

CONNECTING EVERYTHING TO THE INTERNET: WHAT COULD POSSIBLY GO WRONG?





COVER STORY

CONNECTING EVERYTHING TO THE INTERNET: WHAT COULD GO WRONG?

Smart connected devices are not always all that smart.

FEATURES

DNA DATA STORAGE

The next big thing in data storage could be based on something completely organic.

DIGITAL HUMANITIES

This promises to be the most exciting new field you've never heard of.

WHAT'S NEW NOW



REPORT: 300B PASSWORDS AT RISK BY 2020

Damage from data theft could reach \$6 trillion annually.

KOEI TECMO CREATES 5 SENSE VIRTUAL REALITY MACHINE

It's not a headset; it's much, much more.

NEW RESEARCH SUGGESTS ANYONE CAN BECOME AN INTERNET TROLL

Bad moods breed trolling, and trolling leads to more trolling.

TOP GEAR



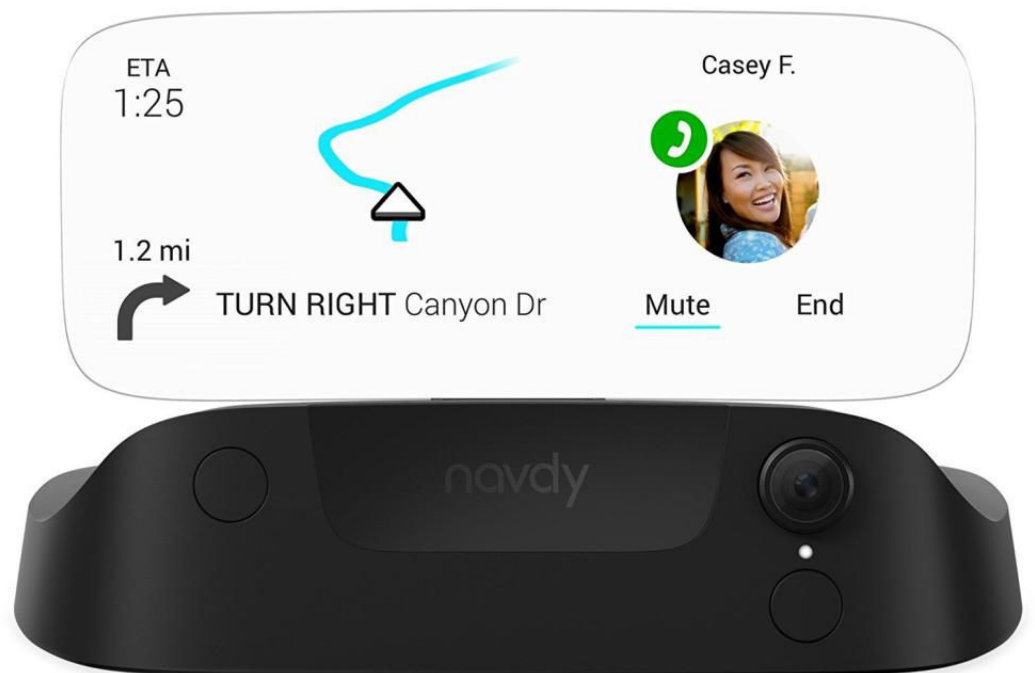
REVIEWS

CONSUMER ELECTRONICS

LG Smart Security Wireless Camera LHC5200WI (With ADT Canopy)

Navdy

Nvidia GeForce Now



Navdy

HARDWARE

Dell XPS 13 2-in-1 (9365)

Asus Chromebook Flip (C302CA-DHM4)

HP Envy 34 Curved All-in-One (2017)



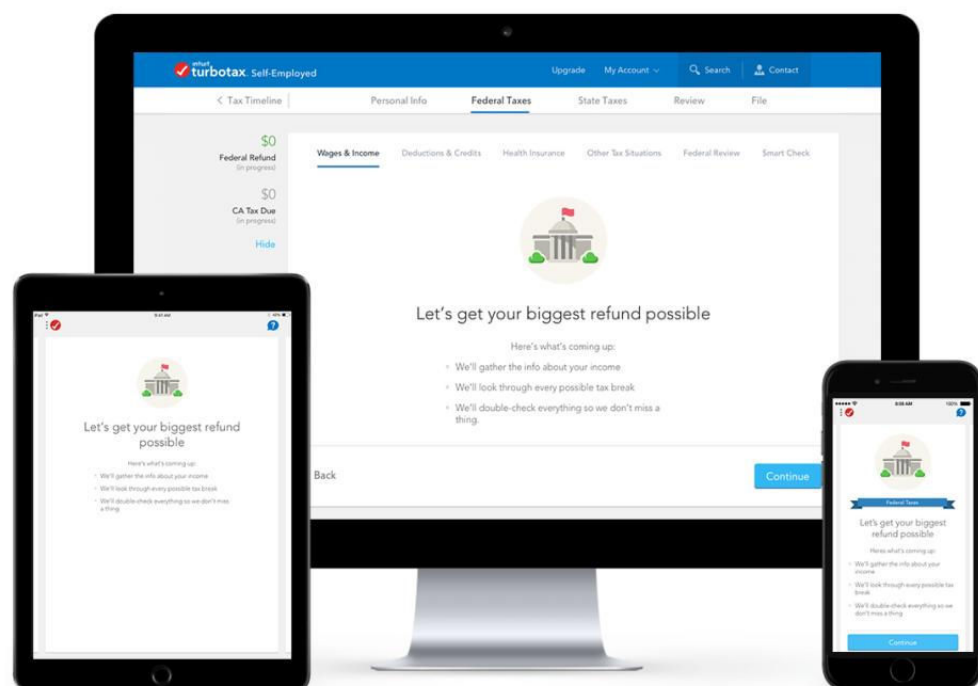
Asus Chromebook Flip (C302CA-DHM4)

SOFTWARE & APPS

Roundup: 5 Top VPN Services

TurboTax

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Turbotax

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DAN COSTA

First Word

READER INPUT

SASCHA SEGAN

**Why the New FCC Chair
Should Leave You Ajit-ated**

TIM BAJARIN

**We Need Smartphone Version
of the Lenovo Yoga Book**

DOUG NEWCOMB

**Watch Out, Bambi: Self-
Driving Car Coming Through**



**Robots can't do
any reporting,
can't make
phone calls,
can't go into
the field.**



JOHN C. DVORAK

Last Word

TIPS & HOW TOS



GET ORGANIZED

How to Make Home & Business
Emergency Documents in
Under an Hour

TIPS

Get the Best Cable Modem:
Buy or Rent?

HOW TO

Share More (or Less) Personal
Data With Cortana.



Pitfalls of the IoT

As a guy who makes his living writing about new technologies, I tend to be a techno-optimist. We are living in fantastic times; computers are cheap, a huge portion of the population carries a smartphone, and the world's knowledge is at our fingertips. And the Internet of Things (IoT) is becoming a reality. Yet there is a darker side to explore. In this month's cover story, Max Eddy shows just how dark things can get—but I want to add two recent examples to set the stage.

The PetNet SmartFeeder is a perfect example of the IoT. The SmartFeeder replaces the traditional food bowl with an Internet-connected container that lets you feed your pet remotely. Problem solved, right? A couple of critiques can be made, though. First, the SmartFeeder sells for \$150. I'm not familiar with the fees professional pet sitters charges these days, but that's a substantial markup over a traditional bowl.

The second critique is less obvious but just as valid. In 2016, some of PetNet's third-party servers went down. As a result, the service stopped working. The company notified its customers of the problem via email and posted a notice on Twitter. Even so, it is fair to say that a lot of customers had no idea the service was down, and a bunch of confused kittens and puppies started wondering why their robot owners hated them. As far as I can discover, the service was back up after a few days, and no pets suffered permanent harm.

This outage was PetNet's fault for not having appropriate backup, but the truth is that connecting a device to the internet always complicates things. What if your power goes out? What if the Wi-Fi signal drops? The stakes get higher than hungry cats.

Just a few months after PetNet went down, investigative journalist Brian Krebs' website got hit by a distributed denial of service (DDoS) attack. Krebs is an intrepid and well-known security expert, so it isn't surprising that he would be a target. But this attack was different. In fact, it was the largest DDoS attack ever in the history of the internet, slamming his site with up to 665 gigabits of data per second; the previous record was 363gbps gigabits per second.

The attack was so strong that Akamai, the caching company that hosts a big part of the internet (including PCMag.com) had to cut off his site. The presumption was that only a state power could have mounted such a devastating attack.

In the aftermath, the likely culprit was identified—a strain of malware called Mirai. But this attack wasn't launched from PCs and servers. Instead, it was hosted by millions of IoT devices, mostly internet-connected security cameras and DVRs. Many of these devices were originally made in China by an OEM called XiongMai Technologies, but the products themselves were all over the world. A few weeks later, a similar botnet attacked Dyn, an internet backbone provider. That attack caused sites including Twitter, Amazon, Tumblr, Reddit, Spotify, and Netflix to wobble and even drop offline.



What if your power goes out? What if the Wi-Fi signal drops? The stakes get higher than hungry cats.

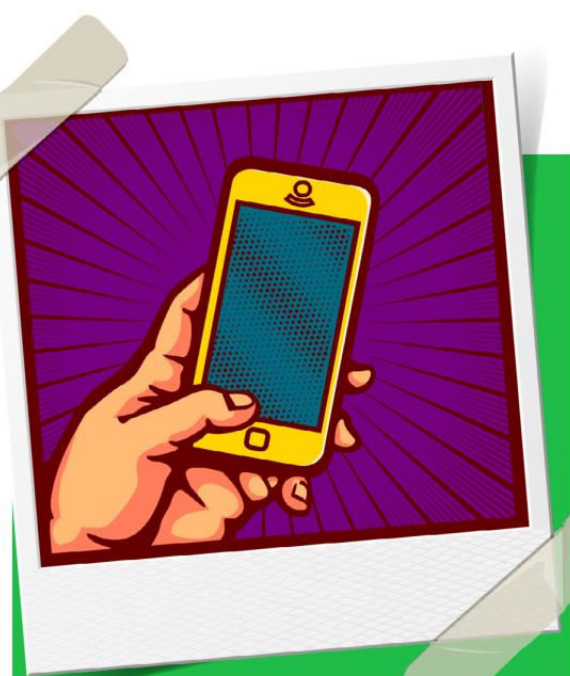


By all means, download some antivirus software for your laptop. But how are you going to secure your DVR?

High cost, low security, dubious user value: These problems are also the Internet of Things. As products flow through the PCMag Lab for testing, we'll keep these points in mind to help you make smart buying decisions. In the meantime, be careful out there.

Now, if you'll excuse me, I have to test this Weight Gurus connected scale. It syncs with FitBit!

dan_costa@pcmag.com



Are Smartphones Obsolete?

In our February issue, Evan Dashevsky asked whether the smartphone was already passé. “In fact,” he stated, “I would argue that the next great form factor is already here.” Here’s what you think.

The next revolution after smartphones is wearable augmented reality with gesture-reading and verbal input. That’s going to require an unobtrusive version of Google Glass or Hololens. Part of the problem with Google Glass is it was too early; people were spooked by others recording and researching them on the fly without their knowing. Now people are [blasé] about taking phone pictures, and nobody even blinks at someone using their phone for checking things on the internet. As for the next revolution after that, it will probably be implantable augmented reality and computer control. Probably 5 to 10 years for bugs to be worked out, costs to come down, security to be at acceptable risk levels, and people to get used to and adopt.

—*Houmid*

Remember the eye rolls that Bluetooth earpieces used to get? I still roll my eyes at them anywhere but at a desk in a business environment.

—*cecil77*

‘Is the smartphone already obsolete?’ Answer: No. It’s very odd that someone would think that smartphones are obsolete when more than a billion of them have been sold in the past year (Apple alone sold close to a quarter billion iPhones last year). Yet desktop and laptop PCs sold less than 10 percent of the amount of smartphones, and sales of PCs have been dropping precipitously for the past 5 years, and is expected to continue to drop this year. But no one

is saying that desktop and laptop PCs are “obsolete,” are they? It is even more odd that you would suggest that the HoloLens (and other VR headsets) is “the next big technological paradigm” to replace smartphones. I can’t imagine the number of deaths and injuries that would result from people walking across streets or driving cars, wearing these cumbersome headsets. The number of deaths and injuries from people using smartphones in those situations is bad enough, but VR headsets would make smartphone accident numbers insignificant in comparison.

—*Jurassic*

For those who don’t want to give Apple credit, imagine what smartphones would look like today if Apple hadn’t produced the iPhone. Would they all look the way they do, large touchscreen displays with colorful icons for applications? I doubt it. My bet is that every single phone would still have some sort of hardware keyboard. Blackberry might be number two, with Android having emulated BlackBerry and not iOS. All the phones would work like BlackBerries.

—Neal Cammy

For AR to be a viable replacement for the smartphone, it has to successfully marry gestures and

voice with the AR display. For example, if I want to take photos, I need to indicate I want a camera, have a virtual camera or viewfinder appear, and have a way to take a photo or record video. Things like photo filters and zoom lens controls need to be easy to access as well. Virtual keyboards are another needed feature.

—*Jeffrey Clinard*

I’m not an ‘early adopter’ type of person, so I’ll be waiting for the AR/VR googles to be the same size and weight of my regular glasses before I bother with it. I’ll be doing the same with all the IoT devices. I need to see a real practical advantage for the price before I’ll jump.

—*Steve Sadler*

Ask us a question

Have a question about a story in *PC Magazine*, one of the products we cover, or how to better use a tech product you own? Email us at letters@pcmag.com and we’ll respond to your question here. Questions may be edited slightly for content and clarity.

Report: 300B Passwords at Risk by 2020

BY TOM BRANT



Not all passwords are created equal, according to a new report from research firm Cybersecurity Ventures, which estimates that by 2020, hackers will have their choice of 300 billion passwords to target.

That total includes an estimated 100 billion user account passwords for things such as social media and email, as well 200 billion passwords or credentials used to log into Internet of Things (IoT) devices. So-called “privileged accounts,” used to maintain IT infrastructure, will be among the most frequently targeted, because they are stored in multiple places and provide access to entire networks of devices.

“One privileged account password breach can allow a hacker to access and steal the credentials and passwords belonging to every employee in a company,” Joseph Carson, Chief Security Officer of Thycotic and one of the report’s co-authors, said in a statement.

Similarly, since consumers often reuse passwords for multiple online accounts, a breach at one site—for example, the massive Yahoo breach revealed in December—will likely provide hackers easier access to accounts at many other sites.

The report also claims that most social media users do not use multi-factor authentication for logins, despite repeated attempts from social media companies to encourage its use. Multi-factor authentication requires a user to enter a unique code generated for a specific login attempt in addition to his or her regular password.

The damage from password theft—which will keep happening, the report predicts—could reach \$6 trillion annually by 2021.

It’s worth noting that the 300 billion passwords figure is a conservative number: it assumes an average of 25 passwords per Internet user, and apparently doesn’t include laptops, desktops, or other non-IoT devices.

“**The report estimates that by 2020, hackers will have their choice of 300 billion passwords to target.**”



Koei Tecmo's Five-Sense Virtual Reality Machine

BY MATTHEW HUMPHRIES



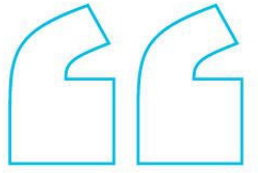
Virtual reality is seen as paving the way for the next generation of interactive entertainment. But right now, it's quite limited. You have cables to worry about, you need extra gadgets to immerse other parts of your body beyond your vision, and you need a large, empty environment in which to enjoy your VR without injury.

Japanese video-game publisher and developer Koei Tecmo doesn't want to wait for virtual-reality technology to mature, so it came up with an alternative. Rather than requiring users to wear a VR headset, it created a virtual reality machine a person sits inside, called VR Sense, that promises to stimulate all five of your senses.

The VR Sense looks similar to a typical arcade racing game, with a seat in front of a display. But it offers 3D visuals as well as a “fragrance function, touch function, wind function, thermal cooling function, and mist function.” So you’ll be able to smell the action, experience the wind rushing through your hair, and feel temperature changes—and if it’s raining in a game, you’re going to get wet.

According to entertainment site TheWolfHall, VR Sense is expected to launch at some point in summer 2017 and looks likely to first appear in Japanese arcades. Three games will be included at launch: a GI Jockey horse-racing game, an entry in the long-running Dynasty Warriors series of games, and an as-yet-untitled VR horror game that’s sure to be extra scary, providing the VR Sense stimulates all five senses properly.

Interested gamers will have to pay per play, and while pricing has yet to be announced, I doubt this will be a cheap machine to use. Hopefully VR Sense makes it outside of Japan, so we can give it a try. I’d really like to know what fear smells like, and the fragrance function on this machine may answer that question.



**It offers 3D
visuals as
well as a
fragrance,
touch, wind,
thermal
cooling and
mist
functions.**



New Research Suggests Anyone Can Become an Internet Troll

BY ANGELA MOSCARITOLO



Are people born Internet trolls, or does the Internet turn them into horrible people? New research from Stanford University and Cornell University suggests that it's the latter.

The research, published as part of the upcoming 2017 Conference on Computer-Supported Cooperative Work and Social Computing, offers evidence that anyone has the potential to become a troll.

“We wanted to understand why trolling is so prevalent today,” Stanford computer science researcher and lead author of the paper Justin Cheng said in a statement. “While the common knowledge is that trolls are particularly sociopathic individuals that occasionally appear in conversations, is it really just these people who are trolling others?”

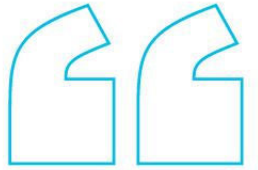
Cheng and his team set up an experiment with 667 subjects recruited via a crowdsourcing platform to investigate whether trolling is an innate character flaw or if situational factors can influence people to act like trolls. In the first part of the experiment, participants were given a test, which was either very easy or very difficult. After the test, they were asked to fill out a questionnaire assessing their mood. As you might have guessed, those who took the hard test were in a worse mood than those who took the easy one.

Next, subjects were asked to read an article and engage in the comment section. They were instructed to leave at least one comment, but could engage beyond that as they saw fit. Everyone saw the same article on the same platform, created just for the experiment, with one exception: Some were given a forum with three troll posts (defined in the research as those containing personal attacks or curse words) at the top, while others saw three neutral posts.

Here's what the researchers found, according to the news release:

“About 35 percent of people who completed the easy test and saw neutral posts then posted troll comments of their own. That percentage jumped to 50 percent if the subject either took the hard test or saw trolling comments. People exposed to both the difficult test and the troll posts trolled approximately 68 percent of the time.”

The researchers also analyzed anonymized data from CNN's comment section from 2012. The data set consisted of more than 1.1 million users, more than 200,000 discussions, and more than 25 million posts.



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While it wasn't possible to evaluate commenters' moods, the researchers looked at the timestamps of posts. Previous research suggests that the time of day and day of the week have an effect on people's moods (think Monday morning versus Friday afternoon).

"Incidents of down-votes and flagged posts lined up closely with established patterns of negative mood," the researchers found. "Such incidents tend to increase late at night and early in the week, which is also when people are most likely to be in a bad mood."

Finally, the researchers created an algorithm that aimed to predict bad behavior, based on a number of factors, including whether the previous post in the discussion was flagged and the author's overall history of writing flagged posts. They found that the flag status of the previous post in the discussion was "the strongest predictor" of whether or not someone would troll.

So basically, bad moods breed trolling, and trolling leads to more trolling.

What We Love Most This Month

BY PCMAG STAFF



UNALIWEAR KANEGA WATCH

With built-in cellular and Wi-Fi access, the Kanega P.E.R.S (Personal Emergency Response Systems) smartwatch for seniors won't require tethering to a smartphone. Its monthly fee will cover cellular service, medical alerts and operator call-back for falls panic and dementia-related confusion, and GPS for getting people home safely via step-by-step instructions. The Kanega is voice-activated for hands-free use, does medication reminders, and solicits self-reporting. Users can say, "Did I take my meds at noon?" and the watch will scroll back to check. It responds to affectionate monikers, too.

Available mid-2017, www.unaliwear.com

SENSTONE

The Senstone, being crowdfunded on Kickstarter at this writing, is a small, wearable voice recorder that lets you record quick voice notes (or any nearby audio) by pressing a button. The LEDs glow in a starburst pattern and flash as it captures sound. We previewed it and found that it's surprisingly well designed and functional for early hardware and software. The company plans to integrate some intriguing AI-based features, too.

Available July 2017, www.kickstarter.com



LOFELT BASSLET

The Basslet portable subwoofer straps onto your wrist so you can literally feel the music.

Using haptic technology, Basslet creates a physical experience: The proprietary LoSound engine recreates bass frequencies from 10 Hz to 250 Hz in high fidelity, and sends them directly to your body.

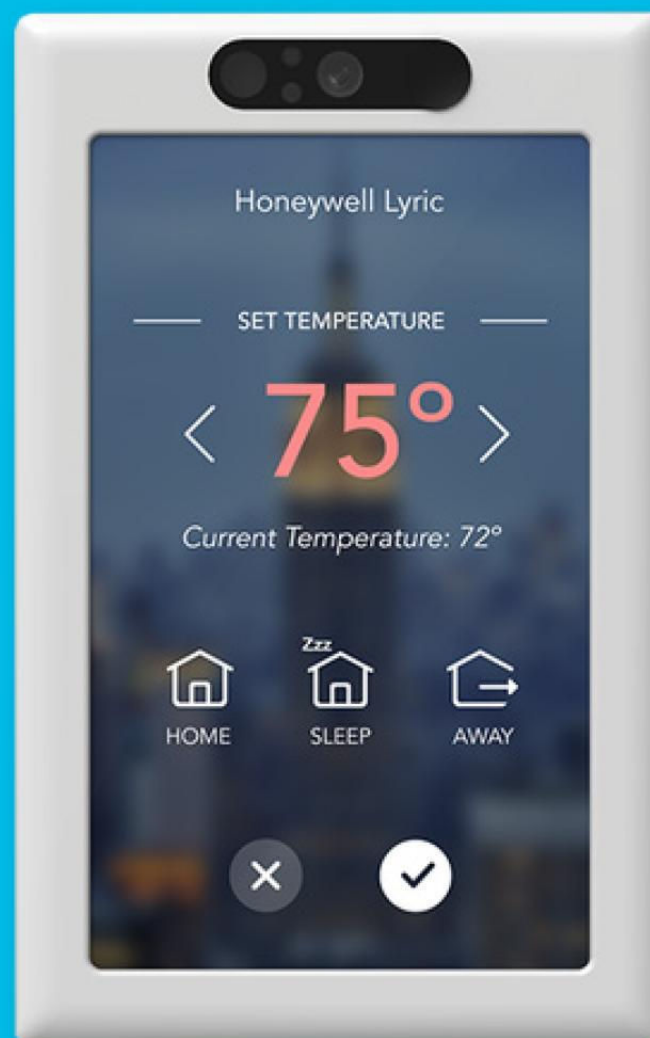
\$199.00, Amazon.com



BRILLIANT CONTROL

This smart-home controller installs right into the space where a light-switch would normally go, and you can use it via voice or touch. Yes, you can dim your lights and turn them on or off—and it's compatible with Home, Nest, and other smart-home systems, so you can control those devices if you have them. And it incorporates Amazon Alexa Voice Services, so it can stand in for an Echo or Dot.

\$149.00, www.brilliant.tech



PROFESSOR EINSTEIN: YOUR PERSONAL GENIUS

Been to the Uncanny Valley lately? Now you can find Einstein there. Hanson Robotics claims the eerily lifelike Professor Einstein is everything you ever wanted in a personal robot—assuming that you want a robot that can hold an enlightened conversation with you, teach you all kinds of great science-y stuff, help you keep your schedule organized, and even give your brain a workout with challenging puzzles and games.

\$299.00, www.professoreinstein.com



We Need a Smartphone Version of the Lenovo Yoga

Over the holidays, I started testing the Lenovo Yoga Book—the Android and Windows versions—and found its clamshell laptop-like design to be one of the most innovative I’ve seen in the past five years.

Both sides of the Yoga Book have a screen. One side is the video display while the other side can be used as a virtual keyboard and writing surface. It’s extremely slim and light, and uses the “watch band” hinges to tie these two screens together.

Apple watchers may recall that the idea for the iPad came before the iPhone. When engineers showed Steve Jobs a prototype tablet, he asked if it could be done with a smaller screen and the iPhone was born.

As I used Lenovo Yoga Pad, I had a similar thought. The Yoga Book has a great display, and the second screen adds extra user interface touches that make it more versatile. Although I am still not proficient using the virtual keyboard, I appreciate the role of that second glass display.

Now imagine if that design was available on a 5.5-inch smartphone that folded out to feature multiple displays? In folded mode, it would look and act like a normal smartphone. But open it up to double the surface space and turn it into an



Tim Bjarin is the president of Creative Strategies and a consultant, analyst, and futurist covering personal computers and consumer technology.

8- or 9-inch tablet. This would take serious engineering chops to create, but it could drive mobility to a new level.

Apparently, I am not the only one who thinks this is an interesting idea. Microsoft recently filed a patent for a foldable smartphone, while Samsung's Galaxy X has a similar concept; a three-screen device with foldable displays.

What appeals to me most about this design concept is that a smartphone could double as a tablet. Today I carry an iPhone and iPad, but it would be nice to merge them into one.

While this concept is highly speculative on my part, I am convinced that if it could be thin enough to be a solid smartphone and unfold for tablet features, too, this design could deliver the kind of innovation the market needs.

tim_bjarin@pcmag.com

Watch Out, Bambi: Self-Driving Car Coming Through

Fully self-driving cars will need to handle lots of variables: aggressive drivers, temporary detours, and animals in the road, to name just a few. Autonomous technology currently can deal with harassment-prone people and construction zones, but it may not be able to avoid killing critters in order to keep the humans inside a self-driving car safe from harm.

According to the Insurance Institute for Highway Safety, about 200 people are killed each year in vehicle collisions with wildlife. State Farm reports that drivers in the US collided with 1.25 million deer alone in 2014, causing \$4 billion in damage to vehicles—and a mess on roads. The Virginia Department of Transportation spends \$4 million per year disposing of roadkill.

While millions more animals die every year in collisions with vehicles, most of these are non-issues for drivers, since their cars typically run over small creatures like rodents and smash into birds. But the autonomous technology company nuTonomy recently found that even flocks of birds can cause problems for self-driving cars.

As nuTonomy's cars have logged miles gathering data while driving around the Raymond L. Flynn



Car tech expert Doug Newcomb has written for *Popular Mechanics*, *Road & Track*, and other publications, and is the author of *Car Audio for Dummies*.

Marine Industrial Park in South Boston, its tech has had trouble recognizing flocks of seagulls on the roads. “One bird is often small enough that the car assumes it can be ignored,” nuTonomy CEO Karl Iagnemma, told the Boston Globe. “But when you have a flock of birds together, it looks like a big object, so we’ve had to train the car to recognize the birds,” Iagnemma added. “It wasn’t something really that we’ve seen before.”

NuTonomy’s autonomous technology reacts to flocks of seagulls the way a human being most likely would: by slowing down while approaching the birds until they scatter and fly away.

Iagnemma said that the company is teaching the car’s software to recognize the birds and “give the vehicle a better capability to predict what’s going to happen next” by feeding imagery of flocks of seagulls into an algorithm.

But as anyone who has ever encountered animals on the road knows, figuring out their next move is the hard part. As Smithsonian.com noted in 2015, “The main challenge is that nature is imperfect and unpredictable, and it isn’t clear yet how the rigid calculations of computers will handle the sometimes erratic behavior of animals.”

“Even if we develop the perfect automated recognition and avoidance system, you still have an imperfect ecology and wildlife behavior system,” Fraser Shilling told Smithsonian.com. He’s the director of the California Roadkill Observation System, which collects data on roadkill and pinpoints collision hotspots to reduce wildlife carnage on roadways.

Even though Volvo developed a Large Animal Detection with Autobrake system, which it introduced on the 2017 S90 sedan, the technology still can't predict a moose's every move. "We can only make a rough prediction of the motion of the [animal] based on its current position and speed," Erik Coelingh, Volvo's senior technical leader, told Smithsonian.com.

Andy Alden, a researcher with the Virginia Tech Transportation Institute, told Smithsonian.com that a study his organization conducted with Toyota found it would be difficult to for autonomous tech to predict animals' actions. But he added that "there certainly are some things you could drop into an algorithm, like time of day, time of year, the kind of environment along the road, the width of the road, the amount of traffic on it..." to help avoid animal collisions.

That's exactly the kind of data that nuTonomy hopes to gather in South Boston and by confronting flocks of seagulls. "You end up having to adapt the system to the local conditions," Iagnemma said.

"It's a good example of a unique aspect of driving in Boston," he added. "Is it a fundamental change to our approach? Absolutely not. Is it something that takes a little time to adjust our software to? Yes."

doug_newcomb@pcmag.com

“
**NuTonomy's
autonomous
technology
reacts to flocks
of seagulls the
way a human
most likely
would.**
”

Why the New FCC Chair Should Leave You Ajit-ated

In the struggle between dot-coms and telecoms, it's clear what side Ajit Pai is on. Trump's pick for FCC chairman will have to referee the constant struggle between Silicon Valley app and content providers, and the big ISPs and mobile networks. That's also known as the debate over net neutrality, and Pai has placed himself firmly on AT&T's and Comcast's sides on this one.

Pai fashions himself a champion of small business, blowing up regulations to let innovation flourish. That was a big theme in his lengthy opposition to the FCC's net neutrality ruling. In support of his low-regulation stance, he cited a slew of tiny little ISPs that serve rural communities all over the U.S.

But that's an unrealistic view of the ISP landscape that doesn't affect most Americans. Pai is right that small, often community-run ISPs serve people in rural areas who otherwise wouldn't be able to get Internet—and they'd benefit from less regulation. But the vast majority of Americans are served by giant, monolithic cable companies with massive sway, and Pai doesn't seem to have much to say about curbing their power.



Sascha Segan is the lead mobile analyst for *PC Magazine*. His commentary has also appeared on Fox News, CNBC, CNN, and various radio stations and newspapers around the world.

Pai's term will coincide with the launch of 5G, the biggest chance for new competition in wireless in years. Here are the positions I think he'll take.

GET READY FOR MERGERS

Pai's term is likely to lead to fewer, larger cable companies and mergers between cable and wireless firms. As he told the *Wall Street Journal* in 2013, when the Comcast-Time Warner Cable deal was still on the table, "a Republican administration likely would be more inclined to approve a deal."

That may not look like it's going to reduce consumer choice, as very few people have any choice between cable companies anyway. But just wait for it. Verizon, for example, is eyeing a Charter or Comcast acquisition, according to the *New York Post*.

The danger of mergers between cable and wireless comes as the wireless firms implement 5G. Right now, a third of Americans have only one choice for high-volume, high-speed home broadband—their cable company. (Wireless companies either have data caps or forbid the use of their unlimited plans on laptops and TVs.) High-speed, 5G wireless from AT&T, Verizon, and the like could finally inject some competition into home Internet. But that won't happen if Verizon buys your local cable company, as the company won't have much of an incentive to compete against itself.

Pai has opposed putting conditions on these sorts of mergers. He voted against the Charter–Time Warner merger not because he disapproved of the merger. Rather, he disapproved of the FCC

forcing conditions and behaviors on the merged companies. He had similar objections to conditions placed on the AT&T-DirecTV merger. Pai appears to trust the ISPs to just sort everything out themselves.

New Internet providers don't seem to be growing up. In fact, they're dropping out. Google has rolled back its attempts to spread fiber nationwide, and promising startup Starry has no sign of a public launch yet.

Much of this is because the major costs of building a new ISP are in dealing with infrastructure buildout and local and state regulations, which the FCC doesn't control. In urban and suburban areas, those hurdles are so time-consuming and expensive that nobody seems to want to jump them.

Pai wants to nurture ISP startups, as he said in a fiery opinion where he tried to close loopholes allowing big ISPs to get wireless spectrum at a discount. But he'll have a hard time finding the authority to do it, even as large ISPs merge and reduce choices.

NOT NEUTRAL ON NET NEUTRALITY

Those fewer Internet providers are going to have more control over what goes over their lines. "Net neutrality" is a tussle over who gets to be the gatekeeper for the Internet. The pro-neutrality forces, many in Silicon Valley, want ISPs to be dumb pipes, simple conduits between consumers and the apps they love.

ISPs have a different idea. They want to be able to control traffic, prefer certain content providers



Pai's term is likely to lead to fewer, larger cable companies and mergers between cable and wireless firms.



over others, and make deals for speedier or less-expensive content delivery. Sometimes, that's consumer-friendly. T-Mobile's famous "Binge On," which exempts video from data caps, was not net neutral. But consumer advocates fear this will lead to less free choice; if AT&T drives users to its own DirecTV Now service rather than to competitor Sling, for example.

Pai sees net neutrality as a "problem that doesn't exist," and in possibly the most epic dissent ever written by an FCC commissioner, says it will lead to "higher broadband prices, slower speeds, less broadband deployment, less innovation, and fewer options for American consumers."

In his dissent, he calls out T-Mobile's popular Music Freedom and MetroPCS's unlimited YouTube deals as the sort of things consumers like but that net neutrality would ban.

He sees the ISP and wireless world as seething with competition, which will self-regulate.

"Small-town cable operators" and "new entrants like Google" are champing at the bit to build out new lines for Americans, and they're being held back by federal regulations and costs, according to his dissent.

One of our columnists, John Dvorak, agrees, in his column titled "Net Neutrality Hysteria." I don't. Competition can take the place of regulation, but as I said before, there's no real competition in home Internet. I don't think the natural monopoly providers will be able to resist taking rents from online services and choking out the ones they don't have deals with, as Americans don't have anywhere else to turn for their high-volume home services.



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WHO NEEDS PROTECTION?

Reading Pai's statements, there's a pure question of worldview here. In his writing, we live in a nation where hundreds of small Internet service providers and innovative wireless companies are thirsting to build and compete. Only government regulation is holding them back. By taking a light touch, the FCC can ensure that innovative new services flourish rather than being forced into old paradigms.

But that's not the nation most of us live in. Most Americans are under the thumb of monopoly cable companies and have nowhere else to turn for home broadband. Even when cities beg for competition, nobody's building it: New York City formed an agreement with Verizon to provide FiOS across the city years ago, but Verizon still doesn't offer it as an option to every resident. 5G could offer an answer, but not if all of the upstart 5G providers merge with the existing cable giants.

Pai's greatest task is going to be to manage the balance of power between consumers, content providers and ISPs. His greatest fear is of a heavy-handed government crushing private innovation into a gray smnk ear. But if the crusher is a private corporation, does he have a response?

sascha_segan@pcmag.com



5G could offer an answer, but not if all of the upstart 5G providers merge with the existing cable giants.





LG's Home Surveillance Camera Is Ideal for Renters



Indoor Wi-Fi security cameras offer a cost-effective way to keep tabs on your home while you're away. But unless they're paired with a comprehensive security system (such as Vivint), it's up to you to monitor activities and call the authorities in the event of a break-in. Enter the LG Smart Security Wireless Camera LHC5200WI, an indoor Wi-Fi camera that offers 24/7 monitoring by ADT's Canopy service. This camera is ideal for renters, apartment dwellers, and homeowners who want the benefit of professional monitoring without having to commit to a contract or pay for professional installation. It installs in minutes, is equipped with multiple sensors, and doubles as a home automation hub. It's also our Editors' Choice for professionally monitored home surveillance cameras.

**LG Smart
Security Wireless
Camera**

**LHC5200WI
(With ADT Canopy)**

\$199.99



DESIGN AND FEATURES

Home security cameras come in all shapes and sizes, but the LHC5200WI is easily one of the most unique-looking models we've seen. The black, cone-shaped camera stands 3 inches high and measures 5 inches across the top and 2 inches at the base, where you'll find an embedded micro USB power port. It's designed to be placed out in the open, and you'd have to look very closely to identify it as a security device.

The lens sits behind a black cover near the top of the housing and is sandwiched by two IR LEDs that provide up to 15 feet of night vision. Just below the lens is a thin, curved LED strip that blinks blue when in Bluetooth pairing mode, blue and green when connecting to Wi-Fi, solid green when a Wi-Fi connection is successful, amber when downloading an update, and amber and green when installing an update.

Inside the housing is a 5-megapixel sensor with a 130-degree field of view, Bluetooth and Wi-Fi radios, motion, temperature, and humidity sensors, a microphone and speaker for two-way communication, and a 93dB siren. There's also Z-Wave circuitry for controlling smart home devices such as light dimmers, water sensors, and smart switches from Aetoe, Eaton, and GE. As of this writing, the number of compatible devices was around ten, but a spokesperson promised that more will be added.

You control the LHC5200WI using ADT's Canopy app for Android and iOS mobile devices. The app is free but offers limited functionality unless you subscribe to the ADT Intrusion Detection plan. For example, you won't get email alerts, you can't arm and disarm the system, and you can't control Z-Wave devices or run Activities without the subscription.

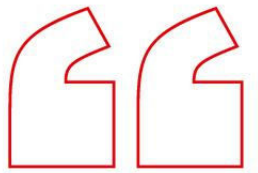
LG Smart Security Wireless Camera LHC5200WI (With ADT Canopy)

PROS Sharp HD video.
ADT Canopy
monitoring available.
Controls Z-Wave
devices. Cool design.

CONS Requires cloud
subscription to view
video, and Canopy
subscription to unlock
some features.

But the biggest advantage of signing up is ADT's 24/7 monitoring service, which contacts you when an alarm is triggered and dispatches the local authorities if you don't respond. As with the SimpliSafe Home Security System, ADT Canopy's Intrusion Detection costs \$19.99 per month and doesn't require a contract, which means you can use it when you need it. By way of comparison, Protect America's landline monitoring service is also \$19.99 per month but requires a three-year contract, and the LiveWatch Plug & Protect IQ 2.0 Mobile Pro plan goes for \$34.99 per month and requires a one-year contract.

You can view live video and change camera settings using the ADT Canopy app, but if you want to view event-triggered recordings, you have to subscribe to an ADT Secure Video Storage plan that costs \$9.99 per month for seven days of storage or \$29.99 per month for 30 days of storage. A combo plan that includes Intrusion Detection and seven days of secure video storage goes for \$24.99 per month.



Home security cameras come in all shapes and sizes, but the LHC5200WI is a unique-looking model.



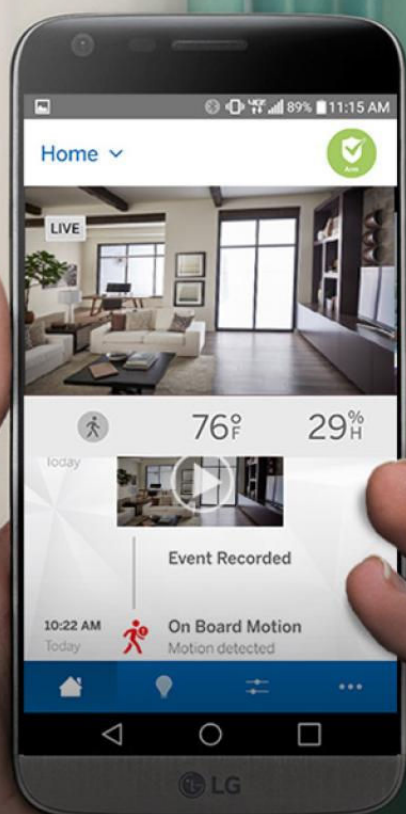
YOUR OWN PRIVATE EYE
With this camera, live viewing and home-automation control features are free, and you won't need a long-term contract.



The ADT Canopy app is easy to navigate. It opens to a Dashboard screen that displays the system's Modes (Home, Away, Sleep, Vacation). The Mode dictates how Activities (actions that you create to have certain connected devices turn on or off according to a schedule or an event) run. For example, you can have lights turn on or off at set times while in Vacation Mode to make it look like someone is home; you can make the system disarm and disable motion detection when you switch to Home mode; and you can turn off all the lights in Sleep mode. Outside of Activities, however, the system has no If This Then That (IFTTT) support, as you get with the IControl Networks Piper nv.

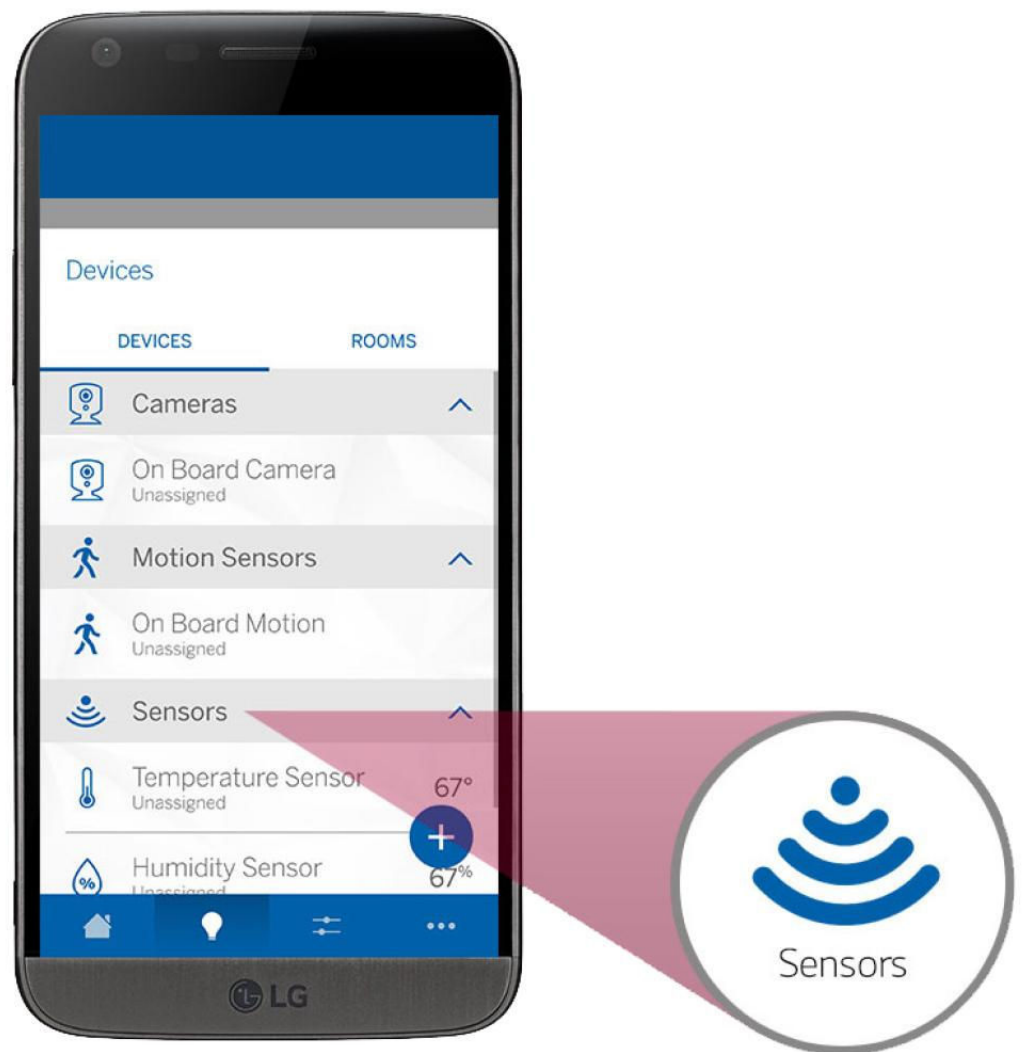
The center of the screen contains a panel that displays a live video feed. Turning your phone sideways gives you full-screen video, and tapping the three dots in the lower-right corner opens a menu bar with a camera button for taking snapshots, a microphone button for push-to-talk communication, and a speaker button for muting the sound. Below the video panel is a bar that displays the current date, temperature, and humidity level. It also contains a motion icon that's red when motion is detected and gray when it's idle. Below that is a timeline of events such as humidity and temperature changes, motion detection, security alarms, and armed/disarmed times.

At the top of the Dashboard on the right is a shield icon that's green when your system is unarmed, red when it's armed, and gray when your subscription has lapsed or is turned off. Tapping the shield lets you arm and disarm the system. At the very bottom of the Dashboard are buttons for accessing the Devices, Activities, More, and Dashboard screens.



APP LIMITATIONS
ADT's free Canopy app for Android and iOS offers limited functionality unless you subscribe to the ADT Intrusion Detection plan.

The Devices screen displays a list of all installed devices, including the camera and built-in sensors and any Z-Wave devices you've added. Tapping the camera takes you to a screen with a live video feed and thumbnails of event-triggered video clips. At the top of each device screen is a gear icon that takes you to settings including video quality (cameras), sensitivity (motion sensors), and temperature thresholds that will trigger a push notification if the temperature goes above or below a certain point.



While in the Activities screen, tap the plus icon to create a new Activity by choosing a trigger (manual, started by a device, start at a specific time) and an action. You can assign the Activity to any or all modes, and run activities using Alexa voice commands. The More screen has options for configuring Monitoring settings (entry and exit delays), editing your address and password, and entering emergency contact information. It also has an option to enter your permit number if you live in an area where a permit is required to have a professionally monitored security system. Here you can configure your user profile and messaging preferences, change billing information, and view help files.

INSTALLATION AND PERFORMANCE

Installing the camera is easy. I started by downloading the app and creating an account. Once the account was verified via email, I followed the on-screen instructions to register it. I plugged in the power cable and waited around 10 seconds for the LED to blink blue, indicating the camera was ready to pair. I hit Next, and the camera was immediately identified and listed on the following screen. I then connected to my Wi-Fi router, entered my password, and waited around two minutes for an update to complete. Then the camera was successfully registered and ready to go.

The LHC5200WI delivered sharp 1080p daytime video with excellent color quality in testing. Night vision showed good contrast and appeared highly detailed out to around 15 feet. The various motion detector sensitivity settings worked wonderfully; when set to Person Detection, my cats wandered freely around the room without triggering the sensor, though I triggered it every time I entered the room. The All Motion setting also worked as advertised; the sensor was triggered by the smallest movement, including passing cars. So if you use this setting, make sure you place the camera in a location that won't create false alarms while you're out of the house.

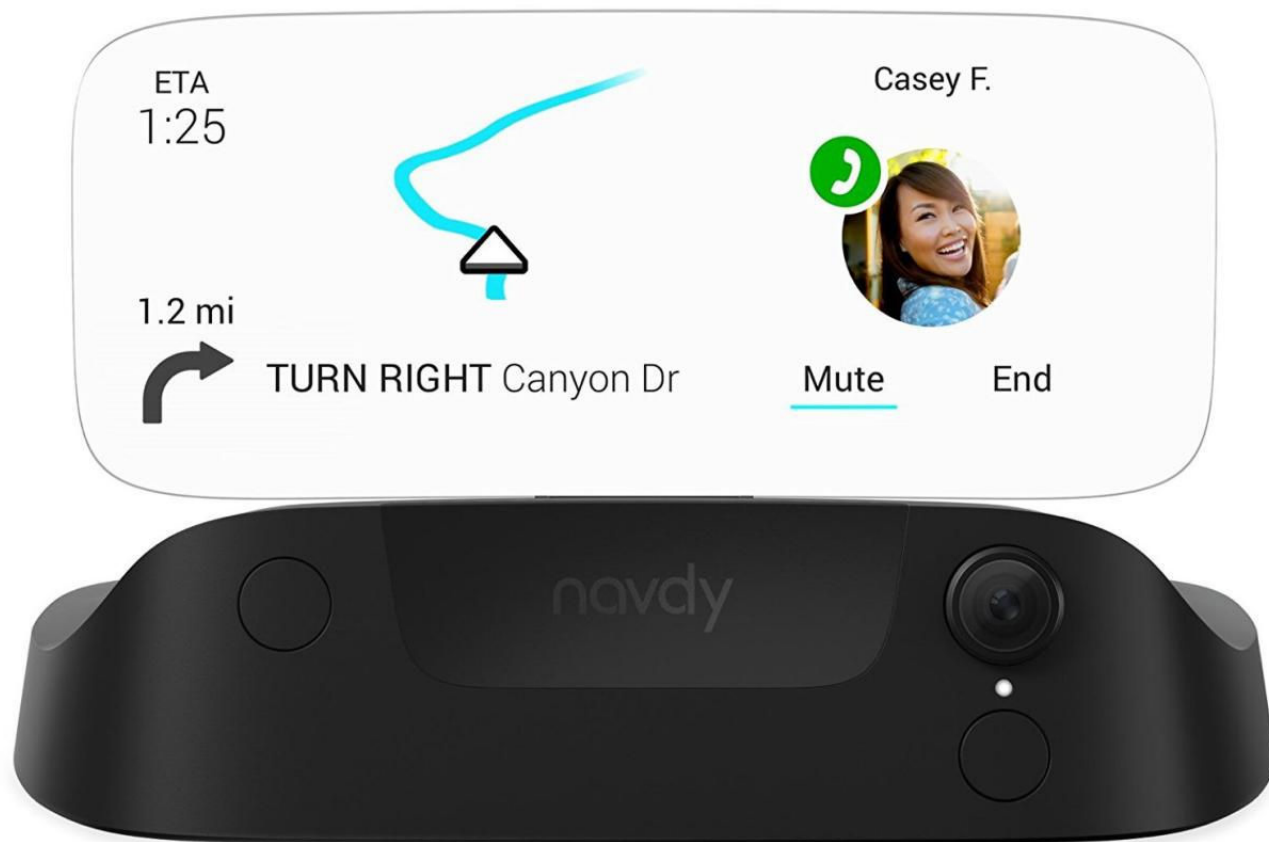
The system reacted instantly whenever an alarm was triggered, and although the 93dB siren isn't deafening, it could be heard throughout the house and in my backyard. Recorded video appeared every bit as sharp as the live feed, and two-way voice communications were clear. The system also responded quickly to my arm and disarm commands and always silenced the siren immediately.

The LHC5200WI's temperature readings were spot-on, matching my Honeywell Prestige thermostat readings to within one degree. Humidity readings were also very accurate.

CONCLUSIONS

Like our other Editors' Choice, the Piper nv, the G Smart Security Wireless Camera LHC5200WI tracks indoor temperature and humidity and can control a number of Z-Wave home automation devices. It also delivers excellent daytime and nighttime HD video and contains a motion detector that can be adjusted to ignore background activity and small pets. But what sets this all-in-one security camera apart from others is the way it monitors your home. The LG Smart Security camera is the first to offer professional monitoring using ADT's Canopy service and app. Granted, you have to pay a monthly fee, but you don't have to commit to a long-term contract like you do with dedicated home security system packages from companies such as LiveWatch, Protect America, and Vivint, and you can turn the service on and off as needed. For this reason, the LG Smart Security Wireless Camera earns our Editors' Choice for professionally monitored home surveillance cameras.

JOHN R. DELANEY



Navdy, the First Portable Head-Up Display



The Navdy, the first portable head-up display (HUD), sits atop the dashboard and plugs into the OBD-II port of any car made after 1996. It projects info such as speed, engine rpm, and compass direction on a transparent screen in front of you and uses built-in GPS and Google Maps to show the surrounding area, display speed limits and street names, and route you to your destination. It also connects to your Android or iOS smartphone via Bluetooth to display data including calls, texts, music, and all manner of social media and alerts. Access to this info is largely controlled using a thumbwheel that attaches to your steering wheel and is supplemented by gesture control you activate by waving your hand in front of the device.

Navdy

\$799.00



DESIGN AND FEATURES

Each Navdy comes with a main unit that includes the screen and electronics, a mount that it slides and magnetically locks into (provided in short, medium, and tall versions), a thumbwheel controller (which Navdy calls the Dial), and the cord that connects to your car's OBD-II port. The flexible, multi-piece underside of the mount has an adhesive that keeps it planted in place, and I had no difficulty in moving it between various vehicles.

The device is simple to connect, although it does require some rummaging beneath the dash to locate the OBD-II port. The entire installation and setup took me about 10 minutes. If you prefer someone else do the not-so-dirty work, Navdy has teamed up with Enjoy to offer same-day delivery and installation in a number of major cities throughout the U.S.

As mentioned, I moved the device among various vehicles, and each time, I found a way to tuck the extra cordage into a crevice. It helped that two of the vehicles—a Volkswagen Tiguan and a VW Jetta Wagon—had a convenient and closable storage pocket just to the left of the steering wheel that I used to hide the extra cord. Cable clips are supplied for a more permanent installation.



Navdy

PROS Easy installation. Sharp, bright, informative display. Doesn't block your line of vision. Can be moved between vehicles. GPS doesn't require a data connection.

CONS Expensive. Flimsy control dial. No voice activation for navigation.

LOTS OF DATA

Without even connecting to the companion app, the Navdy can provide vehicle data such as engine rpm, a compass, clock, and low-fuel warnings.

The main unit measures 3.7 by 5.1 by 5.5 (HWD) including the display, a transparent pane that won't block your vision but can be flipped down when not in use. When it's on, it projects full-color text and images at over 30,000 nits of brightness, so it doesn't wash out or fade in bright sunlight. No resolution info is provided, but the picture looks sharp.

The Navdy has an impressive array of features that surpass those found even in some high-end cars. Without connecting to the companion app, it provides maps, directions, traffic info, a compass, a clock, and vehicle data such as speed, engine rpm, and a low-fuel warning. Connecting the device to your smartphone via Bluetooth adds additional cloud-based content.

The Navdy has an impressive array of features that surpass those found even in some high-end cars.



The various views are divided into Driving Glances and App Glances. Driving Glances include calendar items, fuel level, traffic info, and calls, and playing content from your connected device. App Glances include notifications for text messages, Facebook, Gmail, Google Hangouts, Messenger, Twitter, and WhatsApp. Notifications are also available for apps such as Instagram, Skype, and several others.

HEADS UP!

The Navdy portable HUD can be added to almost any vehicle made after 1996. It projects info from the car and a companion mobile app onto a transparent display.

The app lets you set favorite destinations and contacts and has a Quick Search function with a search bar and icons for ATMs, food, gas, and parking. Finally, a Settings menu allows you to choose different audio connections (speakerphone or Bluetooth, for example), voice guidance volume and styles, turn-by-turn directions, speed limit warnings, and more.

You choose what you want to view via the steering-wheel Dial. The default view is Google Maps, and the map can be scaled by rotating the outside of the Dial. You push a button in the center to access other available features, as well as the main menu. When a call, text, or other Glance comes in, the info associated with it appears on the right side of the display. The Navdy also supports Google Voice and Siri for certain functions.

PERFORMANCE

The Navdy packs a lot of info into its small display and does so in a way that's mostly not distracting. That said, I still recommend using caution when selecting Glances so that your attention isn't pulled away from the road. The Navdy is also relatively easy and intuitive to operate. Some of the HUDs we've tested in production cars require digging into an infotainment menu to tweak the info displayed (we're looking at you, BMW), but with Navdy, everything is done with the steering wheel Dial.

Dialing through different menus and settings is a snap, and I was able to customize the Navdy exactly as desired by setting up various favorites for contacts and destinations. One gripe is that the menu has a quick time-out feature, and often reverts to a previous menu before you have a chance to change a setting. The safest and easiest route is to program your favorites ahead of time, before you're on the road.

As mentioned, the display is easy to see in lighting conditions ranging from bright sun to almost blinding snow. The map display is also very sharp and detailed, and easy to pan in and out using the Dial. I like that the display shows a picture of a contact when a call or text comes in, and it's effortless to answer or respond with just a turn of the Dial. You can perform a number of actions through voice commands using Google Now or Siri, with the exception of entering navigation directions, which must be done within the app.

Gesture controls, which let you swipe your hand in front of the unit to, say, view a text message, initially didn't work well in testing. After a call to Navdy, I learned that your hand needs to be above the steering wheel and relatively close to the unit. I tried it again with this in mind, and the gesture controls worked as advertised. That said, they felt a bit unwieldy while I was driving.



The other chink in the Navdy's otherwise solid armor is that the Dial seems a bit fragile. Twice during testing, the outer ring separated from the main piece (pictured above). While the ring is easy enough to pop back on—and perhaps most people won't be moving the Dial back and forth between cars the way I did—it makes me question the product's long-term durability.

CONCLUSION

One of the vehicles I tested the Navdy in is a 2017 Buick LaCrosse Premium that has one of the best OEM HUDs I've tested, as well as dedicated dashboard switches to change the HUD's content, viewing angle, and brightness. I prefer the graphics of the Buick's HUD over the Navdy. But the former, of course, is built in, so you have to buy the car (starting at \$43,265) to get it.

That's the beauty of the Navdy: You can add a head-up display to any vehicle, even one that has built-in GPS—so that even if you lose cellular coverage, it will keep you on course with its own built-in offline maps. The Navdy is a great head-up display that can potentially add the technology to many vehicles on the road and help keep phones out of many driver's hands. That makes it an Editors' Choice in our book.

DOUG NEWCOMB

 NVIDIA
GEFORCE NOW™

Nvidia GeForce Now Streams Games from Powerful Servers

Game-streaming services let you access video games through a system similar to Netflix, sending your commands to and receiving audio and video data from a server somewhere else in the world, in real time. The first attempts at these services, including the now-defunct OnLive, were extremely rough and plagued with input lag, but they've come a long way since then. Nvidia's GeForce Now service is one of the best examples. Since GeForce Now requires an Nvidia Shield TV, it's a bit limited compared with PlayStation Now and GameFly streaming, which are available on some connected TV platforms. If you have a Shield TV or are open to buying one, however, it's a technically impressive and economical way to play PC games without a high-end PC.

Nvidia
GeForce Now

\$7.99 per month



THE TYPES OF GEFORCE NOW

There are two GeForce Now services, and they're very different beasts. GeForce Now for Shield, reviewed here, is a subscription service that provides unlimited access to a library of more than 100 streaming games for \$7.99 a month, with the option to purchase newer, high-profile PC games to play over GeForce Now at retail prices. As previously noted, it requires an Nvidia Shield TV.

GeForce Now for Mac and PC is available only as an early-access service, with a wildly different pricing structure. To play streaming games over your Mac or PC, you need to purchase blocks of time on Nvidia's servers. After a free period of eight hours on a GTX 1060-based PC or four hours on a GTX 1080-based PC, you can purchase a 10-hour block on a GTX 1080 or a 20-hour block on a GTX 1060 for \$25. The concept of purchasing processing time on servers isn't new for science and enterprise projects, but it's a novelty for gamers. It's also an expensive novelty compared with the Shield TV's \$200 price tag and \$8 monthly subscription fee.

Nvidia GeForce Now

PROS 1080p60 video and no noticeable input lag with a fast wired connection. A la carte games usually include Steam codes for running locally.

CONS Requires fast Internet speeds and an Ethernet cable running to your router for best results. Small library of games. A la carte games still require a monthly subscription to play.

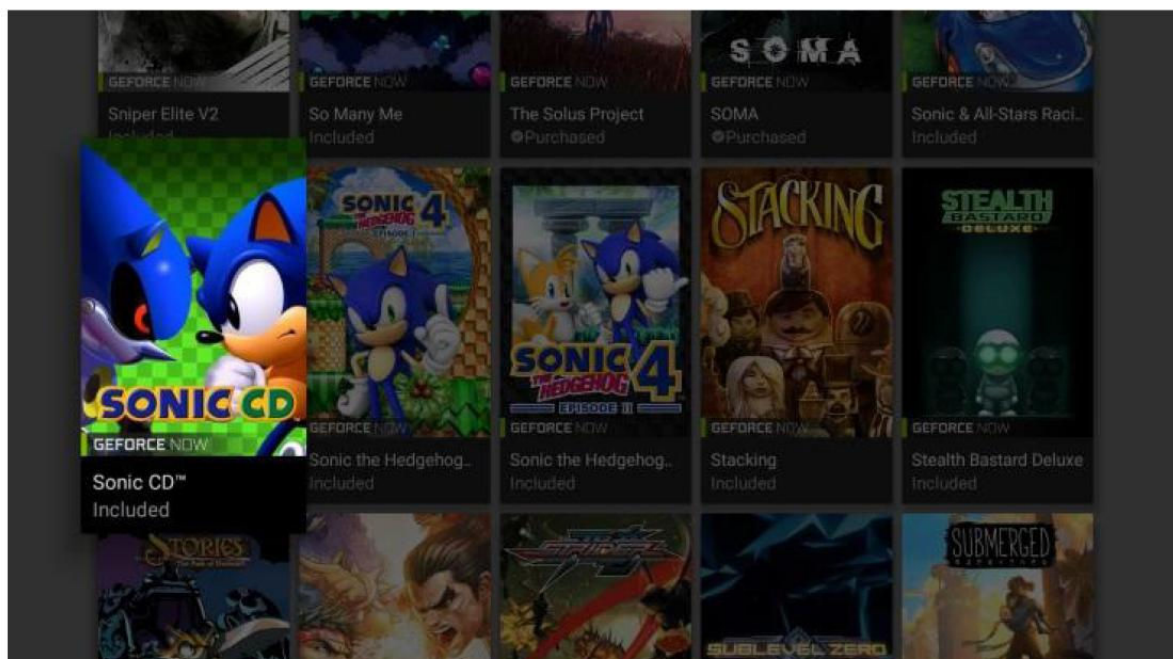
SPEED MATTERS

You'll need a very fast, reliable Internet connection to get the most out of GeForce Now—a minimum of 10Mbps down to stream games at all.



THE GAMES

The game library on GeForce Now is relatively small but pleasantly diverse. The subscription gives you access to more than 60 games, including the first three Batman: Arkham games, five Lego games, Saints Row IV, Thief (2014), Tomb Raider (2013), and sleeper classic Marlow Briggs and the Mask of Death. The service also offers about as many a la carte games, including newer and bigger releases such as Lego: The Force Awakens, Mad Max, No Man's Sky, Shadow Warrior 2, Soma, and The Witcher 3. Most of the games you can purchase include Steam codes, so you can also install and play them on your PC if you like.



Most of the games you can purchase include Steam codes, so you can also install and play them on your PC.

SOMETHING FOR EVERY GAMER

The game library might be relatively small, but it's pleasantly diverse and includes access to over 60 games.

It isn't the most compelling selection—the biggest PC games, such as Battlefield 1 and Call of Duty: Infinite Warfare, are notably absent. But Nvidia announced a partnership with Ubisoft that will significantly increase the number of AAA games on GeForce Now. Ubisoft will add all recent games available on its UPlay service, including Assassin's Creed: Syndicate, Far Cry Primal, For Honor, and Watch Dogs 2. These games will feature cloud-saving and library cross-buying, which means you can play them over GeForce Now simply by buying the games on UPlay (though they still require a subscription).

NVIDIA'S HARDWARE

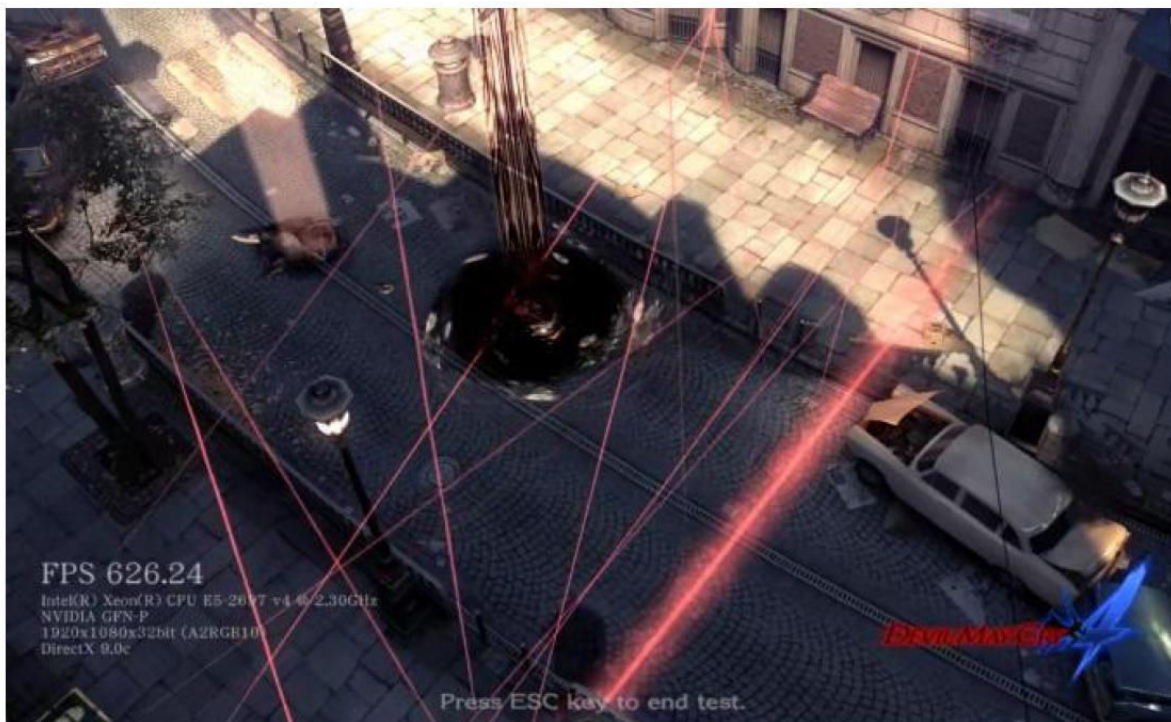
Nvidia recently upgraded its GeForce Now servers with GeForce GTX 1080 GPUs using the company's Pascal architecture. This means that the systems running the games that are streaming to your Shield TV are some of the most powerful gaming systems out there. According to Nvidia, the new graphics processors mean GeForce Now can stream recent games like The Witcher 3 at 60 frames per second at up to 1080p resolution. Don't expect 4K games, though. 4K is hard enough to render locally on a high-end computer; rendering it off-site and then streaming to your Shield TV while maintaining low input lag is a technical feat with too many hurdles to jump over right now.

You need a very fast, reliable Internet connection to get the most out of GeForce Now. Nvidia requires a minimum of 10Mbps down to stream games at all, and 50Mbps to play games in 1080p60. Ideally, that means running an Ethernet cable from your Shield TV to your router. That method consistently got the best results in my testing—both in PC Labs over a Fios test network and at home over a cable-modem connection. The service worked over Wi-Fi as well, but it was much more prone to hiccups and video compression, even when the Shield TV was only a few feet from the router.

GAMING ON GEFORCE NOW

I played Devil May Cry 4, Mad Max, and Shadow Warrior 2 on GeForce Now. For DMC4, I relied entirely on a Wi-Fi connection. Dips in speed resulted in proportionate dips in video quality as the service adjusted compression to keep up, but that wasn't a big problem considering the game is nine years old and looks dated compared with recent titles (the updated Devil May Cry 4 Definitive Edition looks much better but isn't available on GeForce Now). More important, GeForce Now kept my inputs responsive, consistent, and without any noticeable lag. This is very important for character action games such as DMC4, because timing is necessary to both dodge and parry attacks and to perform combos and complex moves.

I played Shadow Warrior 2 both over Wi-Fi and using a wired connection, and the difference between the two were night and day. Streaming the game over Wi-Fi resulted in regular drops in video quality, but the gameplay remained responsive regardless. Using an Ethernet cable, on the other hand, I couldn't tell the game was being streamed. It rendered in 1080p and maintained a high frame rate, performing as though I were playing it locally.



“
**GeForce Now
can stream
recent
games like
The Witcher 3
at 60 frames
per second at
up to 1080p
resolution.**

”

Mad Max had similar results. When I played over a wired connection, the wasteland looked good, and Max handled responsively for both driving and fighting. Wi-Fi streaming suffered from occasional drops in graphic quality but stayed very playable.

CONCLUSION

Nvidia's GeForce Now is a technically impressive service. If you have a very fast network connection and can run a cable from your Shield TV to your router, your gaming experience will be about the same as if you had a much bigger, more expensive gaming PC connected instead of Nvidia's microconsole. The library isn't particularly large, but there are enough games to get your \$8 monthly subscription fee's worth, and the fact that individual game purchases generally include the locally playable PC version means you can play the games you buy on your own terms. The main issue is the requirement of a Shield TV. But the Shield TV itself is a remarkably full-featured, 4K-capable media streamer with impressive power. It's worth checking out as a secondary gaming device regardless.

WILL GREENWALD



Dell's New 2-in-1 Has Adaptability and Power

Looking at the Dell XPS 13 2-in-1 (9365), you'd be forgiven for feeling a sense of déjà vu. Thanks to a new fanless Intel Kaby Lake Y-series processor, this 2-in-1 is thinner and quieter than the Dell XPS 13 Touch while retaining all of its strengths. But you may have to borrow a bit of courage from Apple lovers, as it has only two ports: USB-C and Thunderbolt 3. This, along with slightly stronger overall performance and battery life from the HP Spectre x360 13-w023dx, means the XPS 13 2-in-1 falls just shy of nabbing our Editors' Choice for high-end convertibles. But if dongles don't scare you and you have cash to splash, you'd be remiss if you didn't put this versatile 2-in-1 on your short list.

**Dell XPS 13
2-in-1
(9365)**

\$999.00



THINNER, QUIETER...

Both the original XPS 13 and this 2-in-1 variation feature the same machined-aluminum lids, carbon-fiber palm rests, and super-thin 5.2mm InfinityEdge bezels around the display. Visually, the main differences on the 2-in-1 are the steel-wrapped aluminum hinges (of course), the Windows Hello-compliant fingerprint reader next to the touchpad, and the 720p webcam centered underneath the Dell logo.

The 2-in-1 is also just a skosh thinner, measuring 0.54 inch at the hinge and tapering down to 0.32 inch at its thinnest point. It also has a width of 11.98 inches and a depth of 7.8 inches. That's more compact than both the Spectre x360 (0.5 by 12 by 8.6 inches, HWD) and the Lenovo Yoga 910 (0.56 by 12.72 by 8.84 inches), our Editors' Choice pick for midrange convertibles. This makes it easy to slip into any bag, and at 2.7 pounds, it won't break your back if you can't find a seat on your daily commute.

The nifty thing about the XPS 13 2-in-1 is that it fits a 13.3-inch display onto an 11-inch chassis. This configuration features a full HD 1,920-by-1,080-resolution touch screen, which is par for the course for the category. While a QHD+ (3,200-by-1,800) screen is a configuration option, full HD is perfectly fine if you primarily stream videos from YouTube, Hulu, and Netflix. And as is the case with other convertible-hybrids, you can use this one in four different modes: Laptop, Tablet, Stand, and Tent.

Dell XPS 13 2-in-1 (9365)

PROS Highly portable. Sleek yet sturdy build. Long battery life. USB-C and Thunderbolt ports. Comfortable keyboard. Thin bezels maximize screen real estate. Fanless processor keeps things quiet and cool.

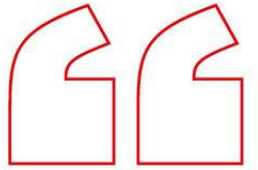
CONS Limited connectivity options. May require additional dongles and accessories. Awkward webcam angle when used in Laptop mode.

CHANGE IS GOOD
The Dell XPS 13 2-in-1 marries the strength of its ultraportables with the flexibility of a convertible laptop.

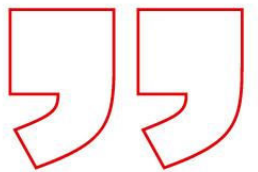


Each is comfortable, though the placement of the webcam makes Stand and Laptop modes less than ideal for video conferencing. Unless you don't mind the person you're talking to looking up at your chin or up your nostrils, you're better off using Tent mode—though that could be frustrating, too, if you like to type and send notes while Skyping. Like the Lenovo Yoga 900S, the XPS 2-in-1 features a fanless Intel processor, which means it's super quiet and there's less heat. A quieter computer is always nice, but the cool factor is particularly good if you're using the XPS in Tablet mode on your lap for long periods of time.

When it comes to work, the XPS 2-in-1 is more than capable of handling your average office tasks. The keyboard is comfortable for long typing sessions, you get extra screen space thanks to the thin bezels, and the touchpad is responsive. But I/O port options are limited. Like the 13-inch Apple MacBook Pro and the Acer Spin 7, the XPS 2-in-1 has no USB Type-A ports. On the left side, you get a Thunderbolt 3 port, a headset jack, a battery gauge indicator, and one speaker. The right side houses a Noble lock slot, a USB-C port, a microSD card slot, the power button, and another speaker. Both the Thunderbolt 3 and USB-C ports feature PowerShare capabilities and can double as DisplayPort connectors.



The nifty thing about the Dell XPS 13 2-in-1 is that it fits a 13.3-inch display onto an 11-inch chassis.



WORK THE WAY YOU WANT TO

This versatile system features a full HD 1,920-by-1,080-resolution touch screen.



Dell includes a USB-C-to-USB-Type-A adapter, though that's not quite enough on its own if you want to use an existing thumb drive, simultaneously charge your phone and laptop, and hook up the 2-in-1 to another monitor. So you can either get creative with the accessories you already have, work around the inconveniences, or shell out for a small arsenal of dongles and adapters. Dell sent us a special power brick that features a USB Type-A port for charging, which is a helpful option but will cost you an extra \$40. This won't really be an issue once USB-C becomes more prevalent, but it is an annoyance for the time being.

Rounding out features, the XPS 2-in-1 has dual-band 802.11ac Wi-Fi and Bluetooth 4.2 for wireless connectivity, 8GB of RAM, and a 256GB PCI Express (PCIe)-based solid-state drive (SSD). This is a decent setup if you're committed to cutting the cord and mostly stream videos, as opposed to storing them locally. The XPS 13 2-in-1 is covered by a one-year limited warranty.

UNDER THE HOOD

Inside, the XPS 13 2-in-1 packs a 1.3GHz Intel Core i7-7Y75 processor with integrated HD Graphics 615, plus 8GB of RAM. That's a combination that results in strong productivity performance at this price. During testing, the 2-in-1 was able to deftly handle multi-tab browsing, streaming, and light productivity tasks. You can see that in its respectable PCMark 8 Work Conventional test score of 3,003 points. It doesn't quite beat out Editors' Choice picks such as the Lenovo Yoga 910 (3,197) or the Spectre x360 (3,286), but it's not far off, either. It did, however, outperform the XPS 13 Touch Rose Gold Edition (2,769) and the Lenovo Yoga 900S (2,636), which is powered by the Intel Core m5-6Y54, another fanless processor.



COOL AND QUIET
Like the Lenovo Yoga 900S, the XPS 2-in-1 features a fanless Intel processor, which means it's super quiet and there's less heat.

It also turned in decent 3D performance, scoring 5,412 points on 3DMark Cloud Gate and 341 points on the more intensive Fire Strike Extreme. That's an improvement over the Lenovo 900S (4,134 on Cloud Gate, 254 on Fire Strike Extreme), but it falls short of the Spectre x360, the Yoga 910, and the XPS 13 Touch. But like its competitors, on our Heaven and Valley gaming tests the XPS 13 2-in-1 wasn't able to reach the 30 frames per second (fps) needed to be smoothly playable, even at midrange graphics settings. If games are a must, you're better off looking at a real gaming laptop.

Multimedia scores were also serviceable, though not particularly stellar. The XPS 13 2-in-1 completed our HandBrake encoding test in 3 minutes, 13 seconds, and lagged behind most other comparable systems on Photoshop (3:58). If you spend a lot of time editing photos and videos, or designing graphics, the 13-inch MacBook Pro, the Spectre x360, and the Yoga 910 are better options.



As for staying power, the XPS 13 2-in-1 features a 46Wh battery that lasted an impressive 11 hours, 46 minutes, on our rundown test. That's long enough to get most of the way through a season of Game of Thrones, a transpacific flight to Japan, or an all-day writing session at a cafe (where open power outlets are a scarce commodity). But some rival systems have really upped the competition in this category. The Yoga 910 leads with a ridiculous 21:28, and the Spectre x360 lasts a neat 14 hours. Others hover around the 12-hour mark, like the MacBook Pro (11:53) and the Yoga 900S (12:06).



If dongles don't scare you and you have cash to splash, you'd be remiss if you didn't put this versatile 2-in-1 on your short list.

PORTABLE PRODUCTIVITY

The Dell XPS 13 2-in-1 (9365) occupies an interesting spot in the world of convertible laptops, straddling the line between what we consider midrange and high-end. And while its performance and features are good for its price point, it falls just short in testing against our high-end Editors' Choice pick, the HP Spectre x360 13-w023dx—which is roughly the same price. The same holds true when you compare it with the slightly less expensive Lenovo Yoga 910, our Editors' Choice for midrange 2-in-1s.

So why would you opt for the XPS 13 2-in-1? There are plenty of reasons, ranging from its sleek look and excellent build quality to its quiet and cool performance and that little bit of extra screen space. While the lack of USB Type-A ports is irksome now, including Thunderbolt and USB-C does future-proof the XPS 2-in-1 for years to come. Ultimately, if you value a compact form factor and solid productivity performance, the XPS 13 2-in-1 should definitely be on your radar.

VICTORIA SONG



This Asus Chromebook Competes with Entry-Level Laptops



The Asus Chromebook Flip (C302CA-DHM4) is priced to compete with entry-level Windows laptops, yet it has the look and feel of a premium offering. Its metal body construction, backlit keyboard, beautiful

screen, and long battery life make this device a very attractive alternative to yet another plastic laptop.

Although ostensibly an update of the Chromebook Flip, one of Asus's earlier convertible laptops, this iteration is all new and is an excellent evolution of the chromebook in general.

**Asus
Chromebook Flip
(C302CA-DHM4)**

\$499.00



HIGH-QUALITY DESIGN

The body of the Chromebook Flip is all aluminum and glass, making it look like a silver Apple MacBook Pro on a smaller scale. Two hinges allow the lid to rotate 360 degrees, so you can use the Flip in laptop, stand, tent, or tablet mode. The last three modes hide the keyboard to give you unobstructed access to the touch screen. The laptop measures 0.53 by 11.96 by 8.26 inches (HWD) and weighs 2.43 pounds. That's quite a bit smaller and lighter than the Acer Chromebook 14, our latest top pick. You should have no trouble using the Flip on your couch, a commuter train, or an airline tray table.



The 12.5-inch full HD touch screen is a highlight of this system. It displays bright, accurate images with a wide-angle view you can share with a few close friends. Touch sensitivity is quick, fast enough for most Web games. The touch screen will serve you well when Android for Chrome OS support is rolled out later this year. Chrome OS now has a tablet mode, which the Chromebook Flip switches into when you turn the screen beyond 180 degrees. The stereo speakers on the left and right side panels can fill a small- to medium-size room with clear sound and music.

Asus Chromebook Flip (C302CA-DHM4)

PROS Convertible hinge design. Lots of storage and RAM. Full HD screen. Metal body construction. Two USB-C ports. Warranty includes damage protection. Bright and clear display. Backlit keyboard.

CONS Legacy connections require adapters. Pricier than other chromebooks.

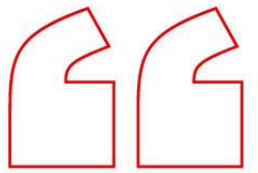
CLASSY CHROMEBOOK

The Asus Chromebook Flip (C302CA-DHM4) is priced to compete with entry-level Windows laptops, yet has the look and feel of a premium offering.

The full-size backlit keyboard is comfortable to use during extended typing sessions. Most less-expensive chromebooks, such as the Acer Chromebook R 13, the Asus Chromebook C202SA-YS02, and the Lenovo ThinkPad 13 Chromebook, come with more basic keyboards that may be smaller or lack backlighting. The Chromebook Flip's is laid out like the one on the MacBook Pro, though the function keys in the top row are customized to Chrome OS specs, with Forward and Back commands, as well as larger-than-usual Ctrl and Alt keys. The wide, one-piece touchpad is responsive and supports multitouch commands.

CHOCK FULL

The 4GB of RAM and 64GB of eMMC flash storage in the Chromebook Flip are respectively two and four times as much as you'll see in most chromebooks costing \$200 to \$300. The extra RAM helps you keep several tabs active simultaneously, while the extra storage, though a lot less than you'll find in a Windows laptop, is sufficient for downloading some video or music files for when you can't be online. You can also use the microSD card slot to expand local storage (up to 512GB), and Google includes two years of 100GB cloud storage to help keep your files safe. There are 802.11ac Wi-Fi and Bluetooth 4.0 for wireless connectivity, and Trusted Platform Module (TPM) security, in case you need it for business applications.



The 12.5-inch full HD touch screen is a highlight. It displays bright, accurate images with a wide-angle view.



JUST OUR TYPE

The Flip's full-size backlit keyboard is comfortable to use during extended typing sessions.

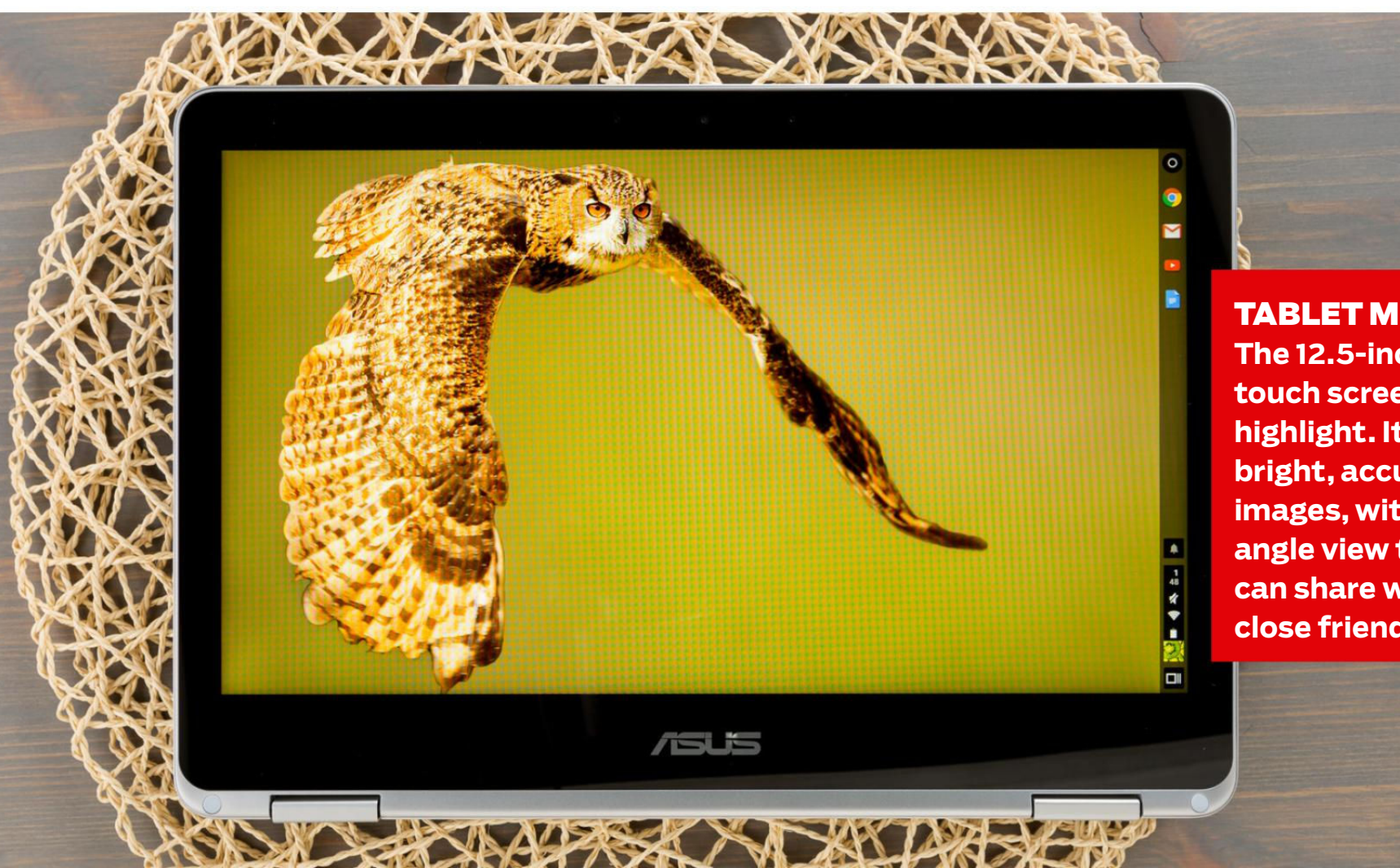


The laptop has two USB-C ports, one on the left side and one on the right. Both can be used for external drives or connecting to an external monitor, though you'll need to buy a DisplayPort, HDMI, or VGA adapter for that (none is included). You'll also need an adapter for drives using USB Type-A, currently the most common interface, but USB-C is likely to become the more prevalent standard in a year or two. The included AC adapter occupies one of the two USB-C ports while the Flip is charging. Asus protects the Chromebook Flip with a one-year warranty with accidental damage protection (even if you caused it).

SPEED RACER

The Chromebook Flip is equipped with an Intel Core m3-6Y30 processor with Intel HD Graphics 515 instead of the typical Celeron or ARM (mobile) processors, which are usually less expensive but occasionally leave performance wanting. As a result, the system feels faster than other chromebooks. A trio of 1080p video streams ran smoothly while I used half-a-dozen other tabs to view websites, check email, and stream music, and so on. A 4K video (displayed at 1080p) played alone only occasionally paused for buffering.

Battery life is good. The Chromebook Flip lasted 10 hours, 23 minutes, on our rundown test. It's a longer time than we saw from the Lenovo N22-20 Touch Chromebook (9:09), though some chromebooks outlast this Flip, like the Acer Chromebook 15 (14:17), the CTL J5 Chromebook (12:21), the Asus Chromebook C202SA-YS02 (12:05), and the Acer Chromebook 14 (11:50).



TABLET MODE

The 12.5-inch full HD touch screen is a highlight. It displays bright, accurate images, with a wide-angle view that you can share with a few close friends.



“
The touch screen will serve you well when Android for Chrome OS support is rolled out later this year.
”

CONCLUSION

The Asus Chromebook Flip (C302CA-DHM4) is appealing to those who want (quite) a bit more than a run-of-the-mill chromebook and are willing to pay for it. It's priced in line with entry-level Windows laptops: For example, the 11-inch Lenovo Yoga 710 comes with Windows 10 and the same CPU and RAM, but its screen is 11 inches, it has no USB-C ports, and it's \$50 more expensive.

Compared with other chromebooks, the Chromebook Flip has premium styling and construction, 4GB of memory, plenty of expandable storage, an attractive full HD screen, a 2-in-1 convertible form factor, and accidental damage protection—all for a bump of \$100 to \$200. It can give you the entire Internet, including desktop sites and plug-ins that don't work or display too small on your Android or iOS phone or tablet. For those reasons, this Chromebook Flip replaces the Acer Chromebook 14 as our Editors' Choice for chromebooks.

JOEL SANTO DOMINGO



HP All-in-One: Impressive Power, Outstanding Display



HP has a winner on its hands with the HP Envy 34 Curved All-in-One (2017). Like its predecessor, the HP Envy Curved 34-A051 Signature Edition All-in-One, this iteration is built around a 34-inch curved screen. But as it did with the more recent Envy All-in-One (27-b010), HP has put the CPU, the motherboard, the storage, and the discrete graphics processor into the base rather than behind the screen to give the PC a slimmer, sleeker look. And the faster Intel 7th-gen Core processor, a larger solid-state boot drive, AMD Radeon RX graphics, and 16GB of memory give a nice boost to performance. As a result of these improvements, we have no qualms naming the Envy Curved All-in-One our Editors' Choice for high-end all-in-one desktop PCs.

**HP Envy
34 Curved
All-in-One
(2017)**

Starts at \$1,729.99;
\$1,999.99 as tested



CURVES AHEAD

The screen is the first thing you notice about the new HP Curved All-in-One, and it's breathtaking. It measures 34 inches diagonally, has an expansive 3,440-by-1,440 resolution, and uses a 21:9 aspect ratio. While most HDTVs, laptops, and desktops use the more common 16:9 aspect ratio, the wider 21:9 is close to matching the CinemaScope (2.35:1) ratio used in big-budget action movies.

What's really notable about the display is that it curves, kind of like that of the Samsung UN55JU7500FXZA UHDTV and its variants. While the large-screen curved HDTV market has been a nonstarter for various reasons (mainly because you have to be in the one sweet spot to see the picture clearly without distracting reflections), curved displays on desktops aren't subject to the same limitations, as the solitary user will generally be seated front and center. Since you're only a few feet away from the screen, the curve makes movies truly immersive. Also, the screen has a matte finish that quells pesky reflections that can wash out the images on the glossier displays you'll find on, say, the 27-inch Apple iMac or the Dell XPS 27.



HP Envy 34 Curved All-in-One (2017)

PROS Gorgeous, feature-rich 34-inch screen. Powerful Intel Core i7 processor. Good storage configuration. USB-C port with Thunderbolt 3. HDMI input and output ports. Excellent speakers. Touch-sensitive volume controller. Secure pop-up webcam.

CONS Curved screen takes some adjustment, especially for artwork. Not wall mountable. Some streaming services don't support 21:9 aspect ratio.

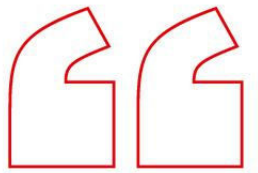
SCREEN STAR

The HP Envy 34's 21:9 screen aspect ratio matches what's used in widescreen blockbusters such as Star Wars and the Marvel movies.

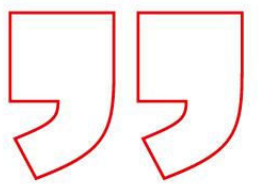
The bezels around the screen are only about 0.41 inch (10.5mm) thick, so you won't notice them while watching videos. This setup is almost ideal for watching widescreen movies from streaming services such as Amazon Prime and YouTube, which support the 21:9 aspect ratio. Unfortunately, some other services (including Epix, Starz, and Disney Movies Anywhere) support only 16:9, so even ultra-widescreen movies will be displayed with black bars above, below, and on the sides of the picture. Hopefully one day, all streaming video companies will adapt to wider screens, since they're showing up on HDTVs as well.

In addition, you can use the included HP Display utility to put the display into a Technicolor-certified mode. In this mode, colors pop and have a 99 percent sRGB color gamut, making images look truer to life than they do on lesser displays. The Apple iMac has an even wider DCI-P3 color gamut that's better for content creators—photographers and videographers who need stronger reds and oranges, for example—but its screen isn't nearly as wide. The Technicolor certification is more than sufficient for movie watching. HP Display can also adjust the colors on the screen to minimize blue light (which supposedly inhibits your sleep hormones).

As on the Envy All-in-One (27-b010), the pop-up camera in the top of the screen can be used to log in with Windows Hello (in Windows 10) or make Skype calls. Since the camera hides away, you have an extra measure of security.



Since you're only a few feet away from the screen, the curve makes movies truly immersive.



NOW YOU SEE IT...

The pop-up webcam can be hidden for privacy, but when deployed is available for use with Windows Hello or Skype.



One of the few nits to pick with the screen is that its curve makes straight lines and picture borders look rounded, which could throw off art hobbyists. While I'm sure some will be able to adapt, I would recommend taking a test run on the system before you buy one if graphics creation is in your wheelhouse.

DASHING DESIGN

The Envy Curved All-in-One has the retro feel of a retro-modern 1950s tube TV. The screen is suspended on a thin, chromed metal arm, and you can tilt it to better view it while seated or standing. The base houses the desktop's motherboard and drives, so the screen is much thinner than on the previous Envy Curved All-in-One, where they were mounted behind the screen. About the only drawback to this is that you can't mount the system to a wall or articulating stand the way you can the iMac or the XPS 27. Altogether, the system measures about 18.5 by 32 by 8 inches (HWD) and weighs 24 pounds, so it should fit in the typical den or home office.

The front of the base is a speaker bar with four 35mm audio drivers and two passive radiators firing stereo sound at you. The speakers are tuned and branded by Bang & Olufsen, and can fill a medium- to large-size room with music or sound from streaming videos, though without the really deep bass notes. The speakers sound much better and play louder than on most all-in-one PCs, save the latest iteration of the XPS 27, which takes a similar approach to audio quality and quantity. The Dell has more forceful sound levels, so it might be a better choice for a dorm room. Like the 27-inch Envy All-in-One, the Envy Curved has a ring-shaped touch-sensitive volume control located on the right side of the base.



PUMP UP THE VOLUME

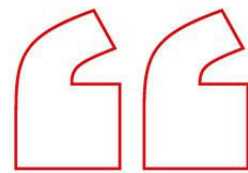
The ring-shaped volume control on the base is touch-sensitive and easy to use.

The keyboard feels a lot more luxurious than the simple plastic one that came with last year's HP Envy Curved. It's full size, but like the Apple iMac's keyboard, it has a short Z-height and is rechargeable. The included wireless mouse is a little oddly shaped, with its body resembling a small bar of soap and a palm rest hanging over the bottom to help it better fit in your hand, but it matches the overall look.

Connectivity options are excellent, including a headset jack, an SD card reader, and a USB-C port with Thunderbolt 3 on the right side. That trumps the iMac, which lacks USB-C/Thunderbolt 3 and has its SD card slot inconveniently placed in the back. On the HP's back panel, you'll find the jack for the AC adapter, an Ethernet port, an HDMI-in port, an HDMI-out port, a button for switching the HDMI source, four USB 3.0 ports, and the power button. Wireless connections are handled by way of 802.11ac Wi-Fi and Bluetooth 4.2.



The desktop comes with 16GB of RAM, which is enough memory for playing most games, multiple video streams, and multitasking. The combination of a 256GB solid-state drive (SSD) for programs and a 1TB SATA hard drive for storing files strikes a good balance between speed and capacity. The Envy Curved All-in-One comes with a one-year warranty.



**One of the few
nits to pick
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PERFORMANCE

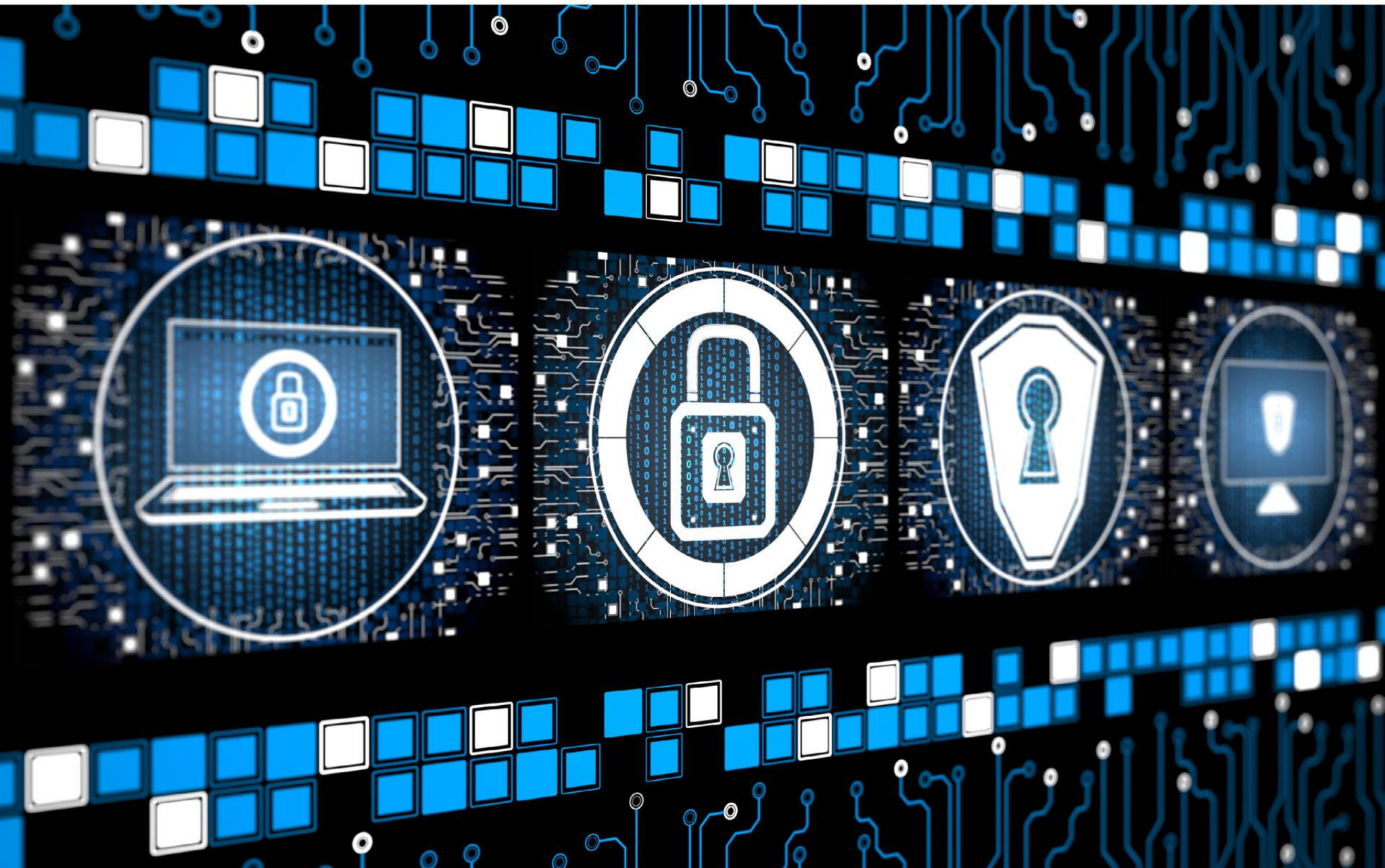
The Intel Core i7-7700T processor and the AMD Radeon RX 460 GPU make the Envy Curved All-in-One ideal for both full HD and 4K video playback, plus it has enough power for mainstream gaming. It smoothly played our Heaven and Valley tests at 1,366-by-768 resolution with the graphics quality set to Medium (75 frames per second (fps) and 89fps, respectively), and was just short of smooth playability (23fps to 24fps) at 1,920-by-1,080 resolution with Ultra graphics quality enabled. That's within a few frames of our class leaders, the Asus Zen AiO Pro Z240IC and last year's Envy Curved All-in-One. Essentially, you can play the occasional game like Overwatch, though you'll want to keep the details down.

On the PCMark 8 Work Conventional test that measures everyday productivity, the Envy Curved All-in-One earned a score of 3,415 points—top marks for the systems listed above. It was also the champ on the CineBench test (714 points) and finished second on the HandBrake test (1 minute, 3 seconds). It was unable to complete our Photoshop CS6 test due to an incompatibility with one of the 11 filters we use in it. Prior to that crash, however, the system was on pace with the others listed here, and it should have more than enough power to feel fast for several years.

CONCLUSION

The new HP Envy 34 Curved All-in-One (2017) eclipses last year's model with twice the SSD storage, a more attractive chassis, a faster processor, an improved keyboard and mouse, and superior ergonomics. It reaps all the benefits of its new design with the internals built into the base, primarily improved port placement, a thinner screen, and a soundbar that makes video viewing a pleasure. And its value is in line with the upgrades, costing just \$50 more than the list price of last year's model. For those reasons, it replaces its predecessor as our newest Editors' Choice for high-end all-in-one desktops. If you're a movie and TV enthusiast but also want to be able to multitask on a huge screen, then the HP Envy Curved All-in-One should be in the top spot on your shopping list.

JOEL SANTO DOMINGO



Five Top VPN Services

As consumers, we expect our computer hardware and software to keep us safe. The problem is, we all too often use our computers in risky ways. Connecting to public Wi-Fi networks, for example, is a commonplace practice, but these are excellent avenues for attackers to seize your personal information. Enter virtual private networks, or VPNs. These services use simple software to secure your Internet connection and give you greater control of how you appear online. While you might never have heard of VPN services, they are valuable tools that everyone should have at their disposal, as we'll explain.

WHAT IS A VPN?

If you've ever had to connect to a corporate network while working remotely, you may already be familiar with VPN technology. In the simplest terms, it creates a secure, encrypted connection, which can be thought of as a tunnel, between your computer and a server operated by the VPN service. In a professional setting, this tunnel makes you part of the company's network as if you were physically sitting in the office, hence the name. While connected to the VPN, all your network traffic passes through this protected tunnel, and no one in between can see what you are up to. A consumer VPN service does the same thing, but for the purposes of protecting data and identity.

Think about it this way: If your car pulls out of your driveway, someone can follow you and see where you are going, how long you are at your destination, and when you are coming back. They might even be able to peek inside your car and learn more about you. With a VPN service, you are essentially driving into a closed parking garage, switching to a different car, and driving out, so that no one who was originally following you knows where you went.

Of course, no security product is a magic bullet. VPN services, while tremendously helpful, are not foolproof. A determined adversary can almost always breach your defenses in one way or another. Using a VPN can't help if you unwisely download ransomware on a visit to the Dark Web. What a VPN can do is to protect you against mass data collection and the casual criminal vacuuming up user data for later use.

WHO NEEDS A VPN?

The protection provided by a VPN offers many advantages. First and foremost, it prevents anyone on the same Wi-Fi hotspot (or anywhere else) from intercepting your Web traffic in a man-in-the-middle attack. This is especially handy for travelers and for those using public Wi-Fi networks, such as those at hotels, airports, and coffee shops. VPNs also cloak your computer's actual IP address, making it harder for advertisers (or spies, or hackers) to track you online.

This is just good security, but for some people, a VPN is essential. Journalists and activists rely on VPN services to circumvent government censorship so they can safely communicate with the outside world. Of course, doing so may be against the law, depending on the country in which they're located.

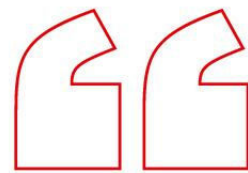
Some services, such as TorGuard and NordVPN, allow peer-to-peer file sharing and the use of BitTorrent sharing. Others will cancel your subscription if you use their servers for file sharing. Be smart: Don't ignore the company's terms of service. That way you can't complain if you get caught.

HOW TO CHOOSE A VPN SERVICE

The VPN services market has exploded over the past few years. Many providers are capitalizing on the general population's growing concerns about surveillance and cybercrime, which means it's getting hard to tell when a company is actually providing a secure service and when it's throwing out a lot of fancy words while selling snake oil.

It's important to keep a few things in mind when evaluating which VPN service is right for you: reputation, performance, type of encryption used, transparency, ease of use, support, and extra features. Don't just focus on price, though that is an important factor.

That said, not all VPN services require that you pay. Several of the services we've listed here also supply free VPN services. You tend to get what you pay for, as far as features and server locations go, but if your needs are basic, a free service can still keep you safe. TunnelBear, for example, offers a limited but serviceable free VPN.



Of course, no security product is a magic bullet. VPN services, while tremendously helpful, are not foolproof.



Some VPN services provide a free trial, so take advantage of it. Make sure you are happy with what you sign up for, and take advantage of money-back guarantees if you're not. This is actually why I also recommend starting out with a short-term subscription—a week or a month—to really make sure you are happy. KeepSolid VPN Unlimited offers a one-week Vacation subscription, for example. Yes, you may get a discount by signing up for a year, but that's more money to lose if you realize the service doesn't meet your performance needs.

I'm not a cryptography expert, so I can't verify all of the encryption claims providers make. I focus, instead, on the features provided. Bonus features like ad-blocking, firewalls, and kill switches that disconnect you from the Web if your VPN connection drops go a long way toward keeping you safe. I also prefer providers that use OpenVPN, since it's a standard that's superior to the older PPTP standard. It's also, as the name implies, open source, so issues with the protocol can be quickly found and addressed.

Be sure to consider transparency and the privacy policy of a VPN service before you buy a subscription. See whether the policy spells out what the service does, what information it collects, and what its responsibilities are. Some companies explain that they collect some information but don't inform you about how they intend to use that information. TorGuard, for example, has a clear explanation of how it keeps track of payment card information without maintaining any logging information. Also, be sure to find out where the company is based. Some countries don't have data-retention laws, making it easier to keep a promise like, "We don't keep any logs."

Most users want a full graphic user interface (GUI) for managing their VPN connection and settings, though a few would rather download a configuration file and import it into the OpenVPN client. Most VPN companies I've reviewed support all levels of technological savvy, and the best have robust customer support for when things go sideways.

While a VPN can protect you online, you still might want to take the additional step of avoiding credit cards for moral or security reasons. Several VPN services now accept PayPal, Bitcoin, and other alternate payment methods. In a few cases, VPN services may even accept retailer gift cards. That Starbucks gift card may be better spent on secure Web browsing than a mediocre latte.

It's also important to remember what a VPN can and cannot do. Although it will hide your IP address, it's not a true anonymization service. For that, you'll want to access the Tor network, which will almost certainly slow down your connection. That said, some services, such as NordVPN, offer Tor access on specific servers. IVPN offers a similar feature called multi-hop VPN, which lets you route your Web traffic in tricky ways.

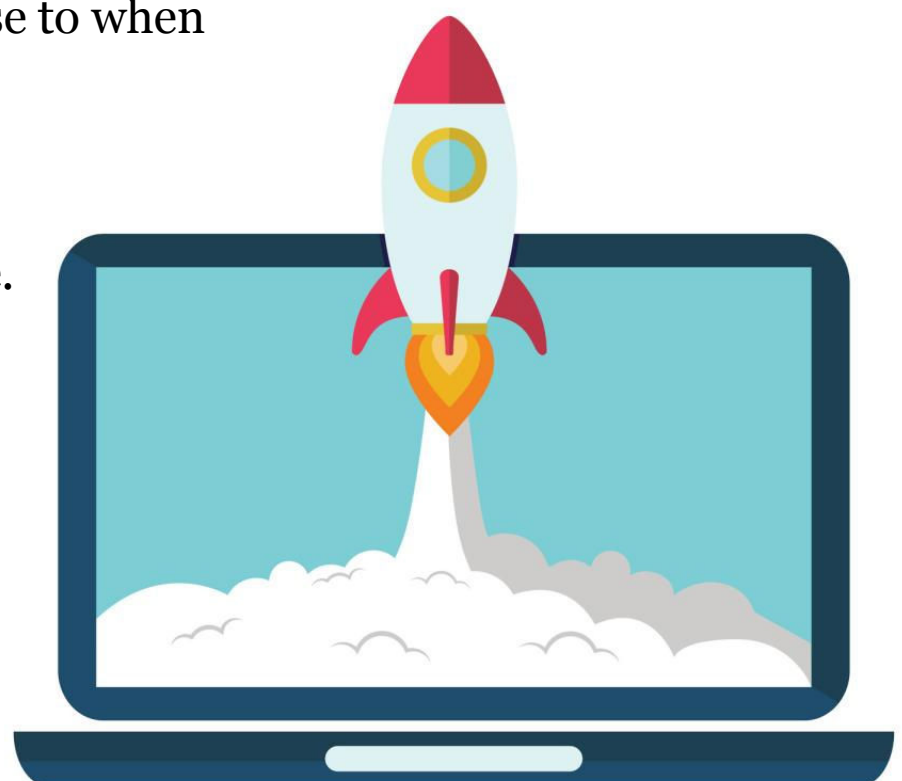
THE PERFORMANCE PROBLEM

It's often said that having to choose between security and convenience is a false dichotomy, but it is at least somewhat true in the case of VPN services. When a VPN is active, your Web traffic is going through many more steps than normal and is probably being bounced around in surprising ways. So your Internet connection may be more sluggish than normal.

The good news is that using a VPN probably isn't going to remind you of the dial-up days of yore. Most services provide perfectly adequate Internet speed when in use and can even handle streaming HD video. 4K video and other data-intensive tasks like gaming are another story. Some VPN services, like NordVPN, have started to roll out specialty servers for high-bandwidth activities. And nearly every service I've tested includes a tool to connect you with the fastest available network. Of course, you can always limit your VPN use to when you're not on a trusted network.

In some very rare cases, VPN services can actually improve your Internet performance. That's the case for PureVPN, IPVanish, and ExpressVPN. This is likely because these services have access to high-bandwidth infrastructure that your traffic is routed through when the service is active.

“
**Most services
provide
perfectly
adequate
Internet speed
when in use and
can even handle
streaming HD
video.**
”



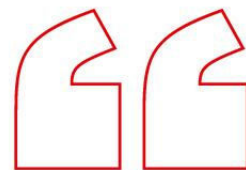
USING A MOBILE VPN

I used to advise people to do banking and other important business over their cellular connection when using a mobile device, since that is generally safer than connecting with a public Wi-Fi network. But even that isn't always a safe bet. Researchers have demonstrated how a portable cell tower, such as a femtocell, can be used for malicious ends. The attack hinges on jamming the LTE and 3G bands, which are secured with strong encryption, and forcing devices to connect with a phony tower over the less-secure 2G band. Because the attacker controls the fake tower, he can carry out a man-in-the-middle attack.

Admittedly, this is an exotic attack, but it's far from impossible. And Wi-Fi attacks are probably far more common than we'd like to believe. That's why I recommend getting a VPN app for your mobile device to protect all your mobile communications. Even if you don't use it all the time, using a mobile VPN is a smart move to protect your personal information.

Most VPN services offer apps on both Android and iOS, saving you the trouble of configuring your phone's VPN settings yourself. VPN providers typically allow up to six devices to be connected simultaneously under a single account. Also, while there are free VPN services available, many require that mobile users sign up for a paid subscription.

Not all mobile VPN apps are created equal. In fact, most VPN providers offer different services (and sometimes, different servers) on their mobile offerings than what is available on their desktop counterparts. I was pleased to see that NordVPN and Private Internet Access provide the same excellent selection of servers regardless of platform. These apps received an Editors' Choice nod both for desktop VPN apps and Android VPN apps.



Even if you don't use it all the time, using a mobile VPN is a smart move to protect your personal information.



Android users should note that some VPN services also block online ads and trackers. While iPhone owners can use apps like 1Blocker to remove ads and trackers from Safari, ad blockers aren't available in the Google Play store. But with Spotflux or Private Internet Access, ads are a thing of the past.

PICK A VPN SERVICE ALREADY!

Computer and software providers work hard to make sure that the devices you buy are safe right out of the box. But they don't provide everything you'll need. Antivirus software, for example, consistently outperforms the built-in protections. In the same vein, VPN software lets you use the Web and Wi-Fi with confidence that your information will remain secure. It's critically important and often overlooked.

Even if you don't use it every moment of every day, a VPN is a fundamental tool that everyone should have at their disposal—like a password manager or online backup service. It's one that will only become more important as our devices become more connected. So get safe, and get a VPN.

Private Internet Access VPN

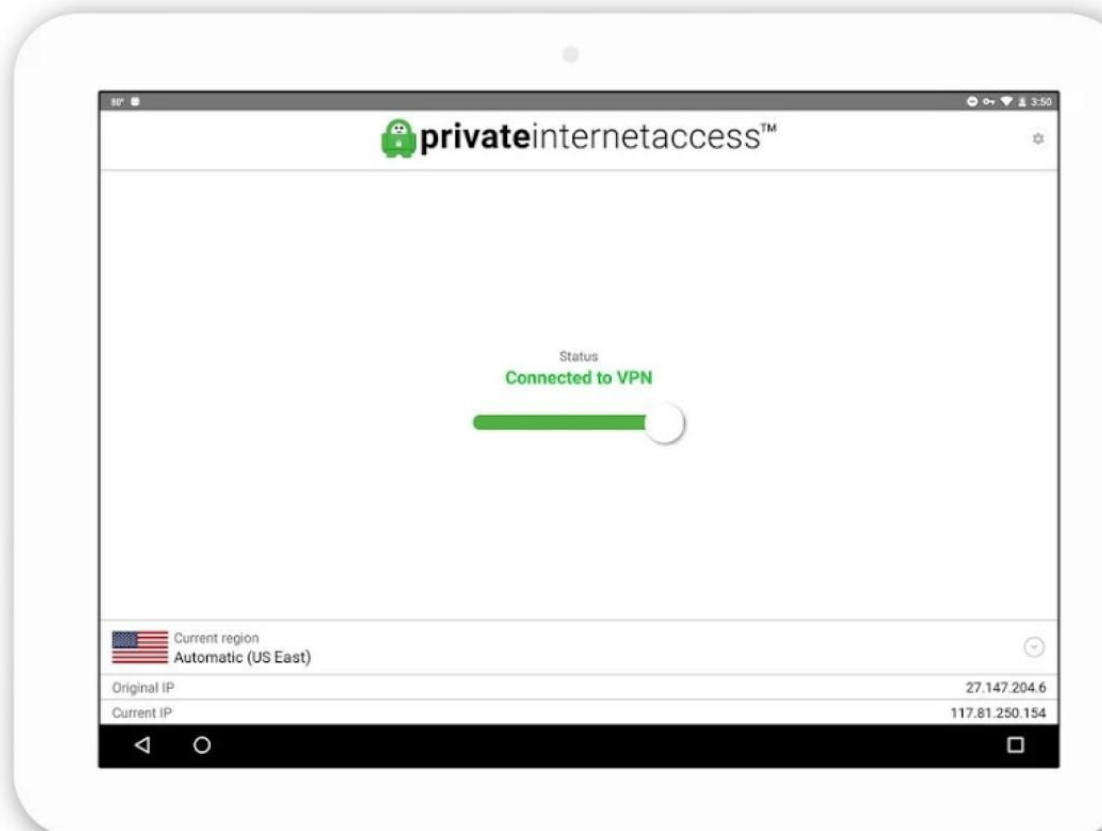
\$6.95 per month

EDITORS' CHOICE



With government spooks, hackers, and advertisers all hungry for our personal information, VPN is bound to become a more critical and common tool. And Private Internet Access is among the best, offering a robust collection of features in a feather-light package for less than the price of a Netflix subscription.

That said, the service's minimal presence on your computer can be a little daunting if you like more hand-holding with your utilities. And it's not easy on the eyes, either. If you prefer a slick interface that offers more reassurance and explanation, then Editors' Choice winners NordVPN and KeepSolid VPN Unlimited are for you. But for excellent features that you won't ever have to look at (as well as an affordable price and live support), try Private Internet Access, one of my Editors' Choice winners for VPN services.



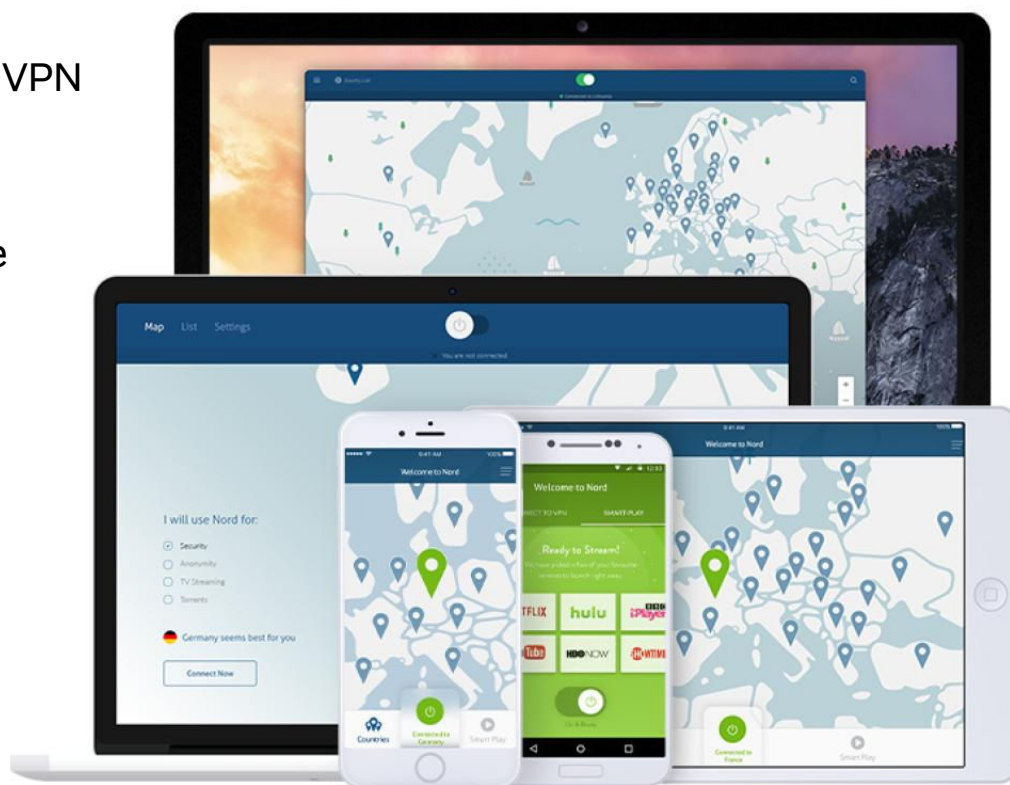
NordVPN

\$11.95 per month

EDITORS' CHOICE



NordVPN is a powerful but unimimidating VPN service that can easily secure your online activities. We really appreciate NordVPN's simplicity, which doesn't come at the price of excellent features. The addition of Kill Switch is very welcome, as are the specialized servers for video streaming, Tor-Over-VPN, and double encryption. NordVPN offers a solid suite of security features in an easy-to-use package at an attractive price. It's a smart choice, and it remains a PCMag Editors' Choice, along with KeepSolid VPN Unlimited and Private Internet Access.



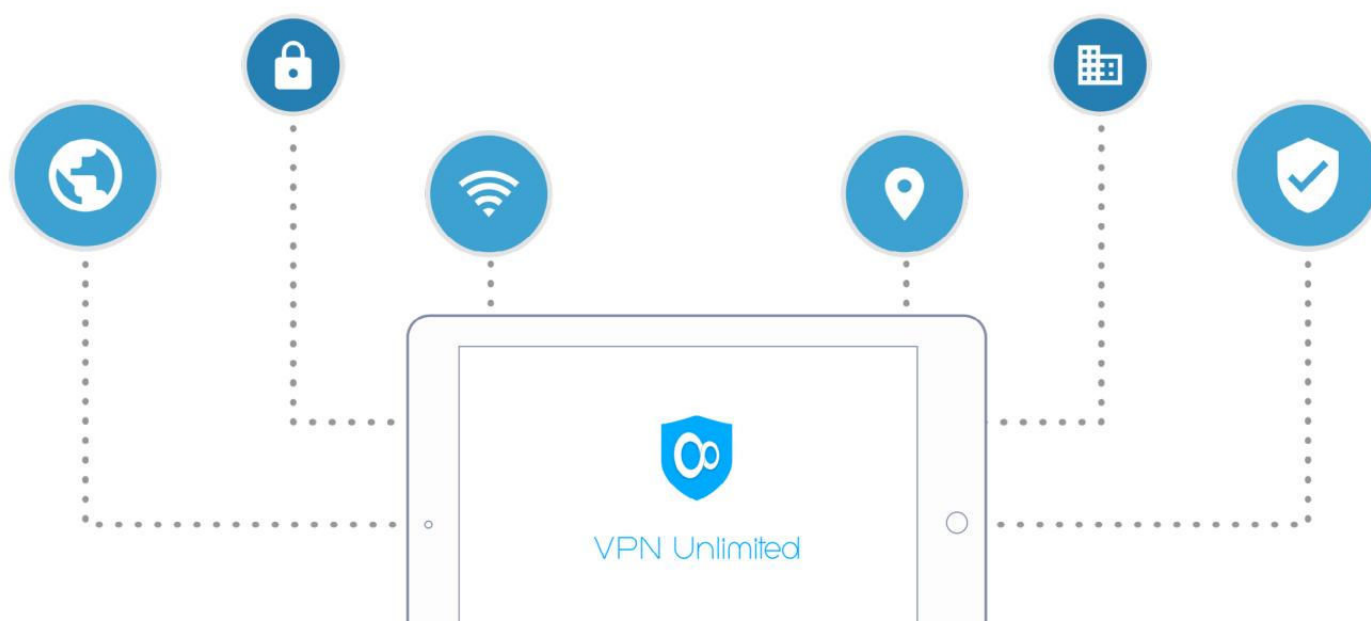
KeepSolid VPN Unlimited

\$5.99 per month

EDITORS' CHOICE



When I test VPN services, I'm looking for speed, flexibility, and features. KeepSolid VPN Unlimited does well in all three categories. Its pricing scheme is inexpensive at the usual monthly subscription cycle, and with subscription periods as short as one week, VPN Unlimited can be available whenever you need it. Its speed test results are solid, especially in the U.S., and most users will barely notice that it's running. Add to that P2P support, a well-designed client, specific streaming servers, browser clients, and other advanced features, and you're looking at an all-around winner. For all of this, VPN Unlimited earns our Editors' Choice award for VPN services, an honor it shares with NordVPN and Private Internet Access.

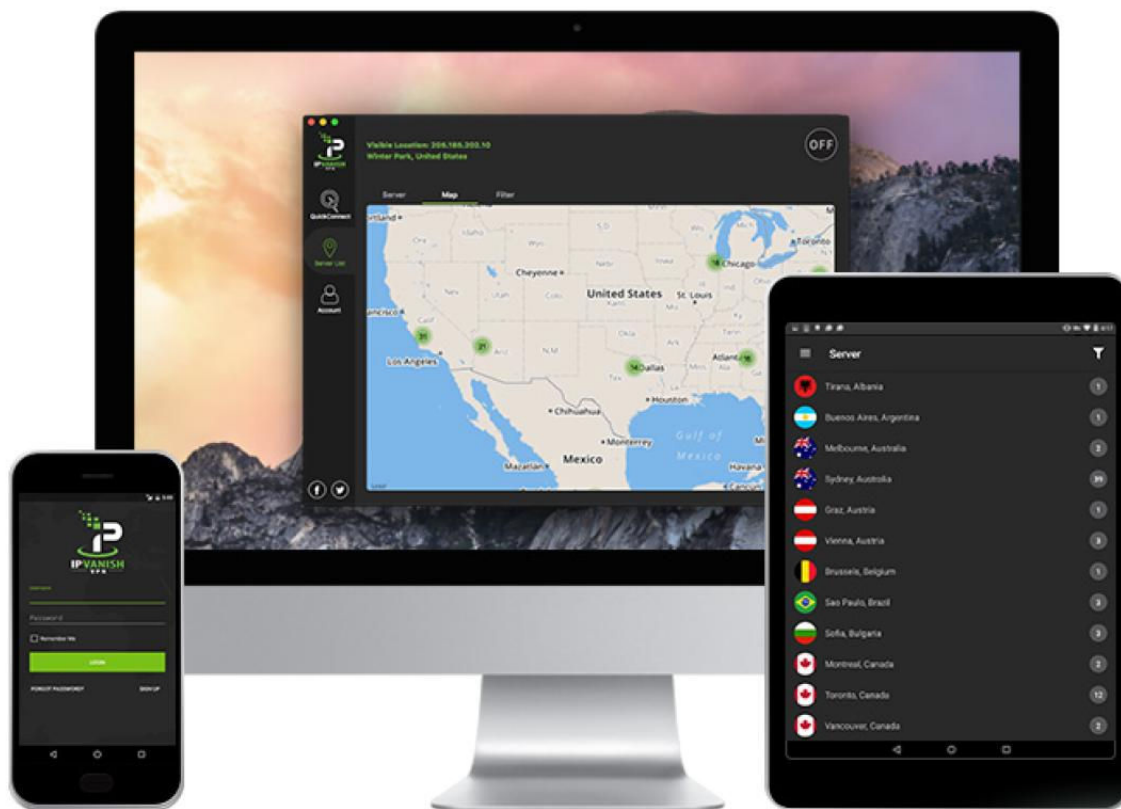


IPVanish VPN

Plans start at \$5.99 per month



IPVanish has a lot going for it. It offers a very usable (if not particularly attractive) interface, simple billing, and a great set of security tools. It's available on every major platform and is one of the rare services that actually improved Web performance in our international VPN test. It's also one of the few VPN services that allows unfettered P2P file sharing and BitTorrenting. Its hundreds of servers distributed around the globe ensure that no matter where you are or what you're doing, IPVanish has a server to meet your needs.

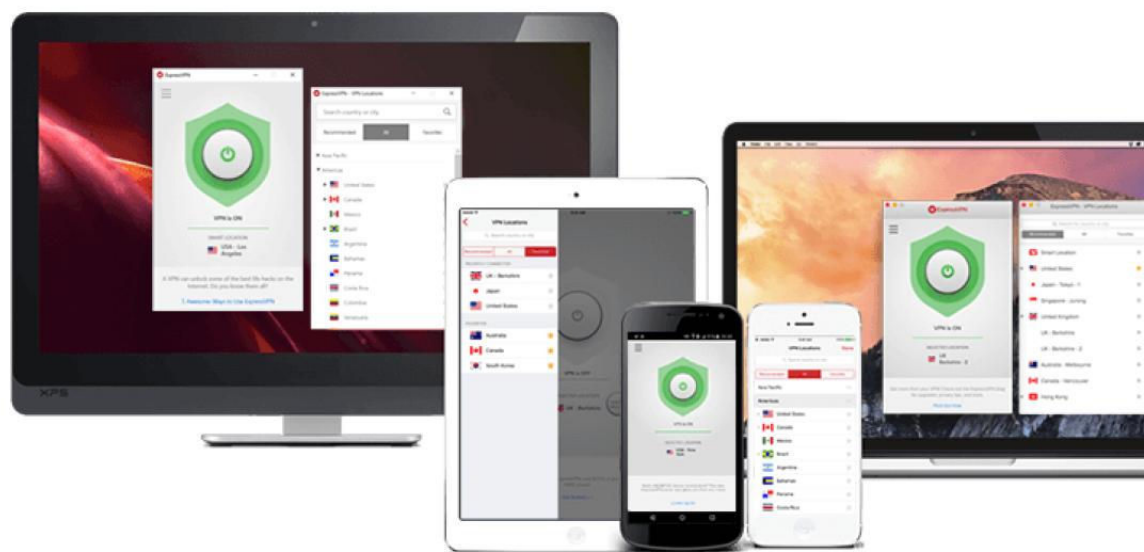


ExpressVPN

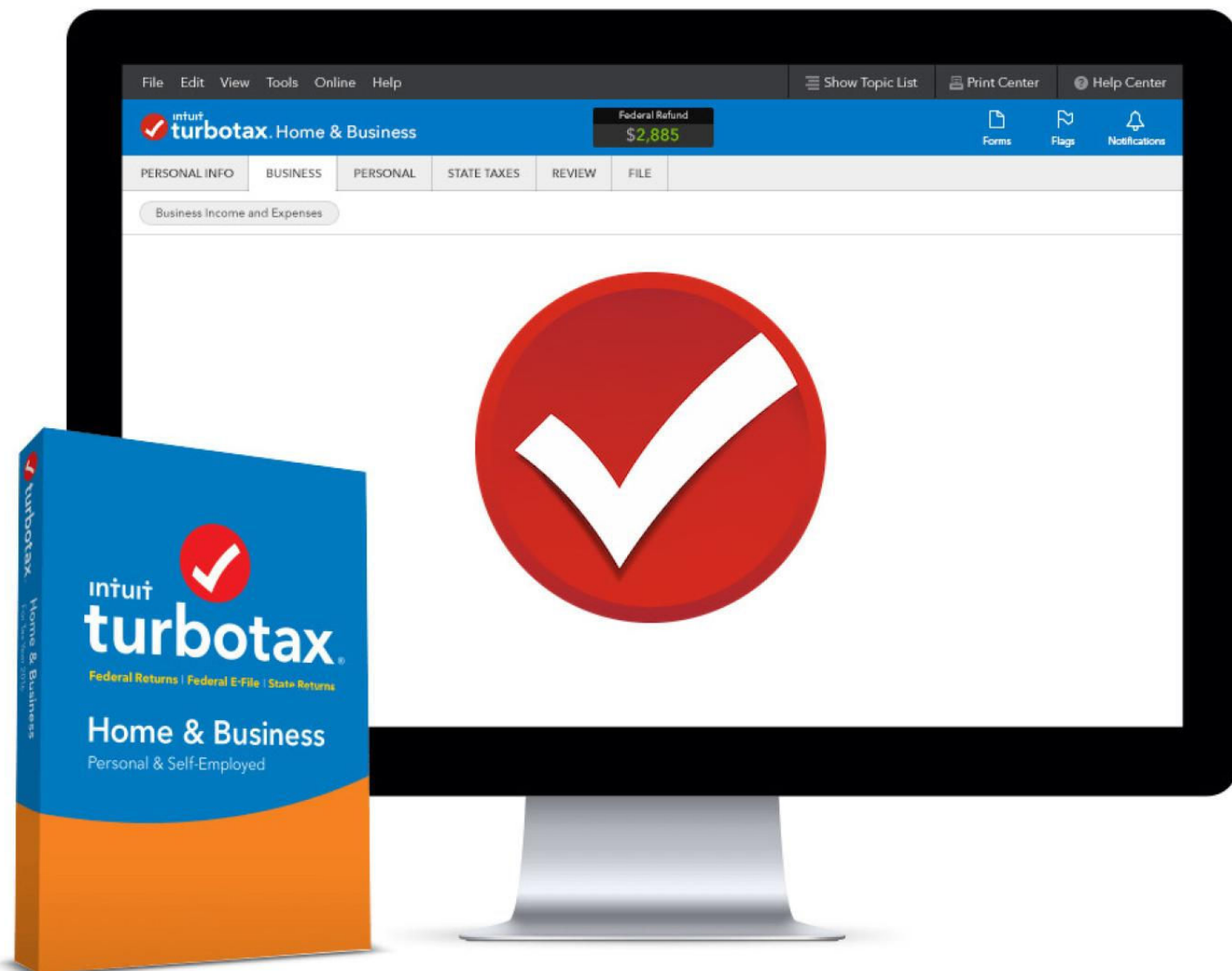
Plans start at \$8.32 per month



ExpressVPN doesn't live up to its speed claims: In my tests, PureVPN beats it in terms of speed and the reliability of those high speeds. But when you remove the boasts from the equation, ExpressVPN looks like a solid VPN service. You'll enjoy decent speeds, assured zero-logging, a wide selection of servers, and one of the best-looking clients I've yet used. If you use BitTorrent or other P2P services, ExpressVPN's download boost on international servers will surely be of interest. It's also one of the very few services I've tested that let me stream Netflix content, though that could change. ExpressVPN could benefit from more reliable speeds and specialized servers for activities such as gaming or video streaming. It's also among the most expensive VPNs I've reviewed, costing even more than PureVPN, which outperformed it in speed tests.



MAX EDDY



TurboTax Excels With Its Coverage, Help, and UI



Intuit's TurboTax family of tax preparation software has won more PCMag Editors' Choice awards than any of its competitors, thanks to its thorough coverage, comprehensive help system and, above all, best-in-class user interface. This year is no different, although it's worth noting that TurboTax users pay a considerable premium for that excellence. This year, TurboTax shares the Editors' Choice with the more reasonably priced TaxAct Premium Online.

**Intuit TurboTax
Self-Employed
2017**

(Tax Year 2016)

\$34.99 and up



The lineup and pricing of TurboTax have changed slightly for 2017 (for filing your 2016 taxes). The company is once again offering its Federal Free Edition (free federal and state for 1040EZ and 1040A filers), which I'll be reviewing soon. For \$54.99 federal and \$39.99 per state, the Deluxe version adds support for the Schedule A as well as live on-screen tax advice, storage of past returns, and import of your 2015 TurboTax data. You need TurboTax Premier (\$79.99 federal, \$39.99 state) if you have to report on investment income and rental property. I reviewed the top-of-the-line product, TurboTax Self-Employed (\$114.99 federal, \$39.99 state), which is the most expensive offering in this year's tax services reviews. It's also the only TurboTax version that lets you record income and expenses on a Schedule C.

As of this writing, TurboTax is available at a discount (\$89.99), but that price may go up closer to April 15, since Intuit doesn't guarantee its prices the way TaxAct does. If you're going with TurboTax, this is one more reason not to file your taxes at the last minute.

Intuit TurboTax Self-Employed 2017 (Tax Year 2016)

PROS Exceptional user experience. Comprehensive coverage of tax topics. Excellent variety of help tools. Includes QuickBooks Self-Employed. SmartLook live-video help feature.

CONS Expensive. Some answers in help database are supplied by non-expert users. Misleading name; not only for the self-employed, it's simply TurboTax's highest-level offering and the only one that lets you file a Schedule C.



SIMPLY THE BEST Plain-spoken help resources, thorough exploration of tax forms and schedules, and an unparalleled user experience make TurboTax our Editors' Choice for tax-prep software.

A FAMILIAR FORMAT

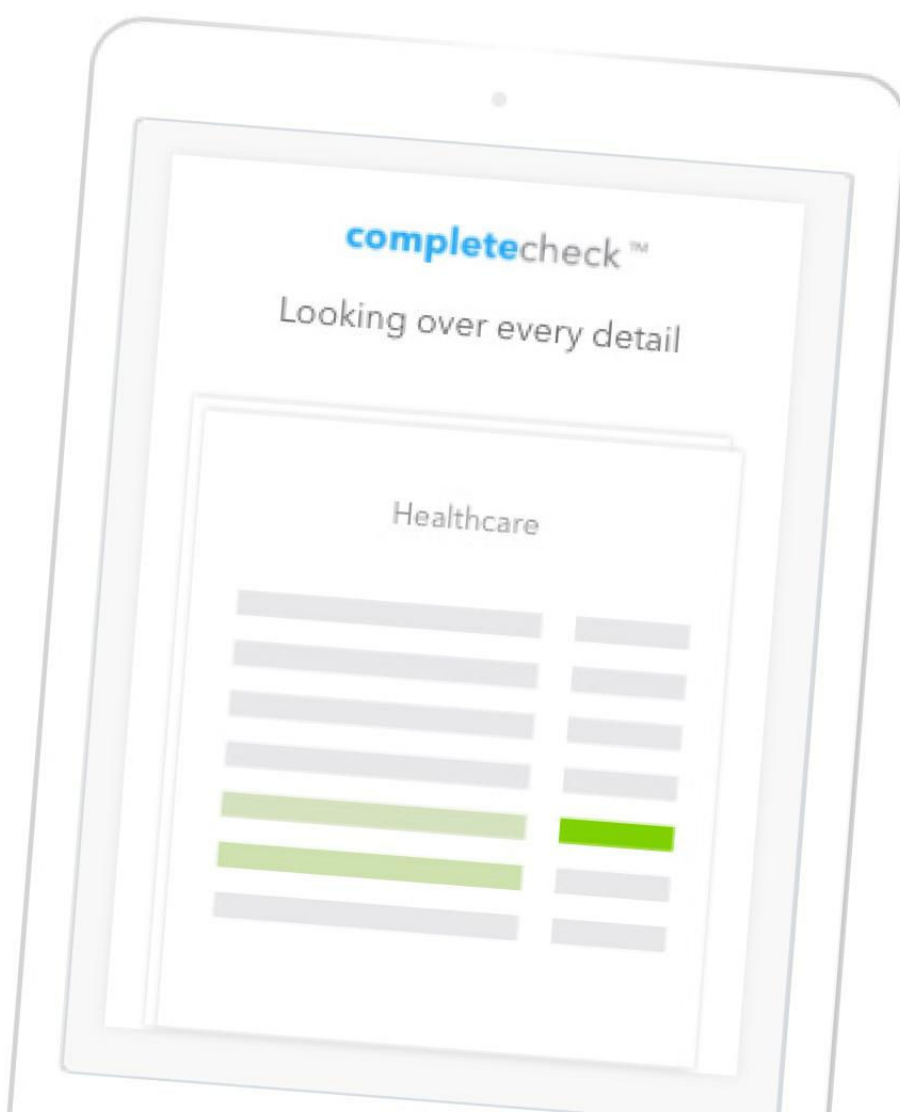
Personal tax preparation websites still use the format Intuit introduced for its desktop software products in 1993. And with good reason: It works beautifully, saving time, easing frustration, and dramatically reducing errors. Instead of shifting your attention among the Form 1040, related forms and schedules, IRS instructions, and third-party reference books, you go through the tax preparation screens one at a time, in a logical order.

TurboTax started this trend of tax preparation services as giant wizards. Intuit's service (and all its imitators) asks you a lengthy series of questions about your personal situation on a variety of tax-related topics. You answer, then click a button to advance to the next screen. You keep answering and clicking until the service says you're done. Then TurboTax combs through your return, helps you fix any problems, and helps you file or print the finished product after you've finally paid for your federal and however many state returns you need to file.

All this time, you never have to look at an IRS form or schedule, because TurboTax and its competitors complete them for you in the background. What you do see—especially in TurboTax—is expert help in the form of simply worded explanations of tax concepts that either accompany the questions or open in a small pop-up window.



You never have to look at an IRS form or schedule, because TurboTax and its competitors complete them for you.

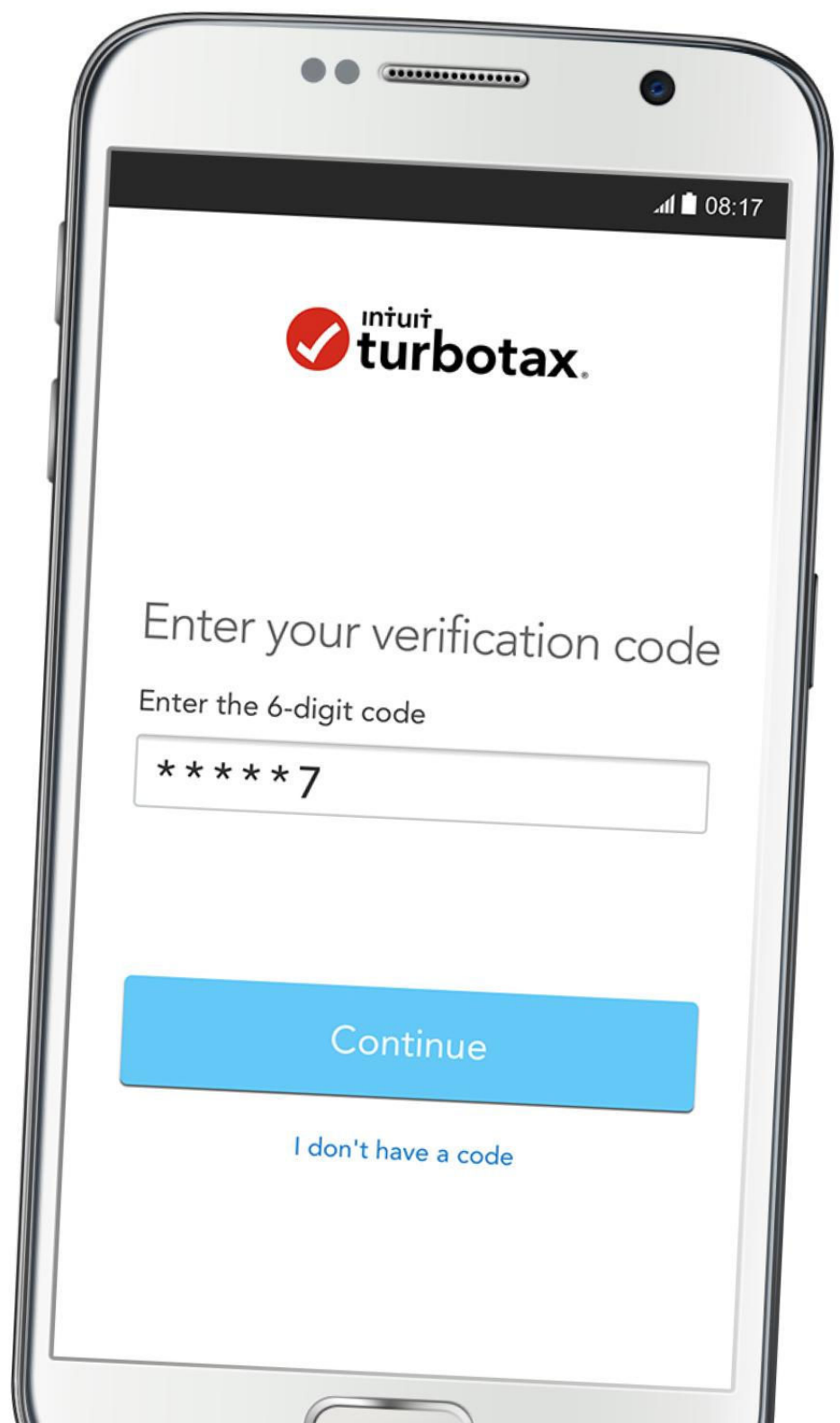


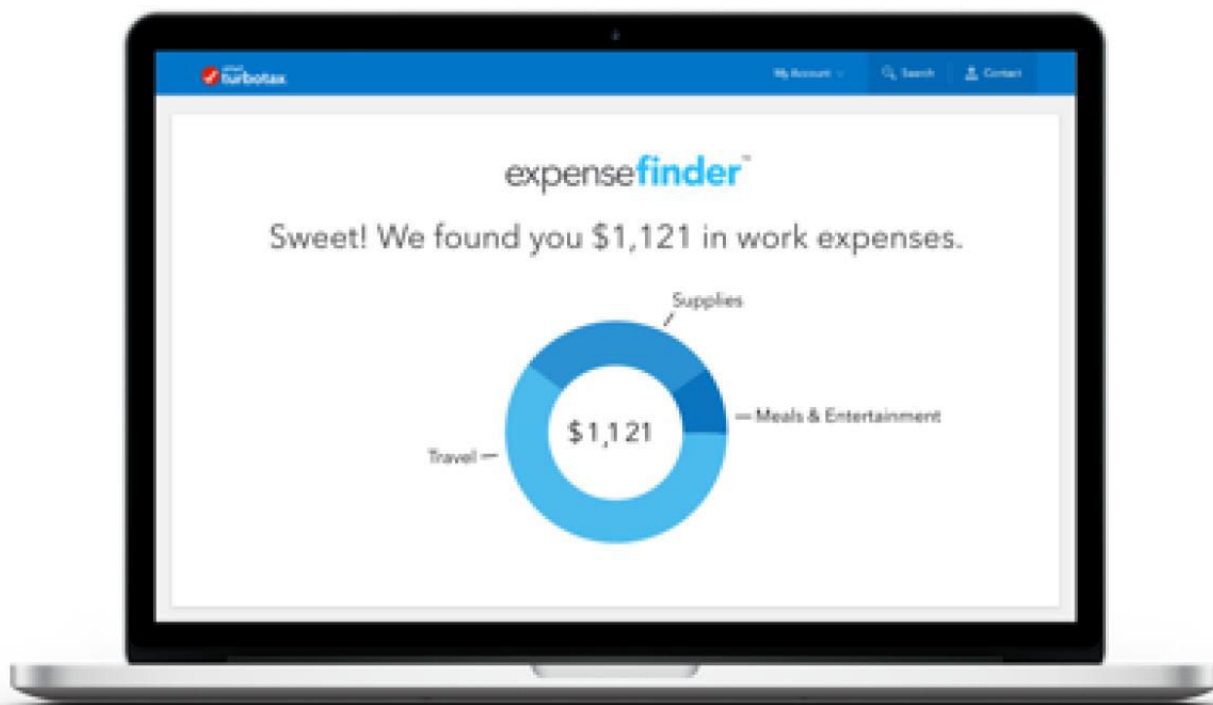
MAKING TAXES FRIENDLIER

Every personal tax-preparation website has a personality of its own, a combination of its voice, user interface (even the choice of fonts, graphics, and so on), and skill at guiding you through its wizard without confusing you. TurboTax's personality is on display from the start, even before you start filling in dollar amounts. First, it asks for basic personal details, such as addresses, Social Security numbers, and dependents. It asks about life events you may have experienced during the last year that might affect your taxes, though it isn't quite as exhaustive in this area as TaxACT Online Premium.

All the while, TurboTax takes a conversational and friendly tone, whereas competing services, such as Jackson Hewitt Online Premium, tend to be more formal and businesslike. You may like this friendliness, especially if you're nervous about your taxes or this is your first time using a tax prep site, or you may just want to get on with it. In any case, the extra chumminess isn't overdone, nor will it slow you down.

Before you dive into reporting income, TurboTax has one more question for you: Do you want additional protection? Intuit offers an add-on service called MAX Assistant & Defend. For an additional \$59.99, you get expert audit assistance as well as tax identity restoration and refund recovery if someone steals your Social Security number and nabs your money. You also get identity theft monitoring, priority support, and additional security measures. It's not a bad deal. Some competitors also provide audit help, but none other offers such a deep set of services.





The site tackles what is probably the most complex element of a self-employed taxpayer's return right at the start.

A CLEAN, LEAN LOOK

TurboTax's user interface has been pared down to the bone over the years. It uses a layout similar to its competitors', but its look is sparser and cleaner. A horizontal toolbar at the top divides the site into its primary sections, such as Personal Info, Business, and Personal. There's nothing outside of the data entry screen other than a running, real-time tally of your refund or taxes due and links to your account, the search box, and the contact page.

The site tackles what is probably the most complex element of a self-employed taxpayer's return right at the start: business income and expenses. It first asks whether you want to select the topic areas that pertain to you (business, rental and royalties, farm, and so on) or whether you want TurboTax to walk you through every possible scenario. Competitors offer these options, too. If you're new to tax preparation, you have a complicated financial situation, or you've been through multiple major changes during the past year, it's advisable to let TurboTax quiz you about every possibility. If something doesn't pertain to you, you can easily click through it using the navigation buttons at the bottom of the screen. Otherwise, you can just visit the pertinent sections.

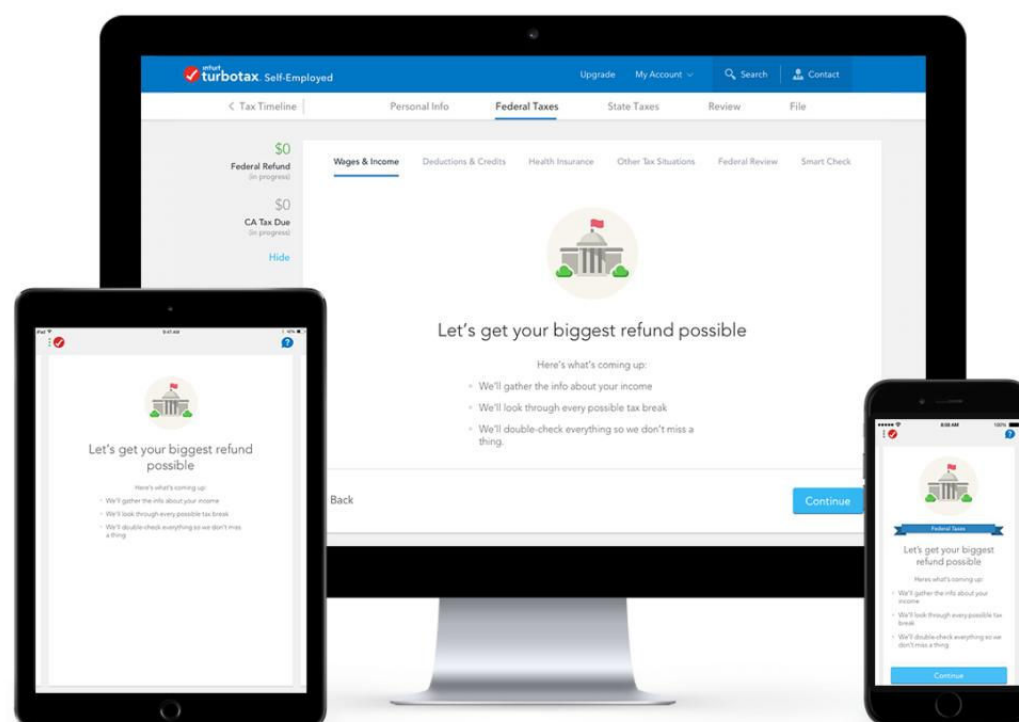
It's hard to get absolutely lost if you simply read everything on the screens. TurboTax makes it clear what it's looking for on every page and how you can respond. For example, when it's asking for interest or brokerage-statement details, it displays two blank fields, one for the related financial institution and one for the dollar amount. If you're filing for more than one individual, you'll need to indicate who the recipient is. You do this by clicking a button in front of the correct name (or by clicking Both of Us, if that's the case), then clicking the Continue button to move to the next topic. You can also add another 1099-INT, or use the Back button to return to the previous page.

This is how you communicate with TurboTax throughout the tax preparation process. It asks a question or makes a statement about what it wants and provides buttons and lists of options and blank fields for your answers. Unlike TaxAct, TurboTax lacks a comprehensive navigation outline that lets you zero in on the exact screen you want if you're working out of sequence.

No other service matches the streamlined elegance of TurboTax, from its clean look to the simple, logical progression through the tax topics you need. For most, this is the most critical aspect of tax preparation. If the interface and interview are clear and simple, e-filing will be, too. That doesn't mean you won't occasionally need help, but TurboTax hits a home run there, too.

UNDERSTANDABLE HELP

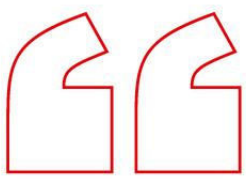
There was one advantage to using the actual IRS instructions when you prepared your taxes in the old days: They were comprehensive. They may have been difficult to understand if you weren't a tax preparer, but the answer to your question was in there, somewhere.



Part of the beauty of personal tax preparation websites is that while you rarely need to search for an answer, the explanatory content has been rewritten so many times over the years that it's usually easy to understand. TurboTax does an especially good job in terms of both comprehensibility and accessibility. It often provides brief, simple explanations of tax topics as it asks its questions. Many words and phrases are hyperlinks that open small pop-up windows containing additional detail. Quite often, you'll see a Learn More link that does the same thing. Sometimes, TurboTax even guesses at a question you might have and provides a link, just in case. It's an excellent and deep system, and it makes the tax process much less stressful.

There are other ways to get help, too. For example, if you're not sure whether you qualify for a credit (Child and Dependent Care, for example), TurboTax asks a series of questions to determine your eligibility. You can also search a voluminous database of questions and answers for more thorough explanations of tax topics. One caveat: Look to see who answered the question. Most often, it will be identified as coming from something like TurboTax FAQ or TurboTax, which is preferable. But anyone can answer questions. So, make sure that if the source isn't TurboTax, it's a tax authority of some sort.

All TurboTax's competitors provide one or more of the aforementioned help options, but their offerings vary greatly in terms of coverage, depth, simplicity, and layout. TaxAct, for example, displays context-sensitive Q&As off to the right side on many screens. H&R Block Premium is good at providing relevant help, too, and its Refund Reveal feature displays the actions you took that contributed to your refund or obligation.



**You can also
search a
voluminous
database of
questions and
answers for
more thorough
explanations of
tax topics.**



UNIQUE TAX TOOLS

TurboTax has one innovative help method no other service offers. Its SmartLook feature connects you to credentialed tax professionals via video. You can see and hear them talking in a window, and you can grant them access to your in-progress return, letting them see what's happening on your screen so they can answer questions and correct problems.

Finally, TurboTax encourages you to provide more thorough documentation than competing sites such as TaxSlayer Premium and Jackson Hewitt Edition do. For example, when you're entering business expenses for advertising, you can break them down into types (business cards, promotional items, and so on) and subtotals. The site provides examples that might be relevant to your specific industry, even less commonly known ones, like warehouse club memberships (Other Office Expenses). If you are ever audited, you'll thank yourself (and TurboTax) for documenting your expenses so carefully. Most competitors simply ask you to enter a total for every category. You can maintain detailed expenses year-round if you use the subscription to QuickBooks Self-Employed that's included. That's an excellent bonus feature.

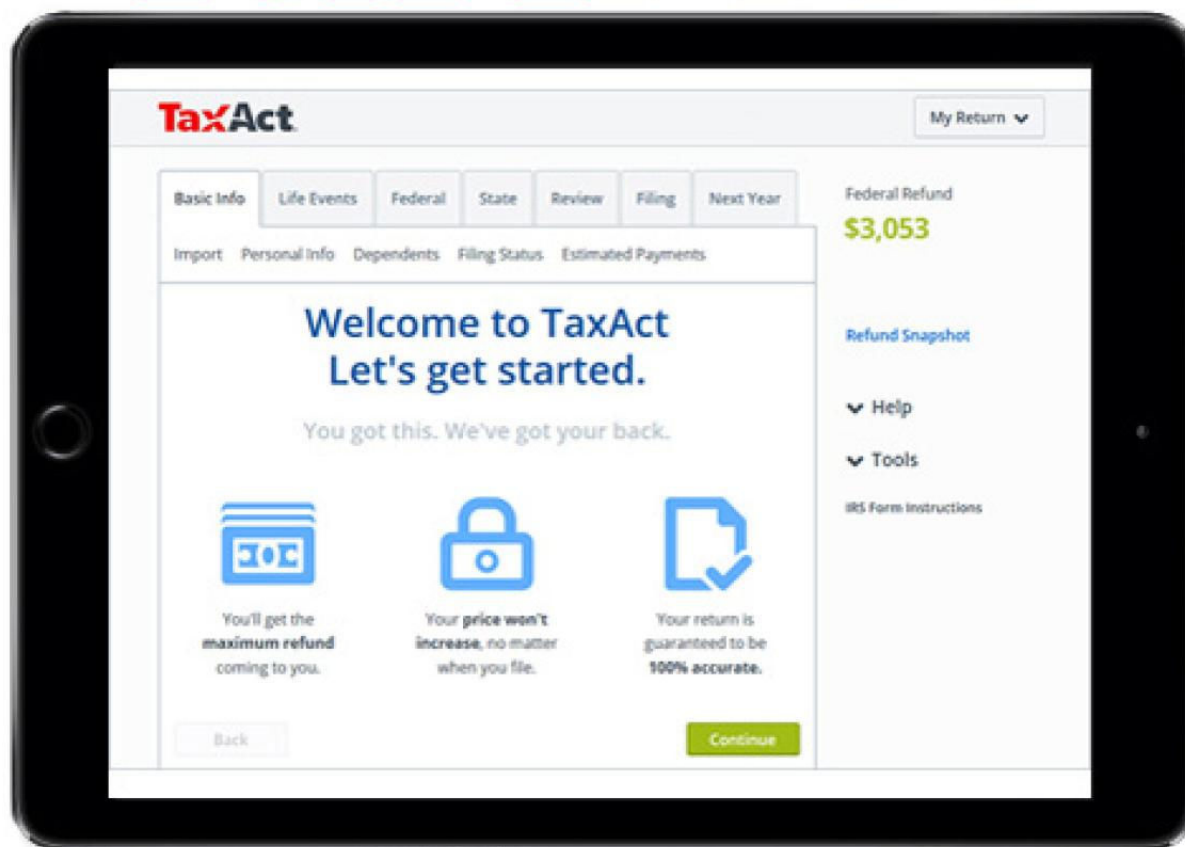
CONCLUSION

TurboTax Self-Employed's final review process is as good as any other and better than most. It checks your return for accuracy and audit risks and provides fields for your changes and additions, unlike TaxSlayer, whose review is not as streamlined. Then TurboTax moves pertinent data into your state return and helps you complete that.

TurboTax Self-Employed is significantly more expensive than the other tax services I reviewed this year, and they're all capable of preparing and filing complex returns—even the free Credit Karma Tax. If you used another site last year and liked it, I wouldn't necessarily switch to TurboTax; stick with what you know. Still, TurboTax is a clear Editors' Choice this year because of its solid tax topic coverage, excellent help options, and the best user experience there is. TaxAct Premium Online also wins an Editors' Choice nod, for the best tax preparation option for those on a budget, thanks to its combination of exceptional preparation tools and guidance at a reasonable price.

KATHY YAKAL

TaxAct®



TaxAct Offers Affordable, Reliable Tax Prep Tools



TaxAct (formerly called Personal TaxEdge) broke the price barrier when it introduced completely free online personal tax preparation and e-filing several years ago.

These days, Credit Karma Tax is the only service that supports all the major forms and schedules for free, but TaxAct remains both affordable and easy to use. If you're looking for an inexpensive service for doing your 2016 taxes (which are due by April 18 of this year), TaxAct is tops.

**TaxAct Online
Premium 2017
(Tax Year 2016)**

\$37 for federal,
\$25 for state



PRICING AND VERSIONS

As mentioned, TaxAct's prices have crept upward, and its product lineup has changed, too. I reviewed TaxAct Online Premium this year (\$37 for federal, \$25 for state), which is the company's top-of-the-line personal tax service. If you don't need to report small business or farm income and expenses (Schedules C and F), you can opt for TaxAct Online Plus (\$27 federal, \$25 state). TaxAct Online Free may not be totally free for you. It charges \$5 to import the data from your 2015 TaxAct return (no fee if you're using Premium or Plus). The free service supports 1040EZ and 1040A filers via a browser or mobile device.



Although these prices represent a definite increase, consider that Credit Karma Tax, this year's only completely free comprehensive tax offering, gets paid in a different way, by serving you ads for credit cards and other financial services. Consider that to get access to Credit Karma Tax, you also have to sign up for Credit Karma's credit-monitoring service. Consider, too, that our other Editors' Choice, TurboTax Self-Employed, costs \$114.99 for federal taxes, and \$39.99 per state return. Yes, TurboTax has an unmatched user experience, but you do pay for it.

TaxAct Online Premium 2017 (Tax Year 2016)

PROS Low price for federal return. Good navigation tools, form, and schedule support. Helpful Life Events feature. Phone and email help. Thorough review process.

CONS Lacks support for W-2 photo imports. Some help links lead to glossary, IRS publications. Some overly complex Q&A explanations.

GREAT BARGAIN

TaxAct Online Premium provides affordable, reliable personal tax-preparation tools that support all major tax scenarios.

WIZARD WIZARDRY

TaxAct, like its competitors, is an online version of all those paper documents you would otherwise have to assemble to do your tax preparation. If you have a complicated financial life and you've ever tried to complete your return on paper, you know how frustrating and time-consuming it is to keep flipping back and forth among forms and schedules, doing all your calculations, and transferring the correct numbers to your 1040.

TaxAct makes this grueling process more organized and manageable. Like a human being in a tax service office would do, it interviews you to get all the information needed to complete your return, taking you through a lengthy step-by-step wizard. All you have to do is answer the questions on each page and then advance to the next by clicking a button. Sometimes you have to fill in a number or a few words, whereas other pages ask you to select responses from lists of options.

As you enter information, TaxAct does the necessary calculations and puts your answers onto the appropriate lines on the right forms or schedules. At every step of the way, there's support of one kind or another. When you've visited every topic applicable to your situation, TaxAct goes through your return and alerts you to potential problems before allowing you to e-file or print out paper returns to mail. You aren't asked to pay until this point, as is usual with these services.

EARLY INFO

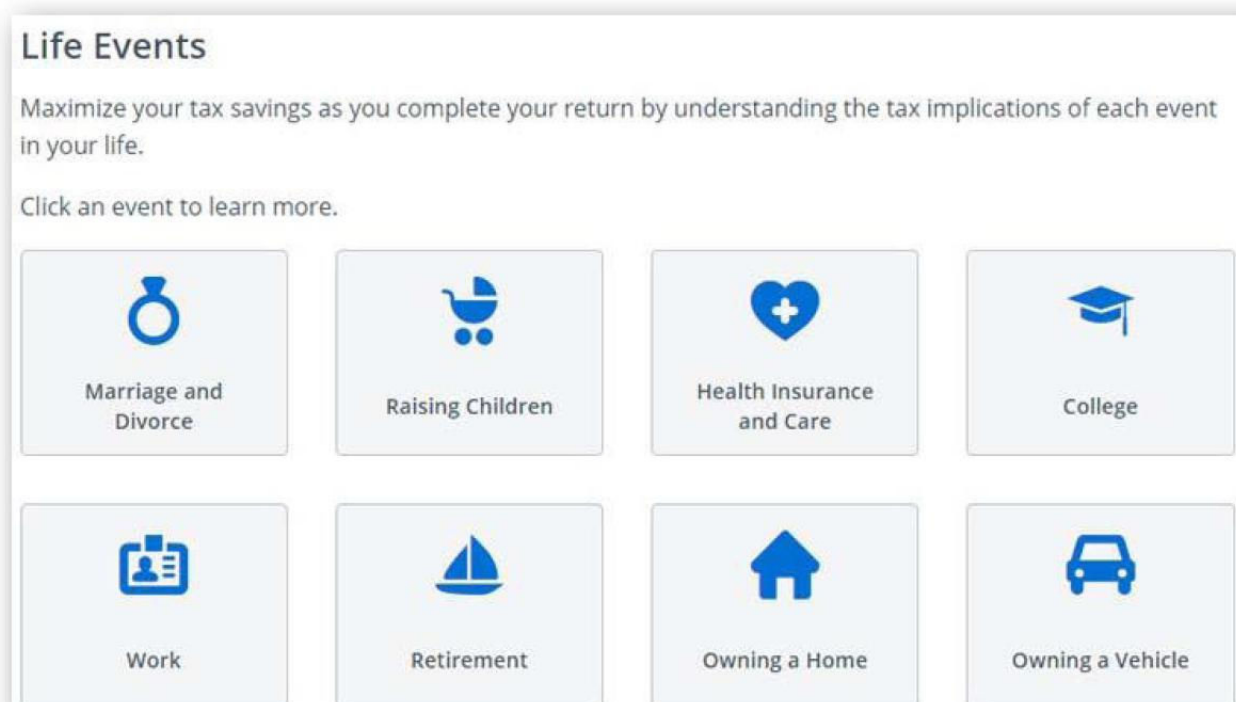
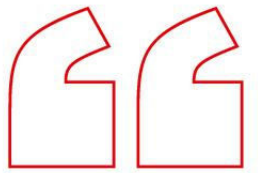
The first step in using TaxAct is to create a username and password. Unlike its competitors, TaxAct uses two-step authentication to make the service even more secure. Once you've gone through the required steps once, you can turn off the authentication tool for the current computer so you don't have to go through it every time you log in. I appreciate both the security and the flexibility. Taxes contain such sensitive information that you might be better off just leaving the two-step authentication on, however.

After getting signed in, the service asks whether you want to import your tax data from last year. TaxAct can bring in that information if you have a PDF file of your 2015 return that was prepared by H&R Block, TaxAct, or TurboTax. This can save you a lot of time and improve the accuracy of your return, too—assuming your data was correct last year.

As a human preparer would do, TaxAct has to get some basic information about you up front, such as names and addresses, birth dates, and Social Security numbers. TaxAct does this in a fairly straightforward, serious way. Other services, such as TurboTax and H&R Block Premium, try to be a little folksier and friendlier here and throughout the interview process. This doesn't affect the actual tax preparation, but some may find a friendlier experience a little more pleasant.

Then it's on to questions about your family's health insurance situation and any estimated taxes you paid that would have been applied to the 2016 tax year. The final step before you begin the actual tax preparation Q&A is the Life Events screen. No one does it better than TaxAct, although most services at least do a decent job here. Credit Karma Tax is a notable exception, as it lacks this step altogether.

The Life Events page displays icons representing 19 different situations that could have an impact on your tax preparation, including marriage and divorce, retirement, financial hard times, and owning a home. You click those that apply to you to advance through the screens, which provide helpful information and tips about each situation.



Unlike its competitors, TaxAct uses two-step authentication to make the service even more secure.



LIFE HAPPENS

TaxAct quizzes you on events that may affect your filing, with useful info and tips along the way.

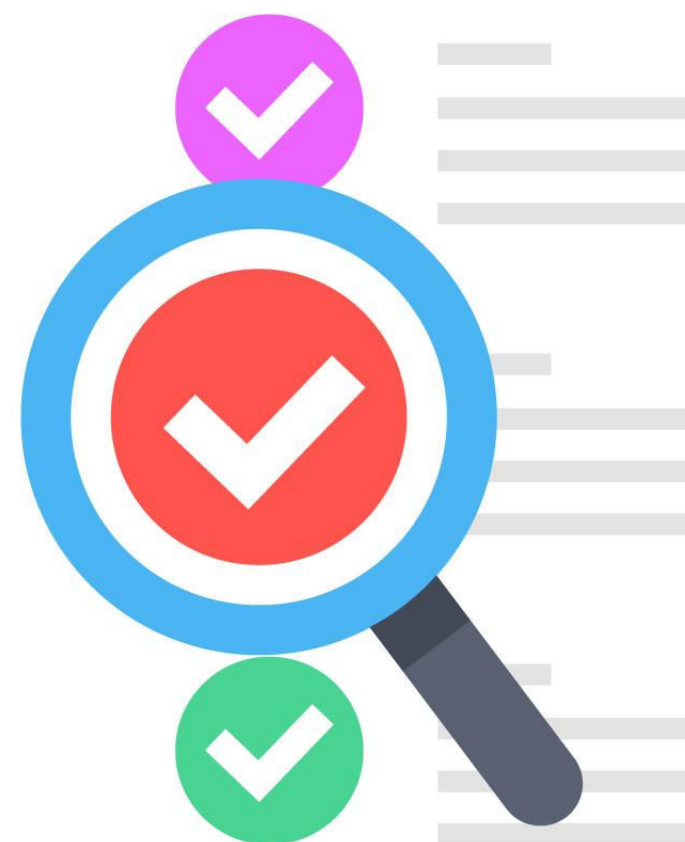
TWO TAX PATHS

So far in the process, using TaxAct only requires clicking the Continue and Back buttons, entering data, and selecting from lists of options. It's easy even in these early stages to know where you are in TaxAct (this will become increasingly more important the deeper in you go). The next step, however, involves a navigational choice.

First, a little explanation: All personal tax preparation websites use similar navigation tools. In TaxAct, the main horizontal toolbar at the top is divided into the site's main sections, including Basic Info, Federal, and Review. When you're working in one of those areas, the toolbar changes to reflect the subsections found there. So, for example, you'll see tabs for Income, Deductions, Credits, Taxes, Miscellaneous, and Summary under Federal.

Tax programs also generally offer two options (here's the choice I mentioned earlier) for moving through the interview process. If your return is simple or you're experienced at tax preparation, you can simply select the topics in each area that apply to you from the lists provided. TaxAct calls this Quick Q&A Topics, and it serves as both a great informational tool and a navigation guide. Click any main header, such as Form 1099-MISC, and the site displays a list of all the relevant options there (rents, fishing boat proceeds, non-employee compensation, and so on). Click any of those, and TaxAct takes you directly to the appropriate Q&A page for that tax situation. When you're done and click Continue, you return to the main page, where you can choose another Quick Q&A Topic. This works very well, and not every service supplies an outline in such detail.

If you're less experienced or you want to be sure you don't miss anything, click Step-by-Step Guidance. When you're working under the Federal tab, you see the new Income Checklist, which lists all income topics. Click the boxes to select the ones that apply to you or click All Income Topics at the bottom of the screen if you want the service to walk you through every possibility. TaxAct then quizzes you about every topic covered in the Form 1040, as well as its supporting forms and schedules. You can click on past if one doesn't pertain to you, and you shouldn't miss anything that does. When you've gone through all of the federal screens, TaxAct transfers applicable information to any state return you must file and helps you complete it.



There's nothing confusing about TaxAct's navigation, and the user interface is aesthetically pleasing enough. But it's not as clean and visually striking as TurboTax Self-Employed. Does that matter? When you're using an application that automates a process as anxiety-producing as personal tax preparation is, I think it does. I believe that skillful, creative design can make any user experience just a little less draining. And when it comes to sheer usability, TurboTax—which pioneered this simple, wizard-based format for tax preparation services—just can't be beat.

HELP AND CLEANUP

The support that tax software offers is critical to its effectiveness. These applications can't be expected to help extensively with every obscure and complicated tax topic (though they might surprise you in this regard). They should, however, at least pose questions in understandable language and provide additional explanations on the screen that answer the most common questions.

You should also have the option to click on hyperlinked words or phrases or buttons that take you to even clearer, simple guidance for advanced topics. Whether or not a site offers those things, it should at least have a searchable database that puts the best-matched links at the top of the results list. Tax preparation websites that do well in our rankings have taken complex IRS language and rewritten it for better clarity.

TaxAct has several points in its favor here. It often displays context-sensitive help topics in the right vertical pane. Hyperlinked words and phrases open the glossary to the correct entry. You can click the circled “i” where it appears to open a small help window and consult TaxAct’s voluminous and excellent TaxTutor Guidance. When you enter a word or phrase in the Search box, the Answer Center opens and displays both explanations—sometimes quite lengthy—and links to related forms and schedules. Finally, phone and email help are free. Of course, you’re much more likely to get a quick response if you file early, before everyone else—one more reason not to be a last-minute e-filer.

“Click the circled “i” to open a help window and consult TaxAct’s voluminous and excellent TaxTutor Guidance.”

TaxAct offers no chat help, which competitors such as TaxSlayer do. Nor does it offer anything comparable to TurboTax’s fantastic SmartLook feature, which lets you video chat with credentialed tax preparers who can look at your actual return to find mistakes. But then, TaxAct is much less expensive than TurboTax.

TaxAct’s answers and hyperlinked help could occur more frequently. For example, when you enter business expenses, it’s hard to know sometimes exactly what fits into subcategories like Office Expenses. TaxAct offers a mini-spreadsheet that helps somewhat, but TurboTax gives you categories and examples. Also, TaxAct’s help system told me several times that I could read a specific IRS publication (which they provided access to) for more information. These are, of course, by definition accurate documents, but they can be difficult to decipher—the ability to avoid them altogether is a big argument for using a service like this in the first place. TaxAct would benefit from more plainly worded guidance on its Q&A screens.

The image shows a 1040 U.S. Individual Income Tax Return form for the year 2016. A yellow sticky note is placed over the form, reading "File Before April 18" in handwritten black ink, with a red underline. The form includes fields for "Your first name and initial", "Last name", "Home address (number and street)", "City", "State", "Zip", "OMB No.", "Department of the Treasury—Internal Revenue Service", "For the year Jan. 1–Dec. 31, 2016, or other tax year beginning", "If a joint return, spouse's first name and initial", "Complete spaces below (see instructions)", "province/state/country", "4", "ome)", "above", "ndent, d", "(3)", "relat", "If more than 10 dependents, see instructions and check here", "Income", "8a Taxable interest. Attach Schedule B if required", "b Tax-exempt interest. Do not include on line 8a", "Dividends. Attach Schedule B if required", "State and

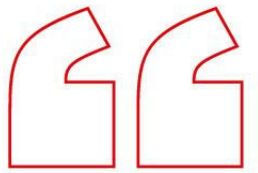
The site has an excellent review process. Once you think you've finished with all topics pertinent to you, TaxAct looks for possible errors and omissions. When it finds one, it displays it on the screen and provides fields for corrections and additions without forcing you to find your way back to the original page (as Jackson Hewitt Deluxe Edition does).

CONCLUSION

The main reason to spring for the Premium version of TaxAct is the need for tools to report self-employment income. TaxAct Plus is half the price and covers all the other major topics, including investing and home ownership. The whole family of websites offers a terrific combination of tax prep tools and guidance at reasonable prices. But, honestly, even at twice the price of Plus, TaxAct Premium is a killer deal, going for less than half the price of TurboTax for federal taxes.

TurboTax Online Premium wins our Editors' Choice for affordable tax preparation software. If ease of use beats price in your book, however, consider our top pick, TurboTax Self-Employed, which is equally capable but also provides the most advanced, state-of-the-art user experience.

KATHY YAKAL



**The main reason
to spring for the
Premium
version of
TaxAct is the
need for tools to
report self-
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income.**



FEATURES

CONNECTING EVERYTHING TO THE INTERNET: WHAT COULD POSSIBLY GO WRONG

BY MAX EDDY



If the Internet of Things industry is the Jedi order, with Philips Hue lightsabers and “smart” cloud-based Force powers, then popular Twitter account Internet of Shit is a Sith Lord. At a time when the technology industry seems eager to put a chip in everything, consequences be damned, Internet of Shit has put a name to the problem of new, useless electronics and helped highlight that some of these products may not be as benign as we might think.

I spoke with the account’s operator under the condition of anonymity, which PCMag extends only in situations like this, in which we feel that public good outweighs all other consideration. I will refer to this person as IOS. I would love to say that I met IOS in a darkened parking garage, but our conversation took place over Twitter direct message and email. Ho-hum.

Internet of Shit focuses on both the niche and the popular. In the case of, say, paying for a meal using a smart water-bottle, it rightly questions the utility. It highlights the absurdity of having to wait for necessities, like light and heat, that are unavailable after “smart” products receive firmware updates.

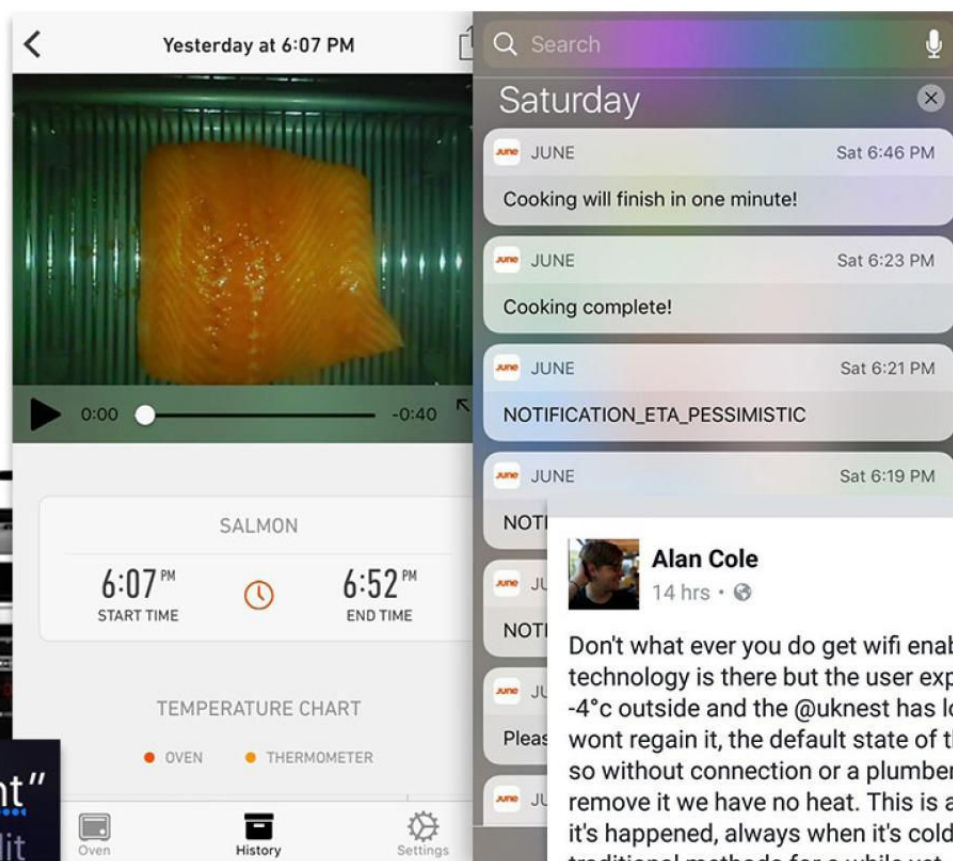
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When we go too far, the important question technology people tend to forget is: Who actually needs this?

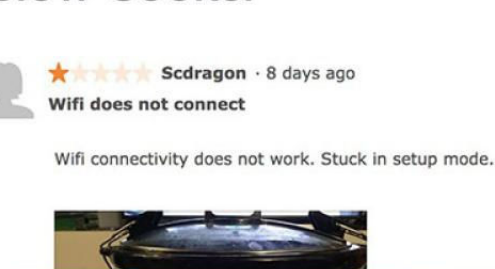
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JUST WHY?

Putting a chip in something doesn’t necessarily make it a “smart” product.

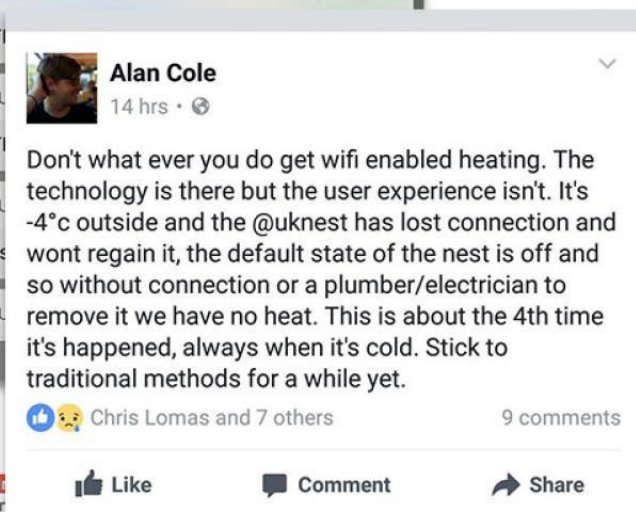


WiFi-Enabled 6-Quart Slow Cooker



"Hey Siri turn off the light"
tap to edit
OK, the lights are on.

★★★★★ Rolando · 7 days ago
Great idea but falls short due to connectivity
Bought this wifi enabled slow cooker due to price and feature... both apple and android apps crash during sync. Tried to con...



As you might imagine, Internet of Shit is able to eviscerate the industry it mocks so effectively because that industry is close to its heart. “It happened so naturally,” IOS said. “I used to spend a lot of time on Kickstarter and saw the rise of the Internet of Things there. It seemed like every other day, some mundane object was having a chip shoved into it, but nobody—even in the media—was being that critical about it. [Websites] would just say things like, ‘Wow, we can finally get the Internet in an umbrella.’”

IOS sees himself as something of a devil’s advocate or collective conscience for consumer culture. In his eyes, the Twitter account is a much-needed sanity check on Silicon Valley’s faux-optimism run amok. “When we go too far, the important question technology people tend to forget is: Who actually needs this? An oven that can’t cook properly without the Internet? Why aren’t people designing these things better?”

But beyond poor design and specious claims of utility, IOS’s primary concern is one of privacy and, ultimately, personal security: “I do see [the] IoT as inherently risky, though. I don’t trust these companies not to leak my data or not to be severely hacked in the future.”

In a Medium post written early in the Twitter account’s life, IOS said he was worried that companies would begin looking for ways to monetize data gathered from people’s homes. From that story: “If Nest wanted to increase profits it could sell your home’s environment data to advertisers. Too cold? Amazon ads for blankets. Too hot? A banner ad for an air conditioner. Too humid? Dehumidifiers up in your Facebook.



IOS still stands by these concerns. “The reason the IoT is so compelling to manufacturers isn’t that they’re adding smart features to your life—that’s just a byproduct,” he wrote me. “It’s more that by doing so, they get unprecedented insight into how those devices are being used, such as how often, what features you use the most, and all the data that comes with that.”

IOS says that IoT companies need to be much more upfront about their data-gathering policies, and who can access information that may be gathered by these devices. “The question we all need to decide is what level of access we’re willing to give these companies in exchange for the data they get—and who we trust with that is key.”

On Christmas day in 2016, IOS enabled his lights to blink whenever his handle was mentioned on Twitter. The results were intense, anticlimactic, and brief, illustrating perhaps all that IOS loathes about the Internet of Things.

INTERNET OF INSECURITY

Far worse than the effect useless IoT devices have on consumers’ wallets, though, is the effect they have on personal security. IOS’s fears of a marketplace for user data collected by IoT devices is not far-fetched (how do you think free apps and free Internet news companies make money?), and there are already other, very real threats.

Attendees at the Black Hat 2016 conference were treated to footage from security researcher Eyal Ronen. Using his research, he was able to seize control of Philips Hue lights from a drone hovering outside an office building. The attack was notable not only for its dramatic results and for using a drone but also because the building was home to several well-known security companies.

Ronen explained to me that he was attempting to demonstrate that an attack against a top-tier line of IoT devices was possible. “There are a lot of IoT hacks aimed at low-end devices that have no real security. We wanted to test the security of a product that is supposed to be safe,” he said. He was also keen to attack a well-known company and settled on Philips. Ronen said that it was harder to crack than he expected, but he and his team found and exploited a bug in the ZigBee Light Link software, a third-party communication protocol used by several IoT companies and regarded as a mature and secure system.

“It uses advanced cryptographic primitives, and it has strong security claims,” said Ronen. “But at the end, in a relatively short time with very low-cost hardware worth around \$1,000, we were able to break it.”

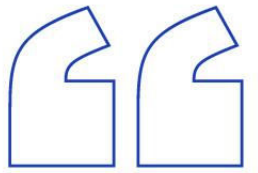
Video of Ronen’s attack shows the lights of the building flashing in sequence, following his commands sent remotely via a hovering drone. If this were to happen to you, it would be annoying—perhaps no more annoying than any of the scenarios IOS highlights on the Twitter account. But security professionals maintain that there are far greater consequences for IoT security.

“In a previous work, we showed how to use lights to exfiltrate data from [an] air-gapped network and cause epileptic seizures, and in this work we show how we can use lights to attack the electric grid and jam Wi-Fi,” Ronen told me. “[The] IoT is getting into every part of our lives, and the security of it can affect everything from medical devices to cars and homes.”

A LACK OF STANDARDS

Ronen’s attack took advantage of proximity, but Chief Security Researcher Alexandru Balan at Bitdefender outlined many other security faults that come baked into some IoT devices. Hardcoded passwords, he said, are particularly problematic, as are devices that are configured to be accessible from the open Internet.

It was this combination of Internet accessibility and simple, default passwords that has caused havoc in October 2016 when the Mirai botnet took major services like Netflix and Hulu either offline or made them so slow as to be unusable. A few weeks later, a variant of Mirai throttled Internet access in the entire nation of Liberia.



Hardcoded passwords are particularly problematic, as are devices that are configured to be accessible from the open Internet.

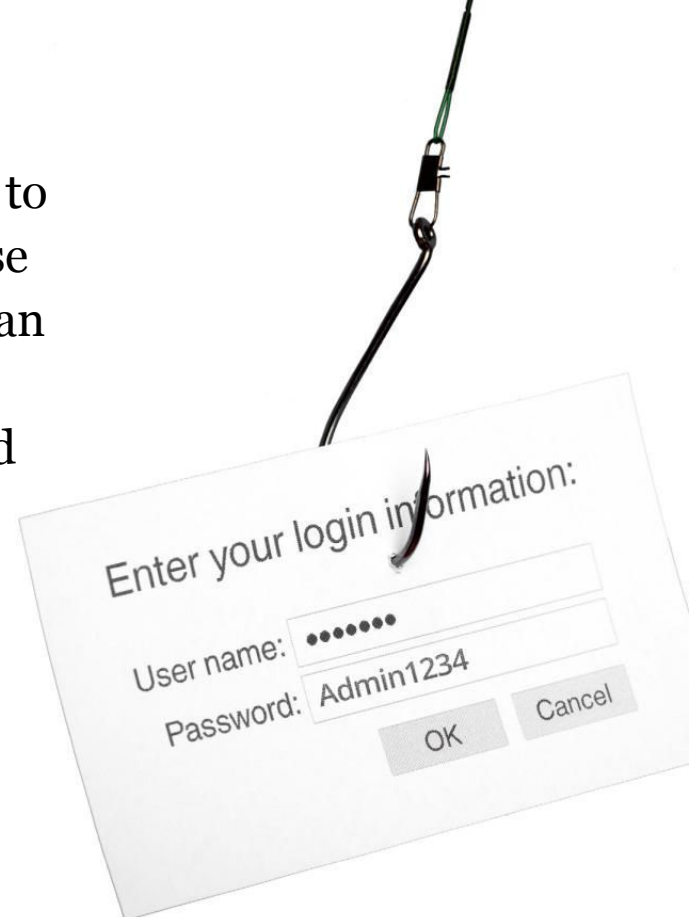


“The worst of them are devices that are directly exposed to the Internet with default credentials,” said Balan. “[These devices] can be found with IoT search engines like Shodan or by simply crawling the Internet and accessing them with admin admin, admin 1234, and so forth,” continued Balan, listing examples of overly simplistic and easily guessable passwords. Because these devices have minimal security and can be attacked from the Internet, the process of infecting them can be automated, leading to thousands or millions of corrupted devices.

Not long after news of Mirai broke, I looked at this scenario and blamed the IoT industry for ignoring the warnings about poor authentication and unnecessary online accessibility. But Balan would not go so far as to call these flaws obvious. “[Attackers] need to do reverse engineering on the firmware to extract those credentials, but it’s very often the case that they find hard-coded credentials in the devices. The reason for that is that in a lot of cases, there’s no standards when it comes to IoT security.”

Vulnerabilities such as these arise, hypothesized Balan, because Internet of Things companies were operating on their own, without universally accepted standards or security expertise. “It’s easier to build it like this. And you can say that they’re cutting corners, but the main issue is that they’re not looking into how to properly build it in a secure fashion. They’re just trying to make it work properly.”

Even when companies develop fixes for attacks like the one Ronen discovered, some IoT devices aren’t able to apply automatic updates. This puts the onus on consumers to find and apply patches themselves, which can be particularly daunting on devices that aren’t intended to be serviced.



But even with devices that can be easily updated, vulnerabilities still exist. Several researchers have shown that not all IoT developers sign their updates with a cryptographic signature. Signed software is encrypted with the private half of an asymmetric cryptographic key owned by the developer. The devices receiving the update have the public half of the key, which is used to decrypt the update. This ensures that the update is official and hasn't been tampered with, since signing a malicious update or modifying the software update would require the developer's secret key. "If they do not digitally sign their updates, they can be hijacked, they can be tampered with; code can be injected into those updates," said Balan.

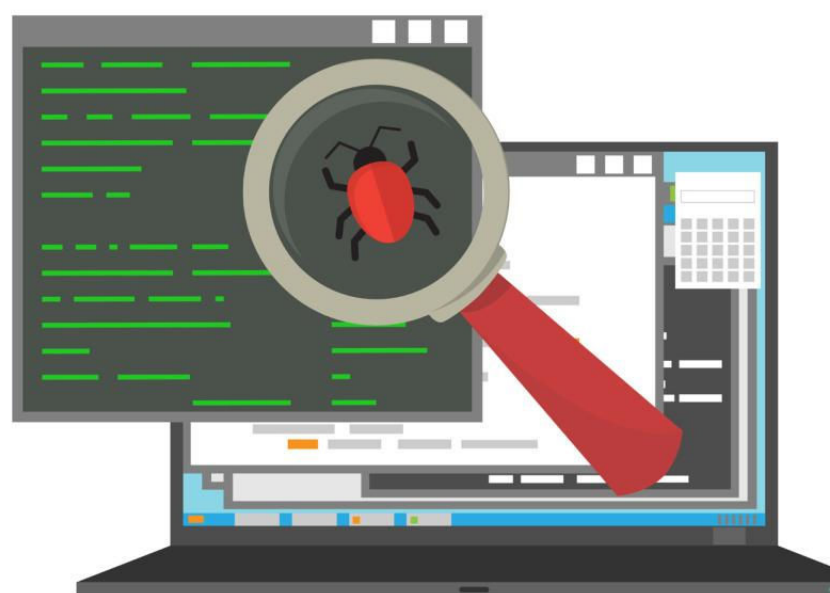


Beyond simply flicking lights on and off, Balan said that infected IoT devices can be used as a part of botnet, as seen with Mirai, or for far more insidious purposes. "I can extract your Wi-Fi credentials, because you've obviously hooked it to your Wi-Fi network and being as [the IoT device] is a Linux box, I can use it to pivot and start to launch attacks within your wireless network. Within the privacy of your own LAN network, authentication mechanisms are lax," said Balan. "The problem with LAN is that once I am in your private network, I can have access to almost everything that's happening in there." In effect, corrupted IoT becomes a beachhead for attacks on more valuable devices on the same network, such as Network Attached Storage or personal computers. Perhaps it's telling that the security industry has started looking closely at the IoT. Over the last few years, several products have entered the market claiming to protect IoT devices from attack. I have seen or read about several such products and reviewed Bitdefender's offering: Called the Bitdefender Box, the

device attaches to your existing network and provides antivirus protection for every device on your network. It even probes your devices for potential weaknesses. Bitdefender will launch the second version of its Box device this year. Norton will enter its own offering, boasting deep-packet inspection. F-Secure has also announced a hardware device.

As one of the first to market, Bitdefender is in the unique position of having a background in software security—and then designing consumer hardware that would, presumably, be impeccably secure. How was that experience? “It was very hard,” answered Balan.

Bitdefender does have a bug bounty program (a monetary reward offered to programmers who uncover and provide a solution to a bug on a website or in an application), which Balan confirmed has helped the development of the Box. “No company should be arrogant enough to believe it can find all of the bugs on their own. This is why bug bounty programs exist, but the challenge with hardware is that there may be backdoors within the actual chips.”



“We know what to look for and what to look at and we actually have a hardware team that can take apart and look into each one of the components on that board. Thankfully, that board is not that large.”

IT'S NOT ALL SHIT

It's easy to discount an entire industry based on its worst actors, and the same is true for the Internet of Things. But George Yianni, the Head of Technology, Home Systems, Philips Lighting finds this view particularly frustrating. “We took [security] very seriously from the beginning. This is a new category.

We have to build trust, and these [attacks] actually damage trust. And that's also why I think the biggest shame of the products that have not done such a good job is that it erodes trust in the overall category. Any product can be made badly. It's not a criticism of the overall industry."

As is often the case for security, how a company responds to an attack is often more important than the effects of the attack itself. In the case of the drone attack on Philips devices, Yianni explained that Ronen submitted his findings through the company's existing responsible-disclosure program. These are procedures that are put in place to allow companies time to respond to a security researcher's discovery before it is made public. That way, consumers can be assured that they are safe and the researchers gets the glory.

Ronen had found a bug in a third-party software stack, said Yianni. Specifically, it was the part of the ZigBee standard that limits communication to devices within two meters. Ronen's work, as you will recall, was able to take control from a distance—40 meters away with a standard antenna and 100 meters with a boosted antenna. Thanks to the responsible disclosure program, Yianni said Philips was able to roll out a patch to the lights in the field before Ronen told the world about the attack.

Having seen many companies grapple with a public security breach or the result of a security researcher's work, Yianni and Phillip's response may sound like after-the-fact back-patting—but it really was a success. "All our products are software-updatable, so that things can be fixed," Yianni told me. "The other thing[s] we do [are] security risk assessment, security audits, penetration testing [hiring people to attack your product or organization, then using the info to keep bad guys from doing the same] on all of our products. But then we also run these responsible disclosure processes, so that if something does come through, we're able to find out in advance and fix it very quickly.

"We have an entire process where we can push software updates from our entire cloud down to the [Hue Hubs] and distribute it to all of the lights. That's super important, because the space is moving so fast and these are products that are going to last 15 years. And if we're going to make sure that they are still relevant in terms of functionality and to be sufficiently secure for the latest attacks, we need to have that."

In his correspondence with me, Ronen confirmed that Philips had indeed done an admirable job securing the Hue lighting system. “Philips [has] put a surprisingly amount of effort in securing the lights,” Ronen told me. “But unfortunately, some of [its] basic security assumptions that relied on the underlying Atmel’s chip security implementation were wrong.” As Balan pointed out with Bitdefender’s work on the Box, every aspect of the Internet of Things device is subject to attack.

Philips also designed the central Hub—the device required for coordinating networks of Philips IoT products—to be inaccessible from the open Internet. “All connections to the Internet are initiated from the device. We never open ports on routers or make it so that a device on the Internet can directly talk to the [Hue Hub],” explained Yianni. Instead, the Hub sends requests out to Phillip’s cloud infrastructure, which responds to the request instead of the other way around. This also allows Philips to add extra layers to protect consumers devices without having to reach into their home and make any changes. “It’s not possible for the [devices] to be communicated with from outside the Hub unless you’re routed through this cloud.”

Yianni explained that this was all part of a multilayered approach Philips took to securing the Hue lighting system. Since the system is composed of different pieces—the hardware inside the bulbs, the software and hardware on the Hue Hub, the app within users’ phones—different measures had to be taken at all levels. “All of them need different security measures to keep them safe. They all have different levels of risk and vulnerability. So we do different measures for all of these different parts,” said Yianni.



HACKING PHILIPS’ HUE SYSTEM

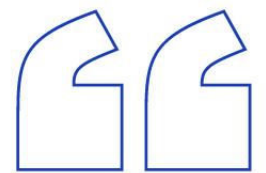
Ronen created a tool that instructed any Philips light within range to join his network instead of the one it had been assigned.

This included penetration testing but also a bottom-up design intended to thwart attackers. “There [are] no global passwords like what was used in this Mirai botnet,” said Yianni. The Mirai malware had dozens of default passcodes that it would use in an attempt to take over IoT devices. “Every [Hue Hub] has unique, asymmetrically signed keys to verify firmware, all this stuff. One device having its hardware modified, there’s no global risk from that,” he explained.

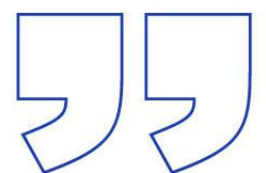
This also applies to IoT devices. “A lot of these products tend to be connectivity for the sake of connectivity,” he said. “The need to automate everything inside your home is not a problem many consumers have, and that’s very hard to get your head around. We think that products that do well are the ones which offer an easier-to-understand value toward consumers.”

IRRESISTIBLE INTERNET OF THINGS

Knowing the risks of the IoT, and even acknowledging its frivolousness, certainly hasn’t stopped people from buying smart lighting such as Philips Hue, always-listening home assistants such as Google Home or the Amazon Echo, and yes, smart water-bottles. Even the operator of Internet of Shit is a huge IoT fan.



Knowing the risks of the IoT, and even acknowledging its frivolousness, certainly hasn’t stopped people.



INVASION OF PRIVACY

The IoT will give manufacturers unprecedented insight into how devices are being used.

“The real irony behind the Internet of Shit is that I’m a sucker for these devices,” said IOS. “I’m an early adopter and work in technology, so a lot of the time I can’t resist these things.” IOS lists Philips connected lights, the Tado thermostat, the Sense sleep tracker, smart speakers, the Canary camera, and Wi-Fi connected plugs among his futuristic home amenities.

“I’m aware that the account got accidentally far bigger than I ever imagined, and I don’t ever want to discourage people from going into technology—I think that experimenting with dumb ideas is how great ideas can be born, which is something that Simone Giertz taught me a little bit,” said IOS.

Giertz, an absurdist roboticist and YouTuber, is the mind behind Shitty Robots. Her creations include a drone that gives haircuts—or, rather, fails to—and a massive hat that places sunglasses dramatically on her face. Think of it as Rube Goldberg with a healthy dose of Silicon Valley cynicism.

The person behind IOS does report that he is trying to rein in his early-adopter instincts these days. “The moment I had to update my lightbulbs’ firmware to turn them on was a bit of a realization for me...”

Bitdefender’s Balan said that he uses light bulbs that double as Wi-Fi repeaters. These devices extend both light and Wi-Fi to every corner of his home. But they are also loaded with many of the vulnerabilities he derided, including weak default passwords. When it comes to the IoT, though, he remains undaunted.

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”



“It’s like sex,” he told me. “You wouldn’t do it without a condom. We like sex, sex is awesome, we’re not gonna give up sex just because it’s dangerous. But we’re gonna use protection when we’re doing it.” Instead of lapsing into paranoia, he believes consumers should rely on security companies and educated friends who can identify the companies that take security seriously with bug bounties and secure, frequent update tools.

And does the drone-piloting hacker Ronen use the IoT? “Currently, no,” he said. “I am afraid about the effect it has on my privacy and security. And the benefits are not high enough for my needs.”

Even your humble author, who has resisted the siren song of talking smoke detectors and color-changing lights for years, has started to crumble. Recently, in an effort to spruce up the office for the holidays, I found myself setting up three separate smart lights. The result, was horrifyingly, compellingly beautiful.

A brand-new Philips Hue light is sitting in my Amazon shopping basket. Someday soon, I’ll hit press the Buy Now button.



FEATURES

DNA DATA STORAGE:



BY TROY DREIER

Engineers have successfully been pushing more storage into smaller spaces for decades, but that can't go on forever. The next big jump in data storage could take the form of the DNA inside all organic matter: Scientists in labs across the country are experimenting with synthetic DNA as a storage medium.

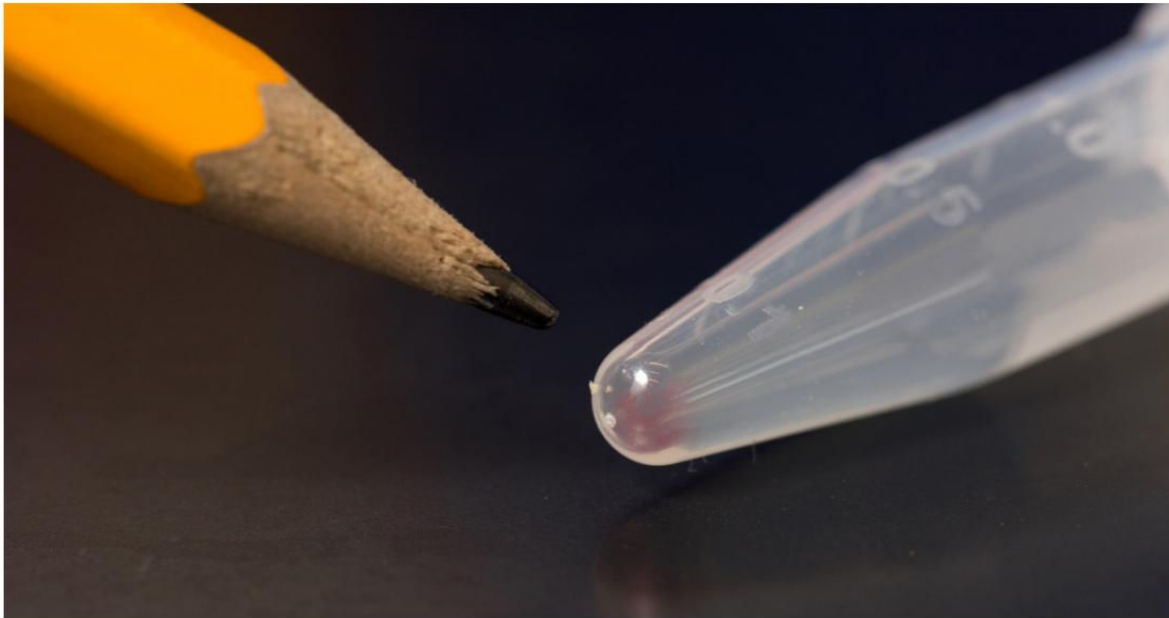
“If you look at where electronics is going, silicon technology, a lot of the basic technology that we use to build computers today, we’re approaching the limit in almost all of them,” says Luis Henrique Ceze, associate professor of computer science and engineering at the University of Washington. “DNA is very dense, it’s very durable, and it takes very little power to maintain, so there’s a lot of advantage of using DNA for data storage.”

Ceze has been working with Karin Strauss, a computer architecture researcher with Microsoft Research, on a collaboration between the two institutions—a project that bridges computer science and biology. For a team of roughly 20 people, the University provides the molecular biologists, and Microsoft provides the computer scientists.



To understand how DNA could be used for storage, consider that all computer data is binary, or base-2. DNA is base-4, composed of adenine, cytosine, guanine, and thymine (abbreviated as A, C, G, and T). The first step is converting base-2 information to base-4, so A corresponds to 00, C to 01, G to 10, and T to 11 (that simplifies it a bit but gets across the idea).

Then scientists use a machine called a DNA synthesizer to combine the four chemicals in the right order. The result stores the information many times over as a salt-like cluster smaller than the tip of a pencil. Reading that information back requires a DNA sequencer.



To understand how DNA could be used for storage, consider that all computer data is binary, or base-2.

While this may sound fragile—like something that might blow away when a door opens suddenly—DNA is the strongest data storage medium we’ve seen. Scientists have successfully read DNA that’s hundreds of thousands of years old.

Sequencing DNA involves removing a tiny bit of the stored material, and the process depletes that sample. Consequently, a DNA recording can be read a finite number of times. That’s not a problem, though, since the stored material has so much redundant data; it can be sampled over and over. Today’s storage mediums also have a limited number of write and read cycles before they fail, so this is nothing new.

As Ceze points out, DNA will never be obsolete. While many of us have floppy discs in the back of a drawer that we no longer have the ability to read, that won’t be the fate of DNA. “We’re always going to care about DNA for life sciences and health reasons, so you’re always going to have a way of reading information stored in DNA,” Ceze says.

In January 2017, Microsoft and the University of Washington successfully encoded 200MB of data into DNA form, besting the previous record of 22MB. Using DNA, Strauss says, it will be possible to store 1 exabyte of data—that's 1 billion GB—in a 1-inch cube.

“We did an estimation of how much data you could put in a particular volume,” Strauss says. “We tried to estimate what would be the volume if we today decided to archive the entire accessible Internet, meaning everything that's not behind a password or any kind of electronic wall, and we came up with the size of a large shoebox.”

That sounds like a far-off proposition, but Ceze believes we'll see commercial DNA storage systems on the market in a decade. They won't work exactly like microprocessor storage, since DNA requires a wet chemical environment for creation, but they'll provide massive capacity and random access at the same speeds that enterprise tape systems provide now.

A QUICKLY ADVANCING FIELD

DNA has been around for billions of years, but demonstrations of DNA as a usable storage technology began in 1986 when MIT researcher Joe Davis encoded a simple binary image into 28 base pairs of DNA.

Another pioneer in this field is George Church, a genetics professor who's been working at Harvard Medical School since 1977 and running his own lab since 1986. Church has been interested in bringing down the cost of DNA reading and writing since the 1970s, believing that someday they would come together to create practical data storage. He became interested in working on DNA research around 2000 and performed critical sequencing and synthesis tests in 2003 and 2004. By 2012, he was able to put both areas together and create a system for encoding data. He wrote up that work in an influential 2012 article in *Science*.



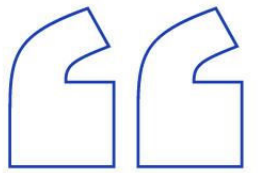
GEORGE CHURCH
Church is Professor of
Genetics at Harvard Medical
School and also Director
of PersonalGenomes.org.

Image courtesy of Shawn Douglas.

“Prior to 2003 and ‘04, sequencing and synthesis were done essentially in capillaries—or small tubes—where you’d have one tube per sequence,” Church explains. “It was pretty manual and not scalable. The lesson that we had learned from the microfabrication semiconductor industry was you needed to come up with a way to put them essentially in a two-dimensional plane and then scale down the feature size. Neither of those column-based methods were compatible with that, and so in 2003, we showed how you could distribute sequences on a two-dimensional plane and then image them with fluorescent imaging, which is now the dominant way of sequencing. Then in 2004, we showed that you could manufacture DNA on a plane and then slip it off, and then it could be even more compact; so the plane was just a temporary place to synthesize them. Then you could compact them into a three-dimensional object that was millions of times more compact than normal data storage.



“Those were proof of concept exercises in 2003 and 2004. In 2012, we and others had refined both the reading and writing methods for DNA, and I put them together into one experiment where I encoded a book that I had just written into DNA, including images, showing that basically anything that’s digital could be encoded with DNA.”



Church has been interested in bringing down the cost of DNA reading and writing since the 1970s.



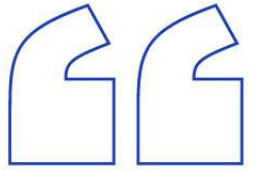
TINY LIBRARY

In 2012, Church encoded 20 million copies of a book he wrote. The speck containing all the copies is in the red circled area in this image.

Though cost is a significant hurdle for DNA storage, Church notes that the price has dropped steeply in the short time that research has been taking place. The cost of reading DNA has improved about 3 million-fold, while the cost of writing has improved by a billion-fold. He can see both improving by another million-fold in even less time. He also points out that the cost of copying DNA material is almost free, as is the cost of long-term storage. For archival storage, the cost of reading data isn't a big obstacle, since much archived material is never read, and some items are read selectively. Look at the costs of the whole system, he advises. Traditional storage methods move at Moore's Law speed and will plateau soon. But DNA storage technology is moving faster than Moore's law and shows no signs of plateauing.

Archival and cloud storage is where Church sees DNA data storage being adopted first. Companies including IBM, Microsoft, and Technicolor have their own research and development teams studying the area, he notes. He collaborated with Technicolor in 2015 to store *A Trip to the Moon*, a classic 1902 film once believed lost, to DNA. Now Technicolor has many DNA copies which, combined, are no bigger than a speck of dust.

Church has a lab of 93 people working on DNA storage and currently focusing on two goals. The first is to radically improve the speed per cycle. Information is stored in hundreds of layers, each as thick as a molecule. Each addition currently takes three minutes, but Church believes that can be brought down to less than a millisecond. That's 200,000 times faster, he notes, and means a change from organic chemistry to biochemistry. He also wants to change how the instruments used for reading and writing are manufactured to make them much smaller. Currently, they're the size of large refrigerators. He wants that scaled down.



He also points out that the cost of copying DNA material is almost free, as is the cost of long-term storage.



BUILT-IN REDUNDANCY AND THE NEED FOR ERROR CORRECTION

One researcher who was influenced by Church's 2012 *Science* article is professor Olgica Milenkovic of the University of Illinois, Urbana-Champaign. The article mentioned the need for coding, which immediately triggered her interest. Coding in storage research is a technique for adding redundancy to data—redundancy that can later be used to correct for errors that occur during the reading and writing process. For an example of why this is important, see the two *Citizen Kane* still photos below. Both were encoded in DNA by Milenkovic's team and then read. Guess which one used redundancy.

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DETAILS

Coding adds redundancy to data: The image on the left was saved with a small amount of redundancy; the right-hand image was not.

A simple way of adding redundancy is repeating each character a set number of times. Rather than writing a zero, write it four times. That's the brute-force approach—simple but terribly inefficient. Milenkovic's work is about achieving the same error correction in a more sophisticated way. It involves techniques called parity checks or linear congruence checks to provide ways of verifying data.

“The whole field, is basically about helping you correct errors if they appear or, even better, avoid errors that you know are very likely to appear,” Milenkovic says.

“We introduce controlled redundancy to get rid of errors, and that controlled redundancy is not in the form of simple repetition, because that’s very ineffective.”

That’s what brought Milenkovic into the field, but her research now is about bringing down the massive cost of DNA synthesis.

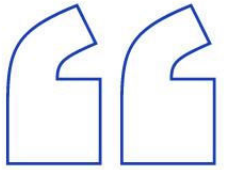
“My student, H. Tabatabae Yazdi, who was very active on this topic, and I have been trying really hard to come up with a smart way to avoid synthesizing DNA.

Synthesizing DNA is absolutely a bottleneck for this technology because of the high cost,” Milenkovic says.

Though Milenkovic is leery of revealing too much about unpublished research, her solution involves “cunning mathematical approaches” and is all about timing, wherein the size of the interval between bits of information is meaningful.

“If you dispense with the formality that you want to use ATGCs to really encode binary symbols at a certain location, you can come up with much smarter and more efficient means of storing information, because you don’t need to synthesize strands over and over again,” Milenkovic explains. “You can synthesize them once in a certain way and then reuse that synthesized DNA in a smart combinatorial fashion.”

Through her work, Milenkovic hopes to drive the cost of synthesizing DNA down at least three orders of magnitude. That’s still not enough, she notes, but it’s progress. It’s also contributing to a line of research she finds fascinating.



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synthesizing
DNA down at
least three
orders of
magnitude.**



“It’s very exciting, to be honest, to play God and encode your own information in DNA,” Milenkovic says. “It gives a person a feeling of excitement to know that you’re playing with a chosen molecule of nature and making it do what you want to store and encode and convey information to the future.”

CASHING IN — ANY DAY NOW

It’s not all dry dusty academic research with DNA storage. Helixworks, a company based in Ireland, is trying to make money off it already. It has a product on Amazon—sort of.

“We launched on Amazon so you could get 512KB of digital data encoded into DNA,” explains Nimesh Pinnamaneni, the company’s cofounder. “It’s something very small. Maybe a picture or perhaps a poem, something like that.”

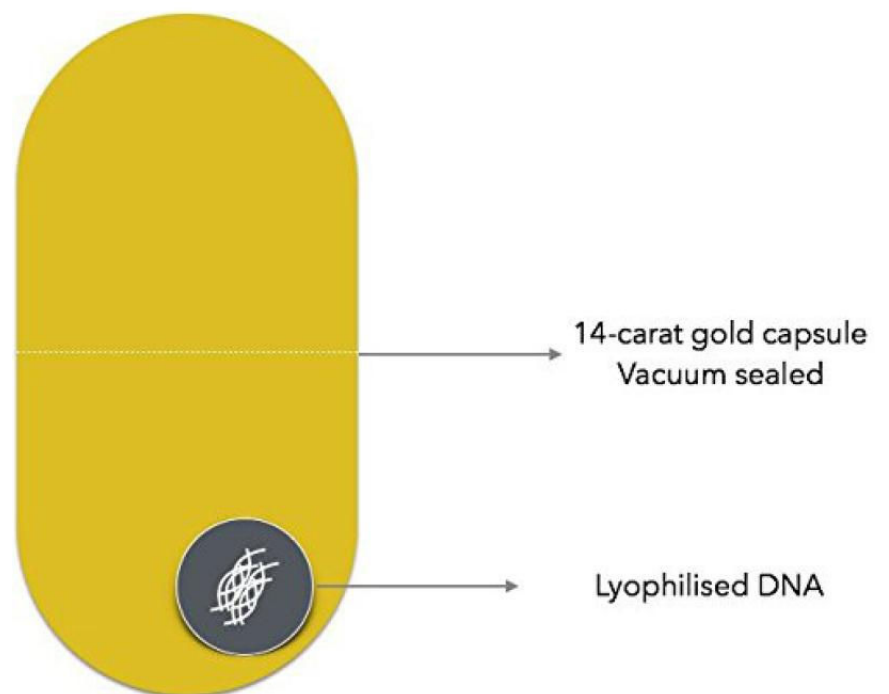
It’s an unusual purchase, but it could be the perfect love token for the person who has everything, especially if that person is a scientist

“I remember one customer calling us. He wanted to gift his wife—they both are biotechnologists—on their wedding anniversary. He wanted to put a message in DNA and gift her a DNA,” Pinnamaneni remembers. “She would have to sequence the DNA to read the message. It’s a fairly complicated way to send a love message, but maybe it’s cute for biotechnologists, you know?”



DNA STORAGE ENTREPRENEURS
Nimesh Pinnamaneni and Sachin Chalapati of Helixworks, first to market—briefly—with a DNA storage product.

But Helixworks got a bit ahead of itself posting its product on Amazon in August of 2016, before it was ready to fulfill orders. Two people purchased the company's \$199 DNADrive—a 14-carat gold capsule with a cluster of DNA inside—before Helixworks was forced to delist its product. DNADrive is still on Amazon, but it's not purchasable.



That doesn't mean Helixworks is over, just over-eager. It's come too far to stop now. The company started at the University of Borås in Sweden, where Pinnamaneni and Sachin Chalapati, the company's other cofounder, were getting master's degrees in biotechnology. They raised funds for DNA storage research, continued their work once back home in Bangalore, India, and developed a proof of concept.

GOOD AS GOLD

Helixworks' DNADrive storage capsule was meant to be worn as a pendant, with a personal poem or picture encoded in DNA.

Casting about for additional funds brought them to the IndieBio accelerator program run by SOSV, a startup venture capital firm in San Francisco, California. Helixworks was selected by the program and won \$50,000 in cash and the ability to work from a lab in County Cork, where it's been for the past six months. The program includes mentoring on pitching a product, which Helixworks will put to use at this year's South by Southwest festival, where it will compete in a pitch event.

While churning out golden DNA capsules might eventually be a lucrative sideline, Pinnamaneni says his company's future is in the compact home and office DNA printers it's developing. He wants to make DNA storage easy and affordable enough for anyone to use.

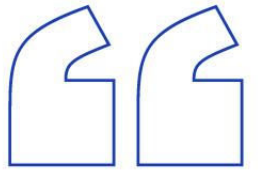
“We figured out you need to have something that works like a cartridge in a printer,” Pinnamaneni explains.

“You just have four colors, and these four colors can combine to form any color possible, right? That’s how your ink printer works. We figured out we need to have something like that in our system. We designed a cartridge of 32 reagents that can be combined to form any DNA sequence possible.”

While other labs are paying around \$30,000 each time they need to have DNA synthesized, an operation that takes weeks to accomplish, Pinnamaneni says his invention can bring the cost and time down dramatically. Helixworks is working with Opentrons, a company that makes automated lab equipment, to create the printer. That’s what it will pitch at SXSW.

“What we will be demonstrating on the expo floor is DNA writing right before your eyes,” Pinnamaneni says.

The company won’t be taking any orders yet, though. And that’s good, because that romantic biotechnologist is still waiting for his anniversary gift.



**We designed
a cartridge of
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DNA
sequence
possible.**



FEATURES

DIGITAL HUMANITIES: THE MOST EXCITING FIELD YOU'VE NEVER HEARD OF

BY WILLIAM FENTON

The digital humanities is the most exciting field you haven't heard of—unless you happen to work on a college or university campus. For everyone else, I'll risk censure and offer the pithiest definition I can muster: Digital humanities is an interdisciplinary field in which scholars and educators bring computational tools and methods to humanistic inquiry. If you've read my "Autodidact" column on PCMag.com, you've already gotten a taste of the digital humanities: many of the online archives, open educational resources, digital reading platforms, online education initiatives, and data visualizations I've examined could be classified as such.

Fairly or unfairly, critics have charged digital humanities with navel-gazing. To an extent, that critique is both warranted and expected given the field's relative nascence. American studies, for example, underwent a similar introspection, and today that field boasts departments, scholarly associations, journals, conferences, and summer institutes.

When I attended the annual Modern Language Association convention, I wasn't sure whether digital humanities would have moved beyond the abstractions of field formation. Certainly, there were more panels than I could possibly attend. Searching the program for "digital humanities" returned no fewer than 41 panels, about 5 percent of the conference proceedings.

To put that number in context, in a convention dedicated to language and literature, the digital humanities inspired more panels than Geoffrey Chaucer, Emily Dickinson, Herman Melville, William Shakespeare, Harriet Beecher Stowe, and Walt Whitman combined. But had DH grown up? Or would practitioners continue to call for incubators—digital humanities centers—that limit participation of students and faculty at small liberal arts colleges and community colleges?



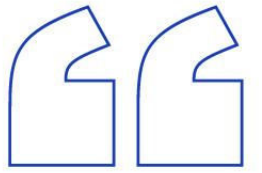
I was heartened to see a lively mix of theoretical and practical panels. Perhaps most reassuringly, I found panelists honestly engaging with how to downsize digital humanities and integrate digital teaching practices and archival research without vast institutional resources or support.

DOWNSIZING DIGITAL HUMANITIES

Several panelists at the Minimal Digital Humanities panel spoke to the need for a downsized digital humanities. In a longer piece, I would gloss each of the excellent papers (which, thankfully, are available online), but in the interest of brevity, I'll focus on one talk that addressed what has been a blind spot in the field: community colleges.

Anne McGrail, an English faculty member at Lane Community College, spoke directly to the challenges of practicing digital humanities at community colleges:

“At open-access, under-resourced institutions such as the community college where I teach, minimal digital humanities has been the only kind possible,” McGrail explained. “Delayed and uneven development have characterized community college digital humanities, which is unfortunate given that digital projects offer empowering tools for students to represent their communities and to challenge inequalities.”



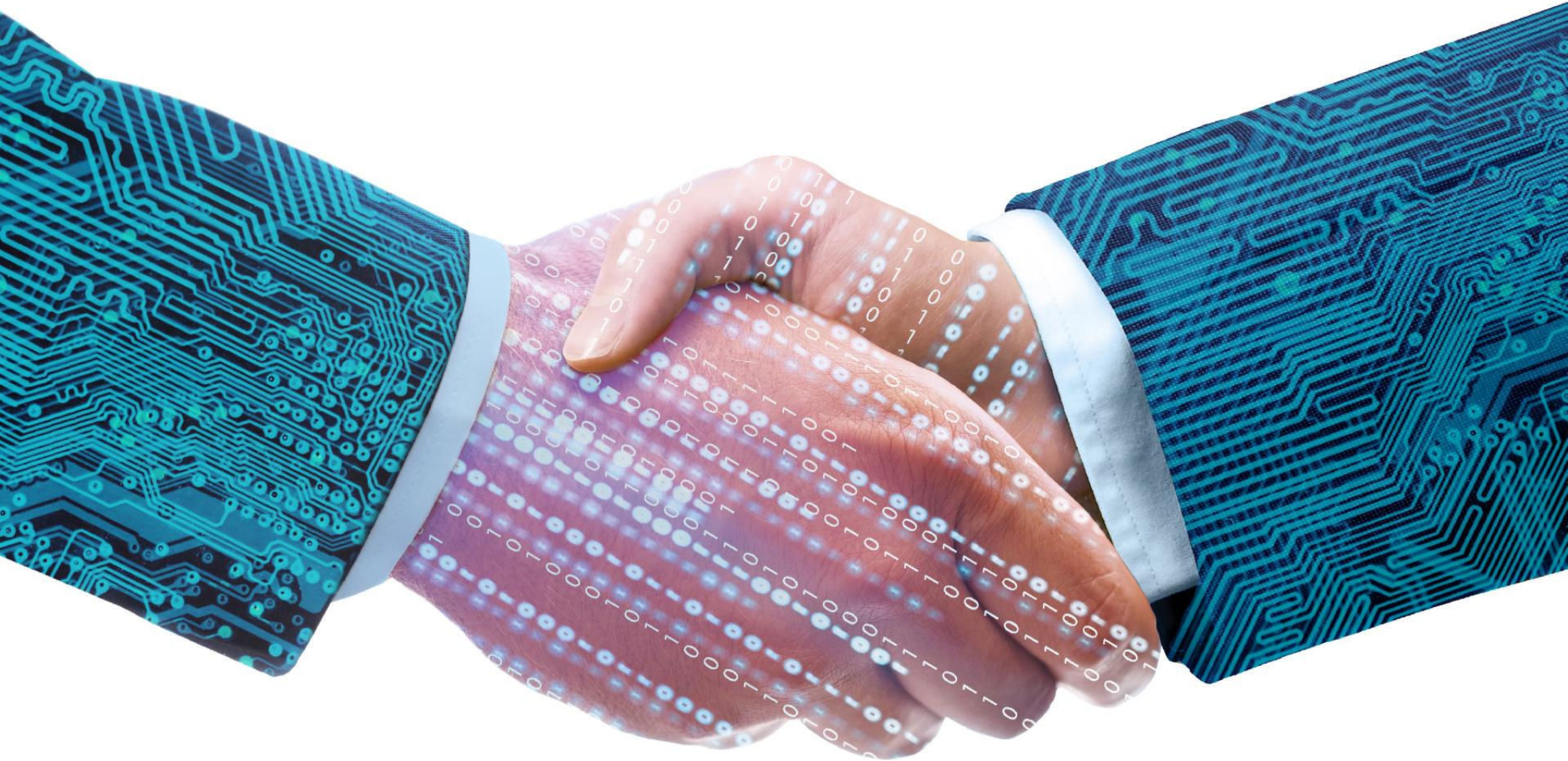
Digital projects offer empowering tools for students to represent their communities and to challenge inequalities.



EDTECH

Digital humanities is an interdisciplinary field in which scholars and educators bring computational tools and methods to humanistic inquiry.

Some of that unevenness is a product of the community college's open-access mission. Heavy teaching loads and limited mentoring mean that the faculty who might otherwise experiment with digital humanities lack the time, energy, or incentive structure to keep pace. Moreover, community college students, who are more likely to be working-class, non-white, or first-generation students, are less likely to take risks on technological experimentation. As McGrail explained it, these students are already taking a risk to go to college. The idea of failing upward is a middle-class assumption, whereas, for the working class, failure is a sign of not belonging.



McGrail advocated for outreach in a form that support community colleges' teaching missions: curricular design. While DH has been historically slow to embrace community colleges, she heralded this "minimal moment" as a sign of the field's maturation, and an opportunity for practitioners to engage at a practical, local level.

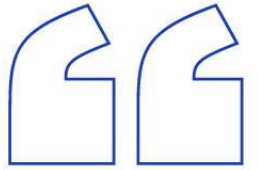
DIGITAL PEDAGOGY

Several panels answered McGrail's call for teaching-centric digital humanities, especially Curating Digital Pedagogy in the Humanities, a roundtable in which participants discussed concrete examples of digitally inflected teaching.

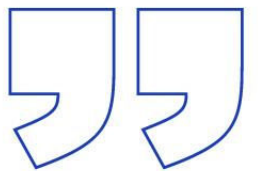
Rebecca Frost Davis, director of instructional and emerging technology at St. Edward's University, argued that moving humanities teaching practices from solitary classrooms into participatory networks increases student engagement and extends the reach of humanistic inquiry. She described the General Education Maps and Markers initiative, for which she served on a digital working group, that found students gain a sense of commonality when they learn and act through networks. (The complete recommendations are available in a [whitepaper](#).)

Matthew Gold, associate professor of English and digital humanities at the CUNY Graduate Center, suggested that open publishing systems can also enable humanities teachers to join new publication workflows. (Digital Pedagogy in the Humanities, which curates pedagogical keywords and related teaching materials such as syllabi, prompts, and, exercises, models this ethos through an open peer-review process.)

"Teaching in public leads us to new forms of publication," Gold said. That is, when educators share their pedagogy, it serves the interest of students—who benefit from the circulation of educational best practices—and it also changes the way scholars think about their teaching. "As scholars share their work publicly, they start to think their pedagogy as scholarship," he said. Practically, Gold encouraged faculty to share materials on platforms like the MLA CORE repository, Open Syllabus Project, or even GitHub.



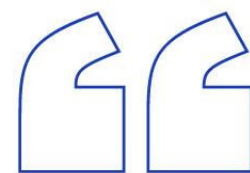
While online platforms can help students envision writing for a wider public, openness can also make students vulnerable.



Gold also touched upon benefits and dangers of teaching on open platforms such as the CUNY Academic Commons. While online platforms can help students envision writing for a wider public, he cautioned that openness can also make students vulnerable, recommending that faculty think carefully about student privacy and data security.



Lauren Coats, associate professor of English and director of the Digital Scholarship Lab at Louisiana State University, also focused on students in her description of an archival-centric pedagogy. Coats asks students to explore print and digital archives in tandem in order to encourage students to evaluate the materiality of textual artifacts as well as their digital surrogates. She described an assignment in which students examine Frederick Douglass' newspaper and compare the historic original to an online surrogate from a database. In another project, Coats asks her students to curate, create, or rearrange an archive or build a digital exhibition in Omeka. Through that hands-on process, students confront the intellectual consequences of curation and presentation—that an object's archival fate determines if and how future users will encounter it, understand it, or use it.



In a panel about scholarly editions, Ray Siemens described open-access resources as “free as in puppies, not as in beer.”



DIGITAL ARCHIVES

As Coats's presentation underscores, online repositories are central to digital pedagogy. It's easy to assume they've been willed into existence, when, in fact, they demand deep and sustained institutional investment, as I've discussed in a recent column about the DPLA-LOC partnership.

Moreover, once those repositories are available, they require continuous caretaking. In a panel about scholarly editions, Ray Siemens described open-access resources as "free as in puppies, not as in beer." That is, digital projects are a commitment, and their caretakers can expect more than a few accidents along the way. Nevertheless, when these digital projects are available, they're invaluable to students and educators. The nineteenth century, in particular, enjoys a veritable embarrassment of archival riches, as illuminated in the Digital Pedagogy and Nineteenth-Century American Literature panel.

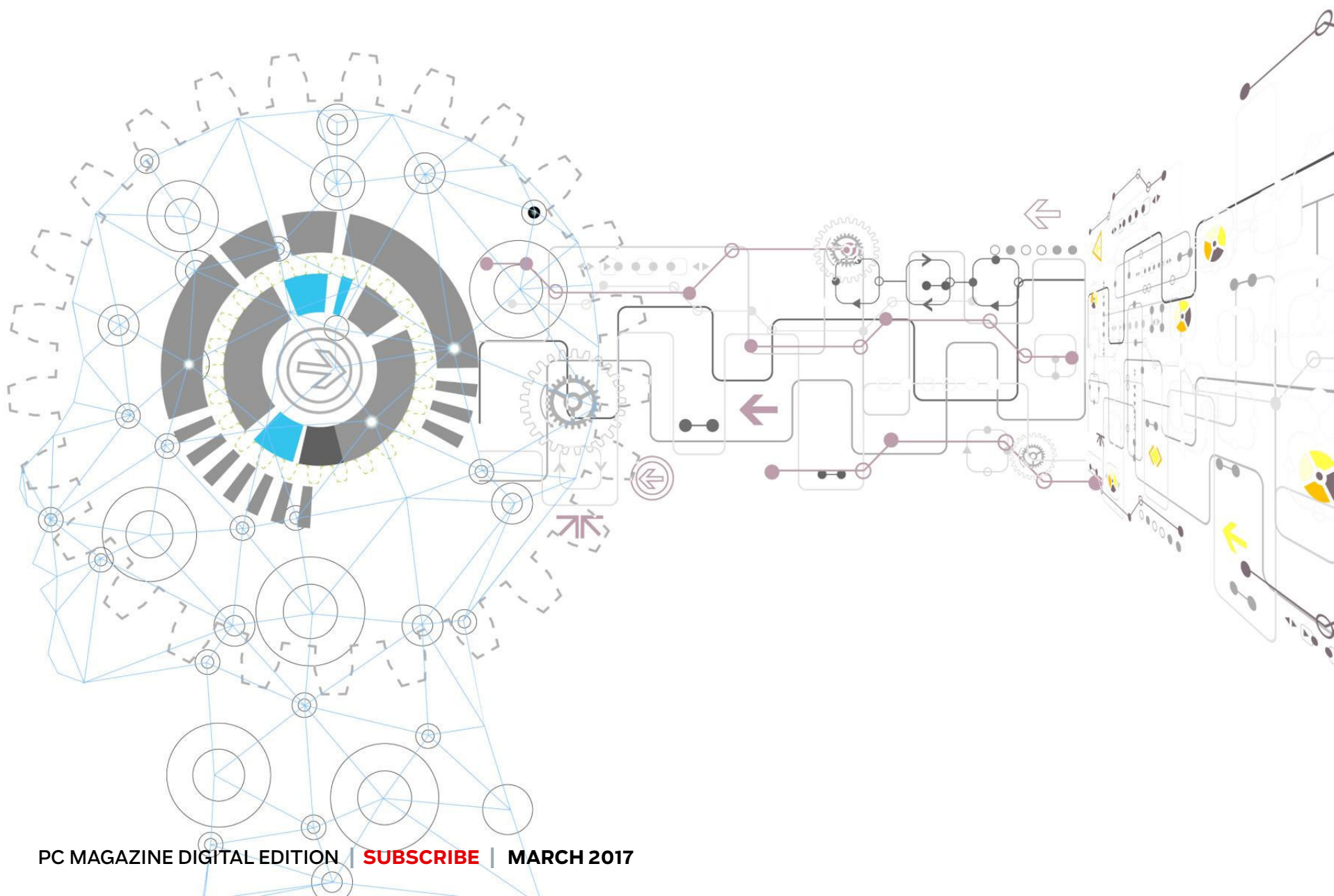
Catherine Waitinas, associate professor of English Cal Poly State University, described how she's used the Whitman Archive to introduce students to Walt Whitman's less canonical poetry and to underscore how his work evolved through editions. The challenge for students is that much of that archival material is in manuscript form, which challenges them to decipher Whitman's hand despite the fact that many students no longer even learn cursive. While the project includes a handwriting tool—and many others—each feature has a learning curve. Waitinas' response has been to ask students to teach students. She's created a video assignment through which students create instructional videos for using the Whitman Archive, several of which are available on YouTube. By circulating videos in advance of meetings, Waitinas frees up class time for close-reading. This flipped classroom wouldn't be possible without the efforts of previous cohorts.

Finally, associate professor of English at Lehigh University Edward Whitley discussed how the idea of the archive can be used to link historical periods and media forms. While Harriet Beecher Stowe is typically read as a sentimental novelist, Whitley asks students to approach her as a curator, to reconceive *Uncle Tom's Cabin* as a "curated archive of responses to slavery." After students evaluate the methods through which Stowe collected and synthesized abolitionist texts, Whitley asks them to evaluate how activists employ similar methods using digital media.

“In the context of Stowe’s novel, students consider how social activists involved in social media campaigns like #blacklivesmatter and #yesallwomen likewise sort, catalogue, organize, select, and reject the documentary record of social injustice appearing online in real-time,” Whitley said. Students aren’t studying an historical period (abolitionism) or media form (Twitter), so much as they are deconstructing the process through which texts are created, structured, shared, stored, and mobilized to enact social change.

Whitley has effectively created a crash course in media literacy inside a literature seminar. In an era of siloed social-media channels and profligate and unverifiable news stories, media literacy is essential for responsible civic participation, and it’s heartening to see Whitley and other scholars and educators at MLA rising to that challenge.

“
**In an era of
siloed social-
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How to Make Home & Business Emergency Documents in Under an Hour

BY JILL DUFFY

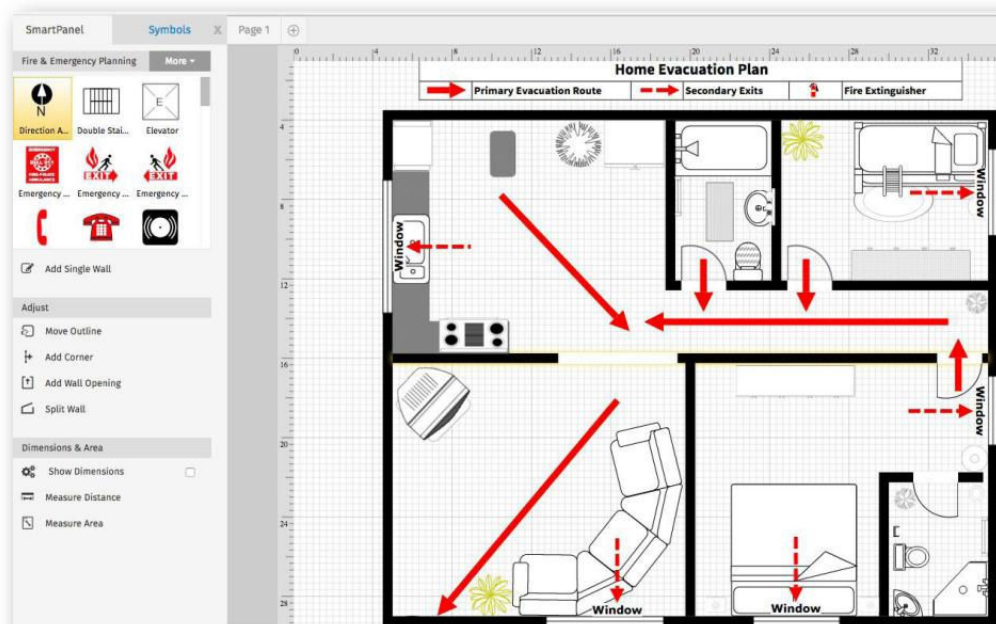


Office managers: Do you have a floor plan saved online in case there's a disaster or some other reason that people who are unfamiliar with the space have to enter it? Those who rent a vacation property or even just rooms in your home: Do you provide your guests with adequate emergency information? Where is your emergency exit map for your family and any guests who may be staying with you?

Thinking about emergency preparedness is never fun, but planning ahead and being prepared is much better than wishing you had done so after a disaster strikes. Here's a simple project to help you be better prepared: Create emergency exit maps, floor plans, and the other documents you need, and do it in about an hour.

The secret to keeping this project short is to use diagramming apps that are freely available online and dead simple to use. Just as important, these apps come with templates for all kinds of diagrams, maps, charts, and so forth. When you work from these templates, all you have to do is rearrange the furniture, as it were. You don't have to draw anything from scratch

Planning ahead and being prepared is much better than wishing you had done so after a disaster strikes.



GET READY

Diagramming apps, many of which offer free levels of service, have templates to help you create emergency documents.

WHICH DIAGRAMMING APP TO USE?

Assuming you know nothing at all about design or vector-drawing software, two apps I recommend using to make emergency exit plans, floor maps, and other key documents for your home, vacation property, and business are Lucidchart and SmartDraw. In my experience with these apps, Lucidchart is marginally easier to use, but SmartDraw has more templates for emergency preparedness. They're both extremely useful, however. Both have a free level of service, so you don't have to pay anything to make these critical files. And they both have a Web app, so you can use the app right in your browser without installing any software.

EMERGENCY PREPAREDNESS DOCUMENTS

I want to provide some examples of emergency preparedness documents, because often you don't know which ones you need until you have a chance to browse some of the options. A few common ones are:

- Floor evacuation plan/map,
- Building evacuation plan/map, including safe meeting point,
- Home evacuation plan/map, including safe meeting point,
- Business continuity plan,
- Emergency contact list (every home should have one on a refrigerator or posted somewhere highly visible),
- Emergency phone tree,
- First aid and CPR information charts, and Wildfire, flood, earthquake, and shelter-in-place tips.

I could go on, but this list may trigger some ideas for documents and diagrams that are suitable for your location and circumstances. Not every document is appropriate for every home or business, of course. Some of these documents are available simply to print, such as CPR and first aid charts. Others are so simple and straightforward to make that you could draft them quickly in a word-processing app. You might even be tempted to write them by hand. I recommend going digital, though, because then it's easier to keep digital copies saved in the cloud. Having digital copies in the cloud means that you can update them easily, and you can get the information even when you aren't in front of the piece of paper you printed.

HOW TO MAKE EMERGENCY DOCUMENTS

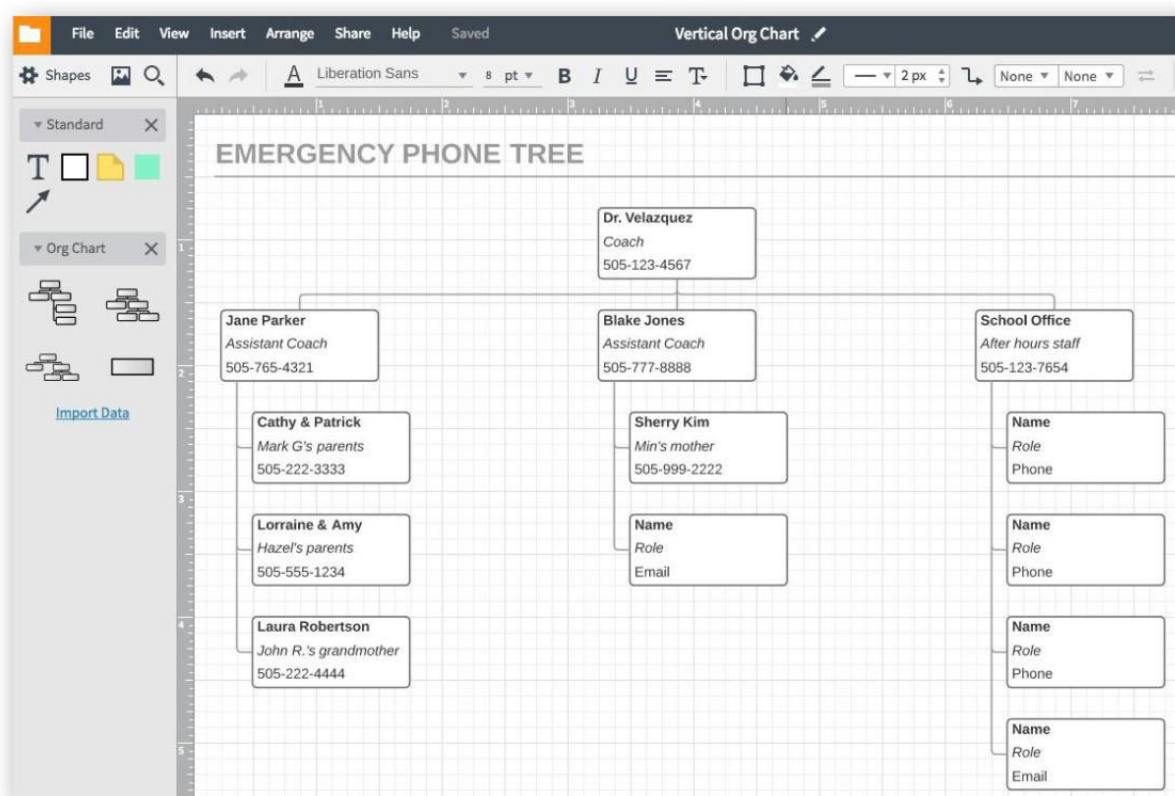
Using one of those two apps I mentioned earlier, SmartDraw or Lucidchart, will make this project fast and efficient. You might even enjoy using the tools.



Lucidchart is marginally easier to use, but SmartDraw has more templates for emergency preparedness.



Start by looking at the templates that the app provides. In diagramming software, “template” means sample document, so you’re getting a lot more than just a file with proper formatting. Let’s take the example of an office evacuation map. The template actually has a sample floor plan and evacuation route already drawn on it (rather than giving you a blank canvas and a library of appropriate objects to slap on it). All you have to do, both literally and metaphorically, is move the furniture around. You drag and drop objects that represent doorways, windows, desks, chairs, potted plants, water coolers, bathrooms, closets, and so forth until the sample floor plan morphs into a representation of your actual office space. Likewise, you can move, rotate, lengthen, and shorten red arrows pointing to the nearest exits.



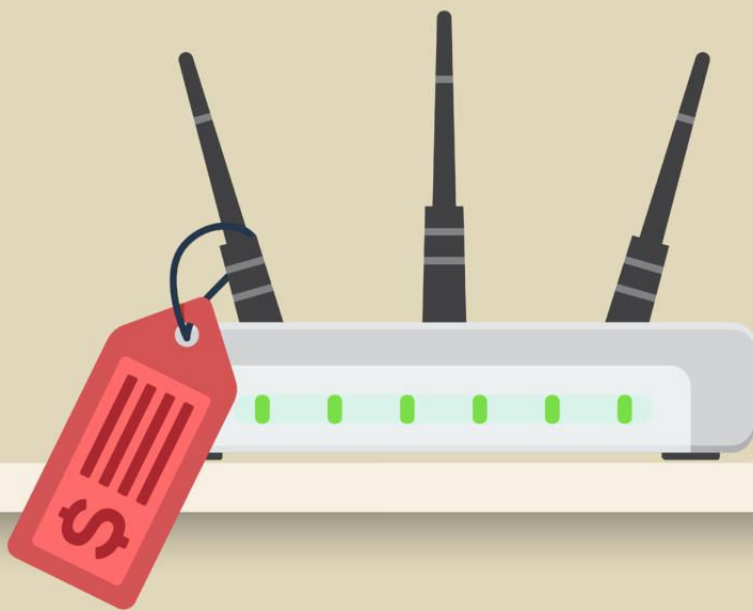
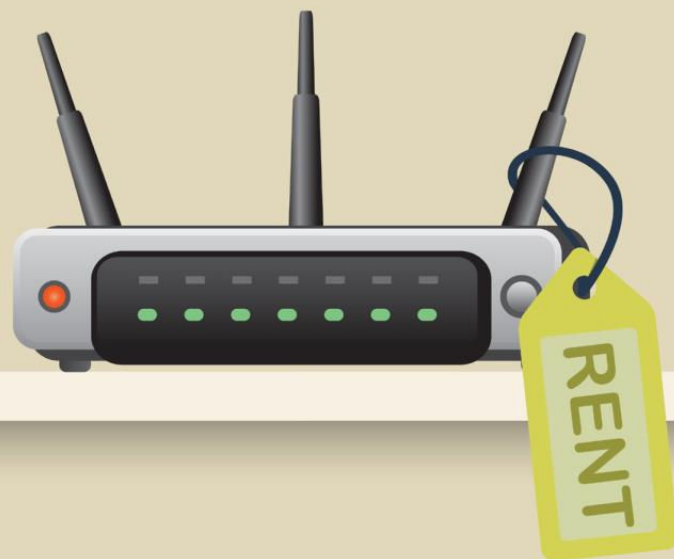
You might not be able to find the exact template you want, but you can always co-opt other similar diagrams. For example, a vertical org chart isn’t all that different, schematically speaking, from a phone tree.

TAKE ONE HOUR TO BE BETTER PREPARED

Diagramming apps make it so simple to churn out a few emergency preparedness documents that you should be able to knock out many of the most important ones you need in an hour or so. Take any Friday afternoon at the office when you’re feeling burned out from doing other work or a Saturday morning at home for personal documents, and get a few critical files made.

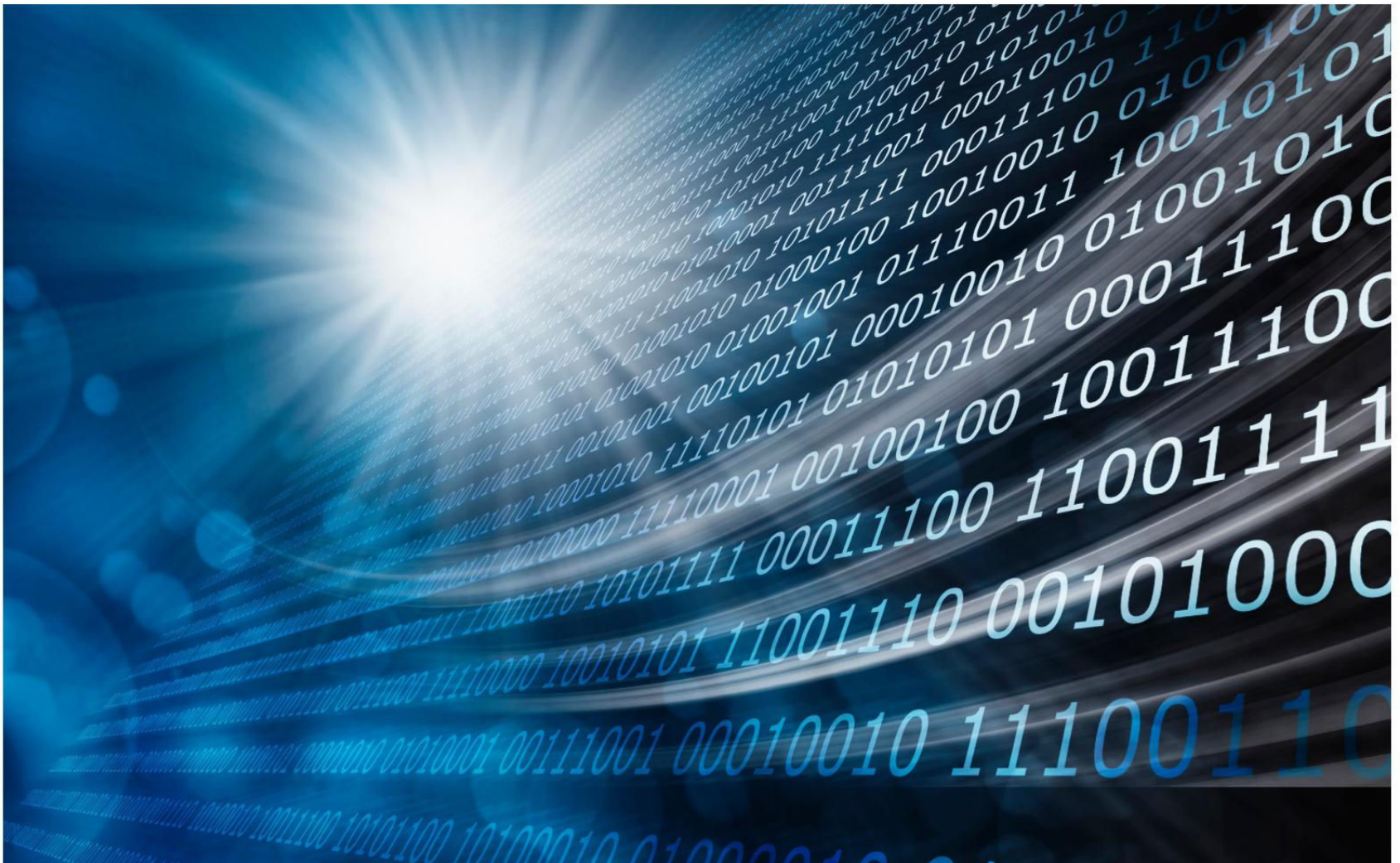
How to Get the Best Cable Modem: Buy or Rent?

BY MOLLY K. MCLAUGHLIN



If you have cable Internet, you probably rent your modem from your service provider for a monthly fee, the same way you do your cable box. You may already have your own wireless router, though many cable companies offer those for rent as well. But did you know that with most Internet Service Providers (ISPs) you can buy your own modem and save those monthly fees?

Renting has some benefits, though. When you rent a modem, you'll often pay a monthly fee that's less than \$10 (though one day, you'll exceed the purchase price). Also, you can trade a rental modem in when it becomes obsolete or if it stops working. And you don't have to worry about compatibility or replacing the unit yourself. Some ISPs include the cost of a modem in your package pricing, so you won't save any money by purchasing your own, but you will be able to continue to use the same one if you change providers. Bottom line: It's not terribly straightforward. Here's how to get the best deal.



WHEN TO BUY YOUR OWN MODEM

Before we dive in, let's talk about modem technology, which affects your maximum upload and download speeds in addition to the service offered by your cable provider. The Data Over Cable Service Interface Specification (DOCSIS) is a telecommunications standard used to provide Internet access over a cable modem. The current standard is DOCSIS 3.0, which offers some of the highest speeds available. Gigabit Internet is faster, but it's found only in select cities around the country. This speed will eventually require the DOCSIS 3.1 standard, which for now is available in just a few test markets; very few compatible modems are currently available.

You'll definitely want to upgrade your modem if it supports only DOCSIS 2.0, as you're sacrificing speed, and ISPs likely won't continue to support those type of modems for much longer. In any case, it's worth contacting your ISP if you're not sure about compatibility.

Internet speeds are measured in two ways: upstream and downstream, aka uploads and downloads. Originally, DOCSIS used one channel for downloading data and one channel for uploads. DOCSIS 3.0 enables modems to combine multiple channels to stream data, increasing the speed of both downloads and uploads. Most users will want a 16x4 or 8x4 modem—that is, 16 or eight downstream channels and four upstream channels. A 16x4 modem generally tops out at around 680Mbps for downloads, while an 8x4 modem will offer maximum download speeds of half that—around 340Mbps. Some high-speed plans require a 24x8 modem, but you should check whether your ISP allows you to use your own modem before purchasing one.

If you're currently renting a cable modem, check your monthly bill for the rental fee, which generally ranges from \$5 to \$10. Among the major cable companies, Comcast, Optimum, and Charter/Spectrum (formerly Time Warner Cable) all charge fees. Charter includes the cost in its Internet plans for current subscribers, which excludes former Time Warner Cable subscribers for the time being. Cox offers a free modem when you bundle a TV and Internet plan, which you likely already do. This means, aside from Cox, you could save between \$60 and \$120 per year, which means a modem that costs \$90 to \$100 would pay for itself in less than a year. Be sure that your cable company stops charging you the rental fee, though.



YOU HAVE CABLE MODEM OPTIONS

You may be able to save money and get faster speeds by buying a cable modem instead of renting one from your ISP. Here's what you need to know.

Choose a modem that's compatible with major cable ISPs in the U.S. in case you move or decide to change service. (Major ISPs typically list compatible modems on their websites.) And be sure the modem supports the speeds you're paying for. If Gigabit Internet is on the horizon in your community, and you know you'll want to upgrade your plan, get a modem with a Gigabit Ethernet port.

WHEN NOT TO BUY A MODEM

Of course, there are exceptions. If you have or switch to DSL or fiber, you can't use a cable modem; each uses special equipment that you'll have to rent or purchase from your ISP.

In addition, if you bundle your home phone service with your Internet plan, you'll need a modem that has a phone port. Telephony modems aren't widely available for sale—a quick search yields expensive products with outdated technology—so you're most likely better off renting from your ISP.

THE RIGHT CABLE MODEM FOR YOU

At PCMag, we don't rate cable modems, because it's not possible to isolate modem performance from ISP speed, and we're unable to test them with every compatible ISP under the same conditions. The right cable modem for you is compatible with your ISP and your particular plan and offers the best balance of price and features. The best modems support DOCSIS 3.0, and are compatible with all the major U.S. cable companies. Each model here costs less than \$100, so if you're paying \$10 a month to rent your modem, you'll make back your investment in less than a year. And all four modems below include a Gigabit Ethernet port, so you'll be ready when Gigabit Internet is available in your area.



If you have or switch to DSL or fiber, you can't use a cable modem; each uses special equipment.



The Arris Surfboard SB6141 (\$70) is a 8x4 modem that provides maximum speeds of 343Mbps download and 131Mbps upload, and has a Gigabit Ethernet port.



The Arris Surfboard SB6183 (\$90) ups the ante with download speeds up to 686Mbps and 131Mbps maximum upload speeds as well as a Gigabit Ethernet port. It has 16 downstream and four upstream channels. If you have the extra \$20, it's worthwhile to upgrade to the SB6183 over the SB6141. Both Arris modems come with a two-year warranty.



The Netgear CM500 High-Speed Cable Modem (\$95) has 16 downstream channels and four upstream channels, which results in download speeds of up to 680Mbps. It also has a Gigabit Ethernet port. Netgear offers a one-year warranty that includes free support within the first 90 days of purchase, as long as you register your product.

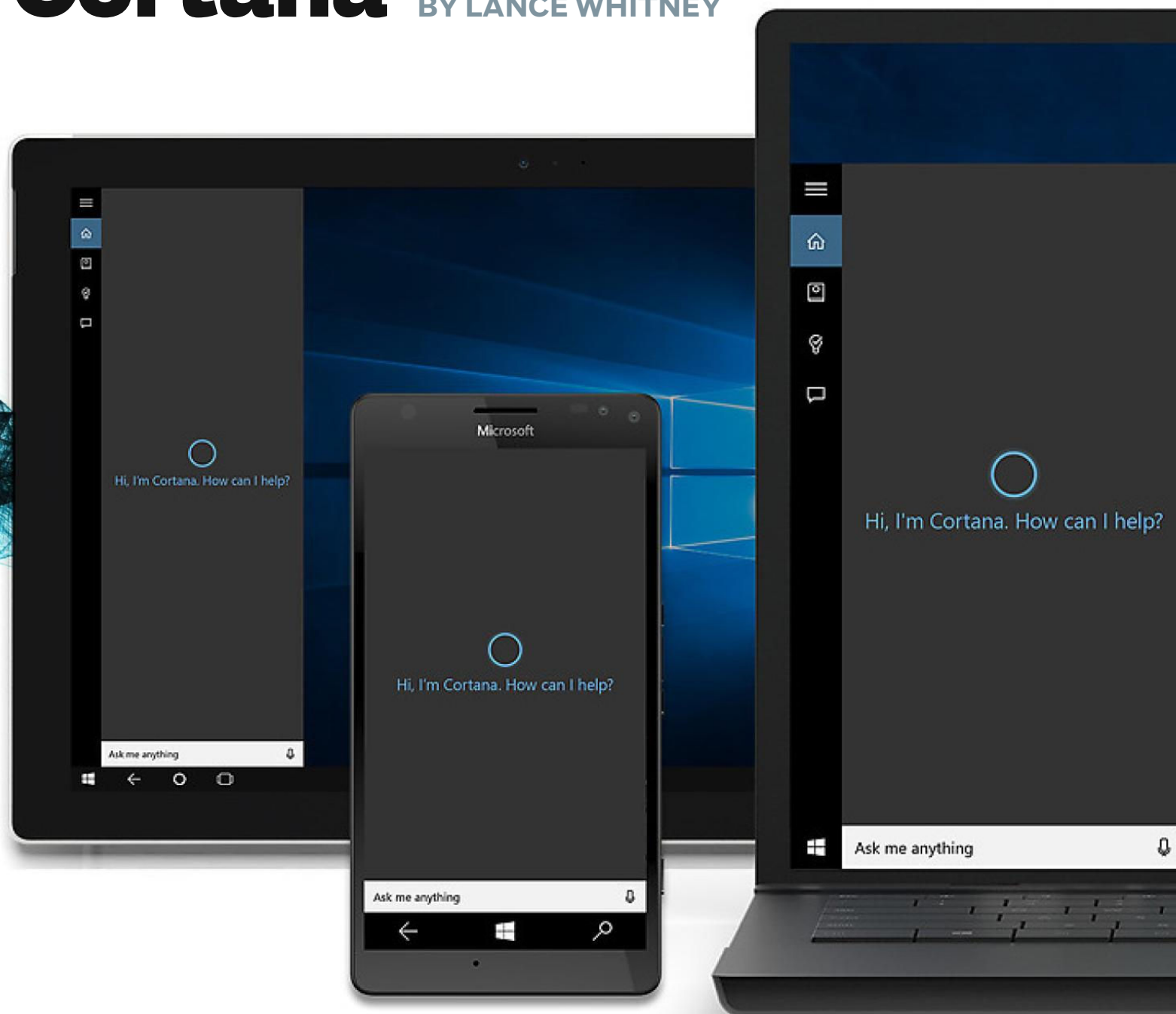


The Zoom 5345 cable modem (\$45) has eight downstream and four upstream channels, resulting in download speeds of up to 343Mbps; it also sports a Gigabit port. Like Arris, Zoom offers a two-year warranty on its modems.



How to Share More (or Less) Personal Data With Cortana

BY LANCE WHITNEY



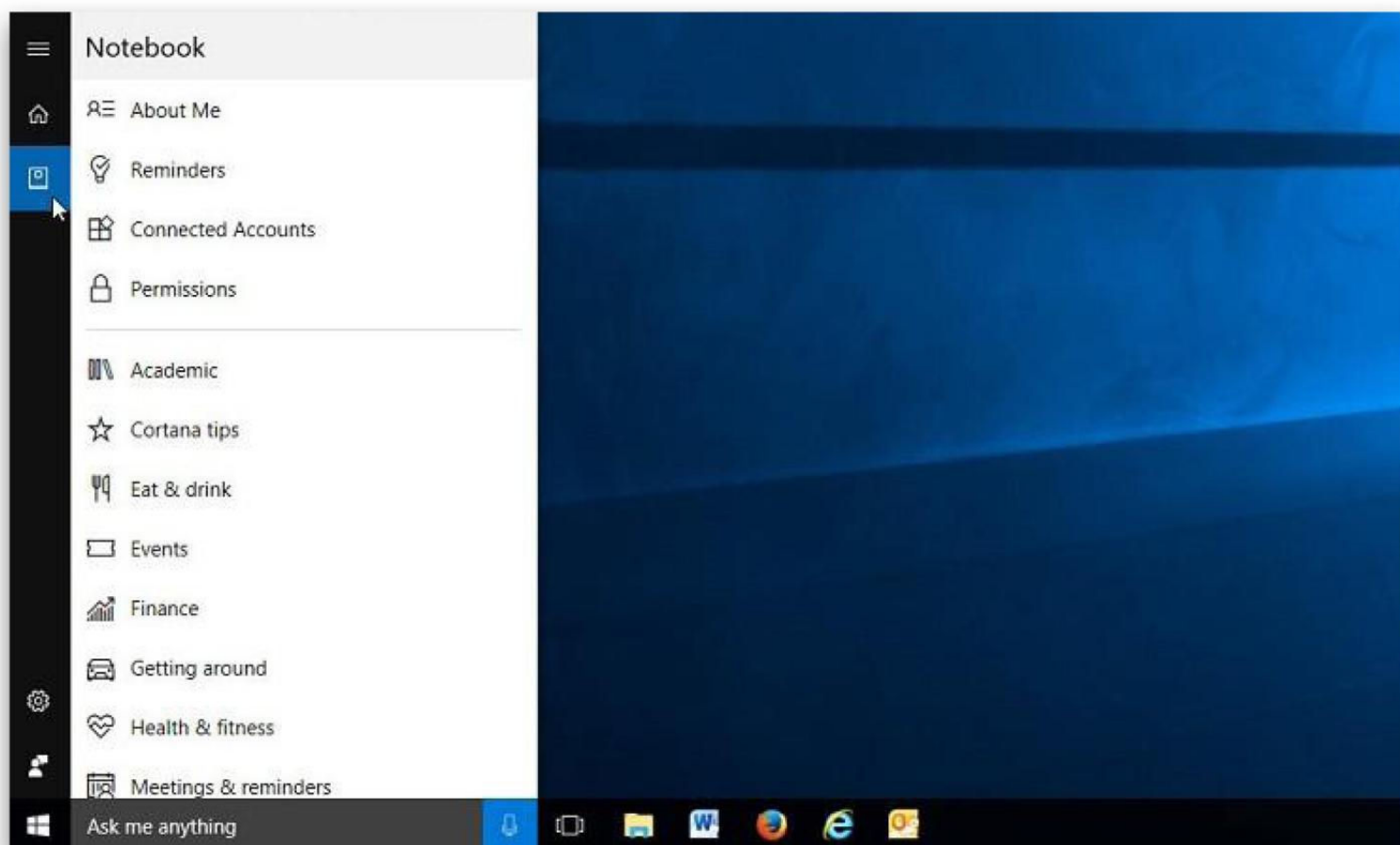
With its ability to respond to your verbal commands, answer questions, and perform various tasks, Cortana is certainly one of the handiest and most helpful features in Windows 10. And the more you share about yourself with Cortana, the more effective it can be in helping you manage your daily activities.

CHOOSE WHAT YOU SHARE

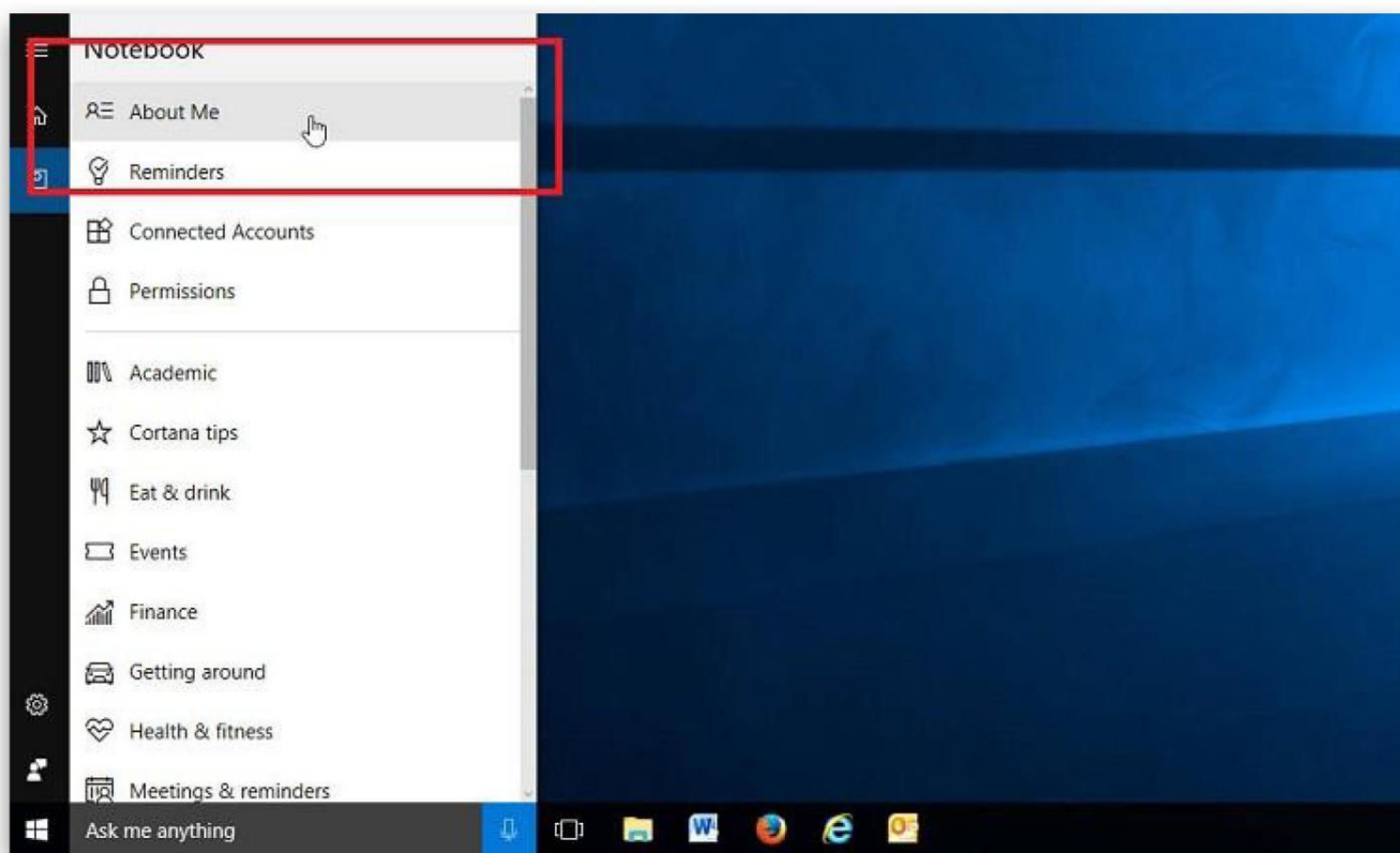
Cortana on Windows 10 is handy; the trick is to provide enough data without infringing on your privacy.

But privacy concerns always crop up when you share data about yourself with today's technology, especially if such data ends up in the hands of advertisers and other third-party entities. Let's look at some of the options for sharing more or less personal info with Cortana.

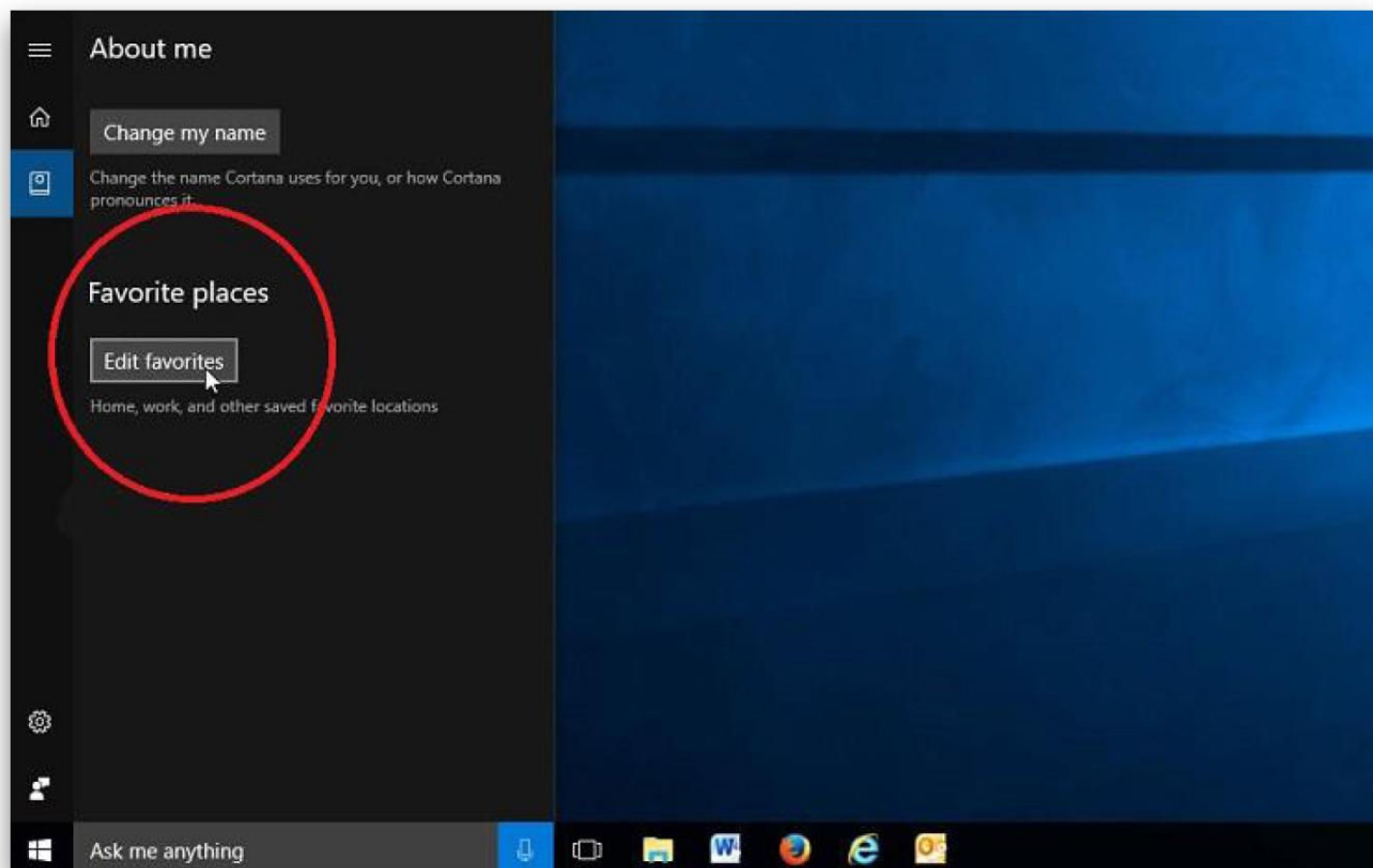
In Windows 10, click on the Cortana microphone icon or click in the Cortana search field to open the Cortana pane. Then click on the Notebook icon (third from the top of the Cortana pane), and it opens to display a variety of different categories.



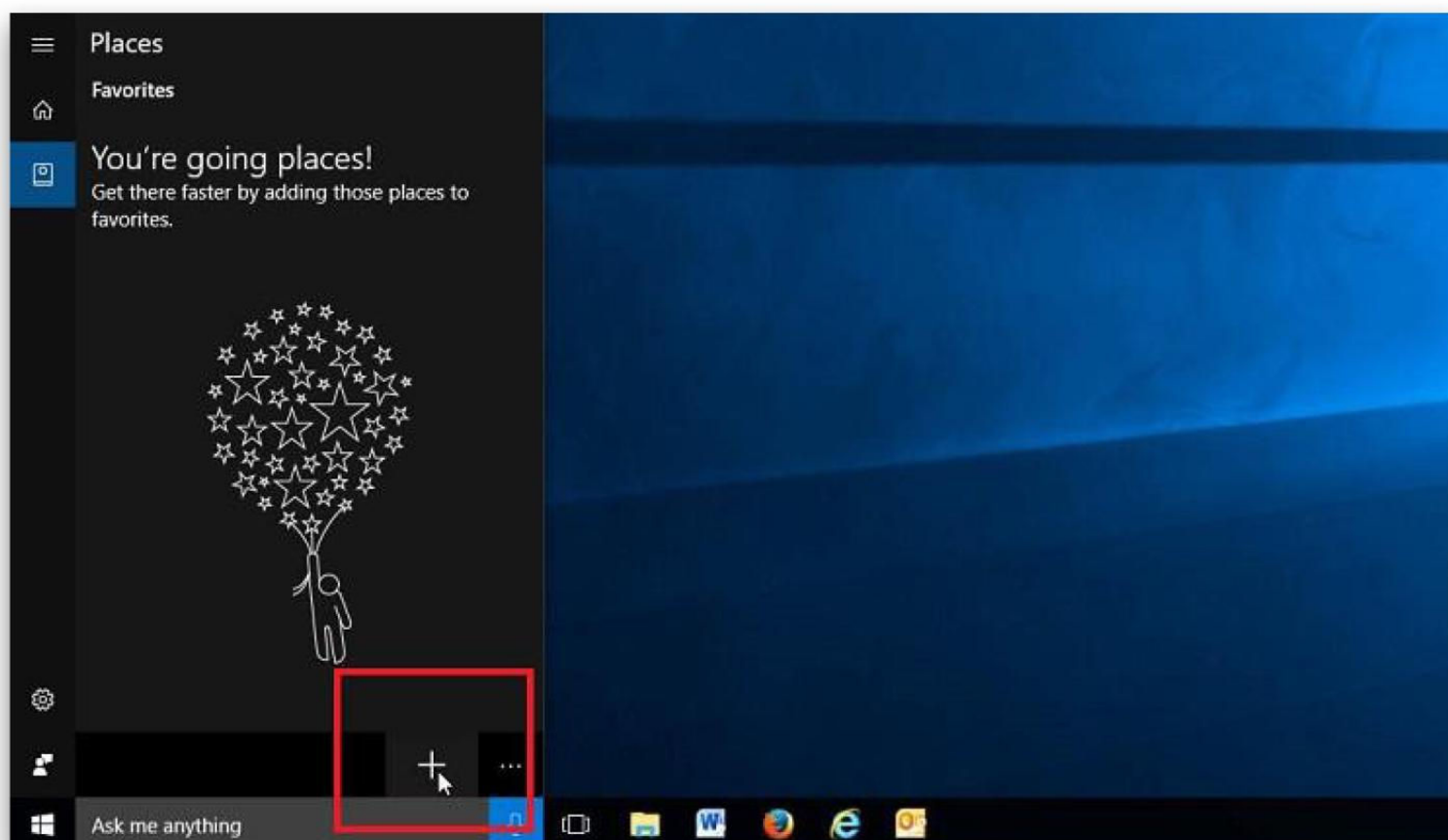
Click on “About me.”



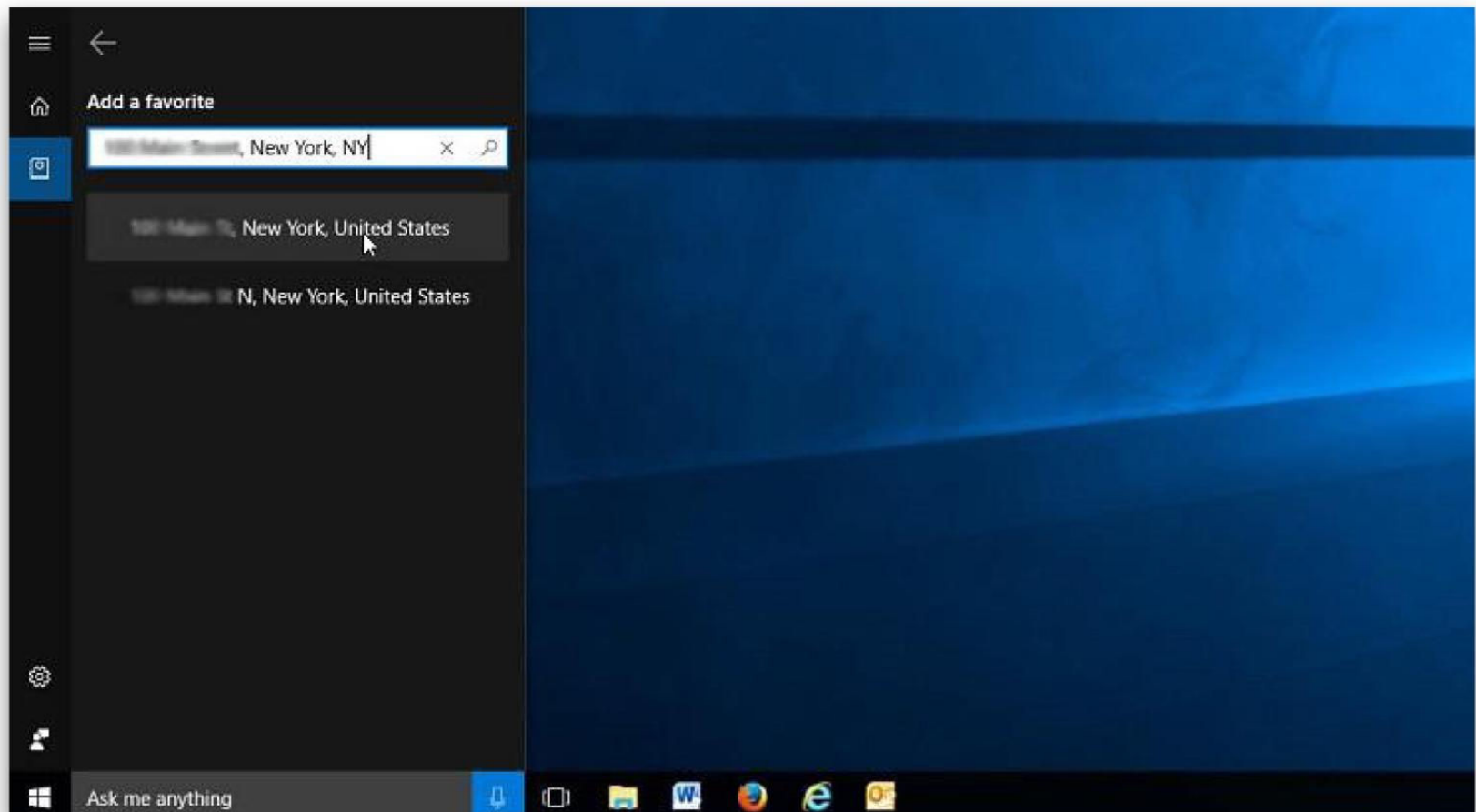
Here you can share with Cortana your home and work addresses, as well as other locations, so it can refer to those places more easily, particularly if you need directions to a certain location. In the “About me” pane, click “Edit favorites.”



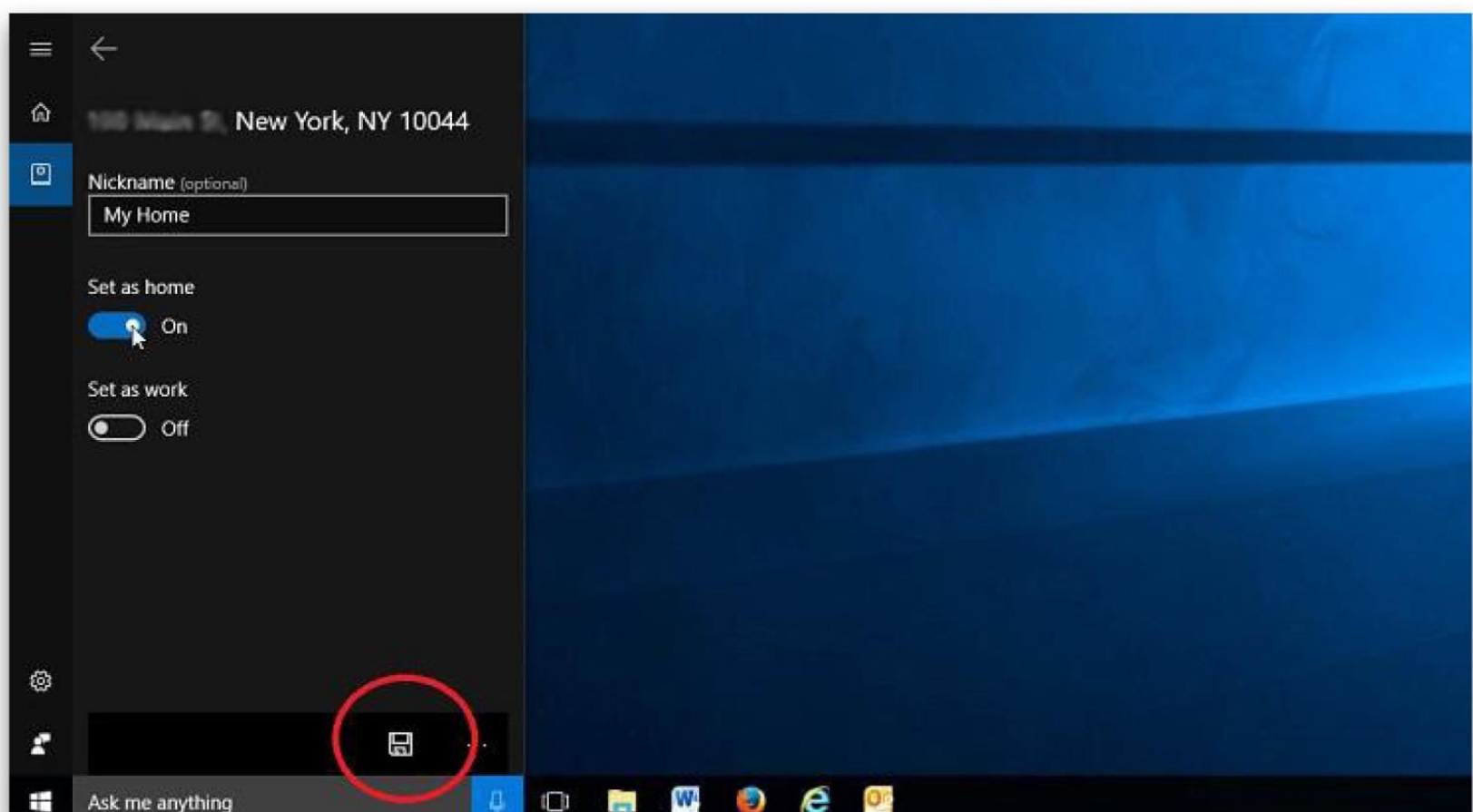
At the Favorites window, click on the plus sign in the lower-right corner.



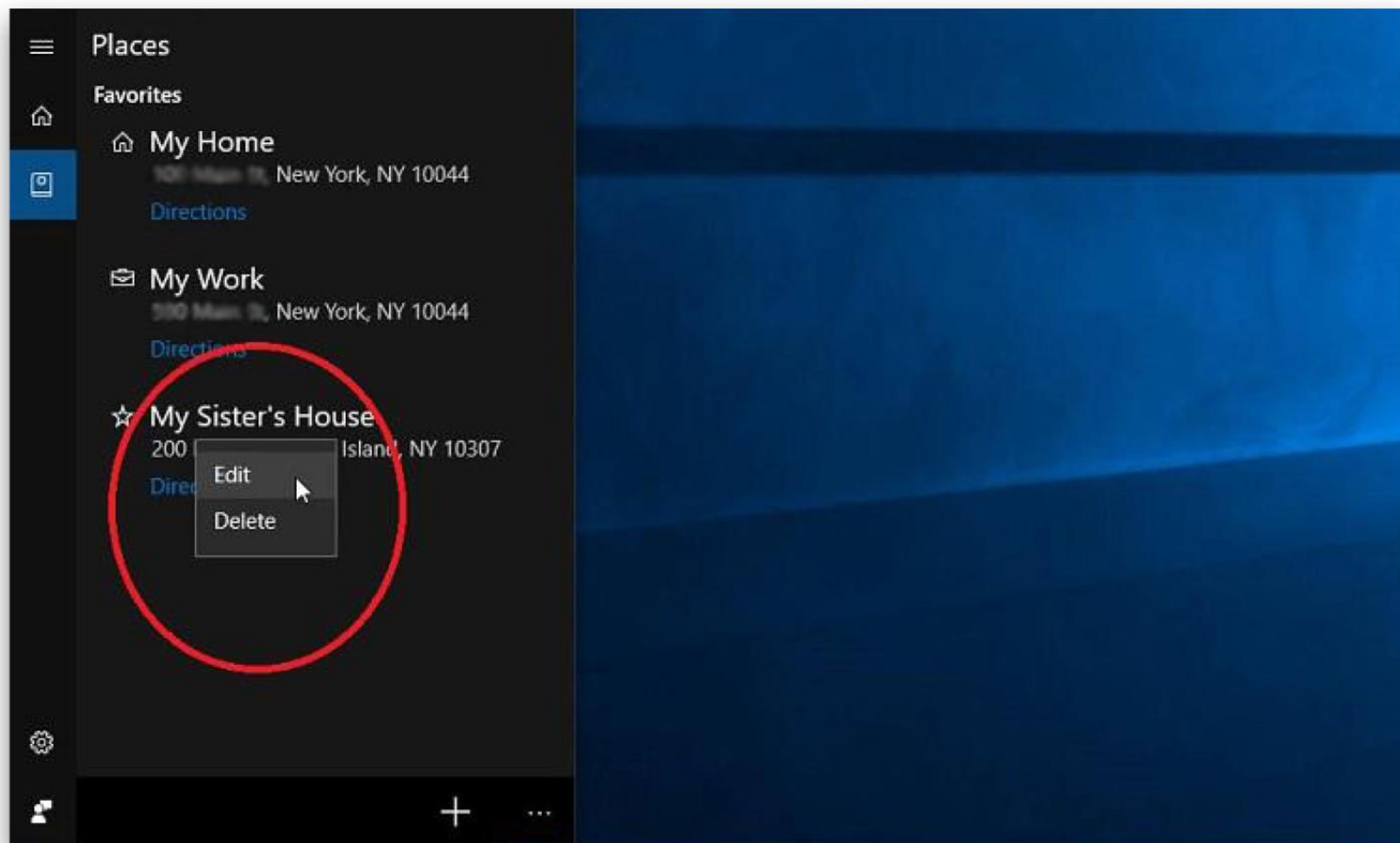
Let's say you want to add your home address. Type in your street address followed by the city and state. You should eventually see your address listed. Click on it.



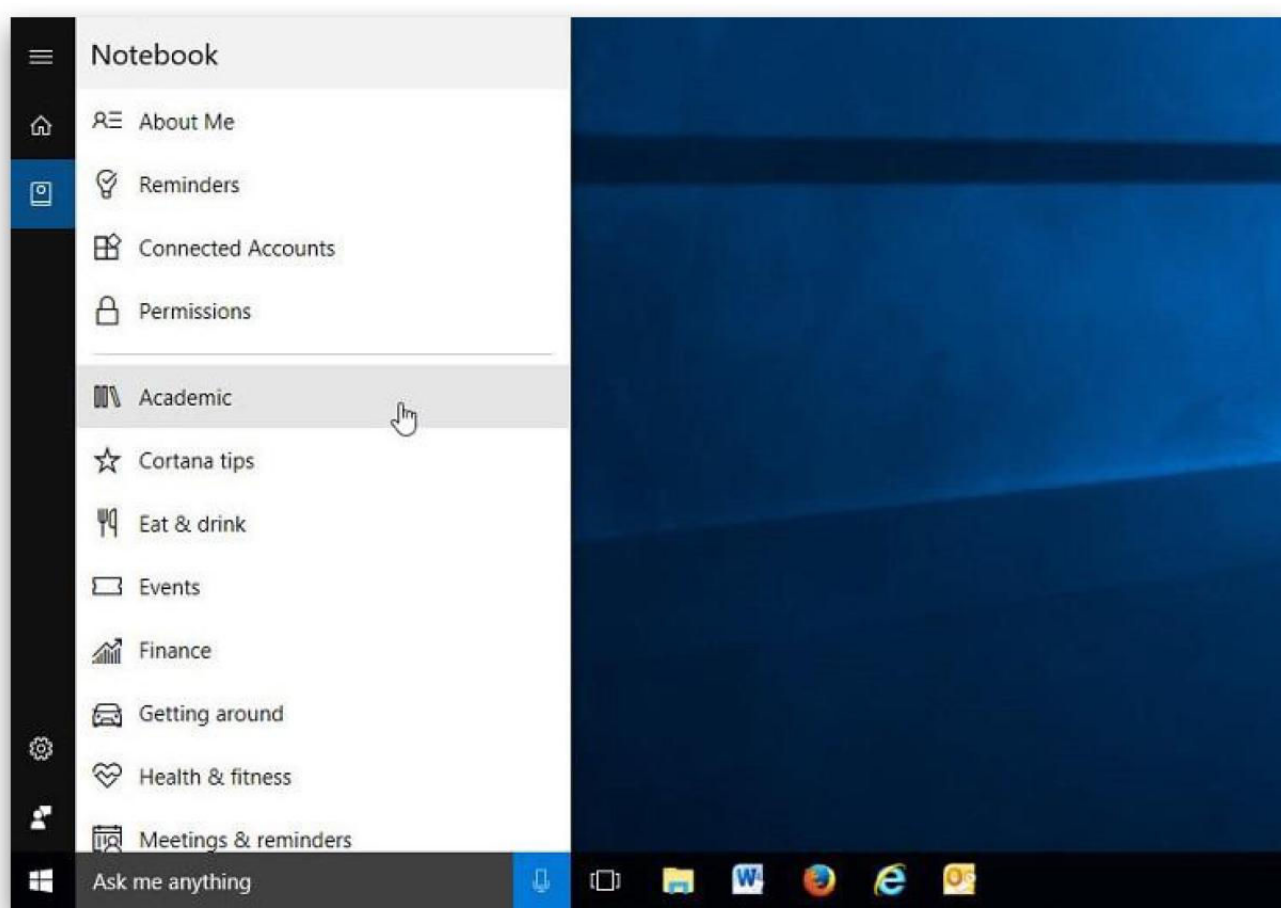
Add a nickname if you wish. Then turn on the “Set as home” option. Click on the save icon at the bottom of the window.



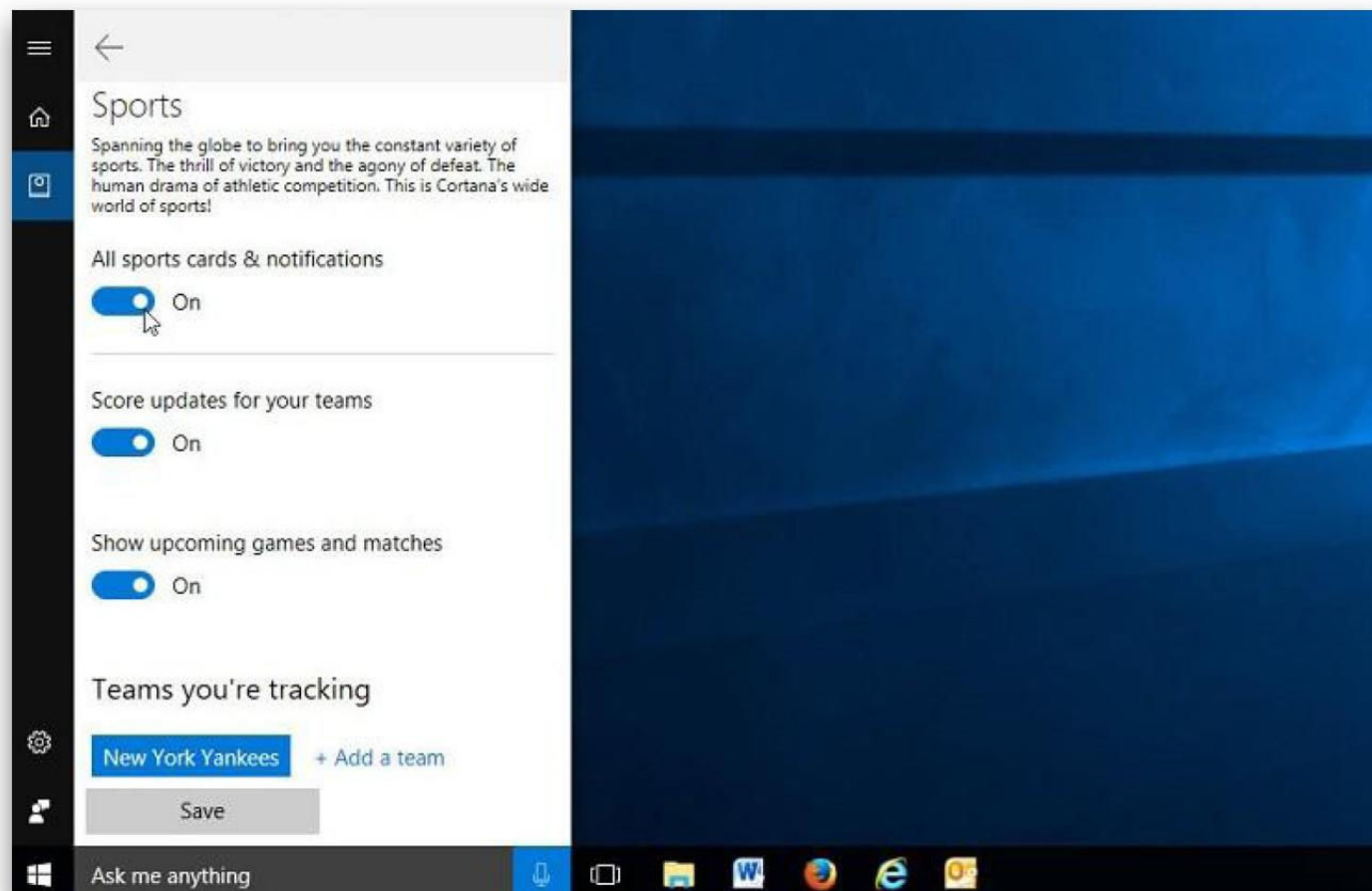
Repeat the process for your work address. You can add other locations. Just remember to come up with a nickname (“My sister’s house”), so you know what it is. If you wish to change or remove a location, right-click on it, and from the pop-up menu, click on Edit or Delete.



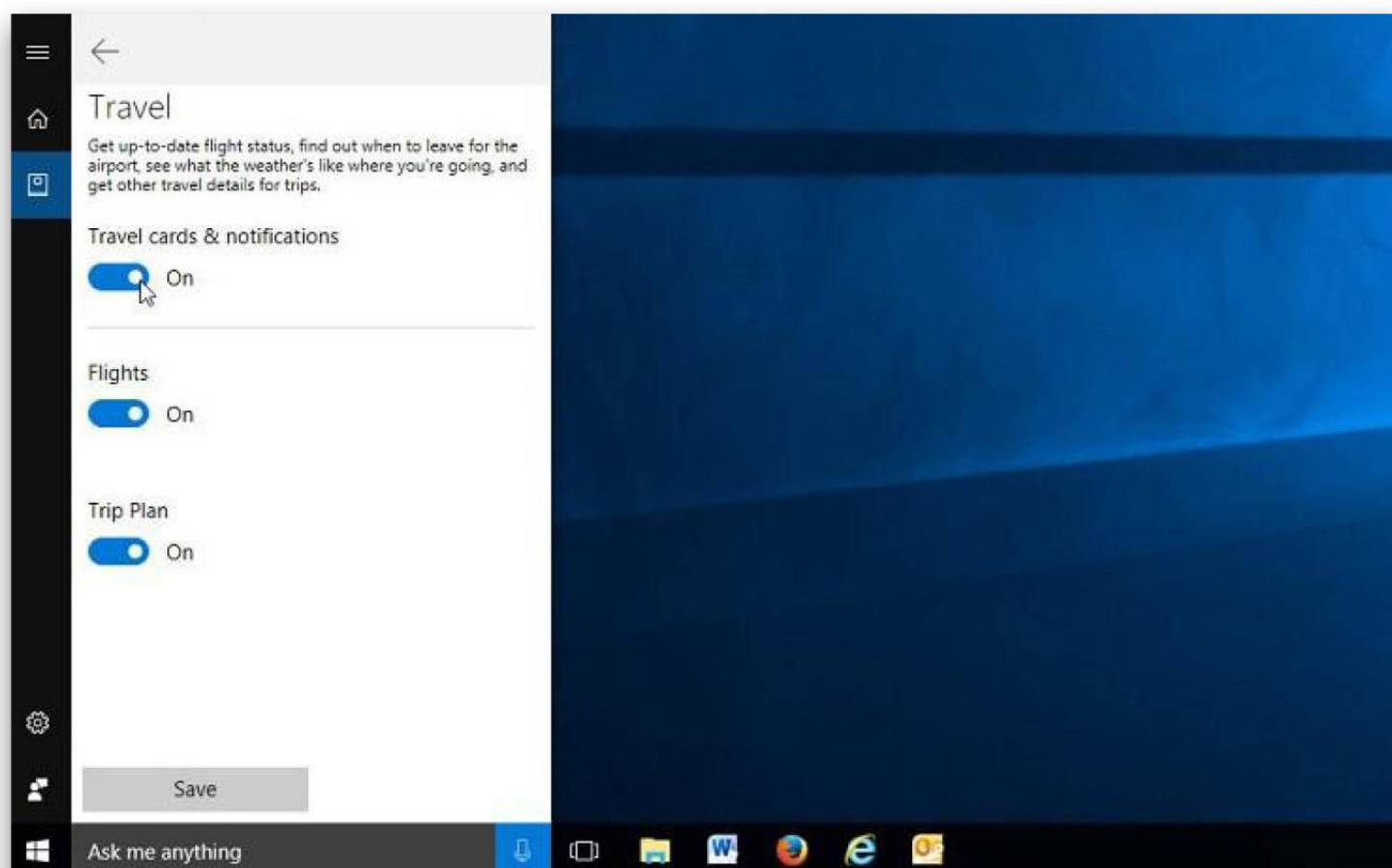
Now, return to the Notebook and start selecting each of the categories, beginning with Academic, then moving to Eat & Drink, Events, Finance, Getting around, Health & fitness, Meetings & reminders, Movies & TV, News, On the go, Packages, Reservations, Shopping, Special days, Sports, Travel, and finally Weather.



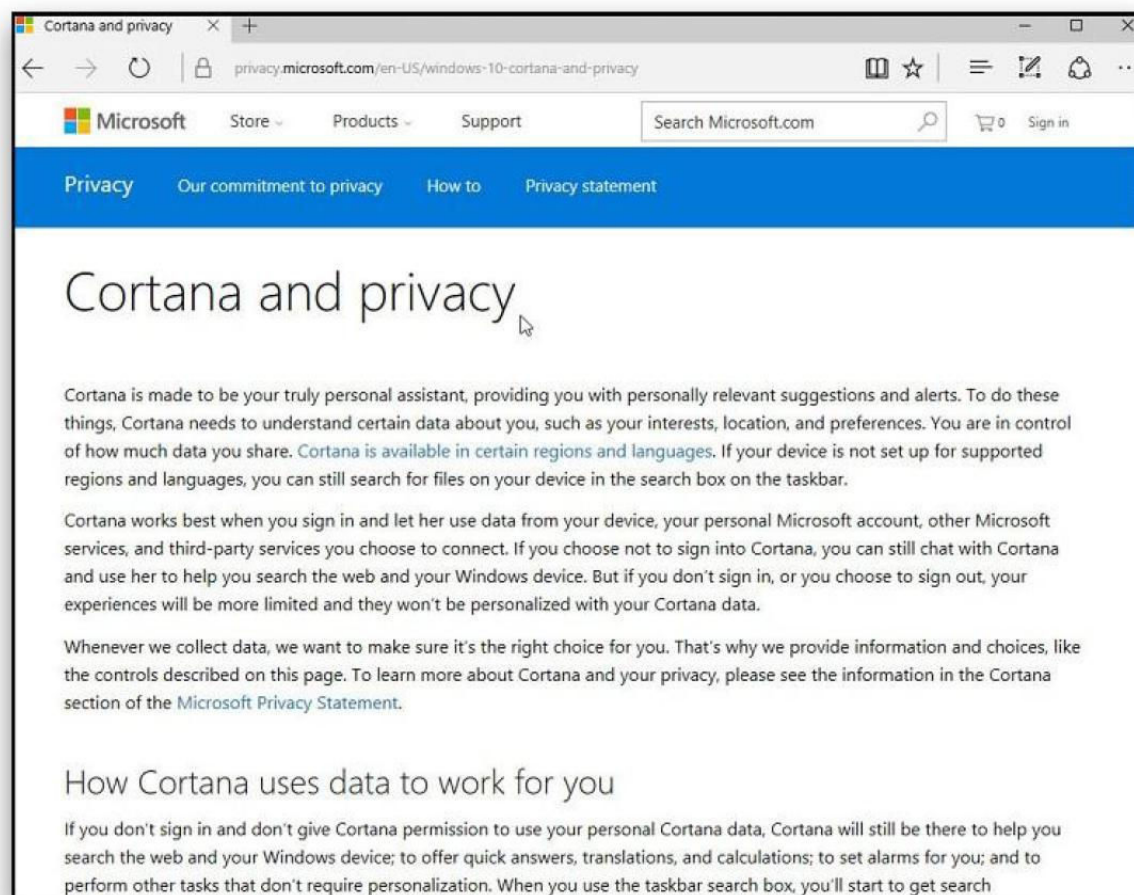
Carefully review each category to decide how much information you wish to share and which options you want to turn on or off. Some of the information collected by certain categories, such as Movies & TV, Sports, and Special days, may seem relatively innocuous.



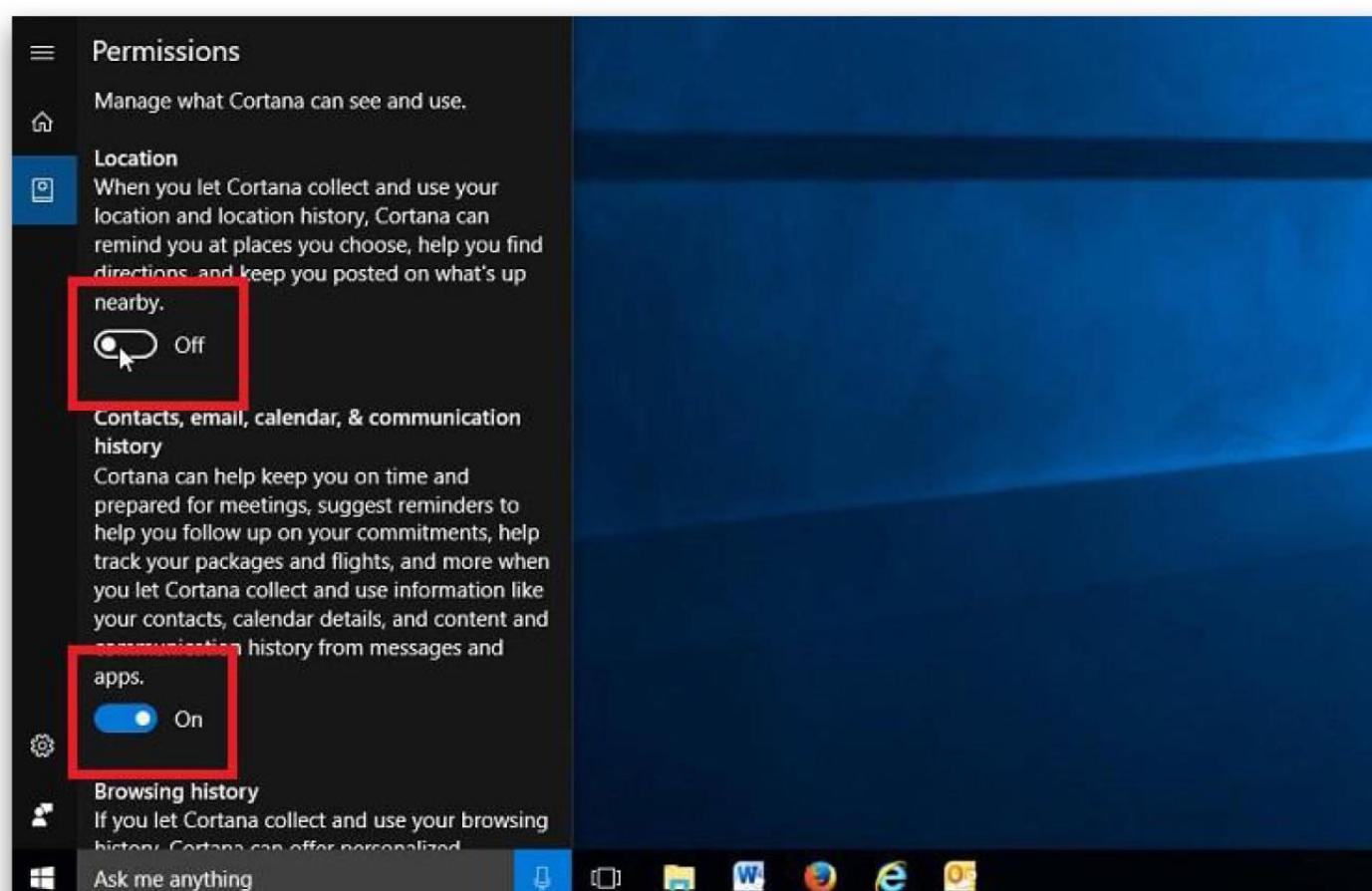
Other information, such as that gathered by Finance, Meetings & reminders, and Travel, may strike you as items you'd prefer not to share. As always, the balance is between convenience and privacy, and that's a balance only you can choose.



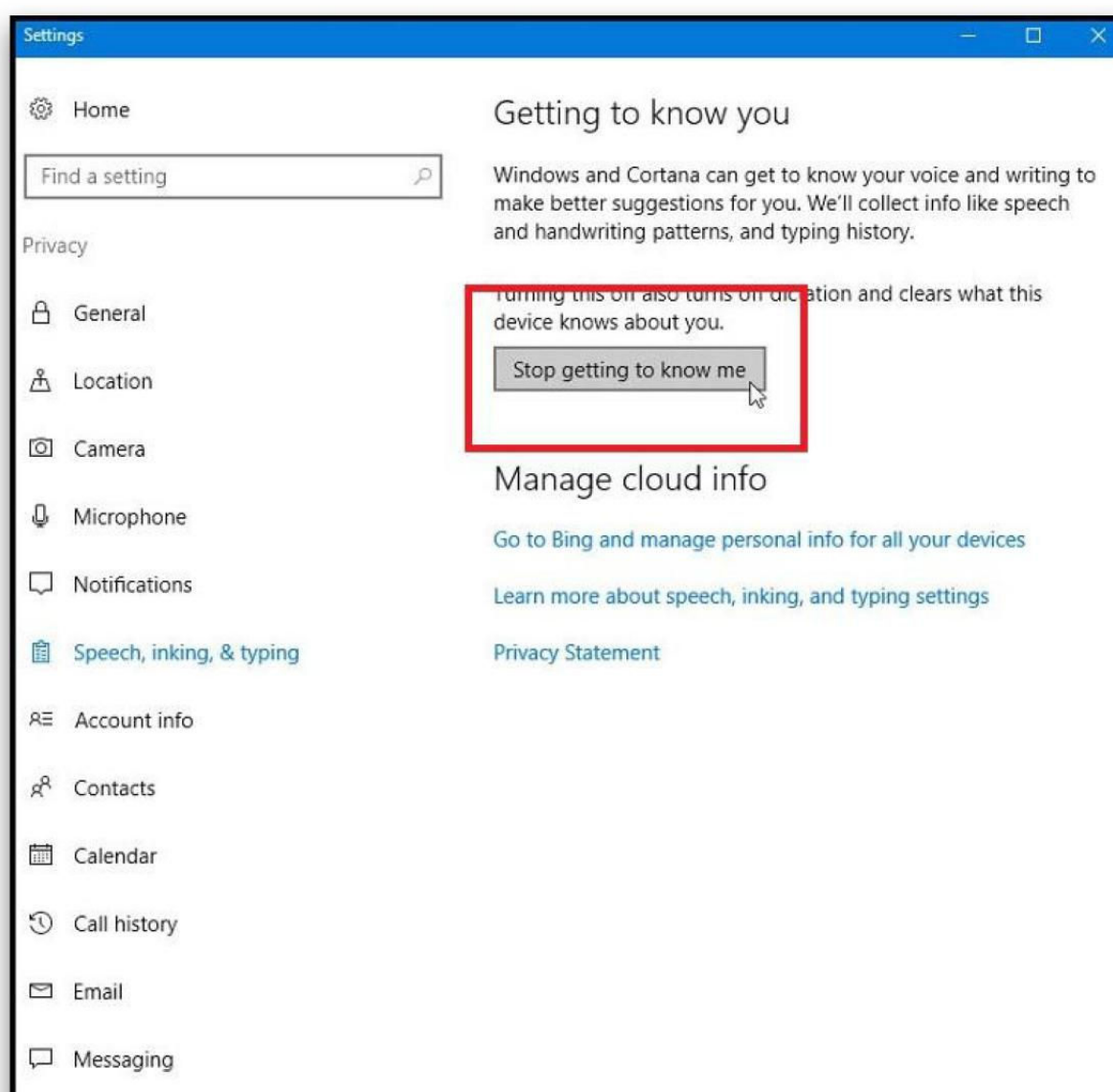
A Microsoft webpage called Cortana and privacy can help you better decide how much or how little data to share, so this page is definitely worth a read as you review your Cortana settings.



Next, click on the Notebook icon again and select the Permissions setting. Here you can manage what information Cortana can gather about you, including location, contacts and communications, and browsing history.



Finally, click on the link at the bottom of the Permissions pane for “Speech, inking & typing privacy settings.” A settings window called “Getting to know you” pops up with links to learn more about these settings, read Microsoft’s privacy statement, and manage the personal information collected by the company. You can also stop the collection of information altogether and erase data already gathered by clicking on the button labeled “Stop getting to know me.”





The Myth of the Robot Writer

Every so often, a slew of hysterical articles bemoan the demise of newspapers and fret about how robots will soon take journalists' jobs. What a crock. I do not want to see this sort of story until these fabulous computers can do optical-character recognition with 100 percent accuracy on old books. Or after voice recognition gets past 97 percent accuracy. Actually, 97 percent is not good enough. Getting three words wrong out of a 100 means a lot of copy editing, which robots can't do either.

The idea of a robot reporter is actually hilarious, for it ignores how a story is written and newspapers work. Most material published in a medium market newspaper is purchased in a syndicate package sold by *The New York Times*, *The Washington Post*, or the Associated Press. Other operations also push news packages such as Bloomberg, UPI, and others.

The best deals from the syndicate include all the news stories plus the columnists. The monthly fees vary according to market size. This method is entrenched, and no robot writers are going to compete. In small markets, journalists—who may add local stories to the syndicated dreck—are already underpaid. There is no reason to replace them with robots.

Let's be clear that this imaginary "robot" is actually a computer and nothing more. It does not roam around the newsroom to flirt or grouse about the coffee. No, it's a computer with news feeds going

in and (ideally) articles coming out. The robot cannot do any reporting, it cannot make phone calls, it cannot go into the field. It's just a rewrite machine, so it's a laughable idea.

Tech journalists have likely thought about computer-assisted writing. Spell checkers and grammar checkers are useful, although they do not go as far as needed. None do any decent contextual editing, and when they try, they suck. A finished product is perhaps 50 years in the future.

I've always been intrigued with computers that can supposedly tell a female from a male writer. When you run anything through a system that is actually literate, it comes up all men. Apparently the only time it comes up as a female is when the person is a teenage dingbat who dots her "i" with a heart. They're bogus and sexist.

A handwritten signature in black ink that reads "John Dvorak". The signature is fluid and cursive, with the first name "John" and last name "Dvorak" clearly legible.

john_dvorak@pcmag.com



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