Finally, on its support page for Windows 8 (go.pcworld.com/w8usbrecovery) Microsoft says the recovery image the software creates, "…is typically 3 to 6 GB in size."

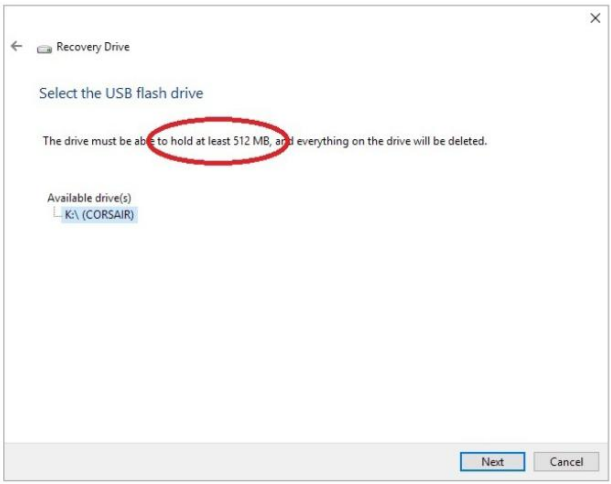
However, based on Atilla's feedback I went in and updated our article. Also in the video that accompanied this article, we mention that when we tried the process on a laptop in our office it said we needed a 16GB key! This got the staff at *PCWorld* curious, so we also looked into this further to see if we could nail down a specific size requirement, and also figure out what factors play a role in determining the size of the recovery data.



On my own PCs (both of them) I needed just 8GB of space.

First, to test what my own system would need I made a recovery drive on my personal PC, which has been running Windows 10 for

approximately two years so I figured it would have a lot of system files, or files that needed to be saved. Yet when I went through the process of creating the Recovery drive, I was met with the screenshot on the previous page.



Imagine that—only 512MB required!

Next I turned to my laptop, which I use only for testing, so it is as minimal of an installation of Windows 10 as you could possibly get. I think the only thing I have installed on that machine is Chrome. Surprisingly Windows told me I needed 8GB for my laptop too!

Therefore, in my experience, with installations of Windows 10 that are both old and new, it only required 8GB of storage. Also, when I examined the contents of the Recovery Drive for my personal PC, I found it was 6.03GB in size.

Back in the office we returned to our 16GB recovery drive. We wondered why it needed to be so large, but then we realized this particular laptop had four user accounts, so we figured maybe it was 3GB per user. That makes sense, right? We decided to ask Microsoft about it, and an "official spokesperson" gave us a statement, which read, "The size of the image varies on a wide variety of factors such as the number of device drivers, OS updates, language packs installed, as well as which version of Windows it is. The recommended size is also rounded up and may show as larger than exactly what is needed."

That's great and all, but it didn't answer our question. When we pressed about how the number of users affects the size of the recovery drive, we received a definitive answer from Microsoft, which was, "The required size of the USB storage is not related to how many

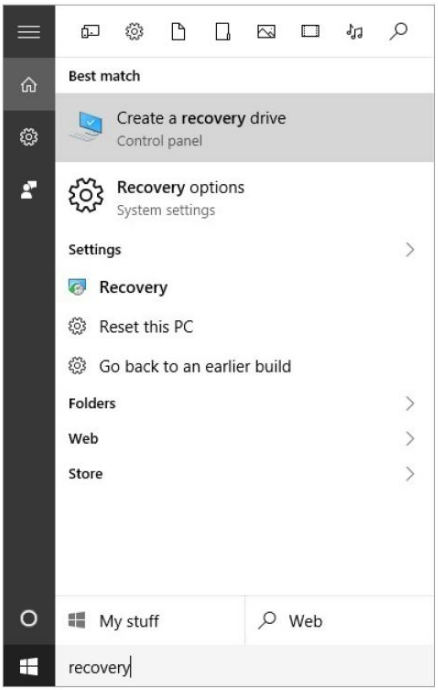
user accounts are on the system."

So there you have it, or at least part of it.

One final ripple: when you start the wizard to create the Recovery Drive, it asks you if you want to include System Files as well. When we unchecked this box, it said we needed a USB key with a whopping—are you ready for this?—512MB of storage! Do they even make those anymore?

The bottom line is this: A 16GB USB key is only $5 on Amazon, so just get more than you need to be safe. You can also find out the specific requirements of your system by simply running the wizard.

To do that just type **recovery** into the Windows search bar and select Create A Recovery Drive from the options. It'll examine your system and tell you how much space you'll need before it does anything.



In the Windows 10 search, just type the word **recovery** to find the launcher.

How to downgrade to iOS 9 if you don't like iOS 10

BY ROMAN LOYOLA

THERE ARE A lot of reasons as to why you may want to revert to iOS 9 after installing iOS 10. It's not difficult to revert, but you need to do it sooner than later.

Each version of iOS is signed (approved) by Apple. When iOS updates are released, the previous version remains signed for a short period of time. Eventually, Apple stops signing the previous version, which prevents you from installing the old version.

Here's how to revert back to iOS 9.

Find the .ipsw file

First, you need to find a file called *[iOS device]*.ipsw. If you are downgrading an iPhone, the file will have a name like, "iPhone8,2_9.3.5_13G36_Restore.ipsw". Here's how to find it.

1. In the Finder, hold down the Option key and select Go > Library. (The Library folder is usually invisible in your Home folder. If you don't hold down the Option key, the Library selection will not be available.)

2. Open the iTunes folder.

3. Look for a Software Updates folder that corresponds to your device. So for the iPhone, look for iPhone Software Updates and open it.

4. Look for a file called "*[yourdevice]*_9.3.5_*[firmwarenumber]*_Restore.ipsw" or something similar. This is the file that will allow you to revert back to iOS 9.

5. Drag that file to the Desktop.

Don't see such a file? Search the Internet for **`ipsw download`**. A few websites (such as IPSW Downloads, ipsw.me) will have the old iOS software available. Download the appropriate .ipsw file ("*[yourdevice]*_9.3.5_*[firmwarenumber]*_Restore.ipsw") and save it to your Desktop.

Install iOS 9

1. Connect your iOS device to your Mac using the sync cable.

2. Launch iTunes.

3. Click on the device icon in the upper left.

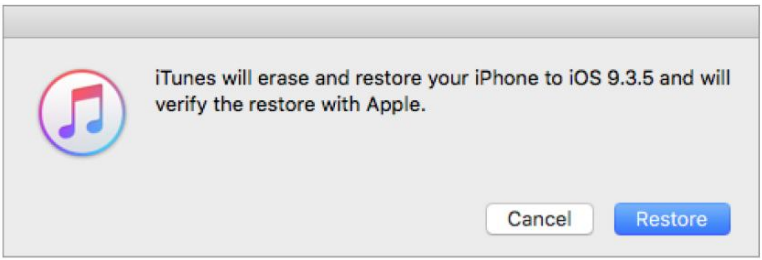
4. Click on the Summary tab in the left column.

5. In the main window, click on the Restore iPhone button while holding down the Option key.

6. You may get an alert that says you need to turn off Find My

iPhone/iPad/iPod. You can do this on the device by going to the Setting apps and then iCloud > Find My iPhone/iPad/iPod. After that, repeat step 5.

7. A navigation window appears. Navigate to the .ipsw file on your Desktop, select it, and click Open.



8. You'll be asked to confirm. Click the Restore button to continue.

It takes a few minutes for iTunes to do its job, and soon you'll have an iOS device running iOS 9.

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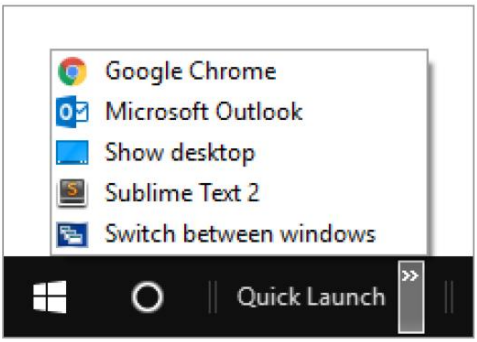
How to have the Windows XP–style Quick Launch bar in Windows 10

WE MIGHT BE in the age of Windows 10, but for longtime Windows users there's nothing like some of the classic features of earlier versions. This tip helps bring an ancient relic to your Windows 10 desktop: the XP-era Quick Launch bar. These instructions are specific to Windows 10, but it will work on earlier versions of Windows as well.

Why would I want that old thing?

Look, I'm not going to spend a lot of time trying to convince you of the Quick Launch toolbar's worth. The fact is, ever since Windows 7 made it possible to pin your desktop icons to the taskbar, there isn't a lot of need for Quick Launch.

That being said, there are still good reasons someone would want this. If you're coming from an XP machine that someone had to drag out of your cold (but not quite dead) hands, then the Quick Launch bar may be more comfortable for you to use. Quick Launch also puts the Show Desktop feature in a more obvious place than that little rectangle on the far right of the taskbar.



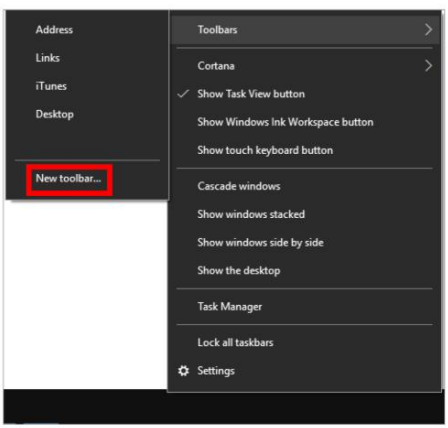
The Quick Launch bar in Windows 10.

Bringing back Quick Launch

Right-click on the taskbar and select Toolbars > New Toolbar.

A File Explorer window will open.

Next, click on File Explorer's address bar so that the current file location is highlighted. Then copy and paste the following bit into File Explorer:



Start by selecting the New Toolbar option.

```
%UserProfile%\AppData\Roaming\Microsoft\Internet Explorer\Quick Launch
```

Now hit Enter and you'll be in the Quick Launch folder and click the Select Folder button.

That's it—the Quick Launch toolbar is now on your taskbar.

The only problem is that it's in the wrong spot. Instead of being close to the Start button, it's on the far right side.

Well, that won't do.

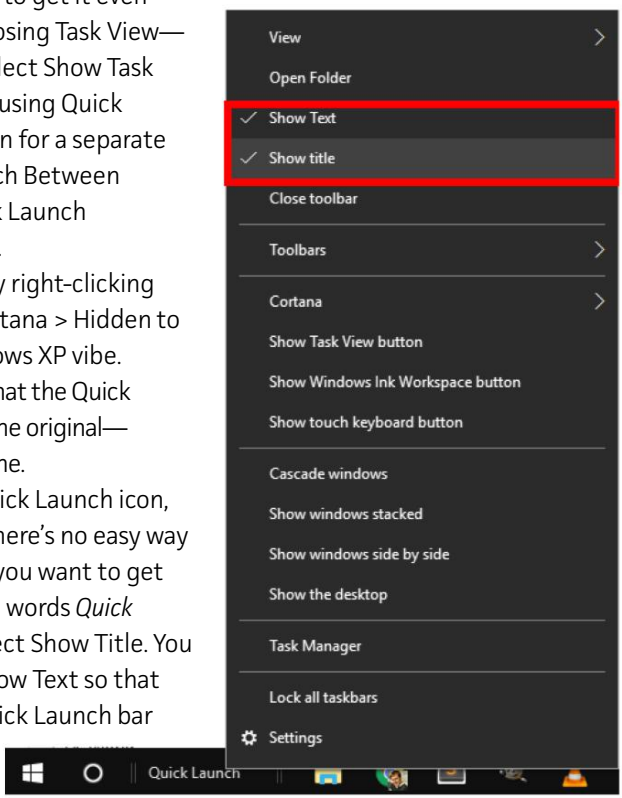
All you have to do is click and drag that double line next to Quick Launch until it's on the other side of the taskbar. This will make the Quick Launch bar extend across half the taskbar. At that point you can shrink it back to normal by clicking and dragging the double line to the right of Quick Launch.

In my tests, I could only get Quick Launch to sit to the right of the Task View button. If you want to get it even closer—and you don't mind losing Task View—right-click the taskbar and select Show Task View Button. In fact, if you're using Quick Launch there's really no reason for a separate Task View icon since the Switch Between Windows feature inside Quick Launch accomplishes the same thing.

You can also hide Cortana by right-clicking the taskbar and selecting Cortana > Hidden to get even closer to that Windows XP vibe.

Now you may have noticed that the Quick Launch bar looks nothing like the original—though it's functionally the same.

For one thing, there's no Quick Launch icon, just the title Quick Launch. There's no easy way to bring back the icon, but if you want to get rid of the title, hover over the words *Quick Launch*, right-click, and deselect Show Title. You may also want to deselect Show Text so that each program icon in your Quick Launch bar won't be labeled.



Once you've got it set up

the way you want, you can expand and contract the Quick Launch bar to show all your icons, a few of the first ones, or only the Quick Launch title—assuming you decided to keep it. You can also add more items to Quick Launch by dragging and dropping program icons from the Start menu.

That's about all there is to bringing the Quick Launch toolbar to Windows 10. It's not for everyone, but for XP fans or anyone else who misses the old way of doing things, bringing back Quick Launch is a great trick to know about.

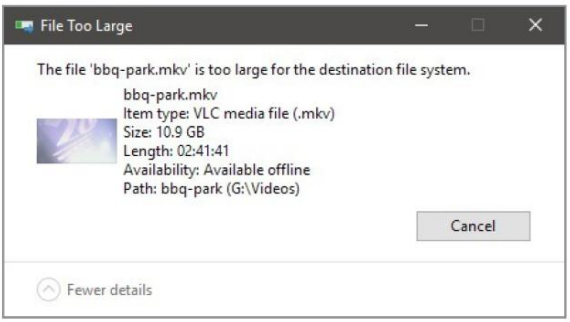
Why your USB drive's file format matters: FAT32 vs. exFAT vs. NTFS

Watch the video at go.pcworld.com/usbfileformatvid

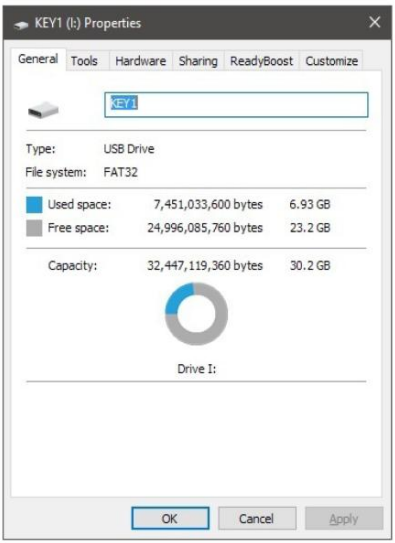
MAJID WAS UNABLE to copy a movie from his PC to his newly acquired 32GB USB key, and wondered why. He sent me a screenshot that clearly indicated the problem, as it read "The file is too large for the destination file system." I replicated the issue quite easily by trying to move a 10GB file to a FAT32 disk, as FAT32 can't handle any file larger than 4GB.

In dealing with this it occurred to me that Majid probably isn't alone, and people might not be aware of the fact that you can format a USB key in Windows using one of three available file systems, and that each system has both advantages and limitations. My colleague wrote about

this previously in regards to external drives (go.pcworld.com/extdrivefilesystem), but he was discussing high-capacity hard drives you plug into your PC. Though Windows file systems work the same regardless of drive type, I wanted to expand on his piece a bit by including the system called exFAT, so in this piece I'll discuss the three file systems, their pluses and negatives, and which one to use according to your needs.



FAT32 has a 4GB file size limitation, making it tough to copy HD or 4K video footage.



FAT32: This is the old standby, and the file system that is usually pre-installed on any USB key you buy from the store.

The reason for its ubiquity is that it will work on any PC you plug it into, including both Macs and PCs, Linux boxes, and vintage machines that use USB 2.0. The biggest limitation is that it has a file size limit of 4GB, which can be a problem with today's Blu-ray rips and 4K video files. If you're just sharing small files between computers, however, it's a fine system to use.

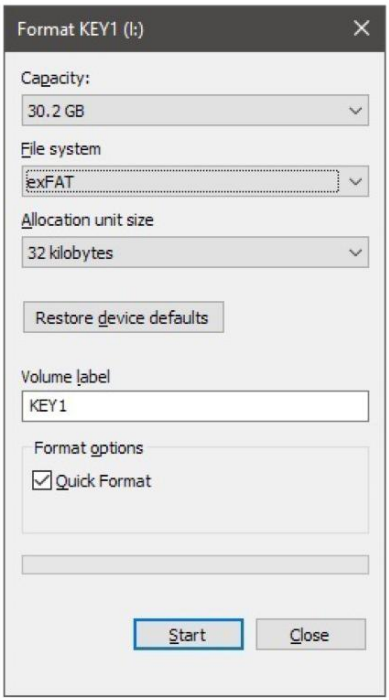
exFAT: This is an updated file system created by Microsoft to replace FAT32. It debuted in Windows Vista SP1, it has a maximum file size of 16 exabytes (EB) (it's going to take us a while to hit that), and it's

compatible with both Mac and PC. Though it's a proprietary Microsoft technology, Apple licensed it for use in its OSs so you'll see it as an option when formatting a drive in OS X. For swapping or sharing large files, especially between OSs, exFAT is the way to go.

One downside to exFAT is that it doesn't have any journaling functionality, which is a system whereby any changes to the files on the disk are noted in a log before they're actually performed. This helps data integrity by recording the changes to files before they take place. The only other downside to exFAT is it's not supported by Apple's Time Machine software.

NTFS: This is the newest file system created by Microsoft and is the de facto file system for almost every modern internal hard drive and SSD.

Its name stands for New Technology File System (clever, no?). Windows can only be installed on an NTFS partition, so chances are your system at home is using it.



The exFAT file system was created by Microsoft as an updated version of FAT32.

The reason it's the default file system for drives that run the OS is that it has all the technology Microsoft has on tap these days: journaling, no reasonable file size limitations; support for file compression and long filenames; file access control for server administrators, and lots more. In a Windows-only household there's no reason for you not to use NTFS on all your drives, both removable and internal.

The catch is, NTFS can be read by Mac OSs, but not written to without third-party software. This means if you plug an NTFS-formatted thumbdrive into a Mac you can copy the contents from it, but you can't alter the contents or write to it, so it's not good for cross-platform sharing.

In summary, for USB drives, you should use exFAT if you're in a Windows and Mac environment, and NTFS if you're only using Windows.

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