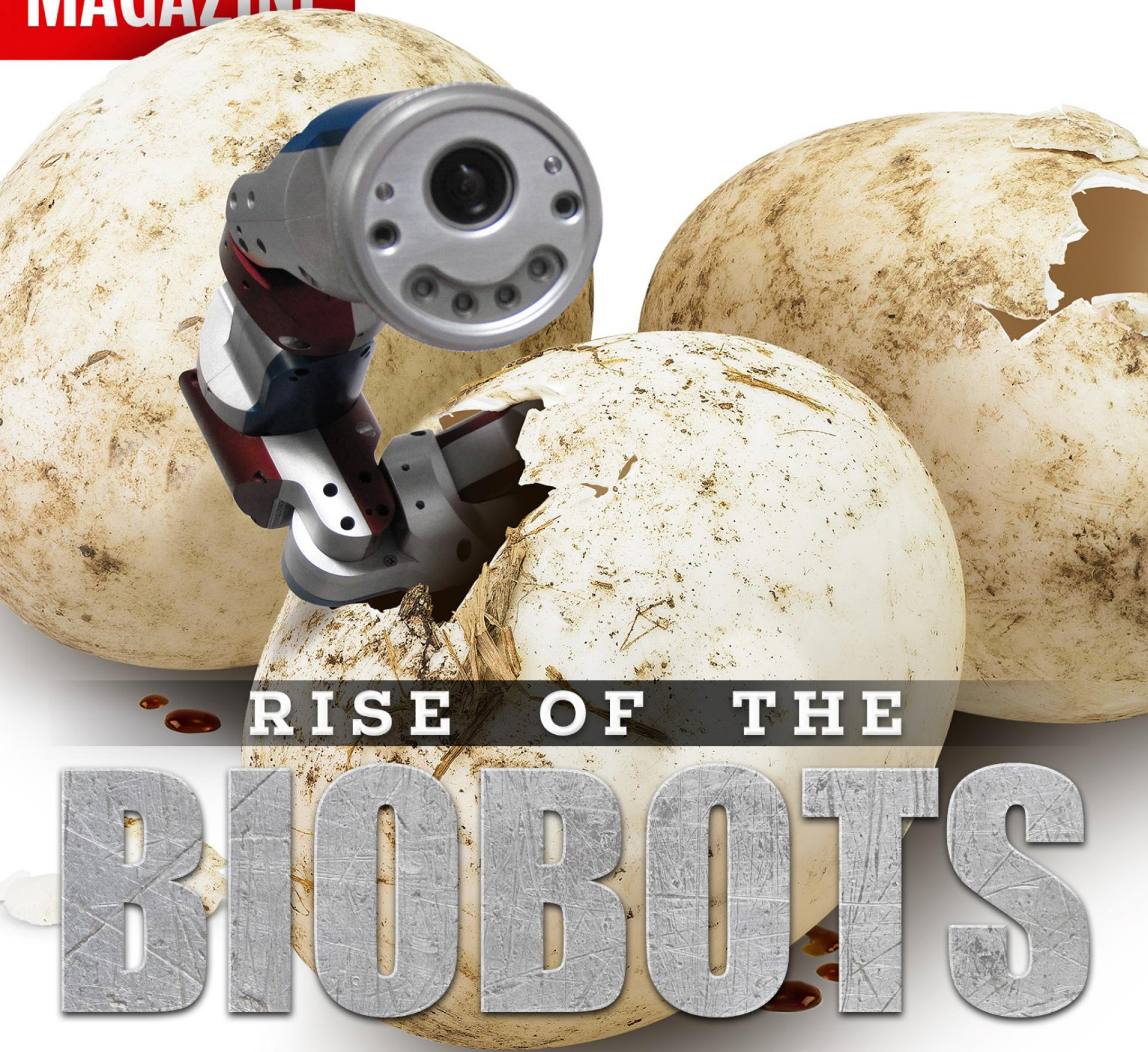
PC MAGAZINE

AI THAT KNOWS YOU BETTER THAN YOU KNOW YOURSELF

NINTENDO SWITCH REVIEW



RISE OF THE BIOBOTS

DIGITAL EDITION
APRIL 2017

PC MAGAZINE

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APRIL 2017

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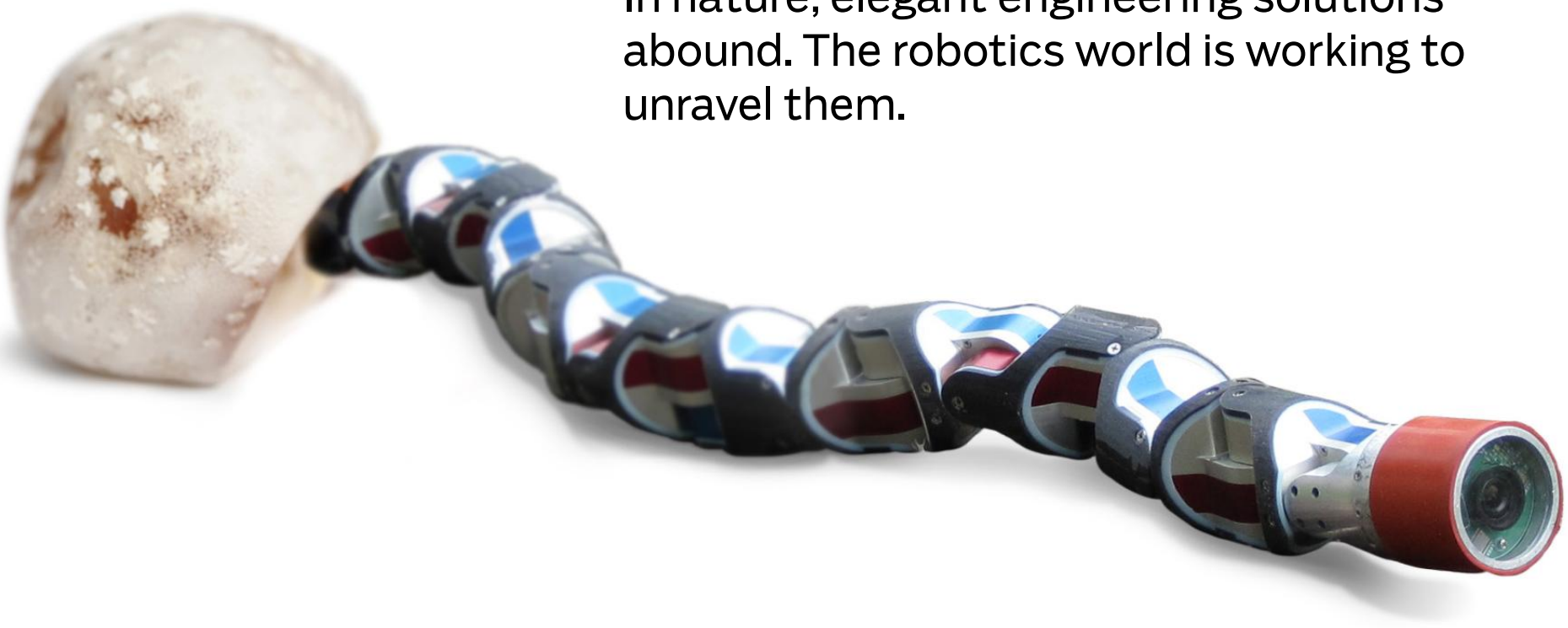

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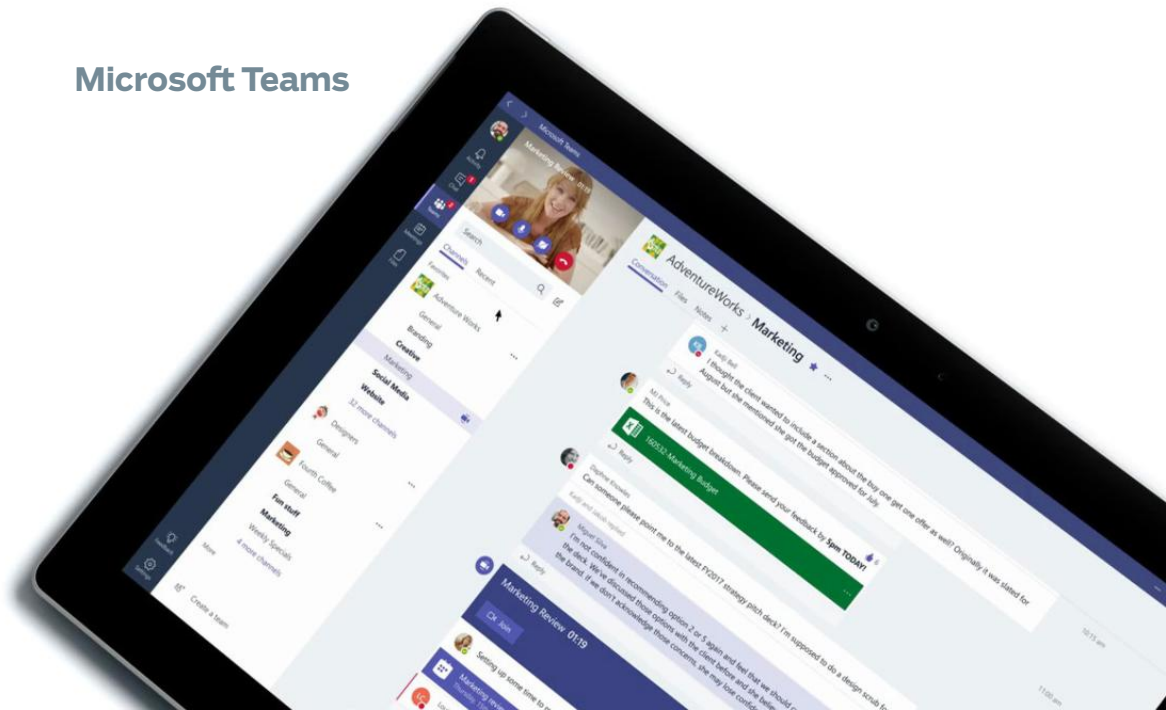

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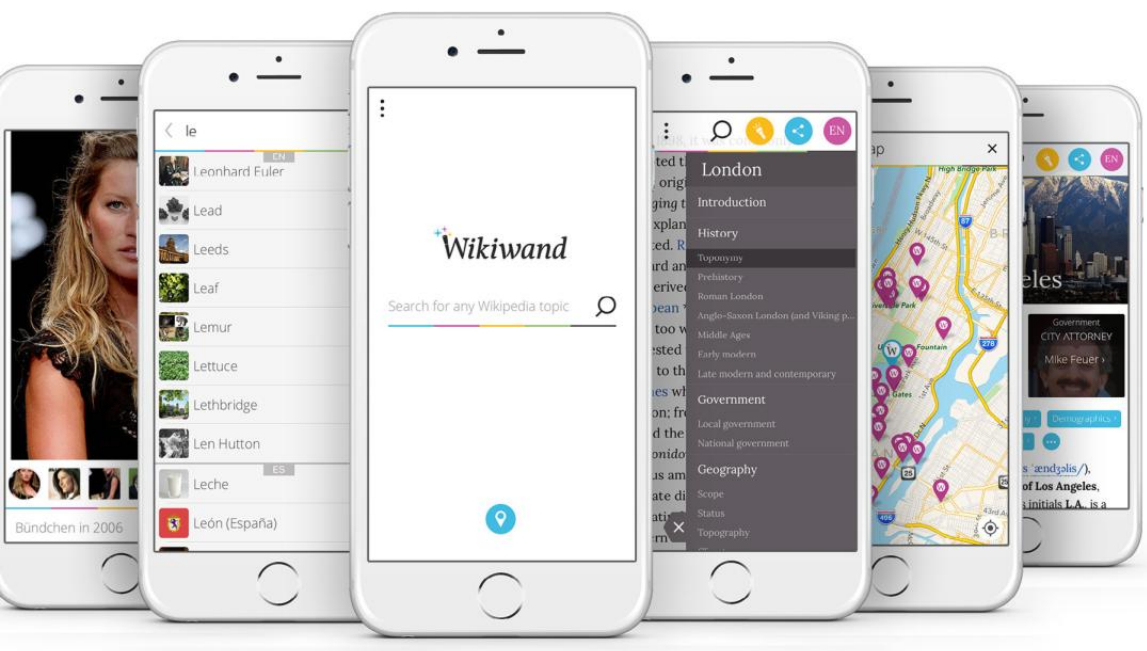

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DAN COSTA

Not In Our Image

God created mankind in his own image, in the image of God he created them; male and female he created them."
—*Genesis 1:27*

Did God make man in his image, or did mankind make God in its image? Whichever side you come down on, it's a lot easier to observe that humans have been trying to make robots that look us for quite a while. The ability to recreate human shape, movement, and ultimately, intelligence has occupied technologists for the last century—longer if you include the alchemical, metaphysical, and purely fictional attempts. What is Frankenstein's monster, if not a kind of biological robot? But the next step may not be toward a more humanlike robot. In fact, the most effective robots may not look like humans at all.

The term *robot* was coined by Josef Capek, who used it in his 1928 play "R.U.R." The play explores the creation of soulless, mindless workers meant to replace human laborers. Since then, we've seen countless humanoid robots in fiction. Maria of *Metropolis* predates the term "robot" by a year, but she's undoubtedly a robot. And science fiction has revealed a long series of humanoid robots: Data from *Star Trek: Next Generation*, The T800 from The Terminator, and even the Major Motoko Kusanagi, who'll be shooting up theaters near you in *Ghost in the Shell*.

Science and technology have delivered plenty of real-life humanoid robots as well. Also in 1928, a robot named Eric was put on display by the Society of Model Engineers in London. Eric couldn't walk, but he gave a nice speech and moved his arms around via remote control. Honda's Asimo robot, generally regarded as the most advanced two-legged robot on the market, was introduced in 2000 and has been improving ever since. And SoftBank's Pepper robot is rolling out even faster, with currently more than 10,000 out in the world. Pepper helps humans do everything from shopping for electronics in Santa Monica to buying pizza in Singapore.

But what if we don't anthropomorphize our robots? After all, nature has a lot more models than the bipedal human, and many non-human creatures specialize in certain kinds of efficient movement that people couldn't hope to emulate—but robots can. Fish, snakes, bats, and even squirrels have a lot to offer the world of robotics. And that's when things start to get interesting.

In this month's cover story, Michelle Z. Donahue takes a look at what future robots will look like. The short answer: Most of them won't look like us.

dan_costa@pcmag.com

The Neutral Zone

President Trump's pick for FCC chairman, Ajit Pai, wants to free private enterprise by doing away with net neutrality. But what does that mean when cable companies dominate Internet service?

I think doing away with net neutrality is a very bad idea. While there are some negatives that I don't particularly like, there need to be some checks and balances in place so that an ISP doesn't start to throttle things on my connection for whatever willy-nilly reason they want. People seem to have forgotten that Comcast, a few years back, practically extorted money from Netflix before net neutrality came into play. What's to stop other big ISPs from doing the same to other services?
—SparkStormrider

I hope this man is removed from the FCC. He is blind, deaf and mute to the real world. He turns his back on the population and will be hated. Petition, fight, and call your regulators to thwart any attempts he will try to stop the free internet, or allowing mergers that will stifle competition like fiber from Google. Millions of voices can't be ignored. Pai is a wolf in sheep's clothing.
—YouWishYou Knew

It's going to take a wireless technology to break the cable companies' grip on home internet in America. As mentioned in the article, "The major costs in building a new ISP are in dealing with infrastructure buildout and local and state regulations." Many of those regulations are put in place to protect cable's monopoly. If a company with the deep of pockets of Google can't bring competition en masse, then there's little chance a new startup could. The author is right. Wireless

companies can't be allowed to merge with cable companies. The future is wireless, including for home internet. There needs to be competition.
—Draconian9054

Meanwhile, we pay far more for less speed than do those in many other countries.
—Waltzin Matilda

This is a tired meme. From the Q3 2016 Akamai "State of the Internet" report, the US has the fastest internet in the Americas, and its average internet speed is 12th globally, which is impressive when you consider a lot of the top 10 is made up of small/dense countries…. Americans pay around $13 more per month than Europeans (based on 2014 data). Of course, I'd love to pay less, but it's hardly "far more." And given the better cost of hardware, software, and availability of internet services in the U.S. versus Europe—and indeed the rest of the world—we have it better than most.
—JordanViray

Well, golly, maybe we should have government-run internet.
—TechSupport

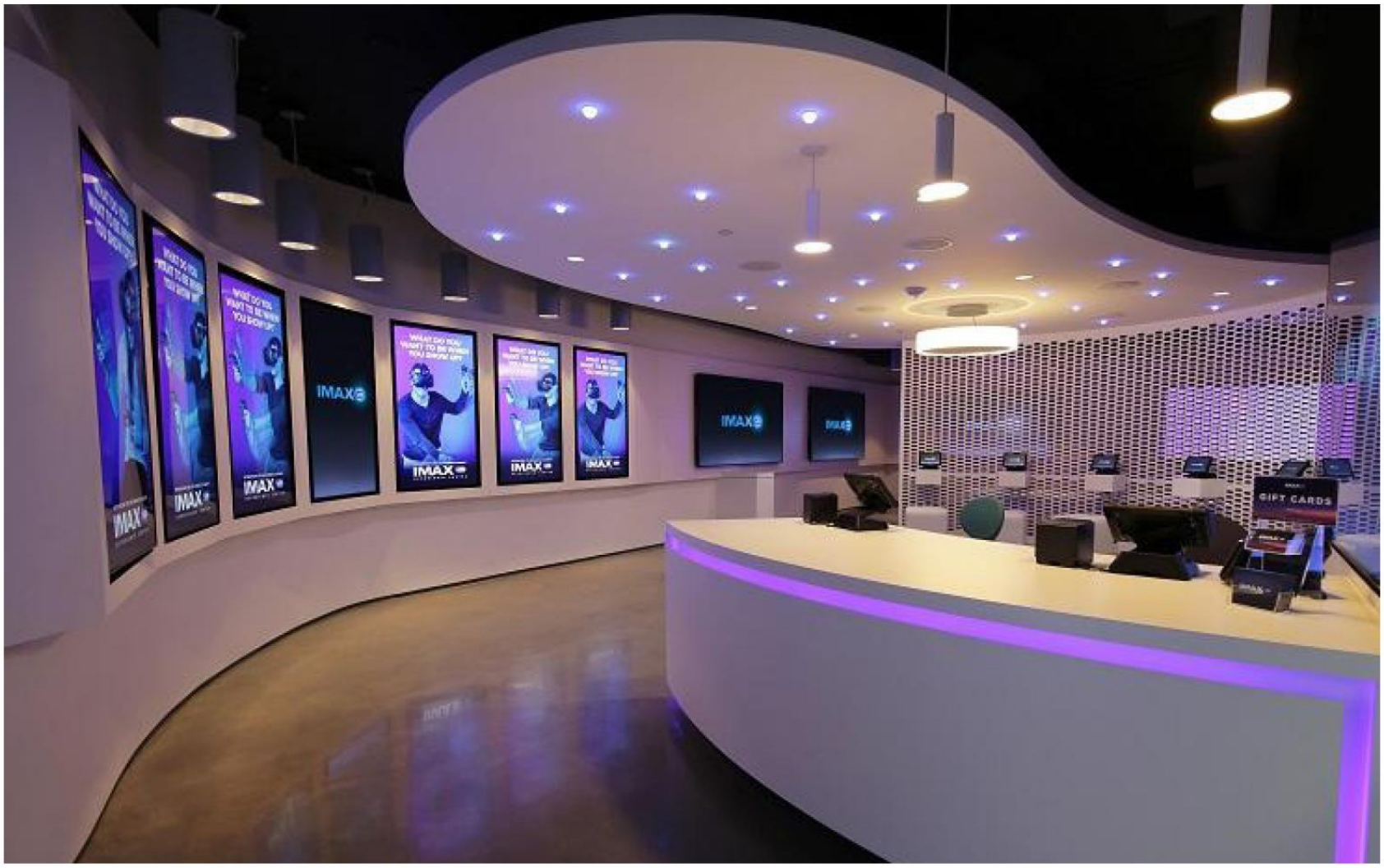
Maybe we should have more competition.
—Waltzin Matilda

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.

First Look at IMAX's VR Experience Centre

BY SOPHIA STUART



IMAX is going all in on virtual reality, with its first flagship consumer-facing IMAX VR Experience Centre opening its doors in Los Angeles earlier this year. Five more are planned for 2017 in locations including New York City, the U.K., and China, with an eye on Japan, the Middle East, and elsewhere in Western Europe.

PCMag checked out the LA space. The partnerships are stellar, and the content demos—which include flights of fantasy (a trip to Tatooine created by ILMxLABs), film-related experiences (*John Wick* from Sony), and VR showcases (Starbreeze, Survios, and Ubisoft)—are best of breed. But the execution is a bit odd. It looks far more futuristic in the marketing photos; in person, IMAX VR in LA looks like a home electronics showroom. There's also a pervasive refurbished-car chemical odor.

When you arrive, you pay at the reception desk; it's $7 to $10 for each VR experience, though IMAX is experimenting with bundled pricing too. Using a touch-screen display, you sign a waiver against injury, and get a pod number. A helper is at your pod where you strap on an HTC Vive for a timed experience; friends can sit in the pod and watch you fall flat on your face while you get your VR sea legs.

If the space is intended as a show-and-tell for industry executives and curious tourists after they've hung out at The Grove mall nearby, that makes more sense. Especially as the IMAX VR team is experimenting with different peripherals to give full-body haptic sensations, like the SubPac, and trying out new devices and VR titles as they get released. But CEO Richard Gelfond's vision is a consumer-entertainment destination.

The IMAX VR team is experimenting with different peripherals to give full-body haptic sensations, like the SubPac.

Perhaps they're missing a trick. Let's face it: No one really predicted the return of vinyl or the retro-vintage craze on social from Gen Y, Z, and whatever generation comes after them. If it really wants to get into the "teenagers hanging out playing games" business, perhaps IMAX VR could reinvent the arcade. Yes, complete with Pac-Man, Space Invaders, and pinball wizards, Coca Cola in bottles, Dance Dance Revolution, and pervasive EDM audio when they're not underneath a VR headset. Then maybe VR has a future as a consumer-entertainment-destination medium.

THE STARVR HEADSET
Game maker Starbreeze collaborated with Acer to build IMAX VR's headsets.

One group that doesn't seem to have reservations, however, are investors. Participants in a newly announced $50 million VR fund include Acer, CAA, China Media Capital, Enlight Media, The Raine Group, Studio City, and WPP. Technology innovation on the hardware front will come from partnerships with HTC, Starbreeze and its Star VR headsets, and Google.

POD PEOPLE
Your IMAX VR experience takes place in an assigned pod; your friends can join and watch you fall flat on your face while you get your VR sea legs.

The last one is the one to watch. IMAX has long prided itself on developing extraordinary image resolution and compression technologies, so a cinema-grade VR camera IMAX is developing with Google, due in 2018, will probably be fantastic.

And then there's Hollywood. Gelfond opened the LA event by name-dropping a few content partners to look for in the coming months, including Warner Brothers/Time Warner, Twentieth Century Fox, Metro-Goldwyn Mayer (MGM), Westfield Corporation, Bold Capital Partners, and Steven Spielberg as first-round investors in Dreamscape Immersive, "a ground-breaking technology" for which details are currently scant. The only Hollywood type on hand at the demo was David Ellison (son of Larry and brother of movie mogul Megan), who was on hand to demo Archangel from his company Skydance Interactive, which will go live in July.

IMAX can afford to go big or go home on VR. It's been in business since 1967, and Gelfond is a known risk-taker. With 1,145 IMAX theaters in 74 countries, the core business is secure; we'll just have to wait and see if people want to trade popcorn and stadium seating for VR headsets and immersive movie going.

Who Should Your Self-Driving Car Save in a Crash? You or Pedestrians?

BY TOM BRANT

More than 75 percent of participants in a recent study said that it would be more moral for a self-driving car to sacrifice one passenger rather than to kill 10 pedestrians. But most said they would not buy an autonomous vehicle if it were programmed to sacrifice its occupants.

The study, published in the journal Science, asked hundreds of people a series of questions about the ethics of autonomous vehicles. Among the findings were that participants did not think that the car should sacrifice its passenger when only one pedestrian could be saved, but their moral approval increased with the number of lives that could be saved.

“This is the classic signature of a social dilemma,” the study’s authors wrote, “in which everyone has a temptation to free-ride instead of adopting the behavior that would lead to the best global outcome.”

The researchers also asked participants about their attitudes toward legally enforcing utilitarian sacrifices. Most believed that machines have a greater requirement to perform sacrifices for the greater good than do humans. Finally, participants were much less likely to consider purchasing an autonomous vehicle if its safety algorithms were regulated by the government.

Most believed that machines have a greater requirement to perform sacrifices for the greater good than do humans.

The ethics of self-driving cars have been the subject of much debate recently among the industry and academics who study it, but this is perhaps the first academic study that has delved into how the public feels about self-driving car ethics.

“Figuring out how to build ethical autonomous machines is one of the thorniest challenges in artificial intelligence today,” the study’s authors wrote. “As we are about to endow millions of vehicles with autonomy, a serious consideration of algorithmic morality has never been more urgent.”

“For the time being, there seems to be no easy way to design algorithms that would reconcile moral values and personal self-interest,” they said.

Police Get Warrant for Entire Minnesota City's Google Searches

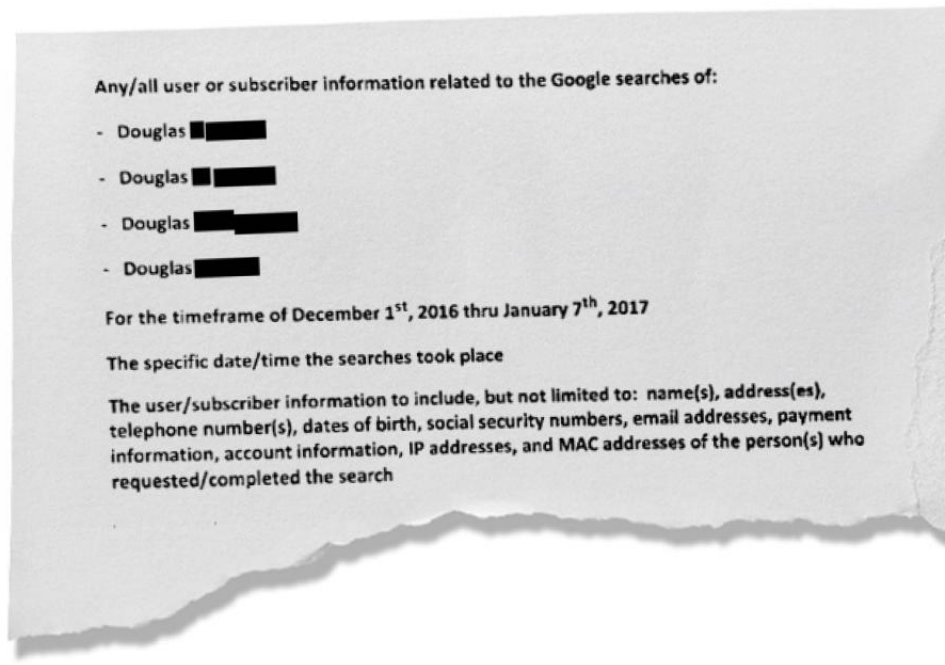
BY RYAN WHITWAM

People expect a certain degree of privacy online, but records of our movement across the internet are stored in various repositories. Police from the Minnesota city of Edina have obtained a wide-ranging court order that grants them access to a lot of it. The warrant — amazingly, approved by a judge in Hennepin county — instructs Google to make data belonging to anyone in the well-to-do suburb available to police.

Police in Edina, a city of 50,000 on the outskirts of Minneapolis, have been looking into a wire fraud case. The suspect was attempting to swipe $28,500 from a branch of Spire Credit Union using a fake passport, and investigators think they know how to narrow their list of suspects. They need to know who in Edina might have searched Google for "Douglas." There are four names (first and last) included in the order, but the last names are redacted.

According to the warrant granted on February 1st, a Google search for "Douglas [last name]" surfaces a photo that was used on the fraudulent passport. The police reason that the suspect conducted this search in order to find the photo (they didn't find the photo on Yahoo or Bing, but that doesn't mean it isn't there). Investigators want to know who in Edina performed that Google search between December 2016 and January 7th of this year. That's a small group that may contain the suspect.

The warrant requests the exact time and date of searches, but the police are after any and all data Google might have on anyone who completed this search. This includes names, addresses, phone numbers, dates of birth, Social Security numbers, email addresses, payment information, account details, IP addresses, and MAC addresses.


Any/all user or subscriber information related to the Google searches of:

- Douglas [redacted]
- Douglas [redacted]
- Douglas [redacted]
- Douglas [redacted]

For the timeframe of December 1st, 2016 thru January 7th, 2017

The specific date/time the searches took place

The user/subscriber information to include, but not limited to: name(s), address(es), telephone number(s), dates of birth, social security numbers, email addresses, payment information, account information, IP addresses, and MAC addresses of the person(s) who requested/completed the search

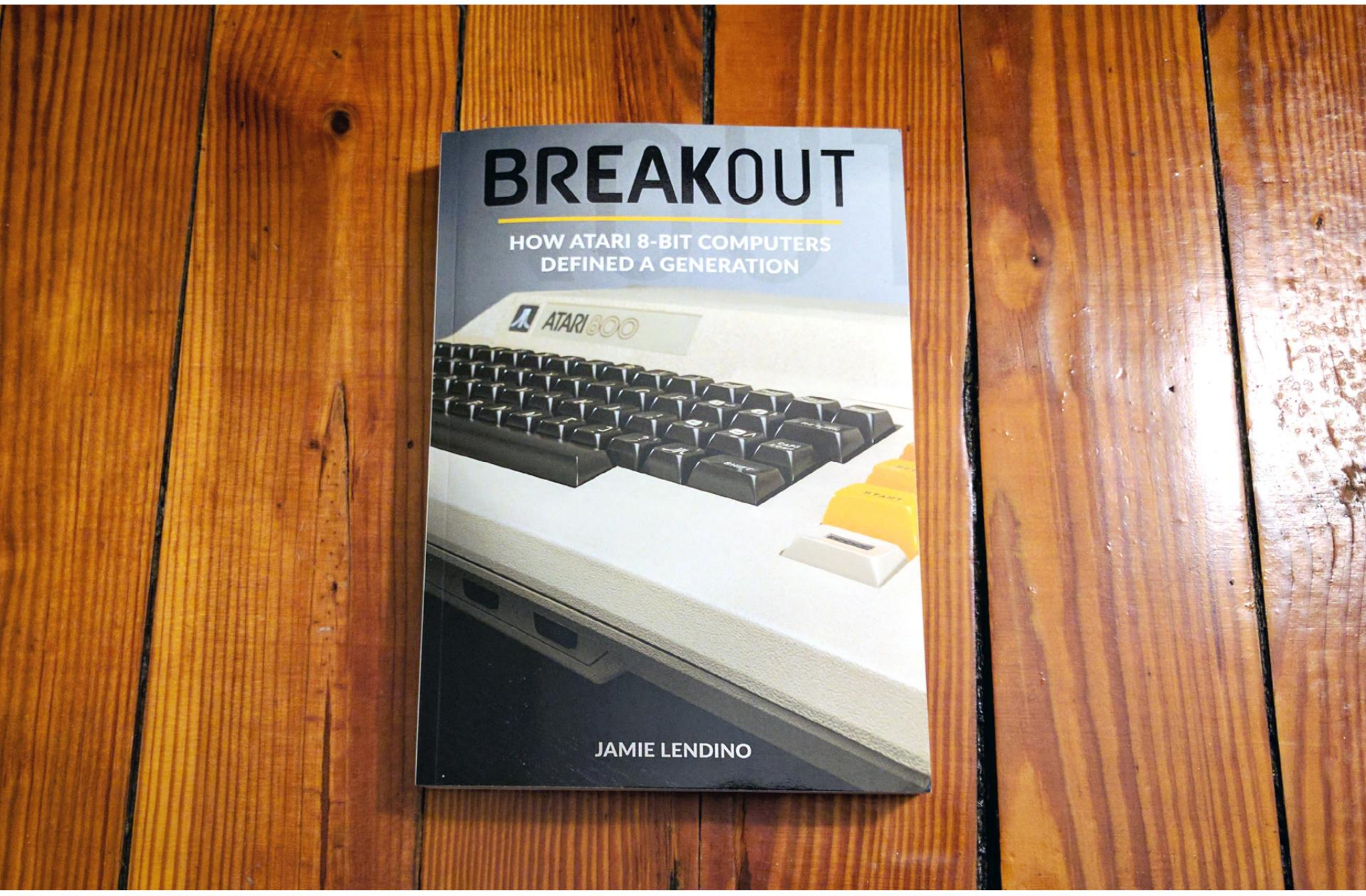
It's unknown whether Google will comply with the warrant. It has regularly protested orders it feels are burdensome; indeed, it rejected a previous administrative subpoena on this case.

Maybe Google won't have to go that route; it may be unable to provide the requested data. For one thing, the police want data from all searches within Edina, but search records aren't necessarily that precise. Someone could have an address in Edina attached to their account but not have been anywhere near the city when doing this search. Likewise, someone could have performed the search while passing through Edina and have no further association with the city. Are both those people fair game? And what if the suspect wasn't anywhere near Edina when putting the scheme together?

This seems like a brute-force attempt to unmask the perpetrator that ignores the reality of the internet. There's no guarantee this person used Google. Even if they did, the search term used to find the photo could have been very different than the ones in the warrant. Considering that law enforcement may continue to cast increasingly wide nets like this, you might want to shop for a good VPN.

Atari 8-bit Fans: This Is Your Next Read

BY JAMIE LENDINO



I've got a shelf full of computer history books, many of which I love and have reread several times. But I wanted to write one that focused on the first real computer I grew up with, the one that eventually led me to the tech industry and journalism: the Atari 800.

We've covered vintage computing many times before on ExtremeTech (PCMag's sister site). I wrote a retro gaming feature back in 2010, and a 2017 rewrite of that is in the works. But I've always wanted to do a deep dive on Atari's 8-bit computer, its peripherals, and most important, its games.

It was an astounding machine. It was the first real gaming PC, one with graphics coprocessors and hardware sprite animation. It blew the contemporary competition out of the water, and was even superior in some respects to the Commodore 64 — also a great early computer, but one that lacked some of the Atari 8-bit's innovations despite coming out three years later.

Breakout: How Atari 8-Bit Computers Defined a Generation looks back at how the Atari 8-bit lineup came to be, how it was designed, and its entire 13-year production run, from the original 400/800 through the XL and XE lines. The book also details over 100 of the best games available for the platform and what makes them significant. And it covers today as well, with a roundup of hardware and software mods made by enterprising Atari fans over the past several decades, along with tips on buying and collecting machines, peripherals, and software now. I also go over the most vibrant communities you'll find discussing the Atari 8-bit today.

More than anything, though, I wanted this book to be a love letter the Atari 800—to all its great features, games, software, programming capabilities, and even foibles (usually self-inflicted by Atari management somewhere along the way). Despite its flaws, I couldn't imagine growing up without it.

After two years of sweat and toil, the book is finally done, and it's on sale now. *Breakout: How Atari 8-Bit Computers Defined a Generation* is published by Ziff Davis LLC (PCMag and ExtremeTech's parent company). You can buy it in paperback and Kindle versions.

Jamie Lendino (@jlendino) is the Editor-in-Chief of ExtremeTech.com. Previously, he managed the consumer electronics and mobile teams at PCMag.com. He's written for the print, Web, and digital versions of PCMag for over 10 years and has frequently covered the retro gaming community in both places.

What We Love Most This Month

BY PCMAG STAFF

BISSEL BARKBATH

Described as "the next generation of dog bathing," the portable system makes it easier to clean your four-legged friend virtually anywhere, anytime. It promises to clean hefty hounds with only 48 ounces of water, stored in an attached container. Specially designed nozzles, adjustable for long- and short-haired dogs, reach under the fur to shampoo the skin, while a soft suction pulls dirt and water away into a separate tank.

Starts at $109.00, www.indiegogo.com

ECOCAPSULE

Are you fan of tiny houses? How about a tiny smart house—that's portable? The self-sufficient EcoCapsule is powered by solar and wind energy and transforms rainwater into drinking water. You can roll, lift, or ship it wherever you like (with permission from landowners, of course). As for its "smart" features, the EcoCapsult has built-in "smart home system and sensors," a tablet system interface, and data network connectivity.

About $86,000, www.ecocapsule.sk

HUSHME

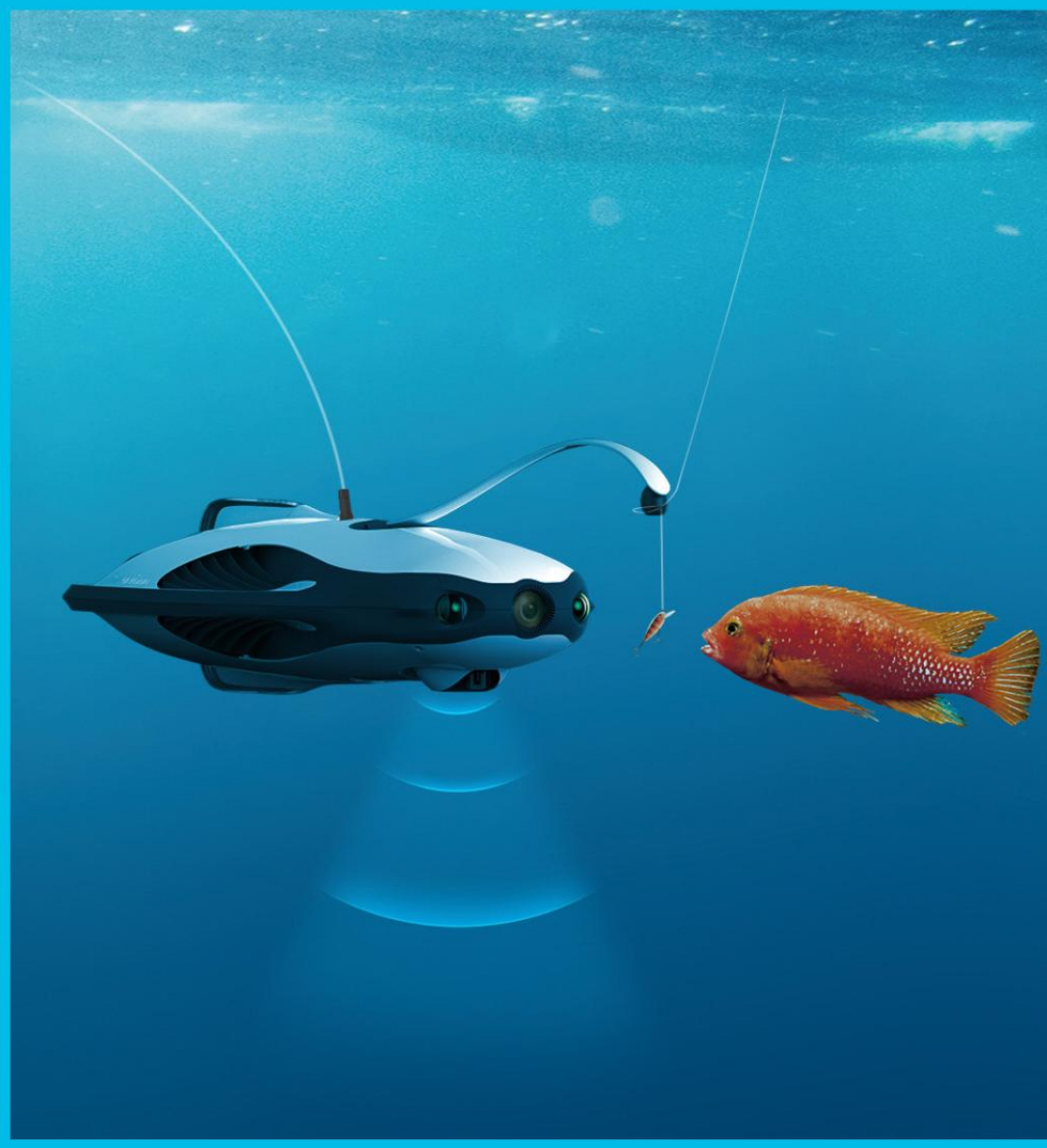
Hushme is "a personal acoustic device that protects speech privacy in open-space environments." Simply insert the attached Bluetooth earbuds, close the device around your face, and start talking. A built-in microphone makes Hushme entirely hands-free. The device uses passive voice suppression and active voice-masking technology—that is, thick padding that deadens your voice. And an accompanying mobile app lets you pipe sounds through external speakers. Expect it to cost $200 or less when it's ready for the world.

gethushme.com

POWERVISION POWERRAY

Reinforcing the notion that there's tech out there for everyone, the PowerRay, an underwater drone, promises to "revolutionize freshwater, saltwater, or ice fishing." The drone (which can dive as deep as 98 feet) can be used alone for fishermen (or underwater enthusiasts—why not?) to view everything under the sea (via Wi-Fi) but also has an optional add-on, FishFinder, which uses sonar to find fish, send 4K images to the user, and measure various underwater data. The company even offers a VR Goggle add-on for a truly, uh, immersive experience.

Price TBA, www.powervision.me



MATTEL NABI ARISTOTLE

It's a voice-activated, AI-driven, smart baby monitor—for now. Aristotle has a built-in LED multiple-color lighting system and is bundled with a Wi-Fi camera to help you keep an eye on your infant via your smart device. You can also soothe baby remotely with a nightlight and lullabies and receive notifications triggered by Mattel's "cry detection technology." And the company plans to extend the platform to include learning features, so it will someday be able to "grow with your child."

$349.99, www.nabitablet.com

Oh God, They're Already Talking About 6G

Please do not let this happen. I mean, it has to happen. Network technologies take years to develop, and are often planned a decade in advance. But 5G isn't even baked yet.

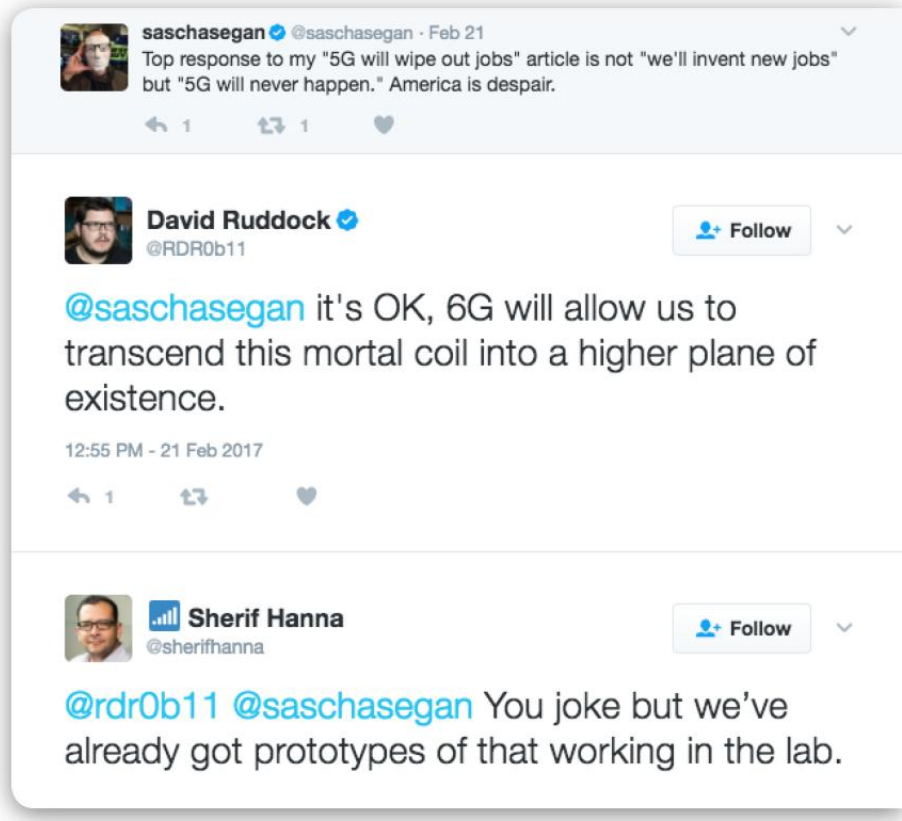
The 5G radio network won't be properly specified until October 2018, and there's a whole 5G standards plan called "IMT-2020," which won't be rolled out until 2020. We're expecting 5G networks in the United States to launch between 2019 and 2024.

Yes, I know AT&T and Verizon are deploying "5G" fixed wireless this year; it's best to think of that as hopefully-forward-compatible pre-5G. But apparently, 5G is too boring now.

"Eventually we'll get to 6G. Yes, we're thinking about that a little bit," Matt Grob, Qualcomm's CTO, told me recently.

And then this happened. I know Sherif Hanna really well (he's one of Qualcomm's modem marketing experts), so he's sort of joking, but he's also sort of not.

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.



What is "6G?" Nobody knows, not even Sherif. There is no 3GPP 6G calendar, because 6G wouldn't even get specified until the 2020s, at which point it could involve technologies that haven't even been invented yet. Quantum computing? Li-Fi? Wormholes? It's anyone's guess.

Obviously, people are going to want to know about 6G, the way people want to know about the iPhone 10. Some of those people are investors who want to know where to make the long bets. Some of these people want their own technologies included. Some of them are just into the future.

Even 4G LTE still has a long glide path, with at least 10 years of life remaining. But 6G? It's good to know that people are planning for the future, but let's not get too far ahead of ourselves.

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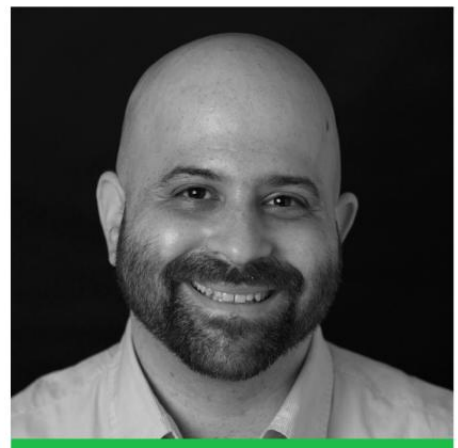
Do Robots and AI Deserve Rights?



Evan Dashevsky, a features editor for *PC Magazine*, has been writing about tech since 2010 for such publications as *PC World*, TechHive, ExtremeTech, and Digital Times.

When it comes to robot-human relations, the conversation typically centers on the welfare of the sentient. Science fiction paints us as petrified by our own creations. Fears of a bot planet have influenced everything from Asimov's "Laws of Robotics" to HAL 9000's homicidal impulses to Skynet's global genocide.

These human-centric anxieties are understandable. But as bots and bits gain skills and personalities, should they be afforded some form of protection from us? It's a question people are seriously starting to ponder.

Last month, the European Parliament's legal affairs committee issued a report on the use and creation of robots and artificial intelligence (AI). It recommended creating a form of "electronic personhood" that would afford rights and responsibilities to the most advanced forms of AI.

Many surely bristle at the concept of "rights" being awarded to software. While AI is increasingly capable of performing specific tasks, it's not complex enough to have an opinion on how it is treated. It's completely reasonable to ask if robo-rights is even a debate worth having right now. Indeed, humanity has far more immediate concerns on its plate, but the era of personhood-

worthy bots isn't as far off into the crazy super future as you might think.

While the human-like AI long promised by science fiction has thus far failed to materialize, researchers around the globe are hard at work turning it into reality. I don't expect to see anything resembling Star Trek's Data or Rosie from The Jetsons in the immediate future, but I wouldn't be surprised to meet them in my lifetime: History has shown that technology—particularly information technology—doesn't just improve incrementally, it rockets forward exponentially. Consider some of modern AI's very impressive feats and try to imagine what it will be able to accomplish in 10, 20, or 30 years.

I can't say for sure what robots or AI of the future will be able to do. But I can say that if robot ethics doesn't rise to the level of a serious concern for society, then—at the very least—robot etiquette should.

The average reasonably connected person in the developed world has probably interacted with modern AI in the form of increasingly capable chatbots or digital assistants (Alexa, Siri, Cortana, and so on). But most AI remains hidden below the virtual surface.

A subfield of AI known as "machine learning" is particularly promising—this discipline is interested in creating algorithms that improve at tasks over time to come to original conclusions. There are even algorithms that are able to rewrite their own source code in limited scenarios. Taken together, the most advanced algorithms could be said to form a unique identity.

Evan Dashevsky

The question then becomes: Will we ever reach a point where this uniqueness rises to the level of being a personality worthy of protection? Few would argue that personhood should be awarded to, say, your smartphone's OS. But your device (including all its the networked cloud resources) has a completely unique character unlike any other piece of software. Your phone remembers the Wi-Fi sources it routinely connects to, it learns your commuting habits based on GPS, and even uses algorithms to learn the nuances of your voice commands (it's how Siri and Google get better at understanding your voice over time).

We can delete all or part of this data and not feel any emotional response. However, we will probably experience a deeper form of attachment if this data takes a physical, touchable form. Humans are inclined to relate to physical objects, no matter how "dumb" they are—people personify stuffed animals, name their cars, or feel bad when their Roomba gets stuck in a corner. It follows that it's far less emotionally taxing to "pull the plug" on a text-based chatbot, no matter how advanced, than it would be on a machine with a discernable face.

“Humans are inclined to relate to physical objects, no matter how “dumb” they are.”

Recently, I interviewed Dr. Kate Darling, a robot ethicist from MIT's Media Lab as part of our streaming interview series and podcast, The Convo (video above). While Darling isn't quite on board with electronic personhood (at least not yet), she is interested in how humans interact with their technology and believes our choices are ultimately a reflection of us.

“The one thing that does separate robots from other machines is that we tend to treat them like

they're alive," explains Darling. "I think that there's a Kantian philosophical argument to be made... Kant's argument for animal rights was always about us and not about the animals. Kant didn't give a shit about animals. He thought, 'If we're cruel to animals, that makes us cruel humans.' And I think that applies to robots that are designed in a lifelike way and we treat like living things. We need to ask what does it do to us to be cruel to these things from a very practical standpoint—and we don't know the answer to this—but it might literally turn us into crueler humans if we get used to certain behaviors with these lifelike robots."

"We need to ask what does it do to us to be cruel to these things from a very practical standpoint."

While science fiction has gotten a lot wrong in its predictions of what the robo-future would look like, it does provide a laboratory of the imagination. Would you rather live in, say, a Westworld universe filled with humans who feel free to rape and maim the park's mechanical inhabitants, or on the deck of Star Trek: The Next Generation, where advanced robots are treated as equals? The humans of one world seem a lot more welcoming than the other, don't they?

So, when it comes to the question of how we interact with our creations, maybe we should be less concerned with determining their personhood than we are with defining our humanity.

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Tim Bajarin

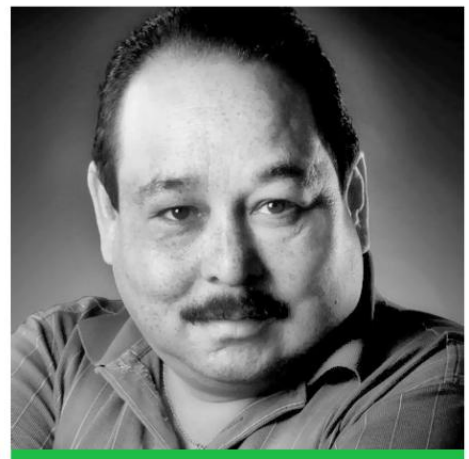
Apple's TV Plans Are Still Alive, But Not How You Think

In his 2011 biography of Steve Jobs, Walter Isaacson wrote that the Apple co-founder "very much wanted to do for television sets what he had done for computers, music players, and phones: make them simple and elegant." Jobs told Isaacson that he had "finally cracked" the key to creating an easy-to-use smart TV that synced with all your devices and the cloud; "the simplest user interface you could imagine."

The tech media took Jobs's comment at face value and speculated that Apple would make a TV. To be fair, Jobs didn't help things by using using "TV" in the physical sense instead of metaphorically, which I believe was his intent.

While there have been reports that Apple at one point looked at doing a TV, my sources say the idea never really got any serious support. A physical TV to Apple is just another screen, so doing one with its logo on it made no sense at all.

Six years later, one has to realize that ultimately Apple is a software and UI company first and a hardware company second. Don't get me wrong: Hardware is critical to Apple, but it is seen just as a vehicle for delivering its software, UI, and



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

services. When the iPhone was introduced, Apple SVP of Marketing Phil Schiller showed me the original iPhone before the launch and put it on the table in off mode and asked me what I saw. I said I saw a block of metal with a glass screen. “It is a blank piece of glass for them to deliver their exciting new software,” he responded.

That conversation has helped me understand Apple much better and has shaped my thinking about the company since 2007. Schiller’s insistence that the iPhone is a blank canvas is at the heart of Cupertino’s raison d’être. Jobs understood that from the time he introduced the Mac and carried that over to every product Apple has introduced since then.

The second thing to understand is that all of Apple’s software innovations are built around a platform of an OS, a UI, and a set of services that are then delivered on “blank screens” such as a PC, tablet, or even a TV. This concept of platform is what drives Apple, and all of its innovation stems from this core value proposition.

Now look at Apple TV. When it was introduced, it was called a hobby. But Apple has since sold millions. It’s a good streaming device, but it also allowed Cupertino to develop the tvOS platform to disrupt TV. While Jobs possibly had an actual TV in mind when he spoke with Isaacson, his real emphasis was not on a physical box but the software.

This vision of Apple disrupting TV was made clear at the the recent Recode Media conference, when Apple SVP Eddy Cue called the Apple TV

platform disruptive because it delivered video on all Apple devices via an easy UI (Siri) all synced to iCloud.

As my friend Benedict Evans of Andreesen Horwitz recently tweeted, "'Apple failed at TV' makes me laugh. They've sold 1.5 billion TVs, meaning iPhones and iPads.

Up next: original content. And while other video distributors like Comcast and Amazon allow for playback on various devices, they do not have Apple's robust app and developer ecosystem. Eventually, Apple will integrate many more features and add-on content and interactions through the Apple tvOS, something that cannot be done by pure video content distributors.

"Apple will integrate many more features and add-on content and interactions through the Apple tvOS."

This phase of making Apple TV even more disruptive is still in its early stages but it is clear, at least to me, that Jobs's vision of creating a richer TV experience will change the overall TV experience in time.

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Nintendo Switch Offers New Play Flexibility

Nintendo Switch
$299.99
●●●●○

PC MAGAZINE EDITORS' CHOICE

Nintendo is taking a bold step with its latest game system. The Switch is effectively a total replacement for the Nintendo Wii U console, but it also can be used as a handheld, like the 3DS. Between its 6-inch tablet body and its detachable, wireless Joy-Con controllers, Nintendo is exploring some very interesting concepts with this device. Instead of directly facing off against the PlayStation 4 and other systems, the Switch represents a whole new path in gaming and earns our Editors' Choice for its execution.

THE TABLET

The Nintendo Switch includes the tablet-like system, left and right Joy-Con controllers, the Joy-Con grip to hold the controllers like a conventional gamepad, two Joy-Con wrist straps, the Switch Dock, a USB-C wall adapter, and an HDMI cable. No games are bundled with the Switch.

The Switch itself looks like a plain, slightly chunky black plastic tablet. It measures 4.0 by 6.8 by 0.5 inches (HWD) and weighs 10.6 ounces, making it slightly thicker and only a bit lighter than the Amazon Fire tablet (7.5 by 4.5 by 0.4 inches, 11 ounces). The thickness and weight work to the Switch's advantage, since it makes the tablet feel much more solid both on its own and with the Joy-Con controllers attached.

Metal rails on the left and right securely hold the Joy-Cons in place, and their edges are rounded enough that you can comfortably hold just the Switch without any connection points poking your hand. The system is available only in black, but you can choose between two bundles: one with two dark gray Joy-Con controllers and one with a blue Joy-Con and an orange Joy-Con.

Nintendo Switch

PROS Attractive, innovative design. Solid build quality. Joy-Cons feel comfortable to use in multiple configurations.

CONS Short battery life. Flimsy kickstand.

GAMING YOUR WAY
The Nintendo Switch can be used both as a portable game system and as a home game console.

Atop the Switch is a small power button and a volume rocker toward the left and a 3.5mm headphone jack and game card slot to the right. Switch games look like slightly thicker SD cards or slightly longer 3DS cards. The bottom of the Switch has a USB-C port for charging and connecting to the Switch Dock.

On the back panel is a pair of speakers that can get surprisingly loud, along with a small plastic kickstand that flips out of the left side. The kickstand lets you stand the Switch up on a table and reveals the microSD card slot behind it. Unfortunately, the kickstand feels flimsy and unstable. You get 32GB of internal storage with support for microSD cards up to 2TB (though 256GB are the largest cards currently available).

A LEG TO STAND ON
The kickstand on the back panel lets you stand the Switch up on a table and reveals the microSD card slot behind it.

DISPLAY AND DOCK

The Switch is equipped with a 6-inch, 720p capacitive touch screen, the most advanced ever put on a Nintendo device. The 3DS's screen shows only a 400-by-240 picture (per eye, for the handheld's 3D effect), which means the Switch's 1,280-by-720 screen has nine times as many pixels. It's a bright, sharp screen, with excellent colors even when viewing it off-angle. It isn't as crisp or as high-res as the 1080p and Quad HD screens of many modern smartphones and tablets, but for a Nintendo gaming device, it's impressive.

"The Nintendo Switch represents a whole new path in gaming and earns our Editors' Choice for its execution."

You can charge the Switch by plugging the included USB-C wall adapter directly into the tablet, but you'll more likely plug the adapter into the included Switch Dock and drop the Switch into the dock when you want to either charge the system or play with it on your TV. The Switch Dock is a block-shaped piece of black plastic measuring 4.0 by 6.8 by 1.9 inches that charges the Switch, provides an HDMI output so you can connect it to your TV and play games in 1080p on a big screen, and includes three USB 3.0 ports for storage and accessories. The Switch drops into the dock easily and switches the system to output over HDMI as soon as it connects.

JOY-CONS

The included Joy-Cons are a pair of wireless controllers that can be used with the Switch in different configurations. Each Joy-Con measures 4.0 by 1.4 by 0.5 inches (not including the analog stick or shoulder trigger protrusions) and looks like half of a conventional gamepad built into a rounded one-handed grip with a large flat side equipped with an attachment rail.

Each of the Joy-Cons feature half the controls found on a standard gamepad, including an analog stick, four face buttons that double as a digital direction pad, and two shoulder buttons you can easily reach when holding it in one hand, plus left and right shoulder buttons, a pairing button, and four indicator lights hidden on the attachment rail. A mechanical release sits near each Joy-Con's rail; accessories stay solidly and securely connected once they click into place, and you can remove them only by pressing the release and then sliding the Joy-Con upward.

BUNDLE OF JOY
The included Joy-Cons are a pair of wireless controllers that can be used with the Switch in different configurations.

The Joy-Cons aren't symmetrical, and the left and right versions have a few different controls and features. The left Joy-Con has a minus button for accessing menus near the top, and a capture button that takes screenshots just below the face buttons. The right Joy-Con has a plus button for pausing games and accessing menus near the top, and a home button just below the right analog stick. The right Joy-Con has some more-advanced internal sensors as well, including an infrared camera and an NFC chip for reading Amiibos.

Typically the left and right Joy-Cons rest in your left and right hands, letting you access the analog sticks and face buttons easily with your thumbs. You can also turn a Joy-Con sideways with the attachment rail facing away from you and use it as a simpler controller. This enables two-player gaming without the need to buy more Joy-Cons.

The asymmetrical design of the Joy-Cons become apparent in this configuration, because the left features the analog stick on the far left side and the face buttons in the middle, while the right features the face buttons on the far right side and the analog stick in the middle. Whether the Joy-Cons are awkward to use in this position is a matter of hand size and personal taste—I didn't mind either after a few moments to get used to the different spacing of the controls.

GRIPS AND STRAPS

The included Joy-Con wrist straps are simple plastic rails that slide over each Joy-Con, providing security and placing larger, easier-to-press mechanical shoulder buttons over the tiny shoulder buttons on the naked controller.

The Joy-Con grip is a plastic shell you can insert the two Joy-Cons into to use them as a conventional gamepad. With the Joy-Cons attached, it feels like a slightly lighter, smaller version of the standard Xbox controller. The grip has four light tunnels for each attached Joy-Con to indicate their connection status—the status lights on the rails of each Joy-Con shines through the tunnels to the front of the grip.

The grip itself is just a plastic shell and doesn't provide power to the Joy-Cons; for longer battery life, you'll need the optional charging grip ($30), which looks very similar to the Joy-Con grip but has an internal battery to keep the controllers charged when in use.

> **Even with the short battery life, I really liked the Nintendo Switch's portable mode.**

PORTABLE OR HOME CONSOLE

Switching between Switch configurations is easy. The system automatically turns the screen on when you remove it from the Switch Dock and outputs video over HDMI within seconds of inserting it in the dock. The Joy-Cons wirelessly connect to the Switch quickly and pair automatically by directly sliding onto the tablet.

As a handheld game system, the Switch feels large but comfortable. It's thicker than a tablet but much thinner than the Wii U gamepad and far more natural to hold. It's 9.4 inches wide with both Joy-Cons attached, making it too cumbersome to easily put in a pocket. But it can fit in most bags without a problem, especially if you detach the Joy-Cons first.

Nintendo says the Switch's battery can last between 3 and 6.5 hours depending on what you play, which is a fairly weak showing for a gaming handheld (the New Nintendo 3DS can easily manage 5 to 6 hours per charge). But because the Switch charges with USB-C instead of a proprietary Nintendo connector, you can keep it topped up with an external battery pack and a USB-C cable. The Joy-Cons are rated to last up to 20 hours per charge.

PLAYING YOUR CARDS RIGHT
Switch game cards look like slightly thicker SD cards or slightly longer 3DS cards. The game card slot is behind a door on the top of the system. The Legend of Zelda: Breath of the Wild and 1, 2, Switch are a couple of currently available games.

Even with the short battery life, I really liked the Switch's portable mode. It's incredibly convenient to pick up the system and go without needing to stop your game. It's just as satisfying to get home after playing on the subway, dock the Switch, and sit back with it like a home console. I often found myself in the middle of a quest in The Legend of Zelda: Breath of the Wild when a favorite show was coming on, so I simply attached the Joy-Cons and played on the couch while half-watching TV. This is a flexibility we simply haven't seen in a game system before.

Nintendo hasn't announced plans for a virtual-reality accessory or system, such as the Sony PlayStation VR for the PS4, to work with the Switch.

GAMEPLAY

I played Breath of the Wild on the Switch both in a handheld configuration and on a 65-inch 4K TV, and the game nicely shows off the system's power in both cases. Though Nintendo has made no claims about the Switch's graphical capabilities in comparison with the PlayStation 4 or the Xbox One, it's clearly more powerful than the Wii U. Connected to a TV and outputting at 1080p, the game's stylized graphics look sharp and eye-catching. They're just as good on the smaller 720p screen of the Switch itself.

The details and draw distance in Breath of the Wild far outshine those of The Legend of Zelda: Wind Waker HD and The Legend of Zelda: Twilight Princess HD, and the game features more impressive models and textures. The graphics stutter slightly in large outdoor scenes with lots of individually modeled waving grass, but generally it's very smooth.

IN THE DOCK
The Switch drops into its dock easily and switches the system to output over HDMI as soon as it connects.

Breath of the Wild is an open-world adventure, incorporating elements of both the Legend of Zelda series and Western open-world games such as Metal Gear Solid V: The Phantom Pain. Not only is it fun to play, it's easily the best-looking Zelda game yet.

The Joy-Cons are fun to use in all configurations. I spent time with them connected to the system, plugged into the Joy-Con grip, and held in each hand with nothing connecting them. All three methods are responsive and surprisingly comfortable. Motion detection feels very accurate, and I could easily aim my bow by tilting the right controller.

NINTENDO ESHOP AND GAMES

Nintendo has been quiet about online features as well as its eShop for digitally distributed games. Online multiplayer will be possible for free to start, but it will become a paid service this fall, when communication features incorporating a mobile app will be launched. Besides the presence of these features and the app, Nintendo has given no specifics.

At the Switch's launch, a small handful of games will be available. First-party Nintendo titles include the aforementioned Breath of the Wild, as well as the motion-sensing mini-game collection 1,-2,-Switch, Just Dance 2017, Skylanders Imaginators, and Super Bomberman R. The Binding of Isaac: Afterbirth+ will come out a few weeks after launch, and Mario Kart 8 Deluxe and Puyo Puyo Tetris should appear by the end of April.

The Switch's eShop is available at launch for native Switch games, but at this writing, Nintendo hadn't announced any details regarding its classic Virtual Console library on the system.

CONCLUSION

The Switch is the Wii U's clear replacement, and Nintendo fans should consider it based on its merits. Nintendo plans to continue supporting the 3DS, and the Switch's battery life limits its use as a purely portable system compared with the 3DS. The option to use it as both is extremely novel, though. The Switch also taps into the family gaming market like the Nintendo Wii did, with the two included Joy-Con controllers allowing two-player same-room gaming out of the box.

The Switch appears to be a valid alternative to the PlayStation 4 and Xbox One, and though its power can't currently be directly compared with those systems, it certainly works well as a home game console, if Breath of the Wild is any indication. The PS4 and Xbox One have been around for a few years and have very large libraries, including many cross-platform AAA titles, and for the time being the Switch appears to be getting few direct ports of games available elsewhere. We'll see how the selections compare as the Switch library expands over the coming months.

“The Switch is the Wii U's clear replacement, and Nintendo fans should consider it based on its merits.”

The Nintendo Switch is a remarkably ambitious, clever game-system concept that manages to live up to its promise of convenient switching between home console and gaming handheld. The Joy-Cons are clever modular controllers that let the system work in a variety of ways, and the Switch itself has enough graphical power to run the best-looking Zelda game yet. The sheer number of options you have for playing are remarkable, and even with the relatively weak battery life, just the ability to take the system anywhere without worrying about wires is one of the most useful additions we've seen to a home game system yet.

We'll have to see how the Switch library develops and just how much power developers can wrangle out of the tablet. But based purely on its own design, flexibility, and ease of use, the Nintendo Switch is a fantastic device. It earns our Editors' Choice for its functionality both in the dock and in your hands.

The ability to take the system anywhere without wires is one of the most useful additions we've seen to a home game system.

WILL GREENWALD

Sony Alpha 6500 Delivers Supurb Image Quality

PC MAGAZINE EDITORS' CHOICE

The Sony Alpha 6500 packs the same stellar 24MP APS-C image sensor, hybrid focus system, and 11.1fps capture rate as the Alpha 6300, and adds in-body image stabilization and a touch screen to the mix. It's an excellent performer, but it lacks some of the features you'd expect in a pro-grade camera—including dual card slots and the ability to add a vertical shooting grip. In every other way, though, it's a solid mirrorless model and a strong option for shooting fast-moving action and sports. It's not our favorite camera in this category—that nod goes to our Editors' Choice Fujifilm X-T2—but it's a strong runner-up.

Sony Alpha 6500

$1,398.00, body only

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DESIGN

The Alpha 6500 maintains a small form factor, a boon for photographers who like to travel or hike with a lightweight kit. It measures 2.6 by 4.7 by 2.1 inches (HWD) and weighs just about a pound without a lens attached. It's smaller than the Olympus OM-D E-M1 Mark II (3.6 by 5.3 by 2.7 inches, 1.3 pounds), and doesn't give you the option of adding a vertical shooting grip like you get with the E-M1 and Fuji X-T2.

The camera is one of the rare mirrorless models to incorporate both a pop-up flash and EVF in its design. It also has a hot shoe, useful for attaching an external flash, microphone, or wireless trigger. It's only available in a matte black finish; Sony offers its entry-level Alpha 6000 in multiple colors, but the midrange Alpha 6300 is available in black only, so I wouldn't expect the 6500 to roll out in any other color variations in the future.

Like the Alpha 6300, the 6500 is protected against dust and moisture, but the sealing is completed only when you mount a full-frame FE lens. This requires you to use lenses that are generally larger, heavier, and more expensive than standard APS-C E lenses in order to confidently use the system in inclement weather. We had an issue with our review sample—after getting it a bit wet for a video shoot, the rear LCD stopped working. A Sony technician diagnosed the issue as a short circuit caused by water seeping into the LCD. He said the touch-screen LCD used on Alpha 6500 isn't as perfectly sealed as other displays without touch support. I ran some water over a second review sample and it continued to work without issue—but be aware that the Alpha 6500's sealing may not be as robust as competing models such as the E-M1 Mark II and X-T2.

Sony Alpha 6500

PROS Compact body. 11.1fps burst shooting. Large buffer. Tilting touchscreen LCD. Crisp 120fps EVF. In-body image stabilization. Excellent image quality. Integrated flash. Wi-Fi with NFC. 4K video and 120fps 1080p.

CONS Dense menu system. Some add-on apps must be purchased. No external charger included. Battery life

SELFLESS SHOOTING
The Alpha 6300's rear LCD tilts up or down, but it doesn't face forward for selfies.

There's no room on the front of the camera for controls, aside from the lens release button. On the top plate is the EVF, hot shoe, and pop-up flash, but there's also room for a Mode dial, Control dial, and programmable C1 and C2 buttons. The power switch and shutter release sit atop the handgrip.

Controls on the back of the camera include a mechanical release that raises the pop-up flash, a dual-function button that changes between AF/MF control and Autoexposure Lock (AEL), depending on the position of its surrounding toggle switch, and a Menu button. To the right of the LCD is the rear control dial and Fn, Play, and Delete buttons. The dial has four directional presses—Display, ISO, EV Compensation, and Drive—and a center button. The Record button is located on the side of the rear thumb rest.

The 6500 is protected against dust and moisture, but the sealing is completed only when you mount a full-frame FE lens.

UP ON TOP
The Sony Alpha 6500 fits the electronic viewfinder (EVF), hot shoe, pop-up flash, Mode dial, Control dial, and C1 and C2 buttons.

Pressing Fn launches an on-screen bank of controls, including focus and metering settings, drive mode, flash power controls, and JPG output options. The bank can be customized to suit your needs, which is a good thing as the Alpha 6500 has a rather dense menu system with dozens of pages of options and settings. You'll want to configure the camera to give you ready access to the settings you use most often.

The rear 3-inch display boasts a 921k-dot resolution, typical for the Alpha 6000 family. It's sharp and bright, and it's mounted on a hinge that can tilt up and down—but not all the way forward for selfies. The display supports touch input, but I found the response to be a bit laggy. You can tap an area to set the focus point, but some pressure is required to make it work—light presses often don't register. When moving the focus point, the camera doesn't reacquire focus immediately: You need to to half-press the shutter to drive the lens and refocus.

It's a little clunky in practice, certainly not as elegant as competing models such as the E-M1 Mark II and Canon EOS M5, which offer much smoother touch operation. I do like the ability to cancel touch focus by pressing the button at the center of the rear dial at any time—that's a big plus.

You can use the touch function to set the focus point when you're using the EVF and the rear screen is dark by sliding your finger across it. By default, only the right half of the screen is active, but if you're a left-eyed photographer, you can turn on the entire screen to set focus using your left thumb. You can cancel it and return to a wider focus area using the center button.

The EVF itself is excellent. It's large, with a 0.7x magnification rating, larger than the 0.65x finder used by the E-M1 Mark II but slightly smaller than the 0.77x EVF in the Fuji X-T2. It refreshes quite quickly—you can set it for 60 or 120fps operation—which is helpful for tracking moving action.

WI-FI, APPS, AND CONNECTIONS

The Alpha 6500 features integrated Wi-Fi with support for NFC and Bluetooth. It works with the Sony PlayMemories Mobile app, available for Android and iOS, to transfer images and video clips to your phone or tablet. Bluetooth is used to transmit location data to the camera only, not for quicker connection or background file transfers as we've seen in other cameras. iPhone users still have to manually connect to the Alpha 6500 when in range of other known networks before using Wi-Fi functions.

You can use your phone as a remote control with the Alpha 6500; it ships with a very basic remote-control system installed, supporting basic exposure adjustment and letting you fire the shutter with your phone. For more control you'll need to set up an account with Sony, connect the Alpha to your home network, and download an updated version of the remote-control app.

I don’t agree with the decision to charge for apps to help you shoot time-lapse, HDR, or star-trail images.

It’s a sneaky trick by Sony to make you sign up for an account. The updated remote is a free download—and one that you should take advantage of, as it adds full exposure control and the ability to tap and set a focus point—but many other apps cost $5 or $10 each. I praise Sony for expanding the functionality of the camera in this manner, but I don’t agree with the decision to charge for apps to help you shoot time-lapse, HDR, or star-trail images.

Also dubious is the decision not to include an external battery charger in the box. To recharge the removable battery, you need to plug the camera itself into the wall via an included USB cable and AC adapter. That’s not a big deal if you only have one battery, but if you opt to buy a spare (or two), you’ll find it frustrating to not be able to use the camera while the spare is charging. The Alpha 6500 is rated for 350 shots per charge using the rear LCD or 310 with the EVF, so a spare is a good idea for extended use. Consider the cost of an external charger ($40) as well as an extra battery ($60) when pricing the camera.

PERFORMANCE AND AUTOFOCUS

Start-up is a little slow, taking about 2.3 seconds. The autofocus is very speedy in ample light, locking on in just 0.05 second, but it can slow in dim conditions; in a dimly lit interior, the Alpha 6500 can take about a second to acquire a focus lock. The Fujifilm X-T2 is quicker to start (0.8 second), focuses in 0.1 second in bright light, and is speedy in dim light at 0.3 second. The X-T2 shares the same size image sensor, APS-C. Sony also makes full-frame mirrorless cameras, but they don't offer the same level of shot-to-shot or focus speed.

Tracking focus is the Alpha 6500's greatest strength. The on-sensor focus system incorporates both contrast and phase detection, with most of the image area covered. The camera shoots and tracks moving subjects at up to 11.1fps—it netted a slightly slower 10.7fps in our tests—with a large shooting buffer. It can keep that pace for 103 Raw+JPG, 110 Raw, or 256 JPG shots. But since only UHS-I speeds are available, a long recovery time is required to completely clear the shooting buffer—91.5 seconds for Raw+JPG, 70 seconds for Raw, and 81 seconds for JPG.

In addition to the 11.1fps mode is an 8fps shooting option. The slower rate minimizes blackout between exposures, so you can more easily track moving subjects. At either speed, the Alpha 6500 does an excellent job keeping subjects in focus as they move toward or away from the lens.

You're not limited to Sony E lenses with autofocus. Adding the LA-EA3 adapter ($199.99) lets you use A-mount SLR lenses with the same focus performance as you can expect from native mirrorless lenses. The Sigma MC-11 is available for Canon EF or Sigma SA lenses and delivers excellent autofocus performance in our testing. Because the Alpha 6500 includes in-body image stabilization, any lens you attach benefits from it.

“The on-sensor focus system incorporates both contrast and phase detection, with most of the image area covered.”

IMAGE AND VIDEO QUALITY

I used Imatest to check the quality of images captured with the camera's 24MP APS-C image sensor. When shooting JPGs at default settings, it controls noise through ISO 12800, keeping it under 1.5 percent. But some aggressive in-camera noise reduction blurs images when pushing the ISO that far. Blur is more significant at ISO 25600—to the point where I don't recommend using it for JPG capture—which is also true of ISO 51200. If you do shoot JPGs, know that image quality is almost as good at ISO 1600 as it is at the clearest, best setting, ISO 100.

To take best advantage of the sensor's high ISO capabilities, shoot in Raw format. When converted using Adobe Lightroom CC, with default settings applied, images are crisp and rife with detail through ISO 6400. Detail remains strong at ISO 12800 and 25600, although grain is rougher. Noise overtakes detail at ISO 51200—avoid pushing the Alpha 6500 that far if possible.

The Alpha 6500 shoots video at up to 4K quality. At 30fps, you'll find that the frame is cropped around the edges, limiting the field of view of wide-angle lenses. But it's not cropped when shooting at a more cinematic 24fps rate. Video is very crisp—a 100Mbps bit rate is available—and the autofocus system delivers pleasant, slow, smooth racks when changing the focus point. Exposure adjustment is available when recording video.

Rolling shutter is an issue when you're shooting in 4K. If you're panning left or right or capturing a fast-moving subject, you'll see a jelly-like motion effect, referred to as skew. The bottom of the frame advances more quickly than the top. Cameras that don't show this effect, such as the E-M1 Mark II, are better choices for serious 4K video work. Like the Alpha 6500, the E-M1 features in-body stabilization.

POP-UP FLASH
The Alpha 6500 is one of the few cameras in its class to include a built-in flash.

If you use the Alpha 6500 in 1080p quality, you'll find that rolling shutter isn't an issue. You can even push the frame rate to 120fps, making it possible to slow footage down by 5x (24fps) or 4x (30fps). Audio quality is typical. The internal mic picks up voices clearly but struggles in environments with heavy wind or other background noise. You'll want to use an external microphone for any project where audio is important.

CONCLUSIONS

The Sony Alpha 6500 maintains the excellent image quality and autofocus system delivered by less expensive models in the family, the Alpha 6000 and 6300. It adds in-body image stabilization and a touch screen and maintains the sealed design and 4K recording introduced with the Alpha 6300. The lesser models represent superb values when compared with similarly priced competition, but the competition is stiffer when the price creeps up to $1,400. Likewise, the compact body design, which is a big selling point for consumers, is a drawback for serious photographers looking for pro features such as dual memory card slots and the ability to add a vertical shooting grip.

We're awarding the Alpha 6500 a 4-star rating. Its image quality and tracking capabilities are superb, and there are certainly photographers that want a camera this serious in a really small package. But we're not awarding it an Editors' Choice like the Alpha 6000 and 6300. Instead that nod goes to the Fujifilm X-T2, which omits in-body stabilization, but has a design, features, and lens system that will make photographers seeking a top-end, fast-shooting, mirrorless system happy.

JIM FISHER

The compact body design, a selling point for consumers, is a drawback for serious photographers looking for pro features.

Spectacles: A Stylish, Playful Wearable

Snapchat Spectacles

$129.99

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Snapchat has always been a different kind of social experience. The ephemeral messaging app never set out to be as universally appealing as Facebook or as serious as Twitter. But with its rebranding to Snap Inc., Snapchat is now part of what Snap calls “a camera company,” pairing nicely with its first foray into hardware: Snapchat Spectacles. Priced at $129.99, these “sunglasses that snap” are not intended as augmented reality devices or heavy-duty action cams. Instead, the Spectacles are connected glasses that do one thing—take snaps—and do so with a playful ease that feeds right back into what makes Snapchat so fun in the first place.

Since their launch in November 2016, the only way to snag a pair of Spectacles has been to find a roaming Snapbot vending machine. But now, Spectacles are finally available to buy online. You can order a pair from the Spectacles site (in your choice of black, coral, or teal), for delivery in two to four weeks at the time of this writing.

DESIGN AND FIT

Spectacles are far less bulky and gaudy than most of the augmented reality (AR) and virtual reality (VR) headsets we've tested, such as the Microsoft HoloLens Development Edition and the Oculus Rift. In fact, you might even say that they're fashionable, which isn't a word you often hear associated with wearable tech.

The design of the glasses is all circles and curves, with some funky ridges near the nose bridge—no boxy edges or chunky camera modules as on Google Glass.

Spectacles currently come in three colors: black, teal, or coral. We got our hands on a pair of classic black shades, which measure 5.25 inches across from arm to arm, with a 1.0-inch-wide bridge, and 6 inches from the front of the lens to the back of the temple. The glasses themselves are pretty light, at 1.76 ounces. On the inside of one arm is the word Spectacles written in a silver script font clearly meant to evoke premium sunglass brands such as Ray-Ban. The other says Designed by Snap Inc.

Snapchat Spectacles

PROS Easy pairing. Simple, straightforward shooting process. Stylish design. Surprisingly good audio/video quality. Fast syncing. Editing and sharing process is identical to that of normal snaps. Makes snaps feel more immersive.

CONS Can't wear with prescription glasses. No geofilters. No Bluetooth syncing on Android.

OH, SNAP!
With Snapchat Spectacles, take your first-person social media curation to the natural next level.

Spectacles have dual outward-facing cameras, one in the corner of each lens, with a yellow ring surrounding each. The actual camera modules are hidden between the frame hinges and temples, so your eyes aren't immediately drawn to a protruding camera box as with Google Glass. Look a bit closer, and you'll see that while the right circle simply houses a camera, the left circle also includes a ring of LED lights that spin when recording. This detail eliminates the "Glasshole" factor: You can't snap someone while wearing Spectacles without them knowing. The LEDs also light up in other combinations, which I'll discuss later.

DOUBLE VISION
The two outward-facing cameras, one on each lens, shoot 115-degree video.

The glasses fit snugly on my face without any need for adjustment. The small rubber comfort circles on the inside of each side of the frame rested firmly on the bridge of my nose. The only obvious drawback of the Spectacles from a design perspective is that you can't wear them over your own glasses. If you're blind as a bat and don't wear contact lenses, you're out of luck, for the moment. Lens manufacturer Rochester Optical makes prescription Spectacles lenses, but they add to the total cost.

SETTING UP YOUR SPECS

A few additional items are squeezed into the clear-plastic tube in which Spectacles are packaged, including a bright-yellow felt charging case, a USB charging cable, and a cleaning cloth shaped like—you guessed it—the Snapchat ghost. No instructions are included in the box aside from a quick three-step diagram showing how to pair the Spectacles to your Snapchat app.

That's not surprising, given that Snapchat is the epitome of the "learn by doing" social media app. It's intentionally difficult to use, with lots of hidden filters and features you'll only find by playing with the app. Spectacles are far simpler to manage on the first try, though, and once your glasses are paired, the app actually gives you a fair bit of instruction and a link to a Spectacles Support FAQ for those who need more help.

To start, plug in the USB cable and attach it to the back of the charging case, then lay the Spectacles in the case. The minimalist design of the Spectacles makes it subtle to spot, but there's another magnetic charging port within the left hinge. It's visible only when they're folded, so you need to fold the glasses and lay them with the hinges lining up with the case's small ledges. The left ledge has a matching port, and you'll feel a magnetic snap when they latch in and start charging.

The Spectacles and charging case each has a single button next to their charging ports. If you turn the Spectacles on while charging, the LED ring lights up according to how full the battery is. If you see a full ring, you're ready to go. A full charge gets you around 100 snaps, and once the case itself is fully charged, it holds an additional four complete charges for the Spectacles before you need to plug it in again.

CASE STUDY
The case holds about 4 charges and has a charging port in the back for the USB cable. It also comes with a cleaning cloth shaped like the Snapchat ghost.

Pairing is pretty simple, at least for iOS users. I tested the Spectacles with my iPhone 7 Plus. Once I made sure my Bluetooth was turned on and that I was running the latest version of the iOS app, I opened my Snapchat app and swiped down to bring up my Snapcode (the unique QR identifier other users can take a photo of to add you on Snapchat). From there, all I had to do was put on the Spectacles and press the button once, and the pairing began. Spectacles can sync with iOS devices over both Bluetooth and Wi-Fi, but Android devices can transfer snaps only over Wi-Fi.

> **Once the case itself is fully charged, it holds an additional four complete charges for the Spectacles.**

Once Snapchat connected to the Spectacles, a box popped up for me to give the glasses a name that would appear in my Bluetooth settings. After naming my glasses “Rob’s Specs” and finishing the sync, the first thing I saw were a few introductory diagrams showing how to use the Spectacles: Press the button once to take a 10-second video snap. Press it again to extend by 10 seconds (you can record up to 30 seconds at a time), or press and hold it to stop recording. Double-tap the side of your glasses to check your battery level.

After that, I was ready to snap. The Spectacles work without your phone present, though snaps won’t sync back to your Memories until the Spectacles are connected to Wi-Fi. As soon as the glasses are in Wi-Fi range, they automatically begin uploading snaps to your account, independent of which smartphone your Snapchat is logged into at the time or whether your phone is on the same network. Essentially, the pairing syncs the Specs directly to your Snapchat account, not to any particular device.

SNAPPING WITH SPECTACLES

Spectacles shoot with a 115-degree lens, which Snap says is meant to mimic the human eye. Once you’re back in the app, Snapchat gives you the option to view a standard (SD) or high-definition (HD) version of the video.

The shooting process is about as straightforward as it gets. Walking around with fully charged Spectacles, I tested out shooting both one snap at a time and multiple snaps. The same LED ring that alerts people you're filming gives you an inward facing light in the corner of your eye that stays lit throughout your recording, flashing briefly when your snap is about to end.

As mentioned, you get about 100 10-second snaps per charge. After I recorded between 20 and 30 snaps, the LED ring showed I still had about two-thirds of my battery left. The LED ring also has some other settings: Five LEDs flash three times when storage is full, two LEDs flash three times when a software update is available, one LED flashes three times (and an inner LED below the snap button blinks red) when battery is low, and there's a rotating LED warning if the hardware is getting too hot or cold.

One thing I'd like to see from "Spectacles 2.0," should Snap ever release them, is a simple DSLR camera-like dial built into the snap button. It's easy enough to end your recording early by holding down on the button for 10 seconds, but one of the best granular user interface (UI) flourishes of the Snapchat app is the ability to set your snaps to anywhere from 1 to 10 seconds. Part of the fun of watching someone's snaps is when they throw a quick 1-to-3 second snap at you in the middle of their story.

I found that reaching back up to press the button again when I was done snapping took me briefly out of the moment. Beyond that, I had no other issues with the actual snapping process. I didn't encounter any errors where I thought I was recording when I wasn't, or vice versa.

SNAP AWAY
Each additional press of the snap button adds 10 seconds to your video, for a max of 30 seconds. Press down for 2 seconds to stop recording.

BACK IN THE APP

When I opened my app and tapped into my Memories, I found a new Specs tab next to Snaps, Stories, and Camera Roll. Since my Spectacles were already back in Wi-Fi range, when I tapped the Specs tab I found that the snaps had already begun importing. The Specs page is also where you'll find a More About Specs button, which brings up a support page with a search bar and icons for popular help topics.

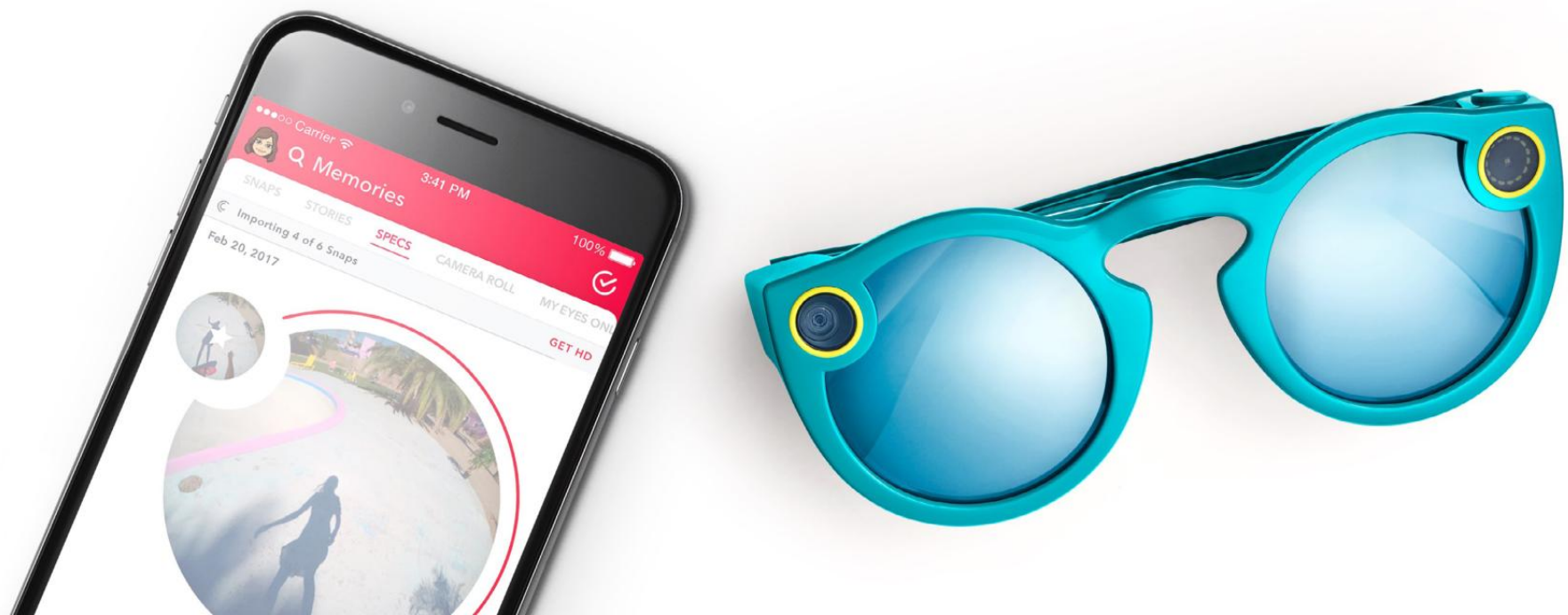
When I opened my app and tapped into my Memories, I found a new Specs tab next to Snaps, Stories, and Camera Roll.

Each snap takes about 15 to 20 seconds to sync, so after a few minutes, all my snaps were finished importing and organized chronologically as a Story in my Specs tab. When it's importing, the app gives you the option to render each snap in SD or HD. Once they're in, the editing and sharing process is identical to that of a normal snap. There are brief split-second gaps where one snap ends and another begins, but for the most part, the snaps play back as one uninterrupted first-person story.

As I began to tap through each of the snaps I'd taken, I noticed that the videos themselves didn't look all that different from snaps taken by the rear camera of my iPhone 7 Plus. The glasses have a slightly wider view angle, so you see a bit more of a scene than you would with the iPhone's main camera. For a $130 wearable camera, that's not bad.

BLUE-TINTED GLASSES

Unlike some of the other wearables we've tested (hello, Google Glass), Spectacles are actually somewhat stylish.



Sound quality is similarly solid. Although the Spectacles have no visible mic, the sound for each snap came through clearly. When I walked through Madison Square Park in Manhattan, the Spectacles picked up not only the people talking around me but also distinct traffic sounds and music from street performers nearby. It's better than I expected.

The Spectacles picked up not only the people talking around me but also traffic sounds and music from nearby street performers.

The most interesting detail in snaps shot with a pair of Spectacles is video orientation. In edit mode, the Snapchat app lets you tab through each snap to add the typical array of filters, captions, emojis, and stickers. One neat feature I found is that after adding captions or images to a video, whatever objects you add will lurch left and right as the video changes orientation. If I turned left and looked up with the Spectacles, the text or objects would lightly distort in that direction to give the viewer a more immersive sense of my perspective. It's a subtle little way of Snap showing off what its new toy can do.

Another nice feature: You can star snaps as you edit them. When you return to the main Specs tab, all your starred snaps are pulled into a Highlights story next to the main Spectacles story from each snapping session. Spectacles make it far more natural to take large volumes of snaps at a time, making this kind of social curation a particularly nifty addition.

Once I finished adding filters, captions, and stickers, I simply sent the snaps as normal. You can add them to your story or local stories, as well as send them to friends. Aside from the minor feature additions you get when editing and organizing Spectacles-specific content, there's no difference whatsoever to the in-app experience.

The lack of geofilters is a minor shortcoming. They're one of the most popular features of Snapchat, letting followers know where in the world or what neighborhood in a given city you're snapping from. When I added filters to the imported snaps from my Spectacles, I found the app was giving me only geofilter options from my current location. Many cameras with Wi-Fi work with a smartphone app that logs location, syncs time stamps, and adds GPS data. Snap could add that functionality to the Spectacles via a software update, but as it stands, if you want your snap to have a specific geofilter, you need to transfer it to your phone and post it from that physical location.

CONCLUSION

Spectacles aren't flawless, but Snap knew what it was doing when it released them in true viral style. Hype aside, Spectacles are a no-brainer for Snapchat devotees. The integration between the hardware and the Snapchat app is seamless, and the glasses truly amplify the Snapchat experience. Spectacles add just enough new features and hands-free convenience to make them a worthwhile addition to the Snapchat experience at a relatively reasonable cost.

For Snapchat addicts, it's easy to decide to buy a pair of Spectacles. They're a simply executed and natural-feeling extension to the social experience of snapping the world as your eyes see it.

ROB MARVIN

Cerise's Tubular PC Has More Than Cool Looks

Cerise Circular Computer

$Starts at $2899.00; $3,300 as tested

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The Cerise Circular Computer is an arresting black metal tube, a design that's all the more striking when compared with the rectangular boxes you usually see on office desks. But the Circular Computer is notable for more than just its design, which efficiently channels both heat and noise from its internal components. It also boasts strong performance, which should help you conquer any work challenges. Though the Dell Precision Tower 3000 Series (3620) remains our Editors' Choice for its superior value proposition, the Circular Computer is an ideal pick if you need a quiet business desktop PC or workstation for studio work—or if you just hate the noise high-end desktops produce under load.

DESIGN AND FEATURES

The Circular Computer has a rectangular interior skeleton that's surrounded by a tubular outer shell of black-painted metal. The case is about 15.5 inches tall and 12 inches in diameter, so it works equally well on top of a desktop or under it. That's larger than the Apple Mac Pro or the MSI Vortex G65 (SLI-002), the last two similarly shaped PCs we've seen. Neither of those competitors has upgradable graphics, and CPU upgrades are also much simpler with the Cerise: The shell lifts off easily after you undo the latch that locks it to the frame.

Inside is an Asus A170i Pro Gaming Mini ITX motherboard loaded with impressive components. These include an unlocked 4GHz Intel Core i7-6700K processor with a low-profile cooler, 32GB of DDR4 memory, a Gigabyte-branded GeForce GTX 1070 graphics card, a 480GB Intel boot SSD, and a 1TB M.2 workspace SSD. Because these are all standard desktop parts, more akin to those used in traditional boxes such as the Dell Precision Tower 3000 Series, HP Z240 SFF Workstation, and Origin Chronos VR than the less-upgradable Mac Pro or MSI Vortex, you can easily find replacement components. But the Cerise's Mini ITX motherboard lacks any free DIMM slots or PCI Express (PCIe) slots, so if you need more memory or better graphics in the future, it's a strict one-for-one replacement. (You can configure the Circular Computer with up to 64GB of memory and a more powerful GTX 1080 or Quadro M4000 graphics card.) All the cords and cables inside are neatly routed and organized.

Cerise Circular Computer

PROS Quiet operation. Powerful components are easy to service and replace, and professional options are available. Lots of I/O ports.

CONS Compact motherboard limits expandability. Top-mounted ports can lead to cable spaghetti.

TOTALLY TUBULAR The Cerise Circular Computer looks striking compared with the usual rectangular boxes you usually see on office workers' desks.

A 120mm cooling fan is mounted on the bottom of Circular Computer's frame, pushing air up the interior of the chassis and over the CPU cooler, the graphics card, the power supply, and the SSDs. The round exterior walls channel the warm airflow naturally to keep the system cool, while the heavy-gauge metal shell keeps sounds contained. Given its large-diameter fan, which turns relatively slowly even under heavy testing, the Cerise PC put out less noise than most of the other desktops on our labs bench. This is a good workstation for use in places where sound levels are critical, such as in a recording studio or an office with an open plan.

FROM THE TOP
The top of the system is open, which helps with cooling and gives you access to the ports.

Because of the cooling scheme, the motherboard and graphics card are mounted so that the ports all face up. We've seen this orientation in such gaming desktops as the Origin Genesis and Falcon Northwest Mach V, but it's fairly rare. You'll find surround-sound audio ports, a DisplayPort connector, an Ethernet port, an HDMI jack, a PS/2 port (for connecting an old-style keyboard or mouse), a microphone jack, a headset jack, two USB 2.0 ports, six USB 3.0 ports, and two USB 3.1 (Type-A) ports on the top.

> **The Circular Computer's round exterior walls channel the warm airflow naturally to keep the system cool.**

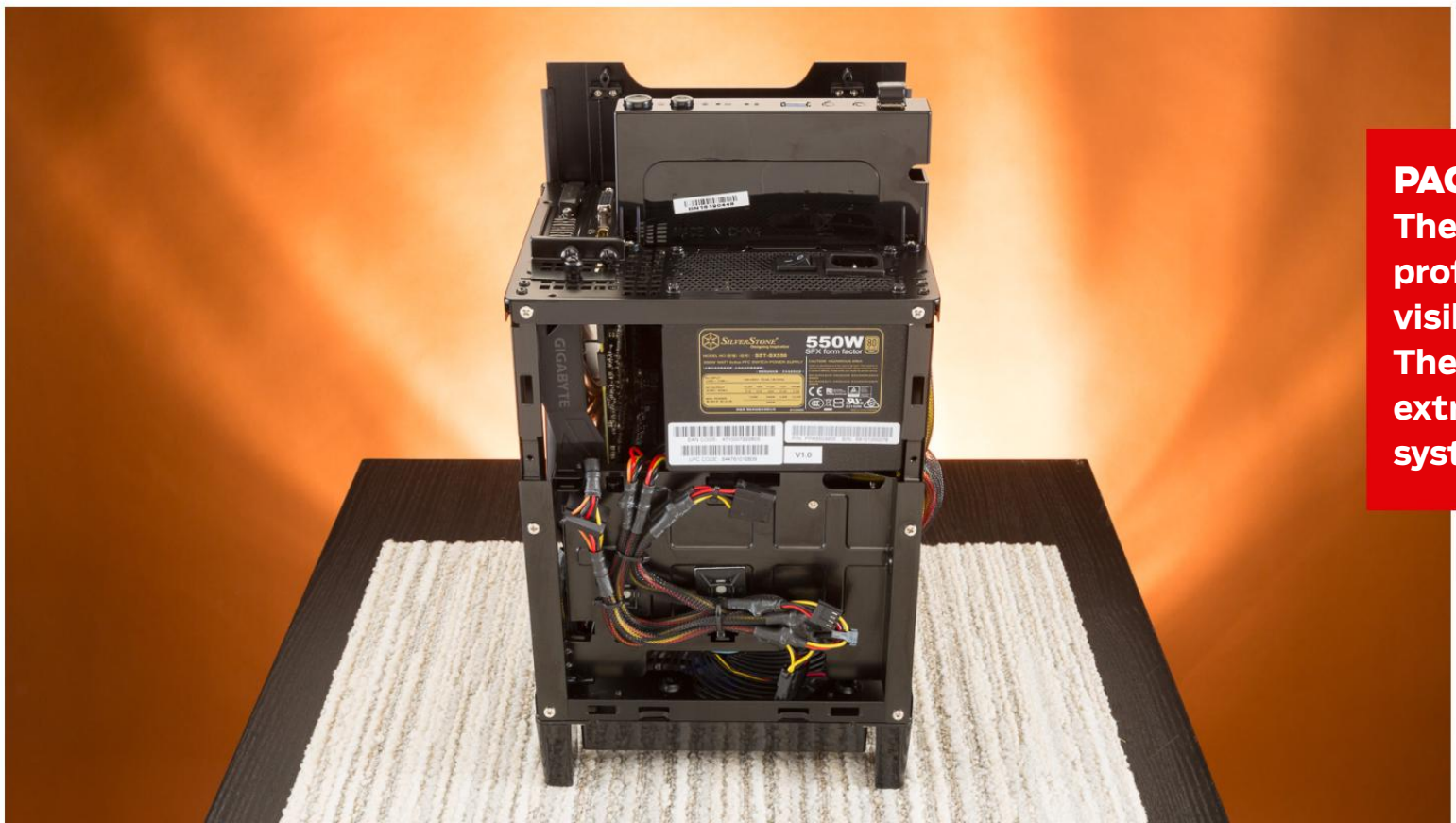
The computer's GeForce GTX 1070 also has its own set of two DVI ports, an HDMI port, and a DisplayPort connector. All the ports are easy to get to, particularly if you have the computer on the floor next to you. If you connect a lot of accessories, though, you can end up with a rat's nest of cables coming out of the top of the PC.

Thankfully, there's enough space between the frame and the tube that you can route the cables around inside the shell, away from the top of the PC and out of the bottom of the chassis. That's more convenient for display cables and the power cord than a microphone lead that you'd have to unplug more often. Cerise protects the Circular Computer with a one-year warranty with lifetime technical support.

PERFORMANCE

The Circular Computer's benchmark test scores show how powerful it is. It returned a speedy score of 3,697 points on the PCMark 8 Work Conventional Test, ensuring that it quickly completes tasks such as office document creation, web browsing (including e-commerce), and video conferencing. Any time under 1 minute is excellent on the HandBrake test; this system took just 51 seconds to complete it.

Granted, the Digital Storm Slade Pro, Falcon Northwest Tiki Workstation, and Origin Chronos Pro were even faster in testing, but each of those workstations costs at least twice as much as the Circular Computer. It also returned excellent results on the CineBench (881 points) and Photoshop CS6 (2:29) tests.



PACKED TIGHTLY
The system's low-profile CPU cooler is visible in this photo. There's not much extra room in the system's frame.

Its GeForce GTX 1070 graphics card helps the Circular Computer with Photoshop editing, 3D rendering, and other GPU-intensive tasks. A consumer-level card like the GeForce GTX 1070 is an excellent GPU for digital content creation using programs such as those in Adobe Creative Cloud (Premiere, Photoshop, and so on) and will save you some money over a pro-level card—say, a Quadro M4000. But you can and should order one of those (an additional $650) for tasks such as creating 3D models in a CAD/CAM program at an automobile design studio or an architecture firm.

Befitting its gaming-enthusiast design, the GeForce GTX 1070 returned much higher test scores on the 3DMark Cloud Gate and Fire Strike Extreme tests than workstations with low-end and midrange Quadro graphics cards, such as the HP Z240 and Dell Precision Tower 3000 Series. Likewise, the Circular Computer returned butter-smooth frame rates on the Heaven (108 frames per second, or fps) and Valley (113fps) tests at full HD resolution with the graphics quality set to Ultra. When bumped up to 4K, the frame rates dropped, but they still hovered around 30fps (Valley was just above, Heaven was just below). This means that you should be able to play recent games at higher resolutions. The Circular Computer is as capable of smoothly rendering 3D for business purposes as it is playing the occasional 3D game when you're off the clock.

CONCLUSION

The Cerise Circular Computer is a compact business computer/workstation that stays quiet while giving you excellent performance, and it's well suited for digital content creation and game development. It's not as upgradable as a full-size tower, but some power users will gladly give that up for a PC that doesn't look like a big, corporate box. The Dell Precision Tower 3000 Series (3620) holds onto its Editors' Choice for single-processor workstations because it is less expensive, has more internal expandability, is more IT friendly, and works better in an office when you're supporting multiple departments. That said, the Circular Computer is a high-powered alternative in creative environments such as an art or audio recording studio.

JOEL SANTO DOMINGO

Fastest Sub-$100 Router We've Tested

PC MAGAZINE EDITORS' CHOICE

The TP-Link Archer C7 AC1750 Wireless Dual Band Gigabit Router (V2) is an affordable router that performs like a more expensive one. Its scores in our 2.4GHz and 5GHz throughput tests were significantly higher than those of the competition, and it offers a nice feature set, including four Gigabit LAN ports and a pair of USB 2.0 ports. Management settings are plentiful, but the web console is slow to respond and lacks user-friendly icons to help you navigate the menu system. Neither gripe prevents it from earning our Editors' Choice for budget routers.

TP-Link Archer C7 AC1750 Wireless Dual Band Gigabit Router (V2)

$92.99

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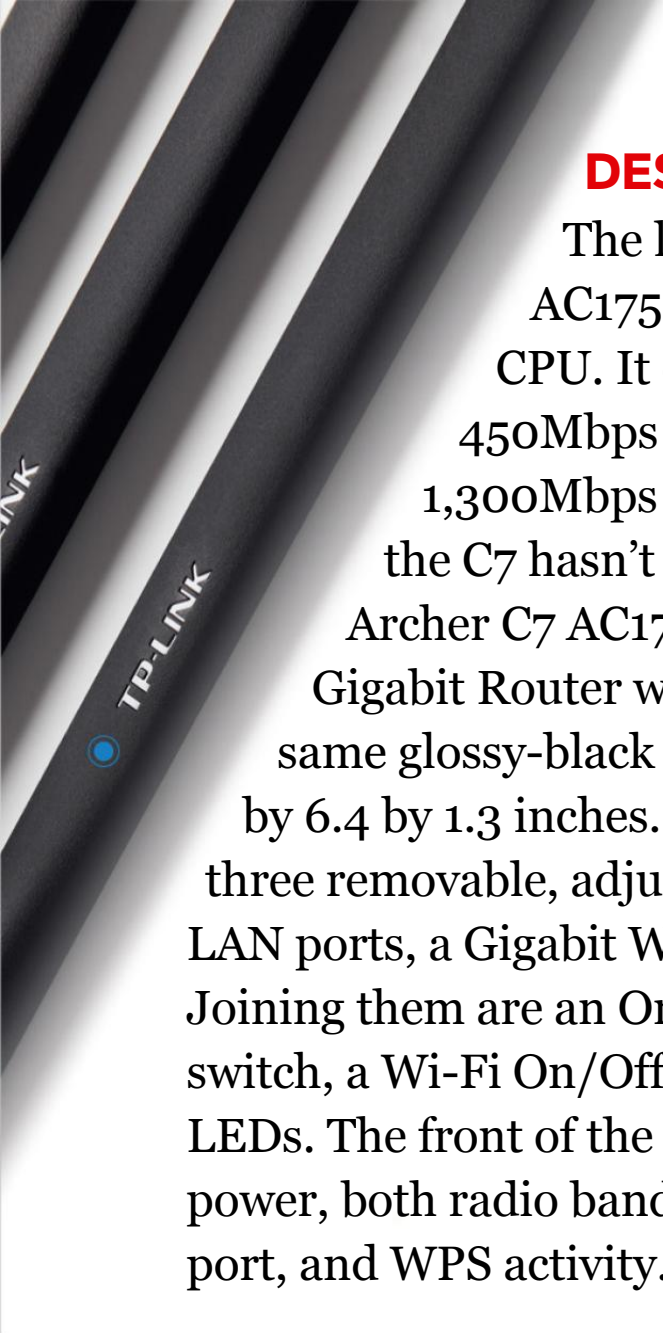


DESIGN AND FEATURES

The latest Archer C7 is a dual-band AC1750 router that uses a 720MHz CPU. It can reach speeds of up to 450Mbps on the 2.4GHz band and 1,300Mbps on the 5GHz band. Design-wise, the C7 hasn't changed from the TP-Link Archer C7 AC1750 Dual Band Wireless AC Gigabit Router we reviewed in 2014. It uses the same glossy-black enclosure, which measures 9.6 by 6.4 by 1.3 inches. The rear of the router is home to three removable, adjustable antennas, four Gigabit LAN ports, a Gigabit WAN port, and two USB 2.0 ports. Joining them are an On/Off button, a Reset/WPS switch, a Wi-Fi On/Off switch, and two USB activity LEDs. The front of the router has LED indicators for power, both radio bands, all four LAN ports, the WAN port, and WPS activity.

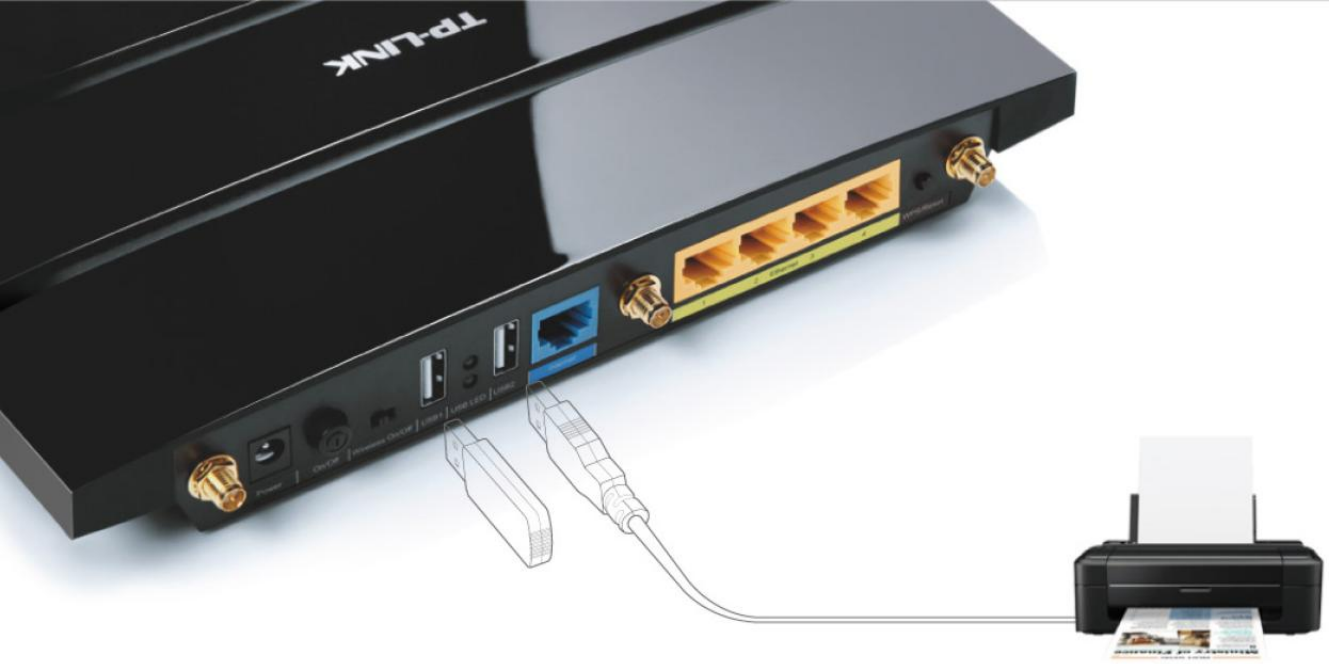
The web console is the same text-based version used on the original TP-Link Archer C7 and lacks the graphical elements that you'll find on newer TP-Link routers, such as the AC2600 Wireless Dual Band Router Archer C2600 and the AC3150 Wireless MU-MIMO Gigabit Router Archer C3150. There's also a noticeable lag between the time that you make a change and the time that the change is saved; in some cases I had to wait up to 30 seconds.

That said, it offers a wealth of basic and advanced settings. The main Status page has a list of settings on the left side and LAN, WAN, Wireless, and Traffic Statistic information in the center. To the right is a detailed explanation for each setting. Network settings include WAN, LAN, MAC Clone, and IPTV options, and each radio band has basic wireless settings (SSID, Mode), as well as WPS, Security (WPA/WPA2 Person and Enterprise), and MAC filtering settings.

TP-Link Archer C7 AC1750 Wireless Dual Band Gigabit Router (V2)

PROS Affordable. Very fast throughput performance. Easy to install. Lots of management settings.

CONS Clunky user interface. Middling file-transfer speeds. USB 2.0 ports only.



REAR PORTS
The rear of the router has three removable, adjustable antennas; four Gigabit LAN ports; a Gigabit WAN port; and two USB 2.0 ports.

The Guest Network page allows you to create separate networks with limited access for guests and set bandwidth control and access schedules for each network. In Parental Controls, you can create access schedules and compile a list of allowed websites for specific clients. There's also a separate Access Control where you can create network-wide internet access rules.

Other settings include Advanced Routing, Bandwidth Control, Port Forwarding and Port Triggering, VPN Pass-Through and Firewall settings, and Dual-Band Selection, which lets you enable and disable each radio band. In System Tools, you can change time settings, run network diagnostics, update the router's firmware, back up settings, and view system logs.

The Guest Network page allows you to create separate networks with limited access for guests.

INSTALLATION AND PERFORMANCE

Installing the Archer C7 was easy. After connecting it to my desktop PC and the internet, I powered it up and typed http://tplinkwifi.net in my browser address bar to access the management console. I clicked the Quick Setup tab on the left and chose Auto-Detect. The console found my internet connection and asked me if I wanted to run Concurrent (dual-band) Wi-Fi or just single band (2.4GHz or 5GHz, but not both). I selected Concurrent and was taken to the wireless settings screen to configure security settings. Once configured, I was ready to go.

The Archer C7 rocked our throughput tests. Its score of 91.3Mbps in our 2.4GHz close-proximity (same-room) test was significantly higher than the other budget routers, including the Netgear AC1200 Smart Wi-Fi Router (R6220) (74.1Mbps), the D-Link AC1200 Wi-Fi Router (DIR-842) (75Mbps), and the Linksys EA6350 AC1200+ Dual-Band Smart Wi-Fi Wireless Router (72.5Mbps). Similarly, its score of 62.8Mbps in our 30-foot test dominated the competition; the Netgear R6220 scored 48.3Mbps, the D-Link DIR-842 had a throughput 41.5Mbps, and the Linksys EA6350 came in at 39.3Mbps.

In our 5GHz throughput testing, the Archer C7's performance was outstanding for a budget router. It scored 509Mbps in the close-proximity test, compared with the Netgear R6220 (331Mbps) and the D-Link AC1200 Wi-Fi Router (DIR-842) (332Mbps). At 30 feet, its score of 250Mbps once again took top honors, beating the Netgear R6220 (104Mbps) and the Linksys EA6350 (199Mbps).

To test the router's read and write file-transfer speeds, we use a USB drive and a 1.5GB folder containing a mix of files. As with other budget routers, the Archer C7's file-transfer speeds were middling; its write speed of 21.5MBps was identical to the Linksys EA6350 and slightly faster than the Netgear R6220's score of 17.6MBps. The Linksys EA6100 AC1200 Dual-Band Smart Wi-Fi Router (also a budget router) scored 27.4MBps. In the read test, the Archer C7 had a throughput of 27.5MBps, which again was just a little slower than the Linksys EA6350 (28MBps) and the Linksys EA6100 (28.3MBps) and a bit faster than the Netgear R6220 (25.6MBps).

CONCLUSION

The TP-Link Archer C7 AC1750 Wireless Dual Band Gigabit Router (V2) may cost less than $100, but you'd never know it based on its performance and feature set. Its 2.4GHz and 5GHz throughput scores were better than similarly priced budget models, including the $90 Linksys EA6350 AC1200+ Dual-Band Smart Wi-Fi Wireless Router, and it offers numerous management settings and plenty of I/O ports. The Archer C7's user interface could use an update, however, and its file-transfer performance could be better. That said, it's the fastest dual-band router in its class and our Editors' Choice for budget routers.

JOHN R. DELANEY

Snowblink Pro Gaming PC's Unique LCD Panel

iBuyPower Snowblind Pro

$Starts at $1,599; $1,849 as tested

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The iBuyPower Snowblind Pro has plenty of appeal as a stylish, powerful gaming desktop, but there's one unique feature that helps it truly stand out: The left-side panel of the case is a semi-translucent LCD on which you can display images, video, and animations. Though this doesn't provide a lot of actual utility, it's an entertaining inclusion and an engaging conversation piece that doesn't add too much to the system's reasonable price. That price, unique design, and strong gaming performance make the Snowblind Pro an entirely viable choice for your next gaming PC.

ON DISPLAY

The case used for the Snowblind Pro is the NZXT Noctis 450 tower, which packs plenty of flair. The white tower has a steel frame and plastic flourishes, including some zigzagging fin cutouts along the top and front. It's more interesting than a generic black rectangle but steers clear of a distinctly "gamer" design, which many people regard as tacky.

The desktop stands at 22.32 by 8.66 by 21.42 inches (HWD), so it takes up a good portion of desk space, particularly if you have limited vertical room. This size falls right in line alongside other gaming desktops, including the CyberPower Gamer Master Ultra and the Digital Storm Velox (Core i7-7700K).

Another draw for this particular build is the innovative side panel: Rather than plain glass or plastic, the left panel is a customizable LCD. It serves as a second screen, extended from your main display, onto which you can drag or place anything you would on a standard monitor. A small internal pass-through box powers the display and has VGA and DVI connections facing out the back of the tower. For the LCD to function, you connect these ports to the graphics card ports just above it, preferably with a short cable (one such DVI cable is included).

iBuyPower Snowblind Pro

PROS Reasonable price. Smooth gaming performance. Entertaining side-panel LCD. Clean, consistent esthetic inside and out. Room for expansion.

CONS Screen panel doesn't add much utility. No wireless capability.

SEEING CLEARLY The left panel of the Snowblind Pro is a semi-translucent LCD on which you can display images, video, and animations.

The display is fairly translucent, since the glass is clear: That can make some images hard to see, but it's more visible with the right background. The interior of the case has super-bright LED strips inside, which make the image appear more clearly since—as I tested by swinging the door opening and shining light through the display—the picture is stronger with direct backlighting. You can change your wallpaper and display it as the full-screen image or pull over a media player and leave a clip, a show, or a movie playing. The system also comes with Rainmeter software, which lets you put up widgets such as CPU and GPU temperature, storage, RAM usage, and more.

DATA DISPLAY
The included Rainmeter software lets you put up widgets like CPU and GPU temperature, storage, RAM usage, and more.

How truly useful is this display? It's tough to say you get much real function out of it, but it does look pretty cool—a major reason to own any extravagant gaming system. According to iBuyPower, it adds about $150 to the cost of the desktop, which is far from nothing but in the same ballpark as adding a custom paint job or decal. The data feedback is fairly useful, even though it's info you can get elsewhere. Since the screen is transparent, however, it's a little too hard use it as a second monitor.

"It's more interesting than a generic black rectangle but steers clear of a distinctly "gamer" design."

During testing, we had fun in the lab swapping out images, playing movie clips, and putting pictures of ourselves on the side of the desktop. It might be more of a gag or a neat party trick than anything else, but if you can't have fun showing *The Fast and the Furious* on the side of your computer, then maybe you're doing something wrong.

Some of the other standout designs we've seen recently include the Transformers-like Asus ROG GT51 and the cube-shaped HP Omen X, but the configurations that we reviewed of both of those systems cost quite a lot more than the IBuyPower Snowblind Pro.

UNDER THE HOOD

Beyond the display, the Snowblind Pro's build is fairly standard, but the system is nicely put together. The interior design and cable management are neat and organized with silver-accented components complementing the white case. The MSI Z270 Tomahawk motherboard features silver accents, the MSI Nvidia GTX 1070 graphics card is a special Quicksilver edition with a metal plate, and the SSD and RAM are silver. The DeepCool liquid cooler is white, and the 800-watt power supply is hidden under a white shroud. These parts all play nicely with the white and black of the case and the bright lighting, for a crisp, clean esthetic.

For storage, the computer has a 1TB, 7,200rpm hard drive installed, and the SSD has a capacity of 240GB. You get a total of five 3.5-inch drive bays for adding storage, and only one is in use as configured. The SSD is mounted in a 2.5-inch slot on top of the power supply shroud, and there's another slot open next to it. There isn't a ton of room to work between the space taken up by the shroud and the internal wall supporting the drive bays, but the motherboard and the graphics card can fit across without being obscured—it may just be tight to plug and unplug some motherboard headers.

Ports are located on the top and rear panel—no connectors are on the front of the case. Up top are two USB 3.0 ports, two USB 2.0 ports, a headphone jack, and a mic jack. Around back are five more USB 3.0 ports and two USB 2.0 ports, a USB-C port, an HDMI port, a DisplayPort connection, two Ethernet jacks, and audio lines. The GTX 1070 card has three DisplayPort connections and an HDMI port for adding multiple displays. The Snowblind Pro has no wireless support on board, though if you need Wi-Fi or Bluetooth, you can add your own. The system is supported by a limited three-year warranty.

SNOWBLINDING SPEED

The Snowblind Pro isn't all flash; it has plenty of of power. A vast array of options are available when configuring this system; our test unit has a 4.2GHz Intel Core i7-7700K processor, 16GB of DDR4 memory, and the GTX 1070. For general productivity, it's quite snappy, scoring high in the PCMark 8 Work Conventional test. It handily beat out the AMD Ryzen-equipped CyberPower Gamer Master Ultra (AMD's chip is, of course, cheaper), though the latter was a better performer in the multimedia tests. Regardless, these components are more than fast enough for daily use, multitasking, and any media projects you want to crunch through on the side.

Gaming performance is the biggest focus for this system, and the GTX 1070 helps the Snowblind Pro excel as expected in testing. It's not Nvidia's top-of-the-line card, but it's a very strong performer for any system in which it's installed. The desktop maintained an average of 30 frames per second (fps) at 4K resolution in the Heaven and Valley gaming tests set to Ultra quality, and soared to more than 100fps at 1080p. 4K pushes even an Nvidia GTX 1080 card to its limits when gaming—the CyberPower Gamer Master Ultra uses one, and it scored 33fps in Heaven and 42fps in Valley at 4K.

“Gaming performance is the biggest focus for this system, and the GTX 1070 helps it excel as expected in testing.”

INSIDE THE BOX
The interior design and cable management are neat and organized, with silver-accented components complementing the white case. The DeepCool liquid cooler is also white, and the power supply is hidden under a white shroud.

If you're choosing a GTX 1070-equipped system, you're accepting that you'll have to turn down the resolution or some settings for smooth 4K performance, as more demanding moments during games will pull your frame rates below 30. I want to be clear that there are only some reservations at 4K: The Snowblind Pro cruises at 2K, VR gameplay is no problem, and 1080p is a cakewalk. This is in line with other GTX 1070-equipped PCs, so you can purchase this desktop knowing you can reliably play any new or near-future games at maximum settings, and some titles will also run smoothly at 4K with tweaks.

CONCLUSION

The LCD side panel helps the iBuyPower Snowblind Pro stand out from the crowd, adding some whimsy to a PC built for fun. It's a bit gimmicky but helps what is otherwise a traditional (though well-built and well-performing) gaming desktop stand apart. The case offers more style than most and has room for upgrades, while the components are perfectly suited to gaming. You could do a lot worse for less than $2,000. The midrange Editors' Choice CyberPower Gamer Master Ultra offers more gaming power, thanks to its Nvidia GTX 1080 card, and is a multithreading champ with its AMD Ryzen CPU, but the iBuyPower Snowblind Pro is an appealing option that will save you several hundred dollars.

MATTHEW BUZZI

XPS 15 Touch Highly Recommended for Artists

PC MAGAZINE EDITORS' CHOICE

The latest version of the Dell XPS 15 Touch is a prime choice for anyone working in art, video, or photography, thanks to its edge-to-edge 4K screen, color fidelsity, Kaby Lake processor, and Nvidia Pascal graphics. The price is lower than its predecessor's and significantly less than that of its prime rival in the high-end desktop-replacement laptop space, the Apple MacBook Pro 15-inch. This is the power user's laptop we'd recommend for working in the visual arts.

Dell XPS 15 Touch
(2017)

Starts at $999.00;
$2,024.99 as tested

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SAME ON THE OUTSIDE

Outwardly, the XPS 15 Touch looks exactly the same as its 2016 iteration, the Dell XPS 15 Touch (9550). The new version is also referred to as the XPS 15 Touch (9560), which Dell says drives home the similarity between the two. The laptop weighs 4.44 pounds, imperceptibly lighter than its 4.48-pound predecessor. It shares the latter's dimensions of 0.66 by 14.06 by 9.27 inches (HWD), and has the same bright, silver-colored aluminum top lid and base, along with a wide, one-piece touchpad embedded in a carbon fiber palm rest. It's more sedate than the similarly priced (and equipped) HP Omen 17 and Origin EVO15-S, both of which are gaming laptops.

The 4K screen has a 100-percent Adobe RGB color gamut (industry-standard color fidelity), perfect for viewing 4K videos at native resolution, and by extension, for editing full HD videos. If there's any drawback to the edge-to-edge display, it's that the webcam is now located below the screen instead of on top of it. That means that when you use the webcam on video calls, you have to tilt the screen back or risk having the people you're talking get an extreme close-up of your face (and your nostrils) when the display is head-on.

Dell XPS 15 Touch (2017)

PROS Excellent performance, thanks to its Intel Core i7-7700HQ processor and Nvidia GeForce GTX 1050 graphics card. Carbon fiber and aluminum construction. Edge-to-edge 4K Ultra High-Definition (UHD) screen. USB-C port with Thunderbolt 3. Large-capacity solid-state drive.

CONS 4K screen is a drain on battery life. Awkward webcam angle.

MEDIA FRENZY
The media-oriented Dell XPS 15 Touch has a large 4K screen—and plenty of power to drive it.

The keyboard, the touchpad, and the touch screen are a joy to use. The laptop's interfaces include Bluetooth 4.1, 802.11ac Wi-Fi, USB 3.0, USB-C/Thunderbolt 3, and HDMI, so you should be able to connect with the majority of peripherals and accessories in use today.

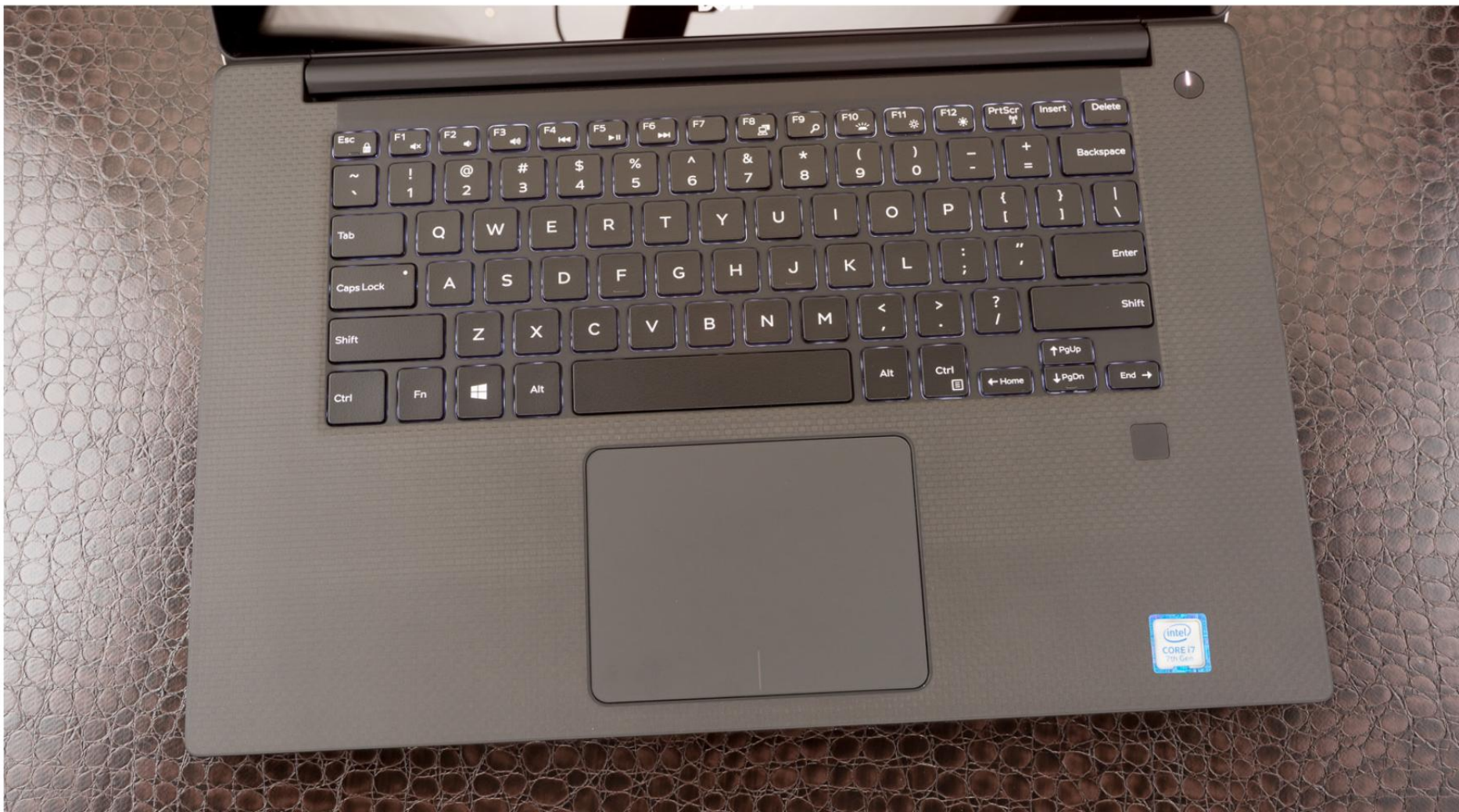
UNDER THE HOOD

Updates on the XPS 15 Touch include an Intel Core i7-7700HQ (Kaby Lake) processor, which is a smidge faster than the previous iteration's Skylake-based Intel Core i7-6700HQ CPU and helps a bit with battery life. A bigger improvement is in gaming performance, with the new Nvidia GeForce GTX 1050 GPU. The Nvidia GTX 1050 also helps drive the 4K display and is a co-processor for graphics-intensive tasks such as video and photo editing. The system's 16GB of RAM is sufficient for most video editing and lets you multitask easily after opening several programs and keeping dozens of tabs open. The 512GB SSD is a plus, though that capacity is becoming a common touchstone for large-screen media laptops. The XPS 15 Touch comes with a one-year warranty.

This is the power user's laptop we'd recommend for those who work in the visual arts.

BUILT FOR INPUT

The comfortable backlit keyboard has a carbon fiber palm rest and a large, one-piece touchpad.

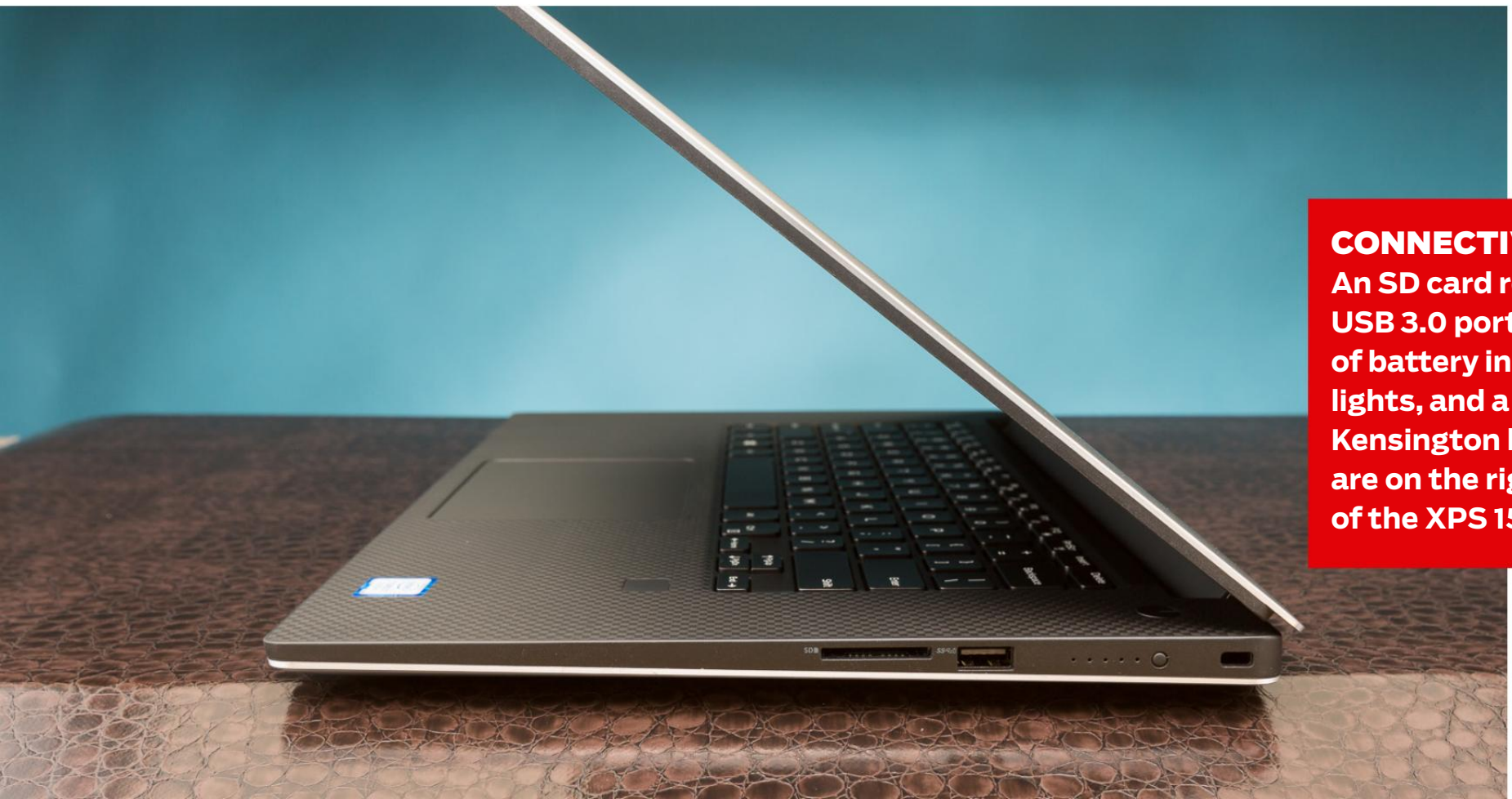


PERFORMANCE

Thanks to its Intel Core i7-7700HQ, 16GB of RAM, and 512GB SSD, the XPS 15 Touch made short work of our multimedia tests. Its time of 1 minute, 1 second in Handbrake matched that of the Apple MacBook Pro 15-inch, another top pick, and was one of the fastest times we've seen for a laptop. Its score of 3:13 in Photoshop beat powerful systems including the Apple MacBook Pro, the Asus ZenBook Pro UX501VW-DS71T, and the previous Dell XPS 15 Touch. The Origin EVO15-S, a gaming laptop, was the fastest in CineBench and Photoshop, but the new XPS 15 Touch was a close second and third, respectively. Its PCMark 8 Work Conventional score (2,859 points) also came second to the Origin EVO15-S.

The Nvidia GeForce GTX 1050 GPU helped the XPS 15 Touch achieve smooth, playable frame rates in the Heaven (54 frames per second or fps) and Valley (42fps) tests set to Ultra quality and full HD (1080p) resolution. When we bumped the resolution up to 4K, frame rates slowed to a crawl, as expected. At this juncture, you'll need a desktop-class graphics processor—the pricey Nvidia GeForce GTX 1080, for example—to run recent games at 4K or beyond.

In any case, the new XPS 15 Touch is much better than last year's Dell XPS 15 Touch, the Apple MacBook Pro, and the Asus ZenBook Pro for playing 3D games. You'll be able to run recent games at 1080p with all the eye candy turned on at strong frame rates, though admittedly not as well as on more specialized gaming laptops.



CONNECTIVITY
An SD card reader, a USB 3.0 port, a series of battery indicator lights, and a Kensington lock port are on the right side of the XPS 15 Touch.

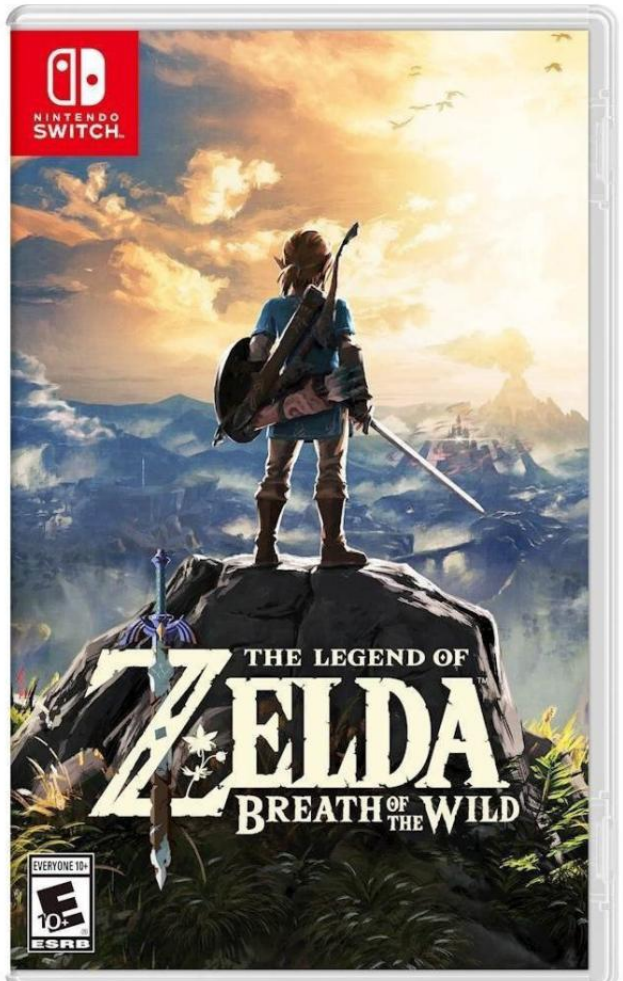
The XPS 15 Touch's 4K display does have a drawback: It's an enormous drain on the battery.

The 4K display does have a drawback: It's an enormous drain on the battery. The XPS 15 Touch lasted 6 hours, 5 minutes in our rundown test, an improvement of only 9 minutes over last year's iteration. That's hours short of the Apple MacBook Pro (11:19) and the Asus ZenBook Pro (11:53). It does, however, beat out the 15-inch Origin EVO15-S gaming laptop (3:28).

CONCLUSION

The Dell XPS 15 Touch should be at the top of your list if you're setting up a graphics or video editing studio or are a well-funded art student. It has the power to complete multimedia projects quickly and features a brilliant screen that shows many more colors than a business-oriented laptop could muster. The only downside is the shortish battery life. Still, it's faster and costs $700 less than the Apple MacBook Pro 15-inch, and it has all the requisite ports; the MacBook Pro needs adapters for all connections except USB-C and Thunderbolt 3.

JOEL SANTO DOMINGO



A Must-Buy Game for Nintendo Switch

PC MAGAZINE EDITORS' CHOICE

Hyrule is in danger again, and Link must save it. That's been the theme for nearly every Legend of Zelda game, and it's still the case in The Legend of Zelda: Breath of the Wild. The series' basic premise and Link-Zelda-Ganon dynamic are present, but nearly everything else is different. The classic Zelda dungeon-exploration structure is replaced by a huge open world that's filled with monsters, puzzles, and quests. Breath of the Wild's scope is one previously unseen in the Zelda series, and Nintendo executes the adventure-filled world with aplomb. This is a must-buy Nintendo Switch game and an Editors' Choice. (It's also available for the Wii U.)

The Legend of Zelda: Breath of the Wild
(for Nintendo Switch)

$59.99

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ANOTHER LINK

In Breath of the Wild, you once again play as Link, the constantly reincarnating elf boy who's tasked with saving Hyrule and Princess Zelda from Ganon. This time around, you're a Link from the past who's left to sleep for a century while the malevolent presence of Calamity Ganon menaces the land—and Zelda is nowhere to be found.

With no memories of what happened 100 years ago, Link must explore Hyrule's many regions and discover how to stop Calamity Ganon, and hopefully, both find and save Zelda.

HOW TO ADVENTURE

Link's skills from previous Zelda games are mostly intact, but he's been given some enhancements and tweaks. Individual tools and items are no longer as vital to progression as they were in the past. You still use a torch to light lamps, a hammer to break rocks, and a bow to shoot targets, but none of these items are acquired from big chests deep in dungeons. Most equipment is readily found scattered throughout the world, in shops, or on enemies. If you need something to solve a puzzle, it'll probably be nearby.

The Legend of Zelda: Breath of the Wild
(for Nintendo Switch)

PROS Massive, diverse open world. Tons of clever puzzles. Wide variety of things to see and do.

CONS Strange desaturation filter makes the game appear hazy. Combat is frustrating early on. Weapon durability is a nuisance.

You can tackle most obstacles using the runes on Link's Sheikah Slate, the tablet-like tool that serves as the game's interface. Different runes let you create bombs, freeze objects in time, freeze water to create blocks, and move metal objects using magnetism. They're helpful abilities that are needed to solve the game's many physics-based puzzles, and they can be useful in combat. But the really powerful abilities have a cooldown, so you can't simply rely on them instead of your weapons. You receive runes very quickly at the beginning of the game, so you play through everything except the very first area with nearly all problem-solving abilities you need. Giving you most of your tools early in the game is unusual for Zelda, but it encourages creative problem-solving instead of treating each new tool as a key for getting through the current dungeon.

Like Slipknot from the Oscar-winning Suicide Squad, Link can climb nearly anything. He can scale all but the sheerest surfaces, albeit at a very slow pace that drains a stamina meter. Swimming also drains stamina, though you can use consumable items to regain or temporarily boost your stamina, and you can permanently expand your stamina meter through the game. Stamina depletion for climbing and swimming helps build soft walls that let Link keep his freedom without disrupting the game's flow. Instead of running into invisible walls or other arbitrary boundaries, you're gently held back from climbing too high or swimming too far, forcing you to find a more roundabout way to your destination than cutting through everything. Unfortunately, running also depletes stamina, and that makes simply dashing around Hyrule when not on horseback feel needlessly jerky and slow.

FIGHTING THE HORDES

Combat is direct, with a few quirks and twists that can lead to frustration. The fighting is basic Zelda fare that consists of locking onto enemies and slashing them with your weapon. But each weapon has limited durability and shatters after only a few fights. Since weapons are scattered throughout the world, you won't often be caught unarmed, but it's a seemingly pointless frustration. Worse, weapons can't be easily repaired; once they break, they're gone.

Enemies hit very hard, so you'll probably die on a regular basis until you build up your heart meter and find better armor. The game usually drops you off close to where you died, thanks to a very forgiving autosave system, but it's still annoying and unsatisfying when you start your adventure. There are some dodging and parrying techniques available to help you avoid attacks and trigger your own powerful rushing attacks, but the controls never feel quite as consistent as they need to be for these mechanics to work. The timing for dodging and parrying attacks is too precise for a Zelda game. It would feel more at home in an action-RPG with more deliberate, involved combat, such as Bloodborne or Dark Souls III. Fortunately, the majority of encounters don't require those special maneuvers.

HUGE HYRULE

Breath of the Wild's Hyrule is gigantic. It feels easily as large and sprawling as any recent Elder Scrolls or Fallout game, with several huge regions stretching from the Gerudo Desert to Death Mountain. Every corner of Hyrule feels distinct, with wildly varying architecture, climate, and geology that ensure no region feels too similar to any other. The variety is impressive, especially when this game is compared with Skyrim or Fallout 4, which featured rather homogenous locations.

WATCH OUT FOR THE BAD GUYS
Enemies hit very hard, so you'll probably die on a regular basis until you build up your heart meter and find better armor.

Hyrule is remarkably dense, as well. The map is loaded with puzzles and collectibles. You can find hidden treasures in lakes, reveal mischievous plantlike Koroks for helpful rewards, and clear 100 different challenge shrines to make Link stronger. The shrines are impressively varied, like the map itself, and almost every one offers a unique set of puzzles to solve. I found five or six "test of strength" shrines where I had to fight an enemy to get the reward, but also dozens for which I had to use Link's rune powers, the game's physics engine, and my own mind to complete.

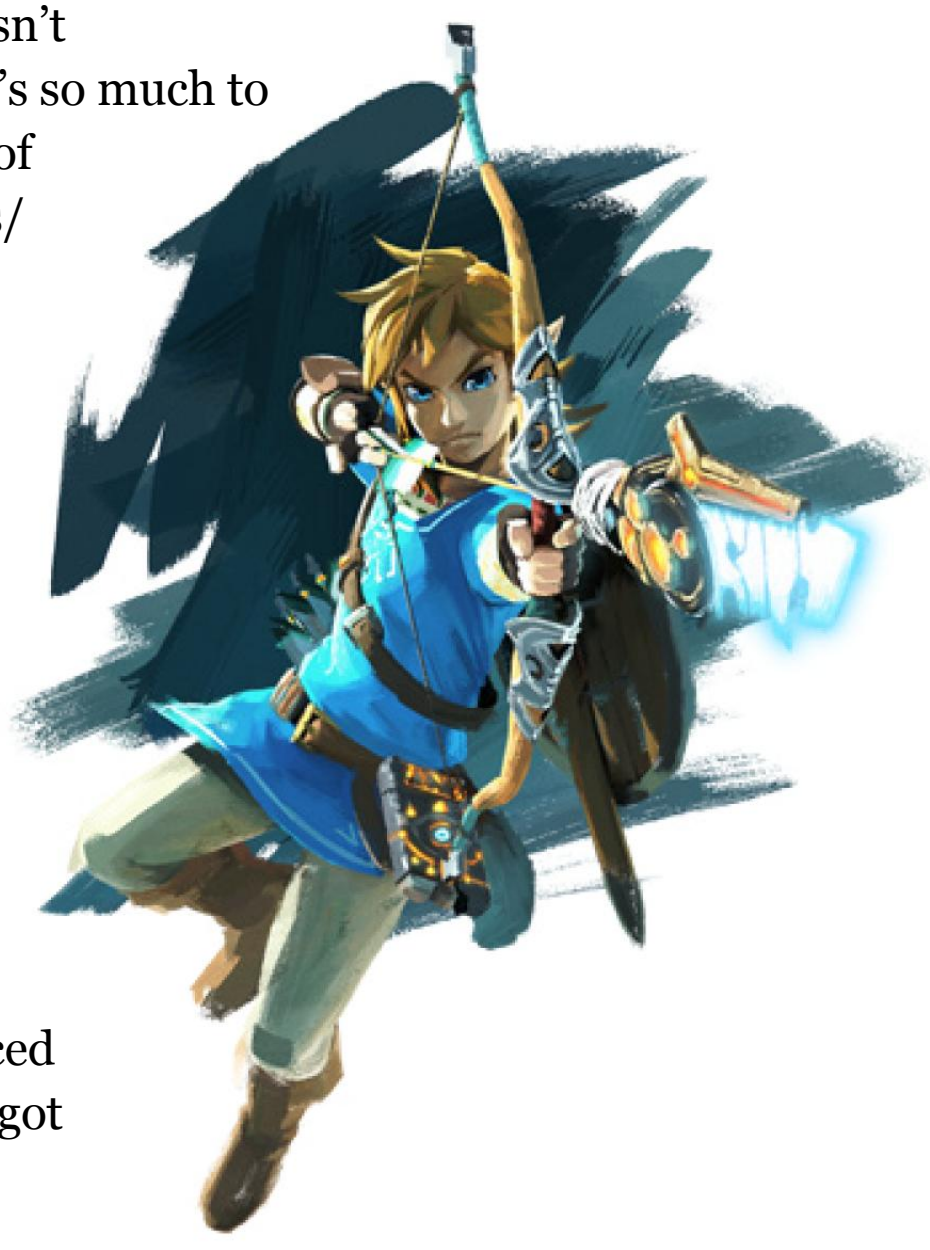
The challenge shrines serve an important function of providing fast-travel locations. When you find a new shrine (or a tower, one of about a dozen you can climb to reveal a detailed map of the region) you activate a new point you can instantly transport to at any time. This is the most convenient way to travel Hyrule, though you need to actually explore the area first. To help with that task, you tame horses to run across fields faster or use a glider to cross far distances if you have a high enough starting point.

OPEN WORLD
Every corner of Hyrule feels distinct, with varying architecture, climate, and geology that ensure no region feels too similar to any other.

On a technical level, Breath of the Wild is incredibly stable and consistent for an open-world game that relies partly on physics-based problem solving. Throughout my time in Hyrule, I never experienced game-breaking clipping glitches or even quest-ruining pathing errors, and for all my climbing, jumping, and gliding, I didn't fall through the world once. Shrine trials that required balls to be dropped into sockets worked consistently, and mechanisms generated new balls without fail if the orbs fell into bottomless pits. It's a testament both to the game's designers and to the ancient Hylians that made the shrines.

You can find hidden treasures in lakes and reveal mischievous plantlike Koroks for helpful rewards.

Deep dungeon-crawling isn't really among the many things you can do in Hyrule. There are plenty of mini-dungeons in the form of challenge shrines and a handful of larger set-piece adventures, but even the full-size dungeons I explored felt tiny compared with other 3D Zelda games' main quest dungeons. This isn't necessarily a complaint, considering there's so much to do in the game without the standard loop of fighting enemies, finding the key/compass/map, and beating the boss, repeated over and over. Still, long-time Zelda fans will find it a jarring change.



SLIGHTLY FADED

Breath of the Wild is the best-looking Zelda game yet. Hyrule looks gorgeous and full of detail, and the draw distance reaches impressively far when you get to a high vantage point. The action sometimes stutters, though, especially when you're fighting outside with a lot of individually waving blades of grass around. I experienced some hiccups in combat, but nothing that got in the way of playing.

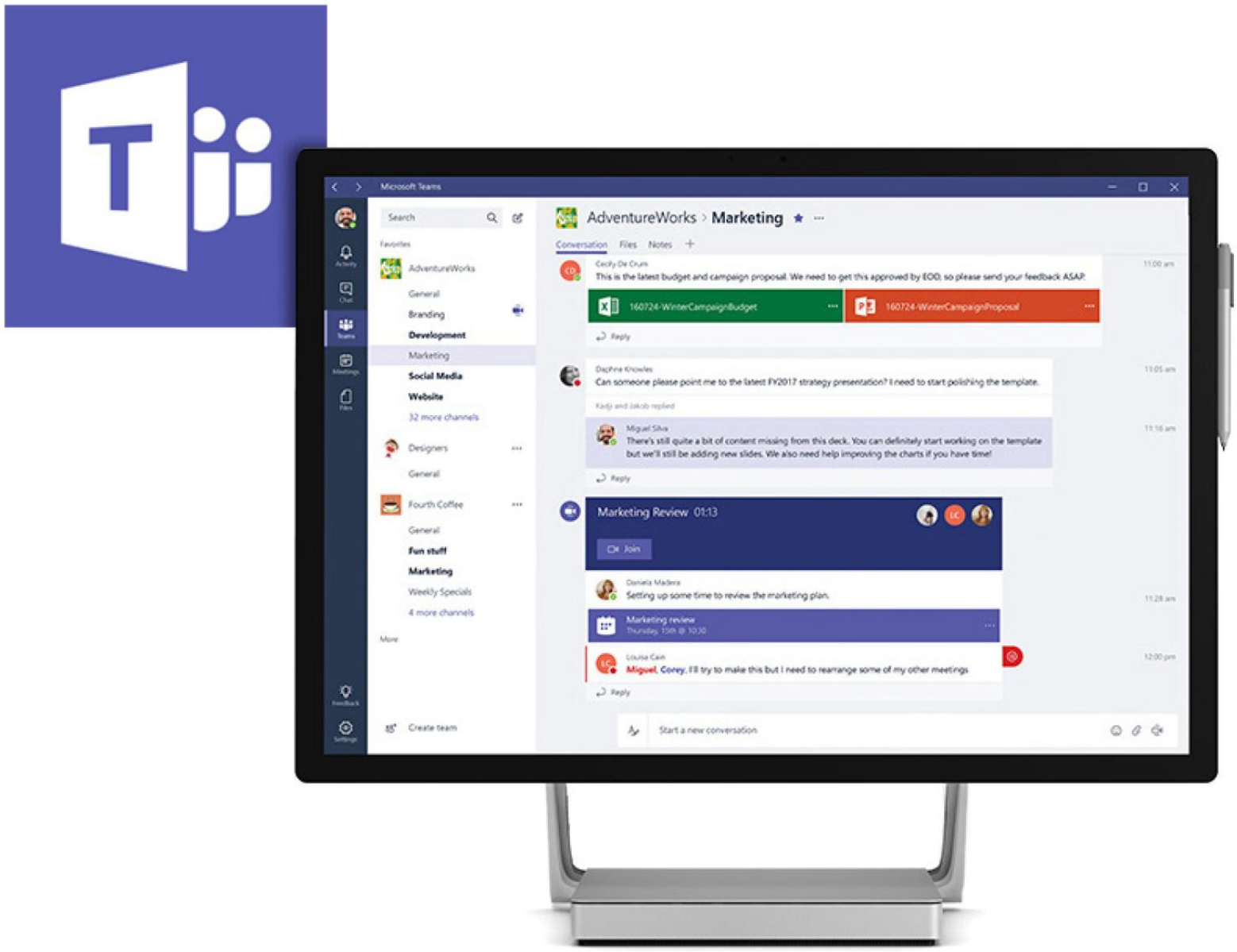
A HAZY SHADE
Breath of the Wild is a terrific-looking game, but often the colors appear a bit faded—a design decision that may not appeal to all players (including this reviewer). Still, this is easily forgiveable considering the massive scope of the game.

The art style is very striking in terms of model detail, but it often shows Link's adventures under a slight desaturation filter. That gives Breath of the Wild a unique look, but it also makes the game appear a tiny bit hazy, with weak color. I got used to the filter fairly quickly, but I never really appreciated it, and ended up switching my TV to its Vivid picture setting (which I haven't done for any other game).

CONCLUSION

The Legend of Zelda: Breath of the Wild is massive, dense, and incredibly satisfying to explore. It suffers from a few frustrations, most notably the strange desaturation filter that pervades the graphics, but they're all easily forgivable when held against the sheer scope and variety of what you can do in the game. This is the biggest and most impressive Zelda game we've seen yet, and after 30 hours in Hyrule, I'm still finding new things. The Legend of Zelda: Breath of the Wild easily earns a PCMag Editors' Choice.

WILL GREENWALD



Microsoft Teams: Excellent Collaboration Service

PC MAGAZINE EDITORS' CHOICE

If you've ever felt a disconnect among your applications, your files, and your coworkers, Microsoft Teams is designed with you in mind. Teams is a cloud-based collaboration chat app that takes the best aspects of Slack and connects them to Office 365, as well as more than 150 third-party applications. It's available as part of a subscription to Microsoft Office 365, which costs $5 per user per month.

Microsoft Teams

$5 per month

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For those of you who've never used a chat app at work, here's a small primer: Programs like Slack, HipChat, Workplace by Facebook, and now Teams provide you with a corporate-wide workspace in which your teams can have conversations as large groups or in smaller, private groups. Want to discuss marketing strategy? Create a private marketing chat room. Want to discuss the National Basketball Association? Create a private sports chat room. Want to send a message to the entire company? Send it in the General channel.

As chat apps have evolved, they've enabled companies to include video-conferencing tools, embedded video via YouTube, GIFs via Giphy, file sharing, and storage. Microsoft Teams can do all this in a cohesive and embedded manner by connecting Redmond's large ecosystem of business apps to the Teams interface on a desktop or via a mobile app across Android, iOS, and Windows phones.

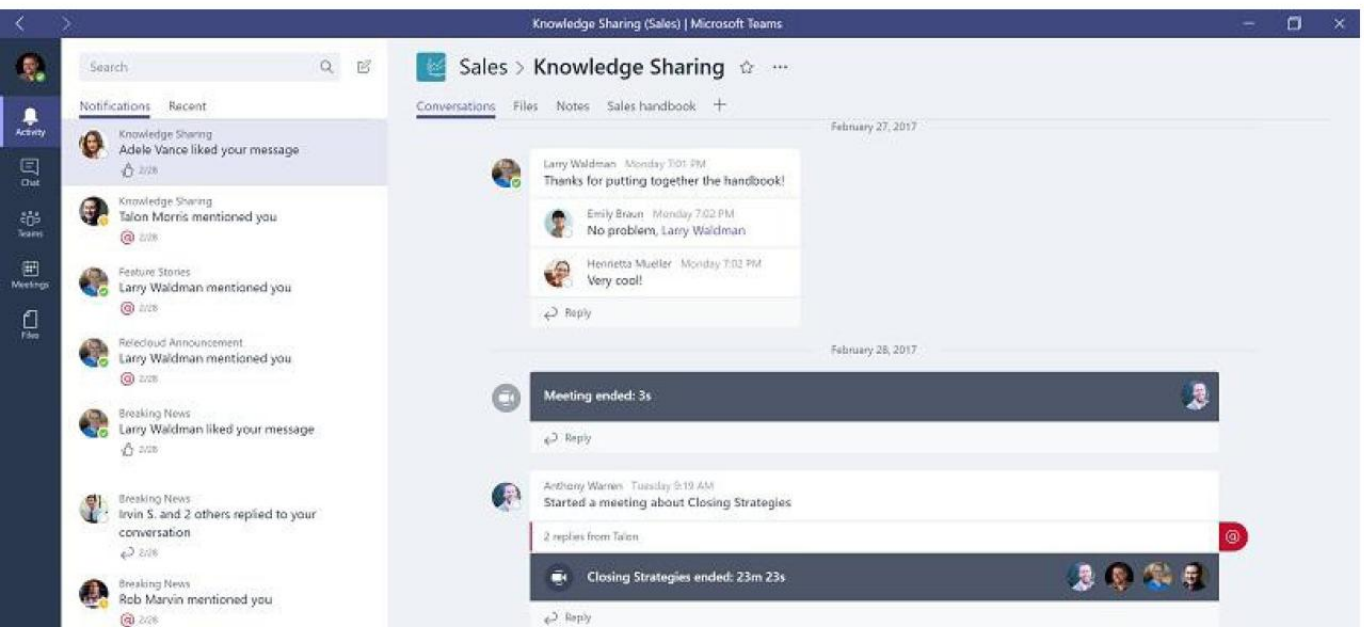
Microsoft Teams

PROS Plugs into the Microsoft Ecosystem for embedded application access. Allows for super-organized channel management.

CONS Looks exactly like Slack. Can only be used as part of Office 365.

INTERFACE

When you first open Teams, you see a left-hand rail that includes the Activity, Chat, Teams, Meetings, and Files tabs. Click into a tab to see the different channels and files that exist within the subgroup. The Teams interface is designed with a standard blue, grey, purple, and white theme that straddles the line between playful and serious. If this isn't your cup of tea, though, you can adjust Team's themes to one of two wackier and less corporate options.

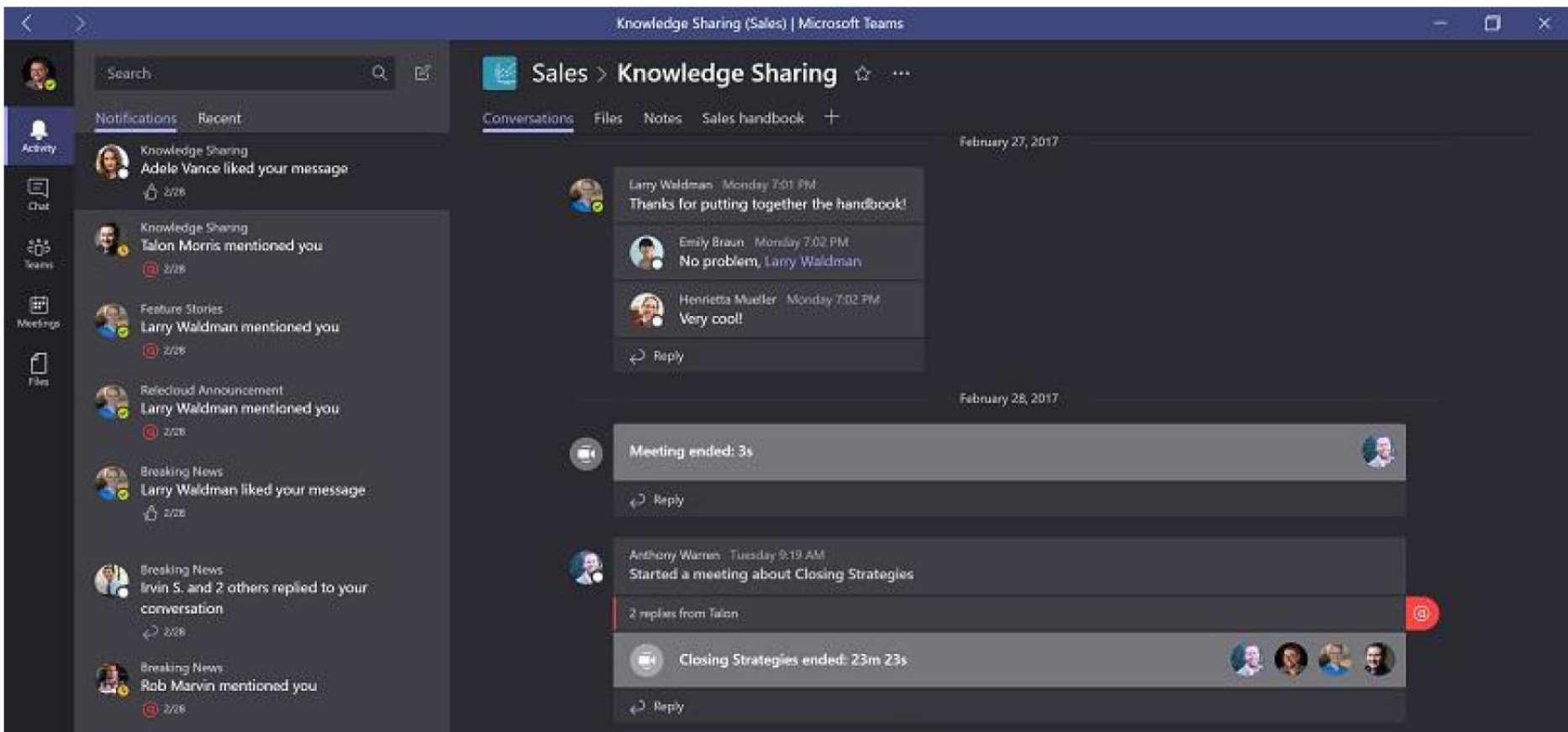


GROUP CHAT
Teams provides a more buttoned-up feel than what you'll get in Slack—a more "stream of group consciousness" philosophy.

Unlike Slack, which relies on a thread of conversations focused solely on the channel's topic, Teams lets you silo topics within a channel, to help you better manage conversations. For example, if your advertising team alternates between conversations about TV and billboard buys, you can create a sub-conversation within the channel for both topics. This has a more buttoned-up feel than Slack, which provides a more stream-of-group-consciousness philosophy to chatting.

Unlike Slack, which relies on a thread of conversations focused solely on the channel's topic, Teams lets you silo topics.

If you require lots of structure, Teams is absolutely more organized than Slack. But this organization can also be daunting. Whereas Slack and Atlassian HipChat focus primarily on chat rooms, Teams' five-pronged approach to navigation leaves more room for navigational error. Thankfully, as with HipChat and Slack, whenever you're mentioned directly anywhere within the Teams application, a red alert pops up on the Activity tab and directs you to your exact destination. You can customize alerts to notify you only when you're mentioned directly, or you can set alerts to notify you whenever any activity happens within a specific room. You can also mark activities as "read" and "unread" in order to set them aside for later. These are the minute features that separate Teams from other collaboration apps on the market.



At the top of each channel, you'll see a list of pre-populated services and tools that provide more context to the channel. Tools including ZenDesk, Microsoft Power BI, and Excel are easily accessible so users can view third-party or external data within the context of the channel. Users can view a document or application while having a conversation along the right side of the file. All cloud-based tools that update in real time will update within the feed. But to make changes to the applications you'll be directed out of Teams and into a web browser. So if you're viewing a Word document in Teams and notice a typo, you can chat with your colleagues to let them know a typo exists—but no one can actually fix the typo without being redirected to Office 365 on the Microsoft Edge browser.

Microsoft claims it is investigating ways to enable changes within the Teams experience, which would be a coup. Currently, tools like Asana, HipChat, and Slack allow users only to attach documents that can be viewed by individual users. Teams is the only tool that lets everyone look at a document within the context of a chatroom's thread. If Microsoft can enable real-time editing within the thread, it will have greatly surpassed its rivals' functionality.

Alongside the embedded tools you'll also find related files, a company organizational chart (powered by Active Directory), and an Activity tab, a running history of all of your interactions within the specific group.

SUPER SOCIAL

As with Slack and HipChat, you can easily embed files and GIFs from Giphy using shortcuts. You can also create memes by clicking on a design, cartoon, or

SHORTCUTS
Keyboard-command fans have plenty shortcuts to choose from in Teams.

image and then plugging in text. This is one of many examples of Microsoft embedding an experience into Teams; on Slack and HipChat, you have to leave the application to grab images and add text in order to create memes. It may seem minor, but given the highly social and collegial nature of chat apps, the ability to stay within the tool is crucial in order to save time for more professional work. Heck, you can even use an emoji to name a chat room. Slack won't even let you use uppercase letters or multiple words.

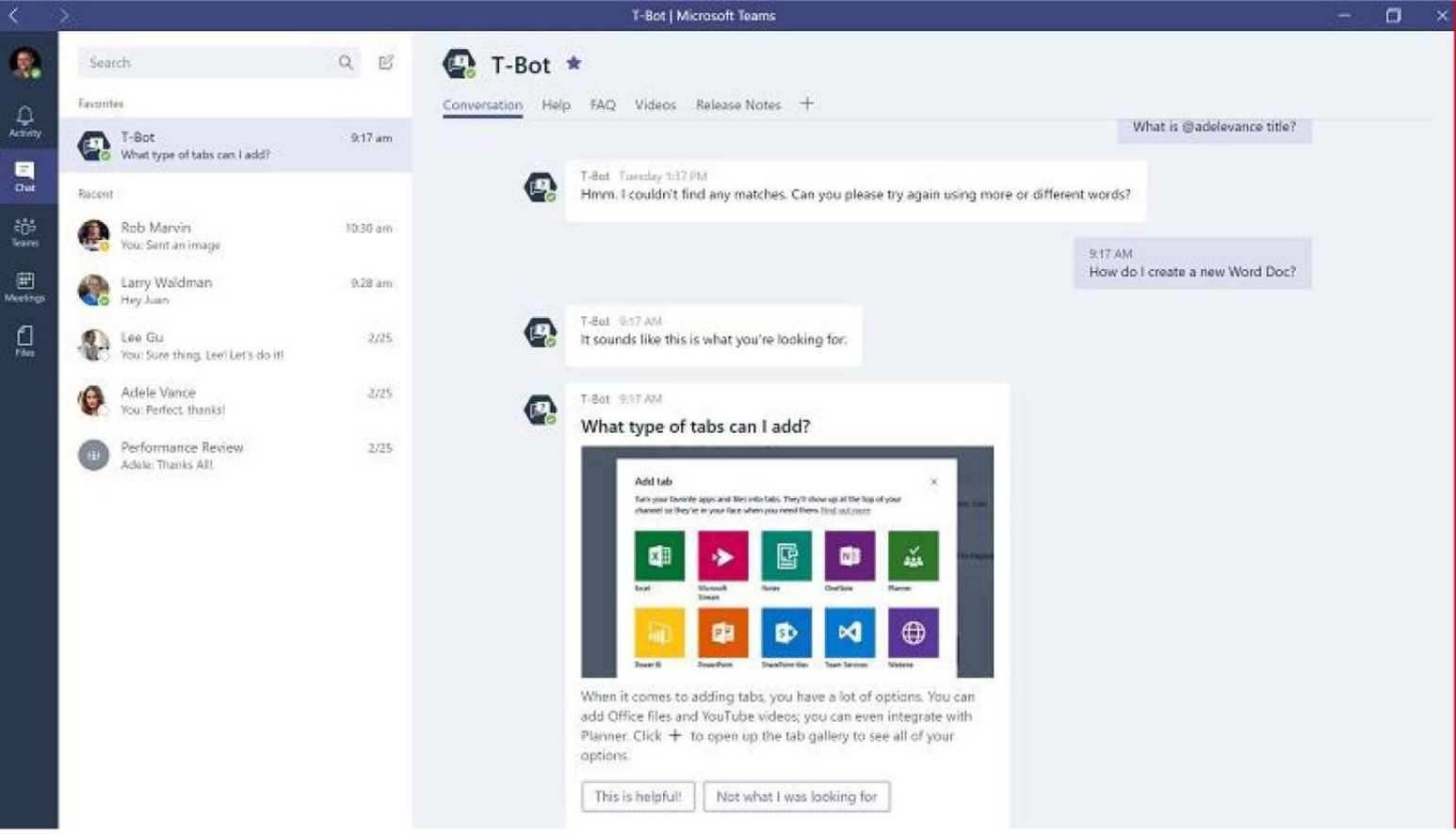
Teams allows you to connect to most cloud-based applications in real time. For example, you can plug a Twitter feed or a Facebook page into a Teams channel. This means that whenever a new tweet or update loads, it gets pushed into the conversation stream. This is a truly valuable experience, especially for organizations that rely on third-party information and timely responses to do their jobs (or for people like me who are too lazy to leave the Teams experience to check their Facebook notifications).

A video icon next to a conversation indicates that an open video conference is happening. You can jump into the meeting and take part, or you can avoid the channel so as not to be disruptive. These video chats aren't Skype conversations, so you don't have to worry about the back-end server implications of your Skype or Skype for Business accounts. Anyone in your Teams account can click on your name, click the video icon, and call you.

You can also schedule video calls for a later date. The tool alerts you that the call is about to begin, which is a nice upgrade over the basic video call feature available in HipChat and Slack. Teams even lets you view someone's Outlook calendar to determine the perfect time to schedule a Teams video call. All video calls can be set to "recurring" so you won't have to check everyone's schedules every time you want to have a conference call. More important, you can squeeze a whopping 80 participants into one Teams video call, which is four times as many as HipChat allows and more than four times as many as Slack allows (15).

BOTS IN MICROSOFT TEAMS

No chat app would be complete without unique bots. Teams integrates with PollyBot to allow you to take polls within a channel. So, if you're trying to decide where to have the company holiday party, you can list three restaurants and have your team vote on which one they'd prefer.



ASK T-BOT

T-Bot isn't the most helpful bot you'll encounter. I asked, "What time is it?" and for a Team member's title, and it couldn't provide responses. But when I asked, "How can I connect a Teams account to Outlook?" it surfaced the exact content I needed to complete the task.

T-Bot allows you to query the Teams tool to access automated answers about the Teams application. Ask the tool how to create memes or GIFs, and the bot surfaces content to help you perform an action. Unfortunately, T-Bot isn't the most helpful bot. I asked, "What time is it?" and it couldn't provide a response. I asked for a Team member's title and it couldn't provide a response. But when I asked, "How can I connect a Teams account to Outlook?" and "How do I create a new Word doc?" it surfaced the exact content I needed to help me accomplish my tasks.

WhoBot will eventually sit on the Microsoft graph and pull in Active Directory data to help you discover or learn more about people within your organization. If you ask WhoBot a question about a person, or if you ask about a specific subject, the bot will surface the person for whom you're looking, or subject matter experts in your organization who can help you find more information. You can also click on someone's profile and see where he or she sits on your company's org chart. Unfortunately, WhoBot wasn't connected to the application we tested for review, but T-Bot said WhoBot would be coming soon, and a human Microsoft rep confirmed that.

THE POSSIBILITIES

Teams is included in Office 365 Business Essentials, Business Premium, and Enterprise E1, E3, and E5 plan accounts. It is currently unclear whether you will one day be able to buy Teams as a standalone application, or whether you'll always need to purchase it as part of a new office 365 Business account. As I previously mentioned, Teams has integrated with more than 100 partners,

including Zendesk, Asana, and HootSuite. It is built with an open application programming interface, which means your company's developers can plug your existing applications into Teams to create similar embedded interactions.

Microsoft is also encouraging developers to create business-specific experiences and customizations for Teams. This is a dramatic departure from the other newcomer to the space, Workplace by Facebook, which connects only with Google G Suite, Okta, OneLogin, Ping, and Windows Azure AD. Although we generally enjoyed the group dynamic delivered in Workplace, we found it to be severely lacking the group collaboration functionality that makes Teams so dynamic.

Teams is a game-changer for any organization that would like its employees to spend the majority of their time in or near the application. If PCMag were to plug our content management system into the Teams interface (which is possible, by the way) there would be very little reason for me to ever leave Teams throughout the day. I assume an Edge plug-in will become available within the next year, which means that you'll never have to leave Teams to use a web browser. There is no indication that this integration is in the works, but it seems like a no-brainer.

Today, instead of Edge, you can plug in specific websites you'd like to navigate within the context of a channel. For example, you can add Bing to a channel to enable in-channel web searches. This is a solid option for extra-curricular Teams usage, but an inevitable Edge integration would be ideal. If it does come to fruition, Teams will function almost like Windows-within-Windows, which means you should expect Cortana integration at some point, as well.

“Your company's developers can plug your existing applications into Teams to create similar interactions.”

An integration with Windows' voice assistant will bring Teams to the ultimate level. You'll be able to ask T-Bot questions without having to type, launch video calls without pressing a button, and pull up a PowerPoint presentation, send it to your boss via a chat message, then create a meme that says something like "Too easy!" without ever having to touch your laptop. But let's not get ahead of ourselves. As of today you still can't even create a GIF using a Giphy shortcut the way you can in Slack. Teams is incredible, but it's still in its infancy.

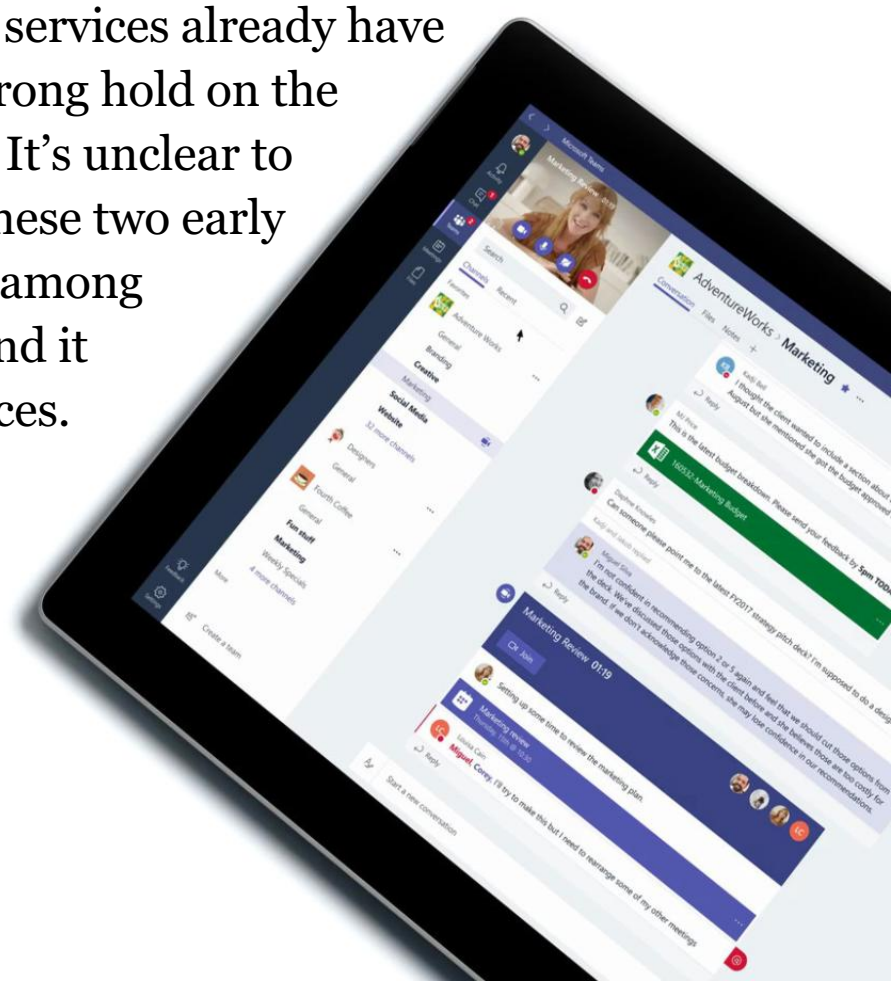
CONCLUSION

Clearly, Slack and HipChat are about to have some serious competition. Teams is capable, flexible, and enjoyable to use. Unfortunately, Teams comes with one huge caveat: Only organizations that are heavily invested in the Microsoft ecosystem will use Teams at full efficiency. If you're a company invested in Google Drive, or if you're on team Zoho, Teams won't really appeal to you in the same way it will to Microsoft Office 365 power users.

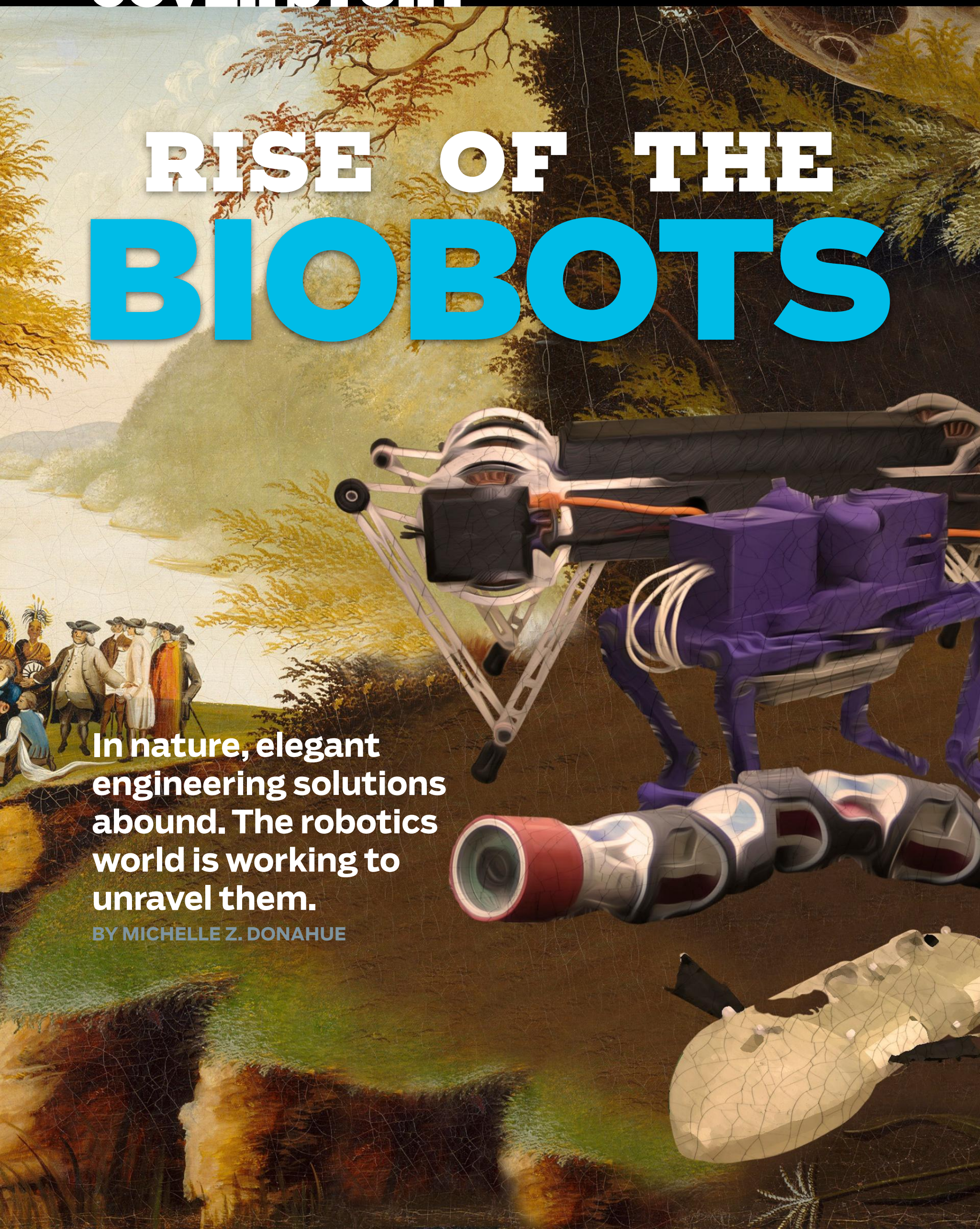
That said, I predict companies will make the switch to Office 365 to take advantage of Teams's impeccable organization and connectivity. The ability to review and approve documents within a video call means teams can essentially remove in-person meetings from the collaboration equation. The same can be said for its third-party integrations: Zendesk reps can answer customer service tickets, Asana team members can delegate tasks, and analytics teams can pivot strategy as Power BI dashboards update in real-time—all within Teams.

Microsoft couldn't have created Teams without the blueprint created by Editors' Choice winners HipChat and Slack. Those two services already have wide adoption, and Slack in particular has a strong hold on the mindshare of the technoscenti at the moment. It's unclear to what extent Teams can steal customers from these two early movers. But even if teams makes inroads only among Office 365 users, it's sure to be a big success, and it wins an Editors' Choice for collaboration services.

JUAN MARTINEZ



RISE OF THE BIOBOTS



In nature, elegant engineering solutions abound. The robotics world is working to unravel them.

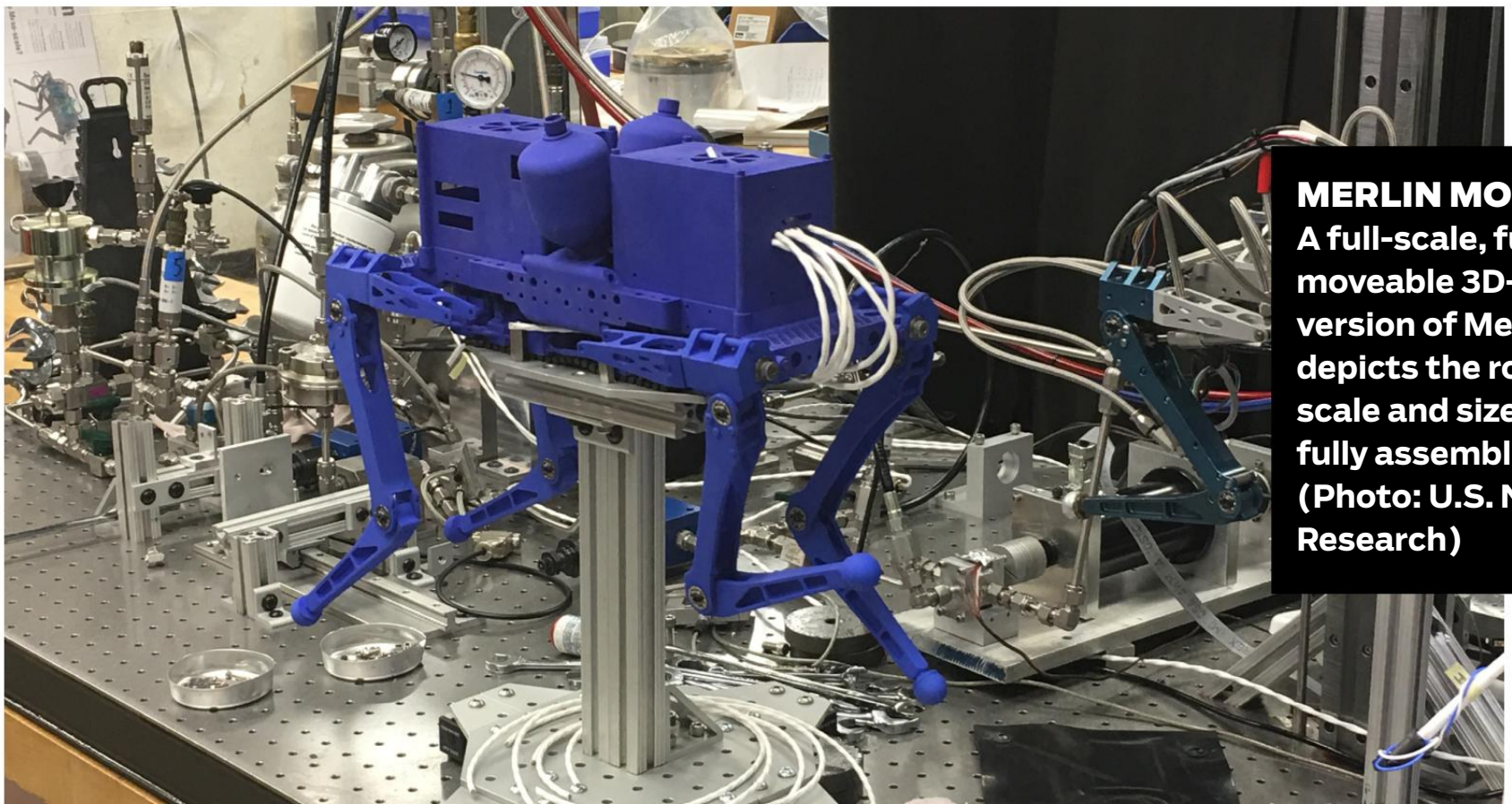
BY MICHELLE Z. DONAHUE

My escorts and I walked for five solid minutes through a converted World War II–era warehouse, winding through a maze of dim corridors and a cavernous rail bay, then through a lab full of spacecraft skeletons in the midst of prototyping. We finally reached the workbench where the Navy is building…a robot squirrel.

“Squirrel” is a bit of a stretch, as the first fully built-out version of the Meso-scale Robotic Locomotion Initiative (MeRLIn) will weigh 10 to 20 pounds when it’s finished this spring—a monster of a rodent, by anyone’s definition. The robot in its current form consists of a rectangular manifold and the 10th iteration of a dog-jointed leg, mounted on a sliding aluminum strut. A bright-blue 3-D printed model nearby showed how it will look when complete: a headless, four-legged machine about the size of a Yorkshire terrier.

But when the project’s engineers fired it up to give me a demonstration, I saw why they refer to MeRLIn as a squirrel: Despite its tiny motors and hydraulic-driven pistons, it can jump like hell.

MeRLIn is just one of the recent robots that have animals to thank for their inspiration. The animal kingdom is rife with examples of clever sensing and movement, and efficiency is king in the battery-driven, limited-power world of autonomous robotics. The ability to imitate a kangaroo’s jump, for instance, would realize an ideal tradeoff between power and performance: The tendons in their formidable hind limbs store energy between every stride, allowing the animals to travel long distances with relatively little energy expenditure.



MERLIN MOCKUP
A full-scale, fully moveable 3D-printed version of MeRLIn depicts the robot’s scale and size when fully assembled. (Photo: U.S. Naval Research)

Biology is behind some of the most innovative robotic designs emerging today: Look at UC Berkeley's Salto, inspired by the high-jumping African bushbaby, or the University of Virginia's mantabot, modeled after cownose rays of the Chesapeake Bay.

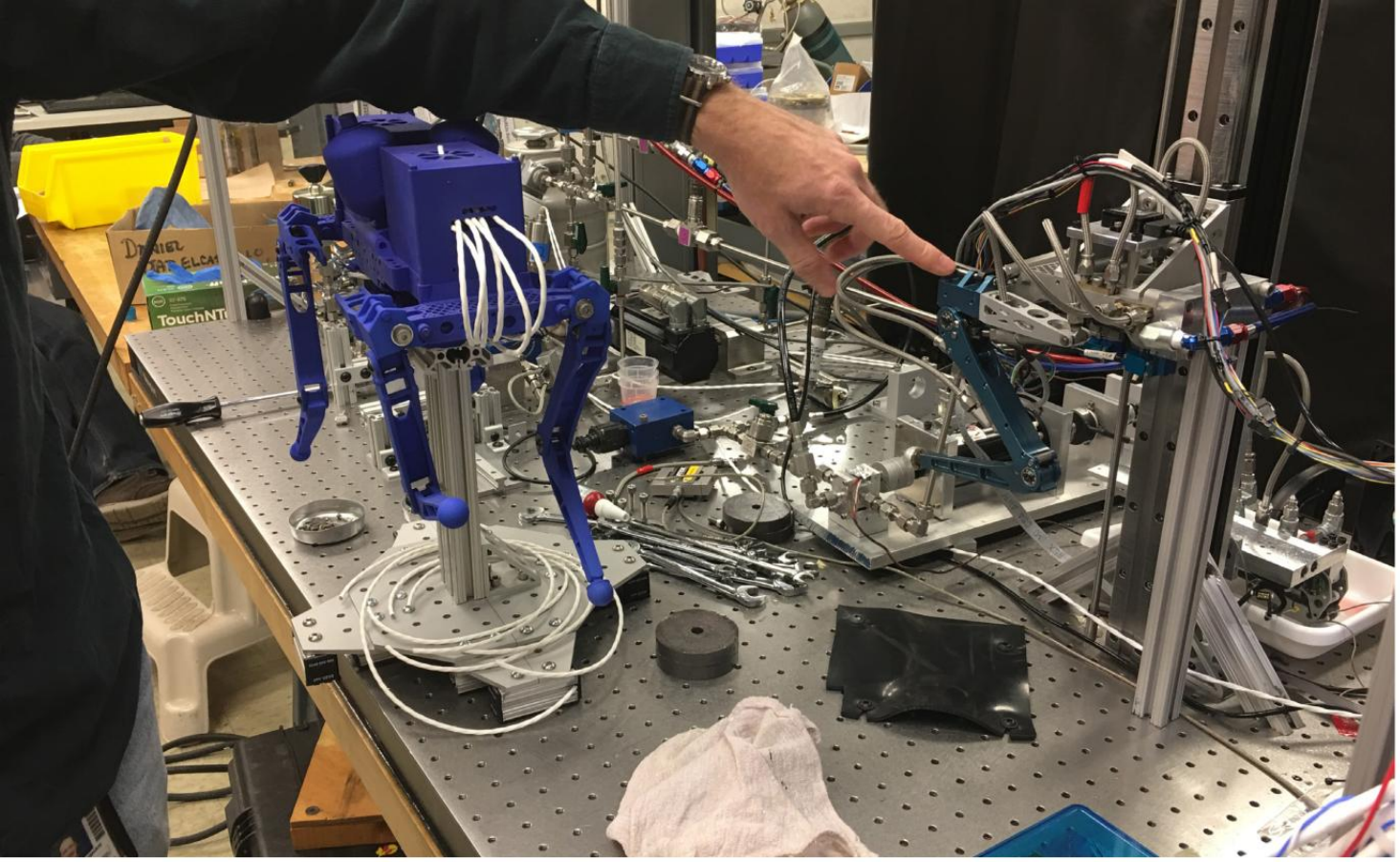
It's easy to see why. Biologically inspired designs have clear advantages when it comes to accomplishing tasks for which the human form is poorly adapted. From tiny flies to deep-sea fish and even microbes (some fuel cells are driven by microbial chemistry), nature has tinkered and tweaked amazingly effective ways to get jobs done. Millions of years of evolution has made animals incredibly effective at the jobs they do—flying, jumping, walking, and swimming; sensing in invisible spectra; and likely more abilities we haven't yet discovered.

But far from being mechanical replicas of animals, the bio-robots being built today are advancing the goal of distilling these elegant biological solutions. The push now is to parse what those strategies are, pare them down into their principal essences, and harness them for our own purposes. While scientists and engineers are building components that can move better, processors that can think deeper, and sensors that can detect more finely, though, stitching it all together into a truly functional, mass-producible package remains an elusive task.

The bio-robots being built today are advancing the goal of distilling these elegant biological solutions.

FALLING BEFORE WALKING

If MeRLIn looks a bit familiar—well, that's because it should. Glen Henshaw, the lead investigator of the project, said his team makes no bones about the fact that MeRLIn is inspired by much larger and heavier ancestors that have already found a good measure of Internet fame, including Boston Dynamics' L3 and Big Dog and MIT's Cheetah.



A LEG UP
Glen Henshaw, the primary investigator on the Navy's Merlin research team, points to the prototype of the robot's jumping leg on a test stand. (Photo: U.S. Naval Research Laboratory/ Victor Chen)

What the Navy Research Lab engineers are aiming for is a smaller, quieter, and more agile robot, one that doesn't require two strapping young Marines to set it up to check out potential hazards. But building MeRLIn is not as simple as merely scaling down all the parts to make a robot that can fit into a soldier's rucksack. It's also a process of understanding how and why certain gaits function, why those gaits are appropriate for varying terrain, and how to build a robot that can learn to adapt and choose the right ones.

Building MeRLIn is not as simple as scaling down all the parts to make a robot that can fit into a soldier's rucksack.

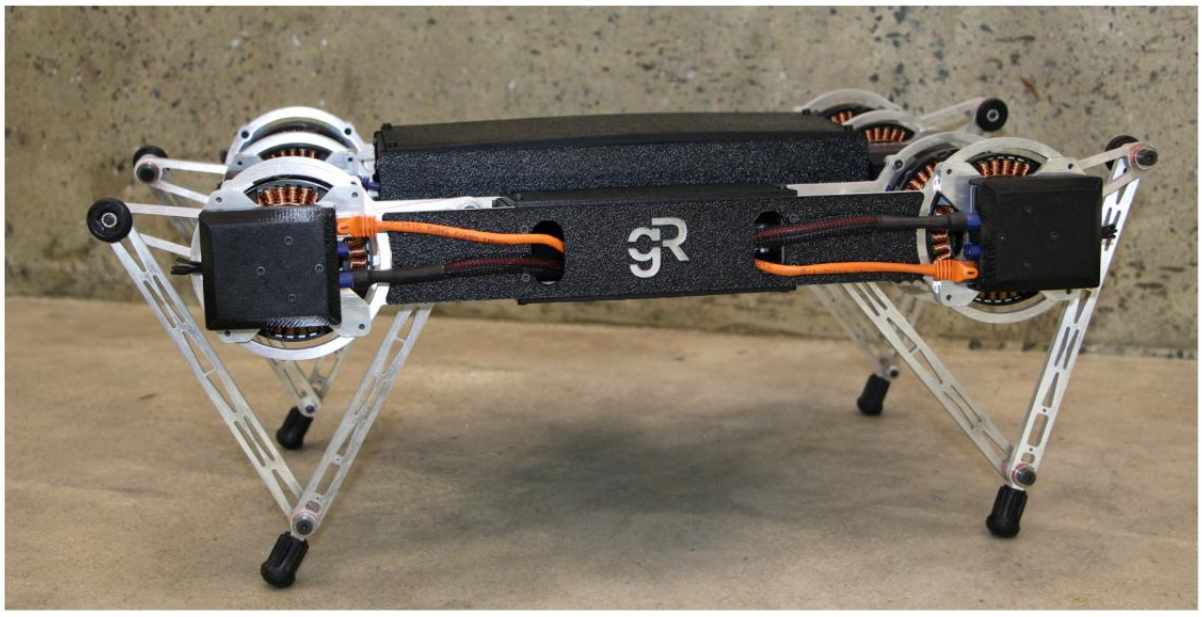
Arriving at MeRLIn's bench, Controls Engineer Joe Hays inputted several test commands to a computer, making the robot's leg twitch and jerk. After he removed its support strut, MeRLIn's single leg held up its brick-sized body under its own power, now charged with hydraulic fluid.

Moments later, with a lightning spasm, the leg launched merRLin nearly three feet into the air, guided up and back to the table by its vertical metal rail. Repeating this exercise three more times, the robot hit the ceiling of its protective enclosure after one final, powerful jump, landing so heavily that its leg collapsed.

“There’s a lot out there we still don’t know about animal locomotion, frankly,” Henshaw said. “And we really don’t understand the neuromuscular system as well as we’d like. We’re trying to build something without knowing exactly how it should walk.”

The team is still working out a few more issues with the hydraulics but has found good success with an adaptive algorithm that probes out and corrects for uncertainties in the hardware’s circuitry at a rate of once per millisecond. They expect to have it try to jump from the ground to a desk within several months.

At the University of Pennsylvania, Avik De and Gavin Kenneally’s Minitaur is another recent super-small, lightweight quadruped, created under the guidance of Dan Koditschek. Weighing scarcely 14 pounds, their little bot has an endearing, bounding gait. Endearment quickly turns to wonder, though, when you watch videos of their creation clambering up stairs, climbing fences, and jumping to unlatch a door handle.



MINITAUR
Avik De and Gavin Keneally’s Minitaur robot can traverse level surfaces, climb stairs and jump to open doors. (Photo courtesy Ghost Robotics)

De and Kenneally drastically cut the bulk of their bot by using free-swinging, direct-drive legs instead of traditional gear-driven legs. The motors act as feedback sensors to the robot’s software, detecting and adjusting the torque they deliver 1,000 times every second. The result is a robot that can bound along slowly or quickly, climb stairs, and jump up and swing a set of legs around to hook a door handle to open it.

Though it’s still far from autonomous, lacking sensors and control systems that would allow it free range, Minitaur’s unique, adjustable pogo-stick action demonstrates that agility is possible even without large, powerful drive mechanisms. It’s also made from commercially available parts.

“Clearly there’s plenty of motivation for having legs, but the current state of the technology is not mature enough and prohibitively expensive,” De said, referring also to Boston Dynamics’ Atlas robot—more than capable, but proprietary and pricey, so not easily replicated. “We wanted to make a robot that was accessible to other people so they could try to implement the platform for their own applications.”

SLITHERY SOLUTIONS

By his own admission, Howie Choset is afraid of snakes. It’s wonderfully ironic, then, that his best-known works can best be described as snakelike.

Choset, an associate professor at Carnegie Mellon University in Pittsburgh, has been working with snake robots since he was a graduate student, and he’s racked up a litany of accomplishments. He runs CMU’s Robotics Institute—a lab where many of the creations in progress feature the repeating body segments of snakes. He’s also an editor of the recently debuted Science Robotics journal and has authored a textbook on principles of robot motion.

And just to stay busy, he’s also founded two companies: Hebi Robotics and Medrobotics. The latter’s advanced endoscopic surgical tool, the Flex Robotic System, received FDA approval in 2015 for use. Though Choset is now no longer formally affiliated with Medrobotics, he said that watching a live operation in which the robot was used was the highpoint of his professional experience.

SNAKEBOT IN THE GRASS
Snake robots use their many internal degrees of freedom to thread through crowded spaces and access locations that people and machinery otherwise cannot. They can perform a variety of locomotive gaits, going beyond crawling, climbing, and swimming.

Choset demurs on whether the Flex was inspired by snakes; he said the robot's serpentine form was designed with the twists and turns of human inner space in mind. But other, more recent work has most certainly involved looking at snakes and modeling robots after them, especially through collaboration with Georgia Tech's Dan Goldman, a physicist whose research in biomechanics has led to the creation of robots inspired by the movement of crabs, sea turtles, cockroaches, mudskippers and sandfish.

Choset also acknowledges the influence of one of the original pioneers of bio-inspired robotics, Robert Full, who runs UC Berkeley's Poly-Pedal lab. By studying how cockroaches move and how geckos climb vertical surfaces, Full, Choset, and others seek to boil these secrets down into general design principles that can be applied in novel ways.

"Should we copy biology? No. Ask a biologist for that," Choset said. "What we want is to cherry-pick the best principles and go from there."

Together, Choset and Goldman, along with Zoo Atlanta's Joseph Mendelson, studied the movement of sidewinder snakes, ultimately characterizing their sharp-turning movements as a series of shape-shifting waves. Applying that knowledge to the programming for his robotic snakes, Choset's team was able to make them clamber over mounds of sand, a previously impossible task. Understanding how snakes change their body shape to get themselves around has also allowed Choset to build snake robots that can writhe up posts and the insides of door lintels, something he envisions as eminently useful for exploring dangerous interiors—say, a nuclear power plant or the inaccessible confines of an archaeological site.

"I'm humbled by the fact that biology is so complex and can only hope to take a little bit of it and put it into our robots," Choset said. "But we're not replicating animals to the fine degree and capability that animals have. What we want is to build mechanisms and systems that have great capabilities."

His description of his own advances and his students' achievements and discoveries as fairly serendipitous also applies to how robots like these will emerge into the world as they mature. Slowly, in small increments, the research is getting there, he said.

"Evolution is haphazard, too," Choset asserted. "There's no one tipping point, only a sequence of developments that, seen from the outside, looks like a big breakthrough."

A CRITICAL CROSSOVER

In the main, engineers can't be expected to know how biology works, which makes collaborations between engineers and biologists critical. At the University of Chicago, biologist Mark Westneat's studies of wrasses, a class of fish, led to a collaboration with the Navy, resulting in a slow-moving but agile underwater drone that can hover in place. Known as WANDA (which stands for "Wrasse-inspired Agile Near-shore Deformable-fin Automaton"), drones like these will be useful for inspections of ships' hulls, piers and oil rigs.

Engineers can't be expected to know how biology works, which makes collaborations with biologists critical.

High-speed photography was central to the effort nearly 20 years ago, when Westneat first started doing imaging studies of the wrasses and before the Navy got interested in the work. In a flow tank with a constant current, which Westneat calls a "treadmill for fish," wrasses swim along happily, using only their pectoral fins to maintain a fixed position in the tank while high-speed cameras capture every detail of that movement at 1,000 frames per second.

FISHBOT OUT OF WATER

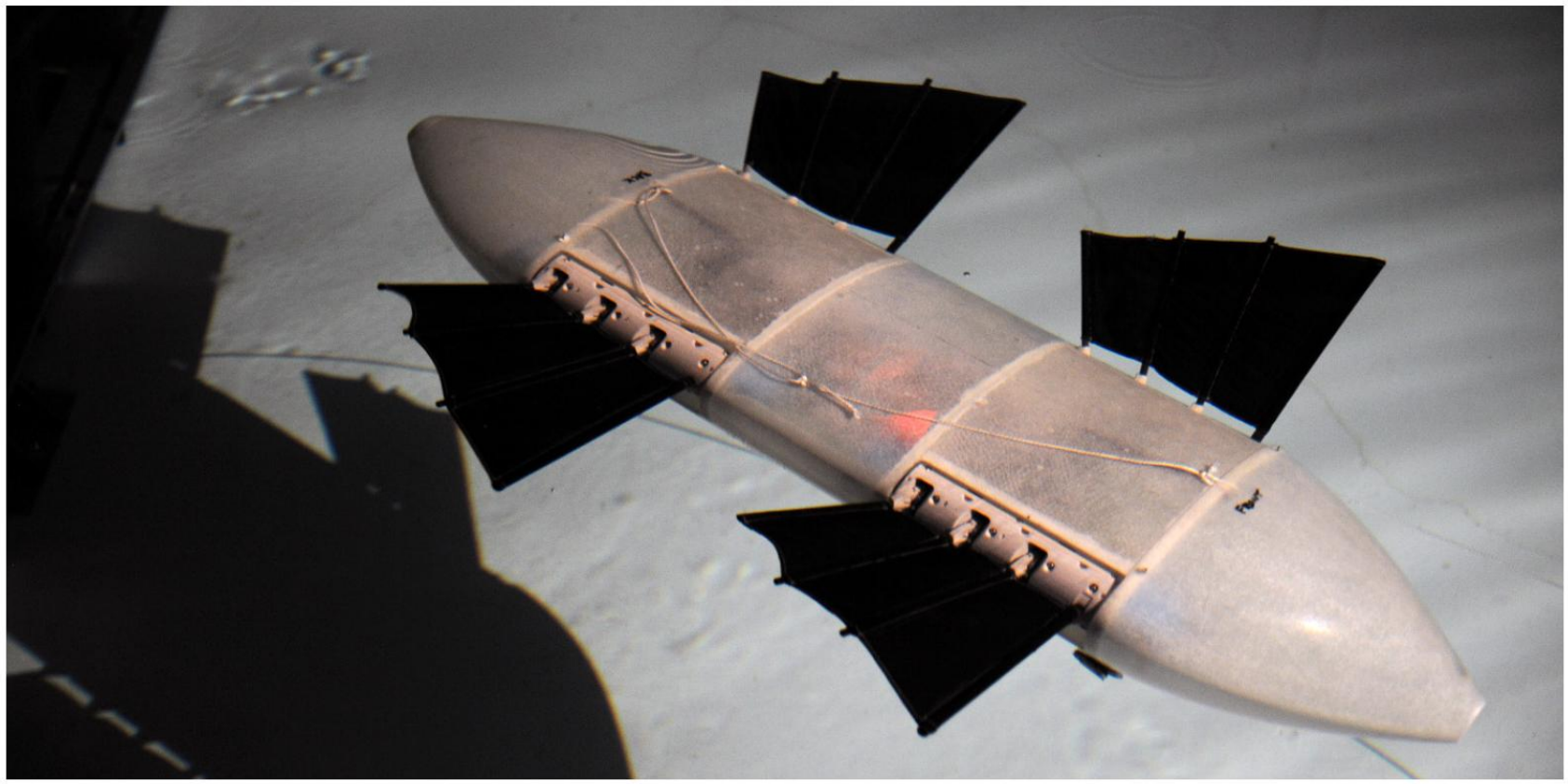
WANDA lead engineer Jason Geder demonstrates how the drone's shape-changing fins let it hover in place and perform tight turns at low speed in shifting water currents. (Photo: U.S. Naval Research Laboratory/ Victor Chen)

Combined with the biologists' highly detailed knowledge of the fish's anatomy—how its fin rays attach to its muscles, how the nerve endings in fin membranes relay stresses and tension—the photography enables a deep knowledge of how exactly the wrasses propel themselves through the water with the twisting and torsion of their characteristic penguin-like flapping stroke. The wrasse's ability to essentially hover in place while keeping its body still in even in strong or fluctuating currents makes it an ideal species to model for a novel type of agile underwater vehicle, said Jason Geder, a lead engineer on the WANDA project at NRL.

A FISH CALLED...
Naval Research Laboratory researcher Marius Pruessner prepares to test WANDA in open water outside of the lab. (Photo: U.S. Naval Research Laboratory/ Jamie Hartman)

"Traditional propeller- or thruster-driven vehicles don't have that kind of maneuverability or have too high of a turn radius," Geder said. "This was a good fish to model, because if we wanted to have a rigid hull for payloads at the center of the vehicle, we could get similar performance just using this kind of pectoral fin movement."

Westneat thinks that newer 3D photographic capability can advance the research even further. "For the fish, it's life or death, but for us, a better understanding of efficiency can mean better battery power," Westneat said. "We'd really like to closely mimic the underlying skeletal structure and mechanical properties of the membranes and see if we can get super-high efficiency."



Museums' biological collections are another rich and underutilized resource for researchers. The Smithsonian, for example, holds nearly 600,000 specimens in its vertebrate collection alone, and Virginia Tech's Rolf Müller has drawn upon these holdings for his work on bat-inspired drones. Using 3D scans of bat ears and noses from the Smithsonian, Mueller has created similar structures for his flying robot to help it report feedback through its zip-line-guided test runs.

"You have these millions of specimens lined up in drawers, which you can access very quickly," Müller said. He's been involved in the creation of a consortium of museum professionals and researchers to help make collections like these across the country more accessible for bioinspired advancement.

And then, no matter whether the source is swimming in a tank or lying in a storage drawer, translating that data into a useful form remains a challenge. "Your typical engineer wants specs, but the biologist might be handing them anatomical drawings," Westneat said.

It wasn't until he started going to some of these engineering talks himself that he realized his work could provide mechanical data of the fish's movements that could translate into motor power and forces, data engineers need to produce a working machine. "Those are the things that natural selection can act upon, but they also make the difference between the autonomous vehicle that makes it back to the ship or not."

BACK TO SCHOOL

Learning, memory, and adaptation are other challenges entirely. Back at the Navy's converted warehouse, the MeRLIn team is still primarily engaged with the problems of miniaturization. But they're all too aware that the robot they envision wouldn't be complete without the ability to learn, remember, and adapt to its environment.

Henshaw, who raises sheep at home when he's not at the lab, said watching newborn lambs go from a moist heap to walking in a matter of hours underscores the difficulty of artificially replicating that process. "There's no one who really understands how it works," Henshaw said of the neural changes required of lambs to continually adapt their locomotion to rapid body mass changes as they grow into sheep. One approach his team is taking to address that strategy is to write software that allows them to change the way MeRLIn gaits are generated.

Separately, Henshaw is part of another project to develop a biologically inspired learning system. He showed me a video of a robotic leg kicking a ball into a small soccer goal. After three programmed kicks, the leg kicks the ball on its own 78 more times, systematically choosing its own targets and keeping track of its successes and failures. Further refined and applied to a robot like MeRLIn, code like this would make it easier for a walking robot to adapt on its own to different payload weights or leg lengths, for example.

"A lot of projects have equations that figure out how to optimize the center of gravity or motion through big mathematical equations in real time," Henshaw said. "It works, but it's not exactly biological. I can't claim that the algorithm I've written [for the ball-kicking robot] is precisely what's going on in the brain, but it seems like something that has to be going on. Humans learn to climb trees and kick balls through practice, not numerical optimization."

Deep learning and access to collected knowledge would probably accelerate this process, Henshaw added, but there again, the hardware isn't robust or small enough yet to fit onto something as diminutive as MeRLIn. "If you want these small robots, it's not so much that we have to improve the algorithms but the hardware they run on," he said. "Otherwise it's going to take a computer that's too big, with batteries that are too big, and it just won't work."

AN EMERGING MARKET

The shortcuts that biology provides for creating innovative body platforms and locomotion strategies may also help make biologically inspired robots more economically viable, as well. Choset is not the only academic who has started a company to help advance practical applications for his creations; in fact, Eelume, founded by Norwegian University of Science and Technology robotics professor Kristin Ytterstad Pettersen, is currently marketing its own robotic swimming snake for underwater exploration and inspection tasks. And De and Kinneally founded Ghost Robotics, a company to market Minitaur.

Large private companies are getting in on the game as well. Boston Engineering is in the end stages of running field demonstrations with its marine-inspection robot, dubbed BioSwimmer. This bot is not merely inspired by a tuna—its entire outer body is based on scans of a five-foot-long bluefin tuna that was caught near the company's offices in Waltham, MA. And as with a living tuna, propulsion power originates in the tail, allowing the front half of the vehicle to be stacked with sensors and payloads. The goal wasn't to mimic a tuna, though, but to harness the efficiency and high performance of the animal.

Mike Rufo, director of Boston Engineering's advanced systems group, said the biological aspects of the design didn't make it easier to build out, but it didn't add extra difficulties either. Rufo claims the company built BioSwimmer (which is five feet long and 100 pounds) for about the same cost as similar projects—around $1 million—and that it will be priced similarly to other vehicles of its size. But efficiencies of motion provided by the tuna-inspired propulsion strategy allow it to operate longer on standard power sources.

“Its entire outer body is based on scans of a five-foot-long bluefin tuna that was caught near the company's offices.”

"There are a few technical hurdles that are in our way, collectively, with bioinspired robotics," Rufo said. "But bioinspiration offers opportunities to address those directly or to improve performance in a way that mitigates the impact of those challenges. For example, despite some really cool advances in battery technology, we're on a plateau of how much power you can integrate into something of a given size. But if you can address the efficiency of a system, then maybe the battery doesn't impact you so much. That's one area where bioinspiration plays a big role." Still, he thinks robots like these won't be commonplace for at least the next five to 10 years.

Huge strides have been made even in the last several years toward encapsulating what biology and evolution have made clear.

Despite the monumental challenges to be surmounted before we have not-too-creepy robotic helpers in our everyday lives, huge strides have been made even in the last several years toward encapsulating what biology and evolution have made clear: the dazzling ability of organisms to adapt and perform.

"It does seem Sisyphean sometimes, yes," Westneat said. "I look at these aquatic robots, and they seem clunky to me; but then, I'm used to seeing these graceful animals swimming through a coral reef. But it's not too outrageous to think that the engineers and biologists can get together and create robots that you throw into the water that swim off by themselves. Everything is exciting."

FEATURE

MEET THE WEAPONIZED PROPAGANDA AI

THAT KNOWS YOU BETTER THAN YOU KNOW YOURSELF

BY JESSICA HALL

Is it worse to be distracted by irrelevant ads or to be monitored closely enough that the ads are accurate but creepy? Why choose? A company called Cambridge Analytica has managed to apply what some are calling a "weaponized AI propaganda machine" in order to visit both fates upon us at once. And it's all made possible by Facebook.

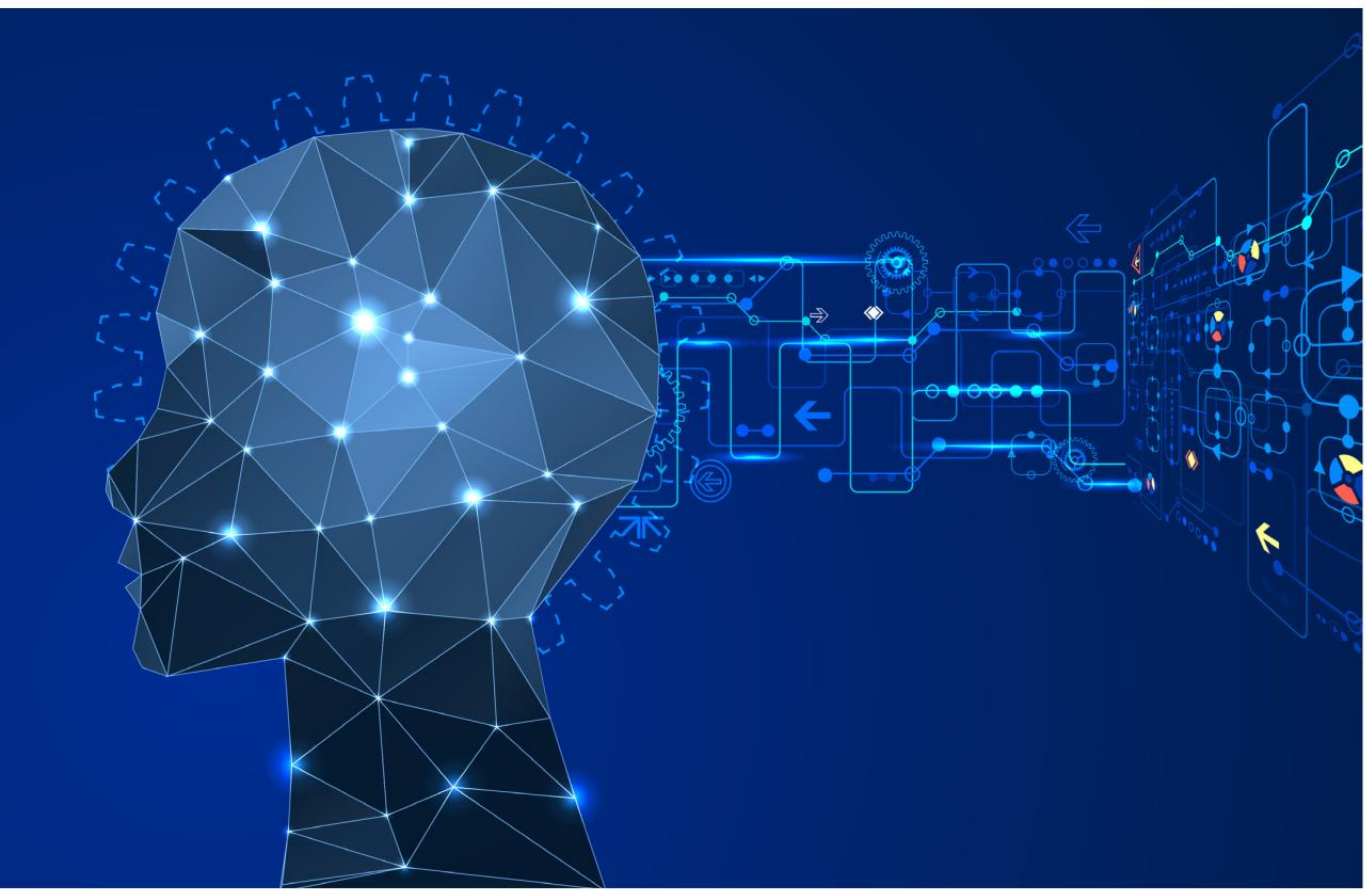
Cambridge Analytica specializes in the mass manipulation of thought. One way it accomplishes this is through social media, particularly by deploying "native advertising." Otherwise known as sponsored content, these are ads designed to fool you into assimilating the ad unchallenged. The company also uses Facebook as a platform to push micro-targeted posts to specific audiences, looking for the tipping point where someone's political inclination can be changed, just a little bit, for the right price. Much like Facebook games designed specifically for their addictive potential, rather than for any entertainment value, these intellectual salesmen exist solely to hit every sub-perceptual lever in order to bypass our conscious barriers.

A NEW APPLICATION FOR BIG DATA

Cambridge Analytica is one subsidiary of a U.K.-based firm called SCL—Strategic Communication Laboratories—that does business in "psychometrics," an emerging field concerned with applying the big data approach to psychology and the social sciences. SCL also claims secretive but highly paid disinformation and psy-ops contract work on at least four continents. Its CV includes work done on the public dime here in America, training our military for counterterrorism. Also among its services is the euphemistically named practice of "election management." It is riding to fame (or at least better funding) on the coattails of Donald Trump's ascension to the White House, for which it claims no small degree of responsibility.

"If you want certainty, you need scale," the company's website asserts, and it says it's just the outfit to provide it. Like any business proposition, this is best taken with some skepticism. But turning political tides in favor of the highest bidder's ideology is its whole business model. Its parent company claims to have exerted material influence over elections and other geopolitical outcomes in 22 countries. It, and Cambridge Analytica as its agent, claims to be a mindshare broker of the highest order.

Nobody is willing to go on the record and put their name to assertions that the emperor has no clothes, for fear of incurring the wrath of newly powerful Cambridge Analytica board member Steve Bannon or yanking too hard on the Koch brothers' monetary speech apparatus. It's not clear whether Cambridge Analytica is pulling the strings it says it's pulling or is just really good at knowing what side is going to win. But it definitely has something under its hat.

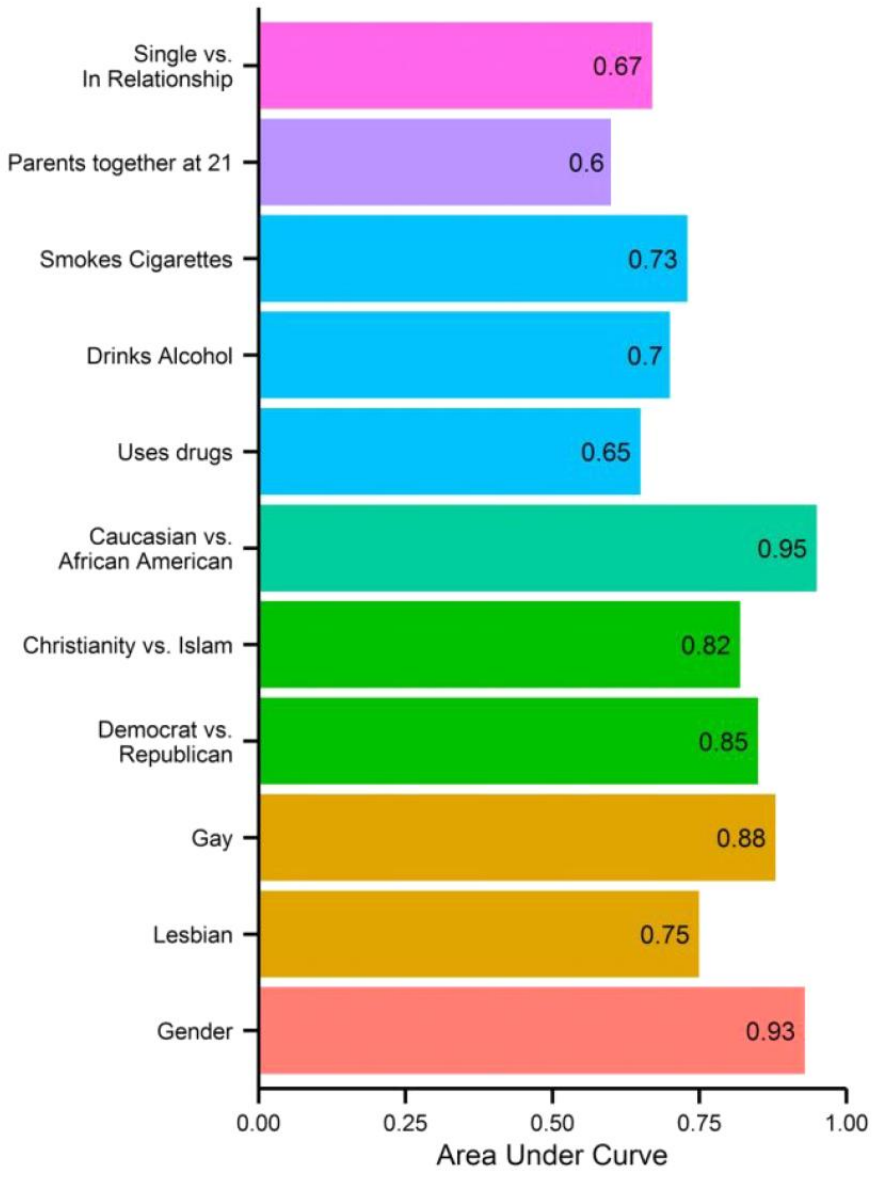


> **Otherwise known as sponsored content, these are ads designed to fool you into assimi-lating them unchallenged.**

A few fundamental tech applications underlie what Cambridge Analytica claims it can do. But they all depend on the idea that artificial intelligence isn't some dissimilar alien entity, sprung fully self-actualized from the forebrain of humanity like HAL. AI is an extension of human intelligence, which we accomplish by applying the organization and data-handling power of computers to our own tasks and problems. On a reductionist level, all they're doing at Cambridge Analytica is using more RAM and a rigorous, written-down set of rules to organize and manipulate data that social scientists handled with clipboards and calculators and pencils back in the day.

The AI that enables the entire business model for the company is likely an intellectual descendant of Dr. Michal Kosinski's work in the Cambridge University social sciences department—and an illegitimate one, if you ask Kosinski. The story reads like a film noir. It starts with the marriage of Facebook, psychology, and AI.

Facebook activity has an uncanny amount of predictive power. Back in the 80s, scientists developed the questionnaire-based OCEAN model of five major psychological traits, still in use today. Michal Kosinski's 2014 PhD project rested on a psychometric Facebook survey called MyPersonality, which added AI to the mix. MyPersonality catalogued participants' Facebook profile information, including social connections and "likes," and also asked participants to take a Facebook quiz to find out their OCEAN scores. Then it used machine learning to predict their OCEAN scores based on their Facebook activity. With only a person's Facebook likes plugged into a MyPersonality dossier, Kosinski's AI could reliably predict "sexual orientation, ethnicity, religious and political views, personality traits, intelligence, happiness, use of addictive substances, parental separation, age, and gender."



WHO ARE YOU?
Success rates for Kosinski's prediction algorithm. *Source: www.pnas.org*

More data meant a better guess, of course. Seventy "likes" were enough to make the AI's prediction of a person's OCEAN score better than their friends could do, 150 made it more accurate than what their parents got, and 300 "likes" could do better predicting a person's OCEAN score than the best human judge of a person: their spouse. More "likes" could even surpass what a person thought they knew about themselves, by predicting their OCEAN score closer than the person's own best estimate of what their score would be.

It goes the other way, too. To a database, a person's name and entries from their profile are just nodes in an n-dimensional space, and the connections between nodes aren't necessarily directional. You can class individuals by similarities in the data, or you can search the data for individuals who fit into a class. It's as simple as doing an alphabetical sort in an Excel sheet.

Working with the predictive power of Facebook likes and quizzes became Kosinski's stock in trade.

Working with the predictive power of Facebook likes and quizzes became Kosinski's stock in trade. Kosinski even used Amazon's Mechanical Turk in some of his research, crowdsourcing his quizzes to probe what made people respond to them. (Spoiler: Getting paid helps.) His work earned him a deputy directorship at Cambridge's Psychometrics Centre. It also earned him the attention of SCL.

Kosinski told Motherboard that in 2014, a junior professor in his department named Aleksandr Kogan cold approached him asking for access to the MyPersonality database. Kogan, it turns out, was affiliated with SCL. Kosinski Googled Kogan, discovered this affiliation, and declined to collaborate. But his research and methods were already in the wild, which meant in Kogan's hands.

Kogan founded his own company that contracted with SCL to do psychometrics and predictive analysis using aggregated Facebook data and a governing AI. At least some of this data came from jobs posted to Mechanical Turk, where participants were paid about $1 in exchange for access to Facebook profile data. Kogan changed his name and moved to Singapore. Kosinski remained deputy director of the Psychometrics Centre until he moved to the U.S. in 2014.

CONVERSION PIXELS AND YOU

Facebook has been in the news again and again because of the sheer extent of its data collection. One way it gets the information is by using something called a conversion pixel. You know that stupid social network widget that's on every webpage these days? It's designed to let you like and share a page without having to navigate back to Facebook. It also affords incredible mass surveillance opportunities.

“Facebook has been in the news again and again because of the sheer extent of its data collection.”

Every time you visit a webpage with a Facebook share widget, you query one of Facebook's servers for a conversion pixel. Facebook then promptly attempts to phone home with what link you visited, how long you lingered on the page, whether you scrolled down or signed up or bought anything, and whether you chose to like or share the page, in addition to the text of whatever comment you might have posted at the bottom using your Facebook profile—even if you delete the text and don't publish the post. Likes already have enough predictive power; between likes and activity, that widget can produce a comprehensive set of metadata on a person's personality.

When logged-in users take Facebook quizzes like Kosinski's, the quiz can ask for permission to scrape any or all of this data out of their Facebook profile and into the hands of any marketer, data analyst, or election management specialist willing to pay for it. That and purchasing life-history data and credit reports from brokers like Experian is how Cambridge Analytica profiles its marks in the first place. In return—maximum—you get to post a little quizlet thing to your wall, so you and all of your friends can know which *Walking Dead* character you would be.

Between likes and activity, that widget can produce a comprehensive set of metadata on a person's personality.

This is not an exchange of equivalent value.

And then there's microtargeting: the idea that Alice the Advertiser can accurately change the mind of Bob the Buyer based on information Alice can buy. The notion of microtargeting is not new, but what Cambridge Analytica is doing with it is novel. It's using the Facebook ecosystem, because it perfectly enables the goal of targeting individuals and using their longer-lasting personality characteristics like a psychological GPS. This all hinges on a Facebook advertising tool called "unpublished posts." Among advertisers, these are simply called "dark posts."

MICROTARGETING
Cambridge Analytica uses this method to use individuals' long-lasting personality characteristics to change their minds.

NEXT STOP: POLITICS

Normally, when you create a Facebook post, it appears on your timeline within your current privacy settings; this is true for people and pages alike. When an advertiser makes a dark post, though, it can choose to serve that post to only a certain subset of users. Nobody sees it but the people the advertiser was targeting. And they're canny about choosing their targets, looking for "persuadable" voters.

When an advertiser makes a dark post, though, it can choose to serve that post to only a certain subset of users.

For example, as Cambridge Analytica's CEO Alexander Nix explained in an op-ed last year about the company's work on the Ted Cruz presidential campaign, "Our issues model identified that there was a small pocket of voters in Iowa who felt strongly that citizens should be required by law to show photo ID at polling stations."

Almost certainly informed by Kosinski's work on Facebook profiling, Cambridge Analytica used the OCEAN model to advise the Cruz campaign on how to capture the vote on the issue of voter ID. The approach: Use machine learning to classify, target, and serve dark posts to specific individuals based on their unique profiles, in order to use this relatively niche issue as a political pressure point to motivate them to go out and vote for Cruz. Later, Cambridge Analytica would use the same approach for the Trump campaign. It's not possible to make a complete count, but various places around the web have claimed that Cambridge Analytica tested between 45,000 and 175,000 different dark posts on the days of the Clinton-Trump debates.

Where does it get all the content to serve? It's difficult to say, because Cambridge Analytica doesn't respond to journalists who ask it about its methods. But the $6 million or so Trump has paid Cambridge Analytica can pay just so many people for just so long. One journalist

has been digging into this issue, and his research strongly suggests that much of the political propaganda surrounding the 2016 election was procedurally generated using machine learning, and then packaged and served to target audiences. As that Facebook widget follows a user around the web, the AI gets better and better at serving the user politically polarizing content she'll click on. Mindshare acquired.

Nix went on: "For people in the 'Temperamental' personality group, who tend to dislike commitment, messaging on the issue should take the line that showing your ID to vote is as 'easy as buying a case of beer.' Whereas the right message for people in the 'Stoic Traditionalist' group, who have strongly held conventional views, is that showing your ID in order to vote is simply part of the privilege of living in a democracy."

The AI gets better and better at serving the user politically polarizing content she'll click on.

"We call this behavioral microtargeting," Nix later told Bloomberg, "and this is really our secret sauce, if you like. This is what we're bringing to America."

WHAT CAN YOU DO?

If you don't want to opt in to the "secret sauce," what recourse do you have? On the individual level, to put it bluntly, get good at knowing when you're being sold something. Don't reward intellectual salesmanship that you wouldn't tolerate elsewhere. After all, if you build a better mousetrap, nature will build a better mouse.

From the top-down direction, one way is to work to pass strong privacy regulations. They would need to entail meaningful oversight and consequences that have teeth when an organization is found in breach of the law. But they also have to be nuanced, because if the government tries to ban something, and then that ban gets challenged in court, the government can lose. That sets legal precedent, just like a win in court would.

Also, here's a thought experiment: Watching *Deadpool* from your desk chair is not the same as taking in a late-night show in a theater, with the popcorn and the bass and all that. If pirating the data that can reconstruct a movie is the moral and legal equivalent of stealing the movie from a store, then pirating a model that can be used to reconstruct someone's personality with enough fidelity to predict and alter their behavior without their consent might also be worth legal attention. Can you consent to be misled and then vote based on that? Our legislature can be sold ideas, and they enact policy by voting. Who's serving dark posts to Congress, and what's in those posts?

"If data feels cold and impersonal," a Cambridge Analytica press release muses, "then consider this: the data revolution is in the end making politics (or shopping) more intimate by restoring the human scale."

That's exactly the problem. It is personal. So much is built on the fact that data can be personal, even when dealing en masse. The salient thing here is that there is an outfit that means to leverage the enormous body of intimately personal data it can gather, in order to conduct large-scale and yet individualized psy-ops for the highest bidder. The stakes it's after are no less than the medium-term fate of nations. Whether or not Cambridge Analytica has done what it claims to have done, Pandora's box is open.

JESSICA HALL

SAFEGUARD YOUR PRIVATE DATA AT THE U.S. BORDER

BY MAX EDDY

On January 27th, President Donald Trump signed an executive order that immediately changed U.S. immigration and travel policies as they related to seven majority-Muslim countries. The change sparked protests that touched the technology industry, so much so that over 100 companies eventually co-signed a document objecting to the order. A revised version of the order, intended to be on firmer legal standing than the first, was signed on March 6th and went into effect on March 16th. As of this writing, the second order has been suspended by actions from federal courts.

Amid stories of visa holders, green card carriers, and even United States citizens being detained at the U.S. border were also reports that some people's phones were searched by Customs and Border Protection (CBP) agents. In some cases, it seems the CBP compelled travellers to unlock their phones as part of a search. (We reached out to the agency for comment but did not receive a response.)

Take a moment to consider your smartphone. It contains all of your text messages, a log of all your calls, and many—if not all—of the photos you've taken. Your contacts list and call log also show who you've been communicating with—a critical piece of information in counter-terrorism investigations.

Consider also, the apps on your phone that don't require additional authentication. Once your phone is unlocked, anyone could browse the entirety of your Facebook profile and read all your messages on encrypted messaging services such as WhatsApp or Signal. It's a major security risk.

Nathan Wessler, a staff attorney with the ACLU speech privacy and technology project, said that CBP agents have two tactics when performing searches of digital devices. [Note that this author is an ACLU donor.] "In some circumstances, they'll do a cursory search and stand there and thumb through or click through the device to see whether they might look through emails, and pictures and contacts, just looking for anything suspicious," he said.

"Then there are the real forensic searches, where they are downloading the contents of the device onto their own computer system and running forensic search algorithms across it, which can reveal all the data, including deleted files that haven't yet been overwritten and metadata that the owner didn't even know was there," said Wessler.

PACK THOUGHTFULLY
The new White House administration has raised questions about how much control you actually have over your data while traveling.

Given what's at stake, travelers may not wish to simply hand over their devices to law enforcement agents to be searched. But Wessler told me that case law for this particular issue is undeveloped and unclear. "CBP claims the authority to search anyone's electronic device at the border anytime they want to, for any reason or no reason at all, and a person does not have any real, practical options to prevent a border agent from seizing your phone."

You can't prevent a CBP agent from taking your bag off a conveyor belt in the airport, he said. The agency has a clear right to search luggage and travelers, after all. That's just how law enforcement works. "Similarly, there's no good way to prevent them from taking your phone out of your bag or out of your hand."

U.S. CITIZENS AT THE BORDER

Of course, having the device in hand does not mean that it can be easily searched, which is presumably why CBP agents are compelling individuals to unlock those devices. Wessler said that for U.S. citizens, who cannot be denied re-entry to the United States, refusing to unlock their phones has fewer consequences than for non-citizens. But there will almost certainly be consequences. "We do not think [citizens] can be legally compelled to turn over their passwords, but every person has to make their own practical decision," said Wessler. "It's possible that border agents will seize your cellphone and you will not get it back for weeks or months while they send it to another facility for an examiner to try and break into it.

“We have heard from people who have tried to refuse to turn over their passwords, and CBP agents gave them what was presented as a choice—although it’s quite coercive: Either you give us the password or you’re not going to see your phone for a month while we try to get access to this data ourselves.”

I pressed Wessler on this point about whether CBP or other agencies within intelligence or law enforcement were actually working to break into citizen’s phones. “We have no information about how often or if they are ever successful in cracking the passwords. But when they’re seizing a phone, that’s quite clearly what they are intending to do,” he said.

Being a citizen at the U.S. border means that law enforcement cannot simply send you back to the country you came from.

GREEN-CARD CARRIERS, VISA CARRIERS, AND EVERYONE ELSE

Being a citizen at the U.S. border means that CBP and other law enforcement cannot simply send you back to the country you came from. You may, at worst, end up in CBP or police custody, but even then you remain on United States soil and within the purview of the U.S. legal system. That is not the case for non-citizens, who could simply be refused entry to the U.S. and put back on a plane. This creates an enormous incentive for non-citizens to cooperate fully with CBP and other border agents.

“Green-card holders have a much stronger right to re-enter the country after a short trip abroad, while visa holders may be more vulnerable,” Wessler explained. “Folks in that situation should consider talking to an immigration attorney before they take a trip, so they have a good handle on what their risks are.”

BIOMETRIC OR PASSWORDS?

Apple and other smartphone makers have begun including a biometric option for unlocking phones. This was mostly done as a means for faster authentication but also to encourage people to lock their phones. Smartphone users had resisted locking their devices with a passcode for years, but the fast and simple action of using biometric authenticators is very tempting.

That said, there are numerous arguments against using biometrics alone as a means of authentication. Researchers have found that Apple's TouchID can be fooled with dummy thumbs. And security experts have criticized over-reliance on biometrics, because the unique physical characteristics of our bodies cannot be changed the way we change passwords. When biometric data is compromised, it's unfixable.

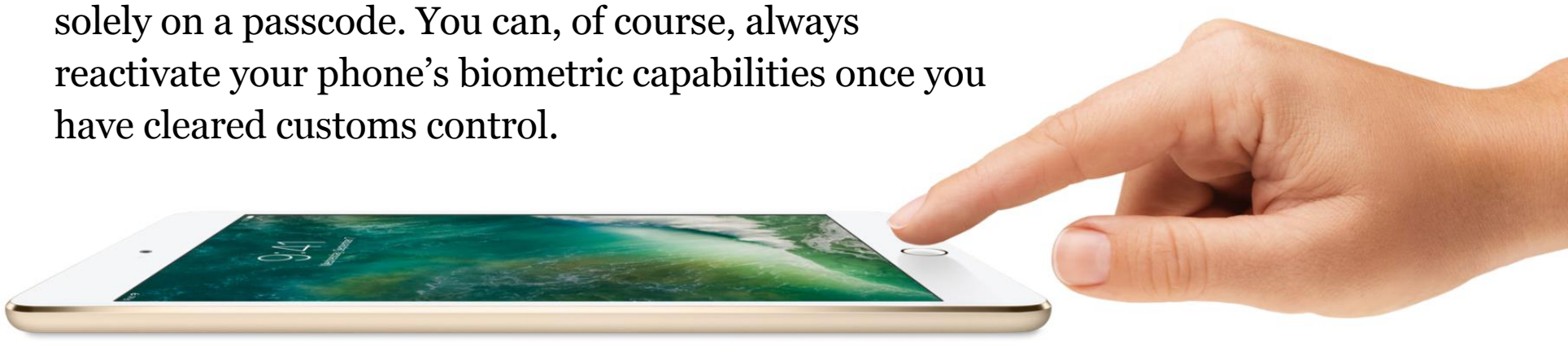
The unique physical characteristics of our bodies cannot be changed the way we change passwords.

Biometrics may also be a legal liability at the border. Wessler said that there currently is no case law about law enforcement demanding biometric information at the border. But more established precedent exists for compelling individuals to be fingerprinted in domestic policing contexts than for just handing over passwords. That could mean that CBP and law enforcement might be on firmer legal footing in trying to compel travelers to unlock devices biometrically than in forcing them to hand over passwords. Unfortunately, Wessler explained that it's not clear how this would translate to the context of a border crossing.

With that in mind, Wessler recommends switching off biometric protection at the border and instead relying solely on a passcode. You can, of course, always reactivate your phone's biometric capabilities once you have cleared customs control.

THE PROBLEM WITH BIOMETRICS

Basically, this: If your biometric information is compromised, you can't reset it.



THE RISK OF REFUSAL

Legal issues aside, there is also the problem of whether phones and other digital devices are secure enough to stand up to focused scrutiny. Generally, the rule is that if an attacker—or investigator—can physically access the device, it will eventually be cracked.

In the case of smartphones, many of the risks depend on what kind of phone you own. Leo Taddeo, Chief Security Officer for Cryptozone and former Special Agent in charge of Cyber and Special Ops for the FBI, explains: "Some phones are very secure right out of the box because they have preset security features. The owner doesn't have to do anything to get robust security. Other phones require the owner to set the security standards."

We know from the recent dump of CIA documents from WikiLeaks that U.S. intelligence agencies are actively working to gain access to consumer smartphones. The vulnerabilities outlined in these documents that affect Android phones appear to be quite old, though, and Apple says that its issues have already been addressed.

"No matter what the settings, if your phone (or tablet or laptop) is open and running when the authorities seize it, they will have just about complete access to anything on it," said Taddeo. This has been an issue in other cases as well. When law enforcement moved to arrest Silk Road mastermind Ross Ulbricht, they were certain to secure his laptop before he could shut it down. Retrieving the information from a password-locked computer would be much more difficult than simply preventing it from locking in the first place.

After hearing Wessler's warnings about government agents impounding cellphones and other devices with the intention of cracking their protection and harvesting user data, I asked Taddeo what (if any) capabilities law enforcement has at its disposal. "As we have seen in recent cases, such as the 2015 terrorist attack in San Bernardino, law enforcement agencies like the FBI have access to very sophisticated techniques to gain access, examine, and extract evidence from seized phones," he said.

In that case, the FBI claimed it was unable to access data on a locked device without assistance from Apple. In the end, the FBI said it was able to access the information with the help of an outside contractor.

A major factor as to whether law enforcement will be able to access data on your phone has less to do with technology and more to do with money: Taddeo explained that not every agency or police precinct has a budget large enough for sophisticated data forensics. The FBI and New York Police Department are examples of organizations that *do* have access to the expertise and technology to potentially bypass security measures and retrieve information from locked devices.

Not every agency or police precinct has a budget large enough for sophisticated data forensics.

"Many smaller departments, however, know where to find the required expertise when the importance of the evidence demands it," Taddeo said. "In the end, if the case is serious enough, a state police forensics unit or a federal agency will be called in."

PRIVACY BY OMISSION

Given all that, Wesler suggests that the best way to secure your information when traveling to the U.S. is simply to bring as little as possible. "The first thing people need to think about is whether or not they need to travel with all of their devices when they're taking an international trip."

Alternatively, you could wipe your phone before entering customs, or keep a separate phone just for travel. These might be good options, as cloud-based services like Google Drive and Google Photos can be reconnected and disconnected from devices as necessary. Note, however, that very advanced digital forensics might be able to retrieve information that has been deleted from devices but not yet overwritten.

Taddeo suggested using additional security measures on top of those available on your phone or computer. “This could include a second layer of encryption and requiring separate multi-factor authentication for files and applications you must keep safe,” he said.

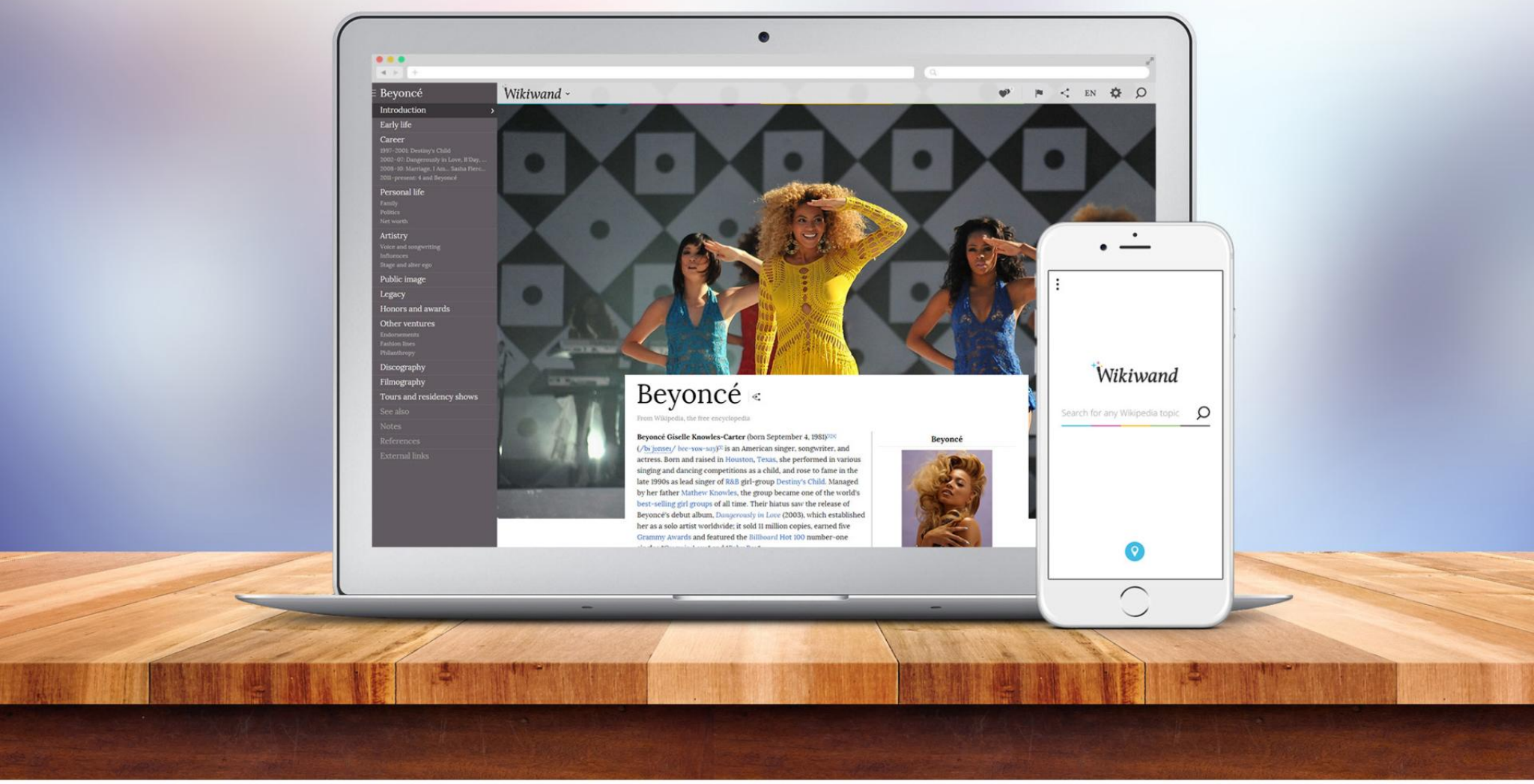
While people can disagree about the Trump administration’s policies, it’s undeniable that the atmosphere at the U.S. border has changed. The new reality is a strange one for anyone that has thought of this country as a bastion of personal privacy.

Wessler explained it this way: “We unfortunately are getting to a place where people are having to make some of the same choices that travelers to China and Russia have had to make for some years now.”

“The new reality is a strange one for anyone that has thought of this country as a bastion of personal privacy.”

The Best Tools to Improve Your Wikipedia Experience

BY ERIC GRIFFITH



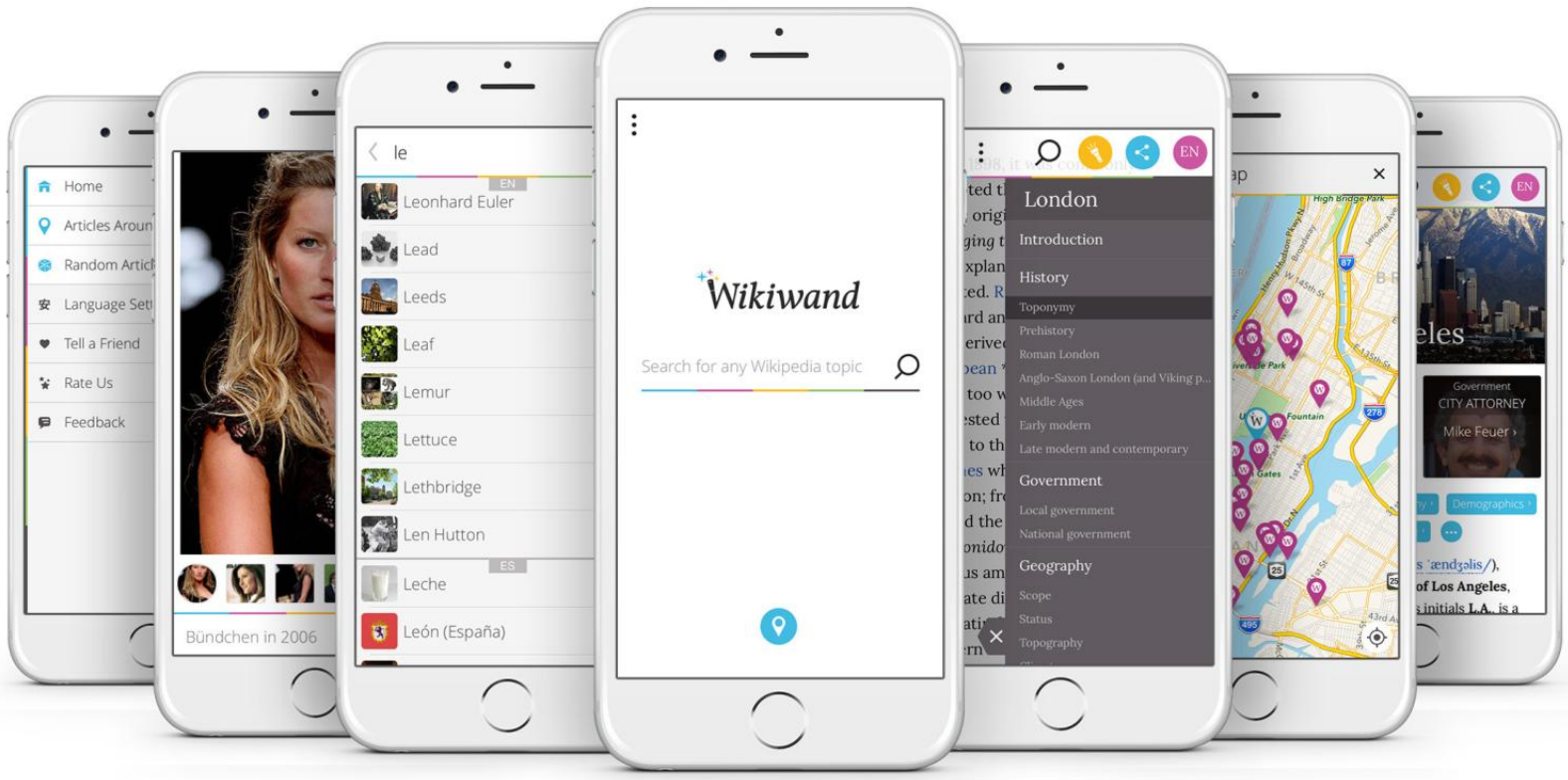
When the clock ticked over into the 21st century, the web was just a toddler. It was walking, but it wasn't ready to write research papers...until Wikipedia arrived.

The site exploded in 2001, going from 600 articles in January to 3,900 by May of that year. As of this writing, the Wikipedia: Size Comparisons page says the service is home to 5,336,928 articles in English—a number that is in constant flux. In total, there are over 40 million pages in 293 languages.

Wikipedia is a phenomenon that helps casual web surfers and students alike. It's had its share of controversy but raises millions of dollars to keep the servers running (by the nonprofit Wikimedia Foundation, which also operates services including Wiktionary and Wikimedia Commons).

That's not to say Wikipedia doesn't have issues ahead. As BoingBoing notes, certain entries face deletion due to what it calls "bureaucratic calcification" and an impending extinction event. And its pages, useful as they may be, are ugly.

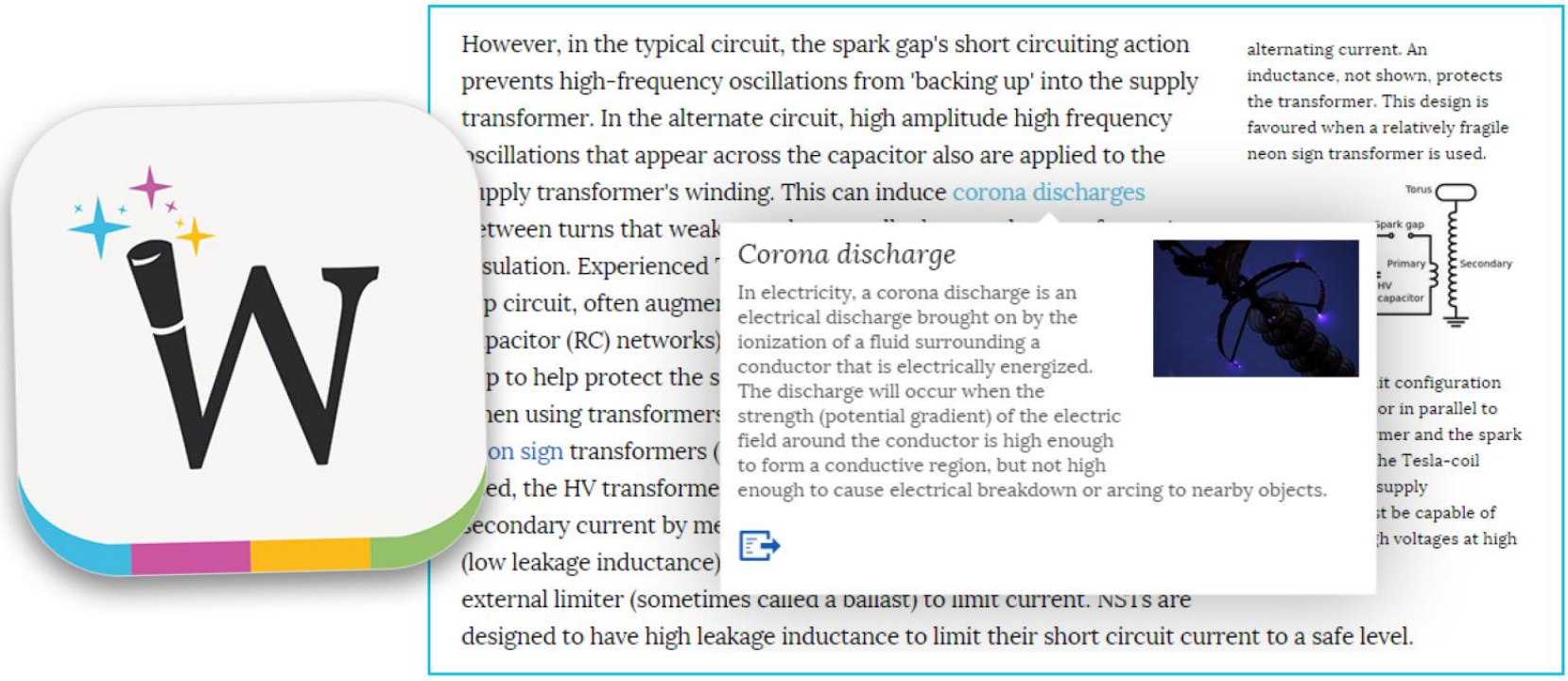
Still, Wikipedia is not going anywhere; half a billion people use it every month, and more and more of them are doing so from mobile devices. Hopefully that will draw a new generation of editors to the site. Until then, there are ways to fix Wikipedia's woes. Read on for a few suggestions.



DESKTOP IMPROVEMENTS

Let's start with what I think of as the Wikipedia KISS: Keep it Simple, Stupid. A little-known feature called Simple English Wikipedia shows a simplified version of an article—in reality, its an entirely different article on the same topic but written for the layman. It actually exists as a separate Wikipedia (much like other languages do). You can access it at simple.wikipedia.org, but when you find a difficult-to-parse page on Wikipedia, the better trick is to look at the URL and replace the "en" between slashes with the word "simple." When a corresponding page exists on the Simple English version, you get it instantly. Try it with topics like archaeology or quantum mechanics. (The same trick works with any supported language; just replace the EN with the 2-letter code.)

Wikipedia needs the most help aesthetically. Its pages are designed to convey information in the most academic way, but it's not always pleasing to the eye. (That said, Wikipedia works on almost any Web browser.) Arguably, the best tool to fix that scholarly ugliness is the service Wikiwand. Install the extensions it offers for Chrome, Firefox, or Safari, and you'll always default to the improved Wikiwand look whenever you search for or link to a Wikipedia page. It's all the same data but presented in a more eye-pleasing manner. You can even customize the colors, fonts, and layout. The quick preview option lets you hover over article links and see what you may get next before you click.



Wikiwand offers an app for iOS, and you can get an early invite for the still-to-be-released Android version. The Simple English trick also works when you look at articles through Wikiwand. Or just select Simple English in the Language drop-down menu. You'll see the occasional ad amidst the articles, but Wikiwand donates 30 percent of what it makes to the Wikimedia Foundation.

Other browser extensions that improve the look of Wikipedia:

- **EAnswer.com** has a similar setup to Wikiwand, using a Chrome extension to redirect you to its version of the pages.
- **Readable Wikipedia for Chrome** does a simple job, adjusting fonts and column sizes using sliders you control.
- **Black Menu for Chrome** puts exactly that—a stylish black menu—on the right column of pages from various Wikimedia sites to make it easier to access them. You don't know you're missing Wikispecies until you see that button.

What about Wikipedia access when you don't have internet? The Xowa open-source wiki application for Windows, Linux, macOS, and Android lets you download the entirety of Wikipedia in any language you pick, or other Wikimedia sites, such as Wiktionary and Wikiquote, all to your hard drive. Make sure it's a big drive; just the text of the full English Wikipedia will take up 30GB. It's more than double that—80GB—with the images. But put it on a flash drive, and you can take it anywhere. Put it on your Android device, and it's a veritable *Hitchhiker's Guide to the Galaxy*. (Or you could just connect those devices to the web.)

The title is a riff on the famous line you'll find in any Wikipedia article where editors decry opinion creep.

Want some fun ways to get access to interesting things on Wikipedia? Enjoy the schadenfreude that comes with reading [Citation Needed], a Tumblr blog that promises "The Best of Wikipedia's Worst Writing"; the title is a riff on the famous line you'll find in any Wikipedia article where editors decry opinion creep.

If you're interested in some nuts-and-bolts, behind-the-scenes Wikipedia info, subscribe to the Weeklypedia, a newsletter listing the most edited articles and most active discussions on the site every week. And The Wiki Game lets you try to connect Wikipedia articles by clicking on the links therein to see how long it takes to get from article A to article B.

THE WIKI GAME
For some online fun, click on links within Wikipedia articles to try to connect two disparate articles.

For a bit of humor that doesn't really have much to do with Wikipedia directly, go to Uncyclopedia, which is to Wikipedia what The Onion is to news. Then visit the Twitter account of TL;DR Wikipedia, a source of condensed articles reduced to their pithy best.

MOBILE

A parade of apps make Wikipedia access on a mobile device a breeze, starting with Wikipedia's own app for iOS, Android, and Windows. An update to the iOS app last year simplified the navigation and improved the search and added "Explore feed," which provides personalized content that always updates.

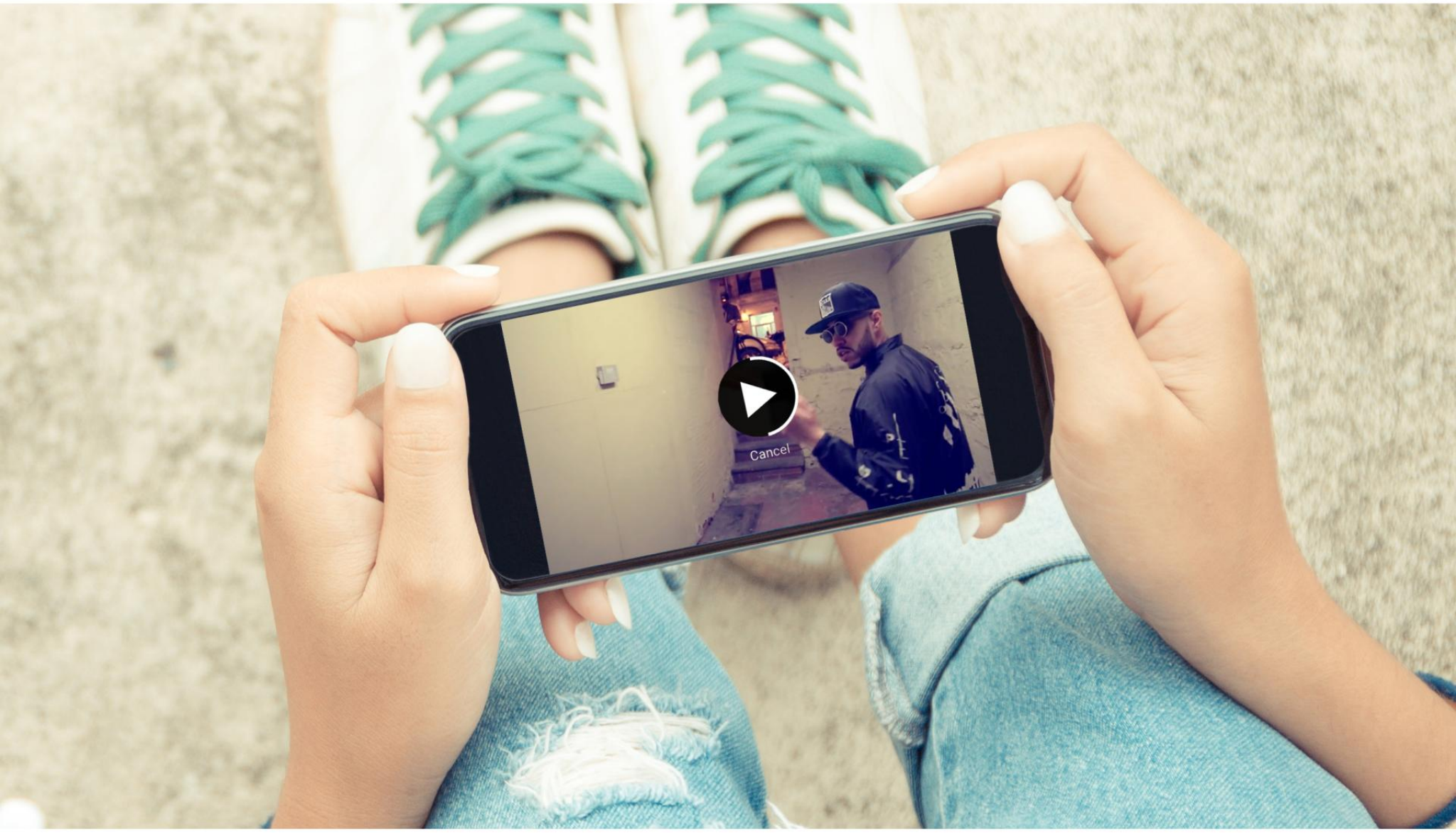
A parade of apps make Wikipedia access on a mobile device a breeze, starting with its own app.

Other free options for mobile downloads include the aforementioned Wikiwand, plus Wikipanion, Articles, and Wikiamo, all for iOS. If you want to take Wikipedia entirely offline on mobile, Kiwix—made by the Swiss chapter of Wikimedia—is on iOS and Android. Android-only Kiwix versions for the Wikivoyage travel guide and Medical Wikipedia are also available. And Endless is a unique iOS-only app that will bring you a random Wikipedia article whenever you open it.

If you prefer a browser to apps, then bookmark the mobile version of Wikipedia at en.m.wikipedia.org. It looks pretty great on a desktop, too.

How to Turn Off Autoplay Videos

BY CHANDRA STEELE

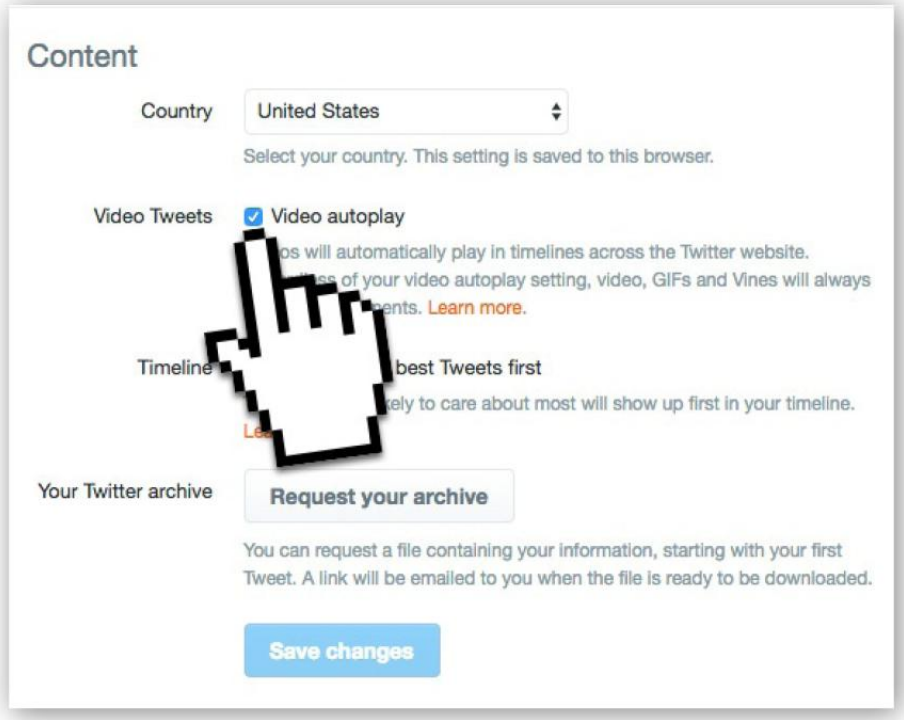


Autoplay is maybe not as grating as Auto-Tune, but it sure is annoying. Social networks have been quick to add the “feature” to their offerings, with the sound on by default unless you take action. On Twitter, videos and GIFs automatically play in your Twitter timeline as you scroll, just as they do on Facebook and Instagram, though you still need to tap for sound on Twitter and Instagram.

It’s the price you pay for a free service, but there are other drawbacks. On mobile, the constant looping can eat into your data and drain your battery. But you do have the option to turn it off or reduce usage.

TWITTER

You can turn off autoplay videos on Twitter.com or on mobile.



On Twitter.com, go to your profile, select Settings > Account > Video Tweets, and uncheck Video autoplay.

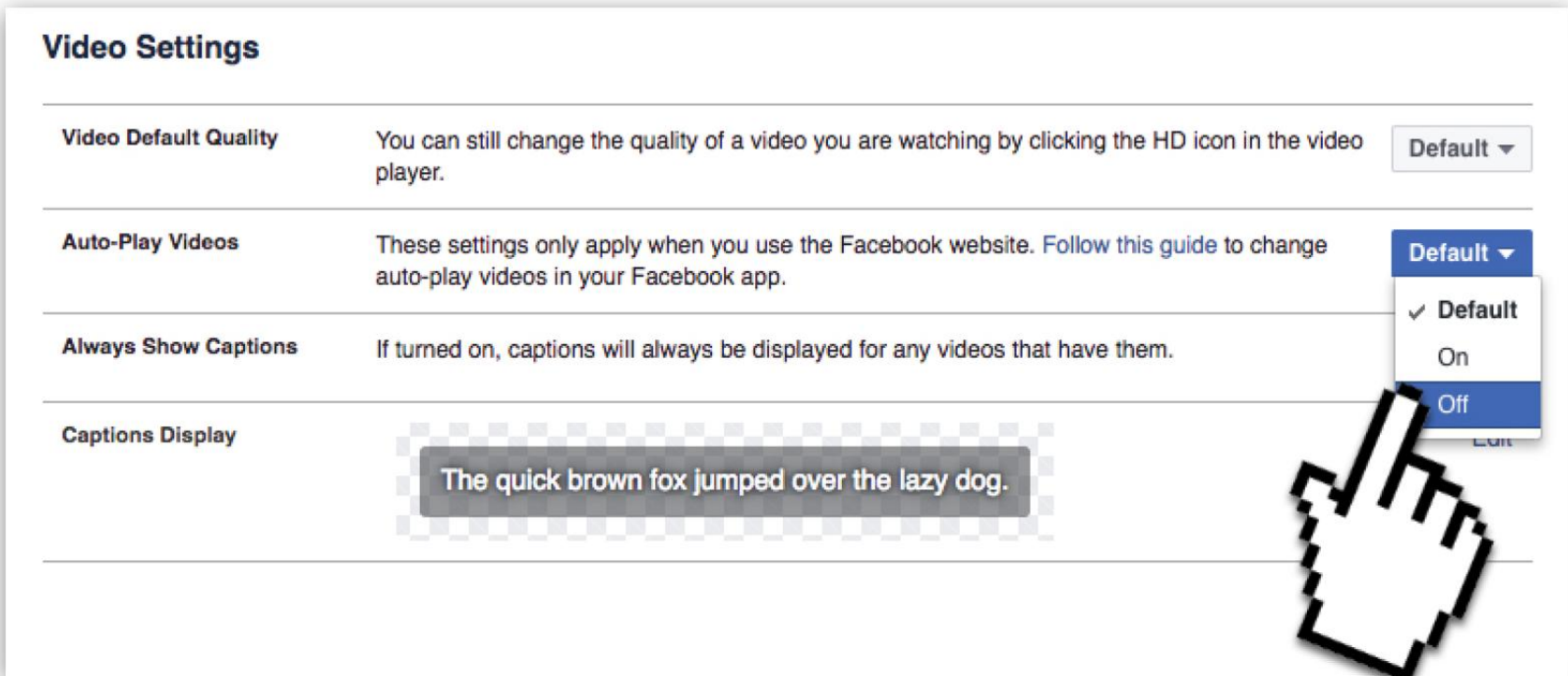
On iOS and Android devices, go to Settings > Data Usage > Video autoplay and select Never Play Videos Automatically, or choose to feature autoplay only when you're on Wi-Fi to save data.

FACEBOOK

Autoplay in Facebook means views, views, views, so the company is unlikely to turn it off. In fact, Facebook recently enhanced autoplay by unmuting the audio as you scroll, so that BuzzFeed video or home movie might suddenly come alive during your commute or another inopportune time.

"As people watch more video on phones, they've come to expect sound when the volume on their device is turned on," according to Facebook.

If you disagree and would prefer your videos remain silent until you tap, navigate on Facebook.com to Settings > Videos and disable the option "Videos in News Feed Start with Sound." You might not see this option yet; "We're slowly bringing it to more people," Facebook says. But on that same menu, you can also turn off autoplay videos entirely under Auto-Play Videos > Off.



On the iPhone, select the hamburger/More button, scroll to Settings > Account Settings > Videos and Photos > Autoplay and select whether you want videos to play while using cellular and Wi-Fi, on Wi-Fi only, or never.

On the iPad, navigate to hamburger menu > Settings >Account Settings > Video and Photos > Autoplay and choose your desired setting.

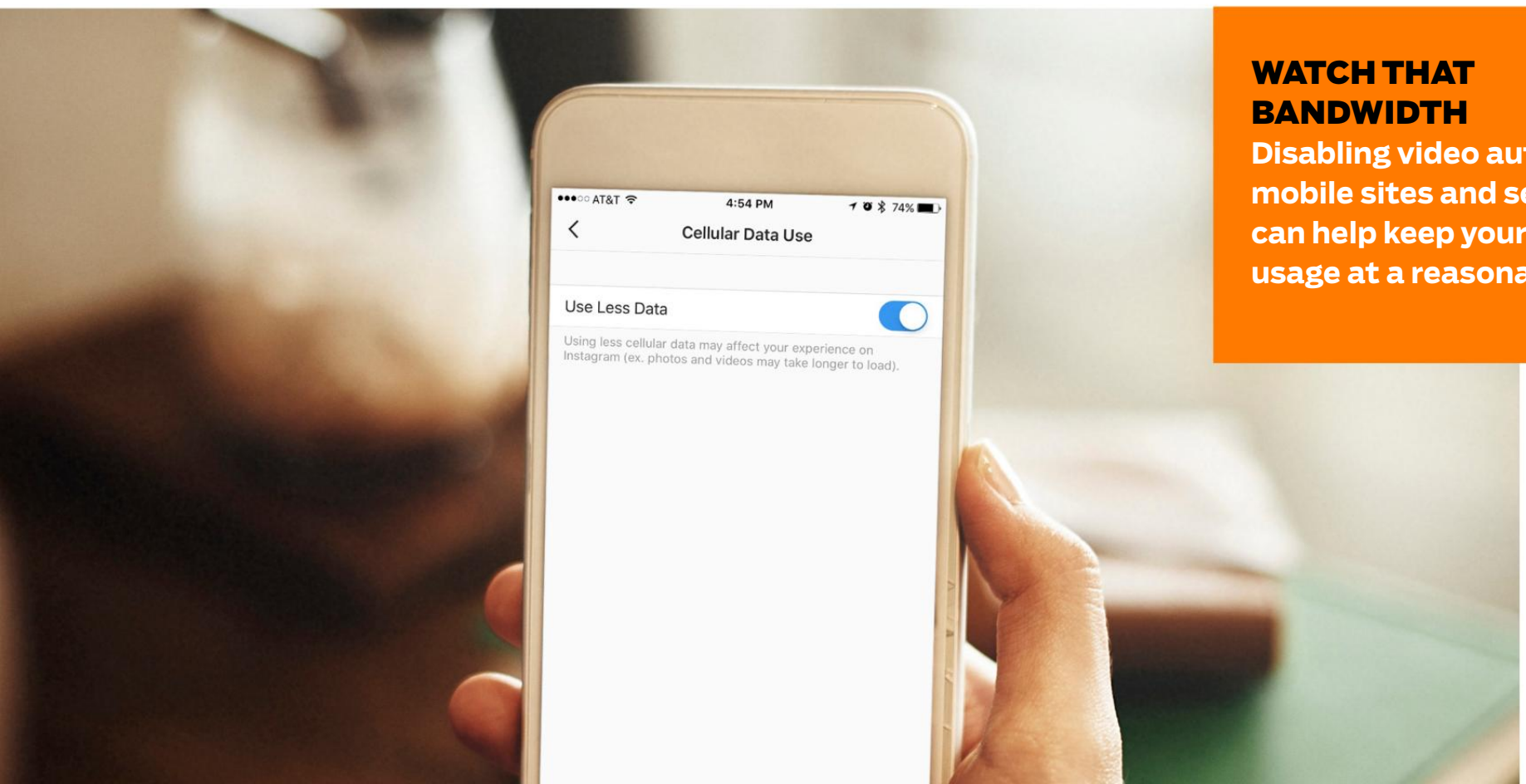
On Android devices, select the hamburger/three lines icon in the Facebook app, choose App Settings > Video Auto-Play and pick your desired setting.

INSTAGRAM

You can fit so much into a 60-second Instagram video. But you're probably looking at Instagram on your phone, so you've got to be selective about how you use your bandwidth. Luckily, Facebook-owned Instagram lets you opt into less bandwidth-intensive video usage. On mobile, go to your profile, select the Gear (iOS) or hamburger (Android) icon on the top right, select Cellular Data Use, and choose Use Less Data.

YOUTUBE

You've watched a YouTube video, and you move on to another tab—but what is that sound you hear? It's another video. Google is not one to give up any sweet, sweet video views, so it too has enabled autoplay on YouTube.com. To disable it, look at the top right of your screen near Up Next. You'll see a slider. If it's blue and has a check mark, that means autoplay is on. Slide it to the left to turn it off. On mobile, look for the same prompt underneath your video in vertical view.



WATCH THAT BANDWIDTH

Disabling video autoplay on mobile sites and services can help keep your data usage at a reasonable level.

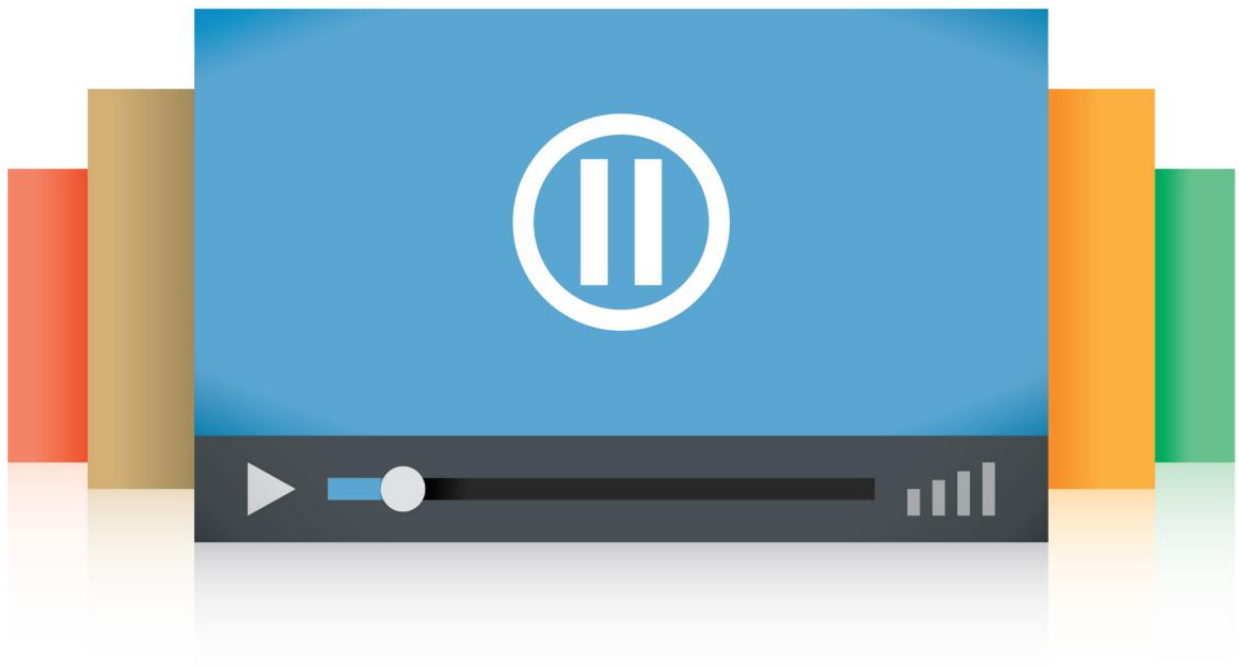
NETFLIX

Sometimes binge-watching is not your fault. You're just going to watch that one episode of the new season of *Orange is the New Black* and get on with the rest of your day, you tell yourself. But as the credits roll, a countdown to the next episode starts and autoplays after a few seconds. If you want to curb your viewing, go to Your Account > Playback settings and uncheck the option to Play next episode automatically. On mobile, select the hamburger menu at the top right > Account, which will redirect you to Safari, where you can select Playback settings.

You're probably looking at Instagram on your phone, so you've got to be selective about how you use your bandwidth.

HULU

Hulu is now streaming *The Golden Girls*, but if you'd rather not binge the adventures of Rose, Blanche, Dorothy, and Sophia, navigate to Hulu.com, click the gear icon on the video, and click "off" under auto play. On mobile, select the hamburger menu > Settings > Autoplay and toggle off.



10 Uses for Your Old Smartphone

BY EVAN DASHEVSKY

Smartphones are an absolute necessity in today's information age. After a few years, though, devices—particularly those that we carry with us at all times—are bound to show a little wear and tear. They might have some bumps and scratches, or perhaps they slow down. But if you take some basic precautions, your old phone can have a productive afterlife.

1. KIDS' CAMERA

Pixl Toys recently launched a Kickstarter to raise funds to produce a shell that could transform old smartphones into handy, rugged cameras for kids. Even if you don't buy into this particular effort by Pixl, the project showcases an obvious second life for smartphones as standalone cameras. You don't need a wireless network for the camera to work, and any images can be transmitted via Wi-Fi or a wired medium.

THE PIXLPLAY
Pixl Toys' shell for old smartphones is easy to use: You just place the phone into the rugged case, which has rubber grips, a protective touchscreen, and a camera strap. Kids then click the working shutter button to shoot.

2. ALWAYS-ON SKYPE MACHINE

As long as you have decent Wi-Fi coverage, your old smartphone could serve as a dedicated Skype interface (or FaceTime, Google Duo, or whichever video chat platform you prefer). This guarantees you won't miss a call, and you can still use your main device while conversing with friends and family.

3. CLOCK (FOR ALARMS OR WALLS)

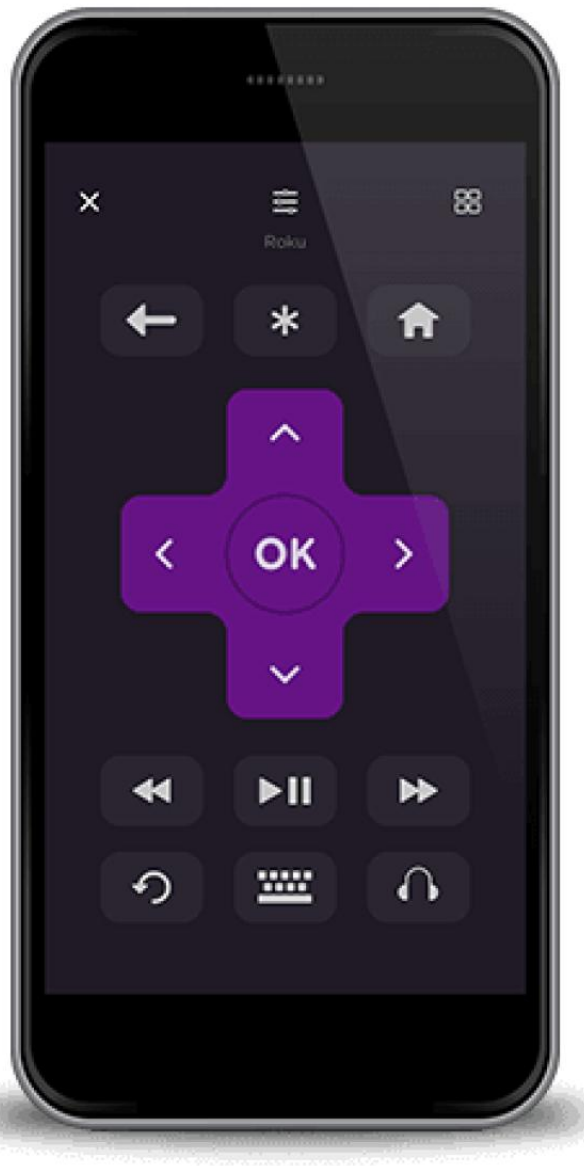
Painfully obvious pro tip: Your phone's nice, big display will still work even if you don't have a network connection. One cool use might be as a permanent clock—but one that is much more versatile than your standard bedside tick-tocker. We used a free Android app, Digital Clock Live Wallpaper-7, which lets you display the date and time in a number of ways. A zillion other clock apps do similar things—just find the right one for you.

4. VR HEADSET

We've seen some truly impressive high-end (expensive) standalone VR headsets, but there are also a number of "shells" designed to transform your smartphone into a decent VR headset for passive viewing. Most are quite good, but they're limited and still fairly expensive. Don't neglect the minimalist pizza-box tech of Google Cardboard, which works with just about all smartphone models (iOS or Android)—and you can pick it up for about $15. Plenty of content is available, as well as numerous VR apps. And it can display any "360" video on YouTube.

5. TV REMOTE

A while ago, I lost my Roku remote. I assume it will turn up someday. For the time being, I've downloaded the official Roku app onto my phone, and boom—it's a virtual remote that connects to the Roku via their shared wireless network. Other setups that allow for Wi-Fi remotes include OTT devices such as Amazon Fire TV and Apple TV and a number of connected TVs.



6. DEDICATED MUSIC PLAYER

If you subscribe to one of the many streaming music services out there, you gain access to just about any song ever recorded. You can use your old phone as a dedicated music player. But if you don't dig the tinny audio quality, pair it with a Bluetooth speaker or connected dongle such as Chromecast Audio, and you'll have a decent internet-connected jukebox.

7. DOORBELL

Check into a smart doorbell setup known matter-of-factly as Ring. It lets you monitor and record who's at your door via a camera on the outside. (Also available are SkyBell and the subscription-based Vivint home security system). Those are fine solutions, though they'll cost you. You could also jerry-rig your own system by connecting your device to any number of quality Wi-Fi cameras or even another phone.

8. EMERGENCY 911 PHONE

As long as your old phone can still power up, it has the ability to connect to emergency services. All phones can connect to 911, even if they don't have SIM cards installed (at least in the U.S.—regulations related to emergency calls vary from country to country). In fact, even if your phone registers zero bars or tells you there's no service, it may still be able to connect to emergency services. If you're in need of assistance in a total dead zone (where there appears to be no coverage at all), you should still try to connect to 911. You may be able to reach a distant cell tower to facilitate a "handshake," in which your device and the tower acknowledge each other's existence, even if they can't facilitate an actual call. When emergency crews are specifically looking for you, this will help them locate you.

9. CONTRIBUTE YOUR PHONE TO SCIENCE

As long your old smartphone can still be turned on, it's probably just about as powerful and capable as your late-90s desktop. So, why not "donate" some of those unused resources to a good cause? The BOINC app (currently just for Android) was developed by the University of Berkeley to harnesses your device's unused computing power for crowdsourced projects such as SETI@Home (searching for signals from extraterrestrial life), IBM's World Community Grid (using computational power for health and sustainability research), and Asteroids@home (to help the Earth from getting smashed). Choose which project you want to help, hook your old phone up to Wi-Fi, and help our species progress into the future!

10. WALL ART

Add a nice post-modern vibe to any room by repurposing your old phone as wall art. A phone offers lots of aesthetic choices: Set it up to display some high-minded meditative video art, use a slideshow/gallery app to cycle through photos and images, or even add an interactive element—it can be a focus point for your room. But do consider how you'll power it. Perhaps your old phones could be charged elsewhere and stuck to a wall when guests are expected, or you could simply set it up near an available outlet.

JOHN C. DVORAK

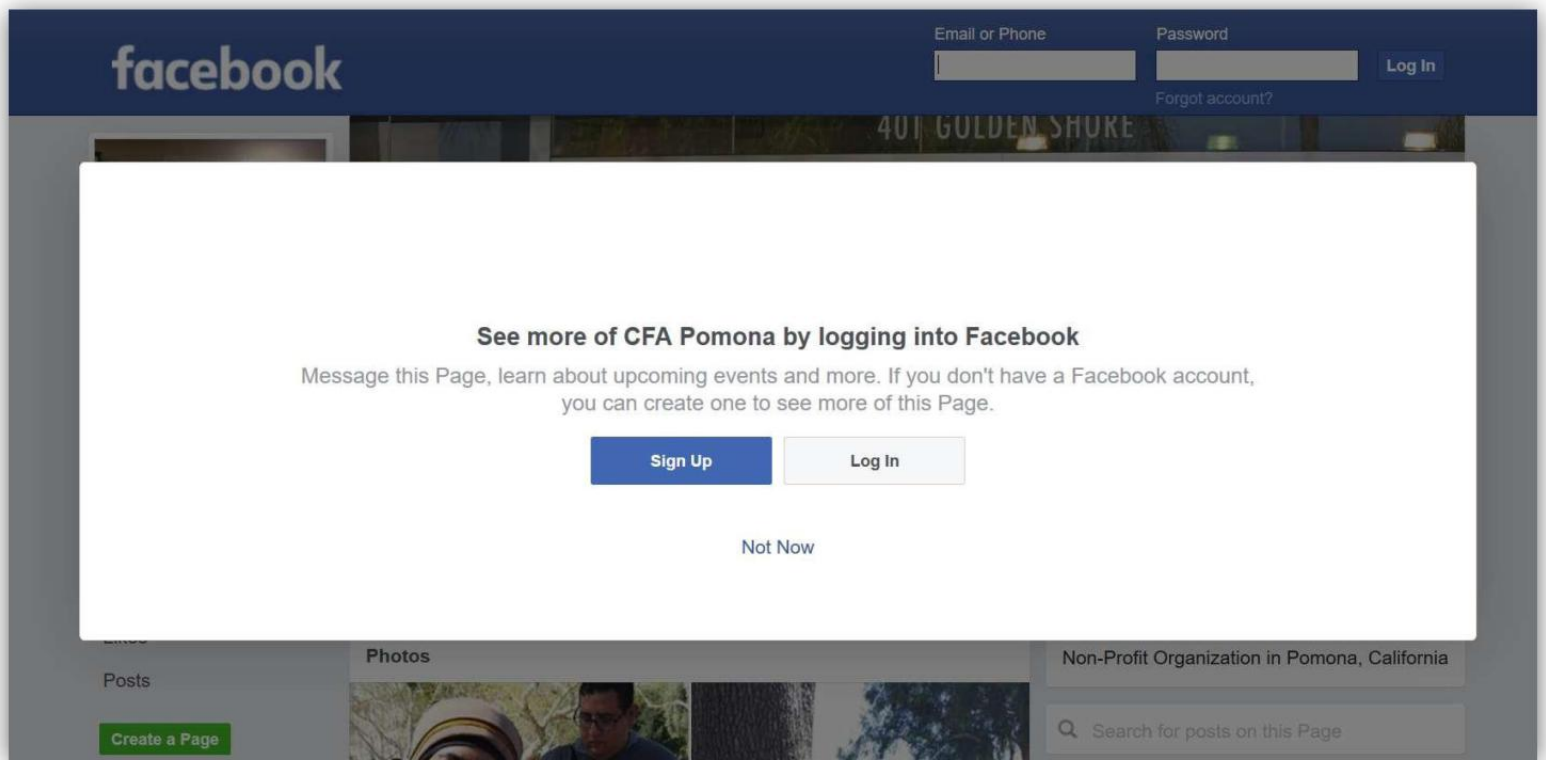
Stop Trying to Make Me Use Facebook.

Why use Facebook for anything?" I tweeted this week. And I mean it. I see no reason to use the ubiquitous social network. I don't need it for marketing. I don't need it to find old relatives. I don't need to keep up with high school classmates or former crushes.

I'm not interested in following the life of someone I'm not hanging out with. If I am hanging out with them, why do I need to friend them on Facebook?

While I can easily avoid Facebook, one thing I can't avoid is site after site requiring Facebook to log in. Luckily, that trend has walked back a bit; most sites currently allow you to create an account with your email address.

Even more annoying is the "check us out on Facebook!" promotion. Instead of simply maintaining a good website, which can be done cheaply using a multitude of methods—hello Wordpress, hello Blogger—they resort to Facebook. Here is why they should not do this.



If you're not a Facebook user, you get this page blocking the site. How is this a good idea? Does the California Faculty Association at Pomona think this helps them?

I do not want to join Facebook. I click on "Not Now." Boom, I get one-third of my browser page blocked by Facebook.

This huge overlay stays there as I scroll around the page. Why does any organization use Facebook as a homepage or sales site or information site knowing this is the way it displays to non-users?

How is this better than an individually designed, free WordPress page using any number of modern templates? Nobody is hounded to join WordPress. The site is easily maintained. The likelihood of users being tossed off the system is minimal.

The funny thing about this is that many domain-name providers assume you'll use Facebook as training wheels for eventually getting your own dedicated page. But it seems that the opposite is true. Small operations and organization like the one above have some sort of rudimentary website first but cannot or will not maintain it. They switch to Facebook with the "check us out on Facebook"

The admins have an excuse to be on Facebook all day, making sure someone did not unfriend them.

plea and end up there for good. Because the association is on Facebook, the admins have an excuse to be on Facebook all day, making sure someone did not unfriend them. Oh, horrors!

Let me summarize: Facebook pages replacing real web pages is not a good trend, period. Although I'm sure some old high school pals have managed to hook up here and there. So what?

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