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PCWorld

MAY 2015

HANDS ON WITH THE **SURFACE 3**



Full Windows and a new CPU make all the difference

ScanSnap

Own productivity

ix500 wireless desktop scanner

Incredibly fast

Intuitively smart

One button simple



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MAY 2015

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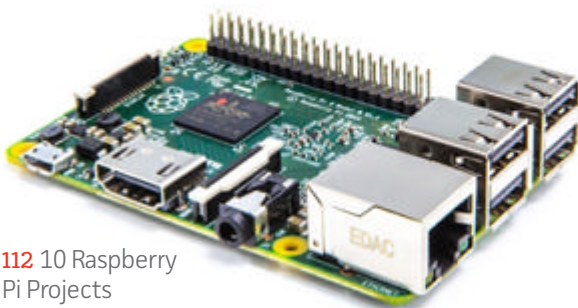


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EDITOR IN CHIEF, CONSUMER BRANDS Jon Phillips

DESIGN DIRECTOR Rob Schultz

EDITORIAL

EXECUTIVE EDITORS Melissa Riofrio, Gordon Mah Ung

SENIOR EDITORS Michael Brown, Brad Chacos, Mark Hachman

ASSOCIATE EDITOR Caitlin McGarry

STAFF WRITER Florence Ion

DESIGN

DESIGNER Kate Godfrey

ADVERTISING SALES

SALES MANAGER Duane Hampson (415/978-3133)

PRODUCTION

DIRECTOR, PRODUCTION Nancy Jonathans

SENIOR PRODUCTION MANAGER Tamara Gargus

FOUNDERS

FOUNDER David Bunnell

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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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join me and help put an
End to childhood hunger.

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Hands on with Microsoft's Surface 3

Full Windows and a new CPU cut the compromises.

BY MARK HACHMAN

With the Surface 3 (go.pcworld/surface3), Microsoft finally puts forth a budget alternative to the Surface Pro 3 that's worth considering—if only because it runs full Windows 8.1 rather than the limited Windows RT of prior Surface models. The \$499 starting price doesn't hurt either (the Surface Pro 3 starts at \$799). But there's more to the Surface 3 than that, and we

The Surface 3,
left, and
Microsoft's
Surface Pro 3.



dove straight in as soon as we received our unit.

Microsoft sent its higher-end Surface 3 for evaluation: the \$599 version with 4GB of memory and 128GB of storage. (The \$499 version has 2GB of memory and 64GB of storage.) As with its pricier cousin, everything else for the Surface costs extra: The separate Type Cover keyboard costs \$130, partially offset by the free one-year subscription to Office 365 Personal, which saves you \$70 initially. The 128GB of storage shrinks to about 93GB after setup and about 88.8GB after installing Office.

A smaller Surface Pro 3

If Microsoft sold the Surface Pro 3 as the “tablet that can replace your notebook,” the Surface 3 offers a similar solution, only everything is just a bit smaller, especially if you’ve been using the Surface Pro 3 as a daily driver, as I have. The Surface 3’s display measures 10.8 inches across, for example, with a resolution of 1920x1280 pixels, compared to the 12-inch, 2160x1440 display of the Surface Pro 3.

The smaller display, combined with the Surface 3 Type Cover, contributes to a slight feeling of claustrophobia. Another noticeable limitation: The Surface 3 includes a kickstand with three fixed positions, rather than the nearly infinite range of pitch options with the SP3’s kickstand.

Docking the Surface 3 alleviates some of the differences between the two tablets. Unfortunately, the \$199 Surface 3 Docking Station is tailor-made for the Surface 3, so you won’t be able to reuse an older

dock with the new tablet.

The Surface 3 dock provides ethernet, two USB 2.0 and two USB 3.0 ports, miniDisplayPort, and a headphone jack. While the dock completely encloses the tablet's own USB port, it also eliminates the power brick that most other docks include. Keep in mind that the Atom processor inside the Surface 3 requires minimal power, so a 13-watt microUSB charger comes with the Surface 3, and you can use your phone's charger in a pinch.

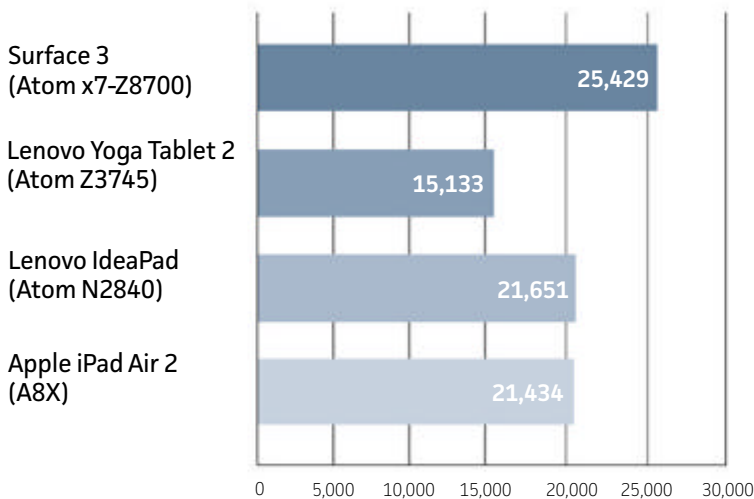


Performance: better than you'd expect

A quick round of tests shows that the Surface 3's 1.6GHz Intel Atom X7-Z8700 powering the Surface 3 is no slouch. 3DMark Ice Storm tests CPU and GPU performance for cross-platform mobile devices. The Surface 3 outpaced all comparison devices, including the iPad Air 2.

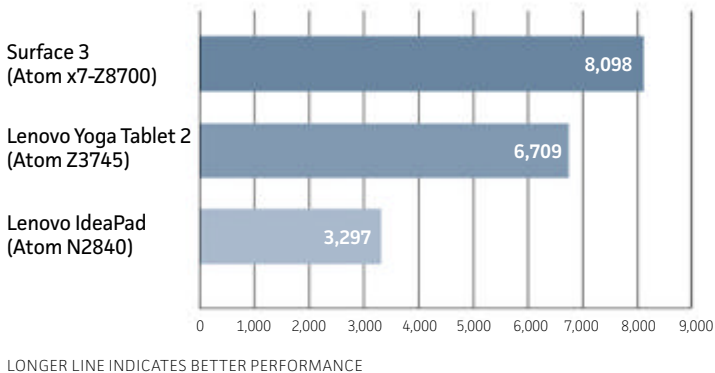
The Surface 3
kickstand has
fixed positions.

3DMark Ice Storm Unlimited



LONGER LINE INDICATES BETTER PERFORMANCE

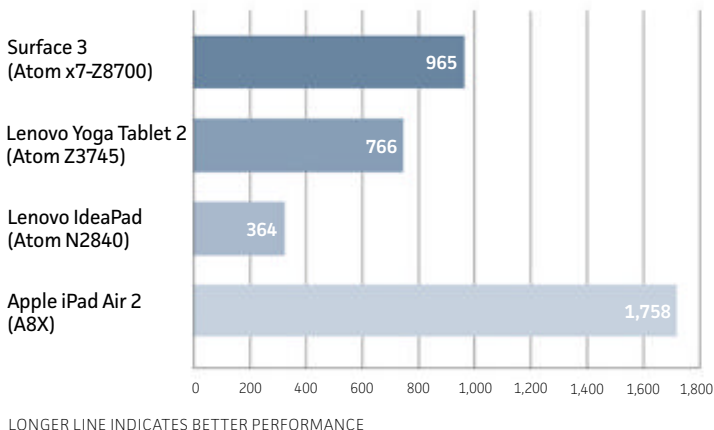
Google Octane V2 Performance



In Google's Octane test of JavaScript performance, the Surface 3 came out on top again, almost 20 percent faster than the next device, the Lenovo Yoga Tablet 2.

We ran Geekbench 3's single-core performance load, in 32-bit

Geekbench 3 Single-Core Performance



mode to improve compatibility with the prior-generation Atoms. The Surface 3 outpaced all the older devices, though nothing could keep up with the iPad Air 2.

Regardless of the test, it's clear that Intel's latest Cherry Trail Atom is noticeably faster than the Bay Trail version found in the Lenovo Yoga Tablet 2—a greater bump-up than the 5 percent to 10 percent improvement we saw when transitioning from Intel's Haswell CPUs to the Broadwell chips found in its Core PC processor lineup. We'd expect similar performance boosts in other Cherry-Trail-based tablets.

The bottom line: There's been a vast improvement in performance over the various generations of Atom chips, and that's a good thing: The early versions of Atom were so lacking that they nearly killed the entire brand.

Microsoft claims the Surface 3's battery life should be about 10 hours. We'll be testing that soon.

There was one red flag: After running several benchmarks, the Surface 3 hard-locked, becoming totally unresponsive to mouse, keyboard, or touch. I suspected thermal issues related to the dock. Here's why: The Surface 3 is completely sealed, relying on passive heat conduction. Yet Microsoft's dock encases the rear of the tablet nearly to the top. A Microsoft spokesman said the company hasn't run into similar problems with other Surface 3 tablets. We'll keep testing.

Building a better econobox

Earlier versions of the Surface were rife with compromise. The Surface 3 has overcome the biggest problems (with the operating system and performance). The result is a basic, (hopefully) reliable performer for students and office workers who just want an Office machine that fits their budget. Those with a bit more coin will upgrade to the Surface Pro 3.

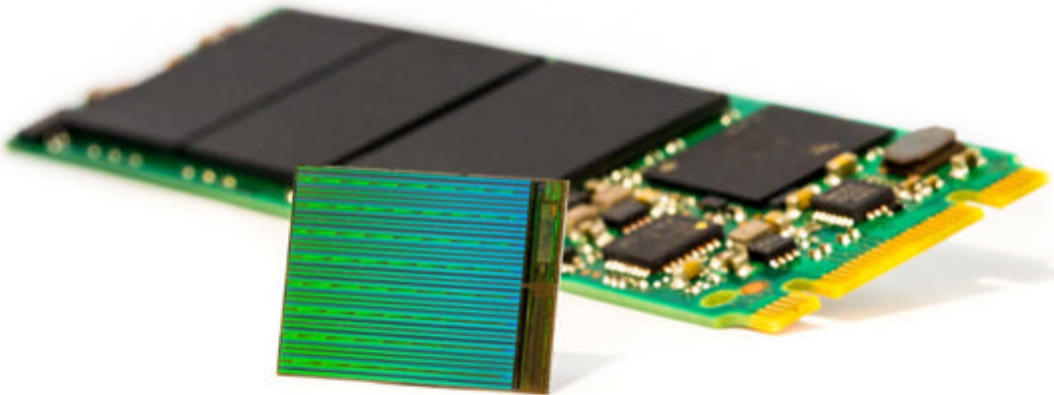
I'm not convinced that long-term use with the Surface 3 will be as enjoyable as the Surface Pro 3, primarily for ergonomic reasons. It's just harder to be productive on a smaller machine. 🍷



The Surface 3's new, slightly smaller keyboard has a redesigned top row.

New 3D NAND flash will triple capacity of SSDs

BY GORDON MAH UNG



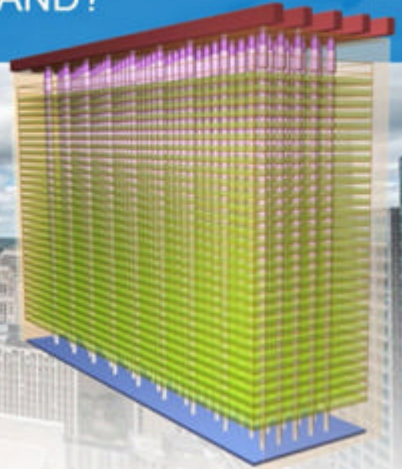
STANDARD CONSUMER SSDS will increase up to an astounding 10TB of storage, thanks to a new type of 3D NAND flash memory that Intel and Micron introduced.

The two companies, longtime joint partners in NAND flash development, said the breakthrough isn't to make larger flash chips, but thicker ones. Much like Manhattan, when you're out of space, the only way to go is up.

Executives at the two companies said that by stacking the NAND they can greatly increase the capacity. The new 3D NAND technology stacks flash cells vertically in 32 layers to achieve a 256Gbit multilevel cell (MLC)

What is 3D NAND?

3D NAND cells are built vertically – like a skyscraper



Micron

March 25, 2013

intel

and 384Gbit triple-level cell (TLC) die that fit within a standard package. Both say this approach will yield greater efficiency and lower the cost too.

You can see from this slide how the 3D NAND builds up rather than out.

Triple capacity boost

Pack a bunch of those together, and the end result is a tripling of capacity over today's drives, at least initially. For a standard 2.5-inch SATA drive, that means up to 10TB of space; for the M.2 drive type used by most laptops, the 3D NAND will boost capacities up to 3.5GB.

"This 3D NAND technology has the potential to create fundamental market shifts," said Brian Shirley, Vice President of Memory Technology and Solutions at Micron Technology, in a statement. "The depth of the impact that flash has had to date—from smartphones to flash-optimized supercomputing—is really just scratching the surface of what's possible."

The chips are already sampling at both companies, and Intel said it expects to offer products for sale using the 3D chips in the later half of this year. But how long will the chips last before they fail? That

information wasn't disclosed.

Intel did say it expects to offer products using the new NAND chips this year.

Why this matters

SSDs have drastically impacted computing—but even as prices have dropped, the capacities still lag far behind those of traditional magnetic hard drives. This 3D NAND announcement puts SSDs on a density increase that could very well see it eclipsing hard drives, at least for most people's needs. 📀



Microsoft to launch universal apps for Windows 10 phones

BY MARK HACHMAN

MICROSOFT JUST PUSH its universal apps vision for Office to Windows 10 phones at the end of April. The new apps are being rolled out as part of a new Windows 10 Technical Preview for phones. Since they're part of the "universal" apps family, they'll look and feel a lot like the universal apps Microsoft has previously released for Windows 10. And yes, they'll require Windows 10, Microsoft executives said.

Microsoft's new apps will essentially replace Office Mobile, Microsoft's first stab at bringing Office apps to the mobile platform. But Office Mobile was limited in its editing and content-creation capabilities and lacked the

richness of desktop apps. Microsoft claims that the new apps will change all that.

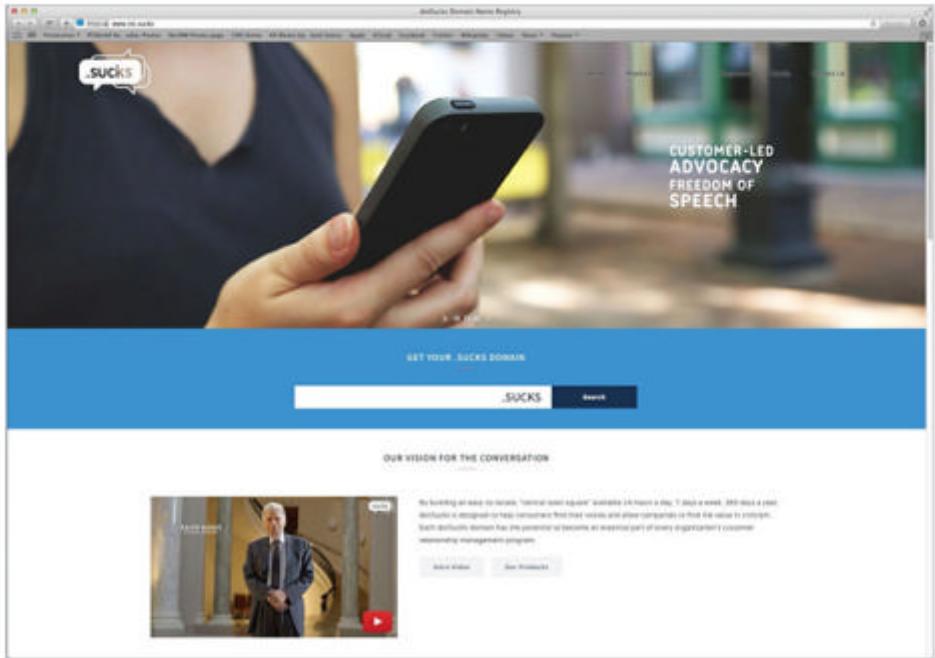
Microsoft's Jared Spataro said that the new universal apps will work on a "freemium" model, providing basic capabilities for free, but also encouraging users to move to an Office 365 subscription to unlock more advanced capabilities.

According to Spataro, the phone is a "triage" device, with the ability to make last-minute changes without pulling out a notebook PC. "The phone isn't a place where a lot of detailed work is happening," he said. "Instead, I would label it as a triage device.... this isn't to say that people aren't reading on it; they are. This isn't to say that people aren't making quick edits; they definitely are. But what we see is that phone is literally the go-to device for how people stay in touch with what's going on, in terms of their editors, in terms of their team."

Why this matters: It's been over a year since Microsoft launched the new Office apps for the Apple iPad, which kicked off a new generation of artfully designed free Office apps. Finally, it's time for Windows phones to receive the same treatment. We haven't had a chance to play around with the apps yet, but what we've seen looks consistent with the quality we've seen in the free Office apps for other platforms. 📱



The new universal apps will work on a "freemium" model, providing basic capabilities for free.



.sucks domain is coming to an angry website near you

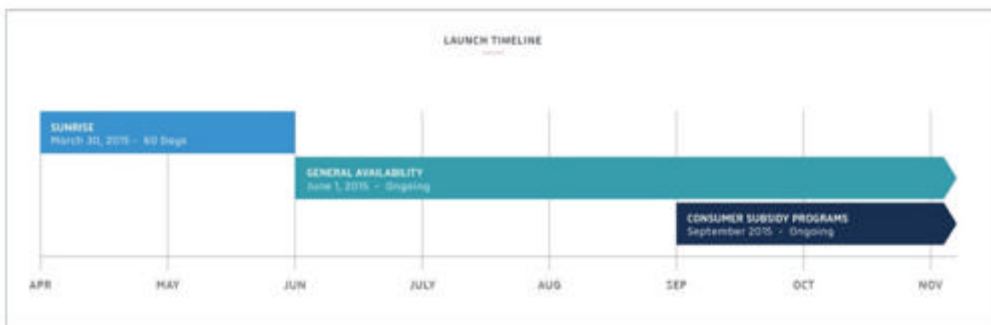
BY IAN PAUL

A BRAND NEW generic top-level domain (gTLD) is now on sale that is the embodiment of modern online sentiment: .sucks. Yes, pretty soon you can own your own piece of Internet hate for the political (HillarysEmail.sucks), the arbitrary (purple.sucks), or the sporty (StandUpPaddleBoarding.sucks).

The Internet Corporation for Assigned Names and Numbers approved the .sucks domain as part of the new gTLD expansion (go.pcworld.com/gtldexpands) that ICANN says could include more than 1,300 TLDs over the next few years.

Some .sucks domain names could end up being nothing more than a little harmless fun. The worst case scenario for major companies, however, might be a disgruntled customer getting their hands on Google.sucks, Nestle.sucks, or Comcast.sucks. And apparently the company behind the .sucks TLD knows it.

Vox Populi Registry (nic.sucks), a Momentous.ca affiliate that owns the right to administer the .sucks domain, has set aside select names that will cost as much as \$2,500 a pop to register. This category of domain names, dubbed Sunrise Premium, are filled with names that are registered with the Trademark Clearinghouse (ICANN's global trademark database), according to *Marketing Land*—in other words, the names of large companies.



The Sunrise Premium names were originally slated to go on sale during the early registration period—dubbed Sunrise—beginning March 30. Vox Populi has since changed its plan and will start selling the names during general availability of .sucks domain names beginning June 1.

General availability starts June 1st.

Why this matters: Vox Populi says the new TLD is a place for common people to make their voices heard and where companies can “find the value in criticism.” Others, however, see .sucks as nothing more than a shakedown by selling acerbic domains to companies at a high price lest they fall into more hateful hands. At \$2,500 each, it may make sense to cave and pay for the domain. After all, the next hot Wordpress or Tumblr blog could very well be Monsanto.sucks or, more

WHY .SUCKS?



PROACTIVE

Applications for cause marketing (e.g. carbon.sucks), consumer advocacy and customer service.



VISIBILITY

Marketing and promotion strategies to support strong visibility and awareness.



FOCUSED

Anti-bullying, anti-pornography and anti-parking policies ensure a focused domain space.

likely given the Internet's love of cats, MickeyMouse.sucks.

Into the hands of the proletariat

Any company that buys a domain from the Sunrise Premium category will be on the hook for \$2,500 every year to keep the domain. But what happens if a company doesn't snap up an offending name like BurgerKing.sucks?

Unclaimed names will become available for a consumer advocate subsidy beginning in September for just \$10 a year. Companies and those associated with them are barred from purchasing .sucks names under the subsidy program.

These subsidized domains will redirect to Everything.sucks, a forum hosting site where angry consumers can get together and vent about a certain company or product in a dedicated forum.

If you build it, will they hate?

While a fresh .sucks domain name may add a little novelty to a site, there's little to stop people from creating a blog at MicrosoftSucks.com right now—as long as the name is available. And recently, Gamergate (go.pcworld.com/gamergate) participants proved how effective online anger can be just with common social media platforms like Reddit and Twitter.

Ultimately, there may not be much point to buying up .sucks domains since there will always be an alternative for anyone with a little creativity. Microsoft could stop XboxOne.sucks from blossoming

Companies that don't purchase their domain name from the Sunrise Premium category may end up with a site that .sucks.

into life, but what about XboxOneReally.sucks, XboxOneReallyReally.sucks, WhyTheXboxOne.sucks, or ManTheXboxOneReallyReallyReally.sucks? Unless major companies plan to use ICANN's Uniform Domain Name Dispute Policy against every .sucks domain that mentions them there's just no stopping the .sucks revolution.

The good news is if PlayStation 4 fans did manage to get their hands on TheXboxOne.sucks domain, Microsoft or Xbox advocates could always rival that site with its exact opposite on the .rocks TLD. Positivity is apparently much cheaper too. At this writing, TheXboxOne.rocks domain was available for less than \$10 per year. 🎮



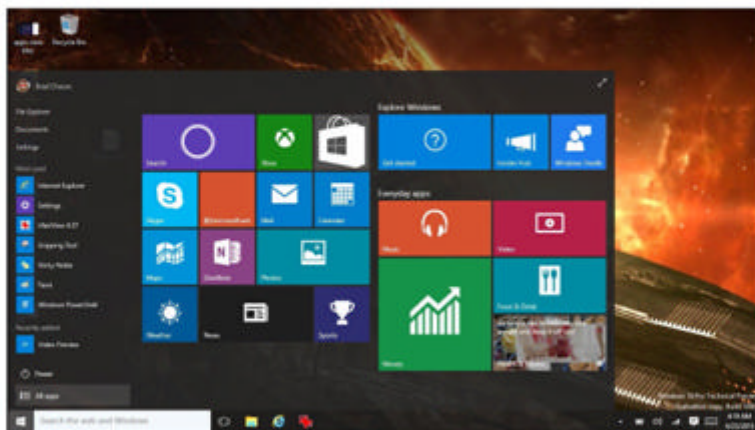
Windows 10 build 10061: Exploring the preview's fresh apps and features

BY BRAD CHACOS

EVEN THOUGH ITS big annual Build conference didn't kick off until the end of April, Microsoft dropped their Windows 10 Technical Preview build 10061 (go.pcworld.com/w10prebuild10016) a week early. Unlike the last Technical Preview release—which merely added the Project Spartan browser—this one is positively stuffed with tweaks, changes and news apps.

Curious, but loath to install pre-release software on your PC? Live

Windows 10 build 10061's Start menu.



vicariously. I've spent some time poking and prodding at Windows 10 build 10061. Read on for screenshots and impressions of all the new changes, and don't forget to check out PCWorld's guides to the best new Windows 10 features to try first (go.pcworld.com/w10first10) and the top Windows 10 tips and tricks (go.pcworld.com/w10besttweaks) to get a deeper feel for the operating system.

Start me up

The very first thing you notice upon booting build 10061 is that Windows 10's Start menu has been tweaked yet again. It's been widened, from one "fat column" of apps to two, lending it a feel closer to Windows 8's Start screen. Don't like it? Fear not: Build 10061 also restores a previous option to resize the Start menu to smaller—or larger—dimensions.

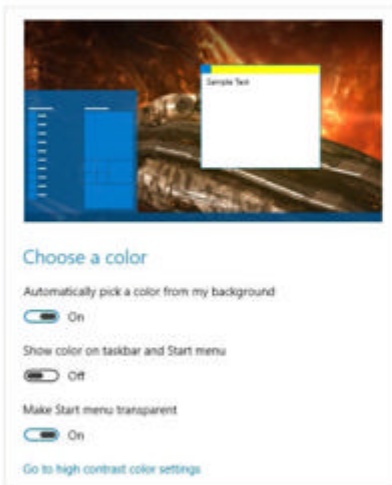
Note that the Power button was moved from the upper-right corner of the Start menu to the lower-left corner. It's a subtle tweak, but an appreciated one for desktop users. Let's hope it sticks!

Paint it black

This build also adds a black system theme that travels across the Start menu, taskbar, and Action Center. The Start Menu and taskbar also

gained some transparency, showing a bit of the screen behind them. It's a nice touch, and the transparency effect is opaque enough that your background doesn't interfere with actually navigating the Start menu and taskbar.

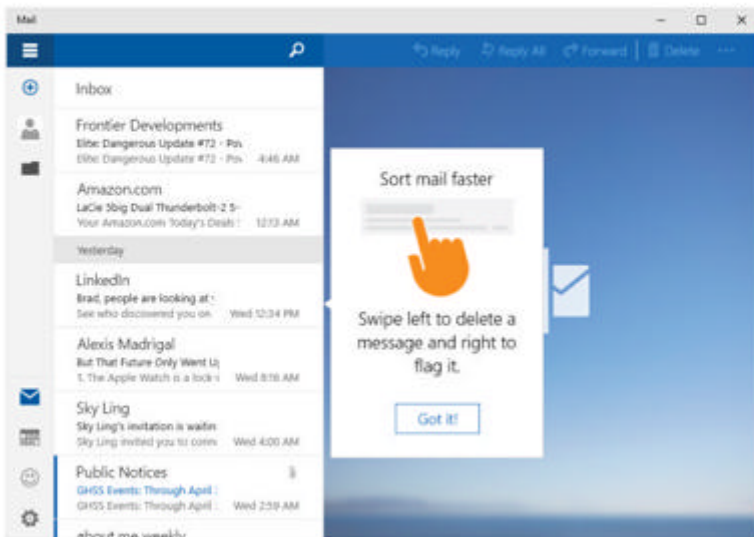
Again, don't worry if you don't like it: The Personalization section of the Settings app has been fleshed out in this build. (It was pretty sparse in the last one.) If you head to it, you'll find options to enable or disable the new aesthetic tweaks in the Colors section.



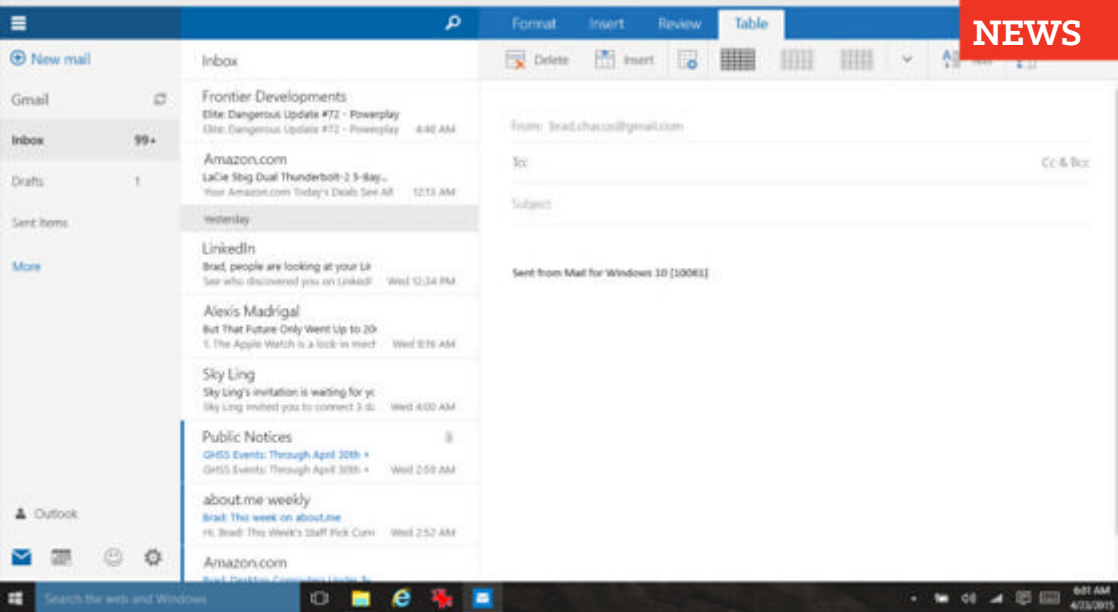
The fleshed-out personalization options in Windows 10 build 10061.

Vastly improved Mail and Calendar apps

Once you move beyond the cosmetic tweaks, you'll find build 10061's



Windows 10 build 10061's revamped Mail app.



biggest additions: overhauled apps galore.

Most notable are the new Mail and Calendar apps, which first appeared in the leaked 10051 build that never officially made it to Windows Insiders. The Mail app introduces a three-pane design, with the ability to add a custom image background to the preview pane when no messages are selected. If you have a touchscreen, you can also swipe left to delete messages or swipe right to flag them, just like in the recently released Outlook mobile apps.

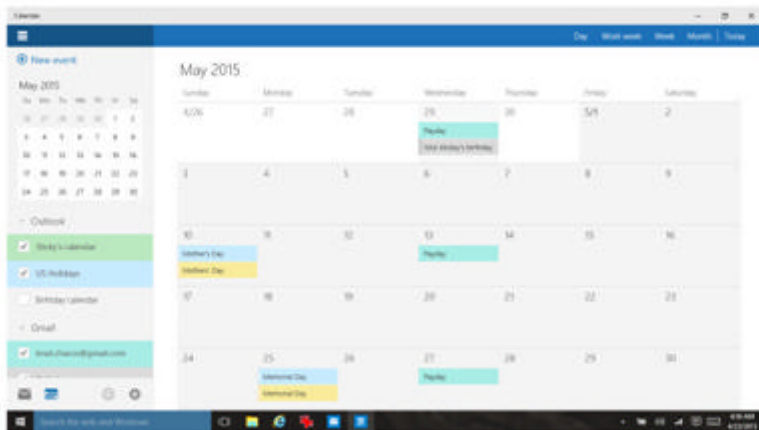
Email authoring has been tweaked to more closely resemble Microsoft's Word, with much more robust formatting options and—get this—the ability to insert tables directly into outgoing emails. The new app also includes POP email support, a feature oh-so-sorely lacking in Windows 8. Hallelujah.

The Calendar app, on the other hand, boasts significantly more color and contrast than the bland monstrosity known as the Windows 8 Calendar app. It also packs a left-hand pane with a small monthly view and checkboxes to quickly select which of your individual calendars are being displayed.

More crucially, the new Calendar app restores Google Calendar support, which Microsoft yanked in Windows 8.1 as part of a childish

Windows 10 build

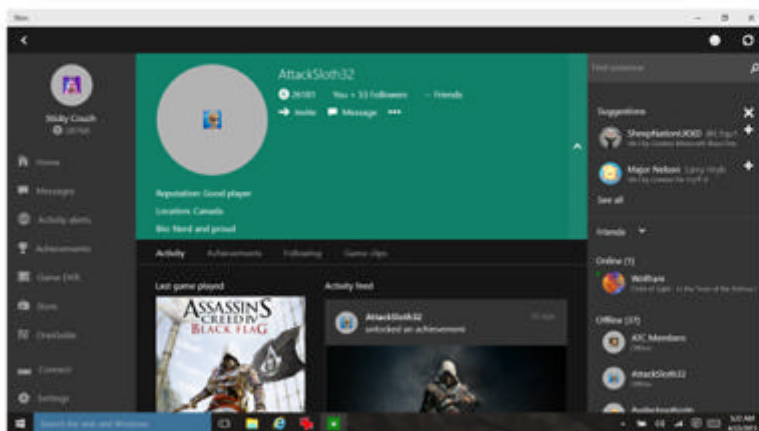
10061's new Mail app has a much more robust authoring experience, including the ability to insert tables. Really. You can see it here in the upper-right corner if you click to enlarge the image.



The new Calendar app in Windows 10 is a vast improvement over Windows 8's dumbed-down gray mess.

slap-fight with Google. Finally. I'd been forced to stop using Windows 8.1's Calendar app because of it, despite my adoration for the app's system-wide notifications

Both represent significant improvements over their Windows 8 counterparts, but perhaps the most vital changes to Windows 10's new Mail and Calendar apps occur under the hood. While the Windows 8 apps were pokey at best—like virtually all Windows apps—the Windows 10 versions are fast and responsive, feeling like true desktop apps.



That AttackSloth32, he's a swell guy. Just look at that reputation!

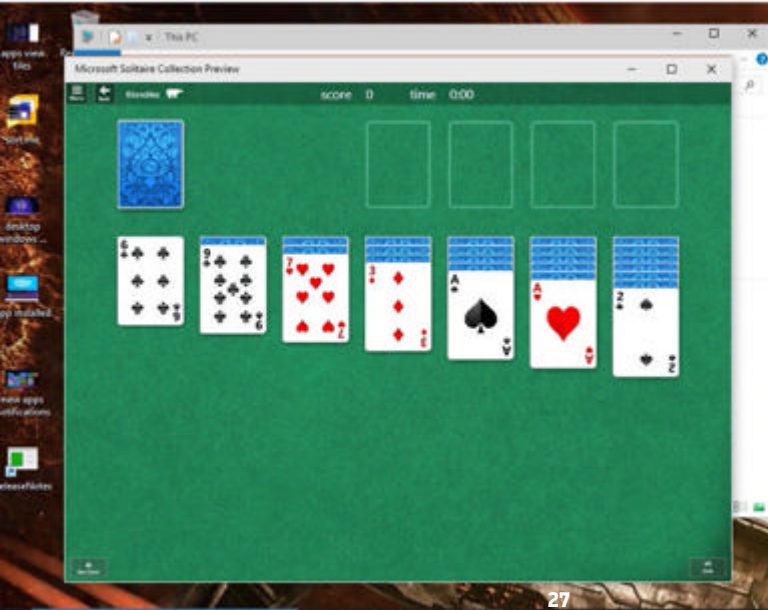
Xbox app power-up

Microsoft showered some love on the Xbox app as well, after introducing a new Xbox Avatars app in the Windows Store.

The changes are mostly subtle. The Xbox app's tile is now a Live tile in the Start menu, flaunting your gamerpic, messages you've received, and more. You can also check out other gamers' reputations and bios by selecting the More Info option on their profile page. If you have an Xbox One (I don't), the app will now show the apps you've most recently used on the console. If you're testing the new Xbox One tuner, the Windows 10 app supports live TV streaming straight from your console to your PC, as well as picture-in-picture support.

The Xbox One is getting updates of its own (go.pcworld.com/xboxupdates2015) to play more nicely with Windows 10, including support for Miracast wireless display mirroring.

Microsoft's Larry Hyrb says the new Windows 10 build also introduces the highly anticipated Game DVR function for PC games, which will let you save video highlights from any PC game, as well the ability to take screenshots of any game using Win + Alt +



Solitaire returns in Windows 10 build 10061.

PrtScr. Alas, the work laptop on which I've installed Windows 10 has no games.

Solitaire is back!

But forget the Xbox app. Here's the real big gaming deal: Windows 10 build 10061 brings Solitaire back to Windows, as first noticed by Steve Troughton-Smith via Twitter.

Windows 8 banished the old standby, casting Solitaire and the other previously preloaded games (like Minesweeper) into the Windows Store as optional downloads. Windows 10 re-embraces Solitaire—though you won't find it in the Start menu, nor the All Apps screen. Put Cortana to work searching for “Solitaire,” however, and it'll pop up lickity-split.

Oh, and a warning for Solitaire purists: It's the new-look Solitaire Windows app that comes preloaded in Windows 10, not the simple desktop application of old.

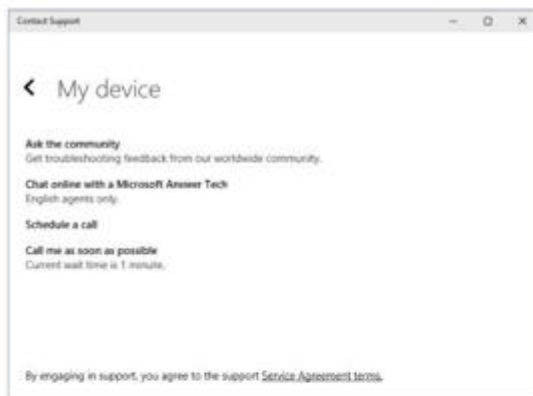
Call me maybe

Interestingly, Windows 10 build 10061 includes a new “Contact Support” app that points you toward resolutions if you run into trouble. You can arrange to chat online with Microsoft agents or (theoretically) schedule a support call from right within the app—which even displays the current wait time for your callback.

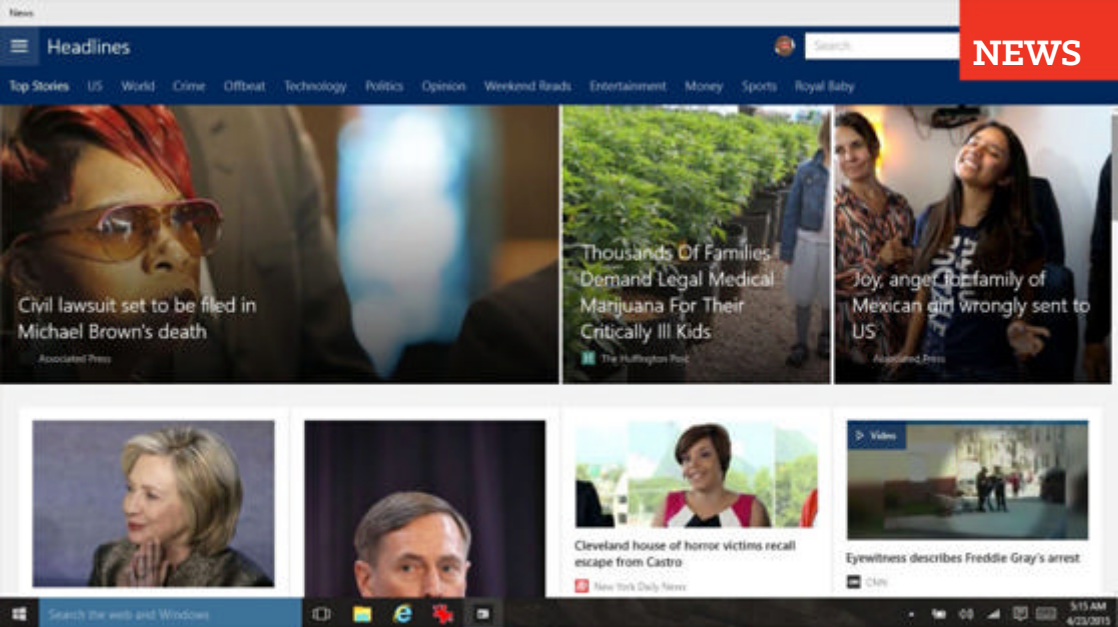
Currently, actually trying to schedule a call results in an error. It'll be a nifty feature in the final build, though.

New news

Windows 10's News app also receives a fresh coat of paint in build 10061. It's a more dense design than its Window 8 counterpart,



**Windows 10
build 10061's**
new Contact
Support app.



ditching its predecessor's full-screen "main story" splash and cramming more stories onto the screen by ditching text descriptions in favor of a grid of images with headlines. There's also a menu row across the top of the screen to jump from topic to topic.

All in all, it's a vast improvement over the ho-hum Windows 8 News app—one that introduces a more appealing aesthetic while simultaneously improving the navigation experience for touch and keyboard-and-mouse users alike.

Finally, the Alarms & Clocks app has been redone with a white design, replacing the previous dark theme. Windows 10 build 10061 also includes a new-look calendar and clock interface when you click on the time and date in the taskbar's system tray.

Tablet mode and virtual desktop tweaks

Microsoft also tweaked Continuum, its solution for swapping between desktop-centric and touch-friendly interfaces.

Activating Tablet Mode (which you can do in the Action Center) strips all apps off your screen, leaving only icons for Task View, the Start screen, and Cortana-search in your taskbar. Those icons are more spread out in Windows 10 build 10061, which is nice for fat-fingered folks like myself. Even open and pinned apps disappear from the

Windows 10 build 10061's revamped News app.

taskbar to “reduce clutter and simplify the experience,” though you can disable that by firing up the Settings app, searching for Tablet Mode, then toggling “Hide app icons on the taskbar when in Tablet Mode” to off.

That same Tablet Mode settings screen

also now contains an option to boot directly into Tablet Mode, rather than the desktop (though the latter is still the default). You can select your default interface from the “When I sign on” drop-down menu.

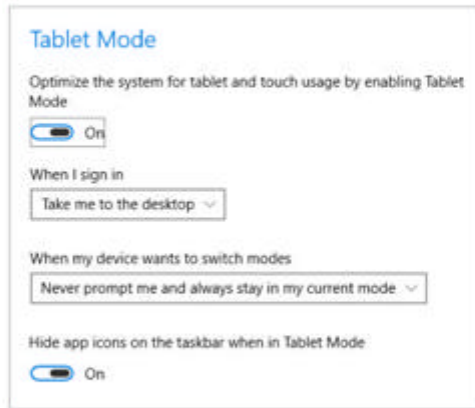
Speaking of interface tweaks, Microsoft’s also slightly refined the look of its Task View interface, which allows you to jump among your various virtual desktops. The new build strips away all desktop clutter to focus solely on your virtual desktops and their open apps. And if you really enjoy virtual desktops, Windows 10 now supports an unlimited number of them. Huzzah?

Wrapping things up

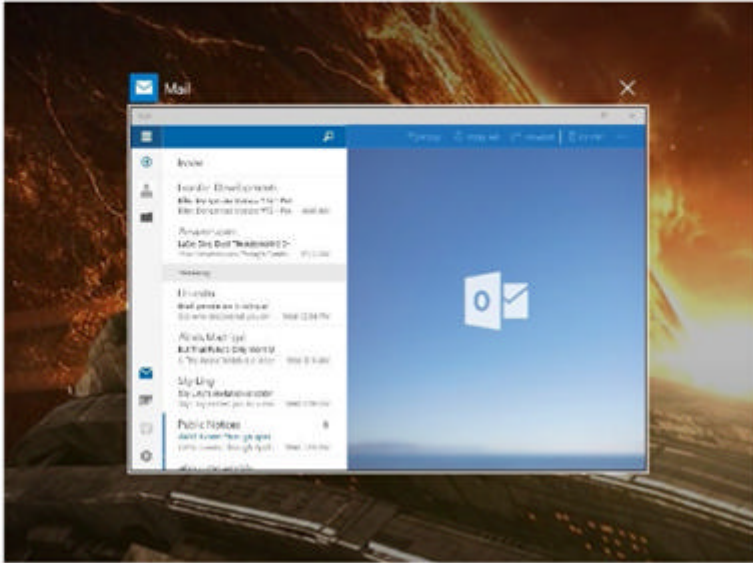
This is pre-release software, so Windows 10 build 10061 still has some rough edges. One cuts particularly sharp: Traditional desktop apps flat-out won’t open when you click them in the Start menu.

“The workaround is to use search to find and launch these apps and pin them to your taskbar for quick access,” says Microsoft’s Gabe Aul—though to be honest, that’s what I do with my most-used apps already. (That behavior prompted Microsoft to drop the Start menu from Windows 8 to begin with, but that’s a whole other can of worms.)

That crippling flaw aside, Windows 10 build 10061 is easily my favorite Technical Preview build thus far. It’s been far less buggy than past Preview builds, and the whole picture’s really starting to coalesce



Windows 10 build 10061's Tablet Mode settings options.



The sparse Task View interface of Windows 10 build 10061.

into a smart, satisfying experience that successfully blends Microsoft's Modern-era ideas with the traditional desktop interface that users love for damn fine reason. In other words, Windows 10 is shaping up into the experience that Windows 8 should have been.

We'll likely hear more about Windows 10 at Microsoft's Build conference, especially considering that the operating system is slated to launch this summer—the end of July, if AMD's CEO Lisa Su, who let it slip at AMD's quarterly earnings call, is to be believed. 

The TAG Heuer smartwatch may deliver the best Android Wear experience yet

BY JON PHILLIPS



ALMOST EXACTLY ONE year ago, TAG Heuer CEO Stephane Linder spent an hour on the phone with me, dissing smartwatches. He was dismissive. He sounded bothered. He said the smartwatches available at the time looked like “cheap wrist computers.”

He also brushed away talk of TAG Heuer jumping into the smartwatch fray anytime soon.

“I don’t see us taking a big risk,” Linder told me, “unless we find a way to make luxury watches, looking like real luxury watches that provide very easy-to-use, smart information.”

That was March 2014, and within eight months he would leave the company. Perhaps now we know why. TAG Heuer recently announced (go.pcworld.com/tag-google) that it’s working with Google and Intel on a smartwatch that will be released by the end of the year.

So what explains TAG Heuer's dramatic about-face, and perhaps even Linder's exit? Is the Swiss powerhouse so spooked by the Apple Watch, it's willing to abandon its design standards? Or have TAG Heuer and friends actually landed on the perfect combination of analog and digital features?

Disclosure: I'm something of a TAG Heuer fanboy. I've been wearing an entry-level Formula 1 for about 10 years. But I also think Google is making very smart choices with its Android Wear vision, and I have ideas on how to merge TAG Heuer and Wear in a way that strengthens Google's platform without sacrificing the craftsmanship of analog timepieces.

A new Carrera

Details about the TAG Heuer project are scant. We know the watch will integrate Android Wear, but we don't know how. *Pocket-lint* says "rumors suggest" the watch will be modeled after the TAG Heuer Carrera model. Meanwhile, TAG Heuer top boss Jean-Claude Biver told *Reuters*, "people will have the impression that they are wearing a normal watch," and has gone on record saying the timepiece will have a Swiss-made dial.

A dial, huh? That doesn't sound like a flat digital watchface to me. So I'm hoping that when the watch is released, we'll see the very first



One of the many Carrera models.

Android Wear device to merge a full-fledged analog watchface—moving hands and all—with Google’s notification cards.

Crescent display, improved battery life

You can see my vision for the Wear Carrera in the illustration at the beginning of this article. There’s really not that much to it—but that’s exactly the point. The watch is essentially a brand-correct Carrera with an analog movement and polished hands inside a stainless steel case. But the lower third of the face plays host to a multi-function Android Wear complication.

My Wear window is an odd shape, a semi-circle. But at least one display expert tells me it can be done.

DisplayMate president Raymond Soneira says an OLED display would be perfect for this application.

“OLEDs are the ideal display for smartwatches because they’re thin, don’t need a backlight, and off pixels don’t use any power... With the same OLED technology and architecture as the display in the LG Watch R, I’m sure that the crescent shape, or almost any shape display, could be produced.”

I’d hazard that when TAG Heuer’s smartwatch finally rolls around, the display will be a full-circle OLED.

Soneira makes an important point about power consumption, but what if we could push battery life past the 18 hours promised by the Apple Watch? Well, for starters, my little crescent has fewer than half the pixels of typical smartwatches. So you’ll find battery-life savings right there.

But what if TAG Heuer eliminated a color display option entirely, and went with a low-power monochrome LCD? Frankly, I don’t think Android Wear needs to be in color. And a stark black-and-white display would much better confirm TAG Heuer’s design statement.

Reduced features, increased simplicity

Reduced screen real estate would have an impact on Android Wear usability. So not only would TAG Heuer and Google have to make this

all work within Android Wear’s UI rules (or, more disruptively, amend those rules), they would also be wise to restrict what actually appears on the watch. I’ll always be your strongest advocate for smartwatch simplicity—I told Apple as much—so why not kick some superfluous features off the Android Wear plate as well?

Ditch the Android Wear heart rate monitor. Ditch navigation. We can even ditch step counting. Focus instead on simple notifications, a few key apps, and text messaging. I’ve used Google’s Roboto font for messaging in my illustration, but I’d like the watch even more if it used TAG Heuer’s house font, Gill Sans. Indeed, this analog-digital merger will really only sing if the digital side of the watch quiets down.

I know I’m asking for a lot of changes—a lot of changes for just a single Android Wear partner. But what if TAG Heuer is Google’s most important Android Wear partner, and this new smartwatch project is just the first of many Swiss-made Wear watches?

We’ll see. If I had to bet my own money, I’d hazard that when TAG Heuer’s smartwatch finally rolls around, we’ll see a dazzling TAG Heuer case and an assortment of sumptuous bands and bracelets, but the display will be a full-circle OLED. The digital watchface collection may recall every single face from the Carrera’s storied history, from 1963 to the present. But it will still, essentially, be an Android Wear watch.

None of that would square with what Linder shared with me a year ago. Perfectly nailing why we love luxury timepieces so much, Linder spoke passionately about their meticulous craftsmanship—“like you can feel the hand of people in it.”

It’s a powerful argument for analog movements somewhere in a smartwatch, and I hope TAG Heuer isn’t ready to give up on them yet. 

Make smart purchases,
stay safe online.

CONSUMER WATCH



The best Windows 8.1 antivirus software

What's the best antivirus software to buy right now?
The list includes BitDefender, Kaspersky, and Avira.

BY MARK HACHMAN

IN SALES, THEY say that you're only as good as your last month's figures. Ditto for antivirus software. And right now, BitDefender, Kaspersky, and Qihoo 360 are the best in the business. AV-Test, one of the two leading antivirus testing houses, released its February antivirus ratings for Windows 8.1 PCs, assessing the 27 or so available anti-malware packages on protection, performance, and usability. The



AV-Test posted

its results on antivirus and antimalware software for Windows 8.1 machines. Microsoft's built-in antivirus came in last.

results shouldn't surprise you: The bigger names in the industry rose to the top, while at the bottom—as usual—sat Microsoft.

Antivirus software ease of use matters, too

The tests didn't just measure how effective each was in protecting your PC from malware of all types. Two-thirds of the score assessed how the software performed and how usable it was. In the latter category, Microsoft scored a perfect six out of six—but so did eleven other vendors, showing how simple most antivirus software is to use. (If you own a Windows 7 PC, there's a separate list (go.pcworld.com/avtestwin7) for home users.)

Security solutions

By now, virtually all of the antivirus vendors offer their solutions on a subscription basis. Avira, for example, charges \$49 to protect one PC for a year and their protection includes link-checking to avoid downloading malware in the first place. Other suites throw in a

firewall. But some antivirus vendors, like Avira and Panda, offer free versions of their software that provide less comprehensive protection without charging you for it, allowing you to build your own custom security solutions as you see fit.

As for Microsoft, some test houses, such as AV-test, use Microsoft as a baseline for comparison's sake. But Microsoft's System Center caught only 76 percent of the known malware samples that AV-test threw at it and 76 percent of the so-called "zero-day" anti-malware as well. That's far worse than the industry average of 95 percent or so that its competitors detected. (BitDefender, by contrast, caught everything—100 percent.)

Microsoft's System Center caught only 76 percent of known malware samples that AV-test threw at it.

The bottom line

The message is pretty simple: If you're just using Microsoft's built-in antivirus tools to protect your PC, you're fooling yourself. Either invest in a paid solution or else download a free version from the top vendors. No antivirus solution is perfect, but you need to give yourself a fighting chance. 🛑



9 compelling reasons not to upgrade your old PC

BY BRAD CHACOS

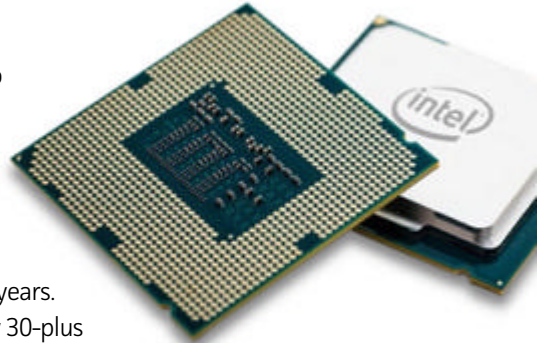
FEW CAN WITHSTAND the siren song of the latest and greatest gear, the deep allure of a new and shiny gadget—but that doesn't mean that tossing your old computer in the trash and picking up a fresh PC is necessarily a smart idea. While gamers and hardcore video editors always stand to gain extra performance out of fresh firepower, more casual users might be better off saving their cash and sticking with the PC you already own. Here's why.

Your old PC still works just fine

You honestly don't need a ton of horsepower to perform most computing tasks. Even old and entry-level PCs can stream 1080p video, sling email, and speed through Office documents like a pro. Browsing Amazon isn't exactly taxing.

Also consider that processor performance increases have trailed off dramatically over the years. Back in the day, CPU performance could leap by 30-plus percent year over year, but in the past decade that torrid advance has slowed considerably. New processors tend to be only 5 to 10 percent faster than their predecessors, and clock speeds have largely remained stagnant.

"You can hold onto your PC five, six, seven years with no problem. Yeah, it might be a little slow, but not enough to really show up [in everyday use]," Linley Gwennap, the principal analyst at the Linley Group, told PCWorld in 2013.



You can give your old PC a speed boost

That's not to say PCs can't slow down over time, but when they do, it tends to be because of software creep or a Windows installation that's just become too darn pokey after years of use. PCWorld's guide to 10 cheap or free ways (go.pcworld.com/pcfaster) to make your old PC run faster can help put some pep back in your aging computer's step for practically no out-of-pocket cost (though it also recommends a handful of helpful, low-cost hardware upgrades).

Install an SSD instead

Upgrading to an SSD can make any old PC with a lethargic mechanical hard drive feel better than new again. Seriously—moving from a hard drive to a SSD imbues your PC with speed that borders on mind-boggling if you've never touched solid-state storage before, turbocharging everything from boot times to application launch times to merely



browsing around your folders. Investing in an SSD is hands-down the smartest upgrade any PC user can make.

And even better, you can now pick up new SSDs for under \$100—depending, of course, on how much storage space you need.

Microsoft is offering free upgrades to all Windows 7 and 8 users.

Windows 10 wants you

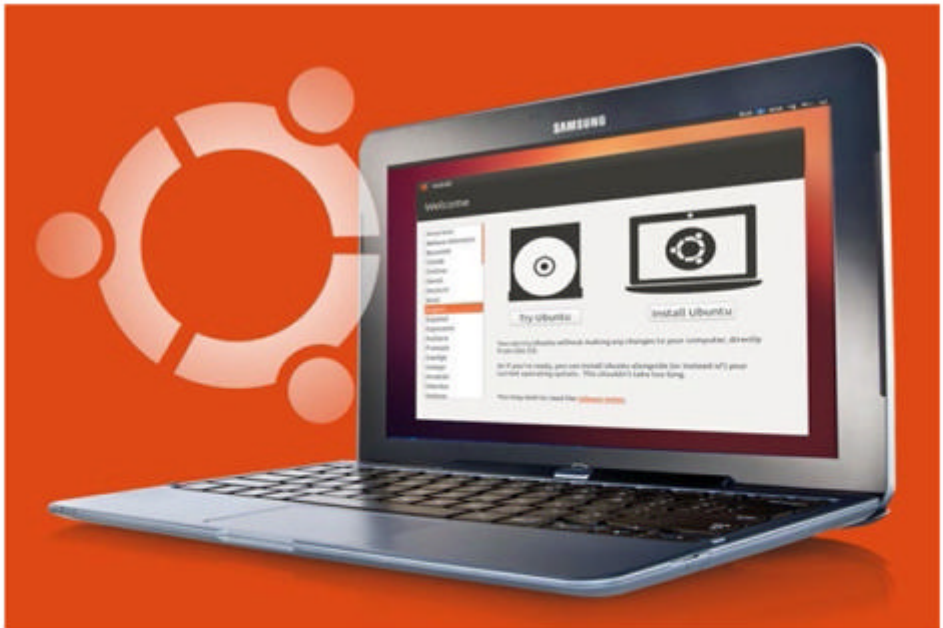
While cutting-edge hardware used to be necessary if you wanted to hop onboard the newest versions of Windows, that's no longer the case. Microsoft's pushing hard to fit Windows into cheap devices with incredibly modest specs—an initiative that also helps the operating system play nice with older PC hardware, though Windows 8.1 proved incompatible with a handful of old processors and abandoned motherboards.

And Microsoft really wants everybody using Windows 10 rather than lingering on older operating systems. So much so, in fact, that it's offering Windows 10 as a free upgrade (go.pcworld.com/winfree) to all Windows 7 and 8 users. That's an unprecedented step for the company, and one that removes a traditional incentive to purchase a new computer.

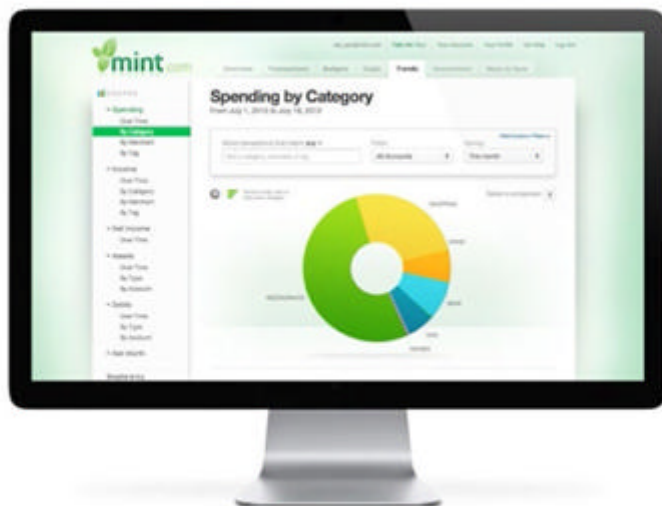
Linux is lighter than ever

But Windows XP systems aren't being offered a Windows 10 upgrade; and that operating system died a year ago. You should truly ditch it, for security's sake. That doesn't mean you need a new PC to do so, however.

Older Windows XP machines might not meet the system requirements to upgrade to a more modern version of Microsoft's operating system, but Linux demands far less from hardware. In fact, there are numerous Linux distributions designed specifically to be lightweight enough to play nice on aging hardware. Windows XP users should hold onto their checkbooks until they check out these 3 Linux alternatives (go.pcworld.com/linuxalt), as well as our guides to popular Ubuntu software (go.pcworld.com/linuxapps), Linux Office alternatives (go.pcworld.com/linuxofficealts), and Linux gaming (go.pcworld.com/



Thousands of free and open-source applications are available through the Ubuntu Software Center, as are numerous paid, commercial contenders.



Mint's web-based personal finance tools sync with your bank accounts.

[linuxgamestips](#)), which can help you find all the programs you need for work and play alike.

Everything's on the web

You might not even need to use desktop software, however. As more and more services move toward a mobile-first philosophy, most of them cater to PC users in the form of web apps, rather than stand-alone desktop software. Email, presentation creation, banking, video chatting, and more are all possible in your web browser ([go.pcworld.com/apps](#)) these days. The entire philosophy behind Chromebooks is that it's possible for most people to handle day-to-day computing via your browser alone. Even Office and Photoshop offer online versions now.

If you spend the majority of your time online, buying a new PC won't really offer much of a performance increase, unless your computer is particularly ancient. You'd be better off spending that money on a faster Internet connection.

Steam in-home streaming

Streaming can even breathe new life into old gaming PCs ([go.pcworld.com/steamstreaming](#))—provided you also have a beefier computer somewhere in your house, that is. If you want to game on a laptop

around your house, Steam in-home streaming works miracles: In our tests, it was able to play *Assassin's Creed IV: Black Flag* flawlessly on an old 2008 MacBook.

Exact performance depends on the power of your host machine and your home network, however. Steam in-home streaming hosts games on your primary PC, then allows you to stream that signal to another laptop in your house, kind of like a Netflix for gaming. How good is it? So good that I've put off getting a new laptop to replace my five-year-old model and simply stream games around my house.

Setting up a new PC kind of sucks

Setting up a new PC is fun for nerds, but pretty much just a pain in the butt for everybody else. Clearing out the pre-installed bloatware and setting a new PC up the right way (go.pcworld.com/newpcsetup) is straightforward but takes a significant time investment. And with bloatware actively becoming dangerous (go.pcworld.com/superfish) these days, you can't afford to skip that step and just ignore the junk, even if your new PC has plenty of storage space and hardware horsepower.

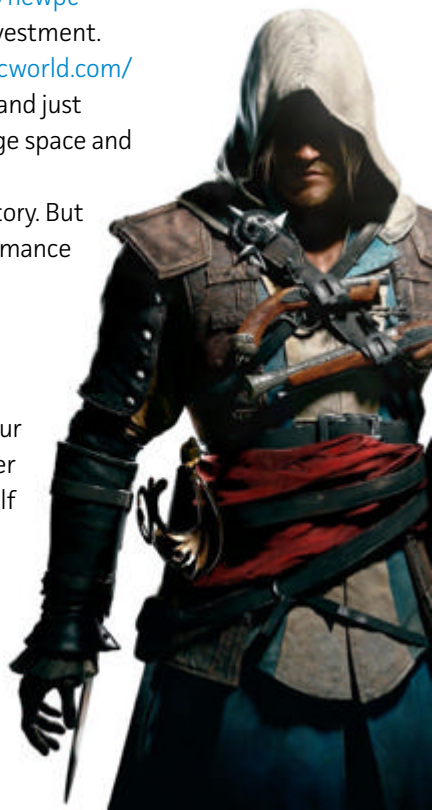
If you truly need a new PC, that's just part of the territory. But it's a lot of hassle if you're not going to see much performance improvement by upgrading anyway.

New PCs cost a lot of money

Finally, new PCs—even dirt-cheap Chromebooks—cost hundreds of dollars, and we can all use more money in our pockets. Before you splurge on a new computer, consider using some of the suggestions in this article. Ask yourself if you really need that new hardware, or merely want it—especially if the majority of your PC usage occurs inside the confines of your browser.

Unless you're rocking a specialized workflow or a truly ancient clunker, the honest answer might surprise you—and save you money. 🍷

Steam in-home streaming was able to play *Assassin's Creed IV: Black Flag* flawlessly on an old 2008 MacBook.





Ransomware: What one company learned the hard way

BY ROBERT LEMOS

IN THE REAL world, kidnapping is a risky crime—getting paid usually means getting caught. In the digital world, however, demanding ransom for data, or ransomware, is an escalating epidemic, a popular crime which is leaving many businesses and consumers at risk of losing data.

One small company in New England—a retailer with some two-dozen employees—learned that the hard way. A click-happy employee ended up infecting one system with a prevalent threat known as CryptoWall, according to the company's co-owner, John, who asked that his real name and details of his business not be revealed.

Ransomware may roam undetected

Quietly, the malware reached out over the Internet to get a unique key and then, over the next three days, encrypted data on the compromised system. Much worse for the company, the malware encrypted accounting data on a mapped drive on the firm's server.

The retailer learned of the infection when its accounting software failed to open financial data on the mapped drive the following Monday. "The ransom note never popped up on the screen," John said. "The accounting program just stopped functioning one morning."

When a support tech investigated the accounting software's problems, more than 200 copies of a ransom note were found scattered around the file system, directing the firm to pay \$500 in Bitcoin to the criminals.

Ransomware is on the rise. Kicking off with Cryptolocker in 2013, a steady parade of pernicious ransom-demanding software has hit unfortunate victims. Cryptolocker likely made its operators tens of millions of dollars until authorities disrupted the network in May 2014, shutting down Cryptolocker command-and-control servers and the GameOver Zeus botnet infrastructure that spread the malware. Yet, other ransomware variants have arisen. Between mid-March and August 24, 2014, for example, more than 600,000 systems were infected with the CryptoWall variant of ransomware, according to research conducted by managed-security firm SecureWorks (go.pcworld.com/cryptowall).

Data-nappers are going mobile as well, according to recent data (go.pcworld.com/mobilethreat2014) from mobile security firm Lookout. In 2014, four of the top five malware programs encountered by Android users in the United States were ransomware, posing as a legitimate app and then, after installation, locking the phone and demanding payment. While the threat of mobile malware continues to be low—only 7 percent of Android users even encountered malware—ransomware accounted for nearly all of the 75 percent

Four of the top five malware programs encountered by Android users in the U.S. were ransomware

increase in encounters from the previous year, according to the company.

Your best defense: back up, back up, back up

The solution to ransomware is fairly simple—at least, for now. Consumers and small businesses with a good backup process will be able to recover much of the data encrypted by the attackers. Companies who are doing backups on-premise should make sure they can recover an image of the data for months in the past and keep multiple copies. Any backups made between the time of infection and when the attack is detected will be encrypted, and thus unrecoverable without paying the ransom.

For that reason, online backups with automatic incremental backups can be a great help, Brian Foster, chief technology officer of network-security firm Damballa, advised. At the very least, companies should be keeping at least one set of backups offsite.

“I’m a big fan of online backups,” he said. “You should expect that, if you get hit by ransomware, you are not going to get the PC back.”

Another possible defense: Ransomware typically reaches out to get an encryption key from an online server. Detecting and blocking that request can prevent the encryption of the data.

Unfortunately for the New England retailer, the infection revealed that the company’s backup program had not been working correctly for more than two years. The company had no choice but to pay. Yet, even that did not go smoothly: Unable to deal with the mapped drive, the ransomware’s decryption routine failed to unscramble more than 100 of the thousands of encrypted files, leaving financial and customer information encrypted. Because the ransomware scheme



Ransomware is on the rise, kicking off with Crypto-locker in 2013.

requires trust that the criminals will hand over the data after receiving payment, the operators offered support to the firm's owner, and even offered to try to decrypt the data, if the company sent the files. The firm declined.

The infection also leaves the owner in a quandary. While the criminals have said that the infected system should be clean, John understandably does not trust them.

"The fear, as an IT person, is you feel like you need to format every drive in the network," he said. "I don't trust the other computers, but do we shell out \$10,000 to rebuild our infrastructure?"

The company is still considering its options. 🛑



Facebook's Like button can still be easily gamed

BY JEREMY KIRK

FACEBOOK'S LIKE BUTTON is a pervasive feature of the Web, a way to gauge the popularity of a website or piece of content. But researchers have found it's easy to inflate the numbers, undermining its value as an accurate measure of popularity.

The problem of bogus Likes has been around for some time, and Facebook has released updates to its software over the last couple of years to cut down on fraudulent ones generated by spammers.

But researchers with McGill University's School of Computer Science in Montreal say the social networking company still hasn't fixed

several major problems with the feature. Recently, they released a research paper (go.pcworld.com/fblikespaper) outlining the problems, which they first told Facebook about in early 2013.

“Those Like numbers may be faked,” said Xue Liu, a professor of computer science at McGill, in a phone interview. “There are easy ways to generate those fake Likes, and unfortunately on the Internet, a lot of companies and economic benefits are related to the number of Likes now.”

Facebook officials couldn’t be immediately reached for comment. The research is important because companies may be making marketing spend decisions based on Likes. There are thriving marketplaces for people to buy fake Likes, which can cost around \$30 for 1,000.

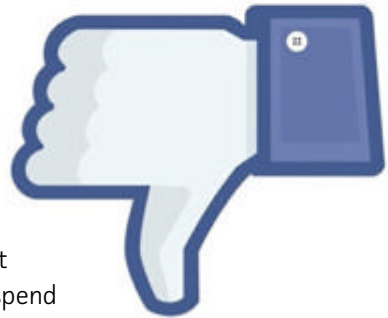
Also, average Facebook users may not be aware of exactly what kind of actions generate a Like. It’s generally assumed that a single user can only generate one Like, but that’s not actually the case. Sharing a link on Facebook from a source with an embedded Like button increases the count by one.

If the same user comments on the post, the Like button continues to rise. A demo video (go.pcworld.com/fbscript) shows how a spammer could write a script that posts a piece of content on Facebook and then adds nonsensical comments, each of which causes the Like count to tick up once.

In that example, 30 Likes were quickly generated. The researchers found it was possible to generate up to 20 likes per minute by creating a post, adding fake comments, deleting the post and repeating. Those actions didn’t trigger a rate-limiting feature in Facebook that might have frozen the account for a while.

The flaw has been around for years and is apparently rooted in outdated Facebook APIs that are still used by many websites,

It’s easy to generate fake Likes, and a lot of economic benefits are related to the number of Likes.



including CNN, ABC News, The Huffington Post and The Economist, according to their research paper.

What's useful about their method is that it can generate a high number of Likes using only a single account. It means that spammers wouldn't need to take the time and expense of creating a high number of zombie accounts that would likely be detected and removed by Facebook.

Another demonstration video (go.pcworld.com/fblikesdemo) shows how a Like—which is essentially a soft endorsement—can appear out of context and may actually be contrary to a user's real opinion.

The researchers created a fake Web page for demonstration purposes that promoted disgraced investor Bernard Madoff. The website had an embedded Like button. If the site's URL was shared on Facebook, anyone who commented on it would increase the page's Like count, even though it's doubtful anyone would truly endorse it.

But people who visited the Web page would have seen an ever-rising Like count, giving the impression that the site is worthy. Other large online services, such as YouTube and Quora have worked around this contextual problem by adding “dislike” or “downvote” buttons.

The researchers also found if a Facebook user deletes a post, the Like count doesn't correspondingly drop.

Facebook wraps a lot of data into the little number next to the Like button. The company is straightforward about it in its documentation, saying that a Like includes not only the people who hit the button, but also the number of times the URL has been shared and the number of comments. But some people may not know that.

The paper was also co-authored by Xinye Lin and Mingyuan Xia of McGill's School of Computer Science. 

MY MOM DIDN'T HAVE MANY OPTIONS. TODAY'S LUNG CANCER PATIENTS DO.

Twenty years ago, my mother was diagnosed with lung cancer. She had very few places to turn, and lost a difficult struggle.

Today, we are on the brink of real breakthroughs in lung cancer research and there are significantly improved treatment options.

Tony Goldwyn
Stand Up To Cancer
Ambassador

And yet, more than 30% of all lung cancer patients still don't know about the therapies, specialists, and clinical trials available to them.

Lung cancer is a formidable foe, but we are finding new ways to fight it. Please visit SU2C.org/LungCancer to learn what questions to ask your health care professional, and for information about options that may be right for you.



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TESTED IN PCWORLD LABS

In this section, hardware & software go through rigorous testing.

REVIEWS & RATINGS



Falcon Northwest Mach V rips the lid off gaming tests

Titan X has already been anointed the king of gaming GPUs. Packing three into the Mach V has made it one of the fastest rigs in the world.

BY GORDON MAH UNG



Watch the
video at
[go.pcworld.
com/titan](http://go.pcworld.com/titan)



A **AMERICANS LOVE** stats. Who has the greatest batting average of all time? (Ty Cobb.) Who was in the most James Bond movies and how many times? (Roger Moore, with six.) Can a gaming PC really cost \$9,683? (Bleep yes!)

Falcon Northwest (falcon-nw.com), the company credited with creating the “gaming PC” category, thinks it has justification for the audacious price of its Mach V Icon2, and many might agree: It has three, count-’em, three of the fastest gaming GPUs on the planet inside of it.

Yes, that’s three of Nvidia’s \$1,000 GeForce Titan X cards running in Tri-SLI mode. One card alone is capable of playing most of today’s most punishing games at 4K resolution, but only if you’re willing to run at high settings instead of Ultra, Ultimate, or Uber, and you have a G-sync monitor that smooths out those occasional slower frame rates.

Three Titan X cards: As fast as you’d expect

How fast are three Titan X cards? When I first received the rig I ran 3DMark’s FireStrike Ultimate, which lets you compare results run at 4K resolution against Futuremark’s massive database of results. The Mach V landed in the top 40.

You might scoff at a result “only” in the 40s, but Futuremark’s leader board includes machines overclocked using liquid nitrogen, liquid helium and all kinds of extreme-overclocking sports entries. To land in that esteemed company with a production machine is no small feat and easily puts the Mach V among the fastest gaming rigs in the world.



The Mach V isn’t just about the Titan X cards, though. Falcon matches those three GPUs with Intel’s 8-core Core i7-5960X, with a smooth little overclock to 4.3GHz. That’s not the most aggressive overclock around, but it’s respectable and stable. We had no issues with crashing during our time with the Mach V.

There’s also 32GB of G.Skill DDR4 buzzing along at 2,400MHz, a pair of Samsung 850 Pro drives in RAID 0, 1,500 watt Silverstone PSU, and even an optical drive for old-school use. That RAID configuration certainly surprised us, though. Sure, 2TB of fast SSD storage is good, but are we truly at the point where a hard drive isn’t needed anymore? People’s opinions will vary, but I’d still like to see a 6TB or even 10TB drive for backup use.

This is all installed on an Asus Rampage V Extreme with USB 3.1 support. Yeah, we were excited about seeing USB 3.1 on this motherboard, but we had nothing to test it with. There are simply no USB 3.1 devices available yet. But hey, we’re ready whenever they do actually appear, right?

The case itself is a custom-painted design built by Silverstone that flips the GPUs into a vertical position. This helps cooling by venting air out the top of the case rather than trying to exhaust it out the back. Falcon aids this effort by adding a massive fan below the cards to help blow air through the top. To keep the GPUs from super-heating the rest

Here’s a better
look at the baffle
to keep hot air
from the GPUs
away from the
CPU.



of the system, a baffle is also used to wall off the GPUs from the CPU.

This probably isn't a bad idea. While the GeForce GTX 980 was known for its gentle temperatures, the GeForce GTX Titan X isn't. I measured temperatures on the cards on some spots at 179 degrees. Yes, that's as hot as McDonald's coffee was before the lawsuit. Much of that heat is trapped between the cards. Others have recorded temps hitting 213 degrees (go.pcworld.com/213)!

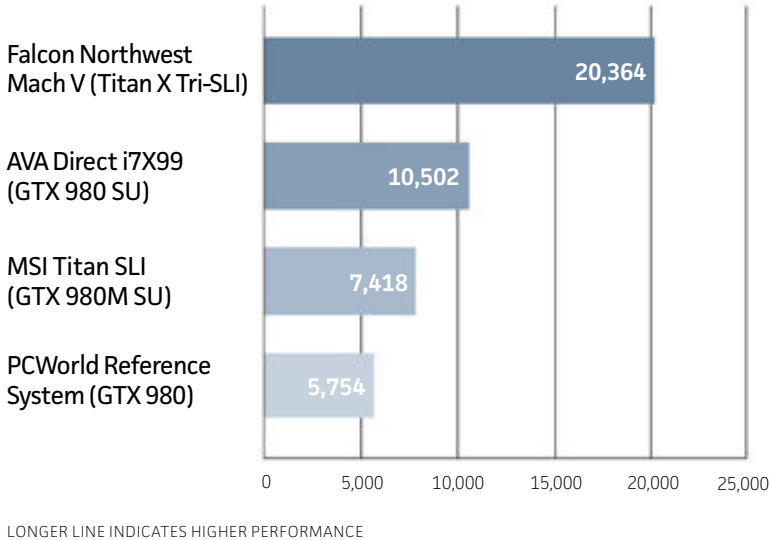
If these temps make you wonder about stability, Falcon says it stress-tests the machines it sells in a room heated up to 80 to 90 degrees overnight to vet bad components.

On the performance tip, the Mach V certainly lights up our charts. Let's just say the three Titan X cards don't disappoint. The next-fastest system is AVA Direct's i7 X99 (go.pcworld.com/ava) box we reviewed in December. Using the synthetic but still-respected 3DMark FireStrike Extreme, we see the Mach V outperforming the pair of GeForce GTX 980s in the AVA Direct by almost double. Our reference system, with its single GeForce GTX 980, is pretty lonely way back there too.

To see how the Mach V does in an actual game, we spooled up *Tomb*

The cards are
flipped vertical
to help exhaust
the hot air
from the GPUs.

3DMark FireStrike Extreme



Here's what three GeForce Titan X cards look like stacked up against GeForce GTX 980's in SLI and a single 980 card. The MSI is a laptop, and there just for reference.

Raider set to Ultimate and running at 2560x1600 resolution on a 30-inch panel. Even though we didn't expect such a difference at this "low" resolution, those three Titan X cards put serious distance between the AVA Direct's pair of GTX 980 cards and our single GeForce GTX 980. For kicks, we also included MSI's Titan SLI "laptop" to see how its pair of GeForce GTX 980M cards in SLI would do. It's not bad considering it's a gaming laptop, albeit one big-ass gaming laptop.

Gaming at 2560x1600 with three Titan X cards is downright criminal, though, and in some states, you can actually be charged with a Class B felony for using too much hardware for your gaming resolution. (Just kidding!) So I also ran the Mach V on a 4K display. You might think with this much firepower you can play with, say, three 4K panels in surround, but I think we're not quite there yet.

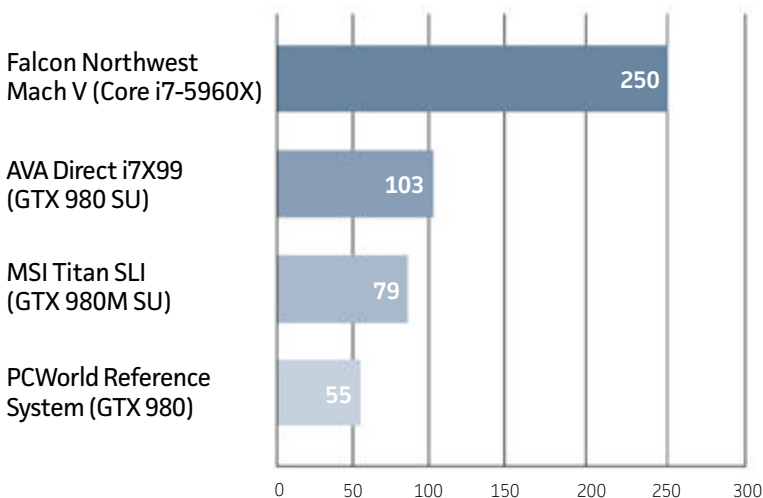
In 3DMark FireStrike Ultra, I saw the Mach V give up 11,238. At the

time of our original run, before Titan X cards were out, that was good enough to put it in the top 40. With Titan X cards in the hands of more folks, the Mach V has slipped all the way back to the low 40s—among all the PCs on the planet. For shame.

In actual gaming, *Tomb Raider* at 4K and set to Ultimate still puts out 135.4 fps. I also ran *Middle-earth: Shadow of Mordor* with the 4K texture pack installed and saw 81.6 fps. I didn't have access to the AVA Direct machine to run this benchmark, but I know from our review of the Titan X, a single card in this benchmark at 4K pushes 35.6 fps, and a pair of 980s plows along at 43.9 fps. That's a testament to just how demanding *Shadow of Mordor* is of GPUs.

Ryse: Son of Rome is another GPU-crushing game. It doesn't have a

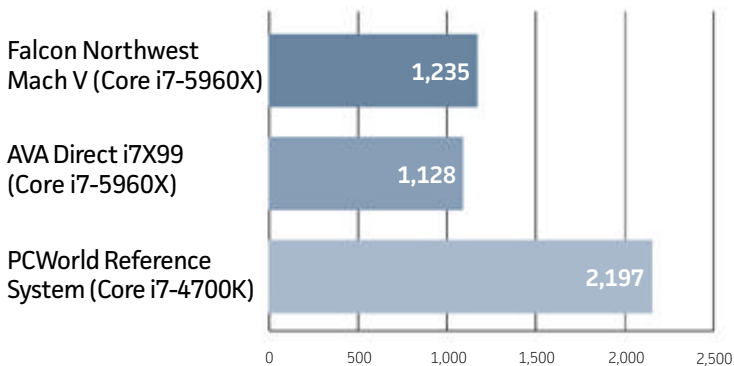
Tomb Raider Ultimate 25x16 (fps)



LONGER LINE INDICATES HIGHER PERFORMANCE

Tomb Raider isn't the most intensive game in town anymore but even at 2560x1600 resolution it'll give cards a good work out. The triple TX cards run away from the pack.

Handbrake Encode (sec)



SHORTER BARS INDICATE HIGHER PERFORMANCE

Eight Haswell cores vs. four Haswell cores unsurprisingly offers better performance.

built-in benchmark mode, so I played through the game a little to see how the frame rate would react playing at 4K and set to Ultra. For the most part the frame rate stayed in the mid- to high 80s, which is still well above the magic threshold of 60 fps to appear smooth without resorting to a G-sync or Freesync panel.

The Mach V is obviously aimed at gamers, but few gamers I know are exclusive to gaming. Most also edit photos and video and use their PC for general tasks. With its 8-core Haswell-E Core i7-5960X overclocked to 4.3GHz, the Mach V isn't going to seem slow, but it won't be the fastest thing on the planet by a long shot.

In fact, the AVA Direct i7 X99 rig that cost almost half as much as the Mach V actually managed to outpace it in our Handbrake Encoding test. This isn't the only test where the AVA Direct beat the Mach V, either: The AVA Direct also outran it in PC Mark 8's Work conventional test. In that test, of course, once you're above a certain performance floor, Word doesn't ever get "faster." The encoding test is a surprise, though, because the AVA Direct wasn't overclocked as heavily.

So where does this leave the Falcon? The most obvious two points:

Damn, it's fast for a gaming box. And, of course, damn it's expensive too. Boutique PC builders have always demanded a premium, though. For those who can even think to pay for a machine with this hardware, it's not too pricey.

It's like the old adage goes: If you need to ask how much, you can't afford it. That can be said of the Mach V too, except its \$9,683 actually isn't that crazy. With each Titan X costing a solid grand, you're already at a third of the price just in the graphics cards alone. And don't forget the beautiful paint job.

I do have a few criticisms. I miss the hard drive, although as a custom builder, Falcon will sell you all the hard drives you want. It likely doesn't include a high-capacity drive here because it didn't want to crack the psychological \$10,000 mark.

With each Titan X costing a solid grand, you're already at a third of the price in graphics cards alone.

More importantly, is it too much to ask for custom liquid cooling? Granted, it isn't available for the new Titan X cards yet and isn't as leak-resistant as closed-loop coolers, but it's starting to become the norm on high-end rigs.

The Falcon Northwest Mach V Icon2 is freaking expensive, but for that price you're relieved of the burden of turning down any in a game. Knowing that it's from the company that literally built the gaming PC category, you've got guts and gravitas to spare. 



The Galaxy S6 is one of the best camera phones ever

BY FLORENCE ION

WE HAVE A lot to say about the new Samsung Galaxy S6 (samsung.com/galaxys6). For one, I can't get over the fact that it kind of looks like an iPhone—my Macworld colleagues certainly agree—and two, it's obvious Samsung put a lot more effort into this phone than the past few generations of its flagship Galaxy family.

We talked about the Galaxy S6 and Galaxy S6 Edge quite a bit in our initial hands-on (go.pcworld.com/handson6) with the devices at Mobile World Congress. One of its standout new features is its new camera hardware. Rather than simply increase the megapixels and

tout a higher number, Samsung worked meticulously on this year's camera to ensure it outperformed its predecessors.

Thus far, we've only had about a day with the phone, so instead of rushing a half-baked review, we took the Galaxy S6 out for a spin on the streets of San Francisco to focus on testing out its new camera capabilities. Whatever Samsung did to its camera software really worked, because this is seriously one of the best camera phones I've ever used.



Our first lab test, under bright studio lights.

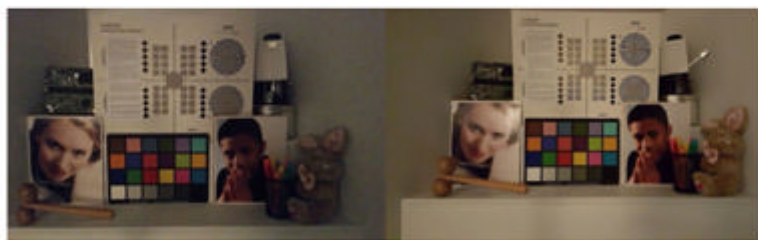
In the lab

I took the Galaxy S6 to the photo lab to begin testing its photo-taking capabilities. I was astonished at how much Samsung actually improved its camera. It's not just clever advertising.

The Galaxy S5's "ghosting" effect seems to have been effectively reduced in the Galaxy S6. This is not only a boon for those who do serious photo editing with their smartphone, but it's also a testament to the fact that Samsung did right by its users in equipping the Galaxy S6 with a camera that takes in more light, rather than simply upping the megapixels.

Low light performance has increased exponentially between the Galaxy S5 and Galaxy S6. The end result is no longer grainy and almost indecipherable, though I've honestly yet to take the Galaxy S6 into a bar setting to really test its low-light chops.

For a while there, I could barely believe the Galaxy S III, Galaxy S4, or



The Galaxy S5 (left) performed abysmally in our low-light test compared to the S6 (right).

Galaxy S5 had Macro abilities because of how frustrating they were to use. Taking Macro shots on the Galaxy S6 is much more stress-free. I still have to hold the lens at a bit of a distance to allow the camera to focus, but it's more akin to using a 50mm lens on an DSLR.

Indoors, the Galaxy S6 camera was inconsistent, though that's to be expected considering the lighting in our building is a bit inconsistent, too. There are some rooms that are brightly lit by windows, while others have fluorescent lights, and still others utilize spot lights. That said, the Galaxy S6 was better at adjusting to the different lighting situations through the building than other smartphones, and it was consistently quick when choosing the mode in which to shoot. The live HDR preview certainly helped in some cases, too.

Outdoors, the Galaxy S6 produced a myriad of stunning shots. In fact, it inspired so much confidence in me, that I posted photos directly to Instagram with the hashtag #nofilter. I hardly ever do that because I'm usually too embarrassed by the quality of the photos I take with whatever Android hardware I have in hand. (This exact reason is also why I switched to the iPhone for six short months in 2012. Seriously.)

The Bay Bridge,
shot with the Galaxy S6.



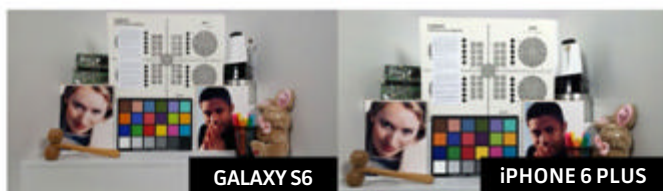
In our initial look at the Galaxy S6, Samsung said that it did a lot of tweaking to the camera sensor's focus abilities. It definitely shows: I tapped the screen to focus in on the stop sign you see on the right, and afterwards the app instantly brightened just that area of the stop sign. It was previously too dark to see it in the shade.

Galaxy S6 versus the iPhone 6 Plus

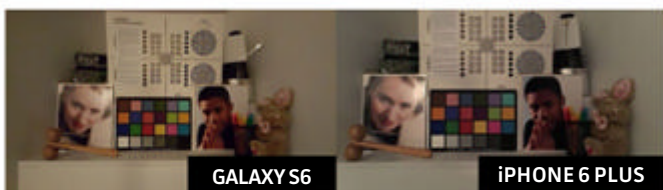
This is always a fun way to do things: Like the Giants and Dodgers, Samsung's feud with Apple's iPhone goes back what seems like eons. With all the talk about how much Samsung's improved the camera sensor on the Galaxy S6, I figured I'd put the two to a head-to-head to really see the differences.



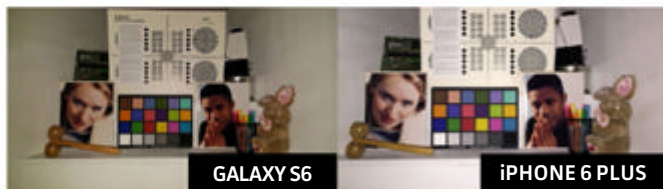
Samsung did a lot of tweaking to the camera sensor's focus abilities .



The bright light test, with the studio lights turned all the way up.



The low light test, with just a dim floor lamp in the back of the room.



The low light test with the flash on. Notice how the Galaxy S6's photo is a bit warmer, while the iPhone's is a bit whiter, but a little blown out.

The Galaxy S6 has one of the best front-facing cameras on the market right now. It's 5-megapixels, with a very wide F1.9 aperture—the same as the Galaxy S6's rear-facing 16-megapixel camera sensor—and offers auto real-time HDR capabilities.

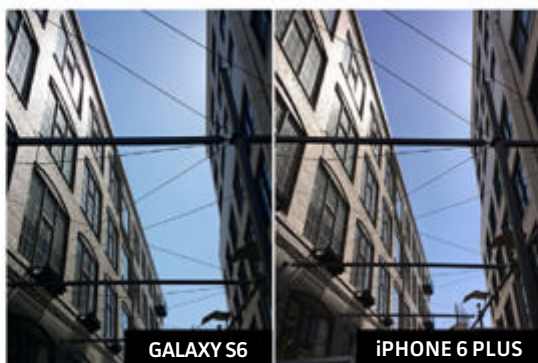
I'm going to be honest here: I liked the photos taken with the iPhone 6 Plus just a bit more. You can't see why with the lab tests, however, so let me show you what kind of photos both the iPhone 6 Plus and Galaxy S6 took out in the real world.

Overall, the iPhone 6 Plus and Galaxy S6 are nearly on par as far as photo performance goes, with the Galaxy S6 skewing toward a deeper contrast in some cases. It still has that annoying issue with light leak, however, which is something that's plagued Samsung's smartphones in the past.

All this anecdotal evidence is good news for Android fans, though: if you want an iPhone-like camera experience, you can get it with the Galaxy S6. (That's good news for anyone trying to leave Apple's eco-system, too!)



There is more light leak from the Galaxy S6 than there is from the iPhone 6 Plus.



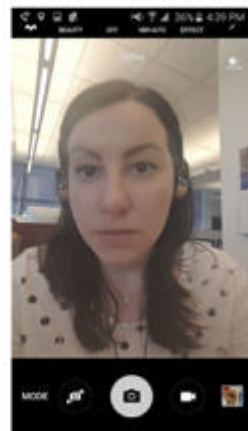
I actually like both of these equally, though I'd go with the higher contrast Galaxy S6 version for Instagram

Software

Samsung hasn't always had the most user friendly camera apps, though it seriously toned things down from all the buttons and switches it tacked on to the viewfinder in the Galaxy S5 camera app.

The Galaxy S6's Camera app, on the other hand, is just right, though it borrows some of its tricks from HTC's interface. When you tap to switch Modes, the camera interface shows eight different options. They're all self explanatory, but this particular motif also greatly resembles what HTC introduced last year in Sense 6's camera interface.

Despite the copycat button layout, the Galaxy S6's Camera app is bundled with a myriad of neat features. There's a Pro mode that lets you adjust every facet of the photo all right there on the screen. There's also a Slow motion and Fast motion mode for filming neat Instagram productions, as well as a Quick launch option you can engage by simply double pressing the Home button to launch the camera app—even if the screen is off or you're in another app. This is absolutely perfect for selfies.



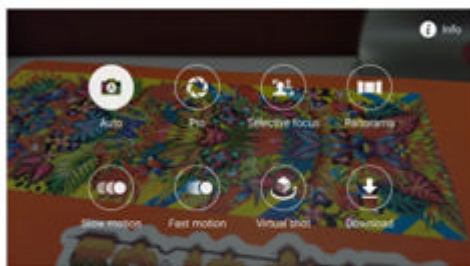
The Galaxy S6's
camera interface.

Final thoughts

There are still a few things I need to test out.

First, I still need to play around with the phone's video capabilities. It's certainly quick and its stabilization abilities are impressive, but I want to spend a little more time with the slow- and fast-motion effects. I also want to test out the Galaxy S6's manual controls. I'm curious to see how accurate they are, and whether I can get the same kind of performance out of it that I get from my Canon DSLR.

I'll have more on the Galaxy S6's camera capabilities in the future, after I've had some time to really use Samsung's new flagship out in the wild. However, I can honestly say with conviction, that this is one of the best camera phones I've ever used. 📱



The button layout.



DirectX 12's potential performance leap is insane

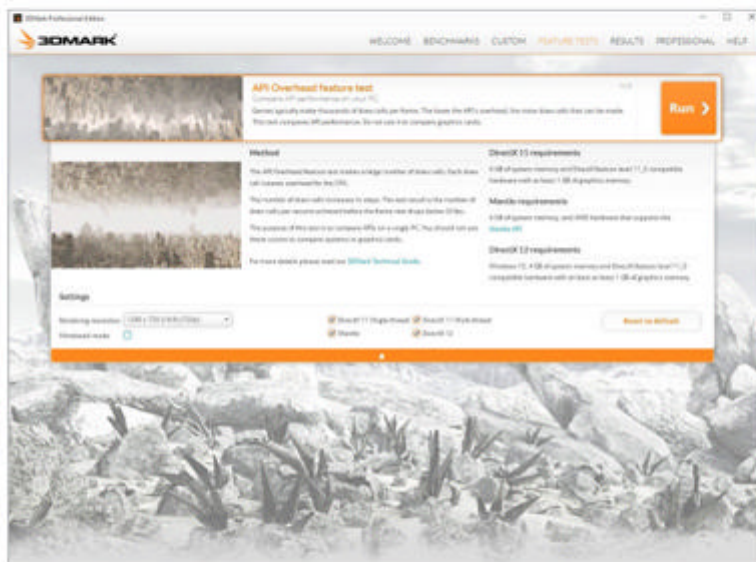
BY GORDON MAH UNG

WE ALREADY KNOW DirectX 12 will drastically improve game performance when Windows 10 ships later this year, but just how much of a “free” boost you’ll get isn’t exactly known.

Microsoft execs expect frame rates to more than double (go.pcworld.com/double) when comparing DX12 to the current DX11 API. But that estimate looks to be conservative if Futuremark’s new API Overhead Feature test is to be believed.

Microsoft and Futuremark gave us early access to the latest 3DMark test, which lets us measure just how much more efficient

Microsoft's Windows 10-only gaming API is than its predecessor, and whoa mama, does it perform. But before we get too carried away and the hype train leaves the station with a big toot toot, remember that this is a *theoretical* test, and not based on an actual game engine.



3DMark's new API Overheat Feature Test measures the performance difference between DirectX 11 and the new Windows 10-only DirectX 12.

How we tested

For the tests, I used an Intel Core i7-4770K processor in an Asus Z87 Deluxe/Dual motherboard alongside 16GB of DDR3/1600 RAM, a 240GB Corsair Neutron SSD, and either a Gigabyte WindForce Radeon R9 290X or a GeForce GTX Titan X. I also switched off the Asus board's "Core enhancement" feature, which essentially overclocks the chip a little for you. All of our tests were performed at 1280x720 resolution at Microsoft's recommendation.

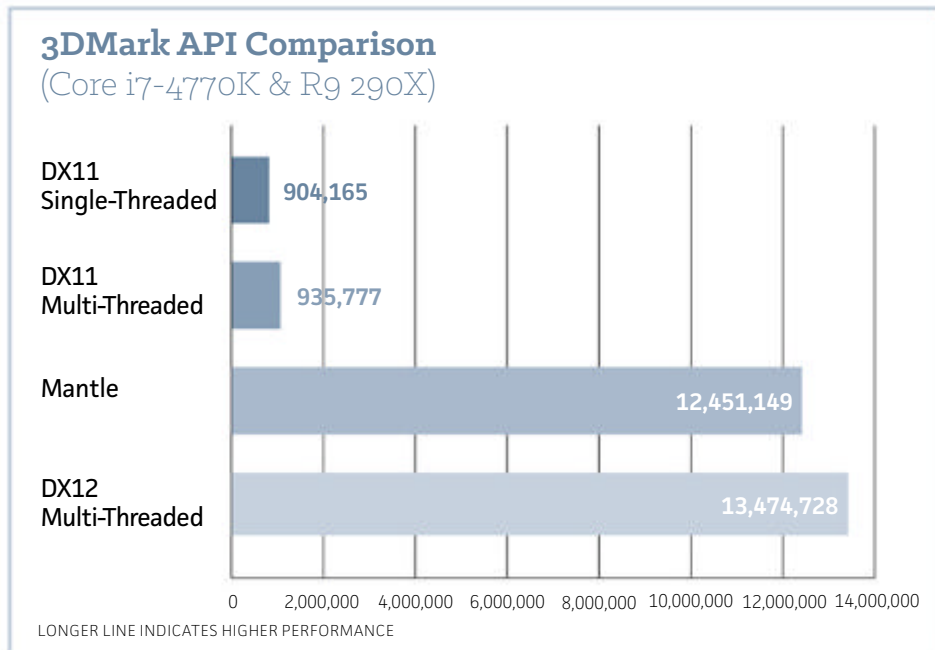
3DMark and Microsoft point out that the new feature test is not a tool to compare GPUs but an easy way to gauge a single PC's performance and API efficiency. Don't use it to compare PC Y with PC X, nor as a GPU test: This is all about how your particular PC

configuration performs when running DX11, and how that same PC configuration performs when running DX12.

Even better, the test is available immediately to anyone who owns 3DMark. See “How to test your PC’s DirectX 12 performance today” on page 77 to learn how.

The test works by tasking the GPU to draw something on the screen. This instruction goes through the API, whether it is DX11, DX12, or AMD’s Mantle. The less efficient the API is in handling these “draw calls” from the CPU to the GPU, the fewer objects can be drawn on the screen. 3DMark rapidly ramps up the draw calls and objects until the frame rate drops under 30 frames per second (fps).

The first test is a comparison of DirectX 11’s single-threaded performance vs. DirectX 11’s multi-threaded performance. It then tests AMD’s DirectX 12-like Mantle API—if Mantle is supported by the hardware—and finally DirectX 12 performance.

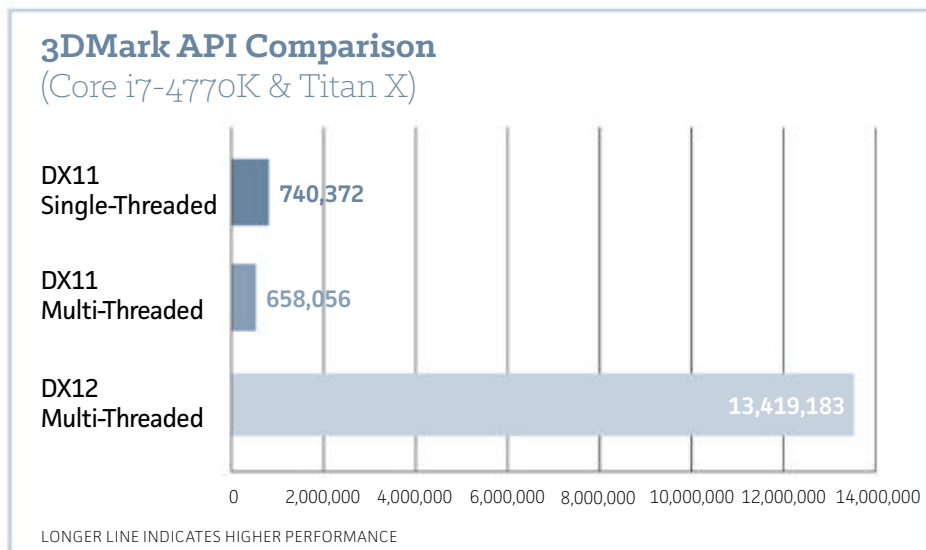


As you can see from the 3D Mark API Comparison chart below, DirectX 11's single-threaded and multi-threaded performance is underwhelming, churning through roughly 900,000 draw calls before performance drops under 30 fps on the Gigabyte WindForce Radeon R9 290X card. Using AMD's Mantle, we see an incredible jump to 12.4 million draw calls per second.

Although it's difficult to actually say which actual API was developed first (I've read stories that said DirectX 12 has been in the works for numerous years, while others report AMD was likely the first to push it), this test at least shows the potential of both of the new APIs. DirectX 12, in fact, is even slightly more efficient, cranking out 13.4 million draw calls per second.

The whole Mantle vs. DirectX debate is over anyway, as AMD itself has encouraged developers to use DirectX 12 or Vulkan, OpenGL's gaming-focused successor, instead.

Remember that part where I said that Futuremark says not to use this as a GPU test? You still want to see this on Nvidia hardware, so I repeated



If gaming only worked like theory. Here we see the GeForce GTX Titan X in action in DirectX 12.

the test with the GeForce GTX Titan X in the R9 290X's place. There's no Mantle, of course, since that's an AMD-only feature.

You're also going to be curious about DX12's impact on integrated graphics processors (IGP). With Intel's graphics actually in use by more "gamers" than AMD and Nvidia's discrete cards, it's a valid question, but I'll be honest: Gaming with IGP ain't real gaming. I didn't see the point in running tests on Intel's IGP.

Fortunately, Microsoft provided results from its own IGP machine using a Core i7-4770R "Crystal Well" CPU with Intel Iris Pro 5200 graphics. The quad-core chip is used in high-end all-in-ones and Gigabyte's Brix Pro. That's pretty much the very best performance you can get out of an Intel chip today, and here are the results.

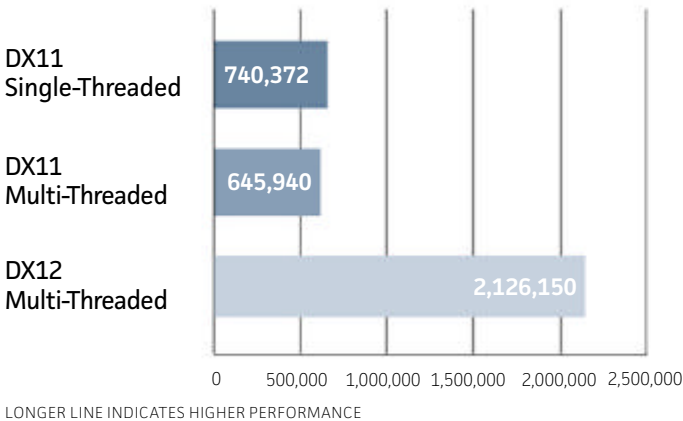
Not bad—until you glance back at the previous AMD and Nvidia charts.

But remember that DirectX 12 is about making the API more efficient so it can take better advantage of multi-core CPUs. It's not really about graphics cards. It's about exploiting more performance from CPUs so they don't bottleneck the GPU.

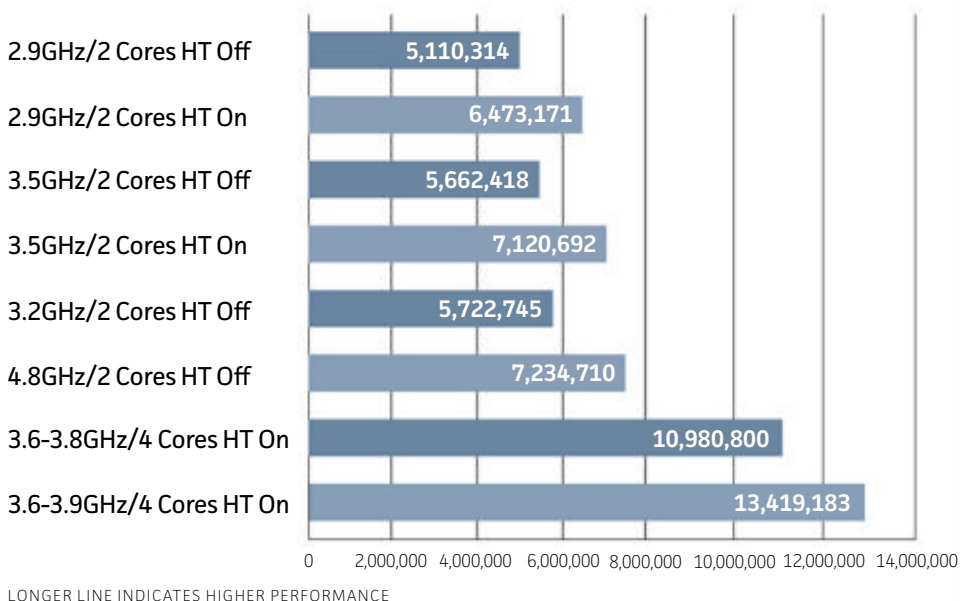
With that in mind, I decided to see how the CPU can change the

Using results
supplied by
Microsoft, DX12
gives a bump to
the Intel's
integrated
graphics but it's
far short of real
gaming metal.

3DMark API Comparison (Core i7-4770K & Iris Pro)



DX12 Multi-Threading Performance 3DMark



Here's how DirectX 12 performance could scale across different clock speeds and thread counts on Futuremark's new API Overhead Feature test.

results, by varying the core and thread count as well as clock speeds in various configurations. I limited the quad-core Core i7-4770K to two cores, switched Hyper-Threading on and off, and limited the clock speeds the CPU could run at.

The big winner was the Core i7-4770K set to its default state: four cores and Hyper-Threading on. All of the tests were conducted with the GeForce GTX Titan X card. I'm only comparing the DirectX 12 performance because that's all that matters here.

Which CPU is best for DirectX 12?

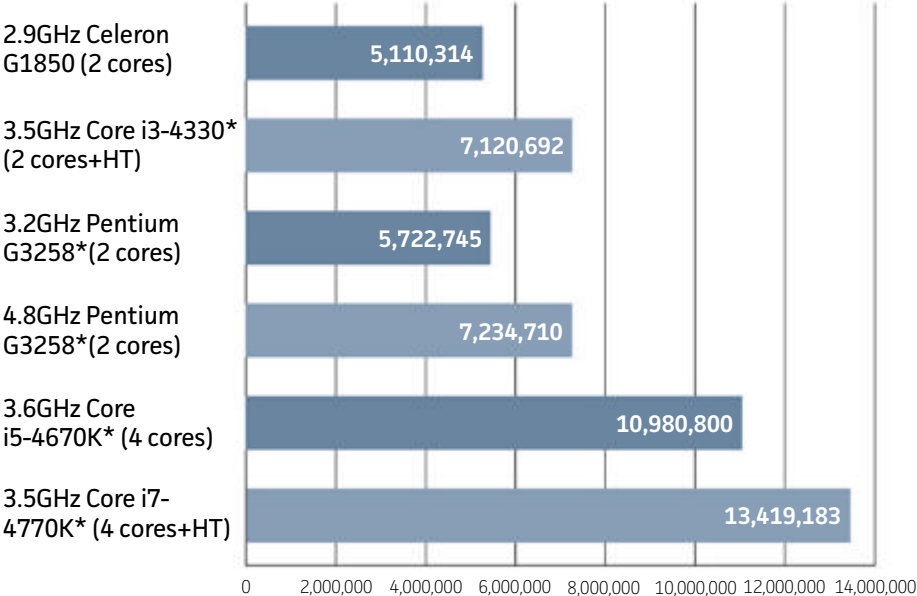
To make this a little easier to understand from a system-buying or

-building perspective, I also tried mimicking the different clock, core count and Hyper-Threading states of various Intel CPUs. (If you want to dig into the details of the chips I tried to simulate, I've lined up the details over at Intel's ARK: go.pcworld.com/thedetails.)

Keep in mind that these are simulated performance results. The Core i7-4770K has 8MB of cache vs. the 2MB on a Celeron or 6MB on a Core i5 chip. I haven't found cache to make huge dents on most tests, and if anything my simulated CPUs would perform better than their actual counterparts thanks to the larger cache available. One other note: I had an issue underclocking the CPU to lower speeds while trying to simulate the Core i5-4670K. The lowest I could set it for was 3.6GHz, which is 200MHz higher than the stock part.

"How many combat drops Lieutenant?"
"Two. Including this one." These are tests of DirectX 12 performance between various simulated CPUs.

DX12 Simulated CPU Performance



LONGER LINE INDICATES HIGHER PERFORMANCE * SIMULATED CPUS

No replacement for displacement

The takeaway from these simulated CPU tests is that thread-count trumps clock speed when it comes to DirectX 12 performance improvements.

Look at the results for the simulated dual-core Core i3-4330, which is a 3.5GHz CPU with no Turbo-Boost and Hyper-Threading. Compare that to Intel's low-cost wonder: the dual-core Pentium G3258 "overclocked" to 4.8GHz. Nicknamed the Pentium K by budget gamers, the chip is the only unlocked dual-core chip in Intel's lineup and cheaper than dirt. It overclocks easily, and just about anyone should be able to push a real one to 4.8GHz.

But look at the benchmark results: Despite running 1.3GHz higher than the simulated Core i3, the Pentium G3258 isn't much better in DX12 draw calls. This isn't anything new. In tests I've performed with CPUs as far back as the 2nd-gen "Sandy Bridge" Core processors in 2011, I've seen a 1GHz overclock on a Core i5 chip hit roughly the same performance as a stock Core i7 with Hyper-Threading in heavy multi-threading tests.

DX12 also seems to scale nicely with core-count. Again, compare the dual-core, 4-thread "Core i3-4330" with the quad-core, 8-thread Core i7-4770K. It's almost exactly double.

Unfortunately, PCWorld's 8-core Core i7-5960X was working on another secret product so I didn't have time to test it with 3DMark's new feature test. I see nothing to make me believe that the test, at least, will scale nicely with an 8-core, Hyper-Threaded CPU.

The silicon elephant in the room is also AMD's FX series. Generally AMD CPUs are inferior to their Intel counterparts clock-for-clock. A quad-core Haswell CPU generally lumps up an "eight" core FX chip in the vast majority of performance tests. But that FX chip, though it uses shared cores, runs much closer to—and sometimes faster than—Haswell if the test is heavily multi-threaded. DirectX 12 may make

The takeaway from these simulated CPU tests is that thread-count trumps clock speed when it comes to DirectX 12 performance improvements.

AMD's often ignored FX parts hot again, since you can find an 8-core FX processor priced for as low as \$153.

At some point, I'll hopefully spool up an FX box to see if that advantage indeed crops up in DX12.

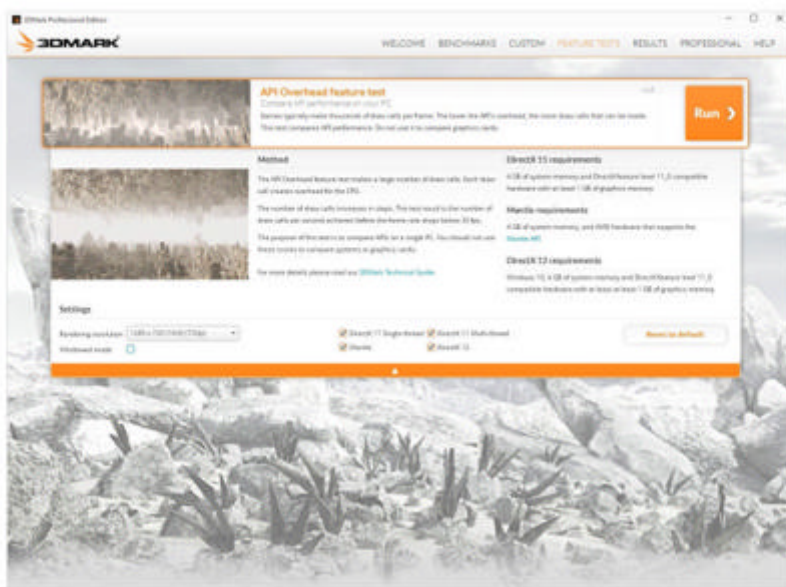
But back in reality

Before you look at the results from these tests and assume you're going to see a frickin' 10x free performance boost from DX12 games later this year, zing, zam, zow! You won't. So ease off the hype engine.

What's realistic? I'd expect anywhere from Microsoft's claims of 50-percent improvement all the way to the what we're seeing here in Futuremark's test. This will depend very much on the kind of game and the coding behind it.

The reality is this test is a theoretical test, although one made with advice from Microsoft and the GPU vendors. This test reveals the potential, but translating that potential into an actual game isn't quite as easy.

We won't know for sure until actual DirectX-12-enabled games ship. Microsoft estimates that will be the end of this year. 🚫



How to test your PC's DirectX 12 performance

BY GORDON MAH UNG

THE FINAL RELEASE of DirectX 12 and Windows 10 is months away but if you're itching to test your system's DX12 theoretical performance today, here's how you can do it.

First, you'll need to have the 64-bit version of the Windows 10 Technical Preview installed. The 32-bit version is not supported. Earlier preview builds had DirectX 12 components aboard (go.pcworld.com/x12) but it will take the latest one build 10041 (go.pcworld.com/10041) to enable the DX12 functionality. If you haven't installed Windows 10 yet, here's everything you need to get it up and running (go.pcworld.com/howto).

Once you've installed it, check the version number by looking in the lower right hand corner of the screen. It should say "Windows 10 Technical Preview Evaluation Copy, Build 10041." If you're running a previous build, you'll need to update the system.

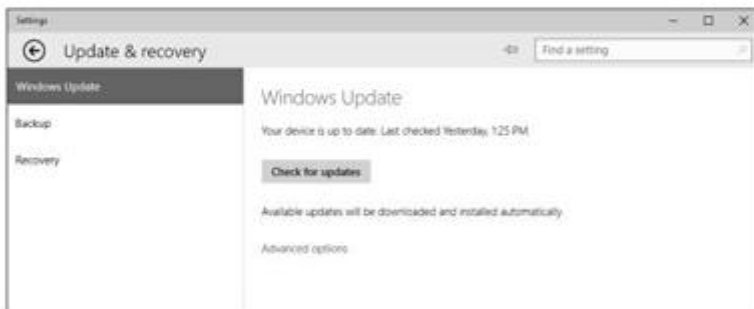
Updating Windows 10 to the most current preview build

Just click in the search box in the taskbar and search for "Windows Update," then click on it when it appears. In the Update & Recovery window, click on the *Advanced options*. Now scroll down and change "Choose how preview builds are installed" from its default of "Slow" to "Fast." Go back to Update & Recovery and select *Check for Updates*. Your system should download the latest Build and install it. This may take some time depending on your Internet connection and a reboot may be required.

If you have a DirectX 12 capable video card or integrated graphics, Windows Update should also install the latest DX12 capable driver. DX12 card driver support on Windows Update currently supports Nvidia's Maxwell and Kepler



You may need to set Windows Update frequency to Fast to get the latest Win10 Build if your box doesn't already have it.



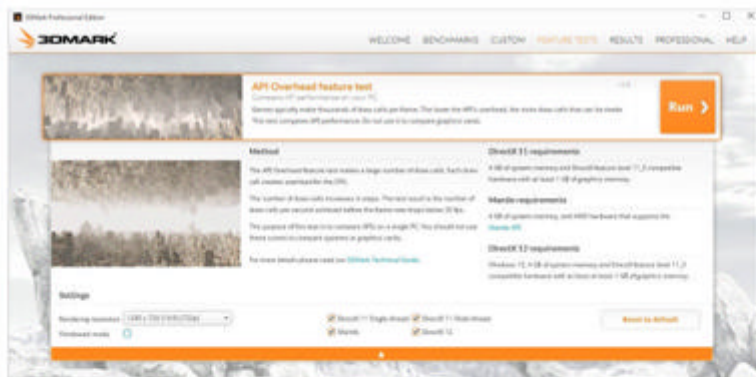
Just push Check for Updates after changing the frequency to Fast and you get the latest update as well as the correct DX12 drivers for your GPU.

cards (GeForce 600-series and up), AMD's GCN-based cards (Radeon 7000-series and R-series) and Intel Haswell parts.

Running the 3DMark API overhead test

The next step is to make sure you own and have 3DMark (3dmark.com) installed. Yup, there's no free lunch here. The test won't work on the free basic version of 3DMark. It only works on the Advanced (\$24.95) and Professional (don't ask) editions.

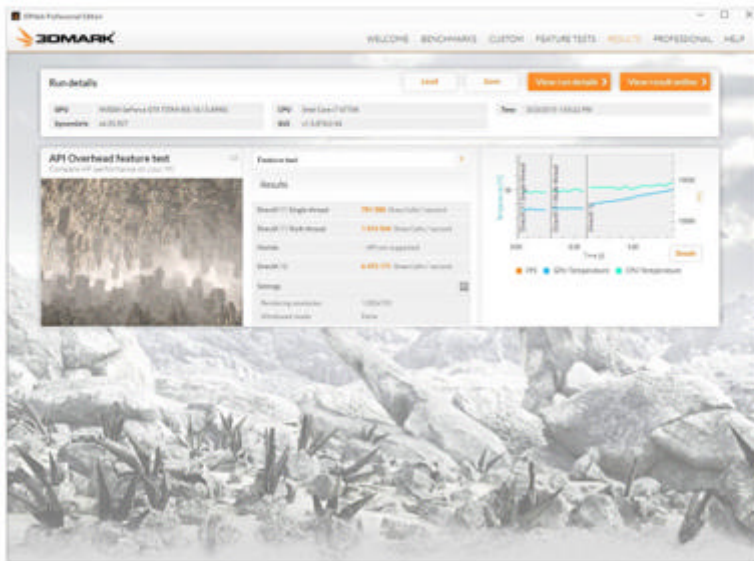
If you're already running one of those, 3DMark should chirp that an update is available when you start it. Download it and install it. If you purchased 3DMark on Steam, an auto-update should also be available for download. You'll also need Internet access to run 3DMark initially, as it validates your code.



3DMark's new API Overheat Feature Test measures the performance difference between DirectX11 and the new Windows 10-only DirectX 12.

Now you're finally ready to run it. Fire up 3DMark and click *Feature Tests*. Select the options you want it to test. By default, it will test DirectX11, DirectX12, and AMD's Mantle, if you're running supported Radeon hardware.

The test will take a minute or two to complete and present you with the draw calls the machine is capable of in the various APIs. These are draw calls per second. You can change the resolution the test is run at, but both Microsoft and Futuremark say the default resolution is all



3DMark's new feature test shows you Draw Calls per second that a system can handle.

you need for the vast majority of systems.

If you're looking for more details on what exactly 3DMark is doing here, point your browser at page 83 of this Futuremark PDF (go.pcworld.com/futuremark). Was it worth the effort? Maybe, maybe not. But for most of us, it's the first DirectX 12 content we'll be running on our PCs.

The test itself is not meant to be compared to other systems and is mostly a theoretical test of DX12's potential—but you're going to look anyway so review the results from the performance tests I ran using a number of different CPU and GPU configurations on page 68. 📄



Nvidia GeForce GTX Titan X Hail to the new GPU king

BY BRAD CHACOS.

NVIDIA SURE KNOWS how to strike a killer first impression. The company revealed its new GeForce GTX Titan X (go.pcworld.com/titanx) not with a massive event, not with a coordinated marketing blitz, but by CEO Jen-Hsun Huang striding unannounced into Epic's Game Developers Conference panel, introducing "the most advanced GPU the world has ever seen," autographing one for Epic's Tim Sweeney, then casually striding back out.

Like a boss (go.pcworld.com/boss).

Nvidia's walking the walk to back up the talk, though. The \$1,000

Titan X truly is the bestest, baddest, most firebreathing single-GPU graphics card in all the land—and it's the first one able to play many games on high detail settings at 4K resolution all by it's lonesome, with no multi-card setup necessary. It is a beast.

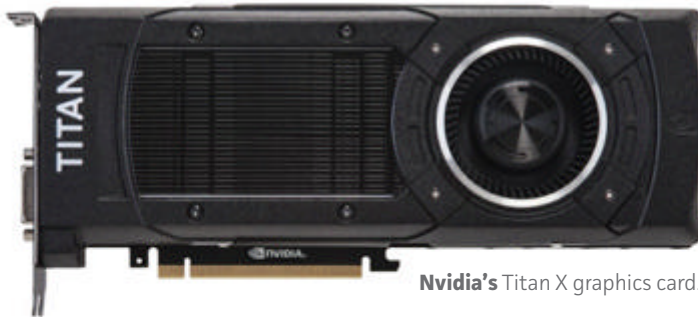
This is going to be fun.

The Titan X truly is the bestest, baddest, most firebreathing single GPU graphics card in all the land.

Meet the Titan X

Let's talk about technical design before jumping into raw performance specs. Huang stayed vague on tech specs when he revealed the Titan X at GDC, only teasing that the graphics card contains 8 billion transistors and 12GB of memory. That extreme amount of memory led some to believe the Titan X would be a dual-GPU card, like AMD's Radeon R9 295x2 or Nvidia's own Titan Z.

Nope.



Nvidia's Titan X graphics card.

The Titan X's beating heart is the all-new 28nm GM200 graphics processor unit (GPU), which is basically the bigger brother of the GM204 chip found in the GTX 980 and 970. Since it's based on "Big Maxwell" rather than the GTX 960's newer GM206 chip, the Titan X lacks the GTX 960's H.265 decoding abilities, and likely its HDCP 2.2 compliance as well. (We've asked Nvidia but haven't received an answer yet.) GM200 can handle H.265 encoding, however.

Built using the same energy-efficient Maxwell architecture as its GTX

900-series brethren, the Titan X packs a whopping 3072 CUDA cores—compared to the GTX 980's 2048—along with 192 texture units. The card comes clocked at 1000MHz, with a boost clock of 1075MHz. You can see the full list of specifications in the chart at right. For most of the core GPU specs, it's basically a GTX 980 plus 50 percent more.

That 12GB of onboard RAM is clocked at a speedy 7Gbps—just like the GTX 900-series graphics cards—and it utilizes a 384-bit bus. AMD's high-end Radeon GPUs use a wider 512-bit bus, but slower 5Gbps memory, for comparison.

Physically, the black, aluminum-clad Titan X rocks three DisplayPort connections, a solitary HDMI 2.0 port, and dual-link DVI. The card draws 275 watts of power through an 8-pin and 6-pin power connection. It measures 10.5-inches long in a traditional dual-slot form factor. Unlike Nvidia's GTX 980 reference card, the Titan X has no backplate, ostensibly to better facilitate cooler airflow in multi-card setups.

Speaking of, here's how Nvidia describes the Titan X's cooler design: "A copper vapor chamber is used to cool TITAN X's GM200 GPU. This vapor chamber is combined with a large, dual-slot aluminum heatsink to dissipate heat off the chip. A blower-style fan then exhausts this hot air through the back of the graphics card and outside the PC's chassis."

The card runs extremely quietly even under load, to the point that I'm not sure if I was hearing the case fans or the GPU cooler during intense

GTX Titan X's specifications

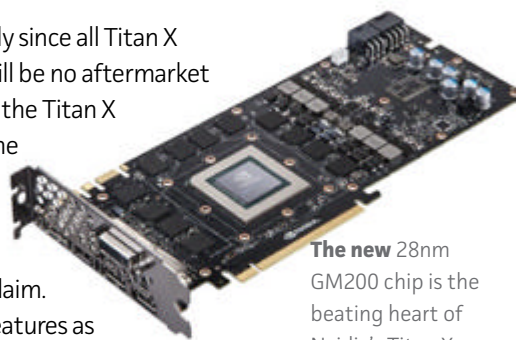
Graphics Processing Clusters	6
Streaming Multiprocessors	24
CUDA Cores (single precision)	3072
Texture Units	192
ROP Units	96
Base Clock	1000 Mhz
Boost Clock	1075 Mhz
Memory Clock	3505 Mhz
Memory Data Rate	7 Gbps
L2 Cache Size	3072K
Total Video Memory	12288MB GDDR5
Memory Interface	384-bit
Total Memory Bandwidth	336.5 GB/s
Texture Rate (Bilinear)	192 GigaTexels/sec
Fabrication Process	28nm
Transistor Count	8 Billion
Connectors	3 x DisplayPort 1 x HDMI 1 x Dual-Link DVI
Form Factor	Dual Slot
Power Connectors	One 8-pin and one 6-pin
Recommended Power Supply	600 Watts
Thermal Design Power (TDP)	250 Watts
Thermal Threshold	91°

benchmarking sessions. That's essential, especially since all Titan X designs will rock reference coolers only—there will be no aftermarket cooler options from board vendors. Nvidia claims the Titan X overclocks like a champ, hitting up to 1.4GHz in the company's internal testing. I was unable to OC the Titan X due to time constraints, but given the superb overclocking capabilities of every other Maxwell-based GPU, I heartily believe the claim.

The Titan X features the same basic software features as the GTX 980 and 970, including Voxel Global Illumination (VXGI), which lets developers create better dynamic lighting without invoking a massive performance hit, and VR Direct for virtual reality gaming. (The Titan X was actually used to power many of the VR demos on display at GDC 2015—hence the surprise launch during Epic's panel.)

It also fully supports Nvidia's impressive Multi-Frame-Sampled Anti-aliasing (MFAA) technology, which smooths out jagged edges at a level similar to traditional MSAA, but with much less of performance hit. This awesome technology works with any DirectX 10 or DX11 title that supports MSAA and basically provides a free—and often substantial—frame rate increase. That's a huge deal at any resolution, but it can mean the difference between a playable game and stuttering garbage at 4K resolution.

If you use Nvidia's GeForce experience to automatically optimize your games, it'll enable MFAA in place of MSAA by default.



The new 28nm GM200 chip is the beating heart of Nvidia's Titan X graphics card.



Removing the Titan X's shroud reveals its heat sink and cooler.

Benchmarking the Titan X's performance

So why does the Titan X rock such a ridiculous amount of RAM? The massive 12GB frame buffer is frankly overkill for today's games, but it helps future-proof one of the Titan X's biggest strengths: ultra-high-resolution gaming. Higher resolutions consume more memory, especially as you ramp up anti-aliasing to smooth out jagged edges even more.

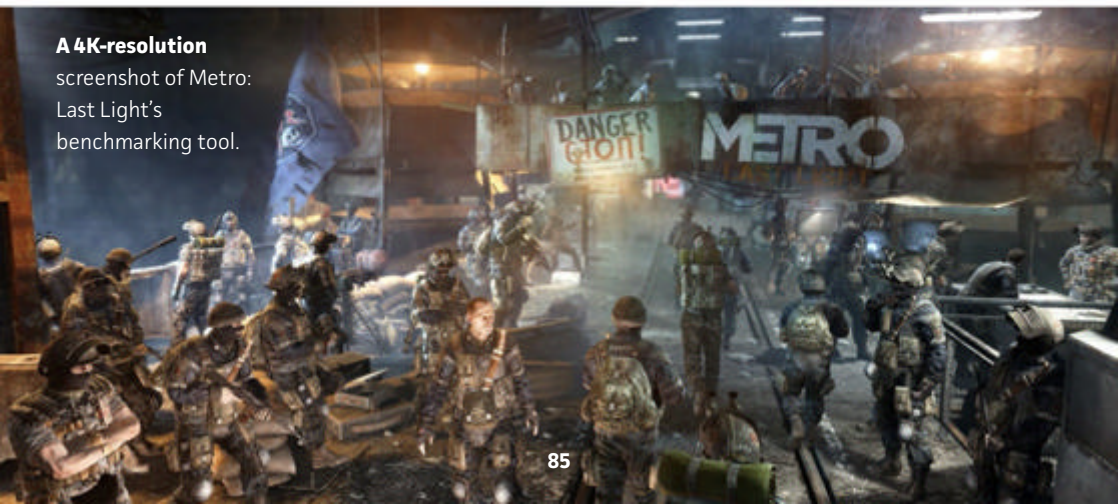
The Titan X is the first video card that can play games at 4K resolution and high graphics settings without frame rates dropping down to slideshow-esque rates.

Not at ultra-high-level details, mind you—just high. And still not at 60 frames per second (fps) in many cases. But you'll be able to play most games with acceptable smoothness, especially if you enable MFAA and have a G-Sync-compatible monitor.

Nvidia sent a G-Sync panel—Acer's superb, 3840x2160-resolution XB280HK gaming monitor (go.pcworld.com/xb2)—along with the Titan X for us to test, and it's easy to see why. When enabled in a compatible monitor, Nvidia's G-Sync technology forces the graphics card and the display to synchronize their refresh rates, which makes stuttering and screen tearing practically disappear. (Monitor makers are expected release displays with AMD's competing FreeSync soon.)

Merely reading the words on a screen doesn't do the technology justice. It rocks. G-Sync makes games buttery smooth. When it's paired

A 4K-resolution
screenshot of Metro:
Last Light's
benchmarking tool.



with the Titan X at 4K resolution, you won't even care that the games aren't technically hitting 60fps.

That said, I disabled G-Sync and MFAA during our benchmark tests to level the playing field for Radeon cards. For comparison benchmarks, we included AMD and Nvidia's top-end mainstream consumer cards—the R9 290X and GTX 980, respectively—as well as two 980s running in SLI and AMD's Radeon R9 295x2, a single-card solution that packs a pair of the

Graphics Cards Compared

	GeForce GTX Titan X	GeForce GTX Titan Z	Gforce GTX Titan Black	GeForce GTX Titan	GeForce GTX 980	Radeon R9 290X
Architecture Codename	Maxwell	Kepler	Kepler	Kepler	Maxwell	GCN 1.1
GPU Name	GM200	GK110B	GK110B	GK110	GM204	Hawaii XT
Transistor Count	8 billion	14 billion	7.1 billion	7.1 billion	5.2 billion	6.2 billion
Process	28nm	28nm	28nm	28nm	28nm	28nm
Cores	3,072	5,760	2,880	2,688	2,048	2,816
Base Clock	1,000 MHz	705 MHz	889 MHz	837 MHz	1,126 MHz	727 MHz
Boost Clock	1,075 MHz	876 MHz	980MHz	876 MHz	1,216 MHz	1,000 MHz
Memory Amount At Launch	12GB	12GB	6GB	6GB	4GB	4GB
Memory Clock	1,750 MHz	1,750 MHz	1,750 MHz	1,500 MHz	1,753 MHz	1,250 MHz
Memory Type	GDDR5	GDDR5	GDDR5	GDDR5	GDDR5	GDDR5
Memory Interface Width	384 bit	768 bit	384 bit	384 bit	384 bit	512 bit
Memory Bandwidth	336.5 GB/s	336 GB/s	336 GB/s	288 GB/s	224 GB/s	320 GB/s
TDP	250 Watts	375 Watts	250 Watts	250 Watts	165 Watts	290 Watts
Power connectors	6+8	8+8	6+8	6+8	6+6	6+8
Single Precision Floating Point Performance	7 TFLOPS	8 TFLOPS	5.1 TFLOPS	4.5 TFLOPS	4.6 TFLOPS	5.6 TFLOPS
Double Precision Floating Point Performance	200 GFLOPS	2,700 GFLOPS	1,707 GFLOPS	1,500 GFLOPS	144 GFLOPS	700 GFLOPS
Launce Date	Mar. 2015	May 2014	Feb. 2014	Feb. 2013	Sept. 2014	Oct. 2013
Launch Price	TBA	\$3,000	\$1,000	\$1,000	\$549	\$549

same GPUs found in the 290X. And, of course, the original Titan.

Since most people don't commit GPU specs to memory the same way they do obscure baseball statistics from 64 years ago, see the quick refresher chart on the previous page to help. The Radeon R9 295x2 isn't on the chart but it's essentially two 290X GPUs crammed into one card.

An interesting side-note: The R9 290X refused to play nice on the G-Sync monitor, flickering constantly. A 4K Dell UltraSharp (go.pcworld.com/4kdell) was called in as cavalry. All tests were done in our DIY test bench consisting of the following components. (You can find full details in our build guide (go.pcworld.com/buildguide) for the system.)

- > **Intel's Core i7-5960X with a Corsair Hydro Series H100i closed-loop water cooler**
- > **An Asus X99 Deluxe motherboard**
- > **Corsair's Vengeance LPX DDR4 memory, Obsidian 750D full tower case, and 1200-watt AX1200i power supply**
- > **A 480GB Intel 730 series SSD (I'm a sucker for that skull logo!)**
- > **Windows 8.1 Pro**

Please see: go.pcworld.com/titanbenchmarks for detailed benchmark charts and explanations.

First up we have *Middle-earth: Shadow of Mordor*. While our reviewer wasn't blown away (go.pcworld.com/mordor) by the game itself, *Shadow of Mordor* garnered numerous industry awards in 2014 for its remarkable Nemesis system—and with the optional Ultra HD Texture pack installed, it can give modern graphics cards a beating. The add-on isn't even recommended for cards with less than 6GB of onboard RAM, though it'll still run on more memory-deprived cards. The game was tested by using the Medium and High quality presets, then by using the Ultra HD texture back and manually cranking every graphics option to its highest setting (which *Shadow of Mordor's* Ultra setting doesn't actually do). You won't find numbers for the dual-GPU Radeon R9 295x2 here because every time I tried to change the game's resolution

graphics settings when using AMD's flagship, it promptly crashed the system, over and over and over again. Attempts to fix the problem proved fruitless.

Sniper Elite III was released in the middle of 2014. While it's not the most graphically demanding game, it scales well across various resolutions, and it's an AMD Gaming Evolved opposite to *Shadow of Mordor*'s Nvidia-focused graphics. Plus, it's always fun to snipe Nazis in the unmentionables in slow motion.

Next up: *Sleeping Dogs: Definitive Edition*. This recent remaster of the surprisingly excellent *Sleeping Dogs* actually puts a pretty severe hurting on graphics cards. Even the highest of highest-end single-GPU options hit 60fps in *Sleeping Dogs: Definitive Edition* with detail settings cranked, at 4K or 2560x1600 resolution.

Metro Last Light Redux is a remaster of the intensely atmospheric *Metro Last Light*, using the custom 4A Engine. Not only is the game gorgeous, it's an utter blast to play. It's tested with SSAA disabled because SSAA drops frame rates by roughly 50 percent across the board.

Alien Isolation is the best, most terrifying Aliens experience since the original Ridley Scott movie. The game scales well across all hardware, but looks especially scrumptious in 4K.

Bizarrely, we couldn't coax *Bioshock Infinite*, a regular in our test suite, into offering a 4K resolution option in its benchmarking utility, despite being able to actually play the game in 4K. For more on how the Titan X stacks up to the competition at lower resolutions, go to our benchmarks page (go.pcworld.com/titanbenchmarks).

I also tested the systems using two off-the-shelf benchmarking tools: 3DMark's Fire Strike and Unigine's Valley. Both are synthetic tests but well respected in general.

Finally, here's the power usage and thermal information. For thermals, we run the Furmark stress test for 15 minutes and record the GPU temperature using SpeedFan. Power usage is the total power

Every time I tried
change the resolution
or graphics settings
when using AMD's
flagship, it promptly
crashed the system.

consumed by the PC at the wall socket, measured with a Watts Up meter during a Furmark run.

All the various Nvidia reference cards run hotter than the Radeon R9 295x2, which uses an integrated closed-loop water-cooling solution, but none of them ever generated much noise or began throttling back performance. No surprise, our Radeon R9 290X—which is known for running hot on account of its atrocious reference cooler—hangs out at the front of the pack.

Nvidia's GeForce GTX Titan X: The final verdict

Nvidia was right: Single-GPU graphics cards don't come more powerful than the Titan X. It's no contest. The Titan X truly is the first solo GPU

card capable of playing 4K games at reasonable detail settings and frame rates. And that ferocious power pushes even further if you're playing with MFAA enabled, especially if you're lucky enough to have a G-Sync monitor to match.

Still, that doesn't mean the Titan X is for everybody.

If you're in the market for a graphics card this expensive, raw power is obviously a major concern. And when it comes to raw power, both the Radeon R9 295x2 and dual GTX 980s running in SLI outpunch the Titan X. While a pair of 980s is fairly equal in price (\$1,100 total) to a \$1,000 Titan X, the cooler-

Nvidia GeForce GTX Titan X

PROS:

- Incredibly powerful gaming performance
- Capable of playing games at 4K resolutions with high detail settings
- Quiet, relatively cool, and easily overclocked

CONS:

- 99 percent of gamers can't afford it

BOTTOM LINE:

Nvidia's GeForce GTX Titan X is hands-down the fastest single-GPU graphics card in the world, and the first capable of gaming at 4K without having to resort to a multiple-card setup.



running 295x2 is far cheaper, starting at \$700 on the street today, and available even cheaper with rebates. Monitors bearing AMD's FreeSync technology will also likely cost less than competing G-Sync displays when they hit the market, given that G-Sync requires the use of a costly, proprietary hardware module where FreeSync simply works over DisplayPort 1.2a.

But!

Dual-GPU solutions require compromise. For one thing, they suck up a ton of case space—two full-length cards in the case of a pair of GeForce 980s in SLI, and a long, heavy card with a sizeable water cooling setup if you go with AMD's flagship 295x2. Drivers and optimizations for multi-GPU setups also tend to be slower to appear and much more finicky, as evidenced by the *Shadow of Mordor* wonkiness with the 295x2. (Nvidia has had an initiative to have SLI support on the day of launch for top titles but the lower-tier games don't get the same commitment.)

Likewise, single-GPU graphics cards can also fit in tighter spaces than multi-GPU solutions. You could, for example, squeeze the Titan X into a relatively small form factor PC, which would be downright impossible with the Radeon 295x2 or dual 980s. Dual-GPU solutions consume more power and tend to spit out more waste heat than single cards, too.

Because of all that, our standard recommendation is to rock the most powerful single-GPU graphics card you can buy. If you're looking for pure, unadulterated, price-is-no-concern single-GPU power, that card is clearly the Titan X, and the 12GB frame buffer helps guarantee the card will continue to be relevant as we move deeper into the 4K resolution era. Hail to the new GPU king, baby—though AMD has a new generation of Radeon cards barreling down the pipeline soon.

And if you're made of cash and aren't scared of running multiple graphics cards, can you imagine how potent two Titan Xs in SLI would be? I'm quivering just thinking about it. 

If you're looking for pure, unadulterated, price-is-no-concern single-GPU power, that card is clearly the Titan X.



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



IWantToBeRecycled.org



KEEP AMERICA
BEAUTIFUL

Chromebook Pixel excels both as a machine and an idea

BY MELISSA RIOFRIO

THE LAPTOP YOU'RE about to see is as much an idea as it is a machine. Google's new Chromebook Pixel (go.pcworld.com/cbpixel) is designed to be the world's best Chromebook—and it is, without even trying hard, by a yawning margin. That's the machine part.

Now for the idea part. Two years ago, when Google introduced the original Chromebook Pixel, you could argue it was too early. Chrome OS was young. There wasn't enough to do with all the processing power, and with an early-gen mobile CPU, battery life was disappointing. It was all dressed up with nowhere to go, and it was also crazy-expensive, with a base price of \$1299 and a higher-end model that cost \$1449.

Also, people looked at the Chromebook Pixel and asked, "Why build



Watch the
video at
[go.pcworld.
com/pixelvid](http://go.pcworld.com/pixelvid)





such a powerful laptop ‘just’ to run browser-based applications?” But they were asking the wrong question. Google made the Chromebook Pixel—the old one and the new one—to answer a different question: “Why not?”

Why not have a flagship for the fledgling Chrome OS that can stand with the best from Apple or any major PC vendor? Whether you thought the Pixel was awesome or ridiculous, Google was simply expressing its ambition to compete head-on with those two platforms.

The new Chromebook Pixel starts at \$999 and has an “LS” model with a faster CPU for \$1299. It’s still expensive—just a little less than before. But if the new 12-inch MacBook can get 4-out-of-5 stars (go.pcworld.com/4of5) for pedestrian performance and a tyrannical, single USB-C port, the Chromebook Pixel must earn more than that for delivering significantly better speed and battery life than its predecessor, plus significantly more generous and versatile connectivity.

It can hold its head up among the flagships of other platforms for beauty and features. Oh, and it’s the best Chromebook available by far, as I’m about to show you.

Compared side by side, the 2015 (left) and 2013 (right) Chromebook Pixels look almost identical. The 2015 model is slightly lighter and thinner.

Built to be the best

Let's be honest: It's not hard to be the best Chromebook when the market remains largely one of small, inexpensive, underpowered machines. But the masses clearly don't mind, because Chromebooks were the top sellers among laptops during the last holiday season, and they're big in education, too.

The Pixel, by contrast, exudes excellence, starting with its aluminum chassis whose subtle texture almost feels soft. Google paid attention to details, giving the Pixel crisply tailored edges and an extremely sturdy hinge.

A slender LED lightbar near the edge of the lid flashes Google's rainbow colors and also shows battery life. Compared to its predecessor, this new Pixel is slightly lighter than before (3.3 pounds compared to 3.35 pounds) and even a scant millimeter thinner (15.3 compared to 16.2).

On the sides, you'll find a lot more connectivity than we've seen on some other new models lately (*cough* MacBook *cough*), including right and left USB-C ports. The ports can be used with the included power adapter from either side—a nice convenience. Google sells a bunch of USB-C adapters: USB-C to HDMI (\$40), DisplayPort (\$40), or USB-A (adapter or cable, both \$13). The new Pixel also has two USB 3.1 ports, an SD card slot, and an audio jack.

Open the Pixel, and there it is: That gorgeous, 12.85-inch touchscreen display with a 2560x1700-pixel resolution and 400-nit brightness. Take that, Retina. Of the machines we've seen, only Dell's XPS 13 has better bragging rights, with its 3200x1800 display option.

According to Google, the new Pixel's display has a wider color gamut. We set the same wallpaper and same display settings on both



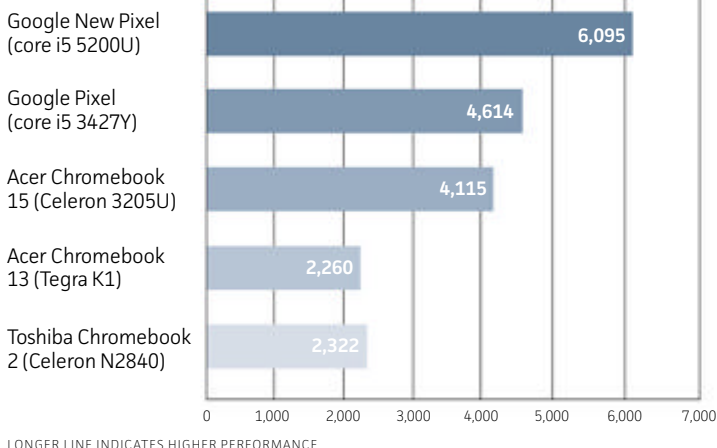
The Pixel's exterior is both luxurious and strong, with subtle finish to the aluminum chassis and a piano-style hinge.



The original Google Chromebook Pixel (left) and the second-generation model (right) have the same screen resolution, but the newer model has a broader color gamut, subtly visible in this side-by-side comparison.

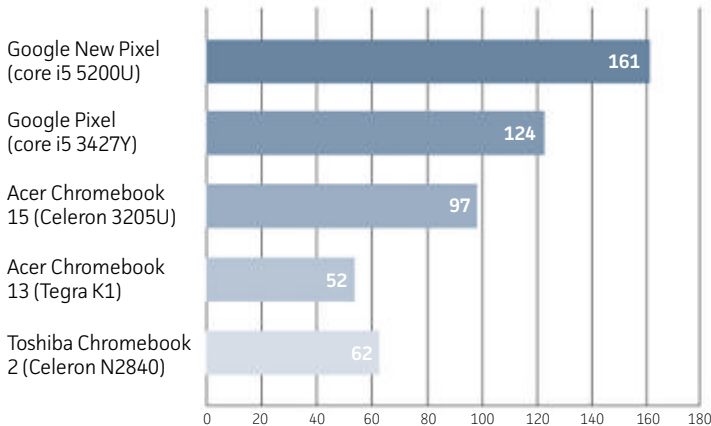
Pixels, and you can see that the new Pixel (at right in the photo) has richer colors. Just look at the richer blue details in the surf and sky, and the red-tinted crags on the sandy cliff.

Browsermark 2.1



Browsermark 2.1 gets right to the heart of the Chrome-book's operating system, measuring graphics and computational performance within the browser.

cr-XPRT 2015 Performance



LONGER LINE INDICATES HIGHER PERFORMANCE

The cr-XPRT performance test measures Chromebook performance in basic productivity tasks as well as more demanding activities

The full-size, island-style keyboard is firm without being harsh. The trackpad on the Pixel is bigger, and it's also supposed to be more responsive than its predecessor. I enjoyed using both for long periods.

Like I said, it wasn't hard for this to be the best-designed Chromebook. But it's also hard to find a feature set this great on any other premium laptop.

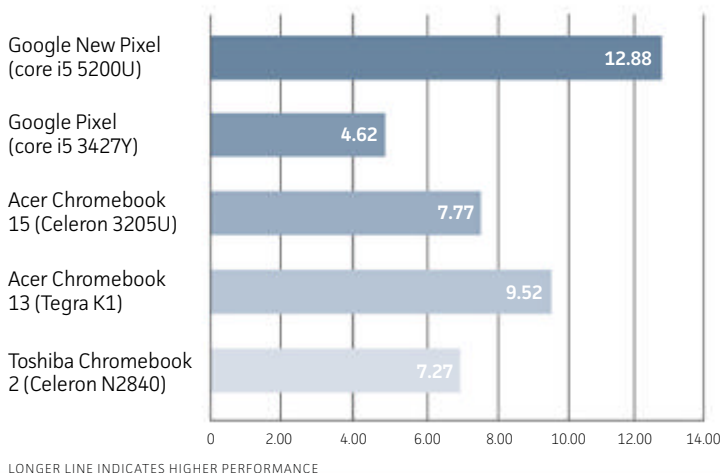
The Broadwell CPU silences all comers

The Pixel's first-class on the inside, too. Our model boasts a Core i5 Broadwell CPU, 8GB of RAM, and a 32GB SSD. (Call the Pixel LS super-ultra-premium: It sports a Core i7 CPU, 16GB of RAM, and a 64GB SSD.)

Intel's improved its mobile CPUs significantly since the first Pixel came out with an Ivy Bridge chip two years ago. Not surprisingly, in test after test, the new Pixel left its predecessor and all other Chromebook comers in the dust.

Browsermark 2.1 gets right to the heart of the Chromebook's operating system, measuring graphics and computational performance within the browser. The new Pixel is 32 percent faster

cr-XPRT 2015 battery life (hours)



The cr-XPRT battery test provides an estimated rundown time of 12.88 hours for the new Pixel

than its predecessor, let alone any other Chromebooks we've tested recently that have advanced CPUs.

The cr-XPRT performance test measures Chromebook performance in basic productivity tasks as well as more demanding activities, such as watching movies or playing games.

In the cr-XPRT performance test, the new Pixel is 30 percent faster than the old Pixel, and once again miles ahead of any other contenders.

Google's Octane 2.0 Javascript benchmark pushes hard on more advanced browser-based activities, including productivity applications, games, and interactive content. Google's new Chromebook Pixel outpaced its forbear by 28 percent, and other contenders weren't anywhere close.

At this point, some people are still going to say there's nothing to do with all that power. That argument is weaker now than it was in 2013. Chrome and the computing world have evolved a great deal in the last two years: There are more online games, more web-based productivity applications, more high-end content that you can stream, and there's more in the works. Even Adobe Photoshop, which has been a rallying-

cry-slash-sacred-cow for many naysayers, is coming to Chromebooks in online form (it's already in beta if you want to try it).

Let's be honest again: Most of us have a PC that's far more powerful than what we really need. We buy more power because we like it. The Pixel is designed to be ready for the future, and the benchmarks show it has muscle to spare.

Finally, the new Pixel's battery life is a huge step up from before. The

Google Chromebook Pixel

PROS:

- Beautiful, advanced design
- Stunning, high-resolution touchscreen display
- Significant improvements in performance and battery life

CONS:

- Expensive

BOTTOM LINE:

The Chromebook Pixel is clearly not for everyone, any more than any flagship is. It's expensive. It pumps much more power than most people need. But as a Chromebook, it's the best you can get. As a flagship, it's as avant-garde as it should be — and it gives other flagships a run for their overpriced money too.

\$999



Broadwell CPU helps, but Google also designed other efficiencies into the Pixel, like turning off the keyboard backlight if you don't use the Pixel for 30 seconds. The cr-XPRT battery test provides an estimated rundown time of 12.88 hours for the new Pixel, compared to 4.62 for its predecessor. Other contenders had good stamina, but the Pixel comes out way ahead once again.

I saw the difference in my hands-on time, too. I streamed a movie at full-screen on both the new Pixel and the old one, using the same display settings, of course. After 20 minutes, the old Pixel had lost 10 percent of its battery capacity. The new Pixel had lost only 3 percent.

The Chromebook Pixel is clearly not for everyone, any more than any flagship is. It's

expensive. It pumps much more power than most people need. But as a Chromebook, it's the best you can get. As a flagship, it's as avant-garde as it should be—and it gives other flagships a run for their overpriced money, too. 🔌



Crucial MX200 Review: A fast SSD at a nice price

BY JON L. JACOBI

CRUCIAL, BEING A Micron subsidiary, has access to NAND from its parent company's fabs. It rolls this advantage over to you, pricing drives such as the company's new MX200 (crucial.com/storage-ssd-mx200) lower than the competition: \$470 for the 1TB version is a bargain in a top-end drive. The kicker is, Crucial makes even less expensive, albeit slower SSDs such as the BX100 that we also hope to review.

Of course, other companies, such as Intel and Samsung, fab their own NAND too, but those vendors opt to keep margins higher. They may have to re-think that. Where Crucial's older generation SSDs were only middling performers that deserved to be discounted, the MX200 can hang with the best around. Hmm, just as fast, cheaper...

Ratings and warranty

It's nice that Crucial provides realistic Terabytes Written (TBW) ratings—that is, how many terabytes can be written before the drive theoretically wears out: 320TBW for the \$470/1TB MX200, 160TBW for the \$250/500GB model, and 80TBW for the \$140/250GB version. You might be put off because those ratings are backed by a mere three-year warranty, but you shouldn't. As SSD warranties are of the whichever-comes-first variety, there's actual little difference in terms of total coverage from Samsung's competing 1TB 850 EVO with a 5-year warranty, but an unrealistic and rather low 180TBW rating.

The varying approaches to coverage can be leveraged to your advantage if you know your usage scenario. Buy the EVO and be covered for 10GB a day for five years, or buy the Crucial and be covered for 30GB a day for three years.

Crucial MX200

PROS:

- The most affordable top-shelf SSD out there.
- Supports encryption.

CONS:

- Not the fastest at any one thing.

BOTTOM LINE:

You can't argue with the MX200's price. However, if you're more about capacity than performance, consider the \$400 1TB Crucial BX100 or even Sandisk's 960GB Ultra II, which is available at a steep discount.

\$470 for 1TB

Software and Performance

The MX200 employs the same Marvell 889189 controller found in the M550 SSD Crucial released last year, but pairs it with Micron's new 16nm MLC NAND. That's squeezin' cells pretty close together, which allows more in less space, but reduces their longevity.

Crucial now provides Storage Executive, a browser-based utility that lets you see S.M.A.R.T

information, download debug info (for tech support), as well as perform firmware upgrades and reset the PSID (Physical Security ID). The latter doesn't zero cells as a secure erase will; it simply creates a new encryption key so that old data on the drive is unreadable. Yes, the MX200 supports encryption.

The MX200 is not the fastest SSD we've tested at any one thing, but it's pretty darn good in all phases, and there's no drop-off in performance with the lower capacities. As a matter of fact, the smaller 250GB and 500GB capacities proved slightly faster. On my testbed, CrystalDiskMark rated the three MX200s at about 495MBps to 500MBps reading, and 480MBps to 490MBps writing 4MB sequential files. The drop with smaller 512KB files was only about 30MBps in each direction.

Random reads and writes were also quite good, at 30KBps/80KBps on single 4KB files and over 300KBps with 4KB files at a queue depth of 32. It really doesn't get much better with a single drive on the SATA bus. You'll need to switch to a PCIe solution or combine drives in RAID 0 to go any faster.

The MX200 is not the fastest SSD we've tested at any one thing, but it's pretty darn good in all phases

Conclusion

You can't argue with the MX200's price. It's the most affordable top-shelf SSD out there. However, if you're more about capacity than performance, consider the \$400 1TB Crucial BX100 or even Sandisk's 960GB Ultra II, which is available at a steep discount.

Note: The MX200 will also be available in other form factors, such as mSATA and M.2 (SATA), but Crucial was unable to provide any at the time of this writing. 🚫

Pillars of Eternity: The Baldur's Gate spiritual successor

BY HAYDEN DINGMAN



I'M NOT DONE with *Pillars of Eternity* (eternity.obsidian.net).

Let's be clear: The only context in which that statement is bad is in the context of writing a review. Do I wish I could've finished the game in time to slap a score on it today? Sure, kind of.

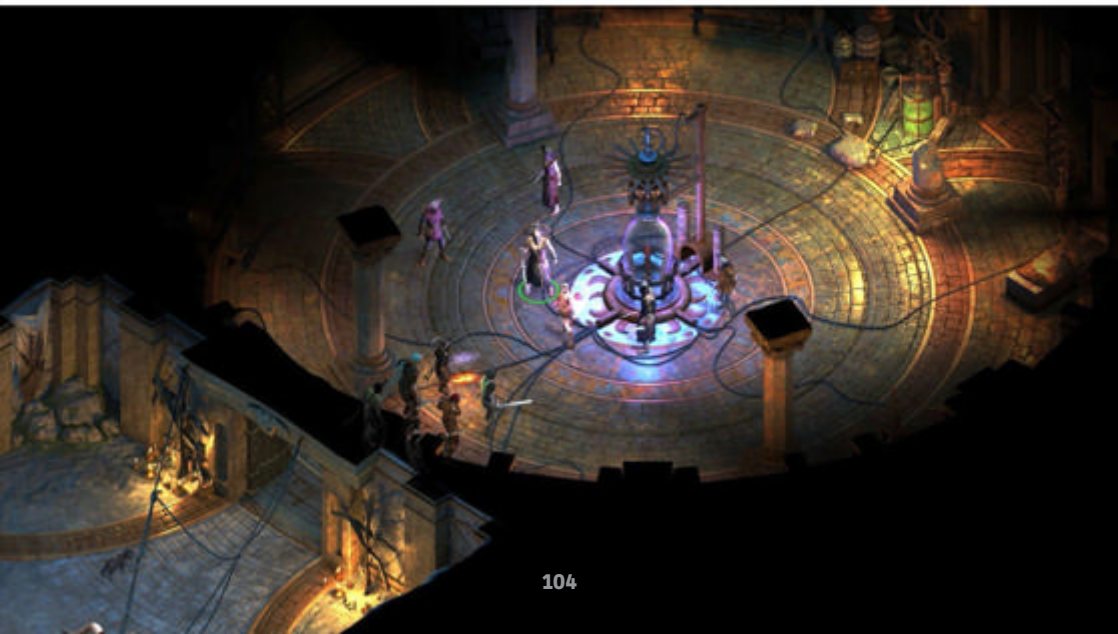
On the other hand, I'm thirty-five hours into the game and I *just* popped an achievement telling me I completed Act Two. Out of (I think, maybe) four or five. All week I've inhabited this zone where I'd wake up at like, six in the morning and think, "Would it be weird for me to get out of bed right now and immediately start playing *Pillars*? Because I *really* want to play *Pillars*." There's no doubt in my mind that if the second half of this game is as good as the first, this is one of 2015's best games.

Endless paths

Obsidian's *Baldur's Gate*, Infinity Engine-era throwback is massive. It's sprawling. It's exactly the type of game (I hope) fans wanted and expected when that Kickstarter page went up two years ago. It's like an Infinity Engine game with the rough edges sanded off.

And normally that's something people say in a derogatory tone, at least when it comes to video games. Like, "Oh, they dumbed it all down." But this time it quite literally just means taking away all the things that didn't quite work in those games or made them intimidating or boring or not fun to play.

For Infinity Engine veterans, that means: Getting rid of THACO. Fine-tuning the "Miss/Miss/Miss/Miss/Crit-and-the-enemy-is-dead" combat. Adding a slow-motion mode so you can play combat (especially the easy encounters) without needing to constantly pause and unpause. Adding a double-speed mode that minimizes the pain of retraversing enormous maps. Allowing you to upgrade the equipment you love instead of throwing it away every level or two. Making inventories more manageable. A better-sorted journal. The list goes on.





Make no mistake: It still feels distinctively like an Infinity Engine game, in ways the other two CRPG revivals last year (*Divinity: Original Sin* and *Wasteland 2*) did not. It's polished, though. Modern even, in some ways. I can't help but think a lot of that comes from the fact Obsidian got to start from scratch here, rather than converting *Dungeons & Dragons* rules into ill-fitting video game form.

I've especially come to love the game's two-reservoir health system. Your characters each have a per-encounter stat termed "Endurance" and then a larger, overall stat termed "Health". For instance, if a character has 80 Endurance and 240 Health, that character will get knocked out if Endurance hits zero but will only *die* if, say, knocked out in three subsequent encounters without resting.

Contrast that with *Baldur's Gate*—you had one pool of health, total, and if it reached zero you died. That made parts of the Infinity Engine games a slog because you'd inevitably have one character with much lower health than the rest of the party. Even if you beat an encounter with your strong characters, you might be forced to reload if your weakest character died and you didn't want to lose that party member. Sorry, wizards.

Pillars of Eternity's change is a small, elegant refinement, and that's

basically the feeling I have about the whole game. It's the Infinity Engine game you wanted, but with some smart tweaks that make the whole thing just a *bit* more playable.

And you'll need that second health reservoir, believe me. This game is still *hard as hell*. I'm only playing on Normal, and even so I've done my fair share of reloading. The review guide we got from Obsidian straight-up recommended playing on Easy, and I understand why.

Pillars is punishing, in the same way *Baldur's Gate* was—anyone who left Candlekeep and immediately died at the hands of a wolf will know what I



mean. I'm just now getting to a point where I feel over-leveled, and I'm thirty hours in and have done most of the side content so far. I can't imagine trying to brute-force the main story straight through.

Pillars of Eternity

PROS:

- Obsidian at its best, crafting a fantastic RPGs.
- One of 2015's best games.

CONS:

- You'll have way too much money if you regularly complete side quests.
- Pathfinding is a bit janky.

BOTTOM LINE:

Obsidian once again proves that it is the foremost RPG studio in the world, with an understanding of its mechanics, its lore, and (most importantly) its story on a level most games don't even aspire.

\$44.99 for Hero Edition

Awakening

So, questing.

This might be the first game to utilize *Pillars of Eternity's* setting, but you wouldn't know it by the amount of world-building and lore that goes on here. Like *Wasteland 2*, Obsidian proves that world-builders and story-tellers can do some of their best work when freed from the shackles of voice-



acting budgets and facial tech that doesn't quite work and "cinematic" camera angles.

This is a book. A book you play. Obsidian's Josh Sawyer was not kidding when he told me that *Pillars of Eternity* is a game "for people who like to read", and honestly if you played the Infinity Engine games you probably already knew that. But that reading allows for some incredible detail that other games simply can't afford—rooms, people, places, quests, everything is imbued with enough lore as to be overwhelming if you try to take it all in. Obsidian's world is an old one, with former civilizations passed into memory and massive ruins left to puzzle over.

But that doesn't matter a whit to your character, at least to start. You're a colonist, coming to the remote frontier-esque realm of Dyrwood because you've been told all settlers will receive free land. Sounds too good to be true, right?

Turns out Dyrwood needs settlers because nobody can have babies. Or, they *can* have babies, but every child birthed in the realm lately is "Hollowborn"—a baby without a soul, or without the spark of life that gives it true consciousness. It breathes, it blinks, but it isn't really *alive*.

Nobody knows why. Some blame the gods, or certain subsets of gods.

Some blame the nobility, which threw off the shackles of the Aedyr Empire not that long ago. Still others blame animancers—scientists studying the nature of the soul. After all, animancy seems like a good enough place to start when casting blame around for *soulless babies*.

And then there's you. You have the opposite issue—your soul has "Awakened". Each soul in *Pillars of Eternity* is subject to strict rules of reincarnation, so when a person dies his or her soul finds itself in another body, though without any memory of its past selves... except when *Awakened*, like you. You remember flashes of your past lives and can actually see other people's past selves as well.



Why you? That's the initial question that sets you wending through Dyrwood, trying to uncover your own fate while also surviving one of the most tumultuous game worlds I've ever experienced. Dyrwood is basically a revolution in the making. The peasants hate the nobility. The nobility cloisters itself away from the peasants. The Galfathans—a tribal group living in the wilderness—hates the people of Dyrwood. Everyone hates the animancers. And there's this whole Hollowborn epidemic hovering over it all.

I don't want to spoil much more, but the story so far is fantastic. Sure, much of it can reduce down to the age-old "random person saves the world" trope, but it's really the amount of care put into presenting the world that sets *Pillars of Eternity* apart. It's the way you'll read a random book and then six hours later realize that book was actually intrinsic to a conversation you're having, not necessarily in terms of actual conversation options but just because you have a deeper sense of the world itself.

It's also interesting how the lore mirrors questions from our own world. You can clearly see shades of debates about stem cells or the

role of religion in government or “*Has science gone too far?*” in Obsidian’s world, albeit couched safely in fantasy. And who’s right? Well, nobody really. Animancers aren’t necessarily evil, nor are the people against animancy. It’s all shades of gray here.

The story is bolstered by fascinating party members: The priest who looks so insane he scares people walking down the road, for instance, and the hulking Aumaua (a race) who, despite his size and strength, is mostly at your side so he can continue his scholarly pursuits. Or the ranger who spent the last five years scouring the earth in search of her former tribe leader’s reincarnated soul.

And these characters are, in turn, bolstered by Obsidian’s unique character classes. The game industry seems content to settle mostly for a fighter-rogue-wizard paradigm, and that’s fine. It’s easy to understand, and the distinctions between those three are huge.

Obsidian’s range is both more granular and more diverse—the mark of people who have a lot of experience building these systems and a

Side note:

Turn off the metagame information in conversations. You can have the game tell you whether specific responses are “Benevolent,” “Rational,” et cetera. Disable those indicators and just play. It’s way more interesting to see how your character’s dialogue is perceived when you don’t know ahead of time.



lot of talent to back it up. Having now dabbled in all eleven classes, I'm amazed how different they all are, even amongst "similar" classes.

The wizard, for instance, has a lot of heavy offensive spells to choose from but only gets to pick one or two when leveling up. Priests? They get access to entire *tiers* of spells when leveling, but these are mostly support buffs and heals, not offensive spells. Then there's the cipher, who's the most interesting "magic" class. Like you, ciphers can "see" into an enemy's soul. The difference is ciphers use this ability akin to magic, causing enemies to for instance relive old wounds. And since their "magic" deals with souls, it can only be targeted at individuals.



Bottom line

What I'm saying in way-too-many words is this: Obsidian has a reputation for crafting fantastic RPGs, and deservedly so. *Pillars of Eternity* is, as far as I'm concerned, Obsidian at its best ever.

There are a few oddities—you'll have way too much money if you regularly complete side quests, I still find it strange not getting XP from every monster slain, and I miss some of the dynamic effects from *Divinity*. It's weird to cast a lightning bolt while standing in a pool of water and have it do nothing. Oh, and pathfinding is a bit janky at times.

But *Pillars of Eternity* is masterful. Earlier this week Obsidian released a documentary on the making of the game where it revealed the studio almost shut down before *Pillars*. Like, *entirely*. Obsidian was working on a project when the publisher pulled out, tons of staff were laid off, and there was even an expected shutdown date in place.

What a shame that would've been. With *Pillars of Eternity*, Obsidian once again proves that it is the foremost RPG studio in the world, with an understanding of its mechanics, its lore, and (most importantly) its story on a level most games don't even aspire to. 🍷

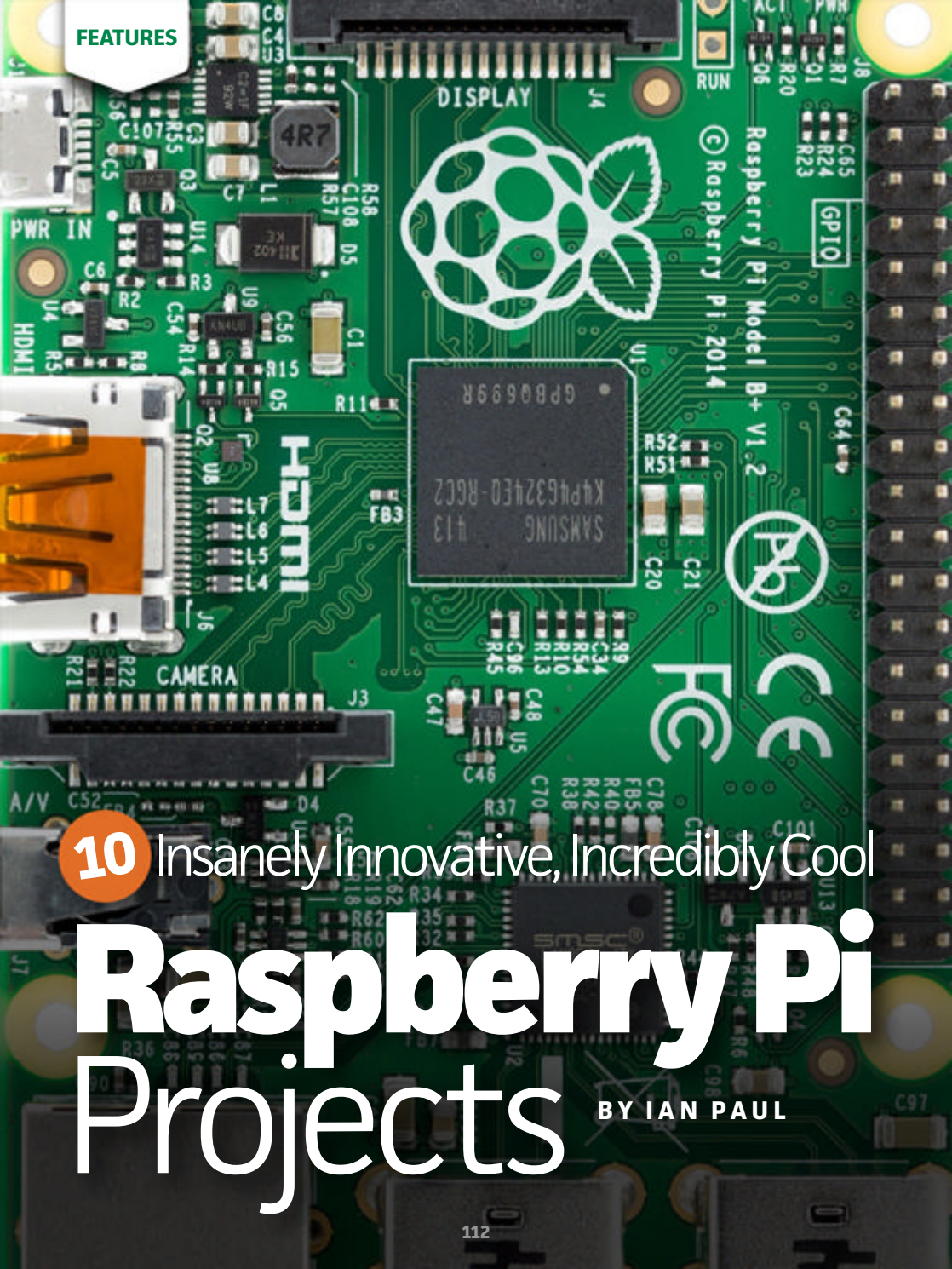
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COMIC BOOKS TALK RADIO

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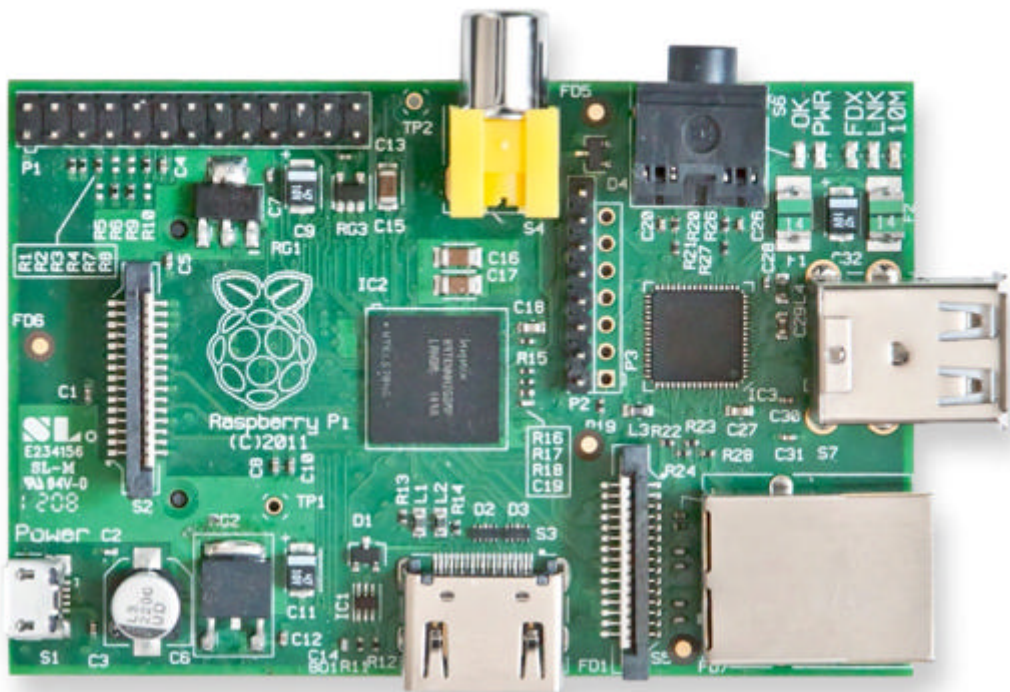
V I D E O G A M E V O T E R S . O R G



10 Insanely Innovative, Incredibly Cool

Raspberry Pi Projects

BY IAN PAUL



A HEAPING HELPING OF PI

The Raspberry Pi's very existence can be chalked up to creativity. Ebon Upton and the Raspberry Pi Foundation created the \$35 mini-PC to inspire students to learn computer science and enable tinkerers to dream up wild projects without breaking the bank.

And they have! In honor of Pi Day (en.wikipedia.org/wiki/Pi_Day)—March 14, or 3/14—and the recent release of the Raspberry Pi 2 (go.pcworld.com/raspi2), we're basking in 10 of the most creative, surprising, and downright interesting Raspberry Pi creations crafted since the micro-PC's launch. Even better, most of the creators share full details on how to replicate these crazy innovative projects in your own home. Let's dig in!



TALKING TOY

1

Inspired by the talking Fisher-Price Chatter Telephone in *Toy Story 3*, UK-based Grant Gibson decided to use a Raspberry Pi to improve on the actual toy. He took a special *Toy Story* edition of the Chatter Telephone (equipped with sound clips from the movie) and added a Wi-Fi-enabled Raspberry Pi B+ (go.pcworld.com/raspidiy) to it. The result is a “Talking Chatter Smartphone” that can tell you the current weather, let you know what’s playing at local theaters, or listen to the radio. It even has geo-fencing notifications: When the owner leaves the office, the toy is alerted at home and lets everyone else know.

Check out the full story, along with some tools to help you build your own, on Grant Gibson’s blog (go.pcworld.com/chatter).

PICROWAVE

2 Why bother owning a traditional microwave when you can swap out some innards and create your very own Pi-powered food nuker (go.pcworld.com/raspimwave)?

Developer Nathan Broadbent took his microwave apart, redesigned the touchpad, and added some new functions like voice control, a barcode scanner to access an online database of cooking times, a web-based interface for remote access, and auto-tweets (twitter.com/rbmimrowave) for when the timer is done.





PORTABERRY PI

3

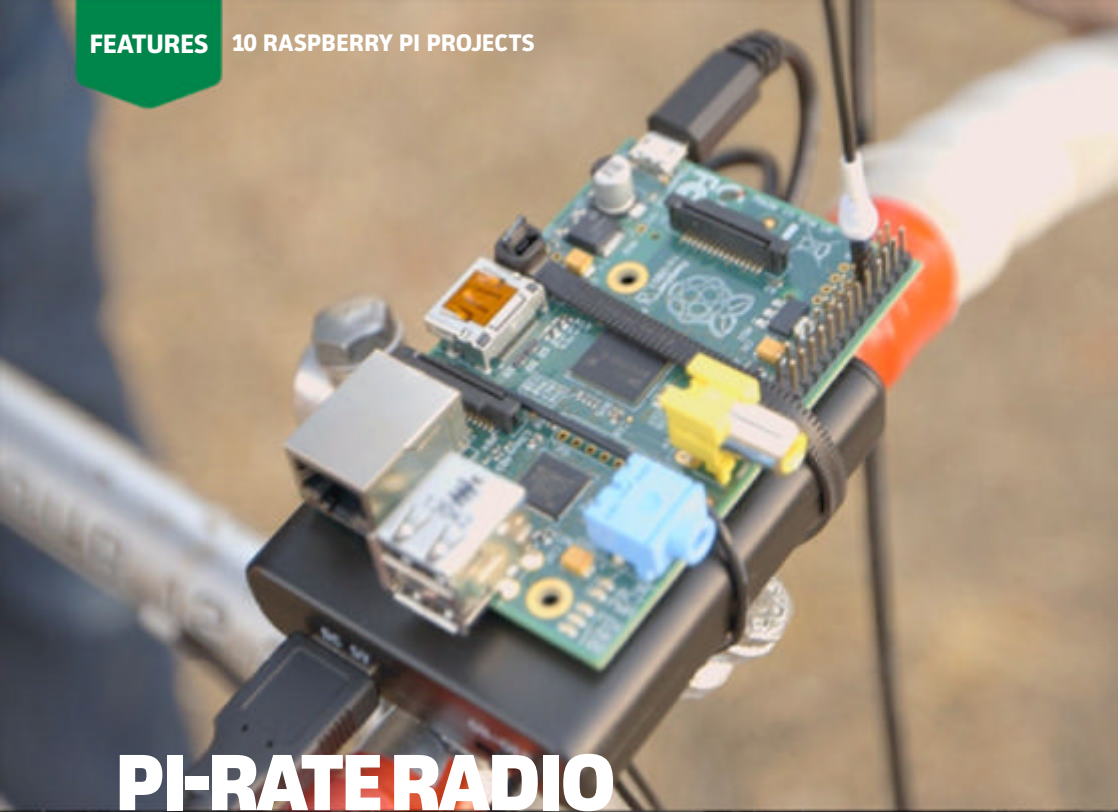
Turning the Raspberry Pi into a gaming machine is a classic use case for the mini computer—emulators for the legally gray win!—but Portaberry Pi is one of the nicer set-ups. It includes a Raspberry Pi Model B, a 4.5-inch TFT display, a 3D-printed case, and various components to construct a boxy handheld retro gaming device (go.pcworld.com/raspigaming). Check out the finished project on ([YouTube go.pcworld.com/raspigaming2](https://www.youtube.com/watch?v=go.pcworld.com/raspigaming2)) with the device running Super Mario World for Super Nintendo.

PIPHONE

4

Some Raspberry Pi projects are cool and useful, and others are just a neat idea. I'd argue that David Hunt's Pi-powered mobile phone (go.pcworld.com/raspihone) falls into the latter category. This isn't something you'd want to stick in your pocket, but it's amazing to think you can take a Raspberry Pi and combine it with a GSM module, battery, and TFT touch screen to create a homegrown cell phone.





PI-RATERADIO

5

A simple, but effective hack from Make shows how you can turn your Raspberry Pi into a mobile FM transmitter (go.pcworld.com/raspiradio) to share your tunes with those around you. The beauty of this project is its simplicity. All you need is the Raspberry Pi basics—SD card, a power source, and the Raspberry Pi—plus a piece of wire for an antenna, some basic tools, and about an hour of your time.

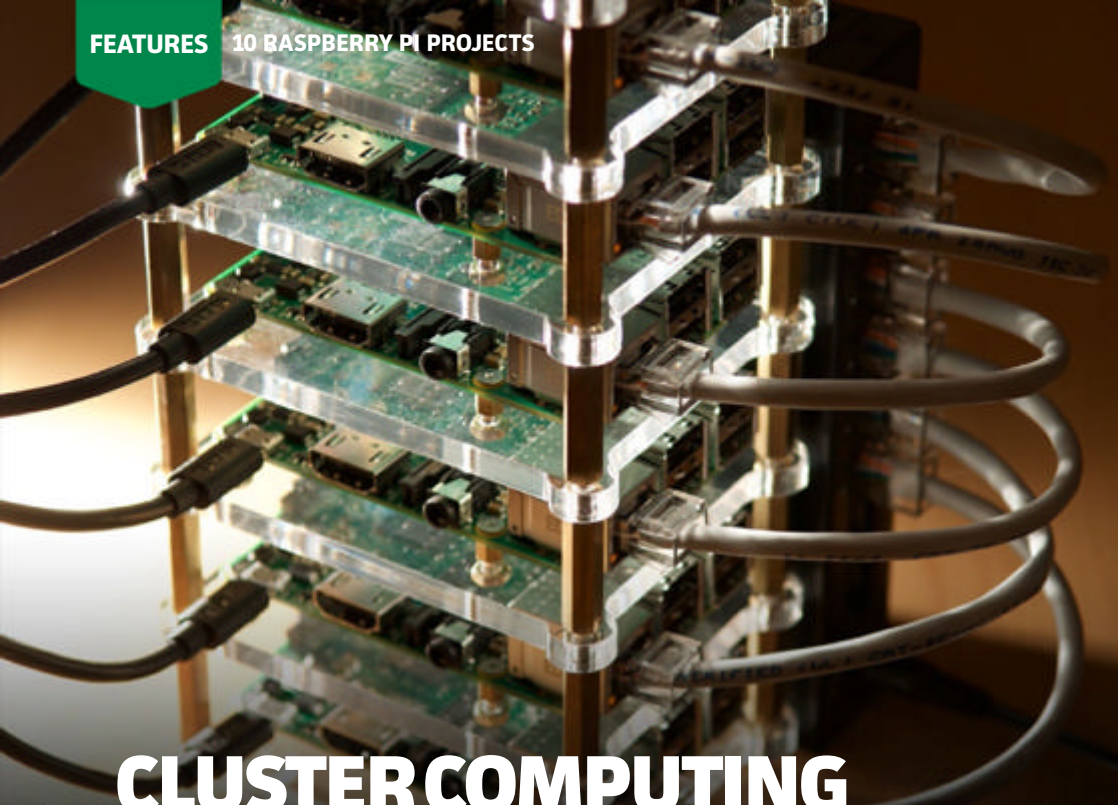
The site also warns you to be careful about choosing a broadcast band for your new transmitter. If you start pumping tunes on government bands or a band used by a licensed radio station, you could quickly end up in more trouble than the project is worth.

MAGIC MIRROR

6 Developer Michael Teeuw came up with a neat idea for a home project: Create a high-tech mirror that shows you the weather, time, and the day's headlines while you're getting ready for the day.

For his project Teeuw took a one-way mirror, attached a display and Raspberry Pi to the back, and put it all together in a custom-made case. It's a killer concept, and his "magic mirror" inspired others to create their own versions. You can find full details on how he built the mirror (go.pcworld.com/raspimirror) on Teeuw's blog, along with another post showing off other mirrors from around the world (go.pcworld.com/raspimirrorworld).





CLUSTER COMPUTING

7

If using one Raspberry Pi is great, then combining a whole bunch of them together must be even better—especially if you’re trying to create a capable, yet cheap and power-efficient computer cluster.

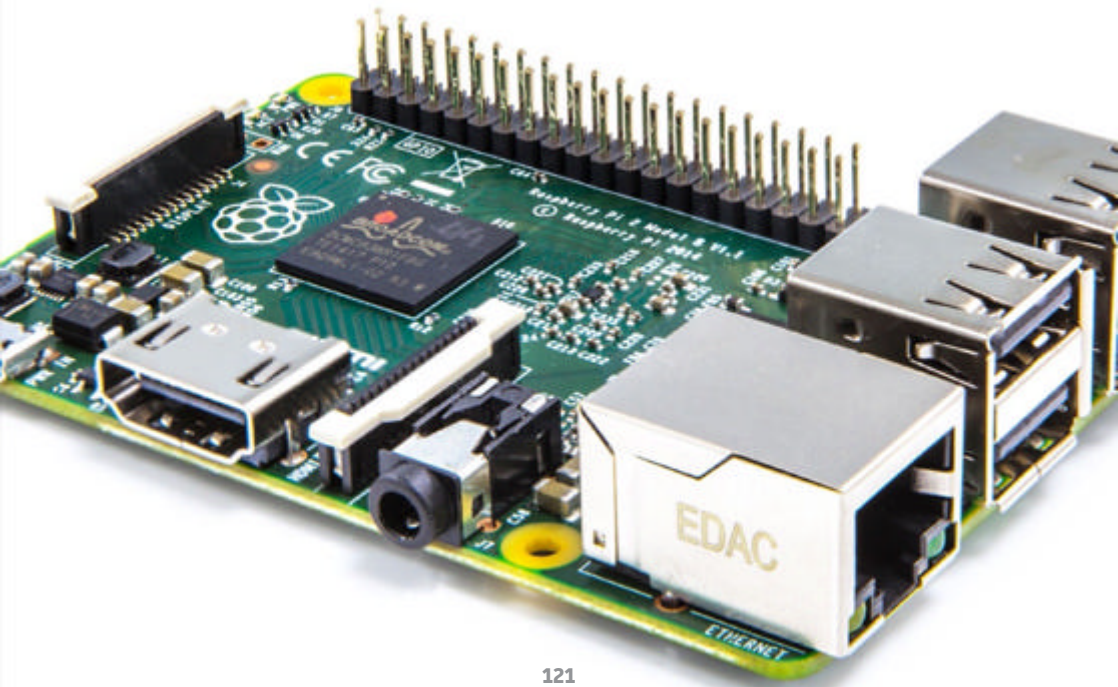
Jeff Geerling, who runs web and mobile development company *Midwestern Mac*, took five Raspberry Pi 2 devices to create a mini-datacenter running *Drupal 8* (a content management platform for websites). Geerling calls his creation a “*Dramble*” (*Drupal* + *bramble*) (go.pcworld.com/dramble). There are lots of people experimenting with Raspberry Pi clusters. Even Britain’s spy agency, the Government Communications Headquarters (*GCHQ*) is playing around with Raspberry Pi clusters—in *GCHQ*’s case, a cluster of 66 Raspberry Pis—which it calls a *Bramble* (go.pcworld.com/bramble).

IN/OUT BOARD

8

Here's a handy tool for anyone who needs to keep track of a large number of roommates or family members. Take a Bluetooth USB dongle, a monitor, and a Raspberry Pi, and you've got yourself an automated way to see who's at home or in the office at a glance.

This project requires that everyone have Bluetooth activated on their smartphones, so the Raspberry Pi can identify which devices are present. Any time someone is in range of home, the display shows that they're present (or at least that their smartphone is). Check out Instructables (go.pcworld.com/raspiwhoshome) for a step-by-step breakdown.





SEMI-AUTONOMOUS QUAD-COPTER

9

This is a more expensive and mechanically intense project, but what's more rewarding than building your own Raspberry Pi-powered miniature vehicle?

UK-based Pi enthusiast Andy Baker has a breakdown of how he built his own semi-autonomous quad-copter that comes programmed with its own flight plan. There are quite a few articles to read through, but this one (go.pcworld.com/raspiflightplan) is probably your best starting point. Also be sure to check out the new quad-copter project (go.pcworld.com/raspiquadcopter) that he started in February.

ERICA THE RHINO

10 The last project we'll look at isn't really something you can do at home, but it is a downright cool use of the Raspberry Pi.

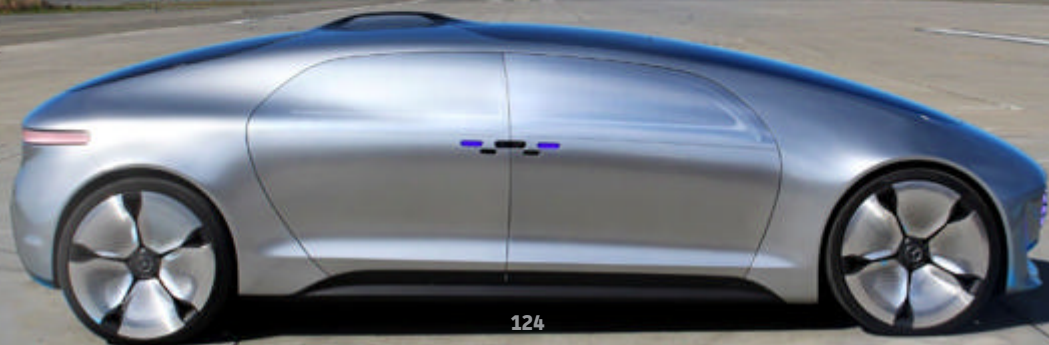
This art installation by the University of Southampton's Electronics and Computer Science team is powered by five Raspberry Pi devices that allow the Rhino to move its ears, send out and read tweets, make Rhino sounds, and even interact with nearby viewers via smartphones. Erica has her own website (ericatherhino.org) where you can find out more about this interesting art experiment.

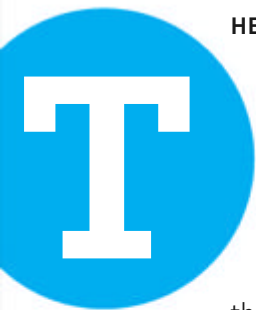


Mercedes -Benz F 015

THE SELF-
DRIVING
LOUNGE
OF THE
FUTURE

BY MELISSA RIOFRIO





THE MERCEDES-BENZ F 015 looks so out-of-this-world amazing, even people who can't stand the idea of a self-driving car might still be willing to ride in it.

And that's exactly what I did—not on city streets, but within the controlled environment of a former naval base. Other journalists and I chatted in the space-age cabin while the car drove. We skimmed music choices on integrated touchscreens that lined the walls—while the car drove. I waved at the dashboard to adjust the air conditioning. The F 015 (go.pcworld.com/benzF015) drove.

First unveiled at CES, the F 015 is just a concept car. It may never become a retail product, and its engineers caution that some of its capabilities are many years away from reality. Still, it takes self-driving cars beyond Google's LiDAR-studded experiments and reconsiders how the most cutting-edge auto tech could change people's lives.

Why this matters: Self-driving cars may be coming in 2020, but we're

The saloon doors on the Mercedes-Benz F 015 concept car open wide for entry and have integrated touchscreen displays for infotainment.

nowhere near figuring out how to incorporate them into our everyday world. We don't know how much to trust them with the thousands of split-second decisions that driving requires. We don't know how to behave as passengers or pedestrians. And, honestly, some of us just don't want to give up control.

And yet, the F 015 has captured the imagination in a way I'd normally have expected for a car like the Alfa Romeo 4C (go.pcworld.com/alfa4c),

a for-reals baby Ferrari

that's the complete opposite: an adrenaline rush, not a German-engineered nap room. So think of the F 015 as an ambassador for autonomous driving. It inspires people to think about all these issues simply because they're excited about the car.



Sure, you can drive the F 015, but wouldn't you rather kick back and let the car worry about it?

GOING BEYOND GOOGLE

Google's experimental self-driving cars, with their whirling roof-mounted LiDARS, have turned heads on San Francisco Bay Area roads for several years. In 2014, the company unveiled a more radical, bug-shaped design that had no steering wheel or brakes and embodied a utopian vision of giving mobility back to blind men and senior citizens.

The F 015 looks a lot less quirky than the Google cars, but it's more than an aesthetic step up: It's designed under the assumption that we'll be spending more time in our cars in the future. "Life will be more

hectic,” explained Koert Groeneveld of Mercedes-Benz. As megacities rise, getting around a denser urban environment will take longer and be more difficult. “Private space and time will become luxury commodities,” Groeneveld predicted. A self-driving car like the F 015 would let people use the time in traffic for other activities.

That’s why the F 015 looks like a lounge on wheels. Mercedes-Benz wants you to relax while the car handles the logistics. The company designed it with an unusually long wheelbase of 3.6 meters (about 11.8 feet) to allow for plenty of cabin room, as well as a more comfortable ride. Even the saloon doors offer a wide, welcoming embrace as you enter the car.

The four captain’s chairs have built-in seat belts and soft leather cushioning. (Although the white leather’s impracticality baffles me, as this car is definitely not self-cleaning.) The front seats turn to face the passengers. A touchscreen coffee table extends into the middle of the space with a quick tap, and even more touchscreens are built into the doors. Warm wood floors whisper of home.

Oh, you want to drive it? The steering wheel, accelerator and pedal



Watch the
video at
[go.pcworld.
com/
benzF015vid](http://go.pcworld.com/benzF015vid)



The Mercedes-Benz F 015

Luxury in Motion concept car can detect pedestrians and yield to them, beaming a safety zone onto the ground for added reassurance.

are still there, though they fold away when you're not driving. The dashboard is a touchscreen, too, and you can control it using eye or hand movements. Eye movements weren't working when we demoed the car, but the gesture control worked pretty well: You have to learn where to hold your hand so the dashboard can sense it.

A CAR THAT COMMUNICATES

Outside the car, the F 015 combines sensors with lights and vocal cues to communicate directly with pedestrians and other drivers. If the F 015 sees a biped waiting to cross, for instance, it'll stop, beam a laser crosswalk onto the pavement, and tell him or her to "please go ahead." (How long until some rascals hack into this system and alter the phrases?)

That crosswalk gimmick isn't just *noblesse oblige*, either. Mercedes-Benz is trying to figure out how a self-driving car would interact with its environment: pedestrians, bicyclists, and other cars of course—which may or may not be self-driving.

The company set up a demo where Roomba-like rolling robots took on these different roles and performed activities such as parking, playing a lawn game, and crossing an intersection while studiously avoiding collisions with each other.

Our ride ended all too soon. I had just set up a panoramic view of verdant forests on the touchscreens. Our driver shooed us out and used a smartphone app to send the F 015 to its parking space. Engineers checked it over carefully, while hungry cameras snapped at the car from behind.

My reluctance to leave the F 015 highlights the most intriguing idea about this concept car: It's designed for lingering. The comfy chairs, huge touchscreen vistas, and sociable seating intend to make your journey into something relaxing rather than arduous.

I don't like the idea that I'll need all this comfort because the future holds nothing but traffic jams and two-hour commutes. But I do like the idea that this car could save me from traffic's worst stresses, and that might be worth giving up some control. 🛑

Mercedes-Benz used

rolling robots to demonstrate how a self-driving car would function in an open environment. The blue-lit "car" at upper right heads for a parking spot while avoiding the pedestrians walking nearby.





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

**— EINSTEIN
adopted 12-09-10**

**A PERSON
IS THE BEST
THING TO HAPPEN
TO A SHELTER PET**



adopt

theshelterpetproject.org



HERE'S HOW

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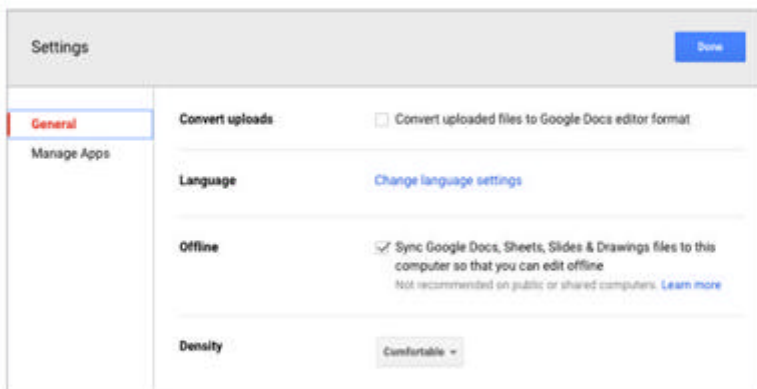
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Try these 5 undiscovered Google Drive tricks

Google Drive and its attendant apps offer a wealth of tools to help you be more productive. Try these five for the biggest boost.

BY MICHAEL ANSALDO



Using Google

Chrome, you can set Google Drive's apps to work offline.

Work offline

1 Like it or not, there are times when you have to work without an Internet connection. Fortunately, Google Drive has an “offline” mode that lets you create, view, or edit documents in these situations.

You'll need the Chrome browser to activate the offline feature. Go to your Google Drive account, click the gear icon in the upper right corner and select *Settings*. On the General tab, make sure the box labeled “Sync Google Doc, Sheets, Slides, & Drawings files to this computer so that you can edit offline” is checked. You'll need to work in Google Drive in Chrome when you don't have a connection, but all your changes will sync once you're back online.

Search for links from within a document

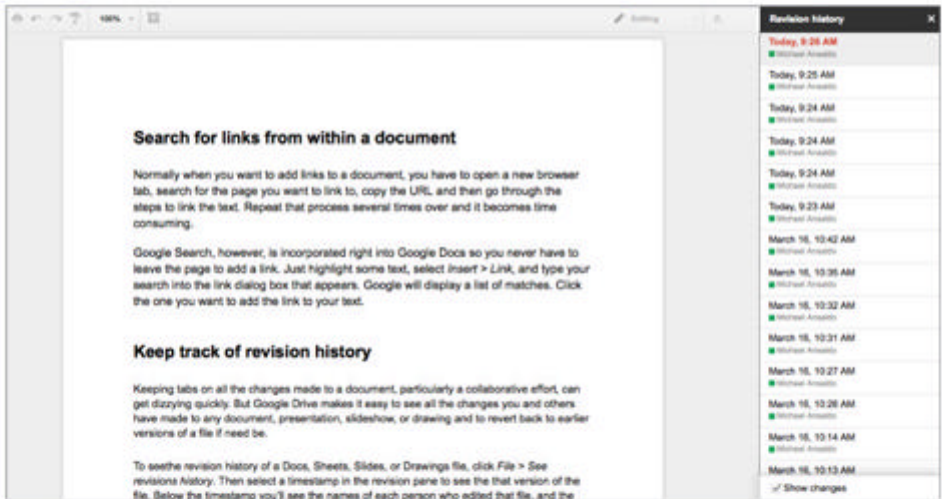
2 Normally when you want to add links to a document, you have to go through the tedious process of opening a new browser tab, searching for the page you want to link to, copying the URL, and going through the steps to link the text.

Google Search, however, is incorporated right into Google Docs so you never have to leave the page to add a link. Just highlight some text, select *Insert > Link*, and type your search into the link dialog box that appears. Google will display a list of matches. Click the one you want to add the link to your text.

Keep track of revision history

3 Keeping tabs on all the changes made to a document, particularly a collaborative effort, can get dizzying quickly. But Google Drive makes it easy to see all the changes you and others have made to any document, presentation, slideshow, or drawing. You can even revert to earlier versions of a file, if need be.

To see the revision history of a Docs, Sheets, Slides, or Drawings file, click *File > See revisions history*. Select a timestamp in the revision pane to see that version of the file. Below the timestamp you'll see

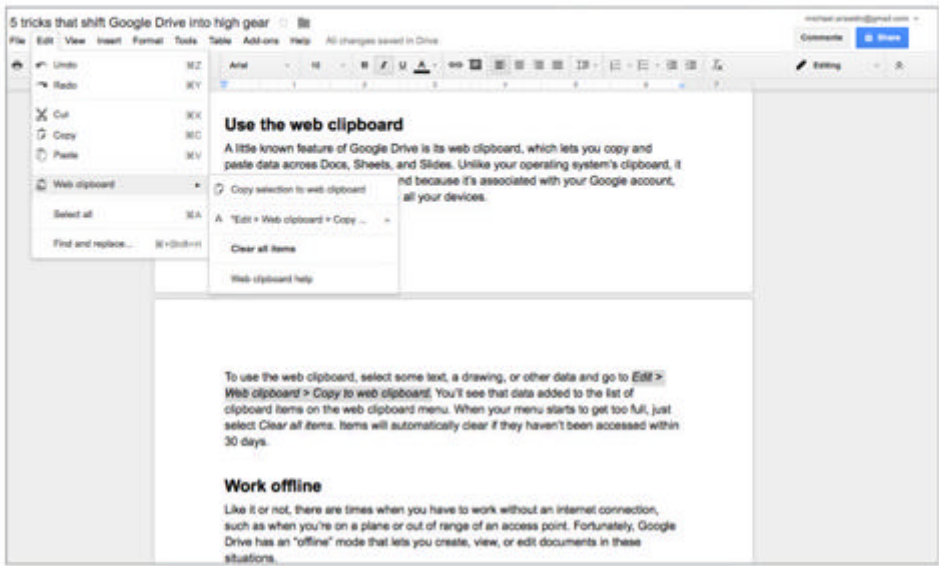


the names of each person who edited that file. The exact edits they made are shown in the document in the same color that appears next to their name.

By default, revisions are grouped into general time frames, but you can view more granular details by clicking *Show more detailed revisions* at the bottom of the revisions pane. To revert to the version you're currently viewing, click *Restore this revision*.

Revision history

helps untangle a document's changes and revert to earlier versions.



Use the web clipboard

4 A little known feature of Google Drive is its web clipboard, which lets you copy and paste data across Docs, Sheets, and Slides. Unlike your operating system's clipboard, it can hold multiple items at once, and because it's associated with your Google account, its contents are accessible across all your devices.

To use the web clipboard, select some text, a drawing, or other data and go to *Edit > Web clipboard > Copy to web clipboard*. You'll see that data added to the list of items on the web clipboard menu. When your menu starts to get too full, just select *Clear all items*. Items will automatically clear if they haven't been accessed within 30 days.

Publish to the web

5 Google Drive's sharing feature is great when you want to make a document available to a handful of people, but what if you want a wider viewing audience? For that, use Drive's Publish feature.

Web clipboard

holds multiple snippets of data and makes them available across all your devices.

To publish a document, spreadsheet, presentation, or drawing, open the file and click *File > Publish to the Web*.

Certain file types have some customization options

available on the menu: You can choose to publish an entire spreadsheet or just

single sheets, set the speed at which a presentation's slides advance, and choose the image size of a drawing. When you're ready, click *Publish*, then copy the link that appears and send it to everyone you want to view to file.

If you want the published file to update automatically when you make changes to the original, go to the File menu and select *Publish to the Web > Published content & settings*. Check the box labeled "Automatically republish when changes are made." To remove the published file, select *Stop publishing*. 

...you can choose to publish an entire spreadsheet or just single sheets, set the speed at which a presentation's slides advance, and choose the image size of a drawing.



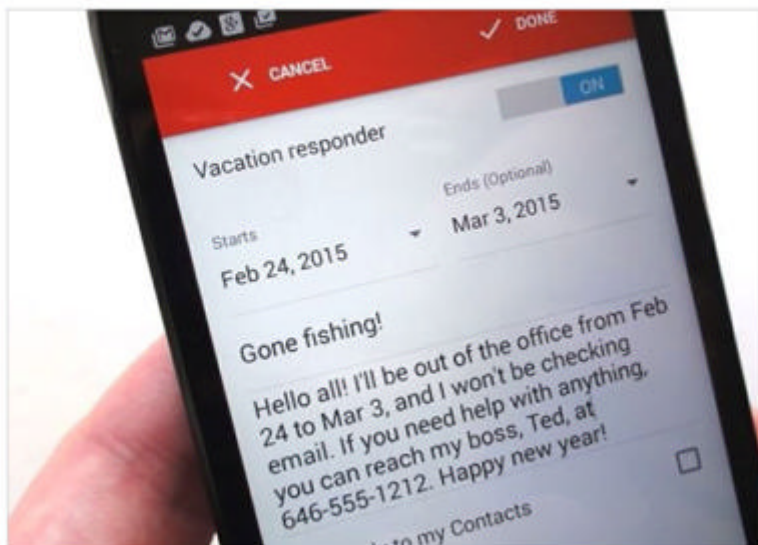
8 Gmail mobile app tricks for iOS and Android

BY BEN PATTERSON

THERE'S MORE TO the recently revamped Gmail app than a pretty Material Design. You can manage threads, sync subfolders, get notifications and more. We found eight new Gmail tricks for Android and iOS that will make your life easier.

Set a vacation responder (Android, iOS)

You can set a vacation reminder directly from the Gmail app, perfect for letting friends, loved ones, and coworkers know that you won't be replying for a good long while.



For Android: Tap the menu button in the top-left corner of the screen, scroll down and tap *Settings*, then tap the Gmail account for which you'd like to set an out-of-office message. Tap *Vacation Responder*, then fill in the start and end dates, a subject line, and the body of your message. Checking the box next to “*Send only to my contacts*” will ensure that only people you know will get the message. Flip the “*Vacation responder*” switch on, then tap *Done*.

For iOS: Tap the menu button in the top-left corner of the page, then tap the *Settings* button (the one shaped like a gear) next to your email address. Flip the *Vacation Responder* switch, then fill in the blanks—you know, start and end dates, subject line, message, and so on. Tap the *Save* button.

Bonus tip: Any vacation message you set in the web version of Gmail will automatically sync with the Vacation Responder settings for the Gmail app, and vice versa.

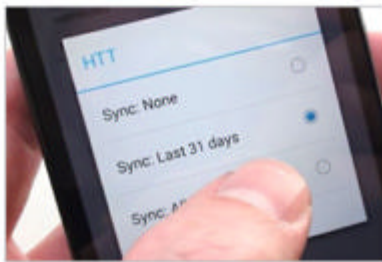
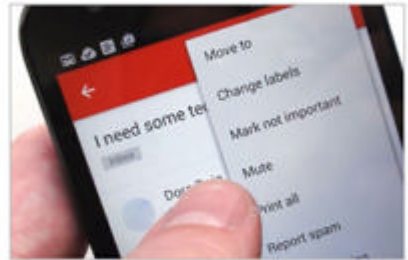
Shush an annoying email thread (Android, iOS)

Gmail makes it easy to “mute” an annoying message thread—like the kind where everyone chimes in with a “congrats!” or “so cute!” or “see

you there"...over and over again. Once muted, the thread won't appear in your inbox again unless you're the only person in the To field.

See a message thread you'd like to mute? Open it, tap the three-dot (for Android) or down-arrow (for iOS) menu in the top corner of the screen, then tap *Mute*.

Want to unmute a message? Search for "**is:muted**," open the muted message you'd like to unmute, then move it back to the inbox. That will clear the thread's Muted label.



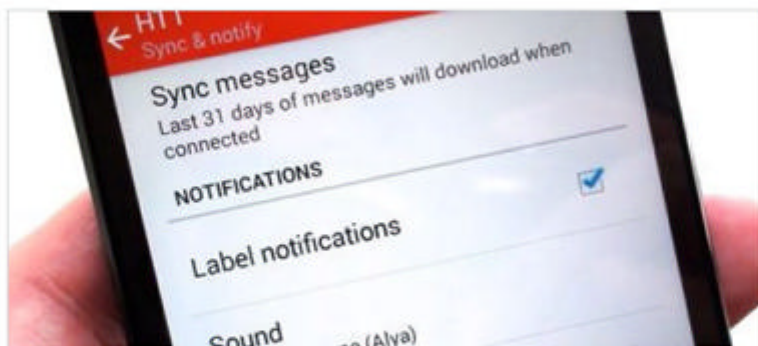
Automatically sync message folders besides the inbox (Android)

By default, the Gmail app syncs only your inbox (or inboxes, if you're signed into multiple accounts). All your other

message folders—er, labels—will only be synced when you open them manually. You can set the Gmail app to sync some or all of your labels automatically, not just the inbox—and that will give you some interesting options when it comes to email notifications.

Tap the menu button in the top-left corner of your Gmail inbox, scroll down and tap *Settings*, then select a Gmail account. Next, scroll down to the Data Usage section and tap *Manage labels*. Select a label, tap *Sync messages*, then pick an option: *None*, *Last 30 days (or another period of time)*, or *All*.

Bonus tip: The more labels you sync, the more mobile data you'll use, so you may want to sync your Gmail labels sparingly.



Get notifications for the Gmail labels you choose (Android)

Now your Gmail app is syncing some of your labels, how about getting a notification whenever a new message with that label hits your account? That could come in handy if you've got Gmail filters that automatically label messages as they arrive, bypassing your inbox as a result.

Go back to the Manage labels setting. Tap the menu button at the top of your inbox, scroll down, tap *Settings*, select an account, tap *Manage labels*, then pick a label that you're syncing.

Check the *Label notifications* box, then choose an alert tone, toggle vibrations on or off, and decide whether you want a notification for each new message with a given label.

Decide how many messages you'd like to sync (Android)

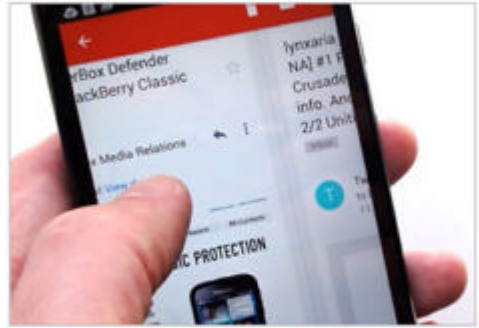
Back when we were learning how to sync messages with certain Gmail labels, one option was how many days of messages you'd like the Gmail app to sync: none, a specific number, or all.

You can decide how many messages you'd like Gmail to sync for your inbox and other specified labels—anywhere from one to a hundred or more. (Again, the more old messages you sync, the more mobile data you'll use.)

Tap the menu button in the top-left corner of your Gmail inbox, scroll down and tap *Settings*, then tap an account. Tap *Days of mail to sync* and make a selection.

Swipe between message threads (Android, iOS)

Here's a handy little Gmail feature that's easy to miss. Want to read the next message thread in your inbox? No need to tap the Back button to return to the inbox screen. Instead, just swipe from right to left (for older threads) or left to right (for more recent threads).



Attach big Google Drive files to your messages (Android, iOS)

With a little help from Google Drive, you can send a massive file—as in, say, more than a few GB—to a friend via email, or deliver a large batch of files.

Don't have a Google Drive account? Well, if you're using Gmail, you've actually got one already (drive.google.com).

First, you'll need to load the files you want to send into Google Drive. Open your Google Drive account, then drag the file you want to send onto the web page. The file should begin uploading automatically.

Next, open the Gmail app, compose a new message or reply to an existing one, tap the Attach button (it looks like a paperclip), then tap *Insert from Drive*.

Find the file you want to send, tap it, then tap the *Select* button (for Android) or the curved arrow (on iOS).

Check a non-Gmail account (Android)

Nope, Gmail isn't just for Gmail any more. The latest version of the Gmail app for Android lets you add non-Gmail email accounts, such as

Yahoo Mail, Outlook, or any account that supports the POP or IMAP email protocols.

Just tap the menu button in the top-left corner of your inbox, tap your email address, tap *Add account*, select *Personal (IMAP/POP)*, then tap *OK*.

For popular email services like Yahoo and Outlook, Gmail should be able to guide you through the setup process using nothing but your email account and password. Otherwise, you may need to know some other information, such as your email provider's POP and IMAP settings. For those details, check your provider's Help pages. 

How to run Windows software in Linux

BY CHRIS HOFFMAN



LINUX IS MORE capable than ever. With over 1000 Linux games available on Steam and a general shift towards more web-based desktop software, there's less need for Windows than ever. After all, you can now watch Netflix on Linux without any hacks, and you can even use Microsoft Office on Linux—a web-based version of it, at least.

But, as most dedicated Linux desktop users will eventually discover, there comes a time when you just need to run a particular piece of

Windows software on your Linux PC. There are quite a few ways to do so. Here's what you need to know.

Wine

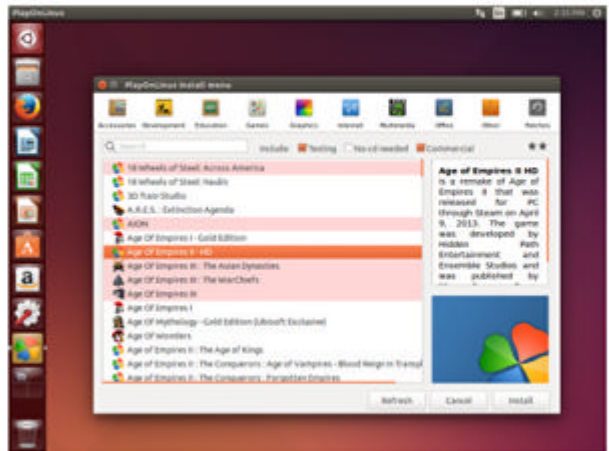
Wine is a way to run Windows software on Linux, but with no Windows required. Wine (winehq.org) is an open-source “Windows compatibility layer” that can run Windows programs directly on your Linux

desktop. Essentially, this open-source project is attempting to re-implement enough of Windows from scratch that it can run all those Windows applications without actually needing Windows.

This is the only method here that won't actually require a copy of Windows, but the downside is that it won't run every application properly. You may encounter bugs or performance issues, especially if you're using Wine to play video games. But if you're running a popular game released a few years ago, you may find that it performs very well. Many people use Wine to play World of Warcraft on Linux, for example. You can get an idea of how an application will run and any tweaks it might require by visiting the Wine Application Database website (appdb.winehq.org) and searching for that application.

First, download Wine from your Linux distribution's software repositories. Once it's installed, you can then download .exe files for Windows applications and double-click them to run them with Wine. You can also try PlayOnLinux (playonlinux.com), a fancy interface over Wine that will help you install popular Windows programs and games.

Codeweavers also offers a commercial version of Wine, known as CrossOver Linux (go.pcworld.com/crossoverlinux). You have to pay



PlayOnLinux's
version of
Wine, running
on Ubuntu

to use it, but Codeweavers tries to go out of their way to officially support popular applications (like Microsoft Office, Adobe Photoshop, and some big PC games) and ensure they work properly. Codeweavers also contributes its changes back to the main Wine project.

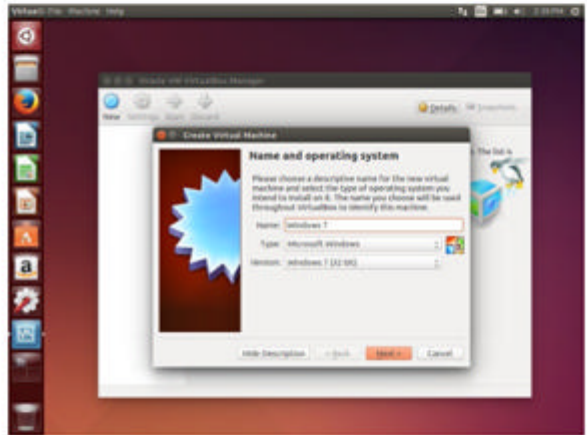
Virtual machines

Virtual machines are a very convenient way to run Windows software on your Linux PC. As PCs have gotten faster, virtual machines have become comparatively more lightweight.

This process involves installing a copy of Windows in a “virtual machine” program like VirtualBox (virtualbox.org), VMware, or Linux’s built-in KVM (Kernel-based Virtual Machine) (linux-kvm.org) solution. That copy of Windows thinks it’s running on real hardware, but it’s really running in a window on your desktop. Modern virtual-machine solutions can even break Windows programs running in the virtual machine out of that window, allowing them to act like normal windows on your Linux desktop.

This solution is more foolproof than Wine. As you’re running those Windows applications on an actual copy of Windows, you won’t encounter bugs.

Using a virtual machine does require a full copy of Windows, however, and there is more hardware overhead because that copy of Windows has to be running alongside your primary operating system. In particular, demanding PC games that need access to your computer’s graphics card won’t perform well at all—you’re better off with Wine for those. But for productivity applications like Microsoft Office or Adobe Photoshop, this is an excellent solution.



VirtualBox in Ubuntu Linux.

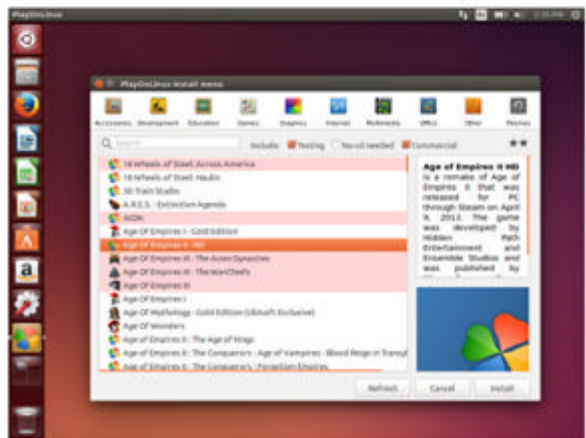
Dual-booting

Dual-booting isn't technically a way to run Windows software on Linux itself, but it is how many Linux users run Windows software. Rather than using it directly under Linux, you just reboot your computer, choose Windows, and boot into Microsoft's operating system. The Windows software can then run in its native environment. Thanks to modern solid-state drives (go.pcworld.com/ssd), that reboot process should be faster than ever.

This is particularly ideal if you're a PC gamer who just can't give Windows up yet. Rather than forgoing all those Windows games, you can just reboot your computer when you want to play Windows-only games. As you're using plain-old Windows running directly on the hardware, you won't have to deal with any compatibility or performance headaches.

The best way to set up a dual-boot system is to install Windows first—if your computer came with Windows installed, that's good enough. Next, install the Linux distribution of your choice and tell it to install alongside Windows. You'll then be able to choose your preferred operating system each time you boot your computer. This Ubuntu guide (go.pcworld.com/ubuntuwindualboot) to installing Linux beside Windows can help walk you through the process.

The best option really depends on what you're trying to do. If you need to run a single application or game that works well in Wine, Wine may be ideal. If you need to run a variety of desktop applications—like the most modern versions of Office and Photoshop, a virtual machine will be best. If you're a PC gamer who still wants to play the latest Windows games, dual-booting will give you the performance you want without the headaches of Wine. 🍷



Installing Linux
in a dual-boot
configuration.



3 tips for easier migration to a new browser

RECENTLY, I SWITCHED to Firefox after Chrome became unresponsive and buggy one too many times. Switching between browsers never used to be a big deal, but that's just not the case now. We customize these programs with extensions, sync open tabs to our mobile devices, and, if you're using Chrome, run apps like they're native to the desktop. If you're thinking about moving between browsers, we show you three things to consider as you plan your move.

Know your sync

1 A key feature for many users is being able to move seamlessly between open browser tabs on any device as well as access your complete browsing history. Google makes this really easy for Android users with Chrome, but other browsers also offer this feature.

Firefox has a feature called Sync that syncs all your browsing data between devices, and Opera's is called Link. Firefox is available on Android (an iOS browser is in the works), while Opera has mobile browsers on

Android, iOS, and Windows Phone. If you're using Safari on an iPhone and a Windows PC, you're a little more limited to what you can sync, but iCloud does allow you to sync your Safari bookmarks with Internet Explorer.

Bookmarks

2 You can't go anywhere without your bookmarks, but luckily this was a problem that was solved a long time ago. We won't go into detail on how to move your bookmarks here. Instead, I'll point you in the right direction for all four major browsers on Windows.

- Chrome: import or export (go.pcworld.com/chromemove)
- Firefox: import (go.pcworld.com/firefoximport), export (go.pcworld.com/firefoxexport)
- Internet Explorer: import or export (go.pcworld.com/explorermove)
- Opera: import or export (go.pcworld.com/operamove)

Check out your new extensions or add-ons

3 Everybody's usually got a few tweaks they've added to their browser via extensions—also known as add-ons in Mozilla-speak. The one thing you'll want to make sure of is that any mission critical services carry over to your new browser, such as a browser-based password manager or services like Evernote.

The reality, however, is that sometimes you may have to give things up or find an alternative. Firefox users won't find NoScript on Chrome, but there are a few alternatives that do something similar. Chrome users moving to Firefox will have to give up Hangouts as a stand-alone app unless they're willing to try an unofficial add-on or just run Chrome in the background to keep Hangouts going. Many of the mainstream services will offer extensions on all the major browsers, but niche stuff like Vimium may be harder to replace.

Those are the main points to think about when moving between browsers. There are other considerations such as the browser interface, how tabs behave on certain websites, and so on, but those are issues that come down to personal preference more than anything else. 🍷



What to do if someone steals your IP address

Sam Cook's ISP informed him that he has been downloading illegal material. He has done no such thing. He asked me to help him solve this problem.

Neither your ISP nor anyone else can actually tell what you are doing on the Internet. But they can follow the activity of your public IP address—the one your router uses to access the Internet. And if someone else uses that address for unsavory purposes, you could become a prime suspect.

Your public IP address is readily accessible on the Internet. Anyone

can use it to discover your general location (your neighborhood, not your house) and your ISP. Your ISP can identify it as yours and will do so if subpoenaed.

So how could someone else be using your public IP address?

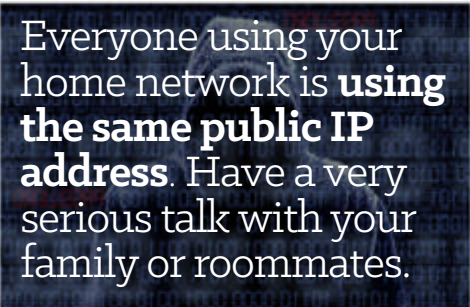
It could very likely be someone you live with. Everyone using your home network is using the same public IP address. Have a very serious talk with your family or roommates.

Another possibility: A neighbor may have hacked into your Wi-Fi network and is now using it without your permission.

You can stop this by changing your Wi-Fi network's password and tightening your router's security.

Something else to keep in mind: Most home Internet connections use a dynamic IP address. From time to time, your address will change. When your ISP accuses you of illegal activity, ask them how long you've had that particular address. Yes, they should have looked that up before contacting you, but we all know that ISPs often lack sterling customer service records.

Finally, it's possible that someone far away could actually be spoofing your IP address. Discuss the possibility with your ISP, and ask them to give you a new IP address. If they comply and the illegal activity stops, you've solved the problem. 🚫



Everyone using your home network is **using the same public IP address**. Have a very serious talk with your family or roommates.

Tech Spotlight

A video showcase of
the latest trends



Watch the
video at
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