PC MAGAZINE

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RECYCLE YOUR OLD TECHNOLOGY PRODUCTS

HOW CUBANS BOOTSTRAP INTERNET ACCESS

DIGITAL EDITION
APRIL 2016

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¡Cuba Libre!

This month's cover story is a bit of a departure for *PC Magazine*. We spend most of our resources helping readers choose, use, and get the most from technology products. But when Contributing Editor William Fenton told me he was going to be visiting Cuba and wanted to write about how the citizens of that remarkably isolated country were getting online, it was an offer I couldn't refuse. And when President Obama announced not long after that he, too, would soon be visiting Cuba—the first sitting United States president to do so in nearly 90 years—we knew that we'd made the right choice (and that we'd better get to work).

Will spent a week in Cuba, staying in *casas particulares* and asking Cubans how they use technology. His story brims with broken stereotypes and stories of incredible ingenuity. To my surprise, smartphones are relatively common on the island, as are iPads, MacBooks, and computers in general. Evidently, a lot of the people there have "a friend in Miami," so the supply of hardware is relatively plentiful. The same cannot be said of Internet access itself, which remains rare, expensive, and painfully slow.

Public Wi-Fi hotspots are the fastest way to get a connection in Cuba, but don't expect to find one by accident—there are only about 65 of them in the entire country. Logging on requires a paid ticket, and during the busiest hours the connections slow to a crawl. Even so, the parks and open spaces where Wi-Fi can be accessed have become a common meeting ground for Cubans of all ages.

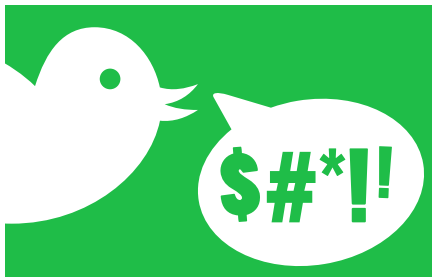
Make no mistake, the Internet in Cuba is not exactly free. In addition to the high cost and limited access, services like WhatsApp, Skype, and YouTube are banned, and many political sites simply don't work. What's more, there's a pervasive sense that the government is always watching what happens online. Regardless of how sophisticated the Cuba's intelligence services are, citizens certainly have reason to be concerned.

To get around closed Internet access, Cubans pass around "El Paquete," aka The Package. A hard drive containing a miniature version of last week's Internet, it's loaded with classified ads, entertainment magazines, and YouTube videos. Like the Internet itself, a resourceful people is routing around broken infrastructure.

Of course, this issue is loaded with groundbreaking products as well. The FitBit Blaze is, in my opinion, one of the best-looking and most feature-rich fitness trackers on the market. Our analyst, Timothy Torres, is less impressed, but you can read his full review to see his reasoning. Our drone analyst, Jim Fisher, is far more psyched about the DJI Phantom 4, quite possibly the best drone you can buy for $1,400. And I personally want to use the new Razer Blade Stealth as my work system. Check out Matthew Buzzi's review and you'll probably feel the same.

With any luck, all of these products will soon be available in Cuba as well.

dan_costa@pcmag.com



Tweets Not So Sweet?

Thank you for your editorial concerning Twitter's recent propensity to limit speech on their service ["Twitter's War on Speech," March 2016]. While I wasn't personally aware of the specific examples that you cited, I wholeheartedly agree that free speech must be supported whether or not we agree with its content and that we must be willing to leave services that don't support this principle.
—Carlisle Herron

OUR ANSWER:

Thanks for your email, Carlisle. Since that editorial was written, there have been more accusations against Twitter of silencing voices on both sides of the political spectrum. Claims are that these actions take multiple forms, from outright banning (Robert Stacy McCain, a conservative vocal about his perceptions of the danger of feminism, said he was kicked out of two separate accounts) to "shadowbanning," in which users see their tweets as normal but their followers don't receive them in their timelines (some celebrities have complained about this, and near the end of Marc, Bernie Sanders supporters protested that it was happening to them, too). In the last month, Twitter has also officially rolled out its algorithmic timeline, which displays what it considers the "best tweets," not all tweets, furthering speculation that Twitter is trying to control discussion, not enable it.

To reiterate an important point from that editorial, Twitter is a private service, and thus can police its tweeters however it likes. But the more of these stories come to light, the more difficult it will be for anyone to accept that they truly are free to say anything they want there. Given Twitter's highly public recent difficulty attracting new users, we may already be seeing the fallout.
—Matthew Murray, Managing Editor of Digital Editions

Ask us a question!

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What's New Now

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TOMORROW'S WARS WILL BE FOUGHT OVER DIGITAL RESOURCES

IS GESTURE THE FUTURE OF COMPUTING?

CHAT: WHAT IF EVERYTHING WERE ENCRYPTED?

TOP GEAR

Surveying Apple's Rare Spring Crop

Apple departed from its usual schedule in March by announcing new versions of its iPhone and iPad. *PC Magazine* Lead Mobile Analyst Sascha Segan was at the announcement in Cupertino and got some up-close-and-personal time with both products. Here's what he found, and what you can expect from them. BY SASCHA SEGAN

NEW SIDES OF THE APPLE TREE
The 9.7-inch iPad Pro (left) and the iPhone SE show Apple trying new strategies to expand both its business and consumer markets.

IPHONE SE

The iPhone SE may be the small phone of your dreams. As anticipated, it's mostly an iPhone 6s crammed into an iPhone 5s body—and because of its smaller size and lower screen resolution, it should have even better performance. At $399 (for 16GB) and $499 (64GB), it will be a test of whether people actually want smaller phones.

The SE's design is very, very similar to that of the 5s. It's really hard to tell the two phones apart. The buttons are in the same places, there are exactly as many speaker holes, and the color of the materials looks about the same. But performance-wise, it's ace. Gaming on the 6s is already good, but I expect it to be even better here, because the same A9 processor is pushing fewer pixels.

Now, I've been using 4.7- to 5.1-inch devices for a while now, so I can't deny that the 4-inch iPhone feels small. The SE has the same 1,136-by-640-pixel screen as the 5s and the same 326ppi pixel density as Apple's larger phones, so it doesn't feel low-res—it's just smaller. The smallness of the phone mostly hit me when I was trying to use the touch keyboard.

One of the biggest changes is invisible, and very important. Apple stepped up to a better modem from the 5s. It adds Band 12 for T-Mobile, which dramatically improves LTE reception, and the Spark bands for Sprint, which will probably improve download speeds by 50 percent over what we saw on the 5s.

Apple told me that this isn't the same modem the 6s uses. It's LTE Category 4, not Category 6, so it won't be able to take advantage of some of the tricks Sprint and AT&T use to make their networks faster. But it's definitely better than the modem in the 5s.

So the SE looks like the 5s—almost disturbingly blink-and-you'll-get-confused so—but it's faster with apps and faster on the Internet, and has better cameras. That's the experience.

Apple also claims up to 50 percent better battery life for the SE over the 5s because of more efficient components, although of course we haven't yet been able to test that.

There are a few small caveats here. One of them is that the SE's cameras are no longer class-leading. As I saw when testing the Samsung Galaxy S7 (check out my review in this issue), the iPhone's 12-megapixel main camera doesn't quite measure up to that phone's in low light. It's really good, though,

DO YOU WANT TO SEE THE SE?
Don't let its size fool you. The new iPhone SE doesn't come cheap: You'll need to pay $399 to get the 16GB model or $499 if you want 64GB.

especially considering that this is a $400 phone and the Galaxy S7 costs $650. The SE also drops back to a 1.2MP front camera from the 5MP offering in the iPhone 6s. That just isn't a lot of pixels for a $400 phone nowadays, making for blocky selfies.

Some of my friends have been lamenting the lack of a 128GB SE model. There's still some of the "smaller means cheaper" mentality going on with this product, and Apple wants to drive people who want 128GB to its bigger, more expensive phones. I think almost everyone who wants the SE will be happy with 64GB—that really is a lot of space.

I'd consider the lack of 3D Touch less of a caveat. I was crazy about 3D Touch when it first came out on the iPhone 6s, especially in the things it could do for gaming. But I haven't seen third parties making much use of it.

Should you replace your iPhone 5s with the SE? If you're on Sprint or T-Mobile, absolutely. No question. Right now. The difference in modem performance is so huge, many connectivity frustrations will go away when you pick up your apparently identical little phone.

If you're on AT&T or Verizon, it's a tougher call. If your battery is running down or your phone is lagging, go for it. You'll get the performance you expect from the latest iPhone, in a more familiar form, and for $250 less. But if your 5s is fine, the SE doesn't have a killer feature that should make you recycle a perfectly good phone.

SCREEN TITAN
The screen on the iPhone SE has the same pixel density as Apple's larger phones, so average display quality is not reduce. (There's no 3D Touch capability, however.)

9.7-INCH IPAD PRO

What would it take for you to buy a new iPad?

That's Apple's challenge, and I don't know if the new iPad Pro answers it. I like this tablet. I like this tablet a lot. But $599 to $899 is still a lot for a tablet that people don't necessarily connect with broad, PC-level functionality.

The Cupertino event marked a day when Apple released gadgets that look and feel like older gadgets, but work better. We didn't have any units of the iPad Air 2 around to immediately compare with the 9.7-inch iPad Pro, but my first impression was definitely that I was holding an iPad 2 in terms of size, weight, and thickness. Checking the specs later, I found my assessment held out—it has exactly the same dimensions as the iPad Air 2.

But there are differences. The one that really jumped out at me was the presence of the quad speakers. I fired up a scene from *The Martian*, and it really blared, even in a crowded room. Apple reps told me that the Pro was twice as loud as the Air 2, and I believe it. Holding my finger next to one of the speakers, I could definitely feel it pushing air.

The Apple Pencil support also worked as expected. I plugged a Pencil into the bottom of the tablet, it paired quickly, and then it worked in Procreate with all of the pressure and tilt sensitivity I remember from the original iPad Pro.

The 9.7-inch iPad Pro connects to a keyboard case designed for it, which is smaller than the 12.2-inch Pro's case. This affects the size of the keys; they felt smaller than I remembered from the larger Pro, although they had the same texture and clickiness. If a roomy physical keyboard in laptop mode is your priority, you'll want the bigger tablet.

I carried an iPad Pro around at Mobile World Congress, though, and, well, it's really big. You basically want to have it on a table, no matter what. For creative professionals who use the

FOUR VARIETIES OF APPLE
The new 9.7-inch iPad Pro comes in four elegant finishes: Silver, Gold, Space Gray, and Rose Gold.

KEYS TO THE KINGDOM
A specially designed keyboard case for the new iPad Pro gives it some office capabilities, but the keys are cramped enough that serious typists might want to use a laptop instead.

Pencil a lot, a 9.7-inch tablet fits much more easily into a hand or the crook of an arm. It's more portable.

I didn't get a grip on the wide color gamut, "true tone" display at all. It supposedly changes its color to respond to ambient lighting conditions, but in the hands-on room, at least, it looked just like a 12.2-inch iPad Pro display. I'll have to take a closer look at it when I get a review unit.

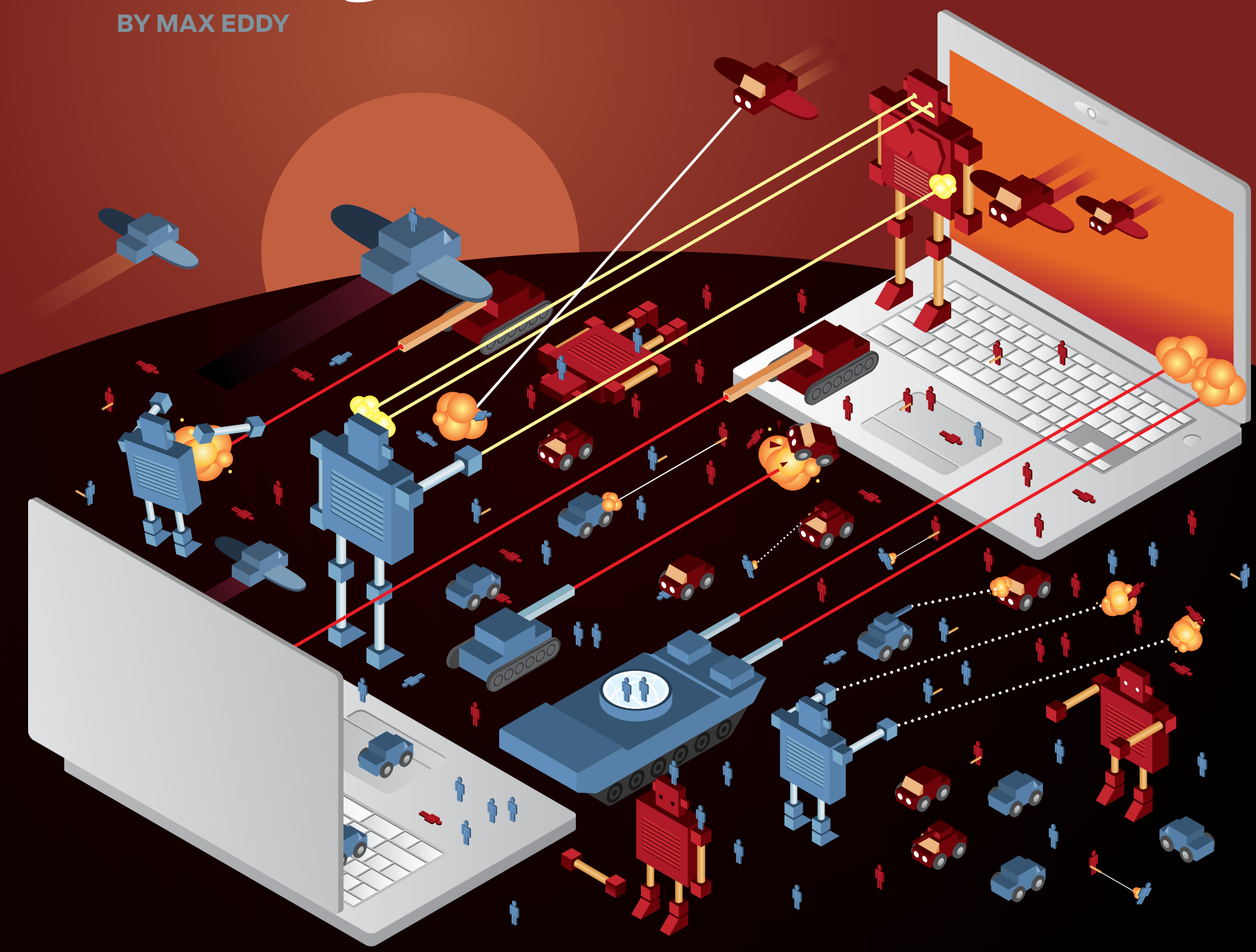
I also didn't test the new cameras, but I'd like to note them: The main camera has been boosted to 12MP, and the front camera is now 5MP with 4K recording. Basically, they're the iPhone 6s cameras instead of the iPhone 6 cameras.

So the new iPad Pro is a quality tablet with a bunch of upgraded features. But what's the killer app that will cause people to upgrade their earlier iPads? Unless you're into the creative apps that work with the Pencil, that's a difficult question to answer. Against the Microsoft Surface, meanwhile, yes, this Pro has a terrific browser and runs Office—but so does the less expensive iPad Air 2.

The new iPad Pro will cost from $599 to $1,029, depending on storage and cellular capability; it comes in 32GB, 128GB and 256GB models, with or without LTE.

Tomorrow's Wars Will Be Fought Over Digital Resources

BY MAX EDDY



In recent weeks, the digital security discussion has been focused on a certain fruit-flavored company's public battle with a three-letter agency. But Kaspersky Principal Security Analyst Vicente Diaz is considering the far larger, and far more complicated, fights that nations might carry on in the digital world.

YOU DON'T NEED STUXNET

In his presentation at the RSA Conference in San Francisco in March, Diaz made a distinction between three kinds of attacks.

The first were exotic attacks, developed and deployed at great expense by nation-states. Think Stuxnet, the complex malware allegedly developed by the United States and Israel to physically disable Iranian nuclear enrichment machinery. The second were so-called "middle-class" attacks, which are assembled by knowledgeable teams of hackers. The third category encompassed all other attacks, usually carried out by individuals with little to no technical knowledge, who purchase malicious payloads and delivery mechanisms from the digital black market.

NEW KINDS OF ATTACKS
Vicente Diaz, principal security analyst at Kaspersky, spoke at the RSA Conference in San Francisco of the difficulties countries will face in the much-more-connected future.

The problem with complicated nation-state campaigns like Stuxnet is that they make attribution easier. When it comes to determining who is capable of developing and deploying such an attack, "the list of countries is very short," said Diaz.

Diaz predicted that, in the future, nation-states will move away from exotic attacks and focus on middle-class attacks that are as simple and stealthy as possible.

In the future, nation-states will move away from exotic attacks and focus on middle-class attacks that are as simple and stealthy as possible.

“Now you don’t need to develop Stuxnet-like malware just to attack,” said Diaz. “Ukraine was attacked by BlackEnergy, which is not in the same league as Stuxnet.”

The key is obtaining the physical and digital infrastructure, like the cable that connects the global Internet. “It’s good for cyber espionage but also good for attacking an adversary,” said Diaz. “You can use it in an offensive way, or you can use it to get information from the people who are using this infrastructure.” As an example, Diaz said that if you control the Internet infrastructure, you can simply snatch passing data rather than having to target specific devices.

This approach sounds similar to the one used by the NSA in its massive data collection operations exposed by Edward Snowden, which used the position of America’s Internet infrastructure to intercept data traveling around the world.

THE FIGHT FOR DIGITAL TERRITORY

Diaz believes that the importance of Internet infrastructure will spark conflict between nations. “Control over physical infrastructure is where the next big battles will happen,” he said. He pointed to efforts made by Brazil to construct its own transatlantic Internet connection and efforts within Europe to foster the development of Internet business and infrastructure within national borders.

Conflicts over control of the Internet could take many forms, and need not be offensive. Instead, countries might form alliances to create spheres of influence over the Internet. For example, Diaz pointed to a diplomatic agreement between the U.S. and China, where the two countries agreed not engage in cyberattacks for financial gain.

Diaz said this agreement was an example of one such alliance, and hinted that it would have wide-ranging consequences. “Obviously these alleged attacks will probably move to some other country because they still need to get this data,” he said.

Digital resources are already playing a role in warfare and politics. March saw confirmation from the Department of Defense that the U.S. was bringing cyber capabilities to bear against ISIS. Also speaking at the RSA conference, Secretary of Defense Ashton Carter declined to go into specifics about these operations, but said they were focused on disrupting ISIS’s command and communications capabilities.

What Diaz is describing is more like the groundwork for larger operations. It’s also a shift in how diplomacy and warfare will be carried out, because the fiber traveling through a stretch of land (or ocean) may be as a valuable as the land, its people, or its resources to a nation-state developing its cyber capabilities.

But perhaps the most important point is Diaz’s prediction that attacks will become simpler rather than increase in complexity. If Diaz is correct, then the most worrisome kinds of cyberattack might be indistinguishable from the everyday work of a hacker and nearly impossible to spot.

“Attacks will become simpler rather than increase in complexity.”

Is Gesture the Future of Computing?

BY SOPHIA STUART

TWO RINGS TO BIND THEM
With its Project Goa, Nod Labs hopes to make gesture control more powerful and portable than ever.

Computing command input mechanisms have gone from the DOS prompt to the mouse to gaming peripherals. But what's next? Some say voice, but Siri, Cortana, and Google Now are still often comically lost in translation. Nod Labs says the future belongs to motion tracking and gesture control.

"There are too many issues with voice input and speech recognition," Nod Labs founder and CEO Anush Elangovan told *PC Magazine* during a recent visit to the company's Mountain View headquarters. "You're often in a shared space and don't necessarily want to be overheard. Much of the time there's too much ambient noise for the computer to be able to isolate the exact audio stream.

“But gesture—quite literally on the other hand,” he said wryly, “is subtle, possible, and most interesting to work with.” And a nod is “the simplest human gesture, and we communicate human intent, so [the name Nod Labs] felt fitting,” said Elangovan.

At the Game Developers Conference (GDC) in San Francisco in March, Nod Labs announced its latest product, the VR-focused Project Goa. Goa features two of the company’s Backspin controllers, a mobile headset that works with all major smartphones, and a charging station that doubles as a discreet camera for precision head and hand tracking. Nod Labs claims it provides a feeling of “presence” that’s similar to what you experience on high-end, head-mounted systems like the Oculus Rift, but is more affordable. It’s not intended to be a direct to consumer product at this time, so manufacturers that decide to incorporate and support the technology will determine its price.

“We challenged ourselves to track human intent with submillimeter accuracy, while also trying to dissolve some of the intimidating setup that’s typically required to do it,” said Elangovan, a Google and Cisco alum. “Project Goa is a complete mobile tracking solution that is easy to use, affordable, and will stimulate innovative content developers to build great mobile VR worlds.”

It was time to put it to the test. In the center of the Nod Labs offices, marketing chief Rebecca Barkin helped me put on a Galaxy Gear VR and gave me a Backspin controller. Director of Product Management Jason Grimm, who joined Nod from Lab126, where he worked on the Amazon Echo, made sure I was in the sight line of the camera and charging station.

I found myself in the center of a skyscape with several images in front of me. I walked toward them and saw they were icons similar to those used on a PC to denote file folders and applications. I looked around for clues of what to do next and figured out the icons must be it.

Grimm explained how to manipulate the controls using my fingers to point, and press to “capture” and select an icon to drag it towards me. It was wild. I was affecting the environment inside a VR world just using simple but natural-feeling gestures. Once you have a comparatively affordable solution for mobile VR, the only limits are the developers’ creativity.

THE GOA WAY
The Project Goa console combines two ergonomic controllers, the charging base with camera, and a universal tracking visor (not shown).

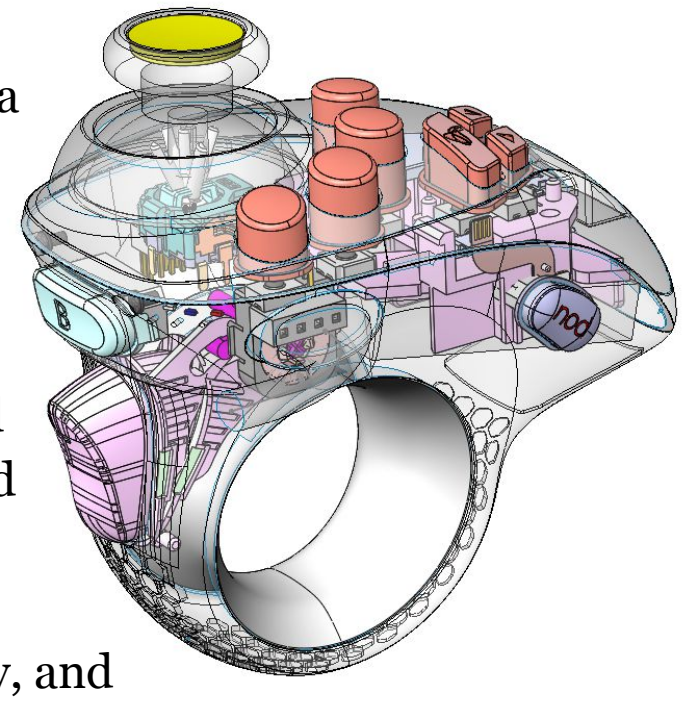
So how did Nod Labs get started?

"I'd been working on ChromeOS and Chromebooks at Google for three years, making affordable computers that addressed usability and interaction challenges," Elangovan said. "The idea to evolve input and interaction started there, and led me to create Nod. I knew it was then time to do my own thing. I belonged to a running group of friends who worked at various companies, including Lab126, Apple, [and] Samsung... and six of us decided to leave our jobs and form a company. We started May 1, 2013, and within two weeks we had a prototype of our first product."

The first iteration was built on a small commercially available Pandaboard circuit board (which they nicknamed a "paw"). They dismissed the glove concept because it desensitizes the tactile experience. That out-of-the-gate prototype had motion trackers, haptics, and other sensors, which captured movement from each individual finger of one hand. But this was dismissed as too complex and bulky.

By 2014, in order to simplify the product, the Nod folks built several new setups, ultimately deciding on a ring as the best form factor. The guts comprised a circuit board, built from scratch, on a copper and gold base, with 70 individual

components. This was then carefully wrapped inside a ring, created in collaboration with product design firm Whipsaw. With the ring on, users could point at sensors that were preprogrammed to respond and command specific actions. One of the earliest test cases was in the Internet of Things (IoT) space. You'd point at a light switch with the ring on your finger and it would turn on, as if by magic.

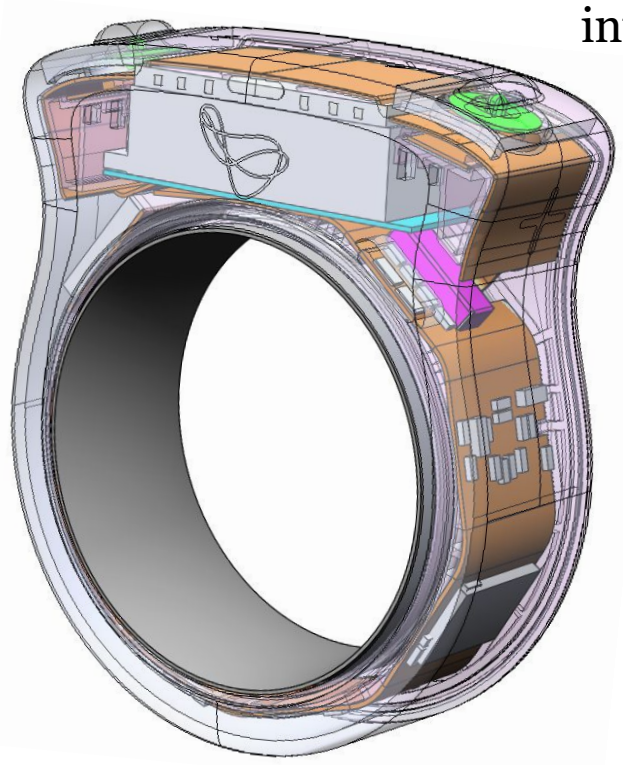


"We proved our theories with the Nod ring," said Elangovan, "We wanted to decouple compute, display, and input—and it worked, beautifully." Nod Labs incorporated the ring technology into its next product, the Backspin Innovation Edition wireless controllers, for use by the gaming developer community.

They have three degrees of freedom, with the potential for six when used with a Samsung Galaxy S6, and are a way to create innovative navigation inside immersive VR and AR environments, on a mobile platform, as opposed to high-end, head-mounted displays. The Ring also has more than 100 programmable haptics and an accelerometer, gyroscope, and magnetometer.

Some very cool companies have adopted Nod Labs' software and hardware. "Until now, we've been mostly working with OEMs to modify our technology on a case-by-case basis, developing to their specific requirements," Barkin said. "For example, one of our current clients is Heddoko, in Montreal, and they have incorporated our Nod sensor technology into their full-body-tracking system for high-performance athletes."

What's next for Nod Labs? Barkin hinted that one of the companies interested in using Project Goa said the feeling of presence would be enhanced if you could sense the weight of an object as you pick it up.



"By the time I got to the lab the next day," Barkin said, "the team were already experimenting with a gimbal adjunct to the Backspin controller."

It's clear the lines are blurring between the real and the virtual worlds.

What If Everything Were Encrypted?

BY EVAN DASHEVSKY

As America's mounting anxieties over terrorism run up against its ingrained mistrust of authority, the result has been a surprisingly robust debate about encryption and digital rights. Various law enforcement agencies have decried how strong encryption makes the Web "go dark" (in other words, it stymies their ability to pursue and stop potential criminals). But privacy advocates are pushing for more default encryption in order to protect the civil liberties of users who are often more than willing to exchange privacy for convenience.

In many ways, the encryption debate is very particular to this exact moment in technological history. If things were to truly "go dark" on a vast scale, it would essentially take the authorities back to a pre-Internet time when it was harder to snoop remotely. Meanwhile, the protection offered by encrypted phones is quickly becoming technologically quaint as intelligence agencies shift their attention from tapping smartphones to tapping smart homes.

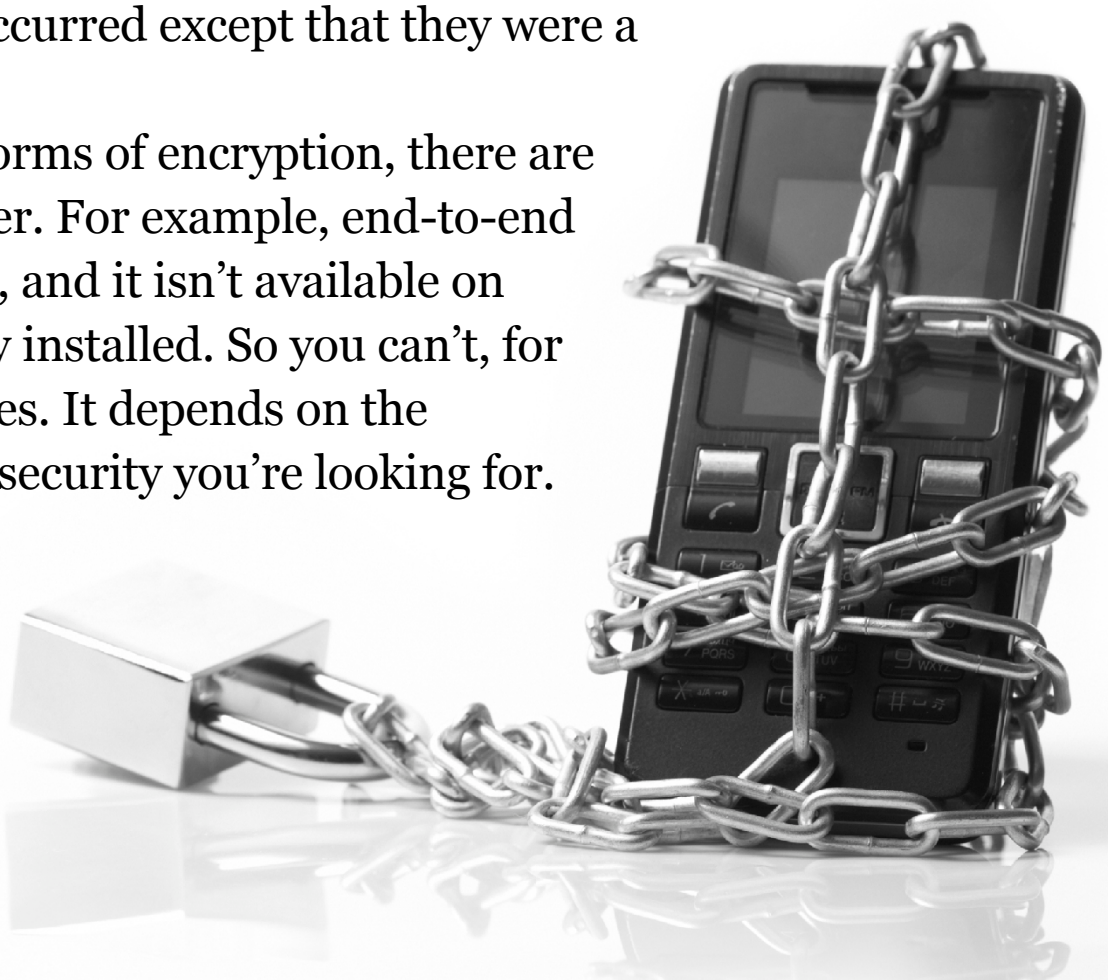
We spoke with two digital privacy experts, Amie Stepanovich, the United States policy manager for Access Now, and Peter Eckersley, chief computer scientist of the Electronic Frontier Foundation (EFF) about what the Internet would like would look like if strong, ubiquitous encryption were the rule rather than the exception (and if that would even be possible).

If all devices and communications were encrypted by default, would users recognize a difference in the end experience?

AS: There are different types of encryption. There's transit encryption and encryption in storage. When you talk about transit encryption, that's what you get when you see HTTPS: at the beginning of a URL. A lot of companies have been slow to transition to that because there was an argument that it was slower or that it broke things. At least the argument about it being slower has fallen by the wayside.

In 2011, there was a big hacking of Gmail by China. At the time, Gmail wasn't using transit encryption. They said it was because it would make things slower. And then after the China hack, they were like, "Oh, maybe we should put that into place." And it really hasn't impacted the user experience at all. People essentially had no idea that the change had occurred except that they were a lot more secure on the other end.

When it comes to more robust forms of encryption, there are some more cost benefits to consider. For example, end-to-end encryption isn't always searchable, and it isn't available on devices where you don't have a key installed. So you can't, for example, check email across devices. It depends on the implementation and what level of security you're looking for. Most of the time you're not even going to recognize them.



Does encryption guarantee that all your data remains private?

AS: [An encrypted device] is not necessarily the end of the story... If you store something in Apple's cloud, [for example,] Apple will have access to it. Even if everyone had a default encrypted iPhone, it doesn't protect your data once you sync your information to the cloud.

[The] rule of thumb is, if you have information on a device and you drop that device in a puddle and it dies, but you can still gain access to your data, your data is not completely secure.

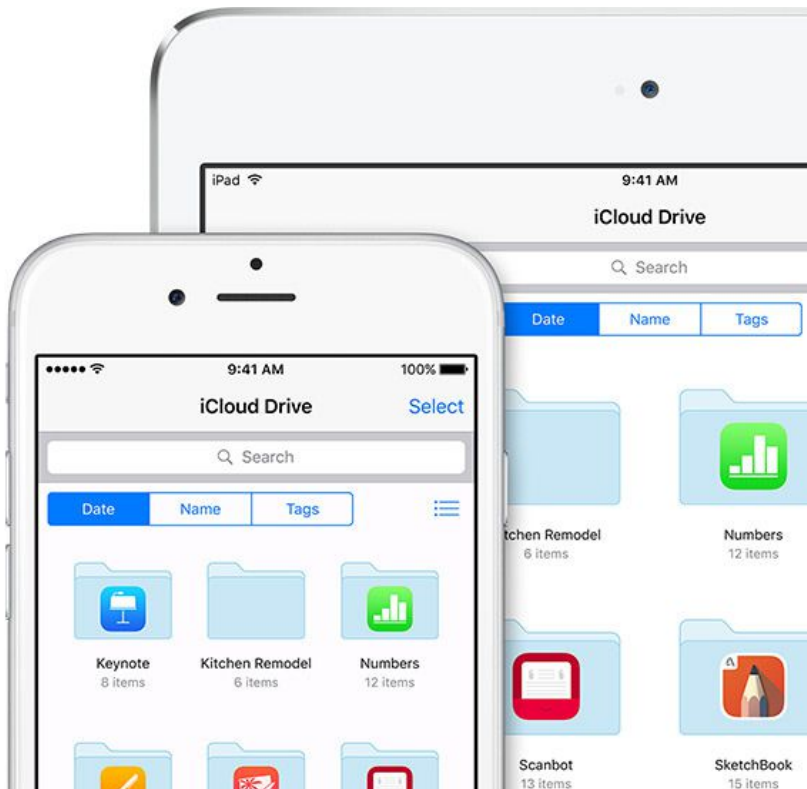
A lot of people turn sync on because of convenience, because they want to be able to get access to their data across devices. The idea that we're heading towards ubiquitous encryption and everyone is going to go dark is quite disingenuous, because people have a reason not to use the strongest security—users might want Apple to store their information on their cloud because they want to back it up and have access to it from many places, but they should just know that Apple will then have access to that information.

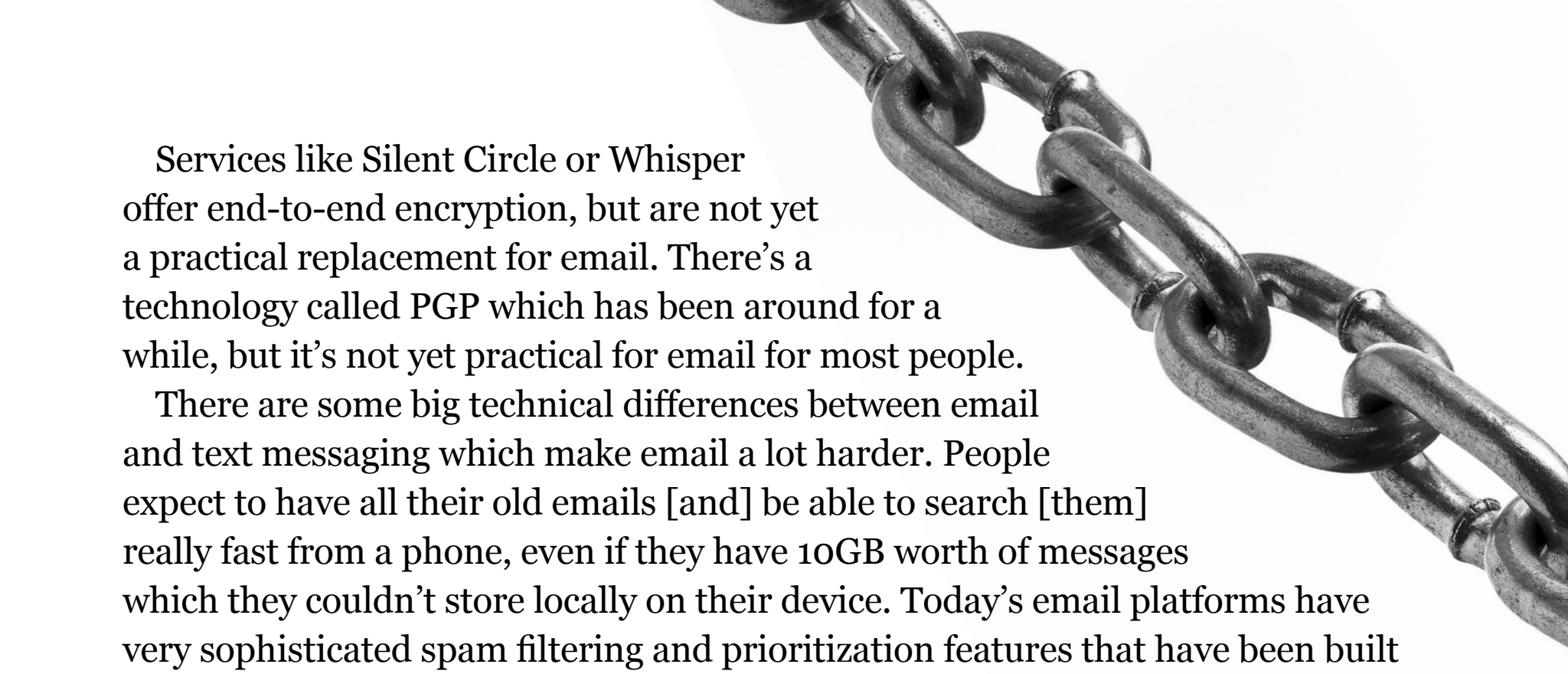
Amie Stepanovich, United States Policy Manager for Access Now

Peter Eckersley, Chief Computer Scientist of the Electronic Frontier Foundation

Does encryption negate the intelligence-collecting capabilities that Edward Snowden revealed, such as PRISM, which allows the NSA to search anyone's email by just looking up their name?

PE: Unfortunately, we aren't close to having any sort of encryption that would protect the contents of your email against a PRISM-like attack. We need to build these things, but the strong encryption that is being debated right now doesn't do that. We are maybe getting there with text messages, but don't have a way to do end-to-end email encryption yet. Not a practical one.





Services like Silent Circle or Whisper offer end-to-end encryption, but are not yet a practical replacement for email. There's a technology called PGP which has been around for a while, but it's not yet practical for email for most people.

There are some big technical differences between email and text messaging which make email a lot harder. People expect to have all their old emails [and] be able to search [them] really fast from a phone, even if they have 10GB worth of messages which they couldn't store locally on their device. Today's email platforms have very sophisticated spam filtering and prioritization features that have been built into these email platforms. To replicate all that functionality in an end-to-end encrypted system is an unsolved problem.

In the age of supercomputers is there even such a thing as encryption that is unbreakable?

AS: There are brute-force attacks that would take years—up to hundreds of millions of years—to access encrypted information. That's the hardest way to gain access. In many cases it's going to be impossible. That's why when people want to gain access to information—be they hackers or governments—they go about it in a different way.

They might encourage the use of a vulnerability they can break. Or they might install a piece of malware that allows them access to your device—whether or not you're using default encryption doesn't matter, because they're on your device and they can see the unencrypted information.

That's what happened in Kazakhstan. The government there required citizens to install a government-mandated vulnerability on their devices. So it wouldn't matter how much encryption you're using or how you're using it—they've owned the devices. All the computers and phones have this program on it which presumably allows encrypted information to be decrypted.

There are brute-force attacks that would take years—up to hundreds of millions of years—to access encrypted information.

Are vulnerabilities and backdoors always created with the knowledge of manufacturers?

AS: They can be inserted with or without the manufacturer's knowledge.... In one example, we know that the NSA and GCHQ got access to SIM card keys. In that case, we have no reason to believe that the manufacturer knew that the SIM card keys had been compromised, but they were compromised all the same. So there's lots of different ways.

Creating a backdoor is actually a lot harder with open-source software, which is why a lot of technologists advocate for it.

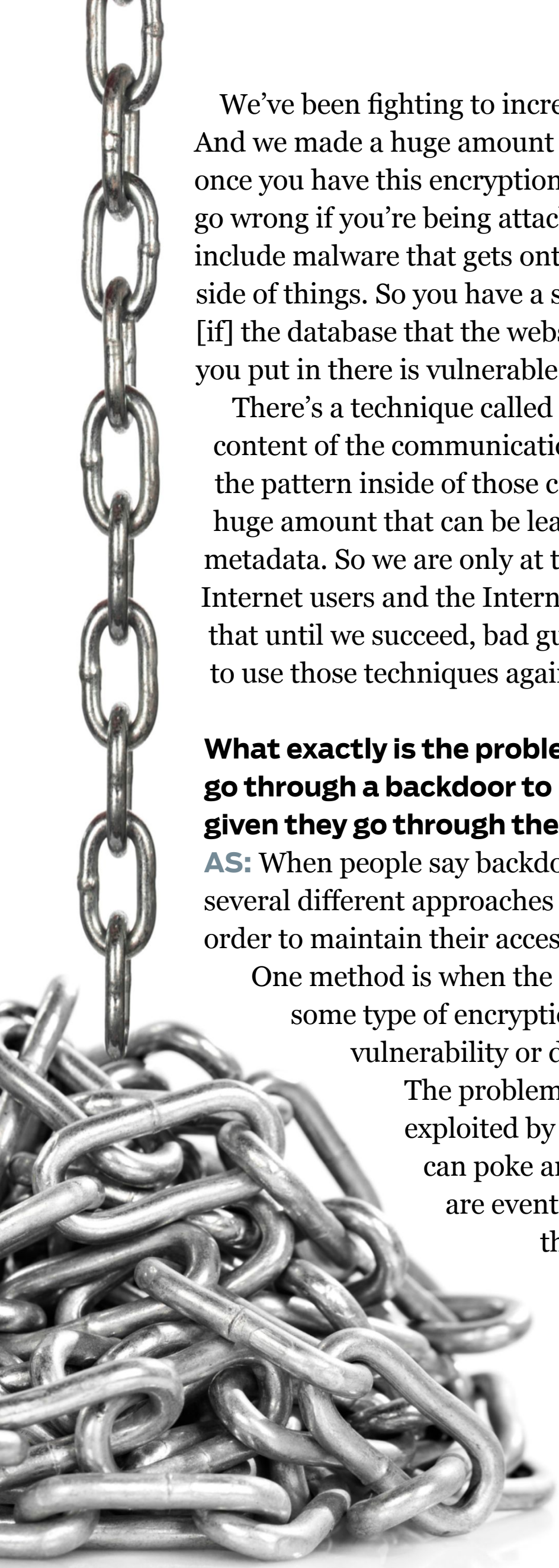
Could a government even completely ban encryption if it really wanted to? It seems like someone could just engineer around it.

PE: : If the FBI wants to create new backdoors into systems, it's not going to affect programmers creating their own software. The authorities, however, might be able to restrict the types of services that large corporations can provide to the American public.

You could install strong crypto software yourself, but the government might be able to restrict Apple or Google's ability to give you that in a convenient product that keeps you or your corporation secure.

Would default encryption really stymie governments' abilities to control things?

PE: : Strong encryption by default would be a great win. One example of things that happen when you have, say, a strong encrypted version of Wikipedia is that governments can't censor particular Wikipedia articles. We've seen a lot of governments around the world that want to allow Wikipedia, but want to block particular articles they really don't like. Having strong encryption means that a connection to Wikipedia can't be distinguished easily from any other connection, so the government has to let people read freely.



We've been fighting to increase the use of transit encryption for decades. And we made a huge amount of progress. But we know that unfortunately once you have this encryption in place there are still a lot of things that can go wrong if you're being attacked by a hacker or an intelligence agency. Those include malware that gets onto your computer or data breaches at the server side of things. So you have a secure encrypted connection to a website, but [if] the database that the website has gets hacked separately, then all the data you put in there is vulnerable.

There's a technique called "traffic analysis," where instead of reading the content of the communications your computer is sending, people surveil the pattern inside of those communications. And, unfortunately, there's a huge amount that can be learned from that type of data analysis and metadata. So we are only at the beginning of a long struggle to protect Internet users and the Internet against these problems. You can be assured that until we succeed, bad guys, be they hackers or governments, are going to use those techniques against us.

What exactly is the problem with governments having the ability to go through a backdoor to peruse encrypted information on a device, given they go through the proper legal challenges?

AS: When people say backdoors and vulnerabilities, it's shorthand for several different approaches the government might take and have taken in order to maintain their access to data.

One method is when the government allows a company to implement some type of encryption, but insists that it has some sort of vulnerability or defect that still allows them to get in.

The problem is that you can't have a defect that can't be exploited by everybody. Once there's a hole there, anyone can poke around and look for that hole.... These things are eventually figured out. Maybe not right away, but they will be eventually. They're gonna get broken into, and they're gonna get broken into by the bad guys.

What We Love Most This Month

BY STEPHANIE MLOT

AMPWARE CASE

Whether you're camping, stranded on the side of the road, or just too far away from the charging cable, an on-board smartphone generator promises no more dead batteries, even in case of an emergency. Two minutes of cranking the AMPware Case is enough to make a call to 911 or a tow truck. Ten minutes, however, will provide up to 2 hours of regular phone use—that includes making phone calls and tweeting about the shooting star you just saw from your tent in the woods. Available in shadow (black), sport (lime green), or ranger (camo green), the rugged case also protects against impact.

$79 getampware.com




What We Love Most This Month

BY STEPHANIE MLOT

BEDOL WATER CLOCK

Waking up every morning just got a lot more eco-friendly: The Bedol Water Clock, as its name suggests, runs only on H_2O. Just unscrew the base and fill it with tap water; the positive and negative ions in the liquid serve as a conductor to create energy and power the clock—no need for batteries or electric cords. The timekeeper lasts six to 12 months on one pot of water, and it's available in a variety of colors and shapes (including some that resemble a droplet of water).

$19-$80 bedolwhatsnext.com




What We Love Most This Month

BY STEPHANIE MLOT

DRUMI

It's laundry day, and while your entire wardrobe is sloshing around the laundromat, you're avoiding public places where someone might see you in paint-splattered sweats and an oversize T-shirt. But what if you could wash a few items at home without a built-in machine? Drumi requires small amounts of water and no electricity, and is small enough to hide in the corner of your 100-square-foot apartment. Plus, pumping the machine gives you an instant arm and leg workout.

$239 yirego.com





What We Love Most This Month

BY STEPHANIE MLOT

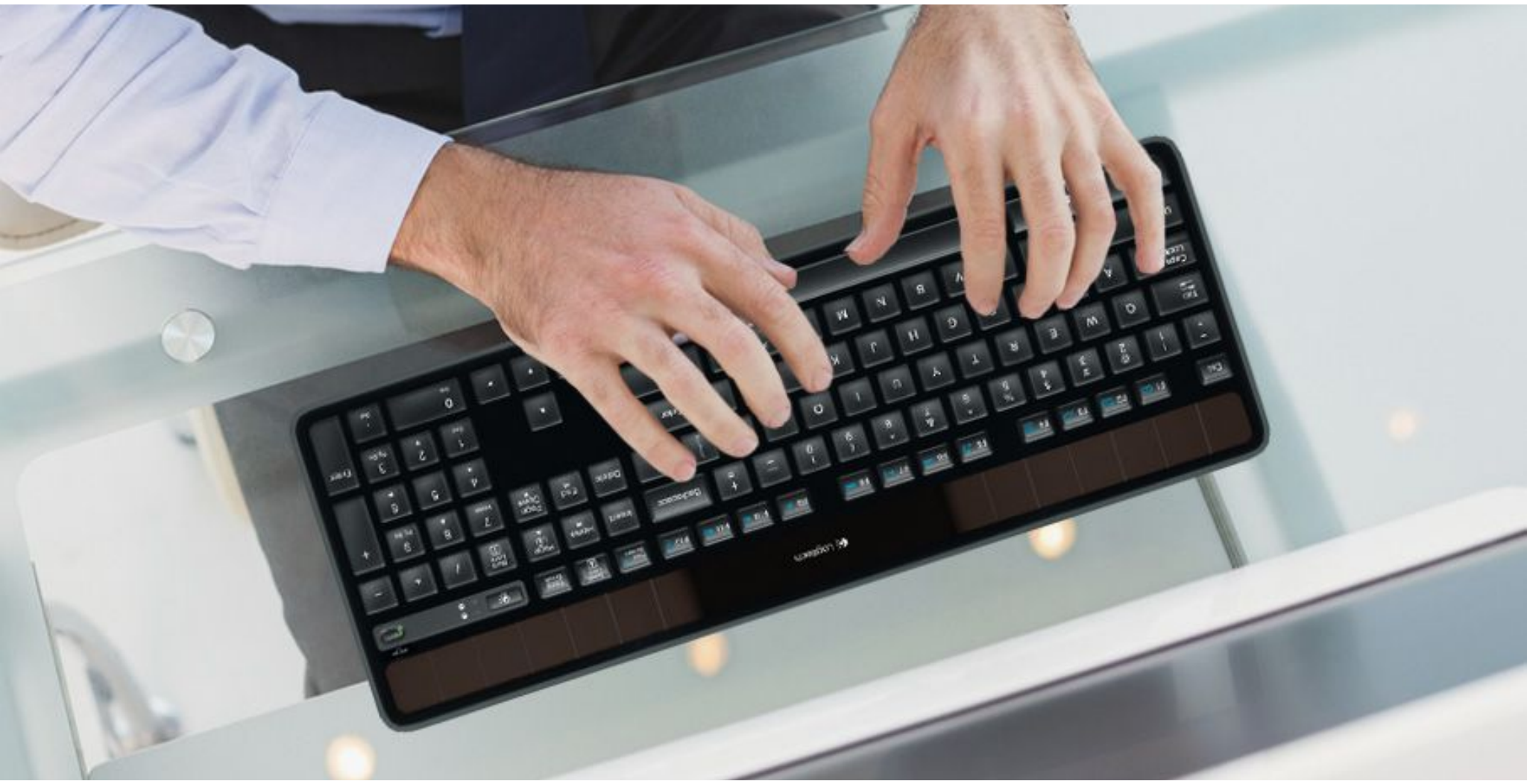
EVE ENERGY SWITCH & POWER METER

As homes get smarter, so must homeowners. Elgato's Eve hardware accessories work with Apple HomeKit to keep you informed about your house. Plug in the Switch & Power Meter to turn on or off household devices, even while you're away from home (via a third-generation Apple TV). The accompanying iOS app lets you power on the TV or shut off a lamp with the touch of a button or a simple voice command, and displays your gadgets' energy usage.

$49.95 elgato.com

What We Love Most This Month

BY STEPHANIE MLOT



LOGITECH WIRELESS SOLAR KEYBOARD K750

Batteries? Where the Logitech Wireless Solar Keyboard is going, it doesn't need batteries. A built-in solar panel keeps the accessory charged—even indoors or in total darkness—for three months, so you can continue blogging from inside that summer rental cave. Plus, the advanced 2.4GHz long-range wireless connection eliminates delays and interference, whether you're signing in from the sofa or tweeting from the kitchen table. Built for Windows PCs, the keyboard requires some sort of light source—the sun's illumination, your desk lamp—for initial charging.

$59.99 logitech.com

Opinions

A stack of cheap TVs won't help if you can't afford to pay rent or go to the doctor.

Sascha Segan

Tech CEOs Won't Stop Donald Trump—They Helped Create Him

Tech CEOs are frantically trying to figure out how to disrupt Donald Trump's presidential candidacy. But it's probably too late, unless they acknowledge how they helped create him. I don't think they will.

Technology creates productivity. But the secret of productivity is that it can lead to fewer jobs. What Trump voters want, more than anything else, are decent jobs that let them raise their families with dignity in depleted communities across America. And that's not what the tech industry, with its focus on highly skilled coding jobs and an insecure "gig economy," is providing.

Trump likes to blame China, and he's right, to some extent, that tech companies' global perspectives have meant that they've sought the least-expensive labor globally, seemingly caring little or not at all for the local American communities they leave jobless.

But pure productivity has also been a problem for the Trump voters. American workers aren't just being replaced by Mexican workers, they're being replaced by American robots. These two huge trends, globalization and mechanization, have sucked the air out of towns all over the United States.

With little social safety net, that means fewer people are able to pay for the five Big Fixed Costs

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

in this country: housing, food, transportation, education, and medical care. And although the tech industry has been doing a terrific job at disrupting entertainment, media, and our social lives, it's done relatively little to help with those big fixed costs. A stack of cheap TVs won't help if you can't afford to pay rent or go to the doctor.

In terms of housing, the tech industry has only made things worse by concentrating jobs in Northern California and New York rather than distributing them over the country. If tech could revitalize Buffalo and Milwaukee, it could do great things for America. Instead, it adds jobs to the nation's most expensive housing markets, including plenty of jobs that don't pay anything near a living wage.

Health care has also been a bust, because nobody can figure out how to loosen the grip of the insurance cartels while still guaranteeing quality of care. The problem there is that people don't make their most critical health care decisions when they have the leisure and peace of mind to think them through, so a "free" shop-around marketplace just becomes noise.

It doesn't help that where tech *is* creating jobs, beyond the coder elite, they're often lousy jobs with poor work-life balance and few worker protections. That's a big part of the resistance to radically remaking education through technology: Teachers and other school employees don't want to see one of the last sectors with decent worker protections, salaries, and insurance evaporate. Overworked parents, meanwhile, aren't thrilled with the concept of adding to their own burdens by having to homeschool everyone through Khan Academy and YouTube.

In transportation, Lyft and Uber are causing more social problems than they're solving by only

slightly reducing taxi rates for consumers in exchange for zeroing out worker protections. Elon Musk has good ideas about transportation, but they'll take years to trickle down, and in the meantime, he's going to put a lot of auto dealers out of work.

The glib answer that you "move and retrain people" when industries get disrupted doesn't reflect human realities. The reality is that people with families and communities may not want or have the financial resources to uproot themselves. It's also difficult for older workers to start new careers, whether that's because of age discrimination or the fact that older workers with families have higher costs than younger or outsourced workers.

I need to make one thing clear: I think Donald Trump is a racist buffoon, and I don't believe about 70 percent of the things that come out of his mouth. I believe, if elected, he would plunge the country into either unprecedented paralysis or a deep recession. But I think Trump is absolutely, positively illuminating important problems that our country is having.

Perhaps if we all pulled together as a society to answer the question of how to help laid-off workers, letting them maintain their dignity and find new jobs that help them keep their standard of living, we wouldn't be here. But the libertarian, Randian streak that runs deep under Silicon Valley says you don't help people, you give them the tools to help themselves. And if they can't help themselves, they deserve their misery.

Well, they couldn't help themselves, and now they're voting for Donald Trump. What are tech CEOs going to do about that?

"I think Trump is absolutely, positively illuminating important problems that our country is having."

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Max Eddy

If You Want a Secure Android Phone, Get an Unlocked Phone

As mobile devices have gone from "things for calls and playing Snake" to powerful computing machines, we've all enjoyed the freedom and ease of being able to live our digital lives anywhere with decent reception. Unfortunately, bad guys understand this as well, and attacks on digital devices will only increase as phones become integral to every part of our lives. We need devices with solid, strong security, but finding ones that check all the boxes can end up costing you quite a lot—if you buy your phone from a wireless carrier, that is.

PC Magazine Software Analyst Max Eddy has also written for publications such as International Digital Times, International Science Times, and The Mary Sue.

EVERYONE ON ANDROID

The security situation for Android is complicated because Android is complicated. Instead of being a single operating system and line of devices, there is a panoply of combinations. And without a central authority to enforce updates, the problem of so-called Android fragmentation persists; many different users own many different devices that run many different versions of the OS.

The situation is exacerbated by the diverse but complicated array of Android devices currently for sale. According to Google's lead engineer for Android security, Adrian Ludwig, about 2,000 different devices are running Lollipop or higher, and are receiving security updates from Google.

At the March 2016 RSA Conference, he noted that device manufacturers were increasingly falling into step with Google's security update cycle.

That's fine—assuming you can find one of those devices. Recently, I looked at the online stores of T-Mobile, AT&T, and Verizon. None were selling any Google Nexus phones, which receive more frequent updates. T-Mobile listed the 2014 Nexus 6, but it was out of stock. The only devices that ran Android 6.0 Marshmallow out of the box were the brand-new Samsung Galaxy S7 and Galaxy S7 Edge. It was far easier to find a Lollipop (5.0) device: Twenty-two out of the 25 devices on AT&T's store ran it, with 17 of 28 devices at Verizon, and 15 out of 22 devices at T-Mobile. Interestingly, Verizon had the highest number of phones (eight of 28) running Android 4.

IT'S THE CARRIERS, STUPID

For security-minded Android users (which should be all Android users), the best option is to look beyond the carriers (and their frequent update delays) and buy a good unlocked phone. *PC Magazine* Lead Mobile Analyst Sascha Segan recommends the Nexus 5X or the Nexus 6P, which cost much less than the newest Samsung phones and also run the latest version of Android.

All Nexus devices are available directly from Google, and in the wake of the Stagefright debacle, the company has committed to more regular and numerous security updates. "Nexus devices will continue to receive major updates for at least two years and security patches for the longer of three years from initial availability or 18 months from last sale of the device via the Google Store," Google said in August.

Like the two Nexus phones, the Moto X Pure and the third-generation Moto G run the latest

version of Android but lack a fingerprint reader. That's a loss, but with a solid PIN or lock pattern your phone can be secured quite well.

MORE THAN UPDATES AND MALWARE

Of course, there's more to mobile security. Ludwig has long maintained that fragmentation is actually diversity, and that the sheer number of Android devices and installs make it very difficult for attackers to tailor their malware.

When it comes to malicious apps, the Google Play store serves as a buffer between attackers and users, and Safety Net extends protection to people who install apps from outside the Play ecosystem. The vast majority of malicious apps come from shady third-party app stores, which are popular in countries where Google Play is not available and among Android users keen to find free versions of for-pay apps. Google has done a remarkably good job establishing a trustworthy app marketplace in Google Play. It has also sought to control more of the underlying Android architecture by compartmentalizing key functions that can be updated through Google Play.

When it comes to malicious apps, the Google Play store serves as a buffer between attackers and users.

But Josh Drake, who discovered the Stagefright vulnerability, disagrees that the number of Android devices is an advantage.

"Diversity in the ecosystem complicates research, but it's not a barrier to exploitation," he said at Black Hat 2015. Drake's argument is that Android's code is so massive and so complex that its core functionality might be exploitable regardless of device. Ludwig and others have pointed out, however, that no one has yet observed a Stagefright exploitation in the wild.

BEYOND ANDROID

Android may be the world's most popular mobile

platform, but it's hardly the only one. According to Apple, 77 percent of devices that connect to the App Store are running iOS 9, and an additional 17 percent are running iOS 8; the rest use some older OS. That means most Apple products are receiving the latest security updates, and because its OSes cover a wide range of devices, owners of older phones aren't necessarily left out. (Devices all the way back to the 3GS include the chips needed for hardware encryption, too.)

Don't like Apple? You can always go with Windows Phone. Though the number of mobile devices running Windows 10 remains low, Microsoft has Apple-like control over Lumia production and is pushing down updates to mobile devices as well as desktops running the latest OS. We haven't yet seen how security will shake out on Windows 10, and how antivirus companies will move to secure the platform, but Microsoft seems committed to ensuring that its devices get the latest and safest updates.

“In the connected world we know is coming, mobile devices will need to be as secure, if not more so, than other devices.”

WE NEED BETTER MOBILE SECURITY

The mobile industry is still relatively young, and has enjoyed only limited attacks thus far. After all, Windows boxes are still far better understood and far more lucrative for the bad guys. But in the connected world we know is coming, mobile devices will need to be as secure, if not more so, than other devices.

Unfortunately, consumers are still paying a premium to carriers (and, sometimes, device manufacturers) in order to get the latest and most secure software. We have to do better than that, and make sure that security doesn't become just a feature reserved for the richest consumers.

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Connected Cars Are Hardly "Smartphones On Wheels"

Automakers have had a difficult time making their "smartphones on wheels" actually work like smartphones. All you need to do is look at a recent J.D. Power survey to confirm that most infotainment interfaces continue to frustrate car owners.

That's a primary reason most automakers have embraced Apple's CarPlay and Google's Android Auto to supplement their own often-kludgy infotainment interfaces. But this means automakers give up valuable branding in the dashboard display. More significantly, with CarPlay and Android Auto, car companies are forced to hand over valuable data that's potentially the most lucrative aspect of connected cars.

In response, we're starting to see cloud-based infotainment solutions from automotive suppliers aimed at taking on the Apple and Google platforms. With its March purchase of a start-up called OpenCar, prominent traffic and parking data provider Inrix has positioned itself to provide car owners with more choices and automakers with a different option—and the ability to control their own car data.

"Inrix has been known for delivering

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

dynamic data to the car, and we've relied on others to figure out what happens once it gets into the car," Steve Banfield, the company's chief marketing officer, told me. "Today, those platforms are proprietary and limited to one OEM. We decided to work on that problem and leverage the OpenCar platform as a jumping-off point."

A MORE OPEN PLATFORM

What OpenCar brings to the table is a more open platform for automakers and third-party developers. "OpenCar has a framework and environment that can be built once and employed in multiple OEMs and in multiple models," Banfield said. "On the backend, OEMs have complete control, with over-the-air updates."

Banfield noted that Inrix has "gotten a lot of feedback from our OEM partners that they're anxious to have an alternative to CarPlay and Android Auto. They want to make the decisions on how the data is coming from the car and what is happening with their customers. They don't want that to be sucked into some server that belongs to someone else, where they have no control at all."

In conjunction with the announcement of the OpenCar acquisition, Inrix also unveiled a new product called Autotelligent that the company says "automatically creates a daily, personalized itinerary of anticipated trips by accessing the user's calendar and contacts."

"It creates a mobility assistant that lives in the cloud that can be deployed across mobile apps and car head units," Banfield added. "It can learn a driver's habits, their interests, where they go, the places they stop along the way, and can use that [data] to predict the information they need

to travel and move around the world more safely and efficiently."

Individual automakers, including Ford and General Motors, have tried to engage third-party developers to create similar platforms. "The problem with that is that no single automaker has a big enough base from which they can entice the breadth of application and service providers," said Banfield, "especially when each platform isn't built on common standards."

Inrix said OpenCar's application ecosystem "includes roughly 1,300 registered developers" and "covers accommodations, city guides, fuel, Internet radio, parking, reviews, and more." OpenCar is also a member of the Genivi Alliance and the World Wide Web Consortium, so it has access to an even larger pool of developers.

Inrix isn't the only one working on such a solution; at CES this year, Bosch showed a similar platform called MySpin. "We think we've created a unique experience and a unique value proposition with the breadth we'll bring to the table," Banfield said. "But it wouldn't surprise me to see other people entering the space, given the need for more and more cars to be connected and a much more compelling user experience."

"No single automaker has a big enough base from which they can entice the breadth of application and service providers."

Reviews

CONSUMER ELECTRONICS

DJI Phantom 4

Fitbit Blaze

Samsung Galaxy S7 (Verizon Wireless)

Nvidia Shield Tablet K1

HARDWARE

Razer Blade Stealth (4K)

HP Pavilion x2 (10-n123dx)

Dell Precision 15 5000 Series (5510)

Raspberry Pi 3 Model B

SOFTWARE

Iolo System Mechanic 15.5

Fly High (and Far) With the Best Consumer Drone

DJI Phantom 4

$1,399

●●●●●

PC MAGAZINE EDITORS' CHOICE

DJI maintains its dominance as the class leader in the consumer drone market with the new Phantom 4. It refines the iconic design of its predecessors with a glossier, more streamlined chassis, and both retains the excellent features of the Phantom 3 Professional and adds a few new ones—chief among them a safety system that stops the drone in its tracks if it detects an obstacle ahead. The Phantom 4 is undoubtedly pricey, but it's the best consumer drone we've tested.

DESIGN

The Phantom 4 retains the same basic footprint and design as the Phantom 3 series, but the white plastic shell has been tweaked to improve its looks and aerodynamics. The aircraft measures about 7 by 11.5 by 11.5 inches (HWD) and weighs 3 pounds, so you will have to register with the FAA before flying it in the United States. Included with the Phantom 4 is a surprisingly compact and functional carrying case, which has room for the drone, all its included accessories, and even a couple of spare batteries.

The gimbal is redesigned. The flexible shock mount is now inside the chassis and the camera is secured at both its left and right sides. It can tilt up and down, and the attachment point to the drone allows for modest left and right movement—but it can't spin all the way around the way the camera can on the higher-end Inspire 1 ($3,899). The micro USB port and microSD memory card slot are now part of the chassis, rather than the shock mount, and are easier to access.

The remote control is almost unchanged from the one that shipped with the Phantom 3. It has the same integrated clip that can accommodate anything from a small smartphone to a full-size tablet, and an identical control layout. The biggest difference is that there is now a dedicated Pause button; press it at any time to cause the Phantom to stop in place and hover.

DJI Phantom 4

PROS Easy to fly. Extremely stable. Incredible operating range with 720p Live View. Smooth 4K video capture. New features include obstacle avoidance, return-to-home, high-speed Sport and other automated flight modes. Camera has 20mm wide-angle lens and is loaded with useful capabilities.

CONS Pricey. True mission planning requires use of third-party app.

REMOTE ACCESS
The DJI Phantom 4's remote control is now equipped with a dedicated Pause button. Just press it to make your drone hover in place.

PREFLIGHT

The Phantom 4 is fun to fly, and thanks to some new features is even easier to control than previous models, but it's still a powerful aircraft and you'll want to take care before sending it into the air. You should make sure that both the remote control and flight battery show a full charge before takeoff.

It's easier to transport the Phantom with its propellers detached. Installing them is a simple matter of latching them on using the appropriate guide marks, similar to the system used on the Inspire 1. To power on the Phantom, set it on a level surface and tap the Power button at the rear of its battery or on the remote twice. The drone will make a few beeping noises and its gimbal will calibrate to ensure that it's capturing a level image. Make sure your phone or tablet is securely locked into the clip and connected via cable to the remote's USB port. Once you've launched the DJI Go app (available for Android and iOS), you'll be able to adjust flight and video capture settings, engage Intelligent Flight Modes, and view telemetry data.

In most modes, the Phantom requires a GPS lock to take off—and it acquires that lock very quickly when flying outdoors. If you set the controller to A (Attitude) mode, you can fly without GPS. That's useful when using the Phantom indoors—its downward-facing Vision Positioning System (VPS) helps to keep it stable when GPS isn't available—but for maximum stability it's a good idea to use GPS for any outdoor flights, as it does a fantastic job keeping the Phantom 4 steady when wind is an issue.

FAST FACT

The FAA has designated certain areas in the U.S. as no-fly zones for drone pilots. Before you take your Phantom to a location, you should check Airmap.io see if it's within five miles of an airport, or designated as a National Park. If it's the former, you can call the control tower and ask for permission to operate. The DJI app won't let you take off if you're in a no-fly zone. It's possible to override this by entering your credit card information to do so; no charge is made to your card, but DJI wants to ensure drone operators in such situations have some semblance of accountability. If you're an operator with a Section 333 FAA exemption (which requires a pilot's license), you have a bit more freedom—the radius around minor airports is smaller, at two or three nautical miles depending on whether there is a published instrument flight procedure for takeoff and landing. Hobbyists are better off sticking to the five-mile rule.

FLIGHT

There are two distinct ways to control the Phantom 4 in the air. You can use the control sticks on the remote control to fly in the traditional, manual manner, or you can delve into the drone's automated flight modes and let it fly itself. Some basic aspects of flight—takeoff and landing—are totally automated and initiated via the control app, and a built-in flight simulator lets you practice manual flight on a virtual landscape.

Intelligent Flight Modes, first made available via a firmware update to Phantom 3 and Inspire 1 models, are still here. Course Lock sets the Phantom on a straight line path based on the orientation of its nose at the time the setting is engaged; Home Lock lets you control the drone's movement relative to your position, which is is useful for bringing the Phantom back toward you. With Waypoint mode, you can save a flight and reproduce it later (a boon for filmmakers), though true preplanned flights require use of a third-party app. Point of Interest is an automated mode that wrests control away from the operator in order to perform perfectly circular orbits around a point in space, while keeping the camera trained on said point. In Follow Me mode, the Phantom will follow the remote control as it moves on the ground; Active Track is similar, but it can track any subject you define. Finally, with TapFly you can use your phone's screen to fly the Phantom, rather than the control sticks.

PERFORMANCE

The Phantom 4's marquee new feature is obstacle avoidance. To test it, I tried flying the Phantom into a wall, my car, and myself, and in each instance, the Phantom detected the obstacle and stopped in its tracks. The system isn't without its limitations, though—the obstacle sensors only face forward, so if you're flying sideways or performing an orbit around a subject, you'll still have to use your eyes to make sure that the path is clear.

> **The Phantom 4 is the most stable consumer drone I've used.**

When flying in the standard mode, the Phantom still cruises along at around 35mph in most scenarios. To fly faster, you'll need to switch to Sport mode, which increases the Phantom's speed to 45-50mph and makes it respond more quickly to the actions you perform.

Operating range is phenomenal. In an open area, clear of visual obstructions, I was able to fly about 4,500 feet before the video signal cut out. In a more crowded, suburban environment, the operating range is just shy of 1,800 feet—both distances are the best we've seen in any drone.

In the U.S., recreational drone flight is limited to a ceiling of 400 feet above ground level. If you're flying in an area with more relaxed regulations, you can set the maximum altitude to 1,640 feet from within the app.

Thanks to dual inertial measurement units, along with GPS and GLONASS satellite stabilization, the Phantom 4 is the most stable consumer drone I've used. If you want it to hover in place, it hovers, unmoved by sudden changes in the wind. You can also fly indoors, without the aid of GPS—the downward-facing cameras and sonar in the drone's VPS read patterns on the ground to keep the aircraft in place. VPS also automatically adjusts the altitude to compensate for changes in terrain and, in conjunction with the obstacle avoidance system, prevents the Phantom from crashing into the ground when flying low in an area with varying terrain. It can be disabled, for those times when you're flying in an area where sudden changes in altitude could cause the Phantom to collide with an object above its propellers.

Battery life has been improved, too. The Phantom 4 is rated for 28 minutes per flight, but you should expect closer to 23 minutes (which is still an improvement from the Phantom 3's 19 minutes). The aircraft will automatically land when the battery dips to about 10 percent—a useful safety feature.

DJI didn't make any major changes to the Phantom 4's camera. It still uses a lens that captures a 20mm (full-frame equivalent) field of view—that's 94 degrees measured diagonally—with a fixed f/2.8 aperture. Video capture is available at up to 4K quality, and stills can be captured in JPEG, Raw DNG, or Raw+JPEG formats at 12-megapixel resolution. DJI states that improvements have been made to the camera lens to add sharpness to the edge of the frame, but I couldn't detect them; in any event, the camera is still good.

You can record at cinema 4K resolution (4,096 by 2,160) at 24 or 25 frames per second (fps). This setting is best used by pros who appreciate the wider 1.9:1 aspect ratio afforded by the format. If you're shooting with the intention of presenting video on an HDTV, stick with 16:9. The UHD 4K format (3,840 by 2,160) fits that bill and is available at 24, 25, or 30fps. You can also shoot at 2.7K (2,704 by 1,520) at those same frame rates or at 720p or 1080p at 24, 25, 30, 48, 50, or 60fps; 1080p also adds 120fps. Using one of the higher settings smooths motion considerably, and gives you the flexibility to slow down footage to play back in slow motion. Several different color filters are available for outputting your shots in styles like Black and White, Film, Dream, and more.

Video is quite sharp, and the 60Mbps compression rate nicely minimizes artifacts. I did notice some compression when flying in Sport mode over a sandy beach and when panning the camera over the same footprint-covered sand, but for the most part the footage was crisp and full of detail, with accurate color and contrast. Automatic exposure can be adjusted with a dial on the remote control, or you can control it manually. Likewise, still image quality is solid for a camera of this type, with JPEGs that are pleasantly crisp, evenly illuminated, and distortion-free, and Raw shots that show only a little distortion and dimmer corners. To see significant gains in video and still quality you'll need to move up to a drone with a larger image sensor.

ADDITIONAL APP FEATURES

There are a few features nestled in the DJI Go app that are worth noting. Every flight you make is logged, so you can go back and view your flight path overlaid on a satellite world map. You can replay your path in real time or at an accelerated rate, and view your altitude, distance from home, airspeed, flight mode, and battery life at any point in time. The log also shows your total flight time, total distance traveled, and maximum altitude.

There's also an in-app video editing tool. It's pretty basic, but you can quickly create a short highlight reel without delving into serious editing. You can opt to edit from the buffered video that's saved to your phone, which can be spotty in quality, or you can copy video over from the Phantom's memory card for original footage. It's also possible to broadcast video live to YouTube using the same feed that's streamed to your smartphone display.

CONCLUSIONS

The Phantom 4 improves on everything we loved about the Phantom 3 Professional, from setup, speed, and flight times to image and video quality, obstacle avoidance, and app features. Put it all together and you have our new Editors' Choice for consumer drones. It may be pricey, but if you want the best drone there is this side of professional models, the Phantom 4 is it.

Smartwatch? No, a Fitness Tracker That Looks Like One

Fitbit Blaze

$199.95

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The Fitbit Blaze is a fitness tracker that looks like a smartwatch. Somewhat of an upgrade to the Fitbit Charge HR, the Blaze automatically tracks activities, exercises, and heart rate, and has a color touch screen that displays workout guidance and notifications from your smartphone. With up to five days of battery life, it certainly lasts longer than smartwatches like the Apple Watch or the Motorola

Moto 360 Sport. But if you're looking for genuine smartwatch functionality you'll be disappointed, as there are no apps or other smart features to speak of. And if you already own a capable fitness tracker there is little reason to upgrade. That said, self-quantification newbies will find a lot to like here.

DESIGN

At a glance, the Blaze looks a lot like the Apple Watch, with a rectangular, Gorilla Glass–covered, 240-by-180-pixel color touch screen. But the similarities end there. The Blaze's screen is smaller, at 1.25 inches, whereas the Apple Watch's measures either 1.34 or 1.53 inches diagonally (depending on the size you choose). The Blaze's display is also dwarfed by a chunky black bezel, and flanked by two large gaps between the screen and the octagonal frame.

The Blaze features a modular design in which the tracker portion easily pops into and out of a frame attached to the band; this lets you easily swap bands so you're always wearing the most appropriate one. The frame measures 1 by 1.58 by 0.5 inches (HWD) and weighs a light 1.44 ounces (including the band). There are three buttons on the frame: one on the left side and two on the right side. It makes for an interesting look that I haven't quite grown to love. I much prefer the sleek, gapless design of the Apple Watch, or even the bracelet-like form factor of the forthcoming Fibit Alta.

Out of the box, the Blaze comes with a black, blue, or purple elastomer strap. Premium bands sell separately as accessories: Black, camel, or gray leather bands come with stainless steel frames for $99.95, and the stainless steel link band and silver frame costs $129.95. I reviewed the base $199.95 model with a black elastomer strap. Fitbit also provided a gray leather band for testing. Swapping bands is simple, thanks to easy spring release buttons. But the bands themselves aren't terribly impressive. The elastomer band is less

Fitbit Blaze

PROS Good battery life. Vibrant color display. Accurate heart rate, sleep, step monitoring. Effective workout guidance.

CONS Awkward design. Lacks built-in GPS. Not waterproof. Wristbands feel cheap. Automatic exercise recognition is slow.

GO SET A WATCH, MAN
The large, clunky bezel on the Fitbit Blaze makes its screen look bigger than it really is.

comfortable than the Charge HR's strap due to a rougher texture that can tug on arm hair. The leather band is softer to the touch, but feels a bit rigid on the wrist, though it will probably break in over time.

The Blaze is rated 1ATM for water resistance, which means it's safe from rain, splashes, and sweat, but you can't wear it in the pool or shower. You also won't want to wear the leather band while you're working out.

DISPLAY AND BATTERY

You can set the watch to wake when you raise your wrist or press the left button. The display itself looks crisp, and colors are vibrant. The Blaze is very responsive. I had no problem swiping and tapping my way through its various screens. All information appears bright and legible indoors and out, even in the sun.

On the main screen you'll find a faint battery icon in the upper left, with the time of day and your active heart rate below. You can customize this screen with different watch faces. Depending on which you select, you can view the time of day, your steps, and continuous heart rate.

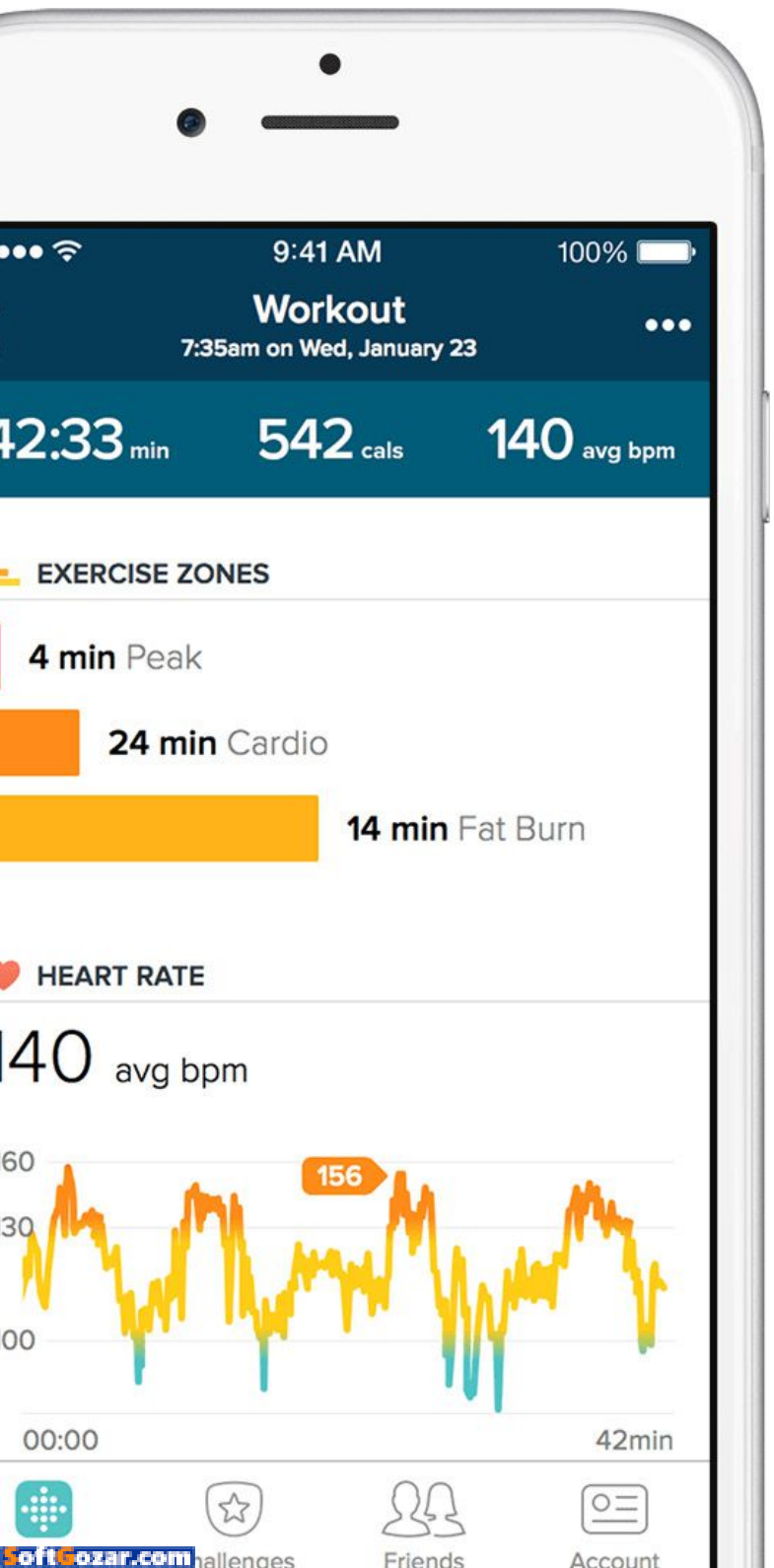
Swipe left or right and you'll see your calories, mileage, floors climbed, and steps taken, as well as shortcuts to fitness monitoring, FitStar on-screen workouts, and various settings (more on these features below). Under Settings, you can adjust the display brightness to Dim, Normal, Max, or Auto. Swiping down on the main watch face reveals a notification toggle (On or Off) and music player controls, and swiping up displays a notification timeline.

On the back of the tracker you'll find the heart rate sensors and a charging port. The Blaze comes with yet another new proprietary charger that won't work with other Fitbit devices, which is disappointing. The Blaze's charger is box-like, with a lid that you have to plug into a USB adapter or laptop. To charge the Blaze you need to open the lid, place the tracker portion inside, and close it. It takes about an hour to recharge the tracker's lithium polymer battery, after which it's good for about five days. That's on par with other fitness trackers, and better than most smartwatches, which usually last up to two days at most.

PAIRING AND NOTIFICATIONS

The Blaze works with Bluetooth 4.0 devices that run Android 4.3 or later and iOS 8.0 or later, as well as a number of Windows Phone devices. To pair, you need to download the free Fitbit app and create an account (also free). From the side menu, tap Devices, then the Plus icon in the upper right, and then select the Blaze from a list of Fitbit devices. I connected the Blaze to a Samsung Galaxy S6 in a few seconds, after which it automatically installed a software update. Once paired, the Blaze automatically syncs with your mobile device whenever it's in range.

When connected, the Blaze displays incoming calls, calendar alerts, texts, and various other notifications. I was able to receive and read full messages from Google Hangouts, but text messages can get muddled. If you receive more than one text from the same person, the messages get lumped into notes like "2 messages" or "3 messages," but you can't actually open or read them. Fitbit is aware of this issue and should address it in a future firmware update. You can also accept or reject calls from the tracker, but that feature is limited to iOS devices.



To use the Blaze for music playback controls, you need to establish a second Bluetooth connection with the phone you're already paired with, which is a bit confusing. You just need to follow the instructions in the app, but it took several tries before I got it working with the Galaxy S6. Meanwhile, iOS users can control music through a single Bluetooth connection. Once the Blaze connects, you can use basic playback controls including Play/Pause, Previous Track, and Skip Track. On the music control screen, you can use the buttons on the Blaze's right side to raise or lower the volume.

FEATURES AND PERFORMANCE

The Blaze tracks calories, distance, floors, steps, sleep, and various exercise stats. You can view all of this data in detail in the Fitbit app, which remains one of our favorite fitness apps. The Blaze also makes it easy to view basic data on its display

GET ON TRACK
As on Fitbit's many other trackers, the measurements from the Blaze are accurate and thorough.

by scrolling through its various screens: Today displays your daily stats, including calories, continuous heart rate, floors, mileage, and steps; Exercise tracks your performance during a variety of individual workouts, though it needs an unreasonable 15 minutes to recognize the exercise you're doing (this can be changed to 10 minutes in the app, but that's still too long); and FitStar turns the Blaze into a personal coach by running you through preprogrammed workouts with fun and effective animated demonstrations.

As usual, Fitbit's various exercise and heart rate measurements appear to be very accurate when compared with my own observations. Automatic sleep tracking also appears to be accurate, measuring different levels of sleep that you can view on the app. You can set silent alarms right on the Blaze, which you can dismiss or snooze by tapping the screen.

Although tracking is solid, I'm disappointed by the lack of built-in GPS. Runners will need their phones on hand if they want to track stats like pace, distance, and mile splits (not to mention a map of your route). The Fitbit Surge includes GPS, as do some smartwatches like the Moto 360 Sport.

COMPARISONS AND CONCLUSIONS

Despite a few drawbacks, I like the Fitbit Blaze, mostly for its accuracy and reliability as a tracker, and its useful new FitStar workouts. But is there enough here to replace your Charge HR or Surge? If you're a runner in need of GPS, you'll certainly want to hold on to your Surge; it has that feature, and it can also deliver basic call and text notifications. And the Charge HR tracks nearly everything the Blaze does, but lacks a color touch screen that isn't a compelling upgrade excuse anyway. And if you're looking for a full-featured smartwatch experience complete with an app store, you'll want an actual smartwatch like the Apple Watch, the Moto 360 Sport, or the Pebble Time. That said, if you're new to the world of fitness trackers, or you're upgrading from a first-generation device, and you're willing to spend $200, the Blaze is a solid choice.

TIMOTHY TORRES

Samsung's New Galaxy Phone Is a Star Performer

Samsung Galaxy S7 (Verizon Wireless)

$672

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Think of it as the Galaxy S6... S. The Samsung Galaxy S7 looks so much like the Galaxy S6 that you'd be excused for thinking it's not a major upgrade. Rather than reinvent the design like it did last year, Samsung has focused on performance improvements in the S7, restoring crowd-pleasing features that were missing from the S6 (like a microSD slot) and boosting battery life. It's the best Android phone available in a truly one-handed form factor.

SIZE AND DESIGN

The 2.74-inch S7 is narrower than the S6 (2.78 inches), making it the same width as the HTC One M9 and narrower than any other high-end Android phone I can name. That will make the S7 the go-to device for anyone who thinks that high-end phones are just too big.

The S7's AMOLED screen is the same size (5.1 inches) and resolution (2,560 by 1440) as the S6's, but Samsung amped up the brightness quite a lot. The S7, like the S6 before it, puts the iPhone 6s to shame here.

Samsung has returned water resistance to the S7, without the need for the irritating port cover we saw on the S5. This time, it's using a water-repellent coating inside the device. I washed and dried the phone, and spilled hot coffee on it, with no issues. The phone is rated IP68, which means it's fully water- and dustproof.

Samsung Galaxy S7
(Verizon Wireless)

PROS Small for a high-end Android phone. Excellent display, modem, Wi-Fi performance. Sharp, bright screen. Includes microSD card slot. Water-resistant.

CONS Not much internal storage. Camera isn't a big jump up from the S6's. Loaded with Verizon bloatware.

SMALL, BUT STANDING TALL
At just 0.31 inch thick and 2.74 inches wide, the Samsung Galaxy S7 is ideal for anyone looking for a small and convenient high-end Android phone.

Otherwise, the S7 looks a lot like the S6, although its slightly more rounded back is just a touch thicker, to allow for a bigger battery. This bigger battery, in turn, gives the phone less of a protruding camera bump on the rear. At 5.36 ounces, the phone is heavier, too (the S6 weighs 4.87 ounces). But it's still a metal-and-glass unibody design, available in black or gold, with a physical Home button that functions as a fingerprint sensor below the display. The sensor is the same as the one in the S6—good, but it will miss an off-center touch. The phone also still uses traditional micro USB, not USB Type-C, for charging and accessories. And note that, because of minor design tweaks, many existing S6 cases just won't work on the S7.

PHONE AND NETWORK PERFORMANCE

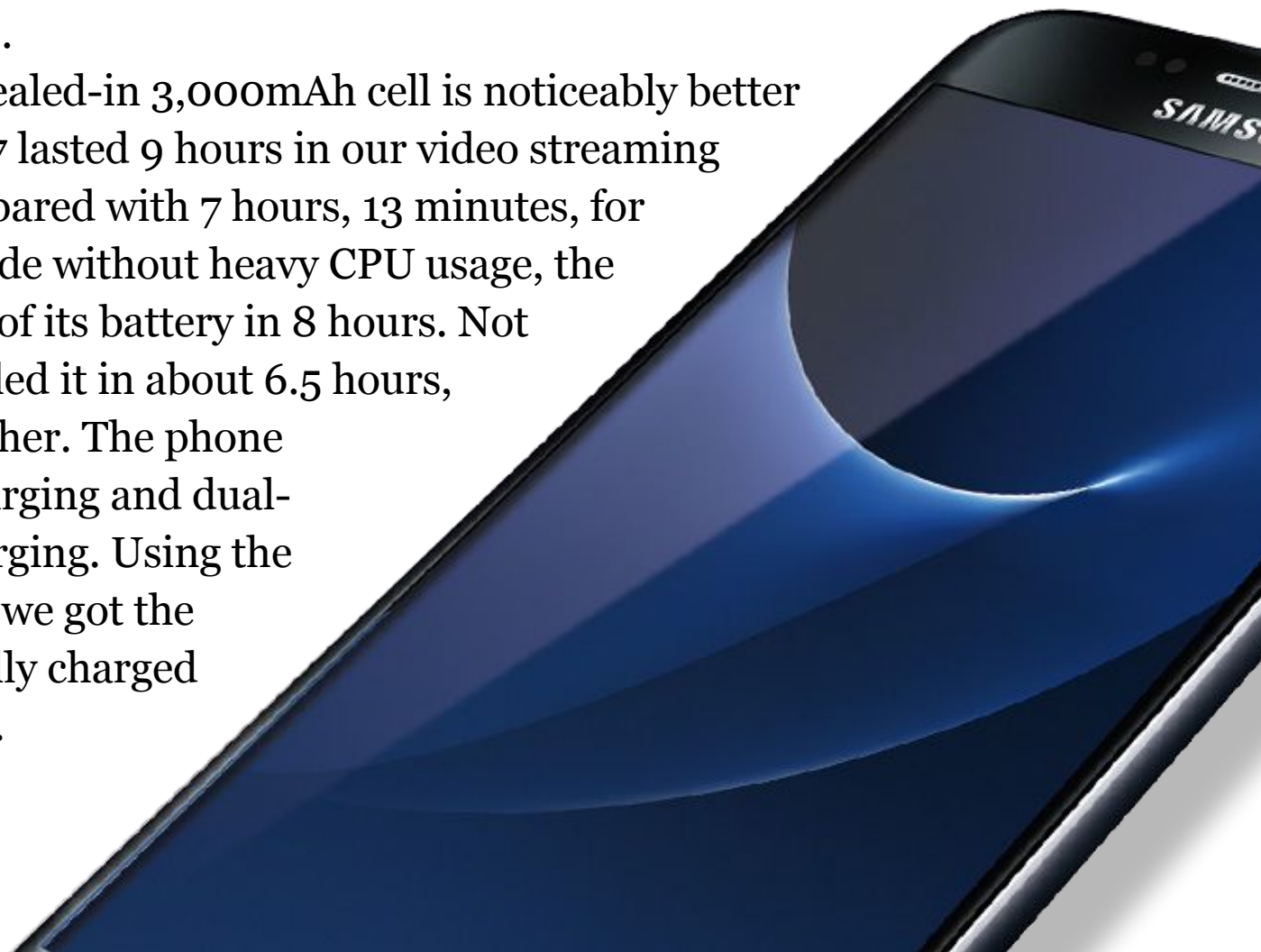
The 2.15GHz Snapdragon 820 processor in the S7 is a big improvement over the Snapdragon 810, Qualcomm's one big chip disappointment last year. Its X12 modem supports LTE download speeds up to 600Mbps and uploads up to 150Mbps, using some technologies that are more important on carriers other than Verizon: 4x4 MIMO will make for faster speeds on T-Mobile, and 3x20 carrier aggregation becomes important on Sprint. Verizon doesn't use those technologies, but the X12 seems to have some advantages here, too.

I couldn't perform any tests that pushed the limits of LTE performance, but I could check Wi-Fi and weak signal conditions. The phone had no trouble with a 150Mbps symmetrical Wi-Fi connection. On Verizon's network, the S7 did a better job holding onto LTE in poor signal conditions than the iPhone 6s, pulling out better data rates.

The phone supports voice-over-LTE (VoLTE) and Wi-Fi calling. It has LTE bands 2/3/4/5/7/8/13/18/19/20/38/39/40/41. Unfortunately, Samsung disabled key LTE bands for the other major U.S. carriers—12 for T-Mobile, 17 for AT&T, and 25 for Sprint—to make using this model elsewhere difficult. That's frustrating, and bad form on Samsung's part; Verizon allows carrier-universal devices from Apple, Google, and Motorola on its network.

I wish call quality on the S7 were a little better. The earpiece is plenty loud, there's no distortion, and noise cancellation is excellent. But with standard calling, voices sound overly harsh and trebly. On VoLTE, you get a more balanced sound without the harshness, but it's not HD-level precise unless you're calling another Verizon phone. I suspect that the issue is just Verizon's voice codecs.

Battery life on the sealed-in 3,000mAh cell is noticeably better than on the S6. The S7 lasted 9 hours in our video streaming rundown test, as compared with 7 hours, 13 minutes, for the S6. In standby mode without heavy CPU usage, the S7 drained 11 percent of its battery in 8 hours. Not bad. Intense usage killed it in about 6.5 hours, which isn't too bad either. The phone supports both fast charging and dual-standard wireless charging. Using the included fast charger, we got the phone from zero to fully charged in around 90 minutes.



ANDROID PERFORMANCE

The S7 runs Android 6.0.1 Marshmallow with Samsung's skin over it. The Snapdragon 820 benchmarks faster than any other chip we've seen in an Android phone. With Geekbench scores of 2,333 single-core and 5,330 multicore, it handily beats the Galaxy S6 (1,440 single, 4,811 multi) and the Galaxy Note 5 (1,472 single, 5,020 multi). GPU performance is also better, taking the GFXBench Manhattan test from 15 frames per second (fps) on the previous generation to 25fps here.

Whether the S7 is faster than the iPhone is another question. The iPhone 6s still benchmarks faster in single-core mode than the Snapdragon 820 does, with a Geekbench score of 2,475, and it does much better with on-screen graphics frame rates because of its lower-resolution screen. The question of whether single- or multicore performance matters more is still intensely debated in programming circles.

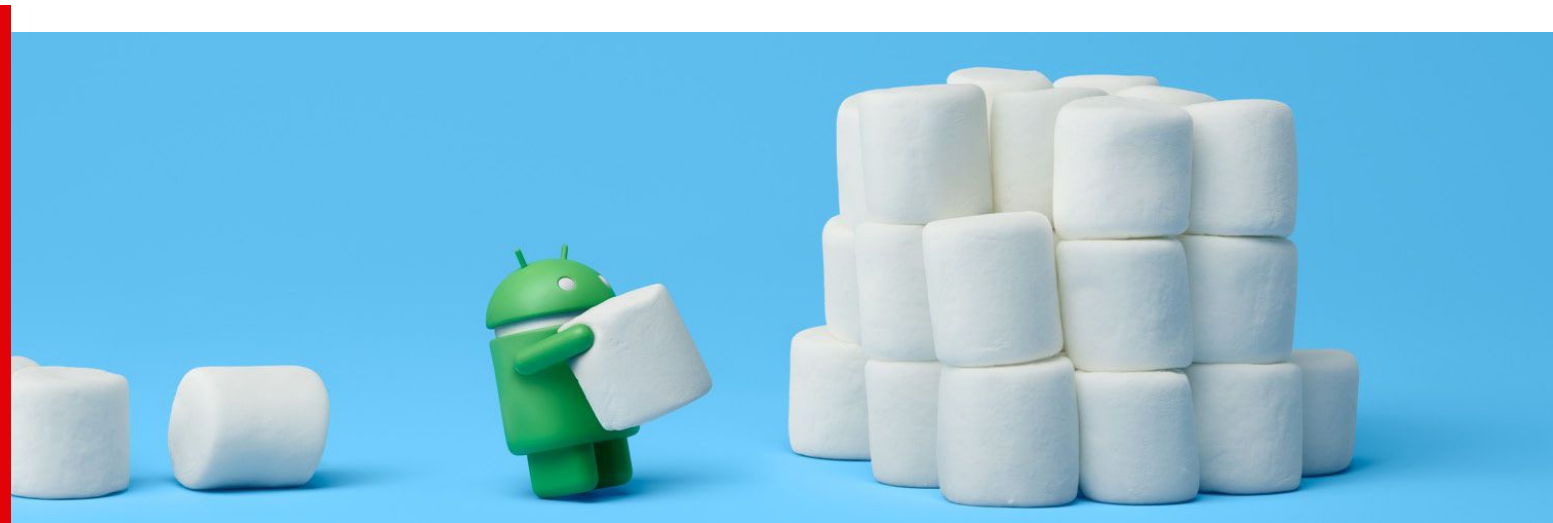
What really matters is how the phone performs in practice. I like to use the controls of Asphalt 8 to check for responsiveness, and the S7 is as smooth as butter. Apps launch quickly and there's no lag. The S7, like the past two generations of Galaxy phones, also has dual-window or pop-up multitasking.

Samsung has once again tried to lighten the burden of its Android skin. Although the icons are still all restyled, Samsung ditched its Briefing screen to the left of the main home screen. It has also resisted the current, horrid trend to get rid of the app drawer in favor of a more iPhone-like interface.

One likable customization is the always-on screen, which floats the time, date, battery status, and basic notification information on the screen at all times; you can swap it out for a calendar or one of a few preset images. The always-on screen information is convenient, and doesn't appear to be a significant drain on battery life, but you can turn it off if it's not for you.

But there are a ton of bloatware applications on the phone, consuming a total of 9.17GB on Verizon's 32GB unit. And bloatware apps can't be deleted or moved to SD cards. Our Verizon model came with three Amazon apps and nine Verizon apps, including Verizon's Go90 video service.

SOFT SELL
Although the S7's operating system is Android 6.0.1 (aka Marshmallow), it uses Samsung's own skin, which changes the OS's overall look and feel.



The bloatware load is at least somewhat alleviated by the phone's microSD card support. The microSD card pops into the SIM card slot, above the SIM card, and the phone supports cards up to the current maximum 200GB card SanDisk offers. Samsung disabled Google's Adoptable Storage feature, which makes the memory card look like internal memory to the system, so you still have to move apps back and forth from the Application Settings screen. You can move downloaded apps to the SD card, but not built-in apps.

PHOTOS AND VIDEO

Samsung replaced the Galaxy S6's 16-megapixel camera with a 12MP shooter with larger pixels, to improve low-light performance. It also increased the number of focus pixels, to speed up focus in low light. The latter part works: There's none of the S6's pulsing as the camera struggles to find focus. The S7 is also better at white balance than the S6, making my skin look orange less often.

The low-light improvements are minor at best. In one of my several tests, the S7 took a much brighter image than the S6 did. But I didn't find that in other tests, and whether my hand was shaky mattered far more than anything else. Both the S6 and the S7 cameras outperform the one on the iPhone 6s, though, turning out sharper and less-noisy images.

The 5MP front camera is also very good, but a minor improvement over the S6's. Mostly images are a little less noisy. The bigger improvement for selfies comes in the addition of a Selfie Flash mode, which lights up the screen when you're taking a shot in the dark.

Video now records at up to 4K resolution at 30fps on the main camera, and 1080p on the front camera. Video recording is excellent, and maintained 30fps even in very dim conditions.

In terms of audio and video playback, the Snapdragon 820 can handle any content you can throw at it. There's no cabled way to attach the S7 to a big screen any more, though—you need to use wireless screencasting.

PHOTO FINISH
Samsung touts the low-light performance of the S7's camera, but we found it on par with that of the S6's shooter.

Samsung Galaxy S7 Edge

From $

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EDITORS' CHOICE

If you don't mind a larger phone, the Galaxy S7 Edge is the way to go—and it packs additional functionality, too. It measures 5.9 by 2.9 by 0.3 inches and has a 5.5-inch 2,560-by-1,440 screen, but also uses its curved edge to display additional panels of information such as favorite contacts and apps, weather, a ruler, and memory status. Another plus over the standard S7: a bigger 3,600mAh battery (that lasted a full hour more in our rundown test).
—Sascha Segan

CONCLUSIONS

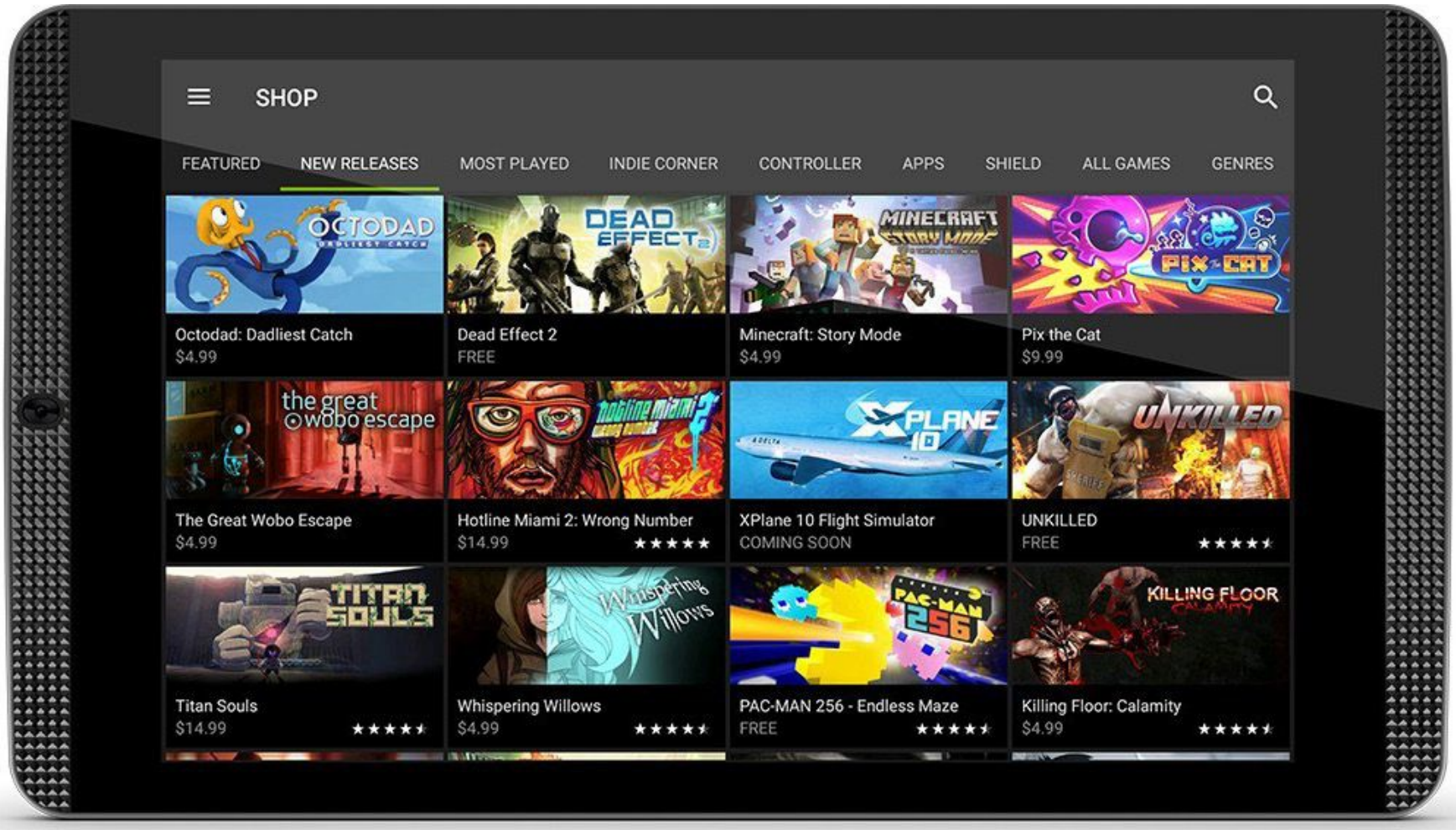
The Samsung Galaxy S7 is a no-compromise luxury phone, and the top of the Android lineup. It's also pretty conventional: It's just a good-looking, powerful smartphone that refines the performance of last year's model. The S7 is also the smallest flagship Android phone out there. It destroys every other Android device in its size class.

But it's hard to argue for the S7 as a $672 upgrade from last year's $650 S6, simply because the changes are pretty incremental. Maybe if you're paranoid about spills it's worth the peace of mind. Or if you've been holding onto an earlier Samsung Android phone on Verizon and you're looking for a small but powerful device, now would be the time to upgrade.

The S7's hardware is better in almost every way than the iPhone's. And yet I can't unequivocally recommend it instead of an iPhone, because of the Apple-exclusive apps and services. If you're a big mobile gamer, want to put your phone on a professional camera mount, or want to use FaceTime, well, no S7 for you. You're locked into Apple's world.

The S7 sets the bar for this year's smartphones, much like the S6 did last year. LG plans to meet that bar and add innovative features, at the cost of a slightly wider design, and one that I suspect will have slightly shorter battery life. HTC will likely try to outdo Samsung with an all-metal design and more tasteful icons. There will also be plenty of competitive larger phones, starting with the Galaxy S7 Edge, which takes our Editors' Choice honors thanks to its longer battery life and innovative edge functionality. (See sidebar on this page.) But if you're looking for a spill-proof, single-hand-operation 4G smartphone with a terrific camera, the Samsung Galaxy S7 fits the bill better than anything else on the market.

SASCHA SEGAN



This Tablet Was Designed For Mobile Gaming

Nvidia Shield Tablet K1

$199.99

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PC MAGAZINE EDITORS' CHOICE

Tablets are good for many things, but gaming isn't typically one of them. Most are designed for media consumption, like browsing through photos on Facebook and watching movies on Netflix. That isn't the case with the Nvidia Shield Tablet K1, an Android slate that's optimized for gaming on both the hardware and software fronts. Sure, it can handle photos and video just fine, but thanks to a combination of powerful on-board gaming performance and the ability to play PC titles via GeForce Now, Nvidia's PC game streaming service, the K1 is the ultimate gaming tablet—and it comes at a relatively affordable price.

DESIGN AND FEATURES

The Shield Tablet K1 is the successor to the original Nvidia Shield Tablet, which was recalled for overheating issues. The K1 is presumably safer, but from an aesthetic standpoint, not much has changed. Compared with the showy Acer Predator 8, the K1 is positively modest in design. Whereas the Predator has sharp, jutting edges and flashy red and silver colors, the K1 is simply a plain black slate. It measures 8.7 by 5.0 by 0.4 inches (HWD) and weighs 12.5 ounces, which is about the same as the Predator 8. The back has a matte black finish with a large Shield logo in the middle and a 5-megapixel camera at the top right.

The top and bottom of the front of the tablet are coated with rubber grips, making it easier to hold while gaming. Another 5MP camera sits in the middle of the top rubber strip. On the left edge of the tablet are two small holes where you can magnetically attach a folding cover (sold separately for $39.99). The right edge is home to a power button, volume controls, and a microSD slot that can handle cards up to 200GB—this is important, as the tablet comes with only 16GB on onboard storage.

The top and bottom edges both house speaker grids. The micro USB port is on top, along with a mini HDMI port for plugging the tablet into your television.

Nvidia Shield Tablet K1

PROS Excellent gaming performance. Rubberized edges. MicroSD support. Inexpensive. Solid cameras. Long battery life. GeForce Now cloud gaming support.

CONS Low amount of onboard storage. No surround sound, haptic feedback. forever.

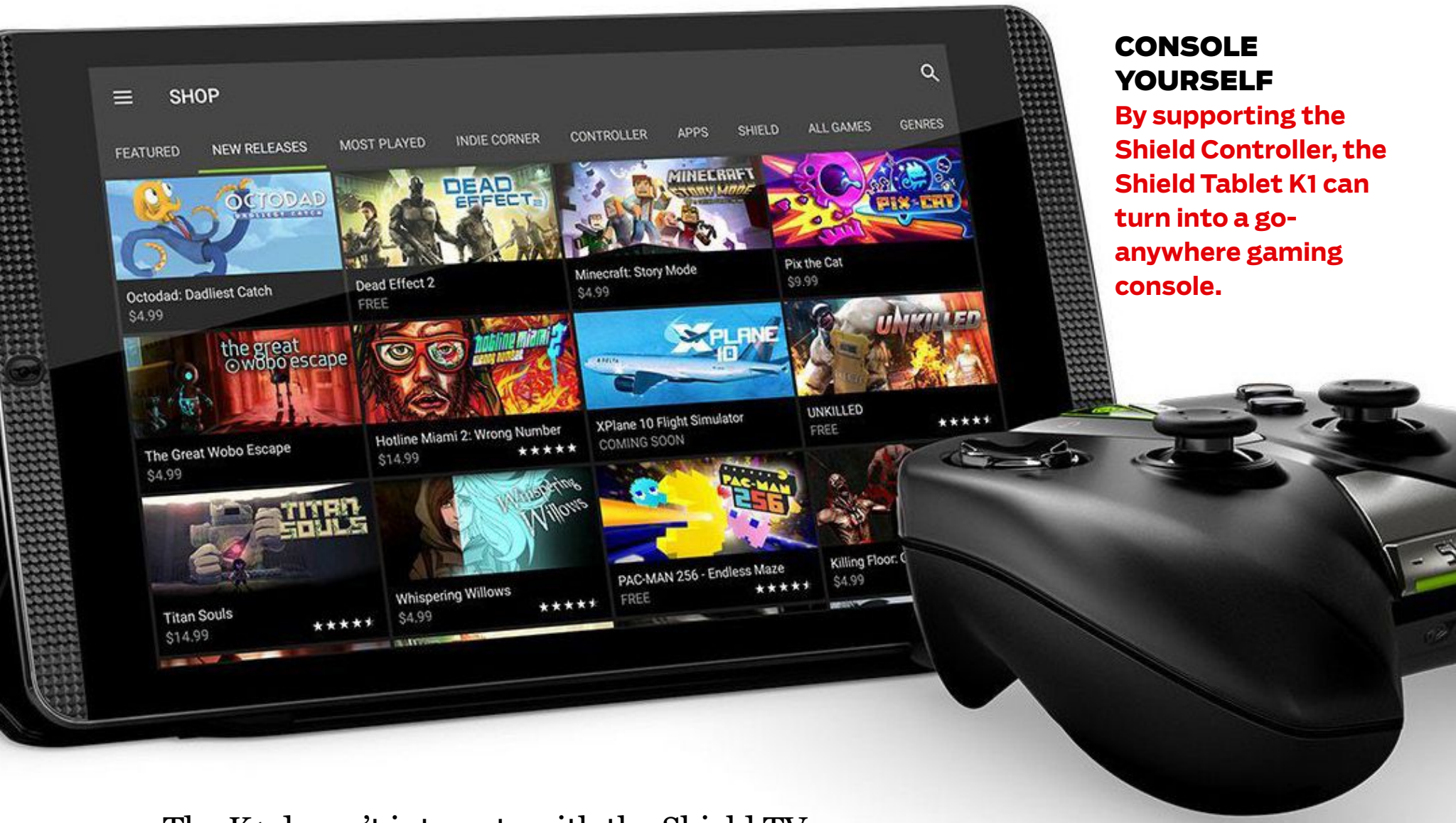
FLAT'S WHERE IT'S AT
The Nvidia Shield Tablet K1 packs a lot of performance and features into a small amount of space, though its storage is limited.

The display is a solid 8-inch 1,920-by-1,200-pixel panel, the same size and resolution as the Predator 8. Both screens look good, but neither pops in quite the same way as the 2,048-by-1,536 AMOLED screen on the more expensive Samsung Galaxy Tab S2 8.0.

SOFTWARE AND GAMES

The K1 runs a stock build of Android 5.0 Lollipop. Of the 16GB of internal storage, 11.24GB is available out of the box. Aside from the standard suite of Google apps, you get a few apps from Nvidia, including Shield Hub, where you can buy games, and Dabbler, for drawing.

You can also join GeForce Now (which costs $7.99 per month, though your first three months with the Shield are free). There are plenty of titles available on the service, including Batman: Arkham Origins, Mad Max, and The Witcher 3: Wild Hunt. The app lets you stream games at 1080p at up to 60 frames per second (fps). This is particularly useful because Android simply isn't the best gaming platform. By putting a bunch of high-quality PC titles at your fingertips, the K1 has an automatic leg up on the competition.



CONSOLE YOURSELF

By supporting the Shield Controller, the Shield Tablet K1 can turn into a go-anywhere gaming console.

The K1 doesn't integrate with the Shield TV or the Shield Portable, but it does work with the Shield Controller. The Controller resembles a standard Xbox controller, and gives you a much greater handle on gameplay than just using the tablet screen itself. And if you connect the K1 to your television, it almost feels like playing on a dedicated console.

PERFORMANCE

The K1 runs on an ARM Cortex A15 CPU that clocks in at 2.2GHz, along with Nvidia's own Tegra K1 192-core Kepler GPU, which makes for some impressive performance results. On the AnTuTu benchmark, which tests overall system performance, the tablet scored an impressive 73,626, slightly edging out the Predator 8 (73,020) and blazing past the Galaxy Tab S2 (52,137), though this is due in part to the K1's lower display resolution. The only tablet we've tested with faster performance is the Google Pixel C, which scored 90,291.

For a gaming tablet, you want strong graphics performance. The K1 averaged 13fps on the GFXBench 1080p Car Chase test. The Predator 8, meanwhile, only managed 8fps on the same test. Although neither of these results is a very playable frame rate, it does mean that you'll see faster performance on the K1 for everyday titles. Indeed, Asphalt 8: Airborne was fast and responsive. I miss the immersive haptic feedback of the Acer Predator 8, but it's not a huge loss as it's only available for a limited number of games.

The rear-facing 5MP camera is quick to focus and shoot, and takes clear photos that are perhaps just a little too saturated. The tablet also has a 5MP front-facing camera that delivers similar performance; I was able to see nearly all the details in my face, which means you can expect higher-quality selfies and video calls.

CONCLUSIONS

The Nvidia Shield Tablet K1 is an excellent midrange slate, and not just for gaming. It delivers powerful performance, a light and unassuming body, and very good battery life. Add to that the fact that it can play more games than any other Android tablet, and you have a winner for gamers and non-gamers alike. The Acer Predator 8 gets you better sound quality and haptic feedback, but it costs $100 more and doesn't have access to GeForce Now games. The Galaxy Tab S2 is another good choice, with a sharper screen and multiple-window multitasking, but it's even more expensive at $400. That makes the K1 a top pick among midrange tablets, and an Editors' Choice.

BEN RADDING

Sharp Looks, Speed Define This Gaming Ultraportable

Razer Blade Stealth (4K)

$1,399 (as tested)

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The Razer Blade Stealth is a high-end ultraportable laptop with fast hardware and some impressive features for gamers. In addition to its fine 4K touch display, it has the world's first RGB keyboard with individually backlit keys that can be customized. Though its potential as a gaming system isn't realized without Razer's external graphics card amplifier, the Razer Core (which is due out later this spring), the laptop still features a premium build and strong performance.

DESIGN AND FEATURES

Light and compact, the Blade Stealth measures 0.52 by

12.6 by 6.1 inches (HWD) and weighs 2.81 pounds; it has a high-quality feel, and it's easy to carry around under one arm. The lid of the all-aluminum laptop bears two muscle lines on either side of a centered Razer logo, which glows green.

The 4K Ultra HD (UHD) display is one of the laptop's major attractions (a less-expensive model is also available with a QHD screen). The 3,840-by-2,160-resolution panel is sharp and vibrant, and features capacitive multitouch capability. It's quite bright, and

Razer Blade Stealth
(4K)

PROS Thin, compact design. Vibrant 4K touch display. Individually backlit RGB keys. Solid performance.

CONS Shallow key travel. Battery life is a bit short for an ultraportable.

KEYED IN
Individually adjustable key backlighting lets you customize the Razer Blade Stealth to look however you want.

colors really pop off the screen, thanks in part to the Indium-Gallium-Zinc-Oxide (IGZO) technology it uses. Razer claims 100-percent Adobe RBG color matching for accurate and rich colors. There's a fairly thick bezel surrounding the screen, making it look a bit smaller than it is.

As is true of Razer's gaming peripherals, the keyboard on the Blade Stealth can be customized through the company's Synapse software. Each key is individually backlit, so you can set the colors and effects for every key separately—something we haven't seen on a notebook keyboard. Synapse is one of the best packaged hardware customization utilities out there, with an easy-to-use interface and a brief introductory guide. Colors (there are 16.8 million to choose from) and a variety of lighting effects (including fade, ripple, horizontal wave, and more) can be applied to sections of the keyboard or to individual keys. The lighting is bright and can be adjusted across several levels or turned off. It takes just a few seconds to switch settings, and the customization process is very straightforward.

Typing on the keyboard feels good, though some may find the keys too shallow. They are, however, nicely sized and spaced out—many other systems this size have much smaller keys. The touchpad is well made, too, and roomy for a small system; it's quick and responsive, and dragging your finger across it is smooth. The speakers, located on either side of the keyboard, are powerful and sound good, though audio can get a little fuzzy when blasting at or near maximum volume.

Our review unit included a 256GB solid-state drive (SSD), though a 512GB SSD is an available option (and the QHD model is available with a 128GB or 256GB SSD). There aren't too many ports on the system, but the essentials are all here. The laptop is powered and charged through a USB Type-C with Thunderbolt 3 port, which offers speeds of up to 40Gbps. The same port can be used to connect the Razer Core, from which the system would then draw power. The left side also includes a USB 3.0 port and

Future Core Competency

Razer plans to launch its external graphics amplifier, the Core, sometime before summer this year. The Core unit connects to the Blade Stealth via a USB Type-C with Thunderbolt port, and can house virtually any desktop-class Nvidia or AMD video card and connects to the Blade Stealth via a USB-C with Thunderbolt 3 port. This will make it possible for the laptop to play demanding games on higher settings than the Intel chip's integrated graphics system can do on its own.

the headset jack. On the right, there's another USB 3.0 port and an HDMI port. The Power button is located just above the keyboard. The laptop has Bluetooth 4.1 and 802.11ac Wi-Fi for wireless connectivity, as well as a Trusted Platform Module (TPM 2.0) security chip, which is usually included in business systems that need to stay secure. Razer offers a one-year warranty on its laptops.

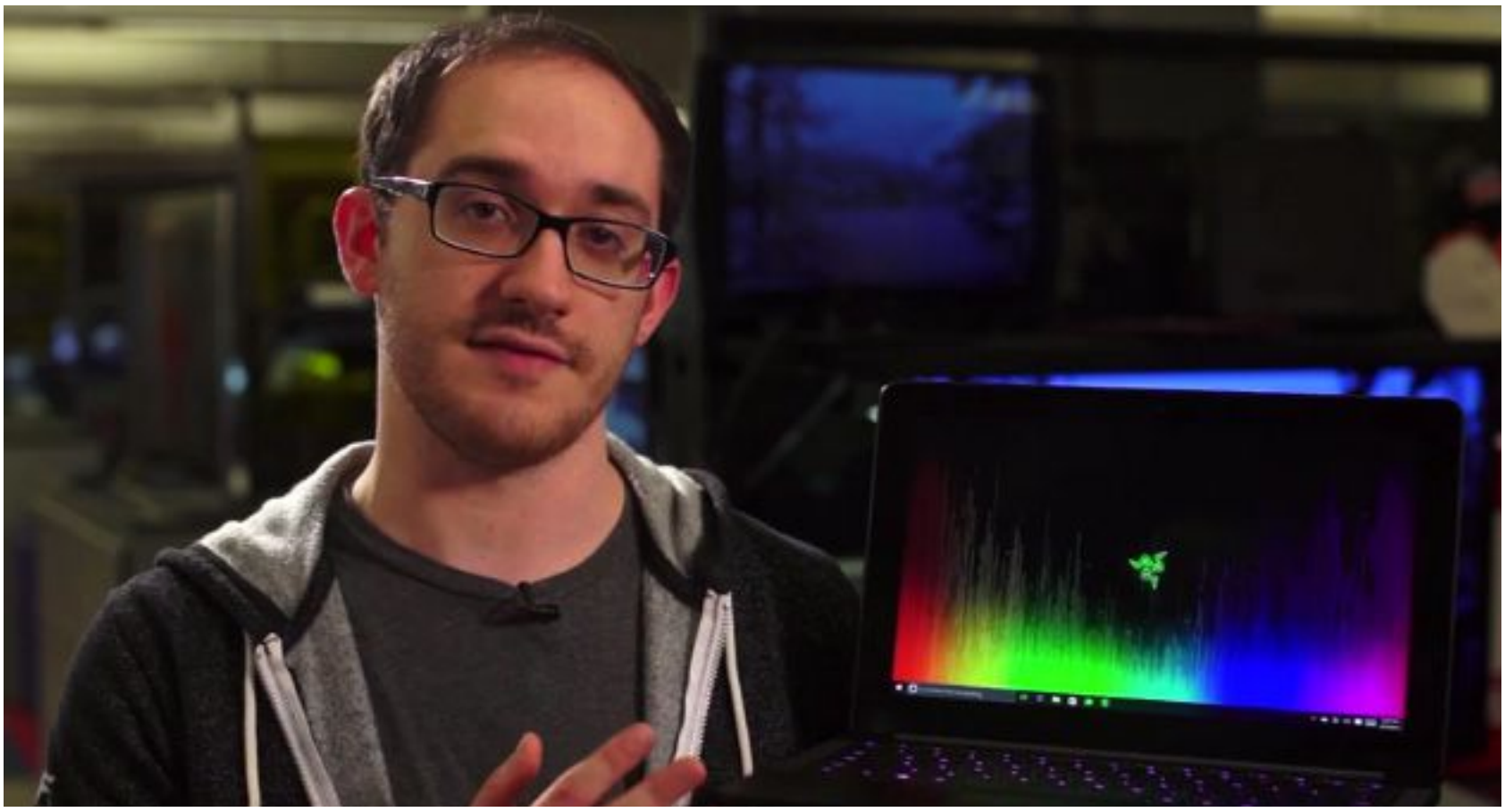
PERFORMANCE

The Blade Stealth is equipped with a 2.5GHz Intel Core i7-6500U processor, 8GB of memory, and integrated Intel HD Graphics 520. Powering a 4K display is demanding on a system, but the Blade Stealth acquitted itself nicely. It scored 2,411 on the PCMark 8 Work Conventional productivity test, not far behind the Dell XPS 13 Touch (2,450), the 4K Toshiba Satellite Radius 12 (2,487), and the Acer Aspire S7 (2,428). The laptop's 3DMark Cloud Gate score of 5,208 was solid, beating the Aspire S7's 4,536, but again lagging behind the XPS 13 Touch (5,606) and the Radius 12 (5,903). It fared better on the more strenuous 3DMark Fire Strike Extreme test, where it earned a best-in-class score of 383.

Multimedia test scores demonstrate the Blade Stealth's speedy hardware. The laptop finished the Handbrake video encoding test in 2 minutes, 25 seconds, the Photoshop test in 4:42, and it scored 309 on CineBench. The Radius 12 was quicker overall, the Aspire S7 did better on the Handbrake and Photoshop tests (mainly because it's not powering a 4K screen), and the XPS 13 Touch was slightly behind on all three. The Blade Stealth is more than capable of finishing media projects quickly.

Without the Razer Core, the Blade Stealth can't handle high-end gaming with just the integrated graphics, but less-demanding games on medium or low settings are playable with tweaking. The laptop scored 19 frames per second (fps) and 23fps on the Heaven and Valley gaming tests, respectively, using medium details, but crawled at 1fps on both when we ratcheted the settings all the way up. None of the other systems are appreciably better for gaming, though: The XPS 13 Touch performed exactly the same as the Blade Stealth at

KEEP IN TOUCH
With 4K resolution and capacitive multitouch, the Blade Stealth's display is great for more than just gaming.



medium quality and just 2fps at the highest settings. The Aspire S7 scored 14fps and 16fps at medium settings on Heaven and Valley, respectively, and 4fps on both when cranked up. The Radius 12 fared the best at medium (21fps on Heaven and 25fps on Valley), but still struggled above that (2fps on both Heaven and Valley). We anticipate that the Blade Stealth will be very capable when hooked up to a desktop-class GPU through the Razer Core, but like all of these other ultraportables, it's not suited to serious gaming on its own.

The Blade Stealth's battery life wasn't terrific on our rundown test: only 6 hours, 25 minutes. That's a decent length, capable of getting you through much of the day (particularly if you're not performing strenuous computing tasks), but the 4K display is no doubt responsible for draining power quickly. The Radius 12 suffered a similar problem, lasting just 5:49, but the Aspire S7 and its 1080p screen lasted 9:57. The XPS 13 Touch fared better, too (9:02). But Apple's systems are still the machines to beat: The 13-inch MacBook Pro lasted 11:10 and the newest-generation MacBook a full 14:10.

CONCLUSION

Razer is known as a gaming company, so the Blade Stealth's inability to serve as a dedicated gaming laptop on its own might seem counterintuitive, but its full potential should be unlocked with the Razer Core. Although we can't render a judgment on that pairing until the Core launches, the Blade Stealth is striking as a high-end ultraportable in its physical design, and it boasts plenty of power under the hood. The 4K display is excellent and the customizable RGB keyboard is unique. If you're willing to commit to the Razer ecosystem and plan on eventually getting the Core, the Blade Stealth will be a worthwhile 4K gaming system that you can also take on the road. As a high-end ultraportable, the Dell XPS 13 Touch remains our Editors' Choice, due to its strong performance, much longer-lasting battery, and stunning, nearly bezel-free display. For gaming, you may also want to consider the Editors' Choice Alienware 15, a heavier gaming laptop that is similar in price to the Blade Stealth ($1,499) and can also connect to Alienware's own proprietary $299.99 Graphics Amplifier. If you'd rather have a portable system with plenty of built-in gaming power, and you're willing to spend $1,000 more, check out the Razer Blade, our Editors' Choice gaming ultraportable.

MATTHEW BUZZI

A Hybrid Windows Tablet That Isn't a Budget Buster

HP Pavilion x2
(10-n123dx)
$329.99 (as tested)

The HP Pavilion x2 is a detachable-hybrid Windows tablet at a budget price. It's a little light on features and speed, but it makes up for those drawbacks with long battery life and the added utility of a detachable In-Plane Switching (IPS) touch screen. It's sleeker, and, in some ways, more comfortable to use than the Editors' Choice Asus Transformer Book T100HA, but it doesn't quite measure up on specs and features. Still, it's a capable alternative, especially if you plan on using your system all day, untethered.

DESIGN AND FEATURES

The compact polycarbonate body of the Pavilion x2 gives the system a sleek look; and it's available in white, silver, or an orangey red. The tablet measures 0.78 by

10.39 by 6.81 inches (HWD) and weighs 2.58 pounds with the keyboard dock attached. Removing the dock slims the tablet down to 0.39 inch thick and 1.36 pounds. It's just as portable as the T100HA and just a smidge lighter than the Acer Aspire Switch 10 E.

The magnetic latch is very similar to the one on the Switch 10 E. It's a snap to both remove the tablet from the keyboard base and reattach it; you don't have to fiddle with a sliding latch. There are guides built into the hinge that align the electrical connection for the keyboard. The magnets are strong enough to keep the tablet and keyboard attached if you pick the system up by its screen with one hand, but also easy enough to detach with a simple two-handed tug (one hand on the keyboard, the other gripping the tablet).

STRANGE ATTRACTORS
The magnetic latch on the HP Pavilion x2 is strong and well designed, so it's easy to attach or remove the keyboard dock as necessary.

You can also attach the tablet to the keyboard with the screen facing in the opposite direction, letting you use the touch screen with the keyboard out of sight. The system's modes include Notebook, Tablet (either with the tablet detached from or backed by the closed keyboard), Stand, and Tent. On the whole, it feels much more secure and usable than detachable-hybrid tablets with fixed keyboard angles, such as the Lenovo Miix 2.

HP Pavilion x2 (10-N123dx)

PROS Nice price. Sleek, balanced design. Magnetic docking mechanism. Bright IPS display. USB Type-C port. Long battery life.

CONS Limited RAM. Small keyboard. Soft speakers. Bloatware.

In Notebook mode, the Pavilion x2 feels more balanced than the T100HA, which has a tendency to tip over if you put too much pressure on the screen. The 10.1-inch display has a 1,280-by-800 resolution, which is a bit lower than the 1,366-by-768 resolution screens that many budget laptops offer, but you'd be hard-pressed to notice the difference, even if the two are sitting side by side. Because it uses an IPS panel, the Pavilion x2 has wide viewing angles. The system's Bang & Olufsen–branded speakers flank the screen, but having them angled toward your face doesn't help much with audio quality. The speakers are barely loud enough for a small, quiet room.

If you want a full-size keyboard, you need a larger 11- or 12-inch system.

The system's compact form factor means that the keyboard is smaller than usual, with relatively tiny keys. This is evident in the quarter-height row of function keys along the top row. Although the keyboard is a little cramped, I found it easy to get used to for quick typing sessions. If you want a full-size keyboard, you need a larger 11- or 12-inch system. The one-piece touchpad is wide and easy to use.

SOUND THINKING

Poor speakers on the Pavilion x2 mean you're better off using an external speaker system if you want to boost sound.

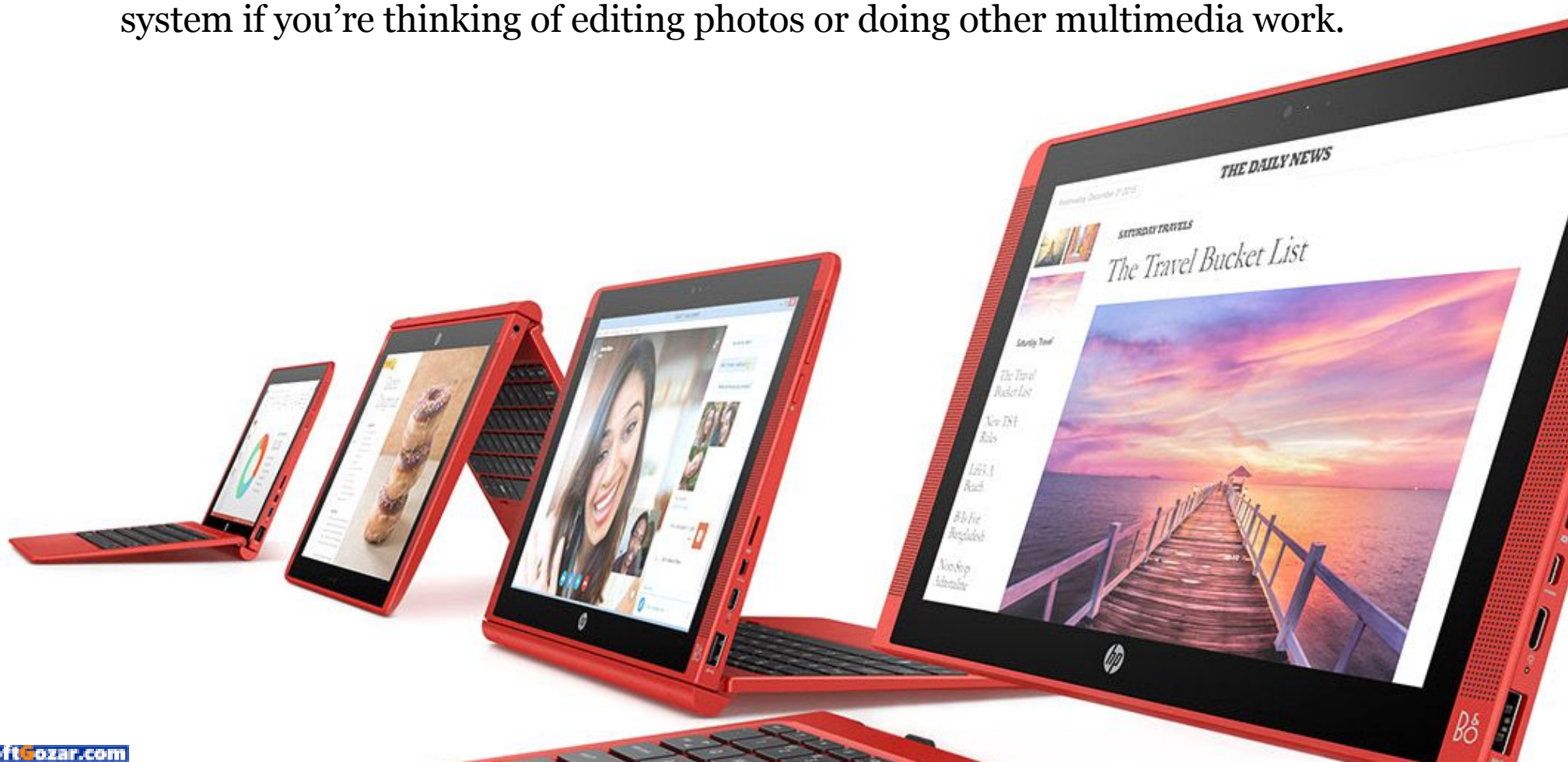
There's a USB Type-C connector on the right side of the tablet for charging, as well as for connecting peripherals, though not at the same time. You can also connect USB 3.0 devices to the port with a third-party adapter (not included). The right edge also holds a micro HDMI port, a micro SD slot, and a USB 2.0 port. I would have preferred a full-size HDMI port, as micro HDMI is inconvenient to use in general because it requires an adapter cable (also not included). Wireless connections include Bluetooth and 802.11ac Wi-Fi.

The system comes with 64GB of eMMC flash storage, which is limited to 45.6GB when you account for the operating system (Windows 10) and preloaded software. The latter includes apps and links for Amazon, Candy Crush, Flipboard, Minecraft, Netflix, Photoshop Express, Priceline, Snapfish, Wild Tangent Games, and the Weather Channel, all of which are removable. The tablet is covered by a one-year warranty.

PERFORMANCE

The Pavilion x2 is equipped with an Intel Atom x5-Z8300 processor with Intel HD Graphics and 2GB of memory. This is sufficient for simple day-to-day computing tasks, as evidenced by the system's average score of 1,478 on the PCMark 8 Work Conventional test. That's ahead of the 10-inch Miix 2 (1,392), but behind the T100HA (1,698), which has 4GB of memory.

Because of its 2GB of system memory, the Pavilion x2 couldn't run the Adobe Photoshop CS6 test, but it completed the Handbrake test in 7 minutes, 38 seconds, and scored 54 on the CineBench test. That's somewhat faster than the T100HA on Handbrake, but much slower on CineBench. You can transcode the occasional video on the Pavilion x2, but we'd recommend a more powerful system if you're thinking of editing photos or doing other multimedia work.



On our battery rundown test, the Pavilion x2 lasted an excellent 10 hours, 39 minutes, which was just ahead of the T100HA's 10:32. That means you'll be able to use the system all day and then some. It outlasted tablets like the E-Fun Nextbook 10.1 (5:52) and the Miix 2 (7:47), although the Switch 10 E returned an even more impressive 13:30 on the same test.

CONCLUSION

The HP Pavilion x2 is a capable choice if you're looking for an inexpensive detachable-hybrid tablet, especially if you're going to be using it unplugged for most of the day. It's also better balanced on your lap than other detachable-hybrid tablets we've tested. The Asus Transformer Book T100HA remains our Editors' Choice for budget detachable-hybrid tablets, however, due to its extra ports and larger system memory, at a list price that's $30 less than the Pavilion x2.

JOEL SANTO DOMINGO

The Modern Mobile Workstation At Its Finest

PC MAGAZINE EDITORS' CHOICE

The Dell Precision 15 5000 Series is a well-crafted mobile workstation, boasting cutting-edge technology and premium materials. Its build quality is impressive at every turn, with a nice metal body and a carbon fiber keyboard deck. This is highlighted by the brilliant 4K touch display, which is one of the sharpest and most impressive screens we've seen on any laptop. A USB Type-C port with Thunderbolt 3, and speedy performance only make it better for on-the-go professionals who need to complete intensive projects.

Dell Precision 15 5000 Series (5510)

$2,603 (as tested)

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DESIGN AND FEATURES

The Precision 15 justifies its expensive price tag with a premium look and feel. The exterior is made of aluminum, and the keyboard deck is built with carbon fiber. It's a high-quality system, though at 0.66 by 14.06 by 9.27 inches (HWD) and 4.98 pounds, it's more substantial and heavier than most 15-inch laptops. Still, it compares well with other mobile workstations.

Built into the carbon fiber deck, the keyboard feels good and features backlighting with two levels of brightness. The chiclet-style keys are solid, and offer good resistance and feedback. The touchpad is smooth

Dell Precision 15 5000 Series (5510)

PROS Fast performance. Outstanding 4K touch display. Premium design is slim, sturdy. Includes USB Type-C port. ISV certified.

CONS Sealed chassis. Middling battery life.

to use, feels sturdy, and is very responsive. The system includes an HD webcam, which records video with good quality, but it's located on the bottom-left side of the bezel above the hinge instead of centered above the screen. This keeps the top and side bezels extremely thin, which means that the display is almost edge-to-edge—a very appealing look.

AT A PREMIUM

The Dell Precision 15 5000 Series earns its premium price with a sleek, solid build, which includes an aluminum exterior and a elegant carbon fiber keyboard deck.

The 15.6-inch 4K touch display is easily one of the best we've seen, with a 3,840-by-2,160 resolution and more than 8 million pixels. The picture is extremely sharp, colors are vibrant, and 4K video looks fantastic.

There's a 512GB solid-state drive (SSD) on board for storage, though if that proves to be too little space, you're out of luck as far as internal expansion—the Precision 15 is sealed, so upgrades are impossible.

You do, however, get a good array of connectivity options with this system, including a USB Type-C port with Thunderbolt 3, a USB 3.0 port, a headset jack, the Power connector, and an HDMI port on its left side. The right side holds an SD card reader, another USB 3.0 port, a Kensington security slot, and a battery status button with light indicators. (As is true of most of the Dell's competitors, the batteries here are not removable.) Wireless connectivity options include Bluetooth 4.1, NFC, and dual-band 802.11ac Wi-Fi. The Precision 15 is also independent software vendor (ISV) certified for compatibility with a wide range of applications. Dell provides one year of hardware service, including on-site repairs after remote diagnosis.

DISPLAY ON DISPLAY

The Precision 15 5000 Series' 15.6-inch 4K touch display delivers outstanding still images and video.

PERFORMANCE

Equipped with a 2.8GHz Intel Core Xeon E3-1505M v5 quad-core processor, 16GB of memory, and a 2GB Nvidia Quadro M1000M graphics card, the Precision 15 is fast. It scored 2,738 in the PCMark 8 Work Conventional test, putting it just ahead of the Lenovo W550s (2,736) and well out in front of the Dell Precision M3800 (2,664). The Lenovo W540 did score higher (3,105) and the HP ZBook 15u G2 led the way with 3,124.

The system excelled in the 3DMark Cloud Gate and Fire Strike Extreme tests, scoring 16,103 and 1,658, respectively. These scores handily beat those of any other system in the category. The W540 was the closest, with 10,049 in Cloud Gate and 821 in Fire Strike Extreme; the HP ZBook 15u G2 (7,532 in Cloud Gate, 408 in Fire Strike Extreme) and the Precision M3800 (7,791 in Cloud Gate, 618 in Fire Strike Extreme) were far behind.

Multimedia test results were also at the front of the pack. The Precision 15 finished the Handbrake video encoding test in 1 minute, 13 seconds, the Photoshop test in 3:01, and it scored 583 on CineBench. The W540 only beat it in CineBench (637), as did the Precision M3800 (599), but the W550s and the ZBook 15u G2 lagged behind in every test. Across the board, the Precision 15 is capable of completing tasks instantly, and is a more capable multimedia creation machine than any of the others.

Despite its business focus, the Precision 15 crushed the Heaven and Valley gaming tests. At medium quality settings, the laptop scored 58 frames per second (fps) on Heaven and 46fps on Valley, which is much smoother than the W540 (30fps on Heaven, 42fps on Valley), the W550s (27fps on Heaven, 33fps on Valley), the Precision M3800 (21fps on Heaven, 29fps on Valley), and the ZBook 15u G2 (25fps on Heaven, 29fps on Valley). None of these systems was

WEAR HARD ON THE HARDWARE
Make sure that the Precision 15's components meet your needs—the sealed chassis precludes post-purchase upgrades.

able to go above 8fps on Heaven or Valley at maximum settings, so intensive gaming isn't an option, but playing less-demanding titles on lower settings is doable. The Precision 15's processing power and discrete video card are better suited to game development than playing demanding games.

The battery lasted 5 hours, 8 minutes, on our rundown test, an average result for a mobile workstation. The W540 lasted 6:10, the Precision M3800 hit 4:53, and the ZBook 15u G2 managed 6:13. The Lenovo W550s showed a decent result of 6:44 on a single battery, but its dual-battery system combined for 17:21. Five hours certainly isn't all-day battery life, but this laptop is pushing pixels to a 4K display, and that requires a lot of energy.

CONCLUSION

The Dell Precision 15 5000 Series is a well-constructed system, and its striking 4K touch screen and fast performance warrant the extra cost. The Precision 15's SSD is also bigger than the one on the Lenovo W540, it comes with double the memory (though the system can't be opened for upgrades, as the W540 can), and you get an HDMI port. With its excellent design, full feature set, and class-leading performance, the Precision 15 5000 Series is our new Editors' Choice for mobile workstations.

MATTHEW BUZZI

Wi-Fi Makes This the Tastiest Raspberry Pi Yet

PC MAGAZINE EDITORS' CHOICE

Manufacturers of full-scale PCs have trouble coming up with exciting new features across each generation of their releases; there are only so many ways you can spin minor improvements. The same would also seem to be true of the Raspberry Pi, if not truer: It's never looked like much more than a light-featured PCB with a couple of familiar ports tacked on. But for the newest iteration of the product, the Raspberry Pi 3 Model B, the usual modest bump in performance is accompanied by a particularly impressive new feature: Wi-Fi. Now that you no longer need to be tethered to an Ethernet cable, there are even fewer limits on where your

Raspberry Pi 3 Model B

$35

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imagination can take you. And as the Pi 3 retains the $35 purchase price that's defined the line since day one, it's now an even better option for the makers, enthusiasts, and educational types who could benefit from this sort of system.

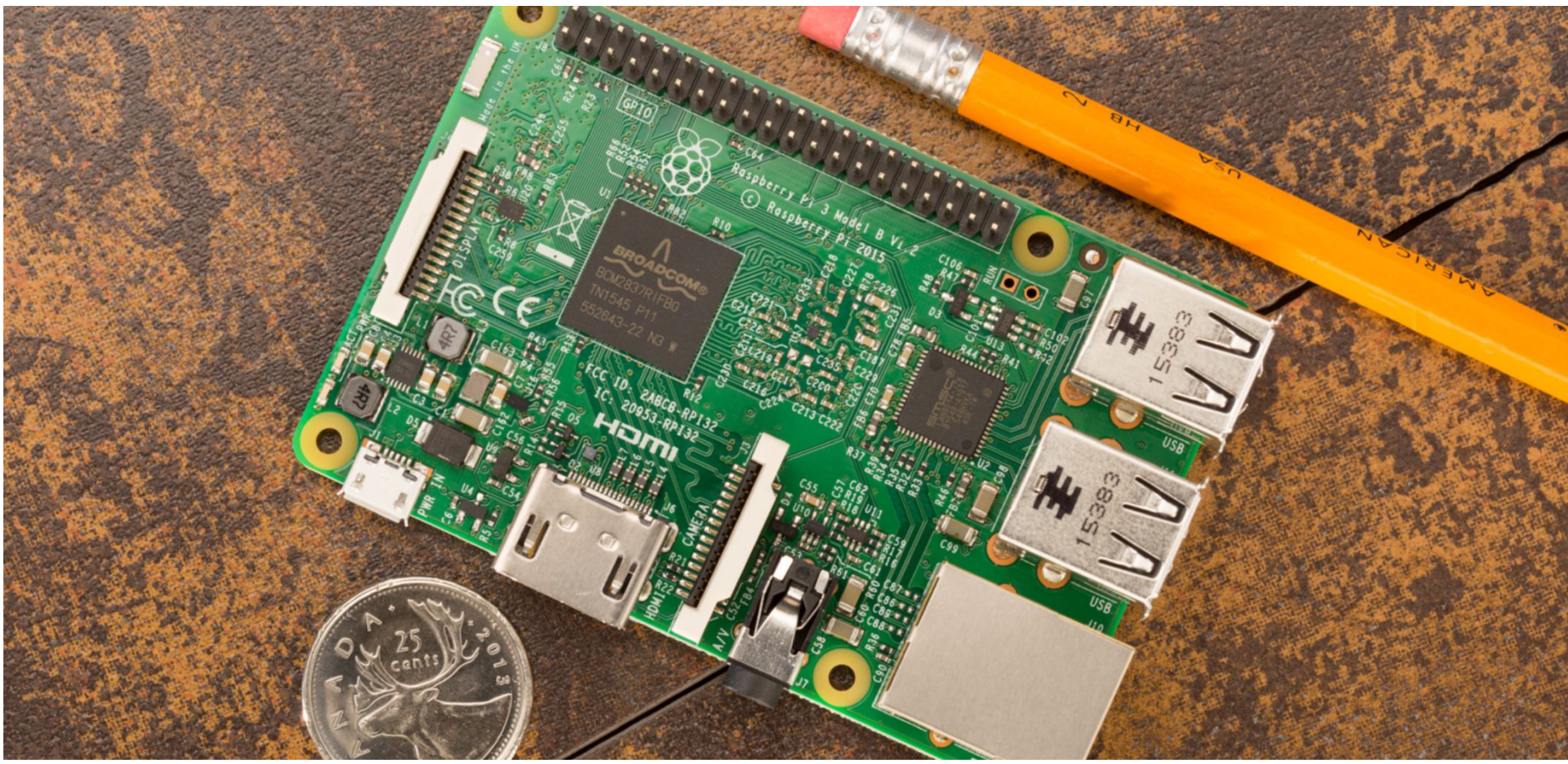
DESIGN AND FEATURES

Like its predecessors, the Raspberry Pi 3 Model B measures only about 3.5 by 2.5 inches—small enough to fit in your shirt pocket—and you should be able to reuse any cases or other devices designed for the earlier models. Also essentially identical are the ports, which offer basic functionality and not a great deal more. You'll need to connect at least a keyboard and a mouse to two of the four USB 2.0 ports, a display to the full-size HDMI port, and a micro USB charger (such as for your cell phone) to actually power the thing. This time around, though, the Raspberry Pi folks recommend a 2.5-amp adapter "if you want to connect power-hungry USB devices." In any case, there's no Power switch; plug in the charger, and the Pi 3 turns on, or unplug it to turn the system off.

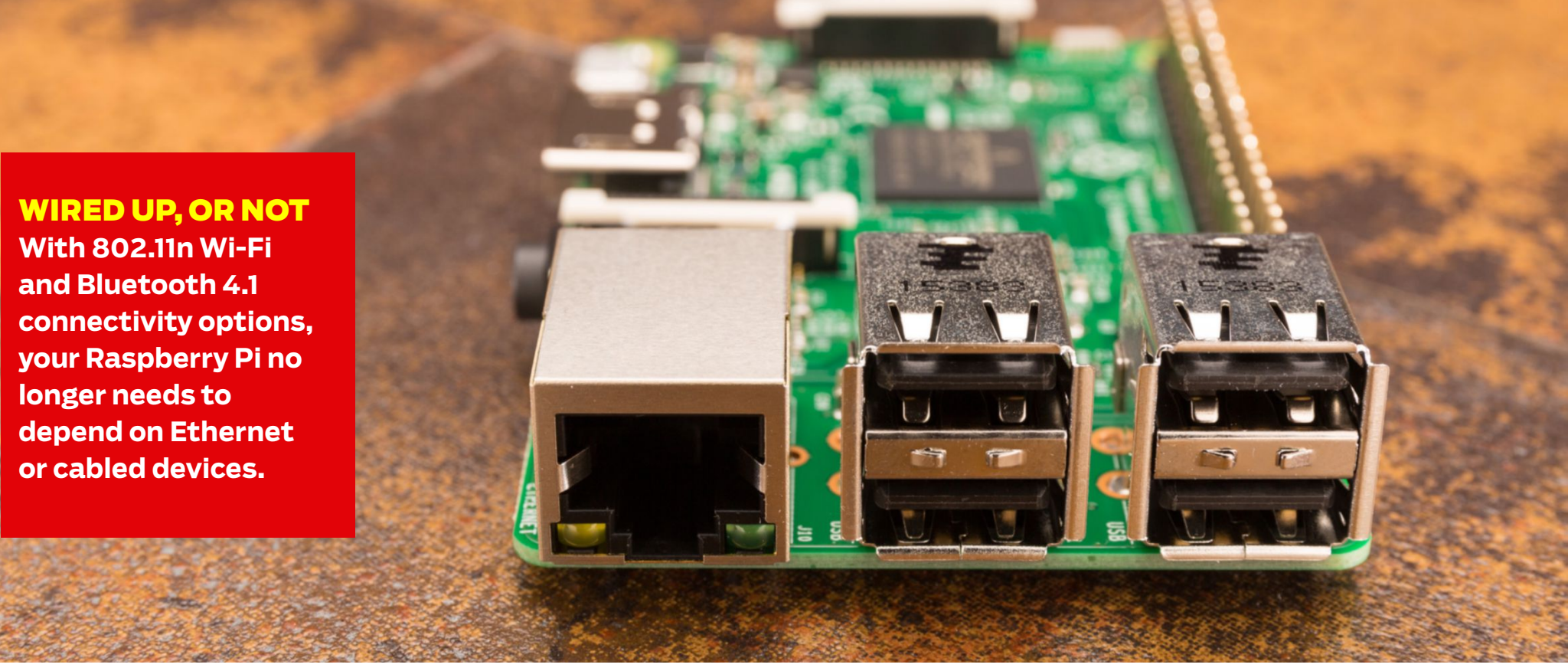
Raspberry Pi 3 Model B

PROS Low price. Includes 802.11n Wi-Fi and Bluetooth 4.1. Improved performance over previous generation.

CONS Requires lots of additional hardware to function as a full PC. Limited operating system selection. Software setup may prove challenging.



CREDIT CARD COMPUTING
Don't let the Raspberry Pi's wallet-ready size fool you. There's a full PC packed onto this tiny chunk of circuit board.



WIRED UP, OR NOT
With 802.11n Wi-Fi and Bluetooth 4.1 connectivity options, your Raspberry Pi no longer needs to depend on Ethernet or cabled devices.

Another must on your end: a microSD card, which has been imaged with the operating system you plan to use, as there's no other on-board storage. (Doing this is not especially difficult, and the instructions on the Raspberry Pi Foundation website are clear and easy to follow, but the process may prove tricky if you're not familiar with it.) Aside from that card slot, which is located on the underside of one of the board's edges, there's also the requisite combo headphone–composite video jack, plus an Ethernet port. Anything else you may want to add is optional, and, of course, is where the "creativity" aspect of the Raspberry Pi comes into play. Headers for hooking up the proprietary camera or touch display are present, too, as are 40 GPIO pins for connecting to whatever else you may be able to dream of. All of this is, likewise, held over from other years' Raspberry Pi models.

What's not, however, is wireless connectivity. Because the Pi 3 comes equipped with 802.11n Wi-Fi and Bluetooth LE (aka Bluetooth 4.1), you now have a lot more methods of connecting with the Internet, other computers, or your Bluetooth devices. Considering that the goal of the Pi has always been freedom, these additions give you more of it than ever.

Also ramped up is performance. You still get 1GB of RAM with the Pi 3, but the 64-bit Broadcom BCM2837 ARM v8 processor is a quad-core chip that runs at 1.2GHz (compared with 900MHz for the 32-bit processor on the still-available Raspberry Pi 2 Model B), for an added speed boost when you're doing pretty much anything.

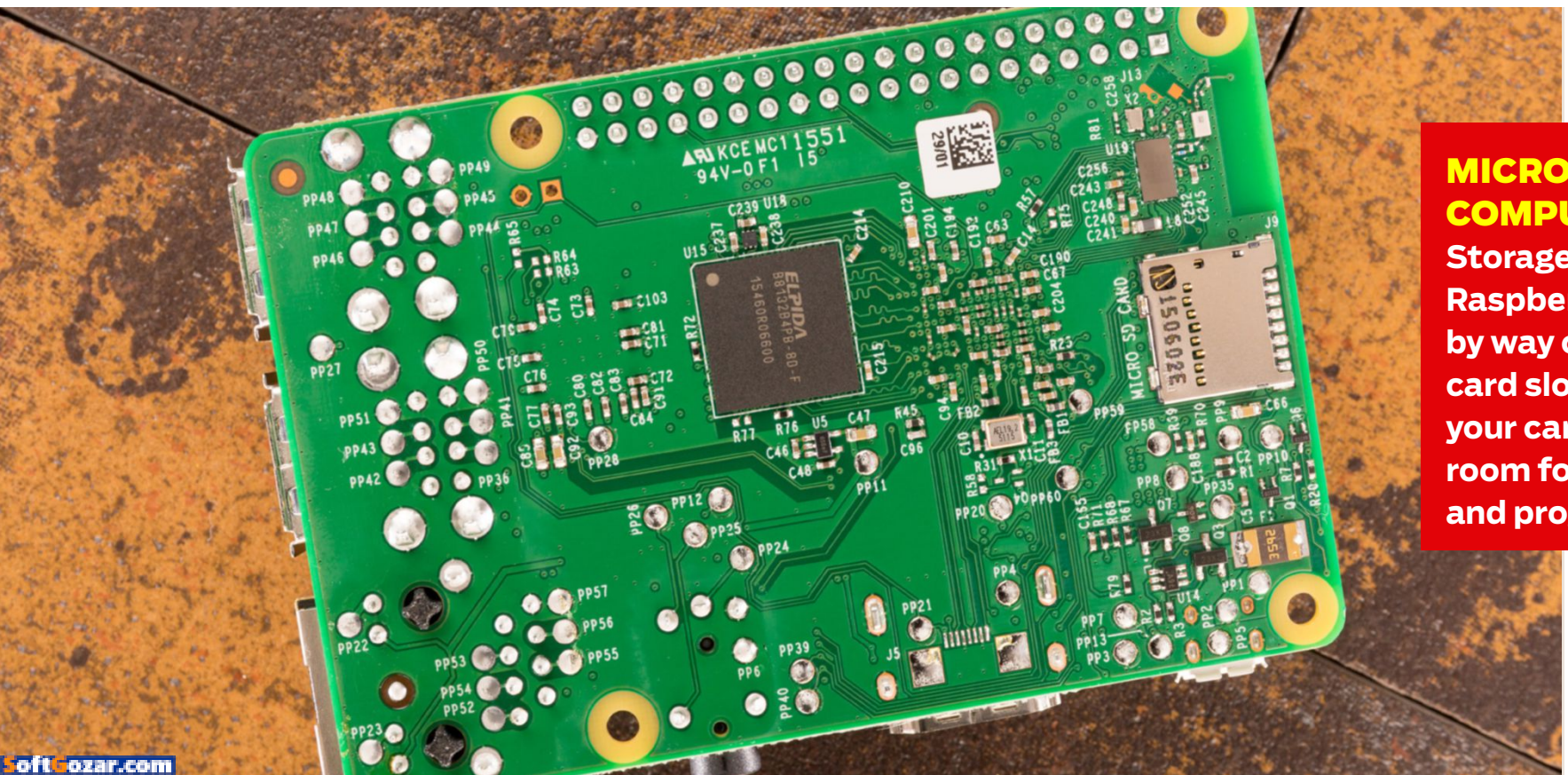
One important thing to remember is that using the Pi 3 with its ARM chip limits your choice of operating systems. Chances are, you'll just want to go with the recommended Linux distribution, Raspbian (based on Debian Jessie), which is optimized for use with the Pi and available for download from the Raspberry Pi Foundation's website either by itself or as part of the NOOBS multi-OS installer. It's

pretty traditional in design and content, and includes a lot of the basic software you'll want, such as the LibreOffice suite, the Epiphany Web browser, and various other free and open-source versions of standard programs. (For the record, Microsoft has released Windows 10 IoT, a stripped-down version of its flagship OS, to work with systems like the Pi 3. But this is intended primarily for use by device manufacturers and serious maker types; Windows 10 IoT doesn't have a standard Windows interface, and thus won't be that attractive to most people, but it's a nice option for those who want a broader range of compatibility and capability than Linux may provide.)

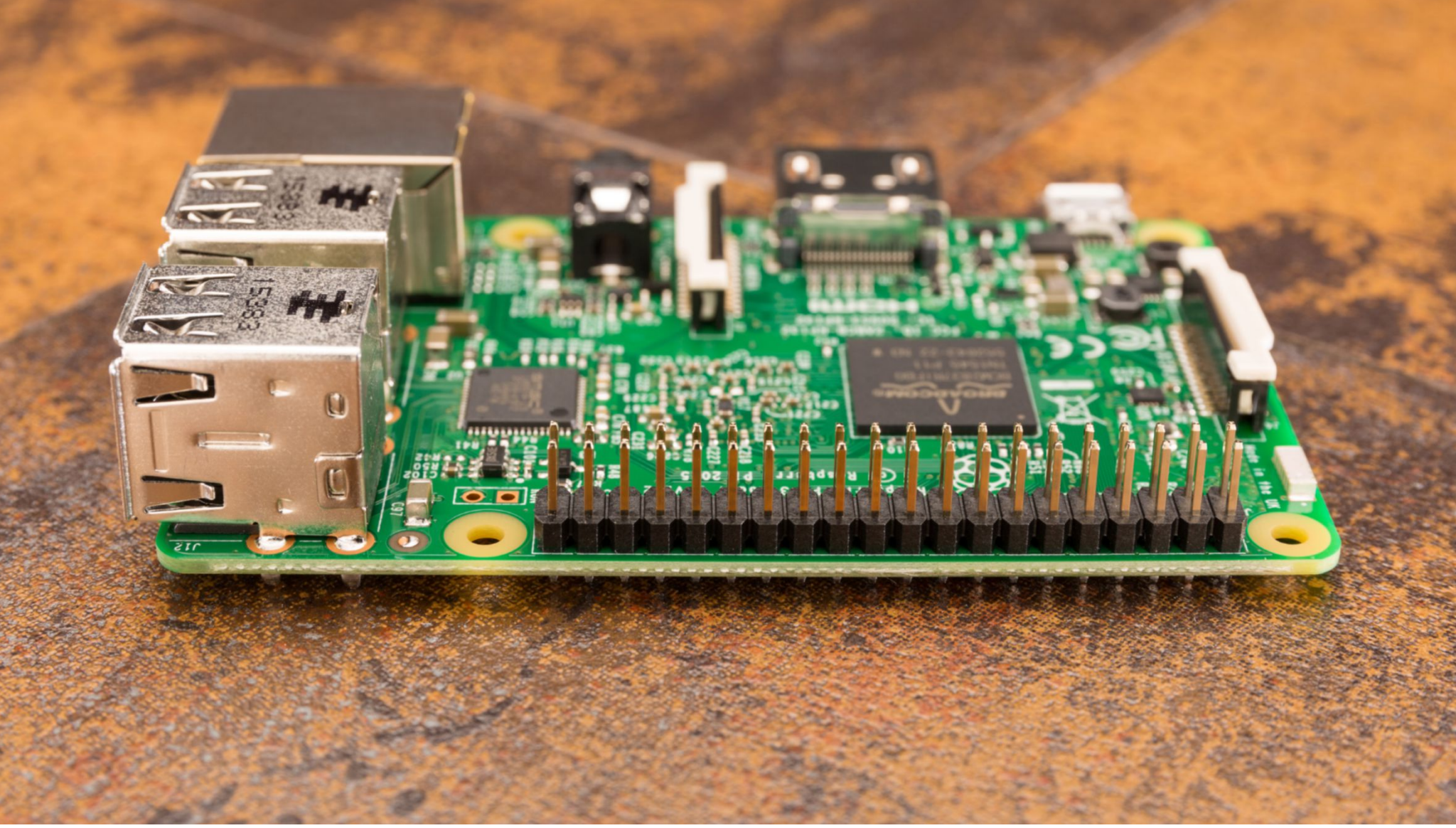
PERFORMANCE AND CONCLUSIONS

Because we weren't able to run our standard suite of benchmark tests on the Pi 3, we had to settle for simpler cross-platform tests that we could use to get a general idea of performance. The Pi 3 completed the SunSpider 1.0.2 JavaScript benchmark test in an average time of 2,860ms—noticeably speedier than the Raspberry Pi 2, which took about 4,630ms on the same test (and using the same OS on the same microSD card). On Browsermark 2.1.3, the Pi 3 earned a score of 315, compared with the Raspberry Pi 2's 201. We saw similar results in the Google Octane 2.0 and the JetStream 1.1 benchmark tests—the Pi 3 would consistently finish well ahead of the previous-generation model.

As always, it's worth pointing out that the Pi 3's performance doesn't compare in any serious way with what you'll see from even a diminutive desktop with a beefier processor. We fired up the 2016 version of the Intel Compute Stick and ran our same tests (using Chrome rather than Epiphany), and the competition wasn't even close. The Compute Stick nabbed a SunSpider time of 938.15ms and a Browsermark score of 1,717. No, you're not likely to perform many intense



MICRO(SD) COMPUTER
Storage on the Raspberry Pi comes by way of a microSD card slot (right)—your card must have room for your OS and programs.



computational chores on the Compute Stick either, but its Intel Atom processor will take you further than the Pi 3's ARM chip will.

The question is: Where do you want to go? And with the Raspberry Pi 3 Model B, you can answer that however you like. You can set it up as a computer for the kids, a super-easy email and Web-browsing machine, or as the basis for some exciting project of your own. You shouldn't get it if power is any sort of an objective concern; on that score, either the InFocus Kangaroo Mobile Desktop, our Editors' Choice for pocketable PCs, or the Shuttle XPC Nano, our top pick for budget desktops, manage much better, and are still pretty inexpensive ($99 and $279, respectively). And for that matter, this top-of-the-line Raspberry Pi isn't even the cheapest PC out there anymore—that honor belongs to its pint-size brother, the $5 Raspberry Pi Zero. But the Pi 3's potent combination of speed, features, price, and near-infinite potential for personal, enthusiast, and educational projects is enough to make it a real winner—and an Editors' Choice—in our book.

MATTHEW MURRAY

System Protection With a Fresh Windows 10 Focus

PC MAGAZINE EDITORS' CHOICE

It happens to all of us: After you've owned a PC for a couple of years, it stops booting and loading applications at the same pace that it did when you first turned it on. To solve this, download Iolo System Mechanic 15.5. This excellent tune-up utility dramatically improves your PC's performance by defragmenting the hard drive, repairing Windows's troublesome Registry, tweaking CPU and RAM usage in real time, and more. With this newest version, Iolo also includes Windows 10–specific privacy tools. System Mechanic is pricier than some of its competition, but it comes packed with features that make it worth the extra money.

Iolo System Mechanic 15.5

$49.95 per year

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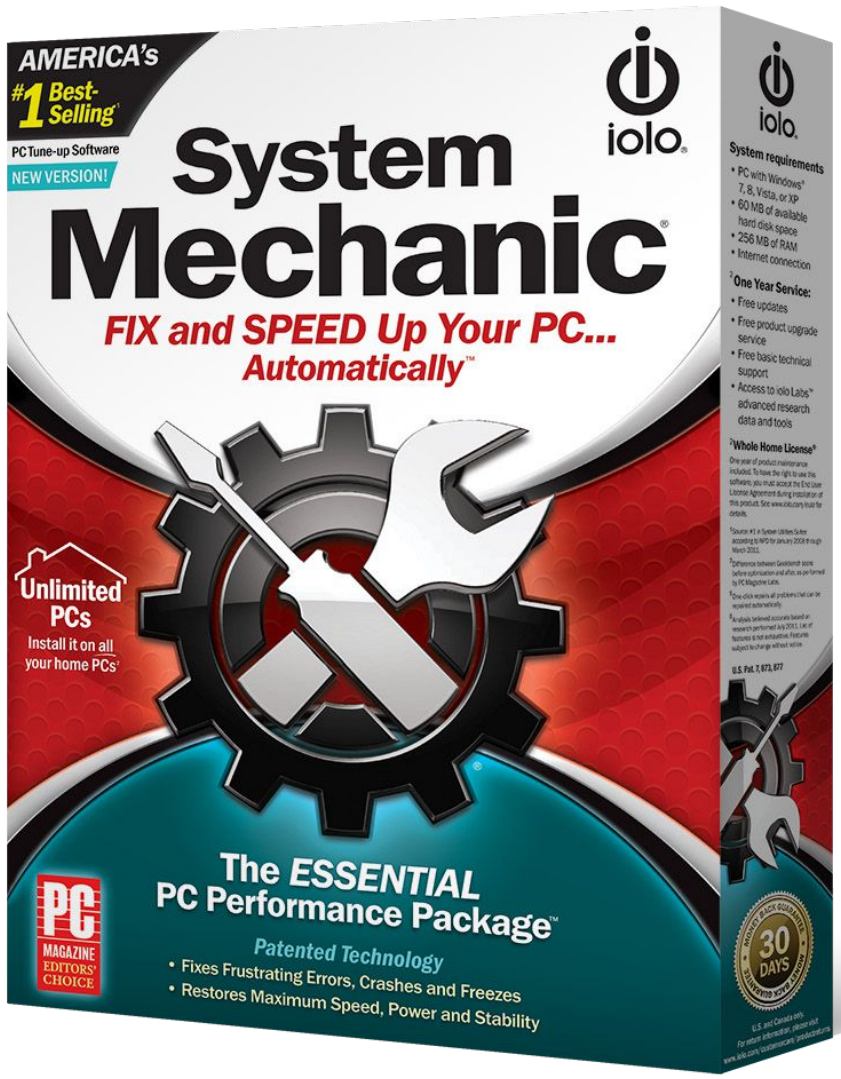
FEATURES

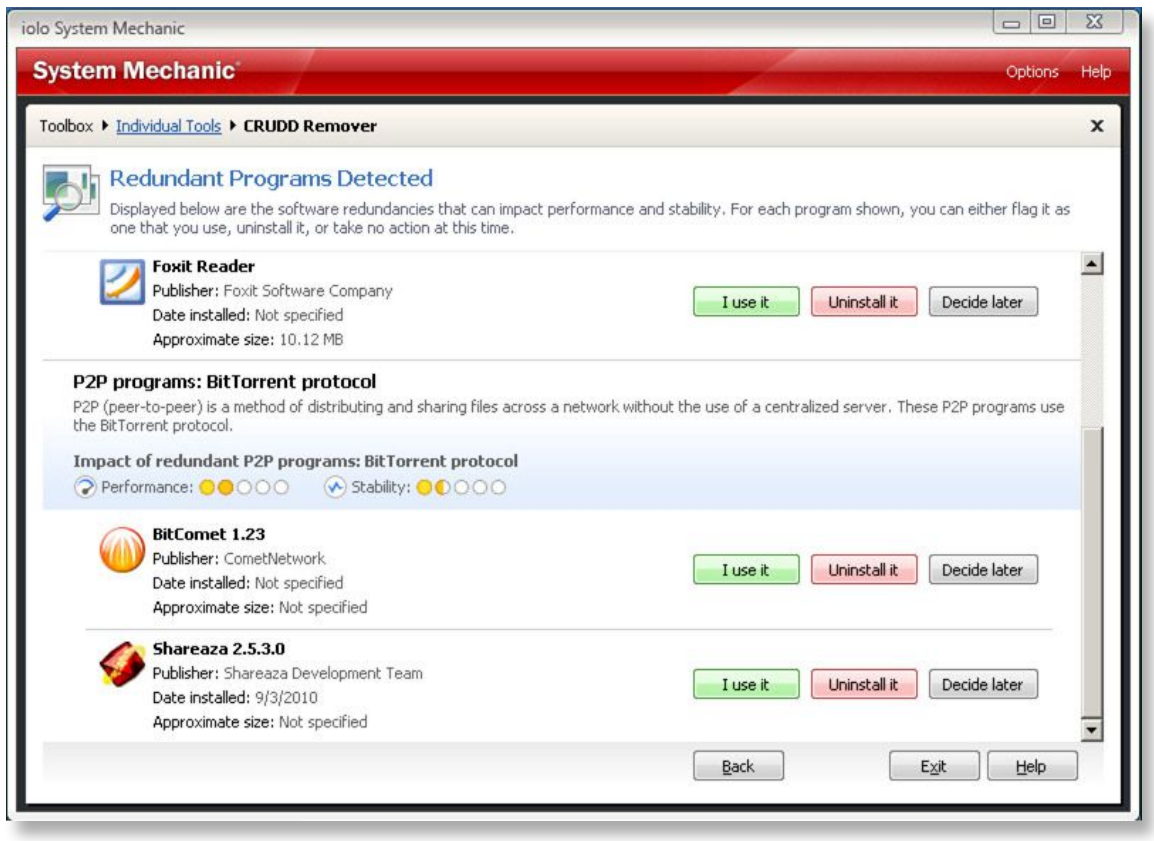
System Mechanic 15.5 is compatible with all PCs running Windows XP or later. Running $49.95 per year, it's on the pricey side, but you can install it on any number of computers for personal purposes—most similar packages limit you to three licenses. This is a welcome, and much-needed, feature in the age of the multi-PC household, and one more companies ought to emulate.

System Mechanic's interface has several options in the left pane with subcategories that let you run specific tune-up tools. The newest of these in version 15.5 is the Privacy Shield suite, which has been designed exclusively for use with Windows 10. With it, you can disable Wi-Fi Sense, SmartScreen



Service, and Microsoft Data Collection and Telemetry Services, and it prevents the involuntary collection and sharing of your personal information. It also lets you turn off services that share your Wi-Fi network connections with your contacts, as well as those that collect information regarding your Web surfing habits, program usage, and more. You can turn them all off within Windows 10, but these options are buried, so I like that Iolo makes them easily accessible.

Privacy Shield is a cool feature, but most people will want System Mechanic for enhancing PC performance. The Overview screen opens by default when the program is launched, and it's here that the Repair Now button appears if Iolo detects a problem. Clicking it causes Iolo to launch the approriate system-fixing tool.



The most useful tools include the drive defragmenter and Commonly Redundant or Unnecessary Decelerators and Destabilizers (CRUDD), which removes the useless files and programs that clutter your PC. After I ran CRUDD Remover, Iolo detected several problems on my testbed, and it explained what they did in simple, everday terms, so I could decide whether to leave them or trash them.

Iolo System Mechanic 15.5

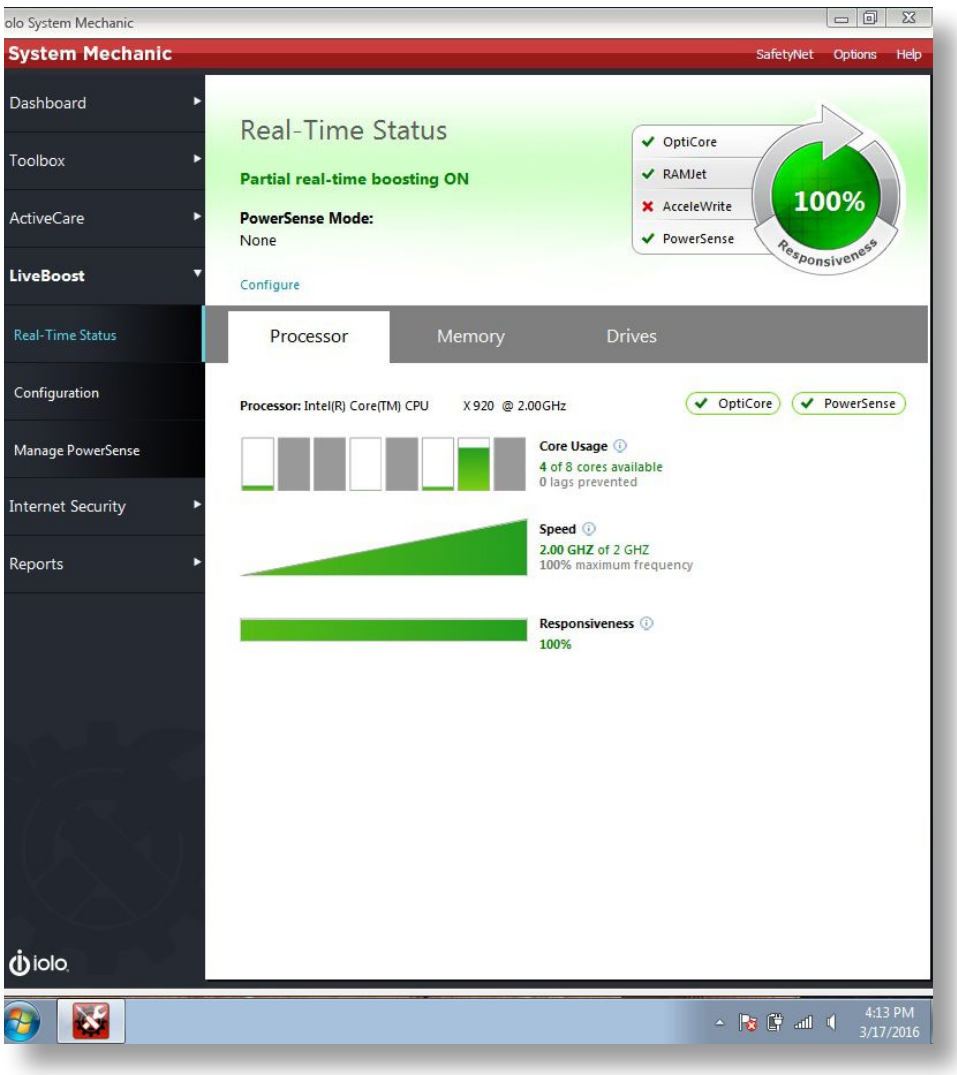
PROS Top-notch performance. Windows 10–specific privacy tool. Excellent explanation of PC problems. Unlimited installs. Useful desktop widget.

CONS NetBooster grants marginal Internet connection performance boost.

THROW IT OUT
System Mechanic 15.5's CRUDD Remover sweeps away old files and programs that may be gunking up and slowing down your PC.

LiveBoost unlocks extra CPU and RAM as needed, and ActiveCare provides real-time system analysis and repair. Iolo also adds anti-malware software if you upgrade to System Mechanic Pro (which costs $69.95 per year). Overall, System Mechanic packs a powerful PC-improvement punch.

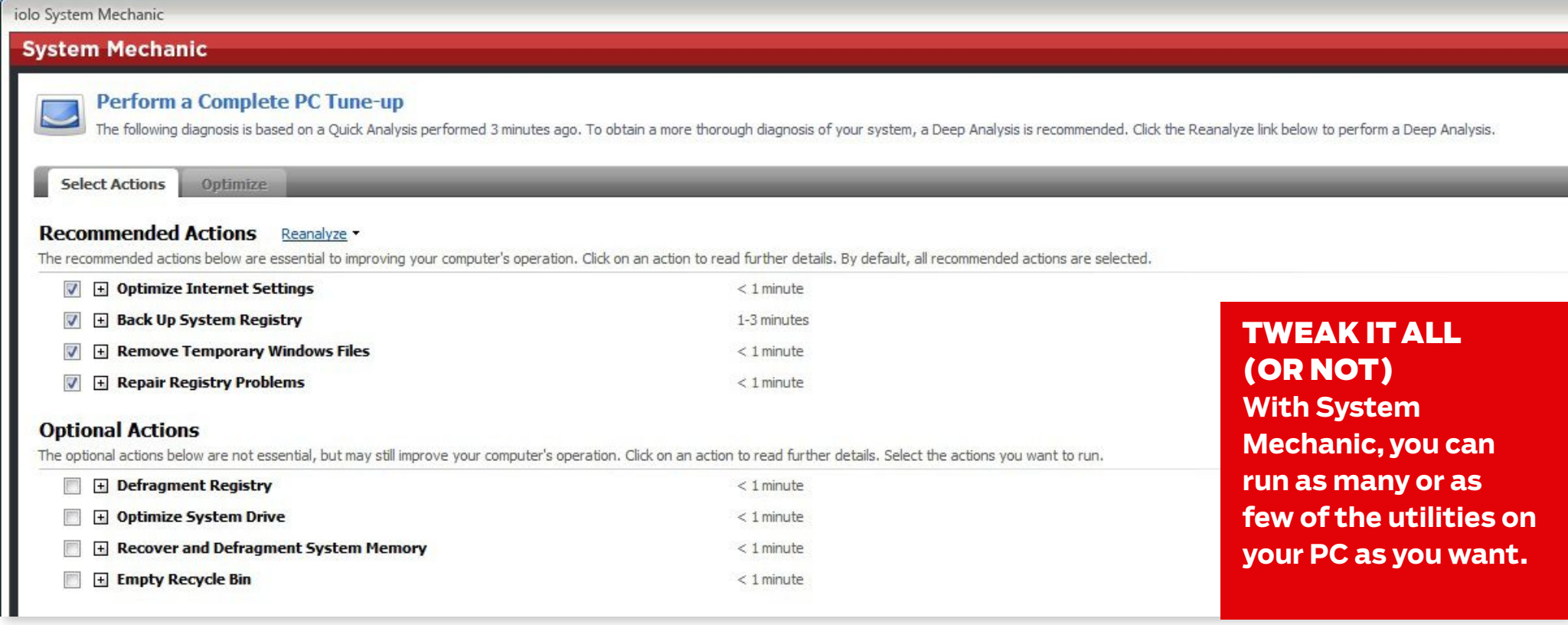
I ran Iolo's PC Accelerator, which smartly realigns all of a program's dependent files on the hard drive. It's touted as being better than regular defragmenters, which can blindly compact and separate files even more than they already are. PC Accelerator took approximately 15 minutes to work its magic, and, when it was done, I discovered that it had realigned thousands of files and hundreds of file fragments.



Among the other tools packed into the suite are AcceleWrite, a new real-time feature that helps organize the way data is written to the PC's hard or solid-state drives; IntelliStatus, which displays RAM and storage information, and serves up cleaning tools; and Stability Guard, which uses algorithms to stop threats to your system.

System Mechanic 15.5 doesn't just serve you up a list of problems—it provides blurbs that explain the impact of these problems on performance. Armed with this information, you can check off the appropriate problems that are listed, click the Repair All button, and reboot to address the issues.

PowerSense (introduced in version 14) is a feature that dynamically senses PC activity and automatically adjusts the computer's power settings and processor modes in real time to match the task at hand. For example, PowerSense kept my five-year-old gaming laptop in Balanced Mode (utilizing four of eight CPU cores and keeping CPU clock speed at 1.2GHz) while I checked email and surfed the Web, but it kicked the computer into Ultra Performance Gaming Mode (utilizing all eight cores and upping the clock speed to 2GHz) when I fired up Steam to play an intense 3D game. With PowerSense, you can also manually switch the power settings and create your own power-management profiles.



TWEAK IT ALL (OR NOT)
With System Mechanic, you can run as many or as few of the utilities on your PC as you want.

GAUGING PERFORMANCE

I tested System Mechanic's ability to whip a PC back into shape by running the Geekbench system performance tool both before and after tune-up. (I ran the tests three times each and averaged the results.)

Before Iolo scrubbed the system, my 2GHz Intel Core i7 X990 MSI Style-Note notebook with 4GB of RAM, Windows 7, and an 80GB Intel SSD drive achieved a Geekbench score of 4,210 Geekbench score and booted in 50.3 seconds. After running System Mechanic, performance much improved: The GeekBench score rose to 6,299 and the boot time decreased to 37.5 seconds. Those are impressive numbers that beat out the results we saw with Slimware SlimCleaner Plus (5,218 on GeekBench, a 42.4-second boot time).

After running the tests, I also used the computer extensively to gauge how the app affected the machine's responsiveness. System Mechanic 15.5 delivered a detectable performance improvement—of special note, iTunes and Steam opened faster in the fresh environment. The NetBooster Internet-boosting tool had only a nominal impact on my download speeds, however.

MUSIC-TO-YOUR-EARS TUNE-UP

Yes, there are plenty of free tune-up utilities out there, and compared with them Iolo System Mechanic 15.5 may seem pricey. But its slow-but-study progression from a basic tweaker to an all-around PC enhancer has had enormous benefits that manifest themselves time and time again—and every computer you own can share in them. If the no-frills tune-up experience is good enough for you, we recommend the no-cost SlimWare Utilities SlimCleaner Free. But if you're serious about improving your PC's performance, go with System Mechanic 15.5.

JEFFREY L. WILSON

Features

HOW CUBANS BOOTSTRAP INTERNET ACCESS

CONFLICT RESOLUTION

HOW TO RECYCLE YOUR TECHNOLOGY

WITHOUT HURRY, WITHOUT REST:

HOW CUBANS BOOTSTRAP INTERNET ACCESS

Black markets, secret thumb drives, and bootleg repeaters—this is how Cubans get online.

BY WILLIAM FENTON

In 2011, Alan Gross faced 15 years in prison for setting up a Wi-Fi network. Today I can sit on a bench in Havana with a Materva soda and a bag of *chiviricos* (fried dough) and surf the *New York Times*' website using a government-issued navigation card.

How did we get here? Gross traveled to Cuba under the auspices of the United States Agency for International Development in 2009 and created three satellite Internet networks via Jewish synagogues in Havana, Santiago, and Camagüey. He was arrested, and served more than five years in prison before he was released through a prisoner exchange on December 17, 2014.


Photo credit: Alan Gross

That date wasn't just when Gross returned to the U.S.; it was also the day the Obama Administration announced that it would begin to normalize relations with Cuba after more than 50 years. (The trade embargo between the two countries—the longest in modern history—was first established in 1960.) Gross was the lynchpin in this so-called "Cuban Thaw."

When he created his underground networks, Gross used a Broadband Global Area Network (BGAN) terminal about the size of a notebook. He positioned the terminal so it faced south toward a satellite, and nudged the panel until it could send a signal to the satellite that reflected down to a teleport. *Connection established*. For Gross, it was a moment of transcendence. "When you lock onto the satellite, you've lit a candle," he told me when I interviewed him for this story. "It's a feeling of elation. After I did it the first time, that's all I wanted to do. Go around the world lighting candles."

In 2009, lighting candles in Cuba was deemed a threat to the "integrity of the state." Today, that very state sells Internet access. Cuban president Raúl Castro's approach to reform, "*sin prisa, pero sin pausa*," translates to

"without haste, without pause." Some Cubans use it to praise initiatives, others use it ironically as a form of critique. The existence of a private rental market, family-run kitchens, and growing Internet access suggests that change is coming, though the pace of that change can feel uneven.

Photo credit: Alan Gross

According to Freedom House, Cuban Internet penetration is somewhere between 5 and 30 percent—about half that of Russia.

According to Freedom House, Cuban Internet penetration is somewhere between 5 and 30 percent—about half that of Russia. But since 2007, when it was illegal to purchase a computer, the government has connected to a Venezuelan fiber-optic cable (ALBA-1), opened dozens of Internet cafés and Wi-Fi hotspots, cracked the door to foreign telecoms, and announced a pilot for residential broadband.

"I think there's a leak in the bucket that's going to get bigger and bigger, and they're never going to be able to fix it like they did in the past because Cubanos are getting a taste of something they've only had a whiff of previously," Gross argued.

I traveled to Cuba as a tourist to find out for myself. In my eight days on the island, I saw firsthand how ordinary Cubans jailbreak the World Wide Web using a combination of hacked apps, Wi-Fi extenders, and cached websites traded on hard drives. This is how Cuba gets online.

"YOU WANT INTERNET?"

On one street in Miramar, a residential district of Havana, I counted seven cell phone workshops—private businesses that sell and service smartphones. Inside one store, several children were jailbreaking iPhones, a mother was downloading bootleg apps onto an Android device, and a father was soldering a new chipset into an aging smartphone.

These workshops look nothing like a typical Sprint or Verizon store in the U.S.; most of the phones for sale were two or three years old. A Samsung Galaxy S4 sold for 220 Cuban convertible pesos (CUC), or $220 U.S., and an unlocked Blu Dash was about 100 CUC.

Just about Cuban I met had a smartphone; for many, it's their only connection to the outside world. Given that Cubacel is effectively the only provider, it has no incentive to offer affordable plans. Last year, Cubacel announced a rate of 1 CUC per megabyte, but even that is out of reach for most residents, many of whom rely on a state salary of 25 or 30 CUC per month.

On account of the extraordinary expense, Cubans largely eschew data and rely instead on the more than 65 Wi-Fi hotspots located across the country.

One I visited in Central Havana might best be described as a block party. Most of the "park" is paved, and people duck under sparsely planted trees and golf umbrellas to escape the sun. Even in the early morning, all the benches are

occupied. Some visitors even reserve seats for friends by plunking down backpacks. By early evening, people tote fold-up chairs and beers. Several teenagers lean against buildings, balancing laptops on knees. A group sits it in a circle on the ground. An entrepreneur takes advantage of the crowds, selling snacks.

Millennials own this park, and although they don't fit into our hipster aesthetic, they possess all the tech you might expect of NYU undergrads, including smartphones, tablets, and MacBooks.

I asked one teenager where she got her iPad Air, and she said she had a "friend" in Miami. This is commonplace. Although many Cubans purchase phones and tablets at cell phone repair shops, many others procure their devices through the States. In Miami, there's a thriving market for "mules," or individuals whose sole profession is to transport technology to and from Cuba via charter flights.

To connect to a hotspot, you need a navigation (or "nav") card, available via Cuba's government-run telecom carrier, ETECSA, which provides an hour of Internet access for 2 CUC. Every ETECSA office I visited had a line out the door, and one ran out of official tickets, prompting workers to use folded printouts.

In Miami, there's a thriving market for "mules," or individuals whose sole profession is to transport technology to and from Cuba via charter flights.

HOTSPOTS RUN COOL
Internet hotspots in Cuba allow Internet access for everyone, by way of a 30-minute nav card (or its black market equivalent).

Not surprisingly, a nav card black market has emerged. The process is simple: Take a seat on a bench, look around furtively, and within minutes one or two vendors (they often compete) will sidle up to you and

ask, “You want Internet?” Give them 3 CUC and they’ll slip you a nav card. The most conspicuous part of the transaction is that these unofficial vendors tend to carry the cards in plastic shopping bags, which makes the entire transaction feel like an inept drug deal.

The downside is that these nav cards cannot be shared among devices, and the network often becomes sluggish when too many people connect. I noticed several visitors throw up their hands in frustration and whisper, “*Sin prisa, pero sin pausa*.”

One of the reasons for the congestion is that many Cubans use their phones as hotspots via the Connectify app, which local repair shops can install on phones. Those who live within a few blocks of a hotspot tend to own repeaters so they can connect to and extend connections. I stayed in two *casas particulares* (private houses) in Havana: Both were in proximity of Wi-Fi hotspots, both hosts owned repeaters, and both hosts complained that they couldn’t get online after 10 a.m.—there were just too many simultaneous connections.

The Cuban government opened Internet cafés, though they’re inadequate compared with the Wi-Fi hotspots. In addition to requiring users to sign in to computers, which puts them at risk of surveillance, the cafés simply can’t keep up with the demand for Internet access. As of 2013, the cafés had just 473 PCs, or one computer for every 24,800 Cubanos.

THE INTERNET WITHOUT THE INTERNET

Earlier this year, the Castro government announced—and quickly scaled back—a program for residential broadband in Old Havana. Hiram Centelles, a cofounder of the popular Cuban classified platform Revolico, is skeptical. “They’re talking about expanding Internet to specific areas in Havana,” he told me via Skype. “I have no expectations. In two or three years it might have some impact.”

Centelles, who currently lives in Madrid, was more optimistic about the prospects of the hotspots. “The government is doing this quickly because it’s cheaper,” he added. “And the people are using these hotspots in very creative ways.”

Some of the most creative modes of “Internet” access, in fact, don’t even require an Internet connection.

The embargo precludes any real enforcement of U.S. copyright in Cuba. You see this when you visit a cell phone repair shop with a homespun Apple logo. You watch it when a proprietor downloads hundreds of apps onto a jailbroken iPhone. And you can experience it at "CD and DVD" stores, where you can purchase copies of any American movie, TV show, or album at staggeringly low prices (such as 1 CUC for the fifth season of *Breaking Bad*).

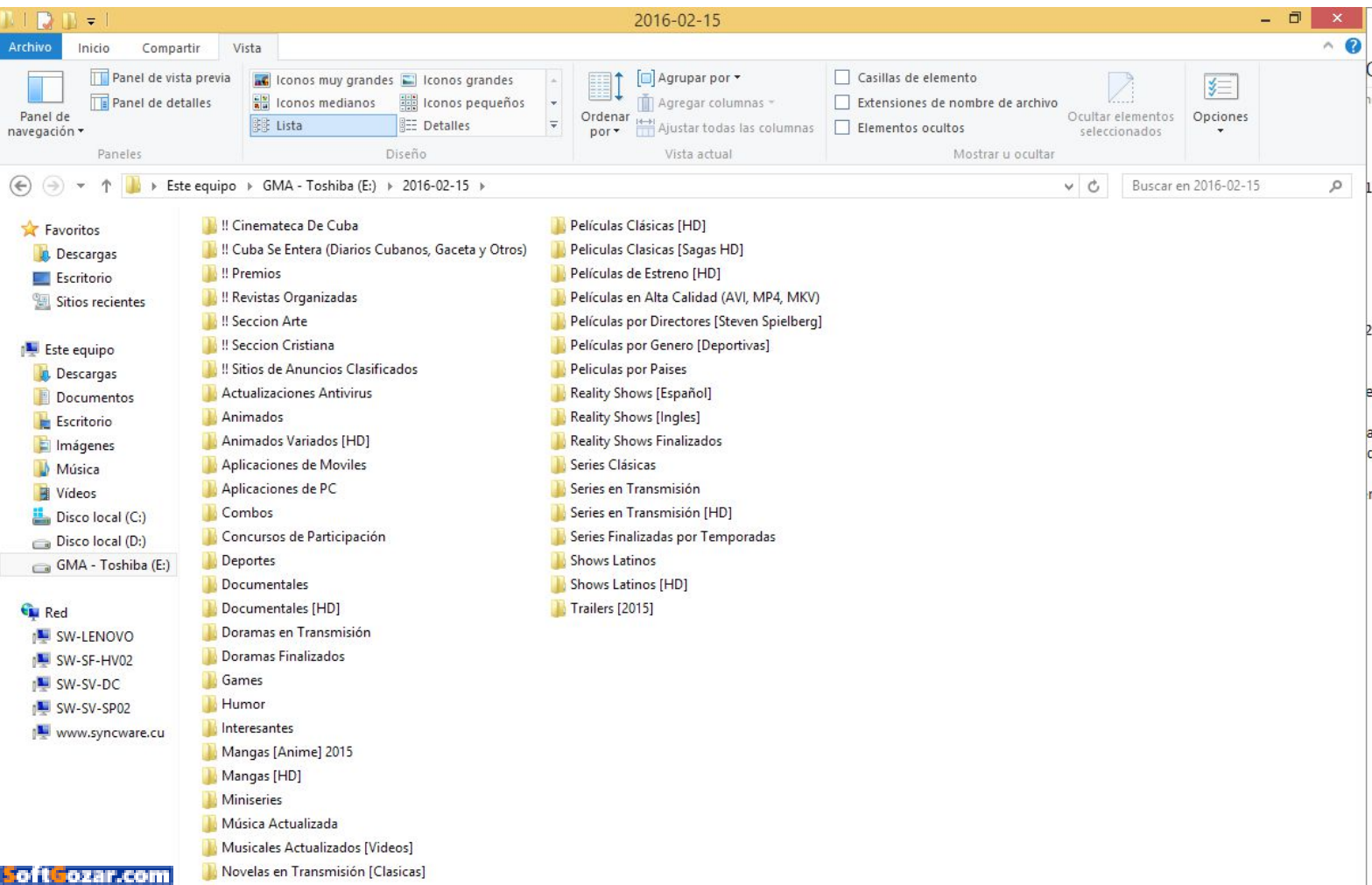
This is what Cuba's top blogger and dissident Yoani Sánchez calls "the Internet without Internet." But there's another permutation of exchange, what you might call "last week's Internet in a box."

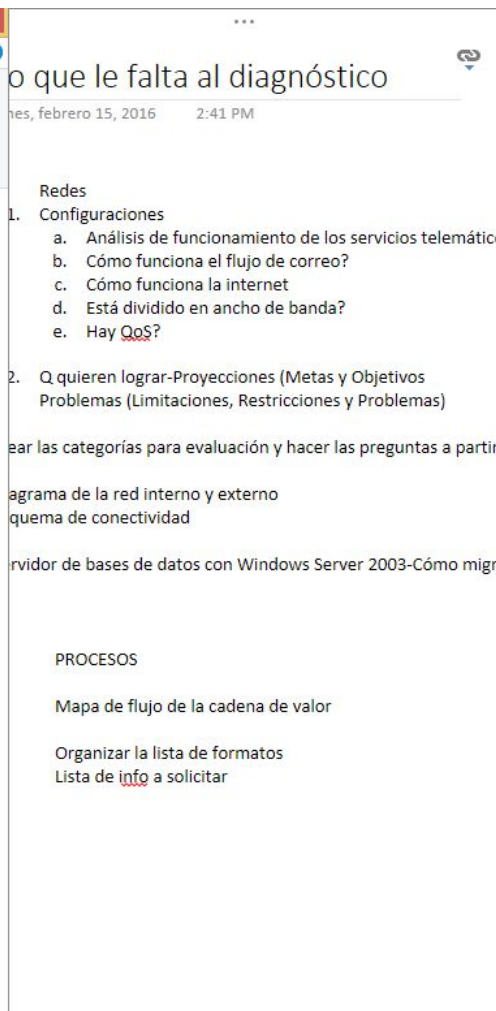
Perhaps the most peculiar way that ordinary Cubans connect with the outside world is through "El Paquete," or "The Package," a cache of weekly materials from the Internet that circulates on hard drives. A couple of subscribers, who asked to remain anonymous, told me that their entire office goes in on one Package for about 2 CUC. Every Monday, a delivery man drops off the drive, they download whatever they want onto their computers, and send The Package to the next subscribers when the delivery man returns in 6 hours.

The embargo precludes any real enforcement of U.S. copyright in Cuba.

OPENING THE PACKAGE

The Package is a hard drive, delivered weekly, that contains an assortment of recent news and entertainment





The subscribers I met allowed me to take a look at the previous week's Package. Its contents were neatly categorized in folders such as "Games" (where I found ROMs and emulators for Mario Galaxy), "Humor" (YouTube video files), "Fashion" (clips from video blogs), and "Reality" (the latest episodes of everything from *American Idol* to *The Tonight Show*). Subscribers can listen to Adele's latest album, read last week's issue of *The Economist*, browse the classifieds, or watch a surprisingly large cache of Korean soap operas.

It should come as little surprise, then, that Cuban entrepreneurs and businesses use The Package as they would the Internet. Instead of posting songs to SoundCloud or YouTube, Cuban artists circulate albums via The Package.

Although Revolico is accessible through a labyrinth of proxy sites, Centelles suspects that thousands of Cubans access listings via The Package. He considers Package compilers "friends," not competitors—so much so, in fact, that he hired a sales force that works on the ground helping "offline" customers promote premium listings online.

Robin Pedraja's pop-culture-oriented *Vistar* magazine also circulates through an unofficial iPhone app available in The Package and through various cell phone repair shops. Pedraja distributes it this way not to escape censorship, but to expand access. In fact, in contrast to Centelles and Sánchez, who have had their sites blocked, Pedraja describes a "new" largely harmonious relationship with government officials.

"They don't kill ideas anymore," Pedraja said. When the Office of Media has contacted him, it isn't to harass him, but to learn from him. "They care about us," he added, "because we represent the voice of a new generation."

"IN CUBA, YOU NEVER KNOW WHO'S LISTENING."

Not everyone shares Pedraja's optimism. Although popular sites like Facebook and nytimes.com are accessible, services like Skype, WhatsApp, and YouTube are blocked. More surprising is the sense that Cubans don't know why some sites just "don't work."

Since Revolico launched in 2007, the Cuban government has repeatedly blocked the Craigslist-style site, and has "yet to offer any explanation," Centelles said.

Together with friend and partner Carlos Peña, Centelles has tried numerous workarounds, from changing IP addresses hourly to creating new domains, tactics that worked to a degree. "The government got tired of blocking our domains," Centelles explained. "When they realized that it was a game of cat-and-mouse, they gave up."

Still, the main site, Revolico.com, is inaccessible in Cuba. It gets eight million page views each month, with about half the traffic coming from abroad. Centelles' main goal is to get it permanently unblocked there in order to grow and better compete with rivals like Port La Livre and Cubisima.

"Cubans use Revolico as a verb, even when they're using another site," he told me.

Investigative journalists face greater challenges. Sánchez, who has seen her blog Generation Y blocked inside of Cuba, pointed to a government-run propaganda initiative, Operation Truth, to discredit critics and promote the government's plans.

In my experience, the surveillance state exerts itself implicitly and explicitly. I found it exceedingly difficult to coordinate with contacts in advance of my visit because, as one put it, "In Cuba, you never know who's listening."

Given the inchoate state of Internet infrastructure in Cuba, the sophistication of surveillance tools is likely overestimated; nevertheless, I understand Cubans' trepidation given the government interference. You feel it not just on the Internet, but also on the city streets. For example, when I was walking along the Malecón, Havana's popular waterfront promenade, a police officer reprimanded me for taking a photo of the Nico oil refinery, even though you can see its flames from almost anywhere in Havana.

FEEL THE BURN
Cuba's government exerts a tight grip on everything, even this photo of the Nico oil refinery, to keep its citizens (and tourists) in check.

"THEN I LEFT"

It's tempting to assume that Cuba is a despotic state in which citizens are quarantined from the outside world—certainly, early accounts from emigrants support such a reading. But the Cuba I visited didn't tell such a simple story.

Despite woefully inadequate broadband infrastructure and a paranoid central authority, the Revolution has bestowed gifts, including a strong social pact, universal health care, and, perhaps somewhat surprisingly, unlimited access to higher education.

Although few commercial opportunities await graduates, Cubans often acquire advanced degrees that they put into practice through a growing freelance economy. In fact, Cuba spends about 10 percent of its central budget on education, compared with around 2 percent in the United States, according to UNESCO. Cuba may not have a Harvard or a Princeton, but the public universities do offer degrees in engineering, programming, and computer science. It seemed as if everyone I met had an advanced degree.

My first host, Dania, is pursuing a PhD in Computer Systems. Her mother works as television news journalist, her father as a surgeon. Her sister, also a journalist, married a man with a PhD in Information Systems. Contrary to the stereotype that Cubans are trapped at home, Dania has family in the Netherlands and Italy.

To get a better sense of what higher education looks like Cuba, I visited the University of Havana, the neoclassical architecture of which conveys much of the grandeur one might expect from a prestigious American

Cubans often acquire advanced degrees that they put into practice through a growing freelance economy.

ME AND U
The University of Havana offers many fields of study for those interested in pursuing careers in technology.

university. In contrast to the noisy streets outside, the campus felt like an oasis: Students chatted on benches, lounged under trees, and sunbathed on steps. Nevertheless, there was a great deal of activity. Contractors were renovating several buildings, including the Aula Magna building, which has hosted many important scientists and political statesmen over the years, including former U.S. President Jimmy Carter in 2002.

The university's Computer Science program graduates around 100 majors per year and has grown so much that Math and Computer Science now occupy what was once the General Sciences building, one of the largest and most beautiful structures on campus.

The problem is that there's more supply than demand, something Centelles saw with his graduating class at Cujae, Havana's main engineering and science university. "Many ended up working in low-level or nontechnical positions, which is really a shame," he told me.

Centelles emigrated to Spain after he completed his engineering degree. "I had to ask for permission to leave before graduating," Centelles said. "Then I left."

Typically, graduates conduct "social work" in university departments, research institutes, and government software enterprises, which provides guaranteed, though not lucrative, state employment. After two years, graduates can freely pursue other positions, including private work outside of Cuba. Some University of Havana students have landed jobs at Google, Microsoft, and Amazon, though most continue freelancing alongside some form of state-based employment.

The students I spoke with admitted that limited Web access poses the greatest impediment to finding work. University students receive Internet access, but data usage is capped between 300 and 800MB per month. And although connections are fast by Cuban standards—26Mbps—they pale in comparison to U.S. broadband.

In the case of the University of Havana, administrators are working to improve the Wi-Fi network, though it's still not sufficient for demanding activities like teleconferencing. During the day, the university even constrains access to Facebook to free up bandwidth.

"CUBA HAS TWO PARALLEL ECONOMIES"

Many Cubans finish their degrees and seek a second—or third—job far afield. If you own a car, you operate a taxi or a ride-share. If you can cook, you establish a *paladar*, a family-run kitchen. And, if you have a spare room, you open a *casa*

PAST MEETS PRESENT
This 1950s-style taxi equipped with a USB drive is a symbol of the social battle being waged in Cuba.

particular. But even these well-established marketplaces—which data back to the early 1990s—are being cracked open as a Web-savvy generation of Cubans embraces the Internet.

Perhaps the most significant game-changer for tourism is Airbnb. The platform can deposit greenbacks directly into Cuban hosts' bank accounts, and enable Americans to reserve rooms for as little as 20 or 30 CUC per night—a bargain compared with traditional hotels, which can cost upwards of 200 or 300 CUC per night. According to representatives at Airbnb, approximately 4,000 of the estimated 8,000 *casas particulares* are already using the service.

When they can connect, that is. Dania couldn't connect to the Internet for three days, and lost reservations and had her account suspended.

"Cuba has two parallel economies: one with the state and one with private business," said Bernardo Romero, the founder of the hardware and software company Ingenius. "In private business, no one can live off $30. In a family, perhaps one person will work for the state. Everyone else works in some kind of private business."

As one of Cuba's growing class of *cuentapropistas*, or self-employed entrepreneurs, Romero sometimes benefits from Cuban particularities. For example, Ingenius creates software for tracking payments in the country's two currencies, the CUC and the traditional peso.

Others straddle the line between the public and private economies, like Syncware founders Adriana Sigüenza and Manuel Bouza, who serve private Cuban companies as well as clients owned either partially or fully by the state. Although Cuban law precludes the company from working directly with foreign businesses, Syncware acts as a "bridge" to foreign investors. Yes, it develops software, sets up Microsoft technology, and offers IT support, but it also helps

businesses scale up operations by developing business plans, deploying CRM software, and designing business process management and enterprise architecture.

"A CAB DRIVER SHOULDN'T BE A FORMER NUCLEAR ENGINEER"

While Romero, Sigüenza, and Bouza take advantage of Cuba's bifurcated economy, other entrepreneurs struggle in a country that does not have enough jobs for its highly educated residents.

"A cab driver shouldn't be a former nuclear engineer," said Tomas Bilbao, managing director at Avila Strategies and advisor to the Policy Council at Engage Cuba.

Consider my host Dania, who runs a bed-and-breakfast despite her advanced degree, or Centelles, who left the country entirely.

Still, Centelles remains hopeful. "Supply continues to outstrip demand, but it's changing," he explained. "After the December 17 announcement, a lot of Americans are trying to get access to this kind of labor."

Centelles sees a marked increase in private companies specializing in outsourcing. These intermediaries typically pay newly minted computer science graduates between 200 and 500 CUC per month. If these kinds of arrangements are agreeable to graduates, they're far from ideal for the state—unless it aspires to become a low-wage outsourcing center.

Perhaps the most formidable barrier is the embargo. Sigüenza, for example, cannot negotiate with Microsoft, which means that Syncware and its clients overpay for products and services. Meanwhile, Centelles incorporated Revolico in Spain to collect Google AdSense revenue.

Short of lifting the embargo, Bilbao argues that the U.S. needs to lower banks' risk calculations. The sooner Google and Visa can operate in Cuba, the sooner Cubans can collect compensation for their labor. As long as the embargo remains in place, Cubans will struggle to move money into and out of their country. As any American tourist knows, most U.S. banks do not operate inside Cuba. (One noteworthy exception is Stonegate Bank, which announced last year that it would open a corresponding bank account in Cuba.) The status quo may inconvenience visitors—I took out cash in advance because I knew that my debit card wouldn't work—but it harms ordinary Cubans.

Incorporating businesses is a challenge, as well. Although the government offers more than 200 categories of employment under its *lineamientos*, or economic guidelines, about three-quarters of those categories do not serve skilled workers, especially in tech, where Bilbao argues that the government needs to create new categories of employment.

This, too, is not an academic exercise for Cubans. Neither Ingenius nor Syncware could be incorporated as IT consultancy businesses. Instead, founders applied for two licenses (Computer Programming and Electrical Repairs) through which they use a loophole to conduct consulting.

Finally, although Bilbao commended the government for expanding access via the Wi-Fi hotspots, he noted that without a clearheaded understanding of infrastructural shortcomings, the government and private sector partners won't be able to make smart investments.

The Cubans who have stayed in Cuba, and the expats who have recommitted to their country since the U.S. reopened diplomatic relations in 2014, appear willing to endure these burdens. It's a testament to their pride, as well as a daily demonstration of their ingenuity and indefatigable spirit.

"I had the opportunity to leave Cuba and develop a profession elsewhere," Romero explained. "I chose to live in Cuba, to develop my business in Cuba, to start my family in Cuba. And, in a few years, I think I will be better off in Cuba."


Photo credit: Alan Gross

Gross agreed, though he suspects it might take more than a few years.

"I absolutely support reestablishing diplomatic relations with Cuba," he told me during our interview. "If we had diplomatic relations, I might not have had to forfeit five years of my life. We have constructive engagement for a reason."

Still, Gross continued, "I think it will take years before we have normalized relations because Cuba does not exist in a normalized state."

SIN PRISA, PERO SIN PAUSA
The lurching pace of technological change in Cuba may be too fast or too slow, but it's here, and Cubans are already learning how to adapt.

"WITHOUT HURRY, WITHOUT REST"

When President Castro describes his reforms as "without haste but without pause," he intentionally or unintentionally cites an American lineage. As Ralph Waldo Emerson wrote in "History," his famous 1841 essay, "Without hurry, without rest, the human spirit goes forth from the beginning to embody every faculty, every thought, every emotion, which belongs to it in appropriate events."

A decade before he founded the Cuban Revolutionary Party, exiled Cuban dissident José Martí penned his now-widely anthologized eulogy to Emerson. Martí claimed Emerson made "idealism human," and as Martí himself gained an almost mythical status within Cuba, so too did many of the attributes he assigned Emerson. Castro's reforms recast Emerson's vision, which, after Martí's hagiography, have come to suffuse Cuba's revolutionary ethos.

If there is something of Emerson's history in Castro's refrain, then there is also something of Emerson's idealism alive in Cuba. It can be glimpsed in the bootstrapped networks, hotspots, and hardware that ordinary Cubans use to connect with the outside world. You can see it in Cubans who refuse to incorporate businesses elsewhere, the students who pursue advanced degrees despite enduringly grim job prospects, and the entrepreneurs who start businesses despite untold practical, technical, and legal challenges.

In 2009, the networks that Gross created were deemed a threat to the "integrity of the state." Today, they are provided by the state. If the curvaceous automobiles of the 1950s epitomized Cuba under the embargo, today it is the Wi-Fi–equipped public park where countless Cubans gather, with lawn chairs and laptops, and wait to light their candles.

CONFLICT RESOLUTION

Intel is leading the charge in removing "conflict metals" from its processors, but the industry still has a long way to go if it wants to advance technology *and* support human rights.

BY GRAHAM TEMPLETON

We tend to think that large corporations have total, intentional control over their own businesses—local abuses are quite reasonably assumed to derive from pressures from above, to be extensions of the overall corporate culture rather than exceptions to it. But highly complex and highly globalized companies often find it difficult to exert total control over their entire operations. Increasingly sprawling and complex, companies as diverse as Coca Cola and Firestone have found that it is often difficult to know whether you're acting ethically across a truly global business.

That's part of the reason why a recent announcement from Intel is so impressive. After having hit its 2014 milestone of eliminating from its processors so-called "conflict minerals," which are typically found and produced under inhumane conditions in violent areas of the world, the electronics giant can now boast that its entire product line is free of conflict metal.

That might not seem like a big achievement—to enforce a buying policy on yourself—but there's a reason it's taken so long: Intel is part of a fight to reform two industries, and that's a fight that's going to have to continue without meaningful help from politicians or regulators.

THE CONFLICT OVER CONFLICT METALS

As electronics manufacturing has skyrocketed in the last several decades, metals such as gold, tin, tantalum, and tungsten, which possess desirable chemical and electrical properties, have become more important, and their value has risen seemingly without end. In the parts of the world termed "conflict zones," mines where these metals are unearthed are often little more than invitations to be murdered. Local populations are treated almost like an extension of the resources themselves, captured nearby and put to work. When one murderous

militia takes an area from another, the locals simply change hands for the most part. Conditions don't generally improve, and each successive conquering brings with it new waves of preemptive punishment. Theft, murder, and particularly rape are used as institutional tools to cow workers and appease the militias' rampant criminal soldiers and employees.

Even mines untouched by violence often have harsh and dangerous working conditions without the protections we in developed nations would demand. For example, coltan, an important mineral that must be pulverized to release the tantalum that is used in capacitors, is hand-crushed with rocks by a largely female workforce. Not only has this been reported to release particles that cause health problems for the workers, but the working mothers often bring their toddlers with them on their backs, causing child health problems as well.

Even mines untouched by violence often have harsh and dangerous working conditions without the protections we in developed nations would demand.

FORCED LABOR
Many minerals that are important for manufacturing tech products are mined and processed using workers acquired (or kept) through violent means.

Activist groups like the Enough Project helped bring this reality to public attention, pointing out that American companies like Intel were indirectly involved in the Democratic Republic of Congo (DRC), perhaps the worst conflict zone on the globe. The civil war there,

and the instability it has created, has cost more than five million lives and has been called the most brutal conflict since World War II. Because DRC is rich with any number of precious materials, from diamonds and copper to conflict metals, that conflict has been fueled by incredible amounts of foreign interest.

In particular, the corrosion-resistant tantalum enjoyed an incredible renaissance in 2011, more than tripling in price almost overnight. Such good fortunes should have produced an explosion of prosperity in any country lucky enough to have large natural reserves, and DRC is thought to provide a large fraction of the world's tantalum production. This blessing has been described as the region's mineral curse, as it drove further conflict by giving chaos a monetary incentive—as well as (mostly) unwitting corporate and international allies. No matter how noble its intentions, no major electronics company in the world could claim that its products were definitely produced without supporting any human rights violations until Intel's announcement.

THE CHALLENGES OF GOING CONFLICT-FREE

Chaos, corruption, and poor organization in conflict zones meant there was no truly reliable way to buy only the responsibly mined ore and refuse the blood-stained. Though it ought to be impossible due to various laws and regulations around the world, minerals from conflict zones still account for a large proportion of the metals in modern electronics—tantalum mined in the eastern Congo, for example, accounts for up to half of the total amount in use today.

To many, the only realistic way to stop this was a ban on all minerals originating from conflict zones—but such bans are imperfect solutions. Although they do take money out of the hands of warlords and murderers, like all sanctions they also siphon money away from innocent workers and worsen poverty in already-destitute areas. Though it's impossible to get truly reliable numbers, the economy of DRC at least largely relies on the mining industry both for jobs in the mines themselves and for overall prosperity driving economic development. Local activist groups tend to focus on reforming mining practices, but are fearful of entirely driving away foreign companies.

But anything other than a blanket ban looked to be impossible to implement. For a high-level manufacturer like Apple or Cisco, simply deciding not to buy conflict minerals often doesn't cut it, and can functionally achieve little more than encouraging dishonesty in the materials companies that do the direct purchasing from mines. Corporate ignorance and even apathy were undoubtedly early factors in prolonging this problem. Carolyn Duran, Intel's supply chain director, said in an interview with The Huffington Post, "In the

beginning, we didn't care, and just got the cheapest material." But as the company became more aware of the ethical sourcing problem, and eventually began to care, even powerful corporate giants could despair at the size of the purely practical obstacles.

With so many mines to check, and such complex interconnections between those mines and materials companies, the problem was imposing to say the least. It was difficult to imagine a way to enforce purchasing standards—so the smelting companies were a perfect target for further effort. These companies, mostly in Russia and China, condense a literally unknown number of mines down to a few dozen listed groups. It's these companies that sell to corporations like Intel, and so they provided the most logical point of attack.

In 2008, a group of electronics powers formed the Conflict Free Sourcing Initiative (CFSI), aimed at making it possible to do the oversight that government and the public were gearing up to demand. It developed a system for smelters to audit the mines with which they do business, and requires those smelters to perform the audits or lose business from CFSI's members. Though the group started small, today its 300-odd corporate members simply cannot be ignored by anyone supplying the electronics industry.

When some smaller companies protested that they wanted to comply but lacked the resources to do so, Intel went a step further and pledged $250,000 to help them. That's important, as reports indicate that even powerful corporations like Apple are running up against the basic claim that their partners simply are not capable of fulfilling the program's requirements.

One of the main such requirements is referred to as “bag and tag,” in which metals from audited mines are loaded into tagged, trackable bags with tamper protections. These bags are monitored from the mine to the smelter, and working only with tagged ore is the main provision for compliance. It’s not a perfect solution, as local corruption is by far the most difficult problem to curb, but by working with local nonprofits, companies can ensure that any positively rated mines that are conquered or that stop acceptable practices will be found and eliminated.

There is a chain of auditing, in which purchasers perform audits of smelters to determine how well those smelters are keeping up with their audits of mines and how well those mines are keeping up with their obligations to workers. If these audits are even mostly accurate, and companies stop buying from any smelter that drops out of the program’s requirements, then warlords and exploitative businesses won’t be able to monetize control over mines, and the problems should all but cease.

This theory came into conflict with reality in 2010, when the United States Congress passed the Dodd–Frank Wall Street Reform and Consumer Protection Act, which included a requirement that the SEC figure out a system to require companies to publicly report whether their supply chains included minerals from conflict zones. Though this disclosure requirement was popular with activists, and in principle lined up with the CFSI’s own goals, the U.S. Court of Appeals struck it down last year. The court’s ruling called it an infringement on the free speech of corporations comparable with requiring health warnings on cigarette boxes. The real point, though, is that the loss of the reporting provision

probably didn't matter in the short term, as a report from Amnesty International found that almost three-quarters of the companies affected by the conflict resource restriction had not reported enough information to satisfy the regulations anyway.

The claim is basically that this is an impossible task, and that attitude pervades the entire conflict-free sourcing issue. This self-serving narrative of helplessness comes not just out of Asian smelting companies, but North American corporations as well. So while the CFSI and industry in general are working to develop the ability to accurately track the use of conflict minerals, that same industry is begging the government not to require that those assessments actually be carried out.

One manufacturing industry group has claimed that even the remaining Dodd–Frank disclosures, which the SEC would collect purely in private, could affect 22,000 companies and cost as much as $16 billion to implement. An independent estimate came in at around 2,000 companies and $180 million. At just $20,000 for the most expensive annual membership, the CFSI is a very affordable measure to help get ready for possible real enforcement of Dodd–Frank's requirements.

Duran admitted that the process wasn't always easy. "Every single member of Intel's conflict team has felt, at some point, that we've hit an insurmountable task," she said.

The biggest source of difficulty has been the smelting companies themselves, and the necessity of actually sending delegations all over the world to find and eliminate any possible cheaters. These foreign companies were unused to the regulatory oversight, and first dismissed inspectors as "bugging" them. It was simple diligence that changed the situation, continuing to show up in person and eventually hand down ultimatums about permanently ending contracts.

TAKING THE NEXT STEPS

Intel isn't the only company putting real resources into this fight. Others, such as HP, Philips, Dell, and SanDisk, also topped the Enough Project's most recent corporate ranking, and have generally joined them in working toward a conflict-free future. Companies like Nikon and Canon were initially slow to adopt increasingly standard checks, and others like Nintendo "made no known effort" at all. Today, even Nintendo claims to be using the CFSI standards and releasing regular reports about its efforts to end conflict mining.

It's important to remember that it's not so much that low-ranked companies are using unethically mined minerals in their manufacturing, but that they

simply can't say with certainty that they aren't. The inspections aren't about finding and punishing those smelters that are buying from conflict mines, but rather about finding and excluding those that might be. This distinction has allowed conflict-free sourcing to reform the smelting industry, rather than destroy it; the simple fact is that many knowingly exploitative companies will likely adapt and thrive under the new rules, ethical but unpunished for their past crimes.

Many knowingly exploitative companies will likely adapt and thrive under the new rules, ethical but unpunished for their past crimes.

Overall, though, the trends on the ground are unequivocally positive. In 2015, DRC exported some 948 tons of certified conflict-free tantalum, about a fifth more than in 2014 and more than three times more than in 2013. The increase is in certified tantalum, meaning that although much of that material could have been ethically mined already, there was no real way to be sure—now there is. According to Enough, some 70 percent of the tin, tungsten, and tantalum mines surveyed by the International Peace Information Service in eastern Congo in 2014 was certified conflict-free.

Justine Masika Bihamba, of Women's Synergy for Sexual Violence Victims, said, "Before, mining was

almost fully controlled by armed groups… Today, let's admit they shy away from doing that. And if we're honest, part of that is because of Dodd–Frank." And as Dodd–Frank's conflict minerals provisions become weaker overall, it's more generally because of the efforts of companies like Intel.

Right now, Intel is the only major electronics company that can say with a reasonable level of certainty that it is not fueling international conflict through its business practices. Other companies are in one of two camps: They are actively trying to catch up, for the most part meeting with great success, or they are actively trying to avoid responsibility. The latter group tends to talk mostly about handing down demands to their corporate partners—but if this problem could be solved with email requests, it would have ended long ago. The primary lesson to be gleaned from the past decade of trial and error on this issue is that policies are only as good as their oversight—and so some conflict minerals policies are no good at all.

Intel clearly derives real pride from being on the good side of the equation and from its refusal to back away from ethically employing so many local Congolese people. By Western standards, miners in the DRC make very little, but by local standards they make enough to provide for a family and save a small amount for the future. As long as companies can ensure that working in a mine doesn't expose workers to a very real risk of being captured and made into literal slaves, the world's electronics manufacturers believe responsible mining is good for developing communities.

LOOKING AHEAD

Still, the future of conflict minerals is not assured to improve. The removal of the Dodd–Frank disclosure requirement is telling, in that the argument was that there is no overall public interest in knowing the human-rights history of the product you're buying, and so it's not an issue of consumer advocacy. In a particularly revealing comment, one corporate lawyer attacked the reporting provision as trying to "affect the international market for these conflict minerals by shaming companies."

Yes. The Dodd–Frank provision was, definitively, an attempt to create a moral hierarchy in a portion of the business world. Rather than the negative labeling on cigarettes, it had more in common with the positive labeling on organic food, though in this case it's compulsory, so lack of certification would have been much more meaningful. It would have created a situation in which the vast majority of companies could not initially claim compliance, and given those that could a new form of elite status within the market. It was attacked for

requiring more oversight than the supply chains could provide, but the whole point was that with proper enforcement it could have forced those supply chains to improve. It had the potential to affect corporate practices far more fundamentally than even a truly enormous industry group could hope to.

Instead, it seems that virtually all foreseeable progress on this issue will have to come from the private sector. Dodd–Frank still requires companies to disclose whether they can track all conflict minerals to the SEC, but, as mentioned, there is still pushback against even those provisions that remain.

Thus, Intel's biggest achievement in all of this is likely not making its supply chains conflict-free, but proving that it *could* do so, and thus invalidating the narrative that large corporations are helpless to police their own behavior in this space. A number of large corporations will likely join Intel in conflict-free manufacturing quite soon, but after that progress will likely begin to slow. We'll need either robust legislation or lasting, highly specific activism to fully end the exploitation of conflict mines, and neither one seems particularly likely at present.

Intel should brag about its moral advantage as much and as loudly as possible, not for the bump in business (though that will certainly be nice), but to actively "shame" less-compliant competitors into spending a couple of years catching up. And the more progress is made in improving conditions around the world in this way, the easier ethical business will be for those that come after.

HOW TO RECYCLE YOUR TECHNOLOGY

Do your part by donating your old technology or getting rid of it in an environmentally friendly way.

BY ERIC GRIFFITH

We love our computers, smartphones, and gadgets—at least until they stop working. Then these devices and their peripherals, from printers, monitors, and cases to batteries, cables, and accessories, often become digital garbage.

These products aren't made to last, after all. No computer or phone maker is going to mind if you upgrade every year or two. In fact, they count on it. Consequently, all this junk ends up in the back of your closet or collecting dust in your garage, because you aren't sure what to do with it.

The best thing to do is donate or recycle it. Contribute your old computers and phones to groups that will fix them, clean them, and put them back into circulation. Even the oldest computer—something you consider the most obsolete of digital dinosaurs—can probably be used by someone.

There are times, though, when a device is too far gone to bring back to life again. Even a charity doesn't want unusable rubbish. That junk—called e-waste—is potentially dangerous. Electronics are filled with "heavy metals" (read: toxic metals) and carcinogenic chemicals that are fine when you're using them, but not so much when they're sitting in a landfill or, worse, when people try to recycle them incorrectly. Thousands of tons of e-waste are shipped overseas yearly to countries like China and India, where they get dumped and maybe burned, a process that puts mercury and lead into the air.

So, here are the places you can take your old or even dead electronics, so they can either end up being used by someone in need or safely recycled.

THE BEST PLACES TO RECYCLE TECH

E-STEWARDS (E-STEWARDS.ORG)

This program is run by the Basel Action Network (BAN), a nonprofit dedicated to confronting environmental injustice caused by toxic chemicals worldwide. It created e-Stewards Certification to address what it says the government does not: "prevent the toxic materials in electronics from continuing to cause long-term harm to human health and the environment." BAN and e-Stewards Recyclers even called on the United States to halt all export of e-waste generated by the federal government alone. A recent UN report found the U.S. makes more e-waste than anyone—a million tons a year more than China, in fact, 80 percent of which goes to Asia.

Check out the list of e-Stewards Recyclers on the organization's website. By using one, you can be assured that you are taking your digital detritus to someone you can trust to recycle it in the safest way possible.

BEST BUY (BESTBUY.COM)

The nationwide electronics retailer has, arguably, the best recycling program going. Its website details exactly what the store will take (small tube TVs, Bluetooth headsets, software, and UPS battery backups, to name a few possibilities) and what it won't (projection TVs, tube TVs over 32 inches, rooftop dish antennas, hard drives, old cassettes, VHS tapes, and eight-tracks—go figure). Small items such as printer ink or toner cartridges, old cables, and batteries can go in recycling kiosks right by the door.

The list of items Best Buy will accept is tremendously long. And even if it won't take an item in-store, it might pick it up. That goes for several large kitchen appliances, plus old CRT televisions upwards of 32 inches in size. Check the listing for your state, however, as this could differ depending on local laws.

What's the catch? There's not much of one. You can take in up to three items per day, and it doesn't matter if you bought them there or not. It's mostly free: If you bring in a small tube TV or CRT monitor, they charge you $20 to take it. State rules can apply.

Check Best Buy's Trade-In calculator to see if what you think is junk could be used to offset buying some new toys.

STAPLES (STAPLES.COM)

The office store, which is a member of e-Stewards, has a program called Easy on the Planet to do better with recycling, as well as to sell more sustainable

products. Bring in as many as ten ink or toner cartridges per month and you get $2 each in Staples Rewards. The retailer also has a trade-in service where it will inspect devices, give you a quote (in-store or online), and pay you in Staples eCash Cards. Staples will also take any other old office electronics, such as computers, monitors, printers, batteries (rechargeables, too), and more—there's a limit of six per day. Staples does not take TVs, big copiers, or appliances. If you have a business with more than 20 employees, Staples Advantage can be used to get free mail-back or pick-up of tech needing a recycle.

OFFICE DEPOT/OFFICEMAX (OFFICEDEPOT.COM)

At Office Depot, you can buy a Tech Recycling Box. Put as much electronic junk in one of these boxes as you want, as long as it will close. Bring the unsealed box back to the store and drop it off for inspection. Office Depot will ship it off to waste management partners to do the rest. It promises to break the devices down to components of glass, plastic, copper, and aluminum to reuse. The boxes come in different sizes and costs: small is $5, medium is $10, and large is $15. Check out the list of what it will and will not accept (which includes such obvious items as devices covered in or leaking liquid, and anything radioactive).

Mobile phones, PDAs, batteries, and ink or toner cartridges can be dropped off for free with any sales associate, however. If you have toner and ink cartridges galore, get recycling boxes for free, including delivery to your home. Then send all the cartridges in by mail with a prepaid return.

E-CYCLE (E-CYCLE.COM)

E-Cycle, also certified by e-Stewards, will buy mobile devices from individuals or organizations. Just go to its site, select the carrier, manufacturer, and model of your device, and it will generate a quote. It will even take broken devices. You simply mail it in a prepaid box E-Cycle provides, and then payment shows up in the mail or your PayPal account. Organizations can also send in items on a regular basis and get inventory reports on what gets recycled.

CALL2RECYCLE (CALL2RECYCLE.ORG)

This nonprofit program specifically collects and safely disposes of rechargeable batteries and cell phones. Enter your ZIP code and it will display any number of retailers that have a Call2Recycle drop-off location. Partners include Staples, Lowes, Home Depot, RadioShack, Verizon, and Apple stores, to name a few. This goes for not just your electronics' batteries, but all those rechargeable batteries on your power tools and flashlights as well—none of them are doing us any favors in a landfill. Plus, it's free. Precious metals are recovered from the dead batteries and turned into useful stuff. For example, the kitchen flatware you use at dinner may once have been powering your drill or phone. Plus, all the recycling stays in North America.

RECYCLE WITH PC MANUFACTURERS AND MOBILE CARRIERS

COMPUTER MANUFACTURERS

It never hurts to goose a company into caring. That's why there are programs like the Environmental Protection Agency's Sustainable Materials Management Electronics Challenge. Best Buy and Staples are participants, as are vendors like Dell, LG, Samsung, and Sony. On the epa.gov website, you'll find basic information about consumer recycling, with one page devoted to electronics donations and recycling.

Most vendors take their own stuff. Each has its own recycling and return programs in place, some working with services like e-Stewards, some not. You can find them for HP, Dell, Apple, Samsung, Sony, and Asus, to name just a few.

MOBILE CARRIERS

All four major mobile phone service providers in the U.S. will take cell phones back, either to dispose of safely or recycle. Better yet, many of the phones get refurbished for special use as 911 emergency phones for those in need, such as abuse victims or active-duty military soldiers. Just remember to erase the data from your phone before you drop it off, and take out the phone's SIM card, too.

AT&T REUSE & RECYCLE

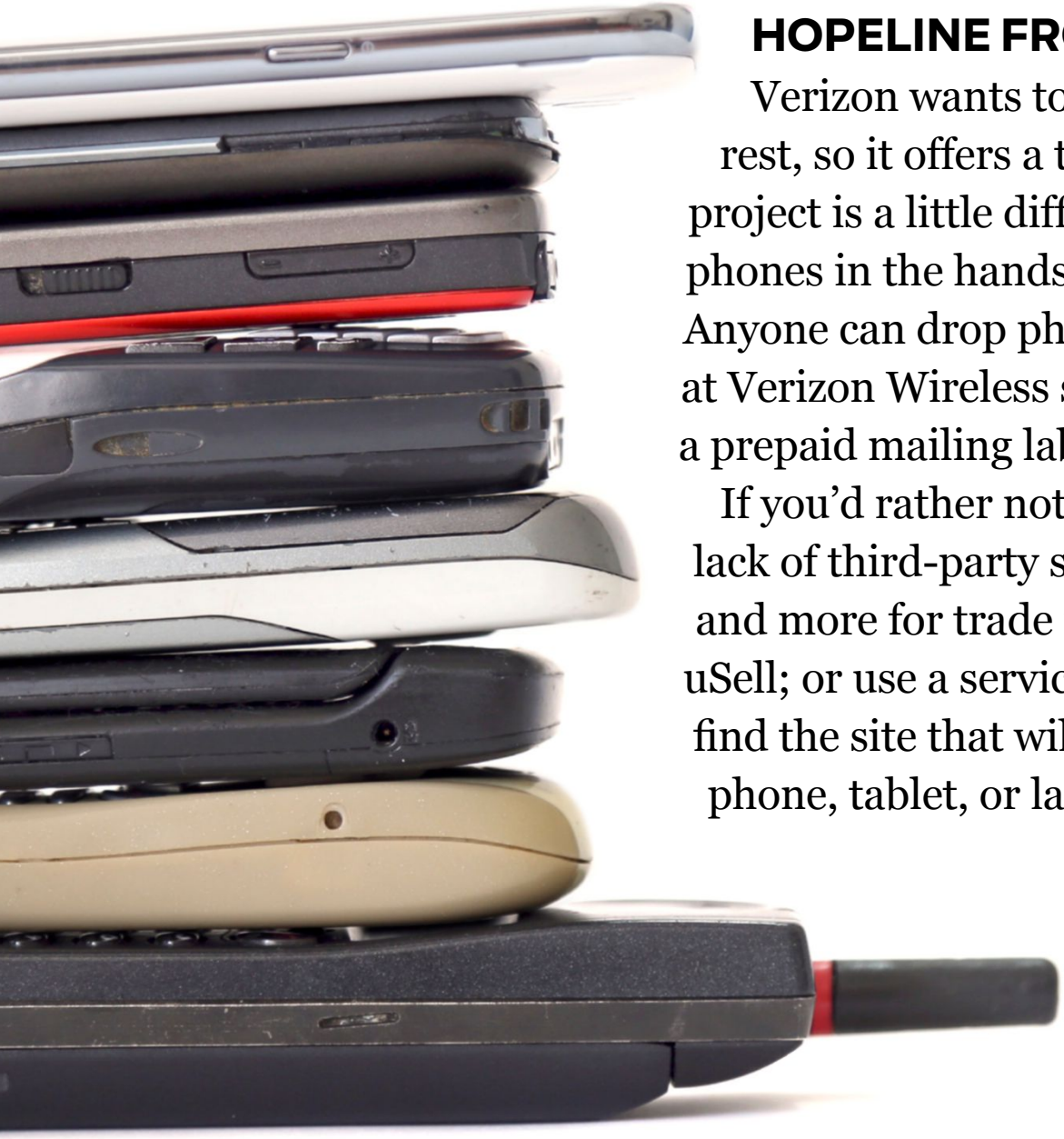
Take any phone, plus batteries and accessories, and drop it at the nearest AT&T store. But first, see if AT&T will buy it back for a credit toward your next purchase. Get an appraisal of your device online—and that includes not just phones, but also tablets and feature phones from other carriers.

SPRINT GOOD WORKS

Sprint offers to buy back some phones from existing customers and provides credit toward a new one. If that doesn't appeal, users of phones from Sprint, Boost Mobile, Virgin Mobile, and Sprint Prepaid can send in phones, batteries, and data cards, in any condition, for recycling. The proceeds going to the 4NetSafety program for kids. Note that in 2013, Sprint broke the Guinness World Record for most cell phones recycled in a single week.

T-MOBILE'S HANDSET RECYCLING PROGRAM

Naturally, T-Mobile has a trade-in program; get an estimate online anytime. It will also take any carrier's phone/tablet and accessories for recycling—it's always a good idea to donate the charger—in-store.



HOPELINE FROM VERIZON

Verizon wants to keep your business like all the rest, so it offers a trade-in program. Its HopeLine project is a little different, however. It puts recycled phones in the hands of victims of domestic violence. Anyone can drop phones, batteries, and accessories at Verizon Wireless stores around the country, or get a prepaid mailing label and put it in the post.

If you'd rather not deal with the carriers, there's no lack of third-party services accepting old phones and more for trade in. Try Amazon, Gazelle, or uSell; or use a service like Compare and Recycle to find the site that will pay you the most for your old phone, tablet, or laptop.

GET ORGANIZED

Improve Your Writing With Grammarly

TIPS

Pick Up Your Slack-ing

HOW TO

Extend Wi-Fi Coverage Throughout Your Whole Home

CONNECTED TRAVELER

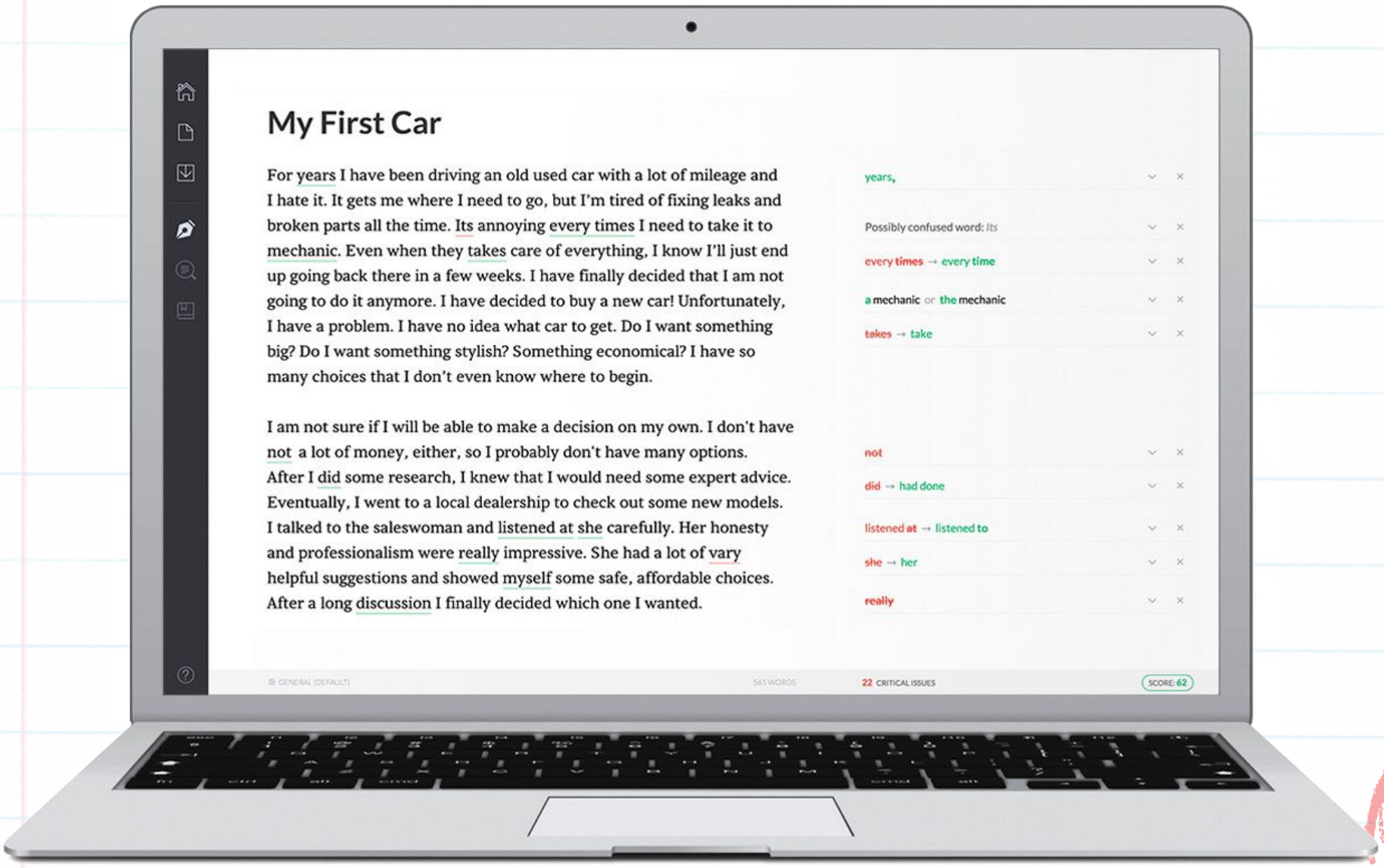
Trip Planning for the Technologist

Digital Life

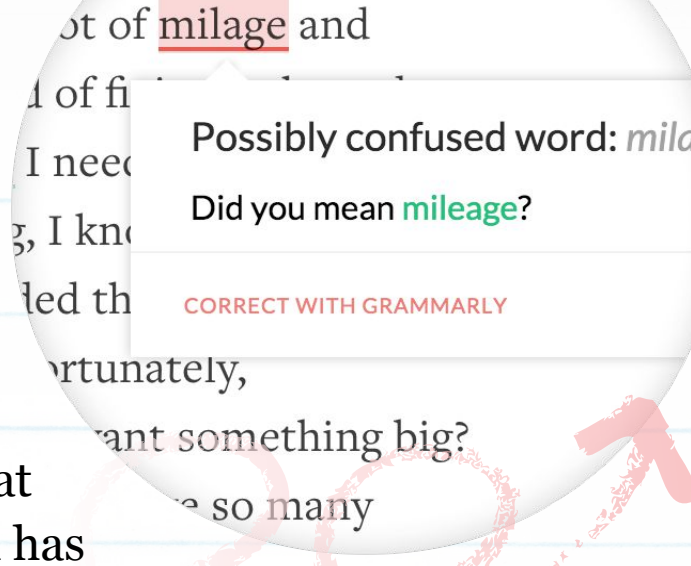
Improve Your Writing With Grammarly

Your words may be saying a lot more about you than you intend. This new software will help you make your best written impression.

BY JILL DUFFY



What we say matters, and so does how we say it. With all the blog posts, cover letters, emails, and other text we produce, there are plenty of opportunities for people to judge us based on the content and quality of our writing. Writing is hard, and with the stakes so high, it's worthwhile to get a little help where you can.



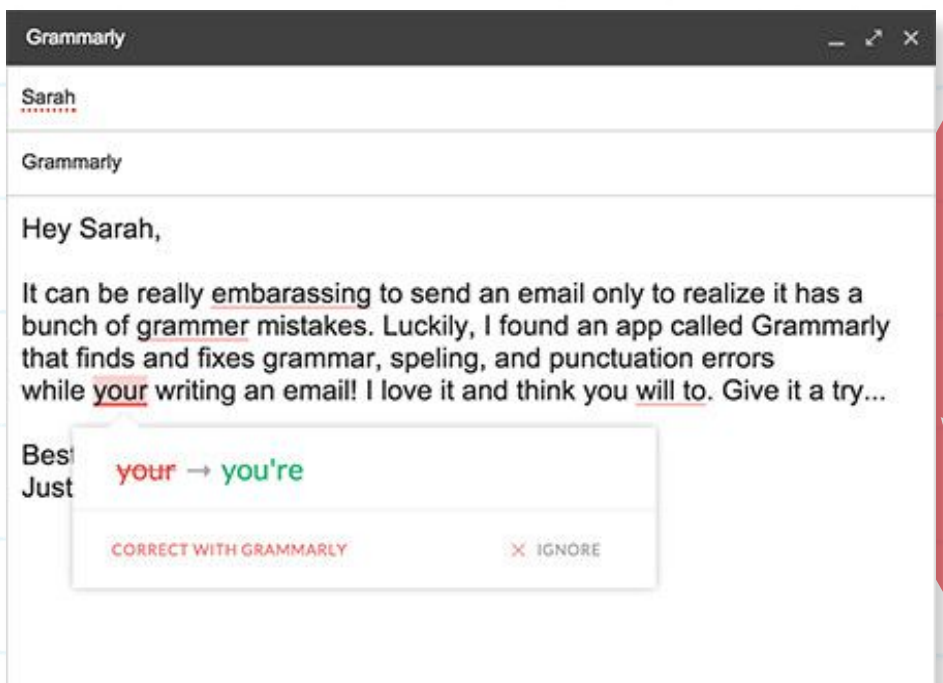
I've been trying out an app called Grammarly that analyzes writing and suggests improvements. Despite its name, Grammarly is much more than a grammar checker. It looks for repetitive words, jargon, homonyms, and hackneyed phrases, as well as words that nonnative speakers commonly misuse. Grammarly even has genre options so that its suggestions will be in line with the style of your writing, whether it's academic work, a business document, or a more casual blog post.

When I first heard about Grammarly, I took it as a dare to test drive it and uncover its faults. I consider myself a writer first and a technology enthusiast second, and although I'm no expert in rhetoric and semantics, I do know a fair amount. I also know that computers are exceptionally bad judges of writing. Compared with the human brain of a native speaker, which effortlessly understands deep complexities of language, computers botch grammar all the time.

GRAMMARLY TEST DRIVE

I installed Grammarly on my computer and enabled its Web browser plug-ins as well. The desktop app analyzes any text that I feed into it, and the plug-ins review in real time all the writing I do online: emails, social media updates, blog posts, and so forth. It doesn't support Google Docs, unfortunately, although you can copy and paste text or upload a document into the desktop app to run a check on it there.

First, Grammarly suggested I could improve my writing by swapping out vague words, like "great," for more descriptive ones. My editor slaps my wrist all the time for that very same offense, so I considered that suggestion a win for Grammarly. Next, it found a few simple typos, which I corrected by simply clicking on Grammarly's recommended changes. It also pointed out that I use the word "really" way too frequently. Really? Yes, really. It had me there. Thanks, Grammarly.



WRITE RIGHT (ER, CORRECTLY)
Whether you're writing an email, a blog post, or a short story, Grammarly can analyze your words and help you improve.

Eventually, I landed on some suggestions that were a little off the mark. I wrote “office email,” for example, referring to email for business rather than personal communication, and Grammarly thought “email office” would be a more appropriate phrase. It didn’t like the word “taskers” either, which appeared in a direct quote. I wasn’t about to change it. Apparently, “walking down the hall” creates a squinting modifier that might confuse my readers. I disagree.

By and large, Grammarly’s suggestions are helpful at steering you to use more direct and clear language. The real trick to getting the most out of Grammarly is knowing when to have confidence in your word choices and ignore its suggestions. For example, Grammarly loves to point out when the passive voice is used (see what I did there?), but skilled writers can use it for style or to put emphasis on one part of speech over another.

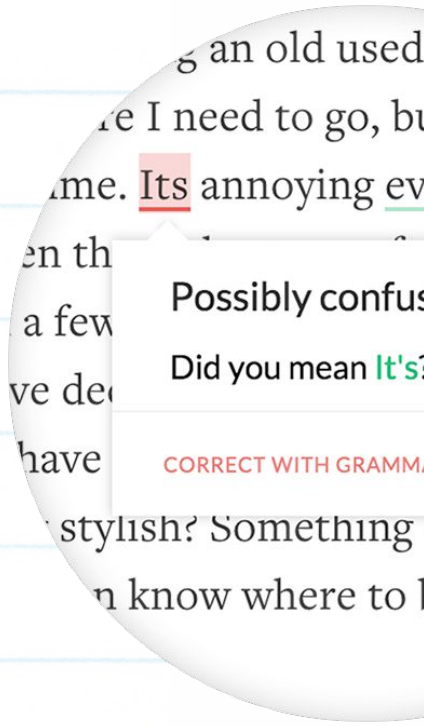
“Grammarly’s suggestions are helpful at steering you to use more direct and clear language.”

TECHNOLOGY AND LANGUAGE

I got in touch with a few people who work for Grammarly, including computational linguist Mariana Romanyshyn. We talked by video conference about how hard it is for computers to parse language and what Grammarly is doing to make computing systems better at it.

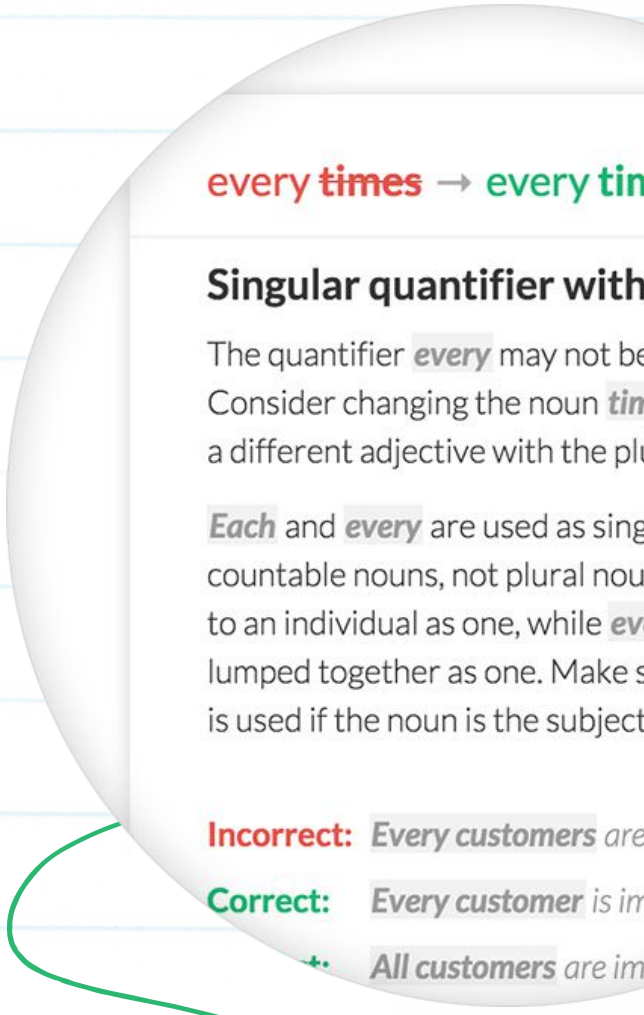
“Language is very ambiguous,” Romanyshyn said. “It’s not always possible for a machine to detect even what part of speech a word is.” She said Grammarly makes incorrect suggestions sometimes, and other times misses errors that should be flagged because of limitations with part-of-speech taggers. “This ambiguity is a really tricky task for computers to solve.”

I asked her for some examples. “There’s this classic linguistic sentence: ‘The old man the boat.’ The word ‘man’ is the verb.” In other words, it means that “those who are old are the ones who man the boat.”



"An automatic language processing system would never be able to detect that," Romanyshyn said. Machines will always assume that "man" is a noun in this context. Another example well known to linguists is the grammatically correct (but difficult-to-parse) sentence "Buffalo buffalo Buffalo buffalo buffalo buffalo Buffalo buffalo."

Romanyshyn also mentioned that although Grammarly already helps writers write better, new features are in the works. "We're planning to launch another version of Grammarly that's going to incorporate different templates of writing and provide more enhancements for writing so that we're not concentrating only on correctness but also on making the writing more cohesive, more coherent, and clearer."



GRAMMARLY MAKES WRITING BETTER

So many people need help with their writing: people on the job market looking to improve their résumés and cover letters, students working on assignments, business professionals drafting important documents and communication. They all have a vested interest in writing as clearly and as well as they can, and a tool like this could be just what they need.

Grammarly isn't cheap, however. There is a limited free version, but the paid Premium edition will cost you $29.95 per month, $59.95 per quarter, or $139.95 per year. But when you're stuck on an important piece of writing that you know could be better, it may be money well spent.

Pick Up Your Slack-ing

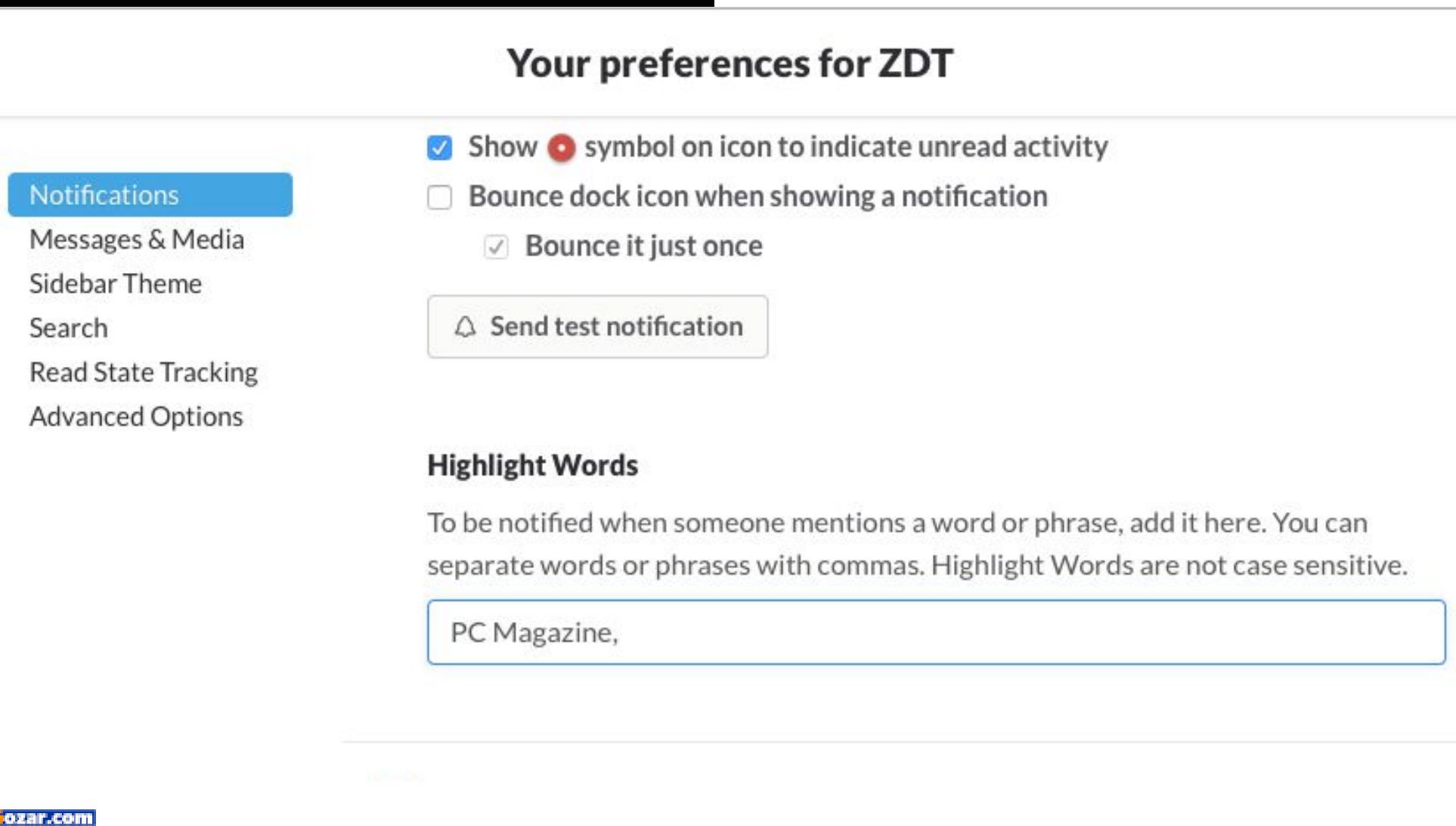
JILL DUFFY AND MATTHEW MURRAW

Slack has become one of the most popular tools that groups use to communicate and collaborate, but it's not necessarily any more efficient than email on its own. These tips will help you get the most out of this powerful new messaging application.

Slack is good about letting you know when someone is talking directly to you (or to your channel, or to everyone), but you can make your experience with the software even more productive by adding custom notifications that will trigger an alert whenever someone in any channel uses the words you specify.

Click on your name at the top left and select Preferences. Go to Notification Settings. Scroll down to where you see Highlighted Words. Type in the words or phrases you want to receive special alerts for here. You don't need to use quotation marks if you want to enter terms of more than one word, and words are not case-sensitive.

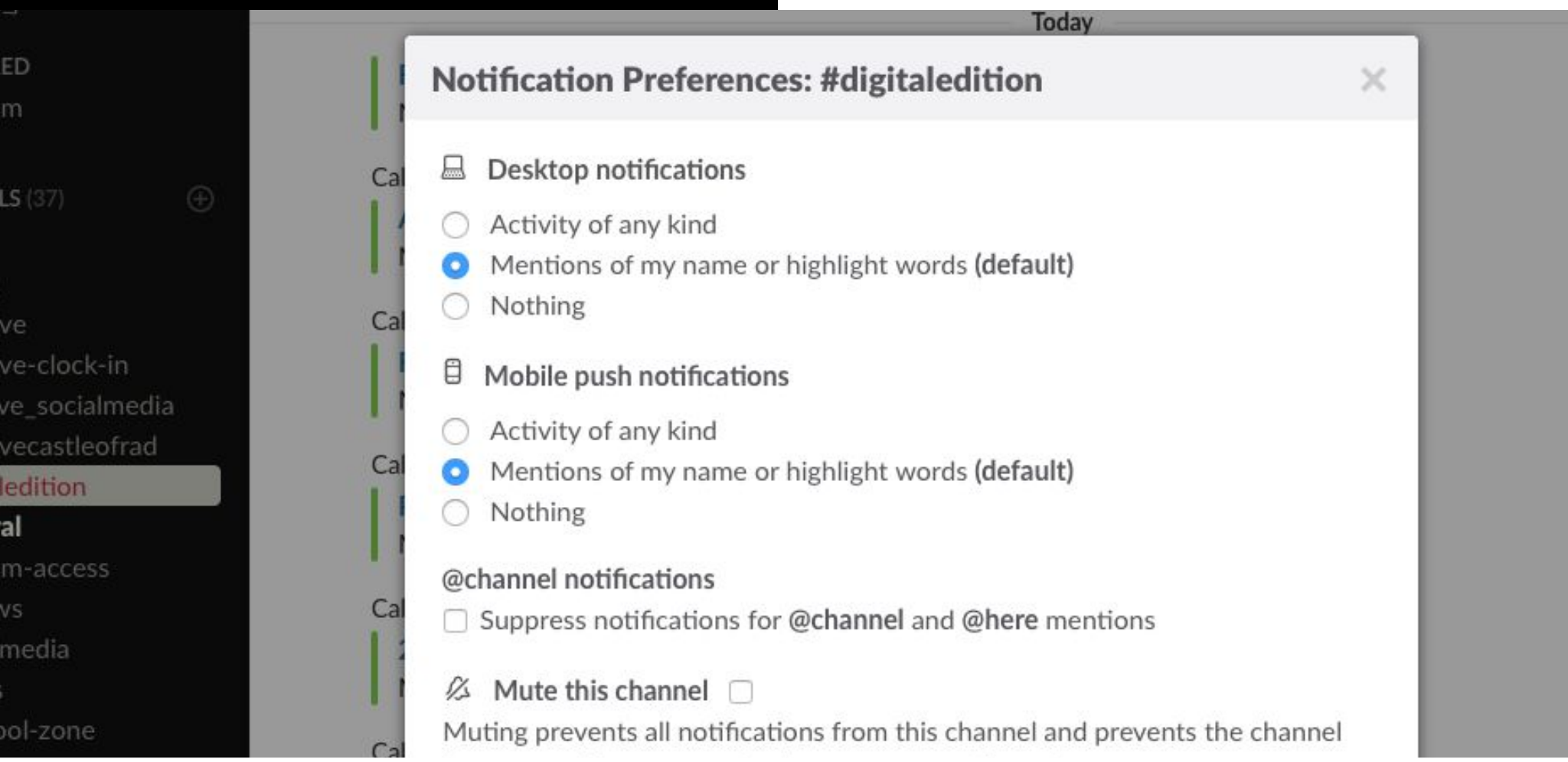
To make the notifications most useful, you should select words that have special meaning to you or are directly related to what you're working on. Seeing too many notifications can be worse than too few.



Custom notifications can ensure that you're alerted to the discussions that are most important to you, but what about the times the opposite is true? After all, not every channel that you join is as important as all the others, and you might not want to hear a sound every time someone in a channel makes an @everyone shout-out.

Start by going to the channel you want to adjust. At the top of the page, click on the gear icon, then select the option about notification preferences. Here you can tweak notifications for both the desktop and mobile versions of Slack, suppress @everyone and @here mentions, or even mute the channel altogether.

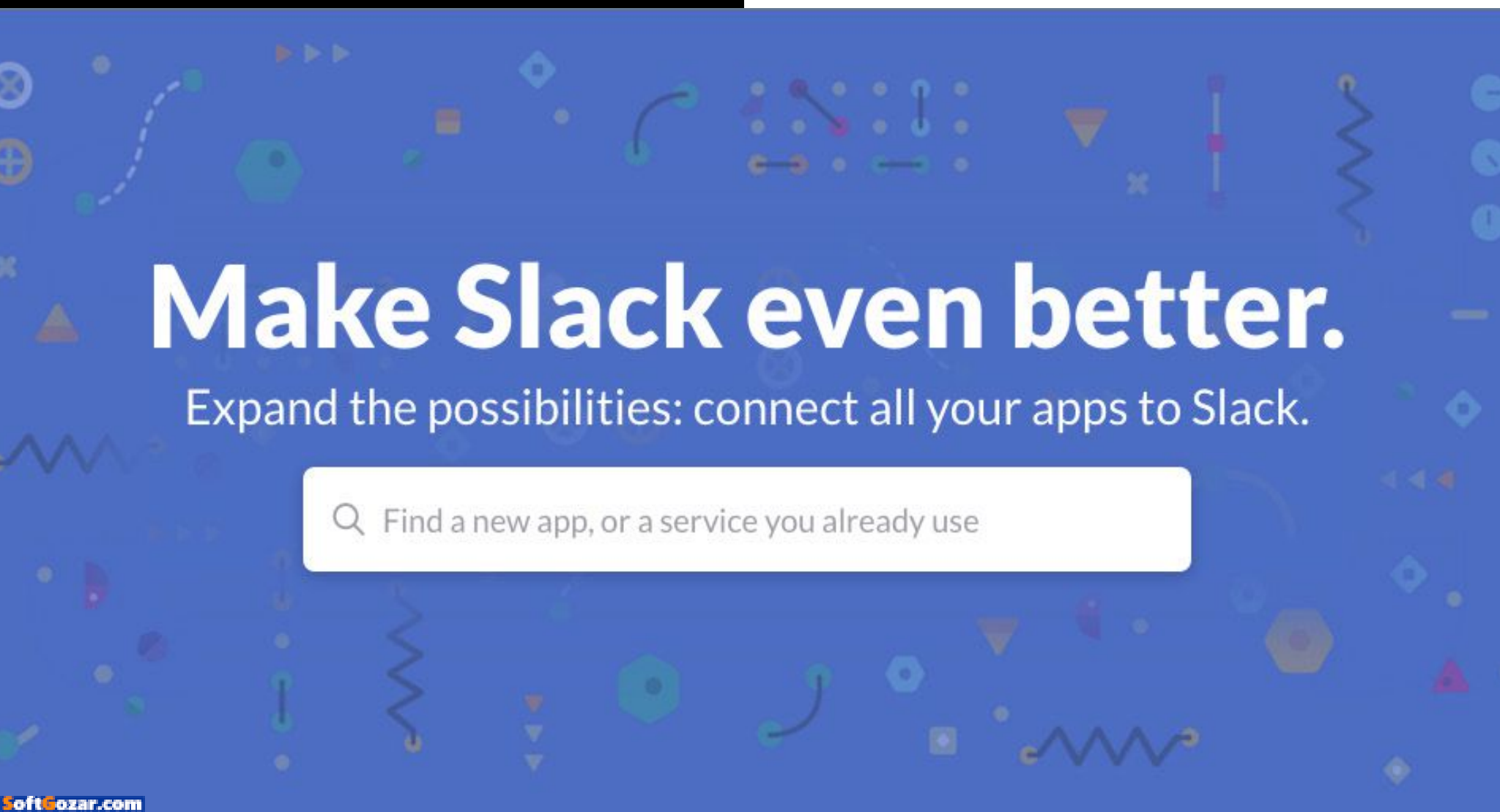
If you only want to see certain keywords or phrases, define them by going to your personal preferences, expanding the Notifications box, and entering them in the Highlight Words field near the bottom.



One nice feature of Slack is that teams can send messages into the software by forwarding emails to a special address. But the email addresses are gobbledygook.

Do yourself a favor by adding the Slack email aliases to your address book and giving them more memorable names. For example, if you use email forwarding to alert your team of press coverage, name the Slack email address Slack Press Coverage. That way, when you think of sending an email to Slack, you can start typing “Slack,” which just makes sense.

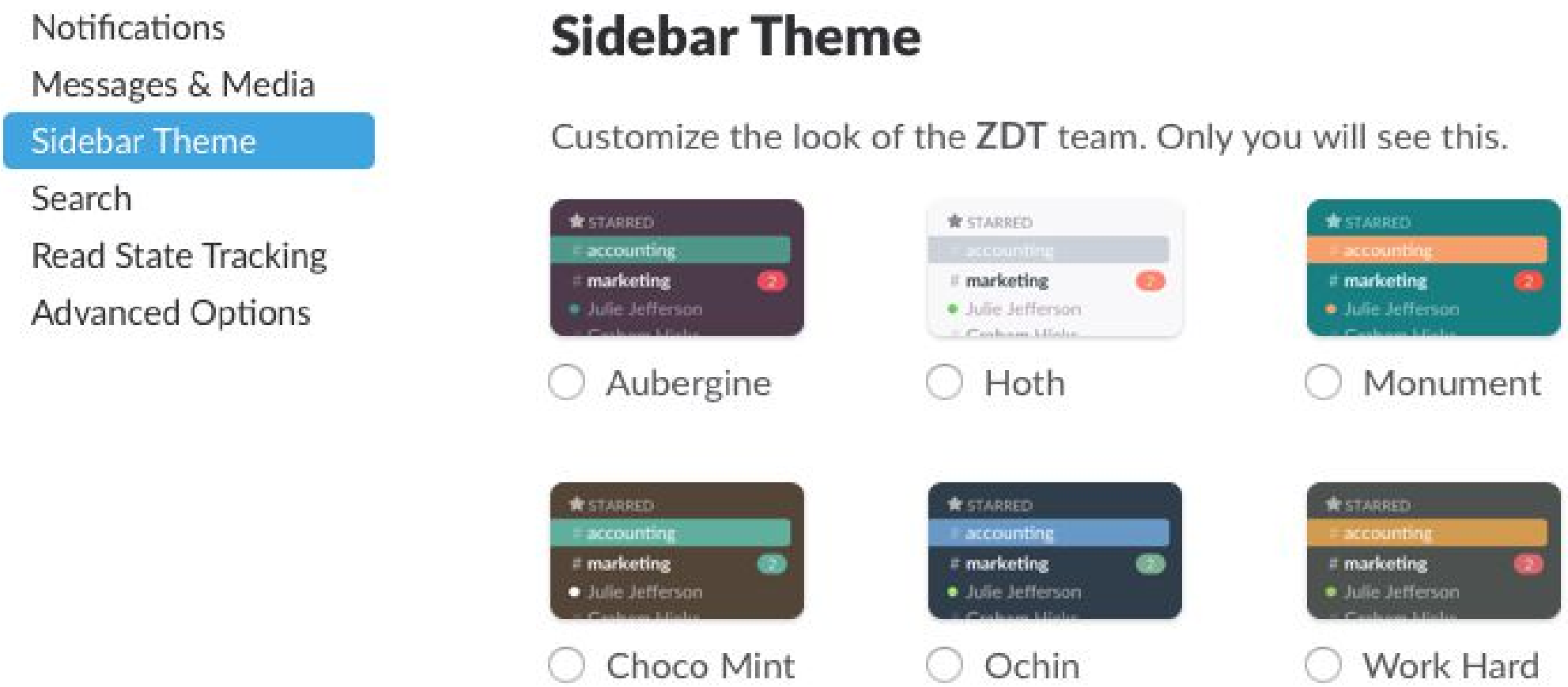
Find your email aliases (or set them up) by going to the team’s Apps and Custom Integrations setting. A new page will open. Select Configure at the top right. Look for Email. To get an email address that’s already set up, select Edit Configurations. You can copy and paste the alias from there.



Although Slack is still finding its footing within individual companies, you can use it for more than one group or purpose. The problem with this: It can get confusing to jump from account to account. Or, for that matter, maybe you just don't like Slack's default color scheme.

In either case, you can change the theme color for your sidebars so you can always tell at a glance what team you're working with or make your eyes a little happier. Click on your name in the top left, select Preferences, then select Sidebar Theme. As of this writing, there are six standard color combinations to choose from, and two designed to improve the Slack experience for people who are color-blind.

One hint: Try choosing themes that are most different from one another to help you quickly and easily recognize which team you're in at any given time.



ADD CUSTOM NOTIFICATIONS

CUSTOMIZE CHANNEL NOTIFICATIONS

ADD SLACK EMAIL ALIASES TO YOUR CONTACTS

ADD COLOR TO YOUR SIDEBAR

LEARN KEYBOARD SHORTCUTS

MASTER SLASH COMMANDS

Because Slack is so typing-focused, using keyboard shortcuts rather than moving and clicking a mouse can save you a lot of time. Type Ctrl+/ on a PC or Command+/ on a Mac to get a full list, but here are some of the most important and useful shortcuts.

Alt+Up Arrow or Down Arrow—*Move to the previous or next channel or direct message*
Alt+Shift+Up Arrow or Down Arrow—*Move to the previous or next channel or direct message with unread messages*
Alt+Left Arrow or Right Arrow—*Move to the previous or next channel in your history*
Ctrl+.—*Open or close right pane*
Ctrl+Shift+M—*Open Recent Mentions*
Ctrl+Shift+E—*Open Team Directory*
Ctrl+Shift+S—*Open starred items*
Esc—*Mark all messages in the current channel or direct message as read*
Shift+Esc—*Mark all messages in all channels and direct messages as read*
Up Arrow—*Edit your most recent message in the current channel*
Tab—*Open autocomplete drop-down (type @ first for username, # for channels, or : for emoji)*
Ctrl+U—*Upload a file*

Keyboard Shortcuts Cmd /

Channels & DMs

Previous in list: Option ↑
Next in list: Option ↓
Previous unread: Option Shift ↑
Next unread: Option Shift ↓
Back in history: Cmd [
Forward in history: Cmd]
Mark as read: Esc
Mark all as read: Shift Esc
Quick switcher: Cmd k or t
Browse DMs: Cmd Shift k

Messaging

Autocomplete
- Names: [a-z] Tab or @ Tab
- Channels: # Tab
- Emoji: : Tab

New line: Shift Enter
Edit last message: ↑ in input
React to last message: Cmd Shift \

Extras

Open Preferences: Cmd ,
Toggle Flexpane: Cmd .
- Channel Info: Cmd Shift i
- Mentions: Cmd Shift m
- Team: Cmd Shift e
- Stars: Cmd Shift s
- Search: Cmd f

Paste Snippet: Cmd Shift v
Upload a File: Cmd u
Dismiss Dialogs: Esc

ADD CUSTOM NOTIFICATIONS

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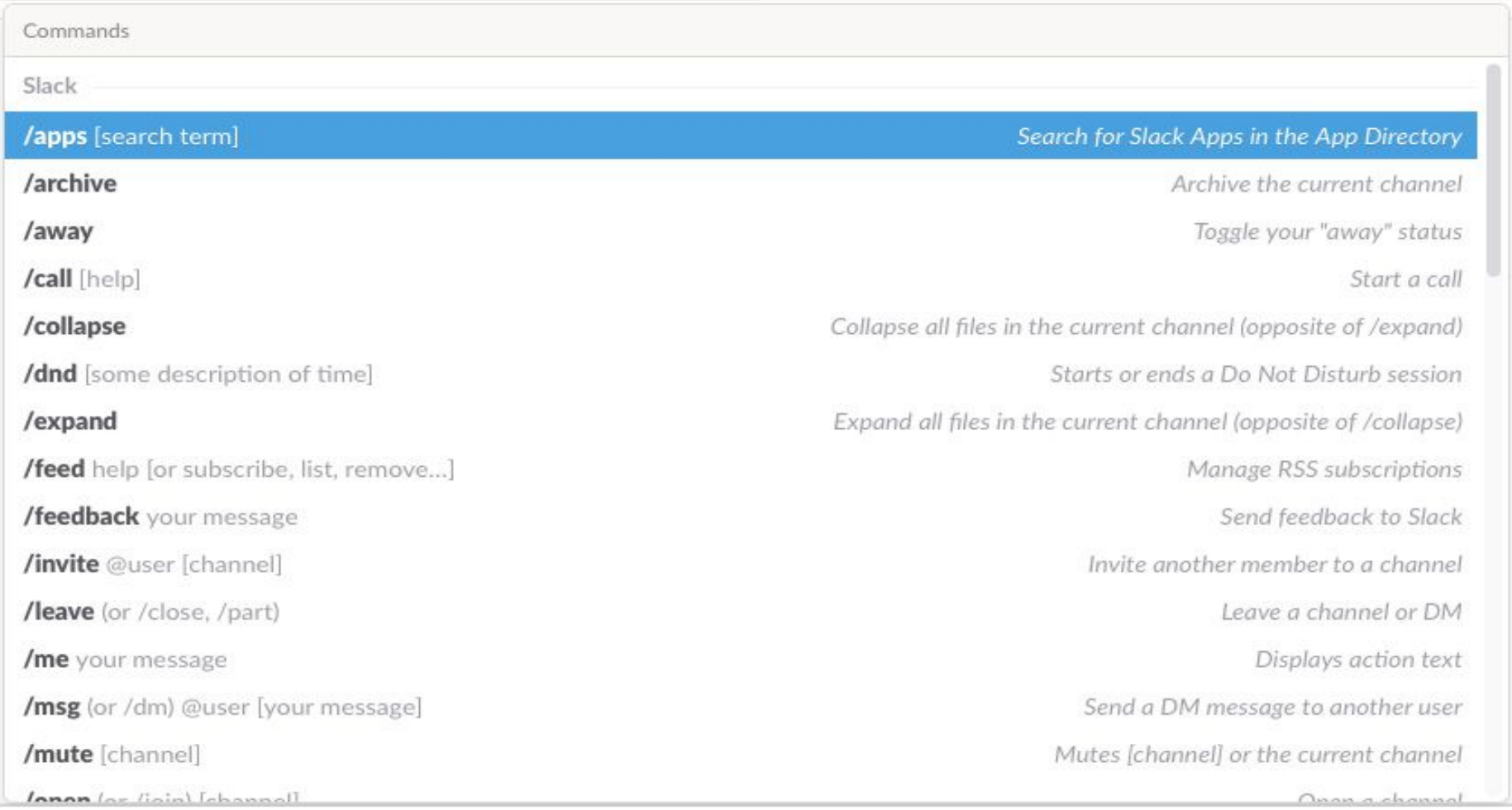
MASTER SLASH COMMANDS

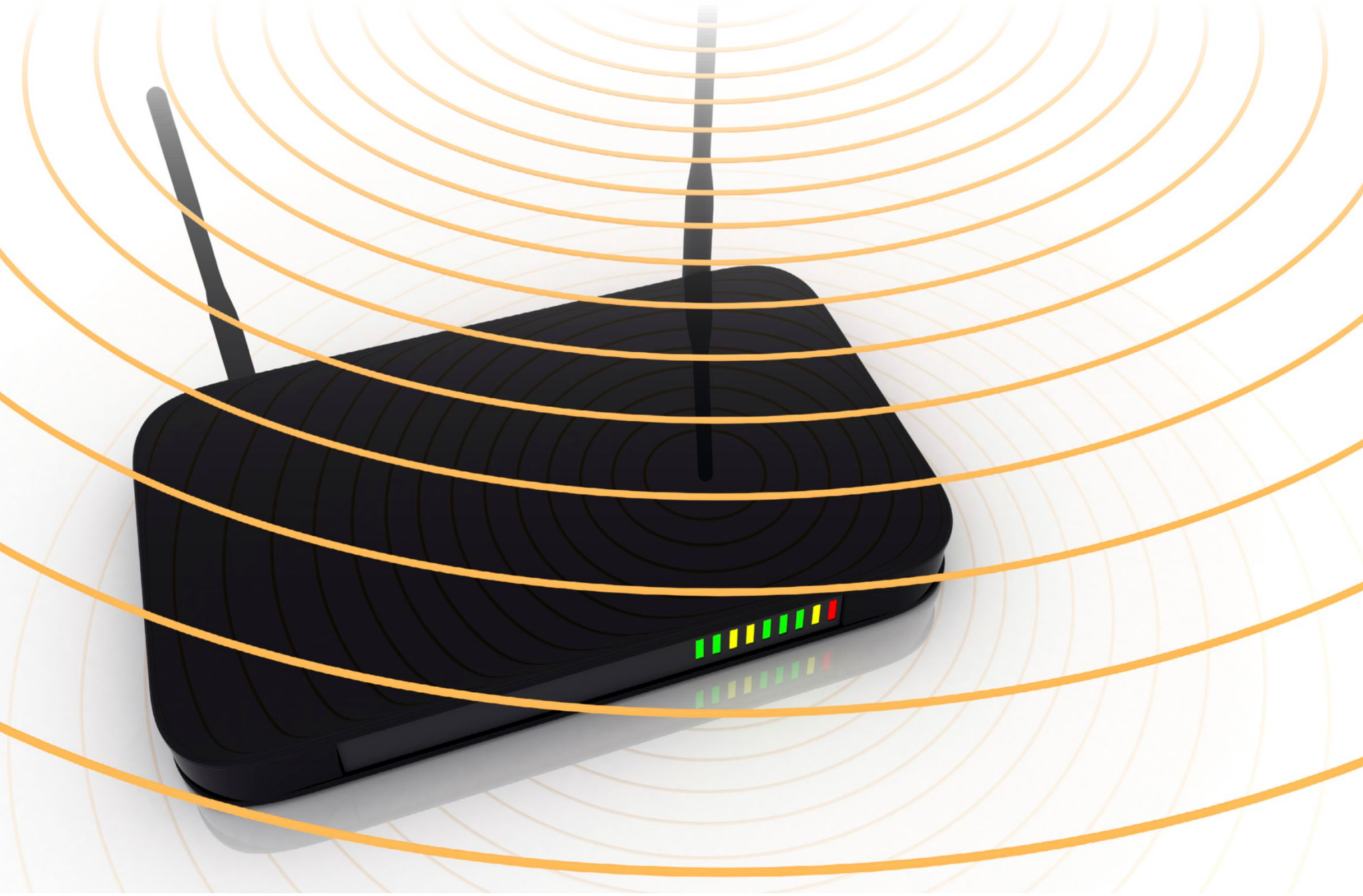
Type a forward slash (/) at the beginning of any message to see a list of commands that give you additional control over how you use Slack. Some of the handiest are:

***/away**—Toggle your away status*
***/dm @username**—Send a private message to the user of your choice*
***/dnd**—Toggle Do Not Disturb mode, which suppresses all notifications*
***/invite @username #channelname**—Invite a user to the specified channel*
***/mute #channelname**—Mutes the specified channel (leave blank to mute the current channel)*
***/remind**—Send a reminder to yourself, another user, or a channel*
***/star**—"Stars" a channel or conversation so it appears at the top of the list in the left pane*
***/topic**—Set the channel topic*
***/who**—List the users in the current channel or group*



Extend Wi-Fi Coverage Throughout Your Whole Home

BY DAVID CARDINAL



Now that Wi-Fi is becoming an integral part of just about every new piece of consumer electronics equipment and household appliances, it's more important than ever to have a usable wireless network throughout your home and office—and possibly your yard. Unfortunately, the typical ISP's simplistic model of providing a single "all-in-one" (modem, router, and wireless) gateway for your site quickly breaks down when faced with the real-world challenges of serving large or sprawling homes or apartments. This is especially true for buildings with lots of wiring, lath and

plaster walls, or metallic heating or air conditioning infrastructure in the floor or ceiling. The good news is that there are several ways to get Wi-Fi everywhere you need it. Here are the available options, along with some perspective on which may be best for you.

WI-FI RANGE EXTENDERS

The simplest approach to extending your Wi-Fi network is to add one or more range extenders. These small units plug into electrical outlets and then can be configured to repeat the signal from your current Wi-Fi source. They are wonderful if you don't need much bandwidth and don't want to take the time or spend the money to deal with a wired device.

If you have an older or slower network, particularly one with limited broadband speeds from your ISP, one or more wireless extenders may be perfect. If you're getting broadband speeds upwards of 50Mbps, however, you probably won't be able to take advantage of all of it in the areas where you use an extender; many extenders have high "faceplate" maximum bandwidth ratings, but in real-world tests their performance is typically substantially less. I've found them most appropriate for filling in coverage gaps while sorting out a better long-term solution.

USING ROUTERS AS ACCESS POINTS

By far the best way to get high-performance networking throughout a larger home is to deploy wireless Access Points throughout. Of the several ways to do this, the easiest is putting into use an older router you may lying around. If there's one in your home, you can use it as a wireless Access Point by simply connecting the LAN port to your main router. Some routers, like Apple's AirPort models, have a built-in bridge mode, in which case you'd connect the one that will be used as an Access Point through its WAN port to your main Apple router. Reusing a router used to be especially valuable when standalone Access Points were much more expensive than consumer-grade routers. More than once I've bought a router specifically to use as an inexpensive Access Point. But now that there are a number of reasonably priced dedicated Access Point options, unless you already own a router you can reuse, it probably isn't worth buying a new one for this purpose.

One other nice feature of using a router as an Access Point is that routers typically come with a number of LAN ports, so they can double as hubs. Dedicated Access Points usually only have a single Ethernet port, so if you have some wired devices to connect at the same location, you'll also need a standalone hub.

OUR RECOMMENDED RANGE EXTENDER

TP-Link AC1750 Wi-Fi Range Extender (RE450)

$309.99

EDITORS' CHOICE ●●●●○

This range extender delivers some of the fastest throughput we've seen, and installing it is a breeze. The only downsides? It's bulky and doesn't have a pass-through outlet.

NEED WI-FI OUTDOORS?

EnGenius ENS1750 Dual Band Outdoor Access Point

$499.99

EDITORS' CHOICE ●●●●○

This access point doesn't come cheap, but if you want blazing speeds and lots of management options even when outside, it's our top choice. A nice bonus: It's waterproof.

OUR RECOMMENDED POWERLINE ADAPTER

Tenda P1002P 2-Port Powerline Adapter Kit

$79.99

EDITORS' CHOICE ●●●●◐

This adapter kit brings wired LAN connectivity to any room in the house. It's a bit big and it blocks access to a second power outlet, but it delivers outstanding throughput and file transfer performance, and it takes just moments to install.

OUR RECOMMENDED ROUTER AND ACCESS POINT

D-Link AC3200 Ultra Wi-Fi Router (DIR-890L/R)

$309.99

EDITORS' CHOICE ●●●●◐

D-Link's powerful tri-band router raises the bar in more ways than one. It not only turned in record-breaking times on our throughput tests, but it also happens to be the coolest-looking router we've ever seen.

USING POWERLINE TO GET ETHERNET TO YOUR ACCESS POINTS

Often you'll want to put an Access Point in a location where you don't have wired Ethernet. There are a variety of products that can supply Ethernet over your existing in-home electrical wiring, a technology called Powerline. They are typically sold by networking vendors (such as Netgear, Linksys, and TP-Link) in pairs, so one can be used at the transmitting end and one at the receiving end.

I've used several Powerline products, and for the most part they work fairly well. But there are two caveats. The first is that your success with these depends on your electrical system. If it's complex, you may need to make sure that your transmitter and receiver devices are either on the same leg of the service or not isolated from each other by some other components. Powerline devices also typically can't be plugged into a power strip. Some include a pass-through socket, so at least they don't consume an outlet, but many don't. And because you'll also be plugging in an Access Point, you may run out of outlets.

Second, Powerline devices can sometimes drop connectivity and need to be reset (by unplugging them and plugging them back in). But if they are in hard-to-reach locations, or if you are relying on them for unattended operation, that may be a drawback.

The good news is that Powerline adapters, when coupled with a reasonable Access Point, will often provide better performance than a simple Wi-Fi range extender. But like range extenders, few of them actually measure up to their claimed performance.

MESH OF ACCESS POINTS

If you're willing to invest the time and money, and you already have wired Ethernet throughout your home or office, then a mesh-like arrangement of Access Points is the way to go. Mesh solutions can be administered from a single location and provide the best options for optimum channel management to avoid interference between units. Until recently, mesh Access Point solutions were expensive and a bit tricky to administer, because they have traditionally been marketed to larger enterprises. Now though, tech-savvy users can use products like Ubiquiti's Unifi wired Access Points to get an excellent blend of price and performance.

Unifi Access Points come in a range of prices and performance levels, and can be powered over their Ethernet connection (using PoE). Unifi offers a powerful centralized management console, but it requires a little effort to understand how to use it properly if you're not an experienced network administrator. The

units do a superb job of managing radio channels and handing off clients between each other—something that most of us have had to do manually until now. My only gripe is that they don't offer any additional LAN ports, so if you need both to connect both wired and wireless devices in a particular location you'll need to add a small hub.

For novice users, or for those who are setting up a new installation and also need routing and a firewall, start-ups Luma and Eero are launching mesh routers and Access Points designed to be configured from your smartphone. You'll pay a little more for the added convenience, and you won't get the wide range of options you do with Unifi, but a three-pack of either model is enough for most homes that are large enough to need a multiple–Access Point solution.

Mesh solutions can be administered from a single location and provide the best options for optimum channel management.

UNIFI-ED FRONT
If you want to set up multiple access points, a system like Unifi from Ubiquiti makes managing them easy—even if you're not a networking guru.

HOW MUCH PERFORMANCE DO YOU NEED?

One lesson I relearn every few years is that no matter what performance level you buy into, it eventually becomes obsolete, or at least superseded. We've moved through 802.11b to g to n to dual-band to 802.11ac. The fact is, 802.11n is more than enough performance for most current devices (with stated maximum data rates between 300 and 450Mbps, depending on the number of device antennas, although actual data transfer rates will be lower). But if you're buying new equipment and have a reasonable budget, getting 802.11ac support probably makes sense. Most 802.11ac devices claim support for 867Mbps or more, although as usual, you probably won't see data rates that high.

UPGRADING TO GIGABIT (WIRING & ROUTERS)

It won't do you much good to upgrade your Wi-Fi to some outrageous speed if your wired infrastructure throttles it back to 100Mbps. So you'll want to check and make sure your router can at least switch your internal traffic at 1Gbps. Or you can supplement it with a small Gigabit switch or hub. If your ISP is providing you with more than 100Mbps, then you'll have one more reason to make sure your router supports Gigabit Ethernet on both the LAN side and the WAN side.

If you have in-wall Ethernet and find you're only getting 100Mbps over it, check to see how many wires are connected to each jack. Ethernet at 100Mbps only requires two pairs of wires to be connected, but 1Gbps requires all four pairs. If you have extra pairs available, upgrading your wiring to 1Gbps may be as simple as connecting them. That worked in our house even with my 20-year-old in-wall Ethernet cables. For patch cables, I recommend Cat 5 or better, although many Cat 4 cables will also work with Gigabit Ethernet.

Trip Planning for the Technologist

BY SASCHA SEGAN

For many of us, planning is half the fun of a trip. I'm a parent with an annoying dietary restriction, so for me it's more like a necessity. Whether you just like to fantasize about where you're going or you absolutely need to have everything nailed down in advance, these online tools will help you plan the perfect journey.

WHERE TO GO?

A good place to begin planning your trip is to see what you can afford. Google Flights (google.com/flights) lets you do broad searches, such as for flights to

beachy destinations in May. (Miami for $174? I might take that.) Then there's the mobile app Hopper (hopper.com), which analyzes current and historical flight prices to tell you not only the best time to fly, but the best time to buy.

Want to micromanage your flight options? Google's ITA Matrix (matrix.itasoftware.com) is a long-standing favorite of expert flyers, as it gives you precise control over your airlines and routings. More important for average travelers, it surveys several different flight search engines, and allows for vague searches involving multiple possible destinations and long potential time periods.

If you're lucky enough to have a whole lot of frequent flier miles, AwardAce.com can tell you where your points can take you.

Expanding a search beyond planes, Rome2Rio.com is the best multimodal search engine I've found—it's even better than Google Maps. Somehow it integrates flights, trains, intercity buses, and even private taxi companies to give you a full menu of options between cities. It also gives you approximate prices, which Google doesn't do. A search engine that knows about the KTEL public bus routes on the Greek island of Aegina is truly a gem.

If you're road tripping, you should call up a map on Roadtrippers.com instead of using Google Maps. Roadtrippers specifically calls out attractions and services along the highway to your destination, and its maps transfer to a custom iPhone app. It will also help you come up with some amazing detours. A similar iPhone app, Along the Way (alongthewayapp.com), also gives you destinations along the road on your journey.

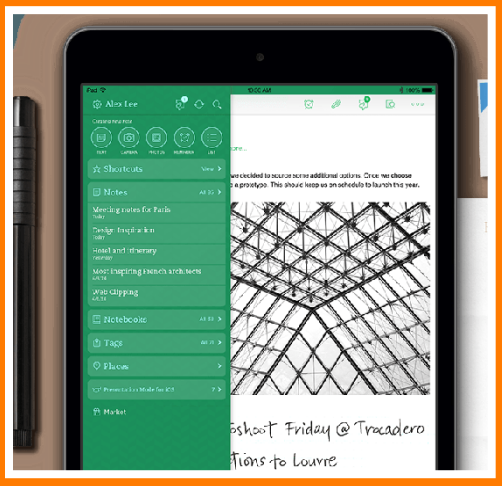
As you're collecting your lists of places to go and things to do once you arrive at your destination, use Google My Maps (mapsengine.google.com/maps). I adore Google's custom mapping tool, which lets you create a trip map with color-coded pins by type of attraction or by day. I have dozens of them. You can

THE RIGHT NOTES

Start by taking notes on a cloud-based notepad that will work on all of your digital devices.

I use Evernote as my universal notepad, although Microsoft's OneNote will also do as well. The point is that it's available everywhere you might have a trip idea—on your phone, on your tablet, on your work PC.

That way, no great concepts will slip out of your head.



search for a point of interest using Google, or just drop pins willy-nilly. You can also add driving or walking routes and then view the maps on your PC, Android phone, or iPhone.

WHAT TO DO?

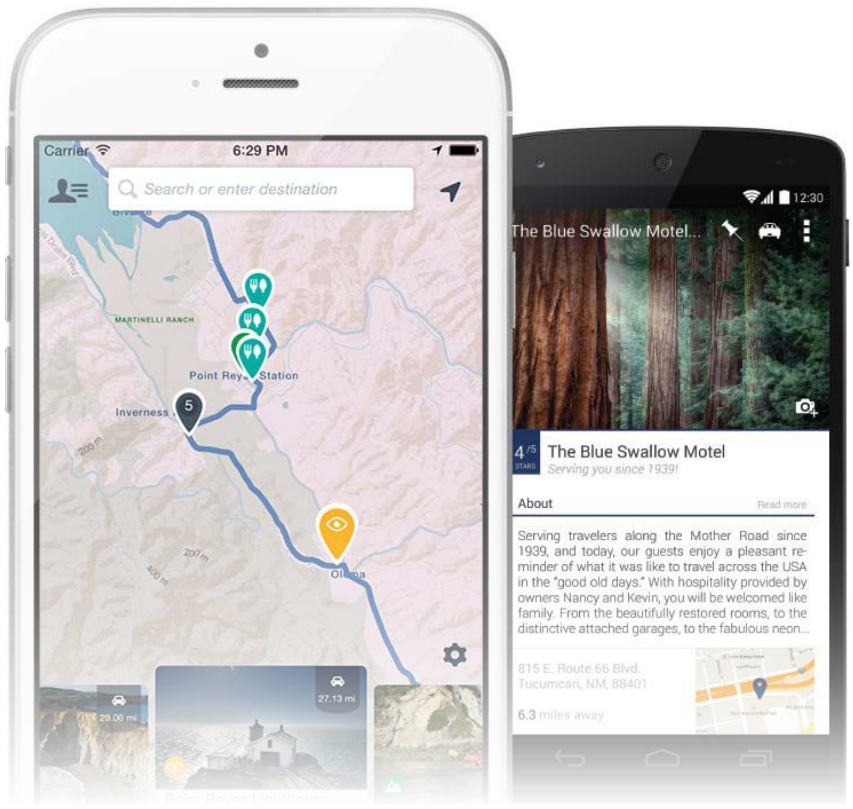
Reading Frommers.com and LonelyPlanet.com for basic guide advice, and then searching TripAdvisor and Yelp for more details on attractions and restaurants, are where any trip should start. (On TripAdvisor, in my view, the forums are even more useful than the user reviews, which are pockmarked with fake reviews and people who have no idea what they're talking about.)

These tools will help advance your planning as you rely on those major sites.

For the airport, GateGuru (gateguru.com) can be a lifesaver. The mobile app has a full list of shops and restaurants in many airline terminals, letting you figure out where you should eat while you're waiting for your plane. Ignore the checkpoint wait time information, though—it's stale.

Google's mobile app Field Trip (fieldtripper.com) aggregates suggestions from a range of other websites to give you ideas of lesser-known, off-the-beaten-path attractions and sights near any destination. It's designed to be used to find places immediately around you, but you can search for suggestions for any location in the world.

Speaking of Google, did you know that it has a built-in currency converter? You can just type, say, "37 CAD to USD" into Google and you'll get an answer. For when you're on the road, print out an OandA exchange rate cheat sheet (oanda.com/currency/travel-exchange-rates), a little paper card that lets you quickly convert currency values without having to resort to your phone.



TAKE IT ON THE ROAD

Here's a good reason not to fear taking a last-minute detour: The RoadTrippers app tells you about the attractions and services you can expect to see on the way to your destination.

JOHN C. DVORAK

Google Needs to Fix Gmail

I use Gmail as my primary backup email system; it does certain things very well and comes in handy. Why don't I use it all the time? I'm not a fan of what I consider to be a very clunky interface.

Gmail began as an invite-only product and quickly became the top free email system. But I think Outlook.com, Yahoo Mail, and dozens of other systems are better and easier to use.

The big attraction with Gmail was the extraordinary free storage space, which initially was an unheard-of 1GB. That capacity quickly grew: Now it's 15GB for free (though that space is shared with other Google services).

The problem I have with the system is the UI on the desktop. It's unworkable for the casual user. With email, there are few actions you ever need to take: compose a message, send the message, read an incoming message, reply to the message's sender, reply to the sender and all others to whom the message was sent, forward a message, and delete a message. That's seven simple items. Everything other than that—such as reporting spam—is ancillary. All you really need are seven easily accessible buttons.

With Gmail, the only clear button is the one that lets you compose. Everything else is either buried or shown as vague, often indecipherable icons representing a function in a cutesy way. For example, if you want to reply or forward a message, the buttons should be visible and clear. But no, the buttons are grayed-out text links at the bottom of the message or a left-facing arrow up

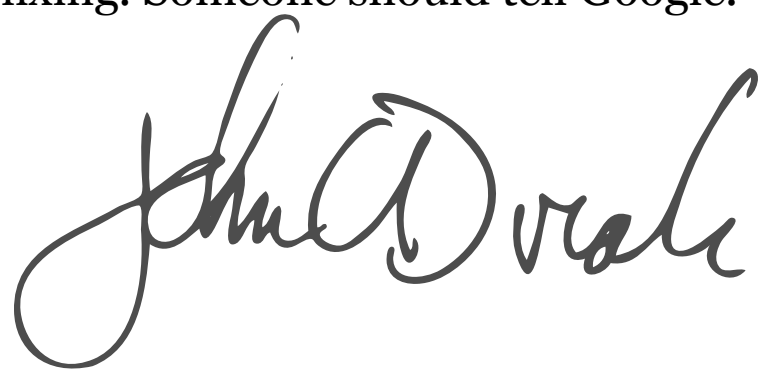
top. Not very interesting.

It gets more confusing when you actually click on the grayed-out reply text link at the bottom of the message. Once you do, another left-facing arrow and a drop-down karat icon appear. When you click on what is actually just one button, you get a drop-down menu with “Reply to [sender]” and “Forward,” which seems redundant, as well as “Edit Subject” and “Pop out reply.” “Edit subject” should not be a separate function—you should just be able to do it. And “Pop out reply” is just a dumb and useless JavaScript gimmick.

In fact, the entire Gmail package is riddled with idiotic and unnecessary JavaScript gimmickry. Things jump around needlessly, pop-ups come and go... It’s ridiculous.

Still, Gmail is almost universally praised as the best webmail system. This astonishes me, because in a side-by-side comparison its only advantage seems to be its integration with some social media systems. In 2012, *PC Magazine* did one of the best jobs of putting Gmail in its place when Gmail tied for second with Yahoo Mail in a roundup of best Web-based mail services, with Outlook.com leading the way. I totally agree with this assessment as far as features are concerned, though the webmail client for IMAP systems, SquirrelMail, is a favorite of mine.

The point is, Gmail needs some long-overdue fixing. Someone should tell Google.



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