

PC MAGAZINE

THE

H O W

ISSUE

THE HOW-TO ISSUE

HOW TO COLOR CALIBRATE YOUR MONITOR TO YOUR PRINTER

See color the way it's meant to be seen.

HOW TO REMAP YOUR KEYBOARD

Give those unused keys something to do!

HOW TO COPY YOUR WINDOWS INSTALLATION TO AN SSD

A solid-state drive (SSD) is one of the best upgrades you can make.

HOW TO PROVIDE REMOTE IT SUPPORT FOR YOUR RELATIVES AND FRIENDS

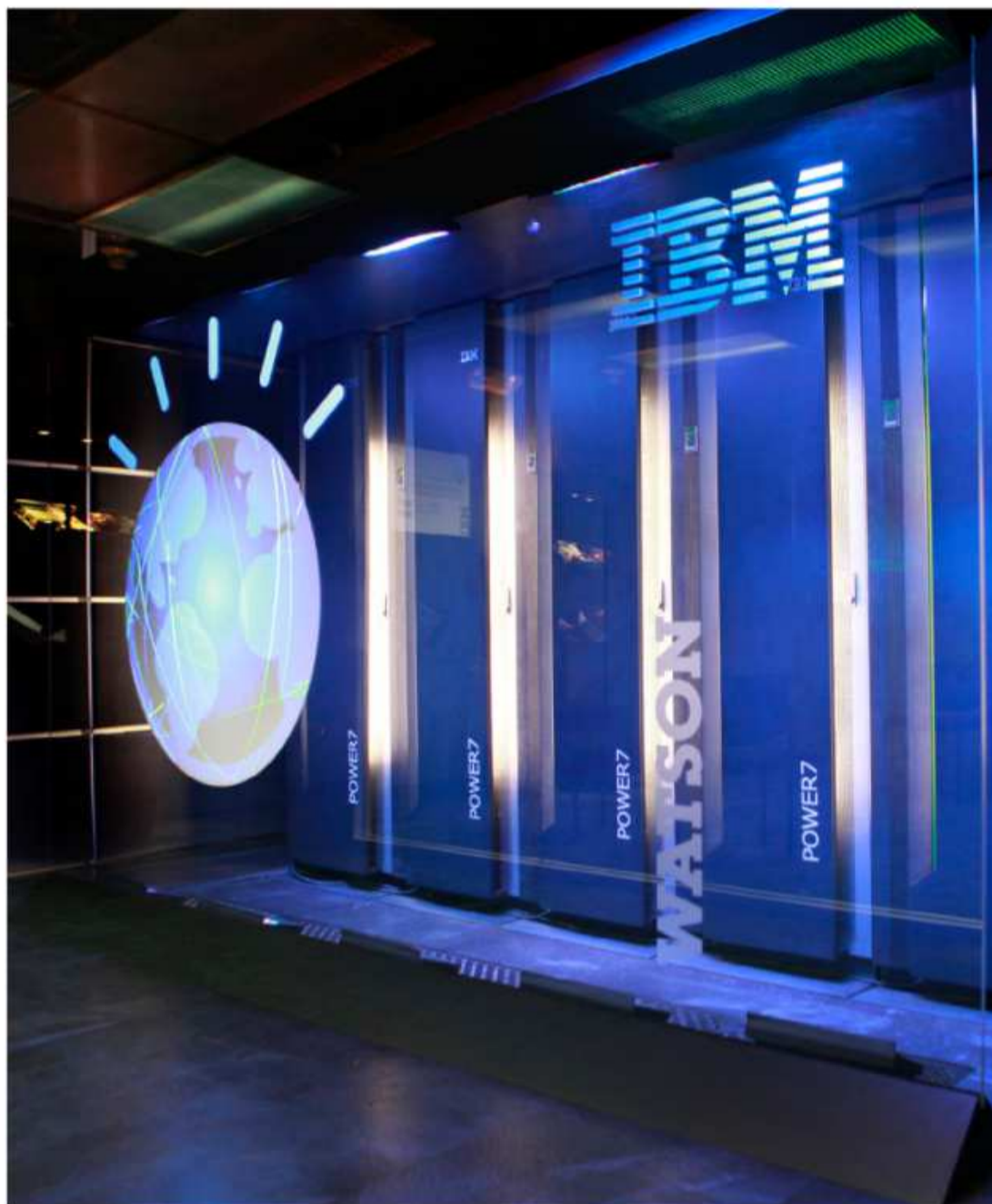
Leverage your tech savvy to save yourself some time, too.

HOW TO ACCESS YOUR WINDOWS PC FROM IOS AND ANDROID

Tap into your home PC no matter where you are.



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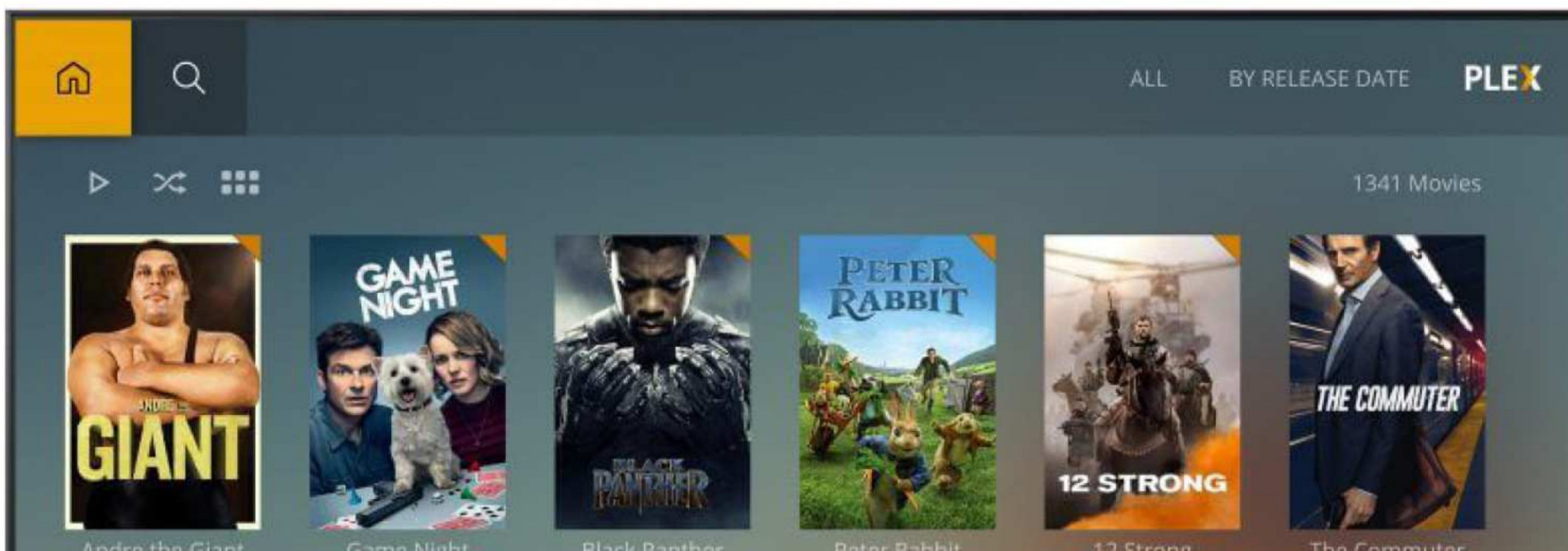


Fitbit Charge 3



HP Chromebook x2

Plex





Showing and Telling

When you think of PCMag, do you think of product reviews? That's understandable, if so, because we do a whole lot of those, as we have since the early days of personal computing. We also write loads of tech news and feature stories. But one of the most important things we do is help readers use their technology products with our how-to guides.

Tech changes so rapidly now that it's nearly impossible to maintain a broad expertise across numerous categories. Fortunately, we know plenty of focused experts who can explain using, troubleshooting, and repairing just about any kind of hardware or software, from the big-picture stuff ("How to Save Money When Shopping Online," "How to Take a Screenshot on Any Device") to the extremely detailed ("How to Create and Edit Video Using TechSmith Camtasia in Trivantis Lectora"). In this, our How-To Issue, we've collected a number of our most popular guides all in one place.

One of my favorites is "How to Provide Remote IT Support for Your Relatives and Friends." This is a task I'm quite familiar with—as are most of our staff, and probably you as well, since you're here reading PCMag. This story can help make your casual IT career a much easier lift by detailing all the ways you can connect to someone else's PC and check things out, when talking them through it just isn't doing the trick.

@cmangis

The stories we chose for this issue are roughly similar in that they are about some aspect of actual computing. But if you need help, say, recording and producing your own podcast, creating a slideshow on your iPhone, deleting your Facebook account, or flying a drone, we've got you covered at PCMag.com.

A lot of our how-to guide ideas came from readers, by the way. If you're struggling with any of your technology, or there's something you have always wanted to learn to do, please let us know! We're sure to have someone around who can help.

carol_mangis@pcmag.com



Protecting Your Data

In our October feature story, “How to Keep Your Data to Yourself,” security expert Max Eddy laid out guidelines on how to stem the flood of your private information to corporations. Here are a couple of reader reactions.

What you need to realize is that the world has changed, and whether you give your information to Peter or Paul, you are still sharing your information. This is the information-sharing generation. At this stage of the game, all of us have already, at one time or another, shared more of our personal information than we may have wanted to. It’s out there and you can’t get it back. Learn to live with it and make the best of it.

—*Norbert Gostischa*

I see it as another way to further the mass surveillance state by mandating we give up even more personal data to the beast so they can better target, use, abuse, and manipulate us. It provides the user with no added security at all. In turn, it does give the service provider a bit more of legalistic theoretical mumbo-jumbo security talk to duck lawsuits. Meanwhile, our stuff gets stolen anyway. Or ‘shared’ or ‘loaned’ or ‘sold.’ Including 2FA data. Many times, right off the corporate servers by insiders or third-tier vendor contract employees with gambling debts.

—*Muddy Road*

YOUR QUESTIONS

I was reading your article on password managers and have a couple of questions. Are the passwords stored on my computer or on their servers? What if you are at Grandma’s house for Christmas and need to check on a credit card. Is the password that is stored in the password manager available to you? And finally, I assume somewhere along the line you [need] a password to access or use

the password manager. So actually, the password manager is only as secure as one's password to access it. Is that correct?

NEIL RUBENKING'S REPLY

In most cases, passwords are stored in highly encrypted form in the cloud. That's so you can use them on all your devices. Some products can be limited to one device, but that's a big limitation. Myki Password Manager & Authenticator is an outlier; it keeps passwords only on your devices but still syncs between them.

As for your second question, if your password manager syncs across all your devices (and most do) and you have your phone with you (when do you not?), then there's no problem. In case you're caught short with none of your devices on hand, many password managers let you log in to your password collection from any browser. When you do use that feature, make sure to use the browser's incognito or private mode as well, so there's no history of your use.

And yes, a strong master password protects your password stash, but the best password managers let you take that further using two-factor authentication (2FA). For example, in addition to a password, a login might require a code texted to your phone, a code supplied by an app on your phone, or a physical device like a YubiKey. That way, even if Ivan Hacker gets hold of your master password, he's stymied because he doesn't have the second factor.

Ask us a question!

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



Why Intel Is Betting on eSports and Virtual Reality

BY ADAM SMITH



BIRMINGHAM, England—Near the back of the EGX Expo hall, two players battle it out over a game of Hearthstone. Watching their moves on two large screens is a crowd of maybe 40 people, with commentators discussing each play. Surrounding the players are suits of armor and fake bags of loot from the eSports League and Intel, two organizations looking to push eSports further into the public consciousness.

EGX isn't Intel's first foray into the eSports market. It's been hosting much bigger events for 12 years now, starting in 2006 with the first Intel Extreme Masters, a series of international eSports tournaments. This year, there have been Masters' events in Sydney and Shanghai; later this year, the competition comes to Chicago before stopping in Katowice, Poland, early next year.

The phenomenon is only going to grow, Scott Gillingham, Intel's Gaming and eSports lead, told PCMag at EGX. He pointed to the 2017 Katowice competition, which attracted 173,000 attendees in the arena and more than 46 million viewers online. Gillingham tells us that the number of online views hit an astonishing two billion.

For Intel, the increased interest in eSports has a number of benefits—most notably that more people will need computers capable of running today's most popular PC games. On the EGX show floor, there were a number of compact laptops and tiny gaming powerhouses, as well as the traditional “gamer PCs.”

These PCs must support a collaborative experience, something Intel touted on banners that read: “Game, Record, Stream.”

“Gamers [are] recording their game, and they're streaming it on Twitch, and they're sharing it socially with their community and their friends,” said Gillingham. “Now if you're doing that at the same time, you need much more performance . . . to maintain 60 or 70 frames per second.”

According to Statista, the average number of concurrent viewers on Twitch during the second quarter of 2018 was about 1,040,000 versus 326,000 for YouTube Gaming Live—up from 953,000 and 271,000 viewers, respectively, the previous quarter.

Twitch has seen a steady climb since Q3 2017, whereas YouTube has had ups and downs. YouTube recently discontinued its standalone YouTube Gaming app after three years in favor of a new gaming hub, where you can browse uploaded videos and live streams.



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With 2.21 billion gamers worldwide at the end of 2017, according to Statista, there's still room to grow.

But there's another area of tech where powerful computers are necessary—virtual reality. Intel is hoping to push VR into the mainstream, which will require powerful chips and, for now, gaming PCs.

While Hearthstone and Dota 2 don't work that well with a VR headset, Intel's partnership with ESL and Oculus has resulted in competitions such as the VR Challenger League at this year's Intel Extreme Master. Players battled it out playing Echo Arena from Ready At Dawn Studios and The Unspoken from Insomniac Games.

Adoption is still slow, though. "I think the overall eSports players, they're not all rushing to do this. That's a slow process. But the ones that have done it have [had] a great experience, [so] there's a definite future there with VR coming," said Gillingham.

"I think there's a stigma today that [for virtual reality] I've got to have a huge PC. At the end of the day, VR is a luxury thing today, [but] let's build a product that's a bit more consumer-friendly," he said.



Intel is hoping to push VR into the mainstream, which will require powerful chips and, for now, gaming PCs.



Intel's already taking that step with products such as the Hades Canyon, which is Intel's smallest VR-capable system. It arrived this spring looking like a tricked-out wireless router and is the sort of thing you could see sitting under your television in lieu of a cable box.

That comparison becomes more apt in the UK, considering Sky's push into the virtual reality space, BT's experiments with VR sports in 2016, and Intel's own True View technology, which has also been used to watch the American NFL, NBA, and NCAA tournaments in VR.

VR headsets and gaming PCs still don't come cheap, which Gillingham acknowledged. But he predicts a price drop over time, like most product categories.

As if to underline his point, Facebook recently showcased the Oculus Quest, a \$399 wireless headset that CEO Mark Zuckerberg describes as the "all-in-one VR experience we have been waiting for."

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Do I Need a VPN at Home?

BY MAX EDDY



When you use a VPN, you're adding a layer of obfuscation to your online activities and digging an encrypted tunnel between your traffic and anyone who tries to spy on you. That makes sense when you're out and about, using Wi-Fi networks that aren't your own. But at home, a VPN can help protect you from other threats and may let you access streaming content that would be otherwise unavailable.

WHAT ARE THE THREATS?

Outside your home, it's hard to tell which networks you encounter are safe. When you're at a coffee shop, for example, how can you tell which Wi-Fi network is legitimate? Unless the SSID is posted somewhere, you're just going to have to guess. Clever bad guys will set up access points with familiar names, hoping to trick people into connecting. Once victims are online, the bad guy does a man-in-the-middle attack, intercepting all the information victims send and receive. This includes a lot of mundane stuff, to be sure, but it can also include bank accounts, login information, and worse.

An attacker doesn't even need to trick you—they just need to trick your phone or computer. Most devices are configured to reconnect to familiar networks by default. But if an attacker uses the same name as a popular Wi-Fi network (think Starbucks or Boingo Hotspot, for example) your devices may automatically connect without your knowledge.

Both of those attacks require a lot of guesswork, but a good attacker won't bother with that. Instead, they'll configure their evil access point to switch SSIDs to match the ones your devices are asking for. Granted, this is an exotic attack, but it can be carried out successfully. At the Black Hat conference a few years ago, a security vendor detected an evil access point that had changed its SSID 1,047 times, tricking 35,000 devices into connecting.

In these situations, a VPN is enormously valuable. The encrypted tunnel it creates blocks anyone on the same network as you—even the person managing the network—from seeing what you're up to.



If an attacker uses the same name as a popular Wi-Fi network, your devices may connect without your knowledge.



For the most part, we can be assured that our home networks are safe. It's very unlikely that a bad guy broke in, replaced your router, and then waited for the good stuff. For one thing, that's just too much work. But for another, attackers need more than one successful hit to make an attack worthwhile. They'll want to rack up as much information from as many victims as possible. Unless you live in an airport, it's unlikely that there's enough foot traffic in your home to justify an attack.

But there are threats to consider when at home. The biggest one is from the company that provides you with access to the internet. The US Congress has allowed ISPs to sell data about users and their online activities to anyone interested. ISPs say that this information will be anonymized, but the idea is still unnerving.

ISPs aren't the only entities who are interested in what you're doing online. The fallout from the 2013 Snowden leaks has revealed that NSA surveillance is far more pervasive than previously believed. A VPN makes it much harder for an outside observer to correlate your online traffic to you.

And then there's net neutrality—or rather, the lack thereof. The rules that would have ensured a free and open internet where ISPs were barred from creating fast and slow lanes or throttling traffic to certain sites have been thrown out. While net neutrality needs to be enshrined in law in the US, using a VPN may help prevent the throttling and restrictions by ISPs that could be allowed in its absence.

VPNS CAN BE FUN

At least half of all VPN use isn't for personal protection—it's for streaming video. That might seem odd considering the negative effect that VPNs have on your upload and download speeds, but it makes sense.



Unless you live in an airport, it's unlikely that there's enough foot traffic in your home to justify an attack.



Not all streaming content is available everywhere. Each streaming service has a contract to carry shows and music that are sometimes limited to specific areas. For example: If you want to watch *Star Trek: Discovery* in the US, you need to have a CBS All Access subscription. If you live outside the US, you can watch it on Netflix. Personally, I pay for *Star Trek*, but I digress.

That's where VPNs come in. You can use your VPN to tunnel to a distant server and access content that is restricted in your home country. While Netflix is very good at blocking VPNs, this trick is also useful for sports fans. Sometimes the best games aren't available for US audiences, or the US coverage is so annoying that die-hard fans would rather see how the BBC or CBC handles the games.

VPNs are all about securing your traffic from prying eyes, though, so that can be a problem when you want your traffic to be seen. If you live in an especially smart home, you're likely to encounter some problems with using a VPN.



You can use your VPN to tunnel to a distant server and access content that is restricted in your home country.



A great example is Chromecast, Google's dead-simple method for getting content from your phone or computer on to your TV. When you try to use Chromecast with a VPN, all your data is shuffled off your devices through an encrypted tunnel and can't reach other devices on your local network. You'll have to switch off your VPN if you want to use this feature, or others like it.

One solution to this problem is to simply raise the level of your VPN and install it on your router. That way, all the data on your local network is funneled through the VPN, giving you protection without causing any of the fuss on the local level. Configuring your router to use a VPN can sound daunting, but some VPN companies will sell you a preconfigured router if you want to give it a try.

While many people are using VPNs to stream online content, many (if not most) streaming services are very good at blocking VPN usage. One possible solution is purchasing a static IP address from your VPN provider. These "clean" addresses aren't associated with VPNs, giving you a better chance of slipping past attempts to block your access.

Speed will always be an issue with VPNs. When a VPN connection is active, your web traffic is going through more machines and more fiber. The result is increased latency and slower transfer speeds. Not all VPNs are the same in how much they affect your connection, but you will see some impact.

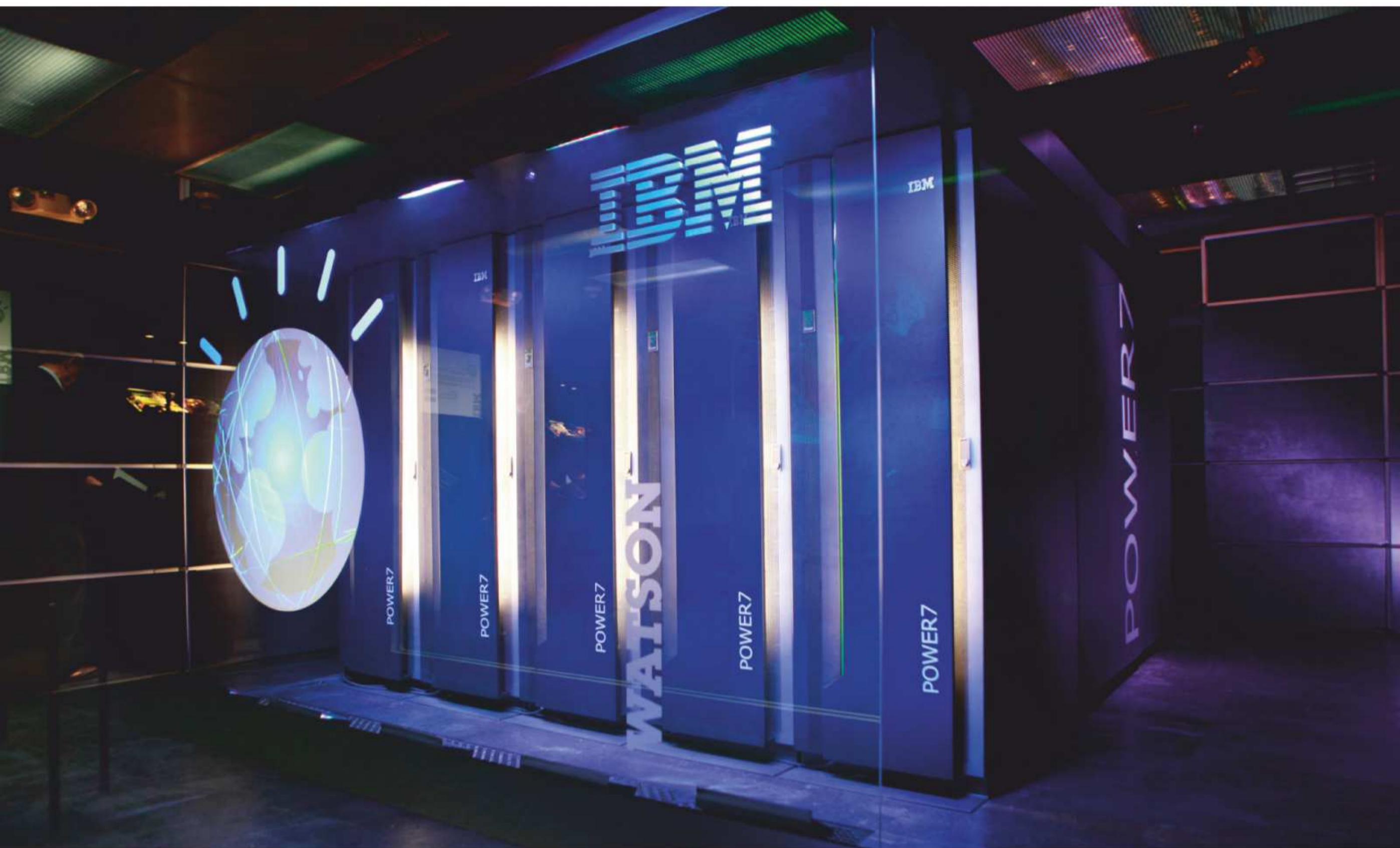
DO YOU NEED A VPN AT HOME?

In truth, the answer to the question of whether you "need" a VPN in your house is going to come down to your own preferences. There are lots of good reasons why a home VPN is a valuable addition to your security arsenal, but what's most important is whether you will use it. If you find yourself too frustrated with reduced internet speeds, or juggling streaming devices, don't use a VPN at home. An unused security feature isn't useful to anyone.

For me, the decision by Congress that allows ISPs to sell anonymized data about their customers is a huge motivator. It's why I keep my VPN switched on as often as possible, even at home. But I do switch it off when I need to cast content to my TV. Security is important, but so is *Star Trek: Discovery*.

IBM Releases Pretrained Watson AI Tools

BY BRIAN T. HOROWITZ



In a significant expansion of the IBM Watson cognitive computing platform, IBM has launched “pretrained” artificial intelligence (AI) tools for a slew of industries, including advertising, agriculture, automotive, building management, customer service, human resources (HR), manufacturing, marketing, and supply chain.

“The focus is on how AI can make each professional—across industries—more effective and more efficient,” Kareem Yusuf, Ph.D, General Manager of IBM Watson IoT, told PCMag.

Watson is IBM's series of AI services and applications. By releasing this series of pretrained tools, Yusuf said, IBM aims to help companies change the way they work.

“A key business advantage lies in tapping into organizational insights, historical customer data, internal reporting, past transactions, and client interactions,” he said. “These elements are too often underutilized.”

Offering pretrained solutions for various industries is a big deal, explained Rob Enderle, Principal Analyst at tech analyst firm The Enderle Group. “It represents a significant maturing of the Watson platform,” Enderle told PCMag.

Sometimes companies that deploy AI hit a snag during the training period. Since Watson completes its training before companies deploy the technology, they can execute a more efficient deployment.

“Training is where AI deployments get hung up,” Enderle said. “Much of the initial work with developed AI is to create this training, which then, through machine learning, can be passed on to new systems, significantly lowering the deployment cost and time to value. This is a critical phase to maturing the platform and getting it closer to its operational and sales potential.”

With the heavy lifting completed during the training period, Watson is ready to start producing targeted, industry-specific insights right away.

“Getting the system to this phase is anything but trivial. Once there, machine learning can allow the replication of an unlimited number of systems,” Enderle said.



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Here are six industries in which IBM Watson is now pretrained:

Agriculture: IBM released the Watson Decision Platform for Agriculture to enable farmers to gather data on weather, Internet of Things (IoT)-enabled tractors and irrigators, and satellite imagery to let companies generate predictive data on farms. AI-powered visual recognition capabilities let growers decide where to spray pesticides, determine the severity of damage from pests and diseases, and forecast water usage. Farmers also gain insights from temperature and moisture levels, as well as crop distress.

Human resources: With recruiters looking to browse through resumes quicker than ever, IBM is now offering AI functionality for HR professionals. IBM Watson Talent lets recruiters analyze the backgrounds of top-performing employees to find candidates for new positions. In fact, AI could help reduce bias in hiring decisions, according to IBM. Psychologists helped IBM produce an AI scoring system, which lets recruiters quickly sort through candidates. IBM says it has used AI to refocus recruitment time for companies such as BuzzFeed and H&R Block.

Marketing and advertising: IBM Watson Assistant for Marketing is a component of Watson Campaign Automation SaaS. The assistant lets companies evaluate their marketing campaigns, engage in more direct conversations with customers, and create a personalized customer experience.

Meanwhile, WEATHERfx Footfall with Watson allows advertising companies to design ads based on shifting weather patterns. AI, machine learning (ML), and cognitive computing in WEATHERfx Footfall with Watson allow triggers to continuously self-adjust based both weather conditions and brand needs. WEATHERfx Footfall with Watson incorporates data from IBM MetroPulse, a business intelligence (BI) app that provides insights from neighborhood demographics.

Manufacturing: The Watson toolset for the manufacturing industry will provide visual and acoustic inspection capabilities. AI technology will also allow manufacturers to predict when equipment failures might occur, as well as energy waste and product quality issues. AI will let manufacturers gain insights and deal with workforce attrition, skills gaps, and rising raw material costs.

Commercial Space: For the commercial property and real estate industry, IBM IoT Buildings Insights lets property owners and building managers use data to reduce energy costs. It also gives them weather data insights and historical property performance. IoT Building Insights connects data from IoT sensors, main meters, and submeters. By working with Watson AI, IBM IoT Buildings Insights lets property owners analyze occupancy patterns. Building Insights is an extension of IBM's Tririga Facilities Management portfolio, an app that standardizes real estate and operations data.

“By using AI, contextual models, IoT, and other sensor data, IBM IoT Building Insights consolidates, stores, and analyzes your data in real time, seamlessly improving building operations and giving you unique insights,” Yusuf said.



**WEATHERfx
Footfall with
Watson lets
advertising
companies
design ads
based on
shifting weather
patterns.**

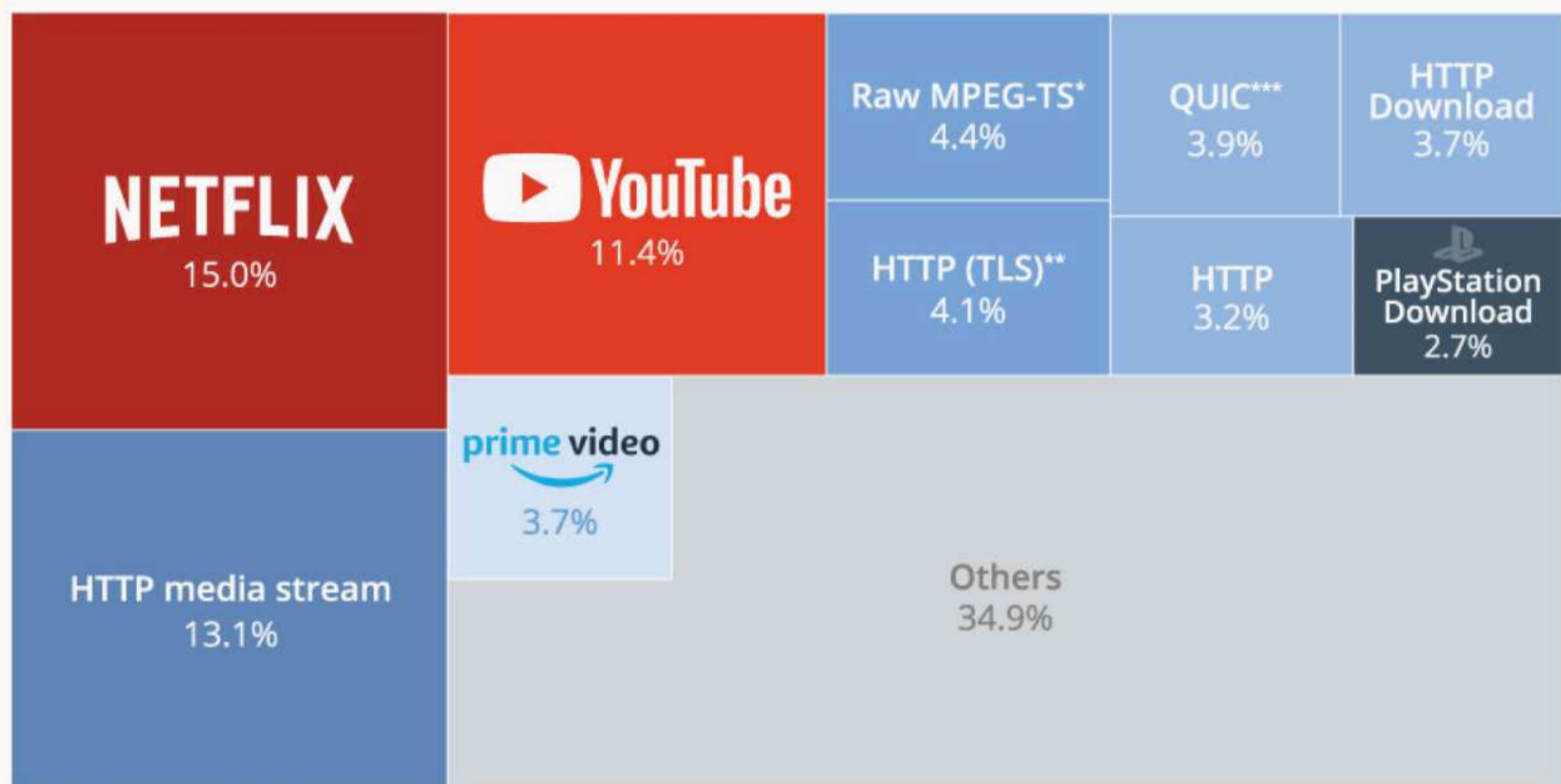


Netflix and YouTube Make Up Over a Quarter of Global Internet Traffic

BY ROB MARVIN

Netflix is Responsible for 15% of Global Internet Traffic

Distribution of worldwide downstream traffic, by web application



* Digital container format for the transmission and storage of audio, video, and data.

** Security protocol

*** Network protocol designed to speed up online web applications



@StatistaCharts

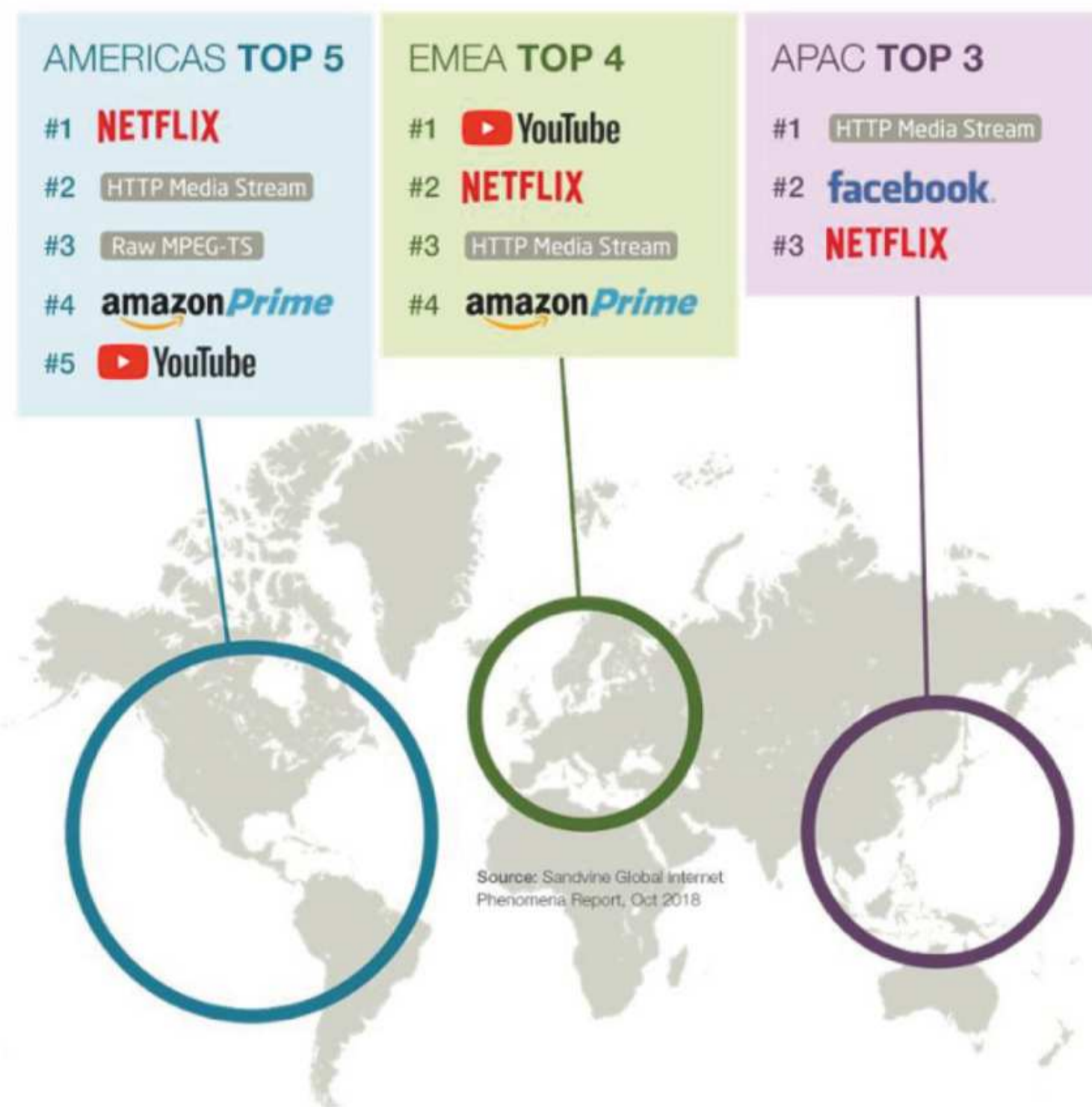
Source: Sandvine | The Global Internet Phenomena Report

statista

Video-streaming services are taking over the entertainment world, and the high bandwidth that comes with them is eating up an increasingly massive chunk of internet traffic around the world.

According to Sandvine's 1H2018 Global Internet Phenomena Report, Netflix is now responsible for 15 percent of worldwide downstream traffic by megabytes, followed by YouTube at 11.4 percent. Together, the two streaming video platforms make up over a quarter of global internet traffic.

Almost 58% of downstream traffic on the internet is video



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Netflix is the number-one video streaming traffic source in the Americas and number three in the Asia Pacific region.
”

Amazon Prime Video has carved out a solid chunk as well, at 3.7 percent, a number that comes into clearer focus as you break it down by region. Netflix is the number-one video streaming traffic source in the Americas and number three in the Asia Pacific region, and Amazon has the number four spot in both the Americas and in Europe, the Middle East, and Africa (EMEA).

YouTube is no slouch either. While it's only number five in the Americas, it's the top video streaming traffic source in EMEA. A last player worth mentioning is PlayStation, which accounted for 2.7 percent of internet traffic in 2018 thanks to its thriving downloads ecosystem.

Of course, there's still plenty of traditional web traffic, such as the Raw MPEG multimedia format and HTTP traffic, but streaming hogs are tipping the balance more each year.

Why Bitcoin Is Struggling to Become a Mainstream Currency

Ten years ago, the Bitcoin whitepaper set the scene for what many believed would be the future of online payments—or even the future of money itself. Since then, Bitcoin has evolved from a geeky, libertarian fad into a landscape of thousands of cryptocurrencies and hundreds of billions of dollars.

But Bitcoin still has a long way to go to fulfill the vision of becoming a mainstream method of payment and a major currency. As the cryptocurrency has grown in popularity and use, its inherent challenges, technical and legal, have become more pronounced. And unless it can overcome these challenges, Bitcoin will never become a real currency like the dollar or euro, as some experts believe.

BITCOIN'S ORIGIN CREATED BIG EXPECTATIONS

The advent of Bitcoin coincided with the financial crisis of 2008, which was triggered by the collapse of several major banks and financial institutions. “It was obvious that the population cannot trust its financial leaders to keep their money safe. There was a strong sense of anxiety about the economy’s structure,” says Ilan Klein, founder of Blockchain Sensible, a blockchain-based art market.



Ben Dickson is a software engineer who writes about disruptive tech trends, including artificial intelligence, VR and AR, the IoT, and blockchain. Ben also runs the blog Tech Talks.

Using blockchain, a distributed-ledger technology that lets users store and exchange data without going through a third-party service, Bitcoin enabled peer-to-peer payments across the world. With trust in banks and traditional financial institutions at a record low, it was easy to see Bitcoin as a solution to the woes of the world economy.

Bitcoin's enthusiasts believed that cryptocurrencies would destroy the banking industry and reshape the financial landscape. But 10 years later, the economy has recovered, investment and banking are performing on a par or even better than they did before the financial crisis, and mistrust in the financial industry has mostly subsided.

"The anxiety seems to be mostly gone as the world's economy continues to grow at a steady clip," Klein says.

Naturally, with banks regaining their lost prestige and trust, investors and customers are less concerned with finding alternative methods to store their funds.

But let's be clear: Even at the climax of the financial crisis, non-tech-savvy users found it hard to use Bitcoin, and it took several years' worth of innovation and a huge spike in the value of the cryptocurrency to draw modest acceptance among the masses.

"Presently, there are over 228,932 active Bitcoin transactions per day, over 22 million wallets hold Bitcoin, 70 percent of people in America are aware of it, and 17.8 percent would consider

buying it,” says Lisa Cheng, founder and chairman of the Vanbex Group, a blockchain consulting firm. “However, as a form of payment to replace credit cards, there still remain technical hurdles.”

BITCOIN'S PROBLEMATIC USER EXPERIENCE

Even after 10 years, getting started with Bitcoin isn't easy. “It takes quite a bit of effort to start using any cryptocurrency... You need to download a wallet, and some currencies require that you download and sync the wallet to the current blockchain status before you can validate a transaction. And depending on the size of the blockchain, this can take a while,” says Klein.

Users also must know how to handle the public and private cryptographic keys, bits of data that enable their owners to send and receive payments on Bitcoin addresses. If you lose your private keys, or if they get stolen, there's no way you can recover your funds.

Some Bitcoin wallets, such as the popular Coinbase exchange, simplify the user experience by managing the private keys for the users. But that pushes the burden of security onto those companies. And if they get breached, which has happened quite often, hackers will get access to the private keys and customers' funds.

Users also must deal with the fact that very few merchants and retailers accept Bitcoin. That's why they must convert their Bitcoins to fiat currency before they can spend them, which further adds to the friction of the experience. Enthusiasts and Bitcoin believers manage to live off Bitcoin, but for the average user, the technical hurdles are just too overwhelming.



If you lose your private keys, or if they get stolen, there's no way you can recover your funds.



BITCOIN TRANSACTIONS ARE SLOW AND EXPENSIVE

The Bitcoin blockchain generates a 1MB block of new transactions every 10 minutes, a constraint that has been set intentionally to prevent attacks on the network. But this also limits the number of transactions the network can process.

Currently, Bitcoin can handle seven transactions per second, which is far from the thousands of transactions that payment networks such as Visa can process.

As Bitcoin has grown in popularity and payment load, it's increasingly difficult for its network to keep up with the demand, and sometimes it becomes overloaded with unhandled transactions. This was especially true at the turn of the year, when cryptocurrency prices were at a record high. Users had to wait hours and sometimes days before their payments were processed.

The Bitcoin protocol allows holders to attach fees to their payments to encourage the “miners,” the computers that verify and process transactions, to prioritize their transactions over others. But this has caused a competition between users who want to push their payments ahead of others. Consequently, Bitcoin transaction fees have sometimes climbed higher than \$50.

These high transaction fees make Bitcoin payments inefficient for small purchases (imagine paying more than \$50 in fees to purchase a \$10 pizza). Slow transactions and high fees go against Bitcoin's vision to be an electronic cash system we can use for daily purposes.

Attempts have been made to improve the speed of Bitcoin transactions. Bitcoin Cash (BCH), an altered version of Bitcoin that went live last August, increased the block size from 1MB to 8MB to support more transactions. It later upgraded the block size to 32MB. While an improvement, that's still a far cry from the thousands of transactions that other payment networks support. And because BCH is increasing the blockchain size at a such a fast pace, many developers have refused to support it.

Another effort to address the transaction speed issue is the Bitcoin Lightning Network, a technology that reduces congestion on the blockchain by allowing users to open side channels to conduct payments between each other without recording them on the blockchain—only the opening and closing transactions of a side chain are registered on the main blockchain. Lightning Network is still in the testing phase and has its own challenges. But if it succeeds, it could offer faster payments and lower fees.

BITCOIN'S PRICE IS VOLATILE

In 2017, the price of a bitcoin rose from around \$1,000 to \$20,000, then lost two-thirds of its value in the first half of 2018. These violent fluctuations make Bitcoin unsuitable for day-to-day payments. This is partly why very few merchants and retailers accept it as a method of payment. But that makes Bitcoin attractive for speculators and investors who want to profit off the price changes.

“We have witnessed that Bitcoin was first envisioned as a digital currency. But lately, with volatility in markets, people start looking at it as a store of value more than an actual currency,” says Vitomir Jevremovic, Founder of VR All Art, a marketplace for virtual-reality assets powered by a cryptocurrency.

“This is logical not only in the case of Bitcoin but with many other cryptocurrencies or so-called coins. If a coin is volatile, there is a little use-case for them in the real-life applications. Speculation in the market is from one side bringing more interested parties at the table, which is good, but it also works against the adoption. User



In 2017, the price of a bitcoin rose from around \$1,000 to \$20,000, then lost two-thirds of its value in 2018.



experiences in crypto space are difficult, and the whole sector needs to understand that regular people don't care about crypto; they care about usability and stability."

"Most of the new coins launched via ICOs [initial coin offerings] and otherwise were used to generate quick profits and did not have specific uses," says Klein from Blockchain Sensible.

An ICO is a process in which a company issues its own cryptocurrency to fund project development and operations. Most of these cryptocurrencies, also referred to as "altcoins," have very small trading volumes, which makes them prone to price manipulation, as Klein noted. "A few miners joining forces can have a large effect on the price of a small coin."

In January, The Outline ran a story in which it described the inner workings of cryptocurrency "pump-and-dumps," in which groups of people engage in coordinated schemes to suddenly start buying a specific coin to create artificial appreciation (the pump phase). The price rise would draw other users who were interested in making profits off the coin, oblivious to the fact that they were walking into a trap. When the coin's price reached their targeted value, the scammers would suddenly sell all their coins (the dump phase), taking away huge profits and leaving unsuspecting investors in the cold.

As the largest and most popular cryptocurrency, Bitcoin is more resistant to pump-and-dump schemes, but it isn't immune. In December, Bloomberg reported how the "whales," the 1,000 or so people who hold 40 percent of all bitcoins, can easily manipulate the cryptocurrency's price.



An ICO is a process in which a company issues its own cryptocurrency to fund project development and operations.



BITCOIN'S LEGAL HURDLES

Users can create their own Bitcoin wallets and obtain cryptocurrencies without presenting any form of identification or going through government institutions. Governments are understandably reluctant to endorse a currency that is beyond their control, especially since it has become a favorite among cybercriminals, online black markets, and scammers.

Although they can't control Bitcoin, governments can heavily regulate and control the companies, exchanges, and institutions that want to become engaged in cryptocurrencies and ICOs. In December, the US Securities and Exchange Commission (SEC) warned against the legality of ICOs and their conformance to SEC security rules. A few months earlier, China banned ICOs altogether.

More recently, the SEC rejected nine proposals for Bitcoin exchange-traded funds (ETFs). Bitcoin ETFs would remove many of the technical hurdles of investing in Bitcoin and make them more understandable and available to the traditional investment markets.

Legal hurdles add to the frustration and hurdles of investors and merchants who want to offer cryptocurrency payment options to their customers. This, in turn, slows down Bitcoin's adoption as a mainstream currency.

THE FUTURE OF BITCOIN

These challenges don't mean Bitcoin is doomed. But its adoption might not happen as fast as initially expected. It's trying to disrupt and institutions that have been standing for millennia.

After a decade of ups and downs, Bitcoin has seen some tremendous progress and recognition as a resilient currency, regardless of political and economic upheavals. Companies that previously shunned or ignored Bitcoin are becoming interested in the opportunities that cryptocurrencies can provide. Blockchain, Bitcoin's infrastructure, is also finding its way into many other domains beyond payments, thanks to its immutable and transparent nature, and it is introducing entirely new ways to run organizations and economies. And engineers and developers are busy fixing bugs, adding features, and improving the experience.

“As long as people believe in Bitcoin and there is an incentive for miners to keep the network operational, it will exist. That is the real power of bitcoin,” says Jevremovic from VR All Art. “What is certain is that crypto is here to stay, because crypto is mostly a computer code, and code gets improved.”

Google Chromecast Is Losing the TV Battle to Roku and Amazon

Google is doing great on handheld screens. The company is dabbling in larger screens with its smart displays, and its Chromebooks are holding their own on even bigger screens. But on what is usually the biggest screen in the house, Google's mobile-first philosophy is failing consumers.

Google announced a new Chromecast in October, but you might not know that. Presenters at its Pixel 3 event in New York didn't even mention the Chromecast. Why? Because it's getting brutally lapped in the media streamer market by Amazon and Roku.

Google's entire TV philosophy is wrong. Most people do not want to control their TV with their phone, it turns out. They're zoning out in front of the TV to get away from the complex handheld experience. They want to use an actual remote or maybe voice control. And Chromecast, insanely, still doesn't offer a remote option or an onscreen content menu to let you browse content from a 10-foot distance.

I get that Google thought it was radically remaking TV in the image of all of the young



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

people who watch YouTube on their phones. The youth are mobile-first, and so the TV should be treated as an expansion of the phone. Also, browsing content involving QWERTY keyboard entry via a TV remote is always a pain.

But that lack of an on-screen menu is a glaring misstep. Amazon and Roku both provide voice control, flexible apps, on-screen menus, and traditional remotes, all at prices under \$50. Apple TV also exists, although that's all I can really say about Apple TV. Google just isn't competing.

You see that in the growing smart TV market, too. Android TV exists. It's good, even. But Google has been unable to spread it beyond higher-end Sony and Sharp TVs into the mainstream where people are snapping up Insignia and TCL TVs running Roku and Amazon software. Google has also been unable to leverage its enduring partnerships with Samsung and LG to make it into their dominant TV lines.

The one low-cost Android TV add-on box is from Xiaomi. The company has a solid brand in China but has been unable to build a brand in the US. I went to a Xiaomi press event recently that was so monumentally clueless about how to market to US consumers, it was hard to take the company seriously at all.

TVs matter. They're still where people consume long-form video content for hours on end. While "traditional" TV is on the decline, streaming services consumed on TV are on the rise. Netflix says 70 percent of its viewing still happens on televisions.

Perhaps Google isn't as competitive in the TV space because Roku is a wild card. Roku's presence doesn't fit into the battle Google is waging on other fronts, where Google, Amazon, Apple, and Microsoft are the main players, and it may make Google's other competition look less urgent.

Or perhaps Google is just too far up its own YouTube—the most successful video service that isn't primarily consumed on TVs. YouTube makes the TV an appendage, not the star of the show, much like the Chromecast does. But there's much more to the living room than YouTube.

Google got beat by Amazon in the smart home before, when Alexa grabbed a ton of market share before Google had its Home systems fully spun up. And Fire TV is looking pretty good. What we watch on TV may be changing, but the fact that we watch it on TVs and want a remote-based experience is not.

Google needs to rev the Chromecast and get it in line, or its lack of a good TV solution will give Amazon and even Apple a leg up. If not, maybe it should buy Roku, which understands better than Google what streaming TV viewers want.

sascha_segan@pcmag.com



What we watch on TV may be changing, but the fact that we watch it on TVs and want a remote-based experience is not.





Fitbit Charge 3: Among the Top Dedicated Fitness Trackers



The Fitbit Charge 2 has been one of our most highly recommended fitness trackers for two years now. With the Charge 3, Fitbit takes a good thing and makes it even better. Thanks to a sharper screen, longer battery life, new sensors, a swim-safe build, and more-informative phone notifications, the Charge 3 features just enough changes to remain the best everyday fitness tracker for casual users. That makes it our Editors' Choice and one of the top wearables for keeping tabs on your health and activity.

Fitbit
Charge 3

\$149.95



BIGGER SCREEN, BETTER BATTERY

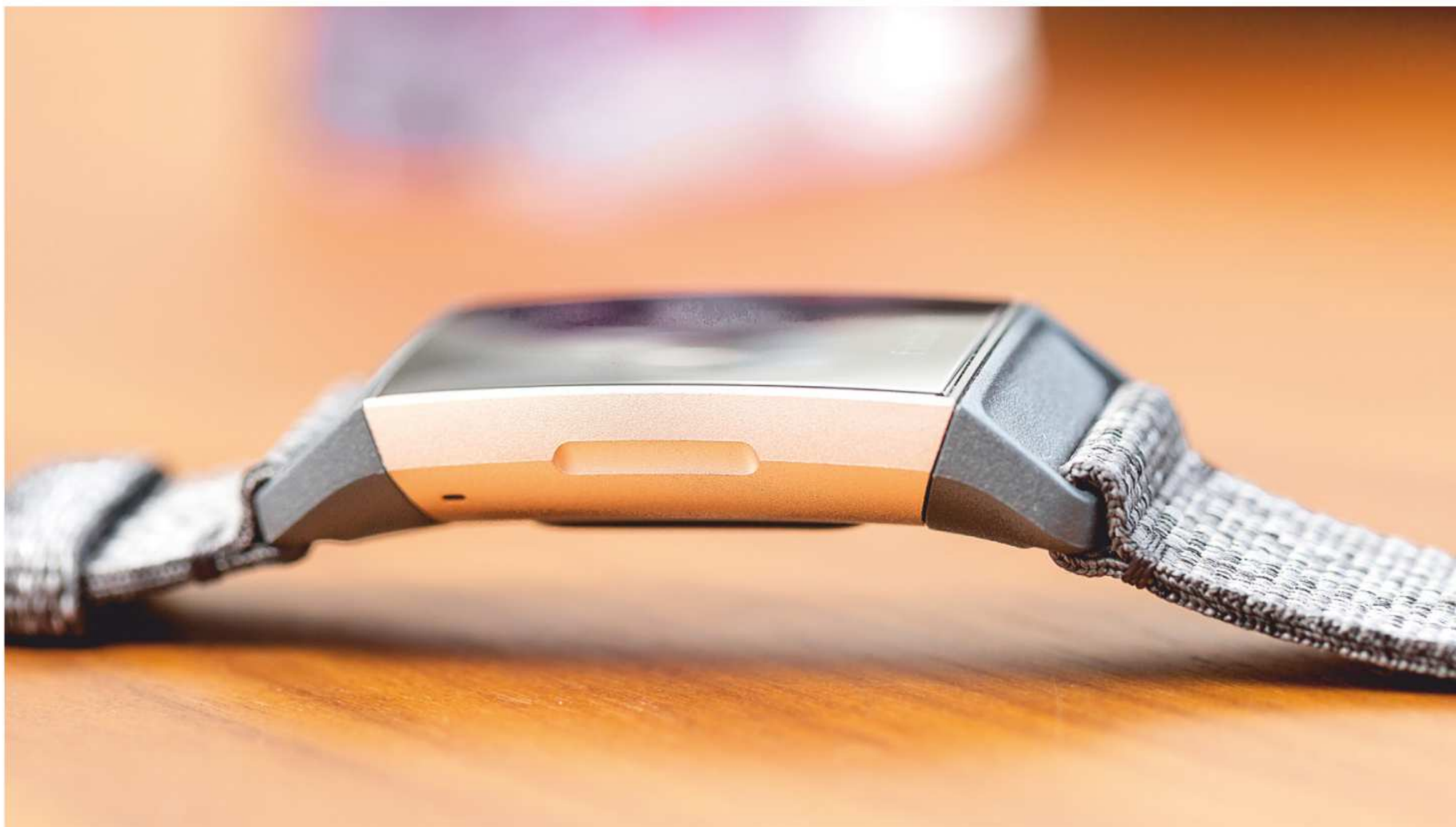
With the Charge 3, Fitbit hasn't changed the design of the Charge 2 so much as tweaked it. The monochrome OLED touch screen is bigger, with an active area of 0.7 by 0.2 inches (HW), and the resolution is higher (Fitbit doesn't share exact specs, but it looks noticeably sharper). This makes receiving notifications from your phone a much better experience, as there's enough space to read a whole text message instead of just a part of it. There's a sizable bezel below the display where the Fitbit logo is, but it's not quite as noticeable as it is on the Fitbit Ionic or Versa.

The body of the tracker is made of aluminum and features a recessed button on the left. It's a slight indentation that replaces the protruding button on the Charge 2 for a more streamlined look. I found it just as easy to use, especially since it gently vibrates with haptic feedback when you press it.

Fitbit Charge 3

PROS Crisp screen. Long battery life. Updated with better heart-rate and SpO2 sensors. Safe for swimming. NFC payments on Special Edition.

CONS Swipe interface can be finicky. Proprietary charger.



The Charge 3 features interchangeable straps, so you can dress it up or down for formal or casual occasions. As for color options, the tracker comes with either a black silicone strap paired with a graphite body or a blue-gray silicone strap with a rose-gold body. A Special Edition version costs \$20 more and features NFC connectivity for use with Fitbit Pay; it comes with a rose-gold body and a lavender woven band or a graphite body with a white, perforated sport band. Fitbit offers additional straps in materials ranging from silicone to leather for \$29.95 to \$49.95.

The larger display makes for a change in the interface that feels a little like navigating around a smartwatch. From the main screen, you can swipe up to get a view of your daily stats. Swipe left to scroll through the apps menu, which shows two apps, stacked vertically, per screen. Swipe down to scroll through your notifications. A short press on the left button brings you back to the previous screen, and a long press brings up a shortcut menu to adjust screen and notification settings.

In testing, I found the screen's touch sensitivity to be slightly less than perfect. It sometimes failed to register swipes, or it registered them incorrectly, bringing up my apps instead of my daily feed. This is an issue we've seen with other OLED touch screens, such as the one on the Garmin Vivosmart 4.

On the plus side, the Charge 3 packs a bigger battery with an estimated seven days of use on a single charge. Ultimately, battery life depends on your usage, but I've been wearing it for nearly a week and still have an impressive 35 percent of battery life left. Another disappointment, though, is that Fitbit still uses a proprietary charger, so you'll have to shell out for a new one if you lose or break the one in the box.



The larger display makes for a change in the interface that feels a little like navigating around a smartwatch.



Rounding out the upgrades, the Charge 3 is more water-resistant than its predecessor (up to 50 meters). You can safely wear it in the shower or the pool and use it to track your laps.

GOING FOR A TEST RUN

Inside, the Charge 3 packs the same sensors for monitoring your activity as the Charge 2 does, with an improved heart-rate monitor and the notable addition of an SpO2 sensor. (SpO2 refers to peripheral capillary oxygen saturation, which is an estimate of the amount of oxygen in your blood and can be used to identify conditions such as sleep apnea.)

Regarding accuracy, the Charge 3 delivered solid performance. When testing fitness devices, we compare step-count results with those of the Yamax SW-200 Digi-Walker as a control. On a one-mile treadmill walk at 3.5 miles per hour, it logged 2,036 steps to the Digi-Walker's 2,095 steps, for a difference of 2.8 percent. On a one-mile run at 5.0 miles per hour, it recorded 1,915 steps to the Digi-Walker's 1,956 steps for a difference of 2.1 percent. Generally speaking, we consider differences under 3 percent to be above average for accuracy.

When it comes to indoor distance tracking, the Charge 3 isn't quite as strong: It logged 0.78 miles on my walk and 0.94 miles on my run. It doesn't have GPS, so this isn't terribly surprising. When you run outdoors, you can connect your phone for more accurate readings.



Heart-rate monitoring is solid. In both controlled treadmill tests, the Charge 3 reported results within five beats per minute of the Polar H10 chest strap (used as a control for measuring heart rates in our testing).

Fitbit's app remains one of our favorite fitness apps, and it's better than ever thanks to its support for female health-tracking (both in-app and on-device) as well as in-depth sleep tracking. Speaking of sleep, Fitbit launched an experimental Sleep Score beta program alongside the Charge 3: Anyone with a Charge 3, Ionic, or Versa device can sign up via Fitbit Labs to receive a nightly score of their sleep quality. This feature rolls out this month, though, so we were unable to test it.

FITNESS TRACKING FOR EVERYONE

Fitbit has been getting into the smartwatch game in a major way lately with the Ionic and the Versa, both of which feature color displays, app stores, and more advanced integration with your smartphone. Along with the Apple Watch Series 4, they're great options when you're looking for lots of apps or to track phone-free runs, but they're also bulkier and more expensive and have shorter battery life than dedicated fitness trackers. There's still a place for those, and they don't get much better than the Fitbit Charge 3. Sure, it isn't perfect, but it's a comfortable wearable that tracks the stats most people want, and you don't have to charge it often. Fitbit's app is excellent, and updates to the Charge 3's screen, sensors, and build quality make this tracker an even better buy than its excellent predecessor and our Editors' Choice.

VICTORIA SONG



Anyone with a Charge 3, Ionic, or Versa device can sign up via Fitbit Labs to receive a nightly score of their sleep quality.





Apple iPhone XS Max: Best Big iPhone Yet



The iPhone XS Max is the biggest breakthrough in big iPhones since the iPhone 6 Plus. Its new design dramatically increases usable screen real estate and makes both text and images denser and sharper, making it a brilliant upgrade for people who want a large phone but don't need the Samsung Galaxy Note 9's S Pen. Although the smaller iPhone XS will split its audience with the less expensive iPhone XR and the even smaller iPhone 8, there's simply nothing like the XS Max. Its grand sweep of screen earns it our Editors' Choice.

**Apple iPhone
XS Max**

Starts at \$1,099.99



That is, if you can afford it. The XS Max is also the most expensive base model phone we've ever tested, starting at \$1,099 for 64GB. I don't like to make a big deal about upfront phone prices. Here in the US, many people pay for their phones on monthly plans with quick-upgrade deals or trade-ins, so the upfront price is often not the price you pay. Still, if there's anything that's going to stop you from buying this phone, it's the price.

Apple iPhone XS Max

PROS Huge, awesome screen. Fastest processor available. Excellent camera. Long battery life.

CONS Expensive.

IT'S THE XS, BUT MAX

Under the hood, the XS and XS Max are the same phone except for the screen and the battery. The iPhone XS Max has a 6.5-inch, 2,688-by-1,242 screen, as compared with the 5.5-inch screen in the iPhone Plus line. The Max's body is actually slightly smaller than that of the iPhone Plus, though. So although there's a big debate around the internet about whether the Max is too big, I feel like that ship sailed three years ago. Apple has had a phone this size since 2014.

Apple can fit a bigger screen into the same size phone because of two related changes: the aspect ratio and the bezels. Previous Plus-sized iPhones had 16:9 screens. The 19.5:9 screen on the XS Max is taller and thinner, enabled by removing the giant top and bottom bezels.



Increasing the relative height of the screen makes the diagonal longer at the same width. That gets you 16.08 square inches of screen, as compared with the iPhone 6/7/8 Plus's 12.93 inches. The XS Max's screen real estate is much more like the Samsung Galaxy Note 9's 16.11 square inches.

What this means for you is simple: You're able to see more of a web page, more lines of an email, and more of your game board at once compared with an iPhone Plus (or any other iPhone, for that matter). Those images and that text will be sharper and richer, too, because the XS Max vaults from 401 to 458 pixels per inch and adopts the glowy colors and deep blacks of OLED screens.

A comprehensive lab test from Dr. Ray Soneira of DisplayMate Labs shows that the iPhone XS Max has an unusually bright OLED screen with amazing color fidelity. It has higher full-screen brightness and better color accuracy than the iPhone X.

You lose your home button, though, and have to take on Face ID. Apple says the A12 processor has made Face ID much faster. In testing, I didn't have any problems with Face ID accuracy.

The camera is the same excellent dual-lens system as in the iPhone XS. See that review on PCMag.com for detailed camera analysis and sample photos.

CRANKING THAT A12

The XS Max has the same A12 processor as the XS, and it benchmark-tested pretty much the same. Both phones do terrifically on strict processor, graphics, and AI benchmarks, outpacing any other phone, whether iPhone or Android. iPhones excel especially at browser benchmark tests, because Apple's Safari is so well-optimized.

I was surprised to find that the speaker volume on the XS Max is just about the same as that of the XS (and also the Samsung Galaxy Note 9). I'd have thought that a bigger phone made for bigger speakers, but apparently not. Ditto for the Wi-Fi performance, camera performance, and call quality. Apple didn't work to make speakers or antennas bigger as it made the XS Max bigger than the XS. It looks like the company basically crammed the extra space with battery and called it a day.

On the plus side, the XS Max's battery life is very good. We recently switched from streaming video over cellular to streaming video over Wi-Fi for our battery tests, which means I can't compare the XS Max results directly with the results of last year's phones. Using our new test, I got 9 hours, 50 minutes of battery life, which is very good, although it's shorter than the 12-plus hours I got with the Samsung Galaxy Note 9.

A WIDER VIEW

The iPhone XS Max runs iOS 12, just like other recent iPhones do. The Max has one key feature that the smaller iPhone X and XS don't have, though: When you turn the phone sideways, many apps fall into a two-paneled landscape mode, almost as though the phone were an iPad.

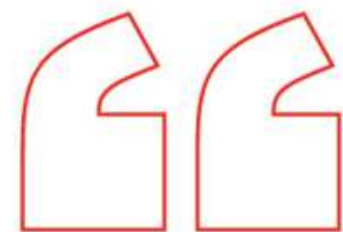
Now, this isn't true dual-window multitasking, like on iPads and recent Galaxy phones. It's just a wider view, controlled by the app. It's active in Calendar, Files, Mail, Notes, and a few other apps, and it mostly lets you see navigation and content panes together rather than just one at a time.

On a screen this big, with a processor this powerful, I think Apple should do dual-window multitasking like on the iPad. But Apple is obsessive about segmenting its product lines, and it may not want to steal the iPad's thunder.

SHOULD YOU BUY THE XS MAX?

I'm a little ambivalent about the iPhone XS. It's good, but older iPhone users will have to get used to a bigger device, and the iPhone XR costs \$250 less. If you want a big iPhone, save up and get the XS Max. You buy a big iPhone for





You buy a big iPhone for a big screen, and the XS Max gives you much more screen than previous models.



a big screen, and the XS Max gives you much more screen than previous models without adding to the size of the phone. All that screen also gives the powerful A12 processor something to do: The A12 is cranking far more pixels than previous phones were and handling them admirably.

How does it stand against other premium phablets? From a pure hardware perspective, the Galaxy Note 9 looks like a slightly better buy than the XS Max. You get an even denser screen, even better connectivity, longer battery life, and the S Pen for \$100 less.

But few people really shop between Android phones and iPhones from a pure hardware perspective. You're paying extra for iOS: the smoother performance over several years, the guaranteed software upgrades, Genius Bars, slicker third-party apps, and better attitude toward privacy and security. If that's what you're after, the gorgeous iPhone XS Max will serve you well until three years from now when you get your 5G iPhone with those Apple AR glasses.

SASCHA SEGAN



Google Pixel 3: The Best Small Android Phone



Fans of small Android phones: Google has answered your prayers with the Pixel 3. For the first time in years, you don't have to make the choice between comfort and performance. The Pixel 3 has the same top-of-line specs and features as its larger sibling, the Pixel 3 XL, including excellent camera performance and some very cool new functionality such as call screening and automated travel booking (once Google Duplex is released). If you want a pure, AI-driven Google experience in a one-handed form factor, the Pixel 3 is the phone to buy, and it's our Editors' Choice.

Google Pixel 3

\$799.99 for 64GB,
\$899.99 for 128GB



DESIGN AND FEATURES

Google is going for a modern look for the Pixel 3. The entire back is glass, but most of it has a proprietary matte finish; the top is glossy. The front is protected by Gorilla Glass 5. Color options include black, white, and a very light pink that Google calls “Not Pink.”

The bezels are slimmer than those of the Pixel 2, and the phone has an 18:9 aspect ratio, maximizing screen real estate relative to its size. That said, there’s still some notable bezel on the top and bottom to accommodate the front-firing stereo speakers.

The phone measures 5.7 by 2.7 by 0.3 inches (HWD) and weighs 5.2 ounces, making it significantly lighter than the Apple iPhone XS (5.7 by 2.8 by 0.3 inches, 6.2 ounces) and just a little shorter than the Samsung Galaxy S9 (5.8 by 2.7 by 0.3 inches, 5.8 ounces). The real selling point over its larger sibling (which is 6.2 by 3.0 by 0.3 inches, 6.5 ounces) is just how manageable it feels in your hand. I found it easy to reach across the screen and to the top to interact with notifications and other elements.

Google Pixel 3

PROS Compact. Fast performance. Beautiful OLED screen. Sharp front and rear camera with impressive low-light, zoom, and bokeh capabilities. Useful Google Assistant functionality. Highly optimized software with guaranteed updates.

CONS No headphone jack or memory card slot.

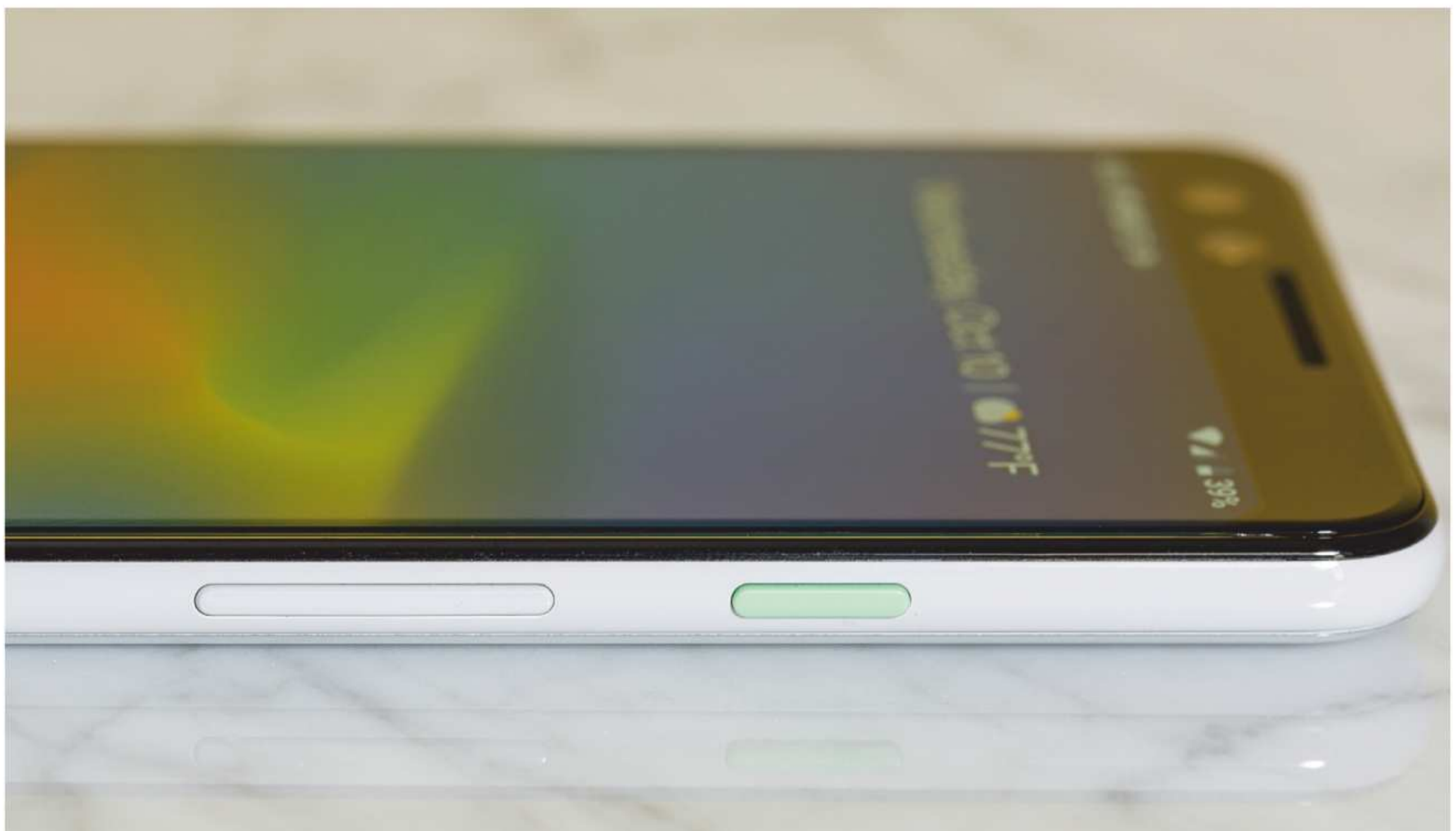


Despite being covered in glass and having a smooth coating along its aluminum sides, the Pixel 3 doesn't feel slippery thanks to its soft-touch finish. The white model we tested didn't pick up fingerprints or scratches while we used it, but you can always use a case if you're worried. Google's distinctive fabric cases (not included) are a particularly nice option.

As far as buttons and ports go, this phone offers no surprises: It has a USB-C port on the bottom for charging next to a SIM card slot but no expandable storage, which has always been the case for Google's Pixel/Nexus line. The fingerprint sensor on the back is within easy reach. And you won't find a 3.5mm headphone jack, but you do get a USB-C dongle along with a pair of wired USB-C Pixel Buds.

A somewhat stiff power button and volume rocker are located on the right side. The former is brightly colored (lime-green on the white Pixel 3), making it stand out. Double pressing it quickly launches the camera. The standard software buttons are gone, replaced with gesture navigation.

Continuous swiping up on the home screen brings up the app drawer. Swiping up once enters multitasking, and swiping to the left or right lets you scroll through apps; swiping right on the home button and quickly releasing takes you to the previous app. It takes some getting used to, but I grew to enjoy it.





The Pixel 3 has Google's Active Edge, with a squeeze sensor on the sides that quickly launches Google Assistant.



Like on the Pixel 2, the Pixel 3 has Google's Active Edge, which incorporates a squeeze sensor on the sides of the phone that quickly launches Google Assistant. It's responsive and doesn't trigger accidentally once you calibrate the squeeze sensitivity, and you'll feel satisfying haptic feedback when it activates. You can't reprogram the squeeze sensor to launch a different app, but you can squeeze to silence timers, alarms, notifications, and incoming calls.

Like other flagship phones, the Pixel 3 is waterproof with an IP68 rating; it can survive in over five feet of water for 30 minutes. It stood up to a thorough dunking and rinsing-off in our kitchen sink.

DISPLAY AND PIXEL STAND

The Pixel 3 has a 5.5-inch 2,160-by-1,080 OLED display that's free from the scourge of a notch. The resolution works out to a crisp 443 pixels per inch. Though we've been seeing higher-resolution screens lately (such as that of the 570ppi Samsung Galaxy S9), the Pixel 3 is still plenty sharp for the size. It's crisp enough to easily read text, watch videos, and play games, and you won't notice any real difference in clarity between the two devices. Note that while the screen is certified to support HDR content, it doesn't do any upscaling, as we've seen on phones including the Sony Xperia XZ3 and the midrange Nokia 7.1

Likely taking heed of complaints from last year, Google has given the Pixel 3 several screen-color modes, including the color-accurate Natural and the rich, saturated Boosted. The default mode is Adaptive, which I find offers the best of both worlds. Viewing angles are great and brightness is high enough to easily see the screen outdoors and even under direct sunlight, barring some reflectivity.



“
When you place it on a Pixel Stand, the Pixel 3 transforms into a smart display, like the Google Home Hub.
”

Like last year's Pixels, the Pixel 3 has an OLED panel that gives it dense, inky blacks and makes it handy for the always-on screen to show the time, date, and notifications without sucking up too much power. When you place the phone on a Pixel Stand (\$79, a 10W wireless charger), the Pixel 3 transforms into a smart display, like the Google Home Hub. With the installation of a separate app, it can display news headlines and calendar appointments and cycle through albums in your photo gallery. This feature becomes particularly useful when you set up morning or bedtime routines, in which Google Assistant will launch into a briefing and give you updates on traffic conditions and weather. It can also interact with the Nest Hello to show you video footage when someone rings your door.

NETWORK PERFORMANCE, CALLS, AND AUDIO

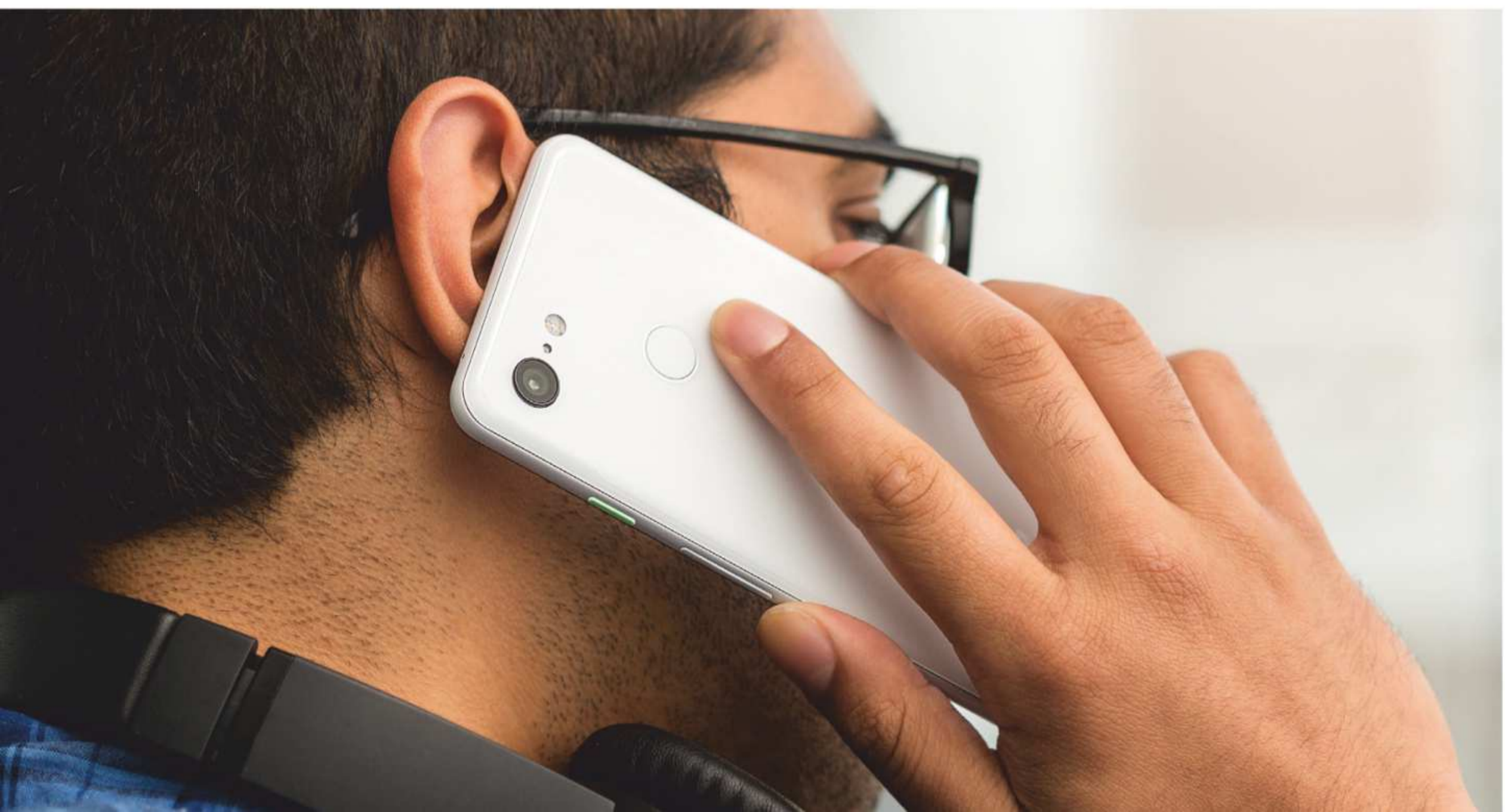
The Pixel 3 is available directly from Verizon, Project Fi, and unlocked. It supports LTE bands 1/2/3/4/5/7/8/12/13/17/18/19/20/25/26/28/29/32/66/71, so it can work on all carriers including AT&T, Sprint, T-Mobile, and Verizon. It has Cat 16 LTE and 4x4 MIMO, and it can support eSIM for certain carriers and markets.

We tested the phone on Verizon, the winner of our Fastest Mobile Networks testing this year. In midtown Manhattan, the phone delivered excellent network performance with top speeds of 51.2Mbps down and 37.6Mbps up. Other connectivity protocols include dual-band Wi-Fi, NFC for use with Google Pay, and Bluetooth 5.0 for wireless listening.

Voice calls are excellent, with clear transmissions through the earpiece and solid noise cancellation for outgoing calls. Voices came across naturally in testing, without the robotic edge we often hear when noise cancellation kicks in. The only background noise that bled through was from loud construction.

One of the most interesting new features on the Pixel 3 is call screening. When you receive calls from unknown numbers, Google gives you the option to have the call screened. On the caller's end, this results in an explanation of what's happening and a request for you to explain the purpose of your call. The receiver then gets the explanation as text. The voice transcription for this is quick and accurate. I can see this service being very useful for filtering out robocalls and spam.

Once Google Duplex is rolled out, the phone will be able to do even more in the call department. It will let Google Assistant actually make calls for you, sparing you from the tedium of tasks such as scheduling hair appointments and making dinner reservations.



The front-firing stereo speakers may not be room-filling at maximum volume, but they were more than sufficient to attract the attention of my colleagues when I blasted Iron Maiden. The Pixel 3 supports 24-bit audio with the included Pixel Buds. The Pixel Buds are comfortable to wear, come with an adjustable ear loop, and integrate with Google Assistant. I found audio quality to be robust, with a crisp and accurate range, though the LG G7 with its dedicated quad DAC still provides more customization for audiophiles.

PROCESSOR AND BATTERY

Performance is everything you'd expect from a flagship phone in late 2018. Like its larger sibling, the Pixel 3 is powered by a top-of-the-line Qualcomm Snapdragon 845 processor, with 4GB of RAM. That isn't as much as some other new phones that come with 6GB or 8GB of RAM, but it's ample for multitasking and high-end gaming.

In the PCMark Work 2.0 test, which measures general performance in a variety of tasks such as web browsing and video and photo editing, the Pixel 3 scored 9,358, higher than any other phone we've tested. The Pixel 3 also had some of the fastest response I've experienced in launching apps and scrolling web pages. Demanding games such as Asphalt 8 and PlayerUnknown's Battlegrounds were smooth as butter, with scarcely any frame drops.

Battery life is solid. The phone clocked 7 hours and 57 minutes in our test, in which we set screen brightness to maximum and stream full-screen video over Wi-Fi. That's on a par with the Pixel 3 XL (8 hours and 10 minutes), though neither can match the Galaxy Note 9, which outlasted our 12-hour battery test with juice to spare. The included 18W adapter lets you fast-charge the phone and supports USB-PD 2.0. You can use wireless fast charging with the Pixel Stand, and the phone will work with other Qi-certified wireless chargers.



The Pixel Buds are comfortable to wear, come with an adjustable ear loop, and integrate with Google Assistant.



CAMERA

Camera performance is where the Pixel 3 really stands out. It has “only” a single 12.2MP dual-pixel camera with optical image stabilization, foregoing the double or triple rear sensors we’re seeing on other leading phones. Despite this, it has one of the fastest, most responsive sensors we’ve tested, with excellent post-processing and low-light capabilities. We put it to the test in a shootout against the iPhone XS Max, the Galaxy Note 9, and the LG V40 ThinQ. While the Pixel 3 didn’t necessarily come out on top in every setting, it took the most consistently good shots, capturing the most detail in a variety of challenging scenarios.



In the above shots, the Pixel 3 focused fast and captured highly detailed images with minimal noise and blur. When it comes to photographing objects such as trees and buildings, the Pixel 3 is true to life, capturing shadows, textures, and crevices without overly smoothing them like the LG V40 does or oversaturating colors like the Note 9 does. That said, we’re really getting down to details here—all four phones are fantastic shooters.

Super Res Zoom kicks in automatically when you zoom in more than 1.2x. Essentially, it increases the resolution of an image more than what you’d typically be able to achieve without a telephoto lens but doesn’t display the graininess and artifacts you’d see using just a digital zoom. To test this, we zoomed the Pixel 3 to 2x focusing on a clock tower, which made for solid results

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When it comes to low-light shooting, the Pixel 3 again holds its own. In the dim lighting of PC Labs, the phone consistently focused with reliable clarity and minimal noise. Unlike LG's Super Bright Camera, the Pixel 3 doesn't use pixel binning to combine pixels, preserving details rather than brightening the shot as a whole. To me, it's a worthwhile trade-off, though shots on the V40 may look clearer to some.



The front set of cameras consist of a pair of 8MP standard and wide-angle sensors. The latter can snap with a wide 97-degree field of view. The sensors are sharp and accurate when it comes to color reproduction and skin tones. Most interesting, while it appears to have barrel distortion in the viewfinder, the effect is removed with post-processing, minimizing the distinctive fish-eye effect we normally see on wide-angle cameras.

Like just about every other phone on the market these days, the Pixel 3 can take bokeh shots, blurring out the background and putting a foreground object into focus. It's able to do this for both the front and back camera. With either set of sensors, the result is a crisp shot with a generally excellent application of the blur effect.

Also deserving of mention are Playmoji, Google's branded AR stickers. Not only do these appear realistic, but they also have the ability to respond to the environment. For instance, if you add Iron Man into a scene, he'll know when you're taking a selfie and will point and wave as you snap the shot. As time goes on, the Pixel 3 will use machine learning to suggest things you can add to your AR scenes.

The Pixel 3's rear camera can record 4K video at 30fps and 1080p at 60fps. In both cases, video is smooth and stable with minimal jittering or frame drops, buoyed by a mix of optical and electronic image stabilization.

SOFTWARE AND AI

The Pixel ships with Android 9.0 Pie, the very latest version of Google's mobile operating system. The phone is free from bloatware and comes with the guarantee of two years of updates at the very least. Pie brings redesigned gesture navigation, integration with the Pixel Stand, improved Google Assistant, and features such as call screening and the upcoming Google Duplex.

One feature we haven't mentioned yet is Digital Wellbeing, a new panel in the Settings menu that shows your device usage and which apps you've accessed. It gives you options to restrict your phone's hold over your life by letting you set a wind-down period before bedtime, limiting interruptions, and graying out the screen to discourage use. Over time, the Pixel 3 uses machine learning to prioritize your often-used apps over others for memory and power.

Since this is a pure Android phone, it comes loaded only with Google apps. Our 64GB model had 51.11GB available for use. That's plenty of space for apps and photos, especially since you get unlimited Google Photos cloud storage for life.

CONCLUSIONS

The Google Pixel 3 has fast performance, excellent camera capabilities, and useful AI functionality that goes beyond what we're seeing in other Android flagships. It's \$100 less than the larger Pixel 3 XL, doesn't have the distracting screen notch, and shares nearly all the same hardware and software features. It's also one of the most comfortable Android phones to hold in one hand that we've seen in some time. All of this earns the Pixel 3 our Editors' Choice as not only the best "small" Android phone you can buy but simply as one of the best Android phones.

AJAY KUMAR



HP Chromebook x2: An Elite of the Chrome OS Field



When I say “Chromebook,” do you think of a plastic clamshell that costs \$199? You couldn’t be further from the truth of today’s sophisticated Chrome OS laptops, and perhaps the one you’re furthest from is the new HP Chromebook x2. For one thing, the x2 isn’t cheap. For another, it’s aluminum rather than plastic, with the same swank faux-ceramic finish as the HP Spectre 13. And instead of a conventional clamshell, it’s a 2-in-1—the first Chromebook to be a detachable rather than a convertible, so it’s much lighter and handier in tablet mode. If you’ve been torn between a Chromebook laptop and an Android tablet, HP just solved your problem.

**HP Chromebook
x2**

\$599.99



PRICEY BUT (ARGUABLY) WORTH IT

The Chromebook x2 features a perky Intel Core m3-7Y30 processor, 4GB of RAM, 32GB of eMMC storage expandable via microSD card, front- and rear-facing cameras, and a 12.3-inch high-resolution (2,400 by 1,600) display. It's \$100 more than the Editors' Choice-winning Asus Chromebook Flip C302CA (\$449.00), which HP would contend is heavier (2.43 versus 1.62 pounds) and more unwieldy when used as a tablet, because you can't jettison its keyboard. The keyboard cover and stylus come standard with the x2, while they're options that bring the cost of Apple's 12.9-inch iPad Pro to \$1,067.

Decorated with HP and Chrome logos, the back of the display gains durability and scratch resistance from its white, ceramic-like finish. The world-facing camera offers 13-megapixel (4,096 by 3,072) resolution. Black bezels surround the glossy screen, above which sits a 5-megapixel (2,560 by 1,920) webcam for video chats. Both cameras take fair images with the featureless Chrome OS camera app, better ones when tweaked with an Android app such as Camera FV-5.

HP Chromebook x2

PROS Elegant detachable design. Spiffy screen. More lap-friendly than tablets with kickstands. Strong performance and battery life.

CONS Expensive. No backlit keyboard. Mediocre cameras.



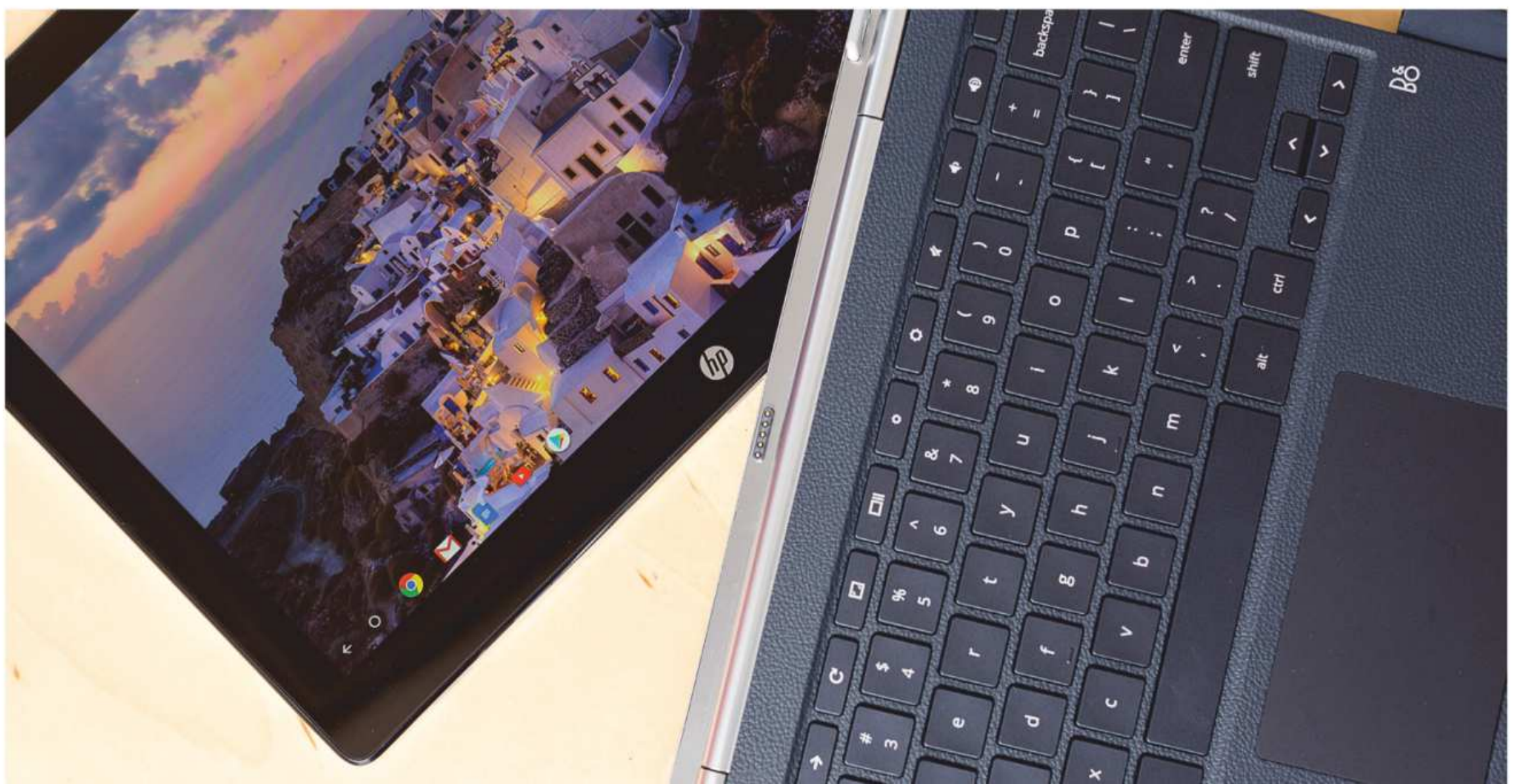
The tablet measures 0.32 by 11.5 by 8.3 inches, increasing in thickness to 0.59 inch (and in weight to 3.07 pounds) with the keyboard cover. You'll find two USB Type-C 3.0 ports, one on either side as you hold the tablet in landscape orientation, along with a microSD card slot on the left and a volume rocker on the right. The supplied AC adapter plugs into either USB Type-C port. The power button is on the top-right corner, near a headphone jack. This Chromebook features 2x2 802.11ac Wi-Fi and Bluetooth wireless. A loop on the side of the keyboard holds the stylus pen.

A firm tug separates the slate from the imitation leather-textured keyboard cover; a little wiggling and a push onto the magnetic latch reunites them. Like other detachables, the HP is a little top-heavy (and the screen doesn't tilt back very far in laptop mode), but the device is much more stable and comfortable in a lap than tablets that use a kickstand are.

SURPRISINGLY NICE TYPING

Whether the Chromebook x2 is in your lap or on your desk, you should be able to type at a reasonably quick clip thanks to the keyboard cover's pliant feel and crisp feedback. Travel is shallow, but response is snappy.

The keyboard follows the standard Chromebook layout—I was pleased to see the cursor arrows in the proper inverted-T layout rather than jammed into the single row common on HP's Windows laptops. Browser and system-control keys line the top. The keyboard is not backlit, ceding those bragging rights to the Asus C302CA. A smallish but smooth touchpad provides an alternative to the touch screen.





Whether you're tilting the slate to play Android games or enjoying Netflix, both enhanced by the front-firing speakers.



The 3:2-aspect-ratio display is beautiful, with ample brightness to show off its pristine white backgrounds and inky blacks. Colors are rich and vivid, and the 235ppi pitch makes individual pixels invisible. My only peeve is that fine details are hampered slightly by the default scaling, which makes the 2,400-by-1,600-pixel screen look like 1,200 by 800. Text and icons will probably be too tiny to read if you use the Settings app to turn scaling off, but those with sharp eyes can choose a compromise resolution such as 1,714 by 1,143 to see more spreadsheet columns on screen and so forth.

The AAAA-battery-powered buttonless pen is fine for jotting notes and casual sketches, though not as well suited for fine art as fancy styli such as the Microsoft Surface Pro's. There seemed to be a tiny bit of lag in my swoops and scribbles, but palm rejection worked well.

What's better than good is the experience of using the Chromebook x2 as a tablet. Four-fifths of a pound may not sound like a game-changer, but the lighter weight is immediately and pleurably noticeable as you hold the unit minus the keyboard, as is the feel of a smooth back instead of a keyboard beneath your fingers. Whether you're tipping and tilting the slate to play Android games or enjoying Netflix, both are enhanced by the front-firing speakers (there's not a lot of bass and the highest notes sound a little tinny, but volume and stereo separation are surprisingly robust). The x2 is the best Android tablet I've used.

PUNCHING ABOVE ITS WEIGHT

The battery-sipping Core M processors have a reputation as the 98-pound weaklings of Intel's lineup, which makes the HP's performance a pleasant surprise. A dozen browser tabs open plus Outlook and YouTube or Netflix? Bring it on.



The buttonless pen is fine for jotting notes and casual sketches, though not as well suited for fine art as fancy styli such as the Microsoft Surface Pro's. There seemed to be a tiny bit of lag in my swoops and scribbles, but palm rejection worked well.

In everyday use, the system feels lively and slick, though its 8-second boot time when switched off is unexceptional. (Chromebook users usually just close and open the lid rather than turn off their machines, anyway.)

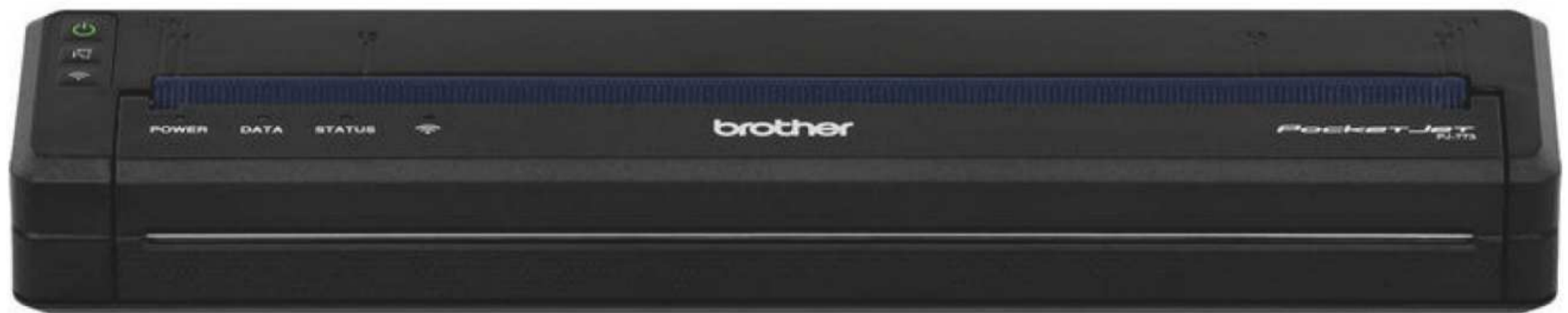
In Principled Technologies' CrXPRT and WebXPRT 2015 JavaScript benchmarks, the Chromebook x2 virtually ties the Core i5-powered Google Pixelbook (\$999). And in our battery rundown test, the HP lasted for 11 hours when playing a locally stored video file.

That falls short of the record set by the low-res Lenovo 500e Chromebook but bests numerous competitors and shows more than enough stamina for a day's work plus an evening's entertainment.

THIS LANDMARK 2-IN-1 DESERVES YOUR DOLLARS

All told, from its seamless laptop/tablet switch to its seamless access to thousands of Google Play Store apps (though I still vote for Microsoft's browser-based Office Online over Office for Android), it's hard to find much fault with the HP Chromebook x2. I think HP missed a chance for a knockout blow by pricing it above the Asus Chromebook Flip and Samsung Chromebook Pro convertibles, but if you plan on spending any amount of time in tablet mode, it's a landmark system that deserves to match the Flip's Editors' Choice.

ERIC GREVSTAD



Brother PocketJet 7 PJ763MFi-WK: Super-Portable Thermal Printer

The Brother PocketJet 7 PJ763MFi-WK portable thermal printer is an update to the PocketJet PJ673-K we reviewed back in 2013: The biggest change comes in the form of Bluetooth connectivity for Apple iOS devices (previously, it had only a Wi-Fi connection). It also comes with a lithium-ion battery for impressive life off of the cord. This device is expensive, but if you're on the go, and down-and-dirty, black-on-white documents are all you need, the PJ763MFi-WK is an excellent option. Depending on your needs, it may be the sole option; it's the only thermal printer we know of that prints pages up to legal size. If you require color prints, the Editors' Choice HP OfficeJet 200 Mobile Printer is probably more your speed.

**Brother
PocketJet 7
PJ763MFi-WK**

\$714.17



PICK A POCKETJET

Thermal printers, much like the thermal fax machines of yesteryear, require no ink, making them easy to operate and maintain; but they can print only in black. Eighteen models of the PocketJet 7 series are available, and three of those are PJ76MFi models, or “kits,” that include varying degrees of connectivity options and accessories in the box. The “MFi” in the product name indicates that these three PocketJet iterations are certified under Apple’s Made for iPhone/iPod/iPad licensing program for developers of hardware and software products that work with iOS.

PJ763MFi prices range from \$529 for the basic package containing only the printer itself with Bluetooth and USB connectivity to the more robustly outfitted PJ763MFi-WK (the “WK” stands for Workforce Kit) reviewed here. Don’t be tempted by the lower price of the stripped-down version of the PJ763MFi, though. It doesn’t include a power adapter or USB cable or the complimentary pack of thermal paper that ships with most of the other models.

Brother PocketJet 7 PJ763MFi-WK

PROS Small and light. Prints up to legal-size pages. Numerous accessories. Long-life battery. Good output quality. No ink required.

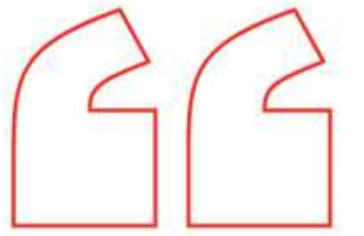
CONS Pricey. Slow. Requires additional purchase for input tray. Can’t print color.



The Workforce Kit I received, on the other hand, comes with just about every feature and accessory Brother offers for this pricey little thermal printer. The box contents and feature list include an AC power supply, a 3-foot cigarette lighter adapter, a lithium-ion battery, a 4-foot USB cable, fan-folded paper, a roll-up carrying case, access to software, special configuration (auto on, auto off, and auto radio on), and the aforementioned iOS-friendly Bluetooth.

The PJ763MFi-WK measures 1.2 by 10 by 2.2 inches (HWD), and with the included 7.7-ounce battery installed, it weighs just a hair less than 2 pounds. That's downright dainty compared with its portable inkjet competition, such as the HP OfficeJet 200 Mobile Printer, which measures 2.7 by 14.3 by 7 inches and weighs almost 5 pounds with its battery installed.

Brother says that it sells most of its PocketJet line of printers to enterprises requiring in-vehicle printing—think, for example, ambulances, delivery trucks, and police cars. They're also practical for office-centric business travelers as long as top-notch inkjet-quality prints are not the expectation. Along with their size and portability, the big benefit of thermal printers is that you'll never run out of ink.



Along with their size and portability, the big benefit of thermal printers is that you'll never run out of ink.



As for paper handling, the PJ763MFi-WK (and its siblings) support three types of thermal media: cut sheets, fanfold, and perforated rolls, available in letter (8.5 by 11 inches), legal (8.5 by 14 inches), A4 (8.3 by 11.7 inches), continuous, and custom sizes directly from Brother. It has no input tray, so cut sheets must be loaded manually, a page at a time. Fanfold paper consists of several perforated sheets stacked so that they easily fan off the stack as they are pulled into the printer.

Paper rolls require one of a few available adapters, or roll holders, that attach behind the printer and dispense paper much like a wall-mounted paper-towel dispenser does. Depending on what you buy and where, one should run you from about \$20 to \$100. Brother sent me its fanfold paper, which also has its own optional holder (\$75). That accessory isn't required to use the fanfold paper, though; I simply set the stack behind the PJ763MFi-WK and inserted the first sheet into the input slot. It loaded into the printer easily and fed, page-by-page, consistently.

The printer is operated using three buttons—Power, Advance Feed, and Bluetooth (which toggles the Bluetooth radio on and off), which are found along the left side. It has four status LEDs running along the bottom-left corner on the face of the printer: Power, Data, Status (which has a few different states itself, depending on what the printer is doing), and Bluetooth. Otherwise, the PocketJet is a fairly simple device. It doesn't even have adjustable paper guides for mounting different sizes of media.

SETUP AND ACCESSORIES

The PJ763MFi-WK comes ready to connect to most PCs and mobile devices via either Bluetooth or USB. It can't, however, connect to Apple AirPrint, Google Cloud Print, Mopria, or any other protocol or service that requires Wi-Fi. Access to those services requires a switch to the PocketJet PJ773 line, which costs the same but swaps Bluetooth for Wi-Fi connectivity.

The printer's lithium-ion battery, according to Brother, is good for 600 pages per charge. Buying it separately or getting a backup will run you the list price of \$125. When purchased with the PJ763MFi-WK, the battery comes wrapped separately, and you must remove a plastic placeholder from the printer to install it. Once you've unwrapped it, you plug the battery into an AC power source and let it charge.



Brother offers a dozen or so optional mounting kits, ranging from the simple (about \$40) to elaborate telescoping models (about \$100) to headrest (\$160) and armrest (upwards of \$300) units. As mentioned, much of this equipment is designed for mounting the PJ763MFi-WK in vehicles.

There are no drivers or other software in the box, but installing them isn't difficult. Simply search for them on Brother's support site, then download and install. You can pair the PJ763MFi-WK with your mobile device using Bluetooth; you'll just need to install the Brother iPrint&Scan app on your phone or tablet to print.

FAST ENOUGH, AND RESPECTABLE PRINT QUALITY

All four major inkjet printer manufacturers—Brother, Canon, Epson, and HP—make at least one mobile printer for road warriors, but PocketJet printers aren't exactly in head-to-head competition with the others, which are mostly color inkjet models. How fast it prints compared with the competition, then, is probably only mildly or anecdotally relevant, but here goes.

Brother rates the PJ763MFi-WK at eight pages per minute (ppm), but, when printing my standard test documents, I couldn't get it to go faster than 4.4ppm. I tested it over USB 2.0 from our standard Intel Core i5 testbed PC running Windows 10 Professional, and the initial test document was a lightly formatted 12-page Microsoft Word doc. That 4.4ppm is about half as fast as HP's OfficeJet 200 Mobile Printer. The two contenders from Epson and Canon, the WorkForce WF-100 and the Pixma iP110 Wireless Mobile, respectively, were tested under a different set of protocols, making it impossible to do head-to-head comparisons.

I then tested the printer's graphics prowess using PCMag's standard PDF, Excel, and PowerPoint test documents, combining the results from these tests with those from the previous 12-page Word document test. The PJ763MFi-WK managed 3.3ppm, which isn't the slowest in our database, but it's close. This printer was designed to print only one- or two-page documents, though, which it's plenty fast enough for.

As for print quality, the PJ763MFi-WK prints quite well for a thermal model. Text is well-shaped and highly legible, even for smaller fonts down around 9 and 10 points. Monochrome and solid-fill graphics look good, too, though when you start throwing gradients and grayscale content at it, the PJ763MFi-WK is clearly out of its league. In fact, if you need to print complex graphics and photos on the road, you'll want to go with one of its inkjet competitors.

WIDE-RANGING RUNNING COSTS

There are a lot of variables in determining the cost per page (CPP), including paper type (cut, fanfold, or roll), quality, and archivability (how long it lasts). For example, you can buy a six-pack of perforated 100-sheet rolls with seven-year archivability at Brother Mall for \$58 or a six-pack of 100-page waterproof rolls rated to last 20 years for \$155.93. (Third-party paper brands are available, but for my testing, I used PocketJet thermal paper prices and page yields from Brother Mall.) The running costs, then, for these two grades of thermal paper rolls are just less than 10 cents per page for the seven-year archivability product, and the 20-year viability paper runs about 26 cents per page.



Rather than going through all the options at Brother Mall (not to mention several other sites and paper brands), here are a few other common examples: 100-sheet packs of premium (20 years) cut paper runs about 14.5 cents per page, and a 1,000-sheet pack of premium (20 years) fanfold paper will run you about 9.5 cents per page.

Again, you can beat these running costs by buying Brother's paper at another outlet, going with a different brand, or using an inkjet mobile printer. When you use HP's highest-yield ink cartridges with the OfficeJet 200, for example, monochrome pages will cost you about 6 cents each. The Epson WF-100 mobile printer's monochrome pages run about 8.8 cents each, and the Canon Pixma iP110 prints black pages at about 6.3 cents each. It's important to note, though, that none of these printers are designed to churn out hundreds of pages each month, and the fewer pages you print, the less important running costs become.

THE CHOICE IS BLACK AND WHITE

While there may be hundreds of portable thermal printers in the world, most are barcode and label printers. We couldn't find any others specifically designed to print legal-size documents, which would, at least to some extent, make them competitors to inkjet mobile printers. The PJ763MFi-WK's inkjet counterparts mentioned above, however, cost hundreds of dollars less, print color, are faster, and can handle two-sided documents. On the other hand, the PJ763MFi-WK is smaller, and its thermal technology means you never have to worry about running out of ink. As long as you have paper, it will print, and it's not susceptible to ink nozzle clogging after periods of dormancy.

Without question, whether the PocketJet PJ763MFi-WK or a mobile inkjet is right for you depends on your application. If you plan to mount the device in a vehicle (think ambulance, delivery truck, or police car) or simply need quality monochrome prints—especially letter or legal size—on the go, the PJ763MFi-WK is an excellent choice. If you need color prints or are willing to tote around a larger and heavier printer to save a good deal of cash, you'll want to go with one of the inkjet competitors.

WILLIAM HARREL



Plex: A Powerful Personal Media Server

Although video streaming services are great for consuming huge amounts of content, you never own any of it, regardless of how long you subscribe. Plex offers an alternative for those who like to maintain collections of music, photos, and videos detached from any provider—it helps you construct an always-accessible media server, no matter which platform you use. Plex earns a top rating for its easy setup, highly reliable performance, and excellent organizational tools, but its data-collection policies should give you some pause.

Plex

Free



WHAT IS PLEX?

At its core, Plex is a media-streaming-server application. There are two main parts to it: the media server itself and the playback application. Users set up a server, add media libraries, and then consume and share that content on other devices and with other people. To clarify, the Plex Media Server provides access to your libraries, although the files live locally on your server device.

Plex is best for users with large repositories of local media files but not necessarily a lot of space on the devices to which they'll be streaming the content. It's also for people who oppose popular video- and music-streaming services. For example, you might hate the fact that despite paying a monthly fee, you'll never own the content you stream, as mentioned above. Or maybe you prefer to support rising creative types by purchasing content outright instead of indirectly paying paltry commission rates via Spotify or Slacker. And although we don't condone the practice, content pirates may be drawn to Plex as well.

Plex

PROS Capable free version and reasonable pricing. Intuitive apps on a wide range of platforms. Easy setup. Dedicated podcasts and news section.

CONS Aggressive data collection. Plex Cloud is dead. No official interface themes. Plexamp is desktop only.

How Plex Works

Plex Media Server runs on the computer where you keep your media



Plex scans your media, automatically organizes it, and makes it beautiful



Play your media on any screen with your favorite Plex app



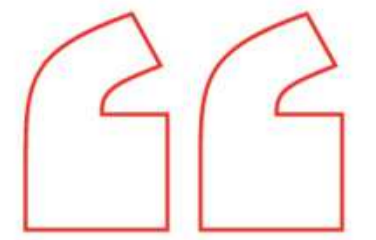
Another benefit of Plex is that it makes synchronizing media libraries across devices more convenient. Instead of trying to keep track of which local files you have stored on each of the devices you own, Plex requires you to worry only about maintaining the collection on your server.

In a recent forum post, Plex announced that it would shut down the Plex Cloud service, effective November 30, 2018. This service was a premium feature that allowed users to host media in the cloud independently of local storage. It was useful for people who didn't want to keep a local server device powered on indefinitely. The service supported Dropbox, Google Drive, and personal OneDrive accounts, but it often suffered from technical difficulties.

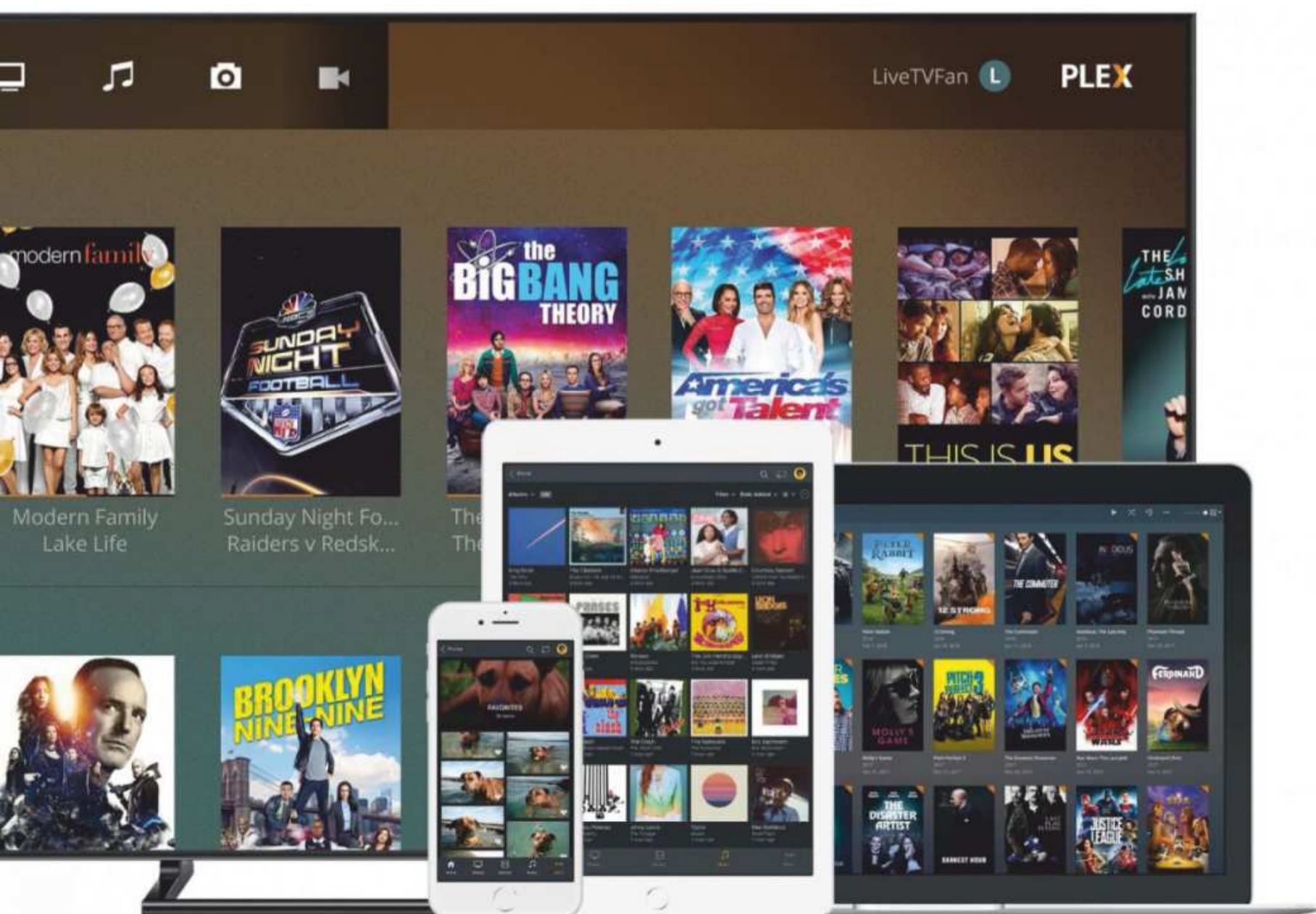
Officially, Plex states that it hasn't "found a solution capable of delivering a truly first class Plex experience to Plex Cloud users at a reasonable cost."

PLATFORMS AND FILE SUPPORT

Plex supports a wide variety of devices on both the server and streaming sides of the equation.



Another benefit of Plex is that it makes synchronizing media libraries across devices more convenient.



To start, you have the option of running your media server on a macOS, Windows, or Linux computer. Alternatively, you can use the Nvidia Shield as the backbone of the service. Network-attached storage (NAS) drives are yet another option, with support for models from popular manufacturers such as QNAP, Seagate, Synology, and Western Digital. Make sure to check CPU requirements for desktop devices and NAS drive compatibility up front.

On the playback side, Plex users have an even greater range of options. Supported streaming-media devices include the Amazon Fire TV, Android TV, Apple TV, Chromecast, PlayStation 3 and 4, Roku, TiVo, and Xbox One. Plex also works on devices with at least Android 5.0, Android Auto 6.6, and iOS 9.3. On the desktop, Plex offers a web app, the Plex Media Player Application, as well as a Kodi extension. You can even access your Plex server from VR platforms if you have a Google Daydream-compatible phone and accompanying headset (the Daydream View, Samsung Gear VR, or Oculus Go).

I tested Plex on multiple devices, including several Windows 10 machines, a Fire TV Stick, and a Google Pixel running Android 9 Pie. For reference, I set up both servers on Windows 10 PCs, each connected to the internet over an Ethernet connection.

Plex can play nearly any media file you throw at it. In terms of audio, Plex supports MP3, M4A, FLAC, and WMA files. For videos, the list includes MP4, MKV, HEVC, AVI, MOV, and DIVX. Plex can also display JPG, PNG, RAW, and TBN image files. Plex includes built-in tools that convert non-natively supported files, such as DTS, to a usable format. You can also stream 4K content. Plex's wide range of file support is similar to that of VLC Player.



HOW MUCH DOES PLEX COST?

For users who want to try hosting files or who don't need high-level features, Plex offers a free account. With this tier, you get all the basic media organization and streaming capabilities, the ability to cast to other devices, and support for tons of media formats, including 4K. This account level also lets you share your server with others, use Plex's VR app, and control playback with voice controls on supported hardware.

Advanced users should consider a premium Plex Pass account, which costs \$4.99 per month, \$39.99 per year, or \$119.99 for a lifetime subscription. A Plex Pass includes everything in the free account plus a host of other usability features. For example, Plex Pass subscribers get Premium Photos and Music options, including auto-tagging and automatic lyrics, support for live TV via an antenna and tuner, and offline mobile syncing. Plex Pass also features multi-user support, a Timeline organizational view, and early access to new Plex features. I used a Plex Pass account to test the service.

For comparison, Kodi is completely free and includes most of the same features. Emby, another media server option, offers both a free and premium tier. Roughly in line with Plex, Emby Premiere costs \$4.99 per month, \$54 per year, or \$119 for a permanent license.

WHAT'S THE DIFFERENCE BETWEEN PLEX AND KODI?

Plex and Kodi are very similar, and you shouldn't beat yourself up for not understanding the difference immediately. In fact, at one point, Plex existed as a development fork of Kodi. Now the two are separate, and there are some notable differences. To begin with, Plex is not fully open-source. Developers can contribute or review much of Plex's code, but some parts are not publicly available. That's probably fine if you don't plan to dive into customizations at the code level. Still, some users may prefer the truly open-source Kodi.

Plex is easier to install on more platforms than Kodi, with dedicated apps for iOS and Amazon Fire TV devices, for example. Also, Plex seems to escape the wide-ranging condemnation of Kodi, despite the fact that using the latter as intended is completely legal. On the other hand, Kodi doesn't require the same server setup step as Plex does.

Plex and Kodi are still very similar, though, as both aim to provide robust and customizable media-streaming solutions. For example, users add local or networked media libraries to each program. Both Plex and Kodi organize content by type. Further, some of the functionality can be expanded with the use of official plug-ins or add-ons, though Plex likely has the edge in terms of first-party support. Both support live TV and DVR options, assuming that you own or purchase the necessary antenna and receiver hardware. We'd suggest you give both Plex and Kodi a try with a few media files before uploading your entire collection, to see which one you prefer.



As mentioned, Plex and Kodi are not the only services competing in this space. Emby is likely the most comparable. You can download a dedicated Emby app on the majority of devices that Plex supports. Depending on the platform you intend to stream content on, OSMC and Open Media Server are options as well, especially for DIY platforms such as the Raspberry Pi (RPI). Most of these alternatives are not as popular or established as Plex or Kodi.

HOW TO SET UP AND USE A PLEX SERVER

To get started with Plex, the first step is to download the server application onto the device where you store your media libraries. Plex Pass subscribers can set up and maintain multiple servers under the same account. Whatever device you install the server software on needs to remain powered up for you to access the media. If you're worried about electricity costs (monetary or environmental), consider using a NAS device as your server instead of a full-blown desktop, which requires more power.

Plex's installation process is pretty straightforward. Just follow all the prompts, and at the end, the application will launch a browser window with a prompt to connect to your web login. The next step is to name your server and add your media folders. You have the option to either use preselected folders or create your own.

To add a folder, hit the Add Library button, select a content type (Movies, TV Shows, Music, Photos, or Other Videos), and browse for media files on your local hard drive. Depending on the media type, Plex gives you extra contextual organizational options. For example, with my test Photos library, Plex offered to automatically identify objects and tag them accordingly.

After you add all the media libraries and complete the setup, Plex takes you to the web application from which you can access and edit the contents of your server. If you intend to open access to your server from points outside your network, you need to enable Remote Management in the Settings > Server > Remote Access section.

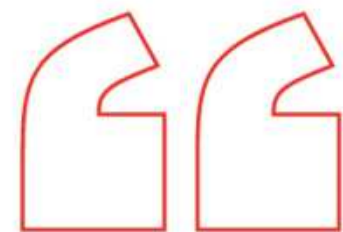


PLEX ON THE WEB

Plex's web application is sleek and modern, with tons of options. I particularly appreciate the dark default theme. Speaking of themes and customization, though, Kodi has the upper hand: You can't change Plex's theme as of the time of this review, but this feature is baked right into Kodi.

Starting at the top, you get a search bar and navigation tools on the left. Account settings and interface preferences live on the right. Along the left sidebar, Plex organizes media library categories and other content sections, such as podcasts, news videos, and plug-ins. The center of the console is where you can browse the latest files on your server and play them directly. You can also filter by content type and make changes to individual file details.

Power users will appreciate the depth of options in the settings panel, which is broken down into four subcategories: Web, Server, Users, and Devices. In the Web and Server sections, enable the advanced options. The Web section allows you to adjust streaming quality and player settings to fit your preferences. The Server section goes much more in depth, since the server is the main component of any Plex setup. At the top level, you can check for updates to the server software, enable remote access, and set up network encryption. Plex also provides a host of media-related options for your library as well as the option to set up Plex's DVR functionality.



The Web section allows you to adjust streaming quality and player settings to fit your preferences.



The next tab over, Users, lets you give other people access to your Plex server. Under the My Home tab, Plex lets you add two types of accounts: existing Plex users and managed users. If you add someone with an existing Plex account, both accounts will have equal access to your server. Managed users are a subset of regular Plex accounts; this setting is useful for managing restrictions to content access. Plex also allows you to invite friends to your Plex Server; you control which libraries are accessible.

The last section, Devices, gives you information on when and how users accessed your Plex server. In testing, this console successfully noted the time of each access, the software portal used, and whether the attempt accessed Plex or Plex Amp.

PODCASTS, NEWS, AND WEB SHOWS

One of Plex's latest and best features is the introduction of podcasts to the platform. To get started, click on the Podcasts menu item on the left-hand menu. In the center console, you can browse through recommended or featured categories of podcasts such as Popular, News & Politics, and Society & Culture, or click the Categories button to see the whole list. Of course, if you already know what podcast you want to listen to, just search for it in the top bar or, in the case that it's not there, add it directly via its URL. Plex lets you organize your favorites into a collection called My Podcasts for easy access.

All the controls you expect are present in Plex when it comes to podcast playback. Hovering over a podcast's cover art and clicking the expand icon brings up Queue and Mark Played options directly. For individual podcasts, you can adjust playback speed, skip or rewind, and manage the current playlist.



The last section, Devices, gives you information on when and how users accessed your Plex server.



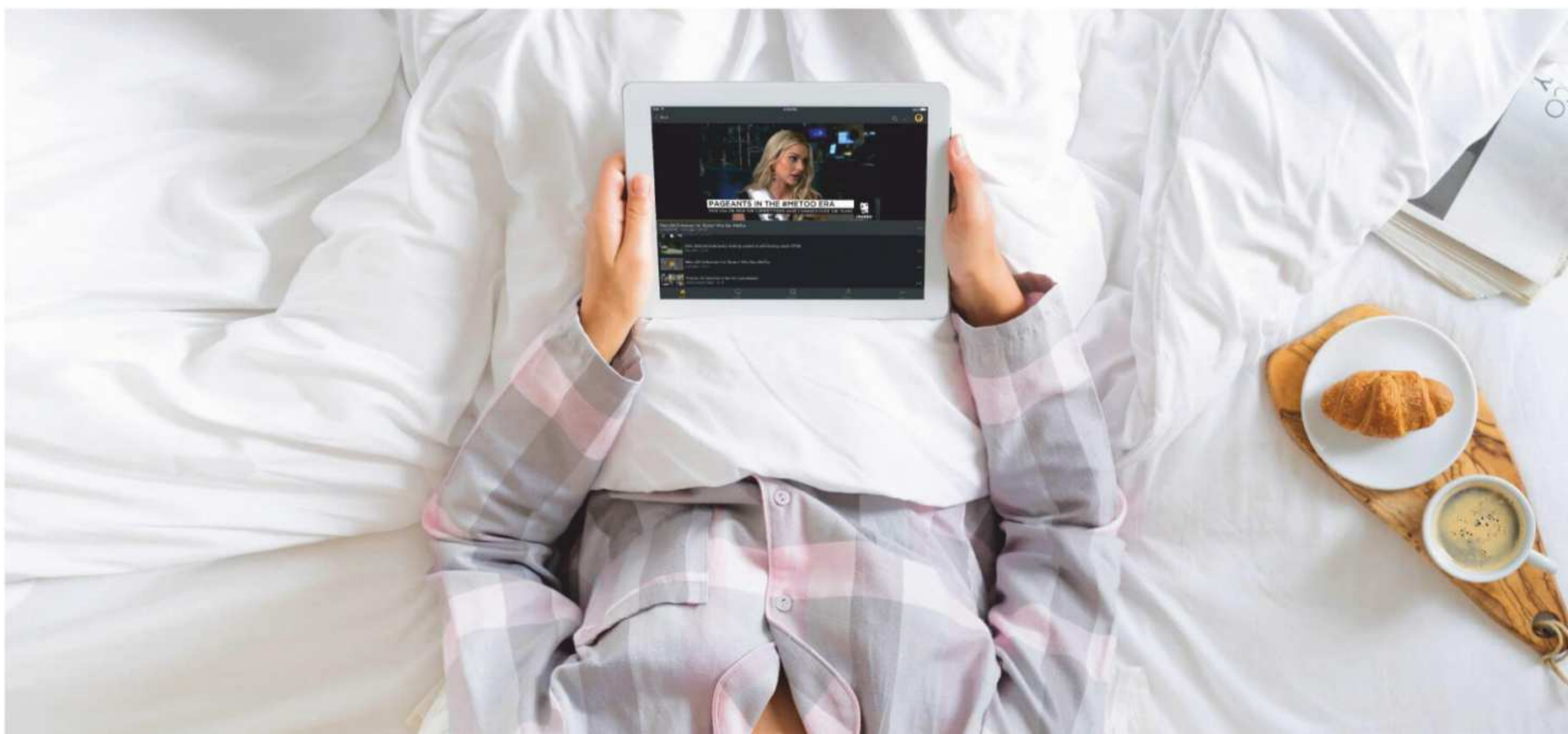
Another recent feature, News, is a collection of recent and newsworthy video content. On the main screen, Plex organizes content in a series of featured categories, but you can view all categories at once via the left-hand menu such as Business, Lifestyle, Politics & Government, Science & Technology, Sports, and World News. You can also browse by specific channels for the Associated Press, *The Guardian*, and Reuters. In the Personalize section, you can set your location and specify the categories that most interest you.

Plex also recently debuted Web Shows, a feature currently in beta. The Web Shows section highlights episodic series of videos across a range of categories, such as Arts & Entertainment, Autos & Vehicles, Computers & Electronics, Health, Science, Sports, and Travel. If you find a show you like, you can add it to the My Shows list.

I appreciate Plex's focus on supplementing users' existing media libraries and hope that the News and Web Show sections attract more and higher-quality content over time.

PLUG-INS AND WEBHOOKS

One way to extend the functionality of Plex is by installing plug-ins. Plug-ins are similar to Kodi's add-ons, but Plex's extensions are primarily content channels. Some of Kodi's add-ons are specifically for adding extra utilities or functions to the software. Plex includes a decent selection of fully supported plug-ins, including BBC iPlayer, Twitch, and Vimeo. In terms of selection, Plex may support a few more first-party developer apps than Kodi, but you likely can get the same content, in one way or another.



Both Plex and Kodi also work with tons of other unofficial plug-ins. Officially, Plex states plug-ins listed on the Unsupported Appstore (UAS) “either haven’t been reviewed for inclusion in the Plex Channel Directory, are considered less stable and harder to maintain, or contain content that may be considered offensive or questionable.” Most of these plug-ins are hosted on GitHub and require a manual installation, so unless you’re prepared to deal with this inconvenience, you’re better off sticking with the official repository.

Another way to extend Plex’s functionality is via Webhooks. In short, Webhooks are used to relay user actions in Plex to external applications and services. For instance, Plex gives the home-automation example of dimming smart light bulbs when commencing file playback. Note that building a Webhook from scratch requires coding, so be sure to check out Plex’s full explanation and samples. Thankfully, Webhooks integrate with Zapier, so people who don’t want to mess with a compiler have an alternative.

PLEXAMP AND COMMUNITY SOFTWARE

Recently, Plex launched an application specifically for music playback called Plexamp. This software is available on Windows, macOS, and Linux platforms, but that’s it. Don’t expect a full replacement for iTunes or Groove Music, either. Plexamp is more similar to foobar2000 or Winamp than anything else, given its style and playback-focused design. Despite its small and non-resizable windows, Plexamp includes a good set of features, such as gapless playback, visualizations, and lyrics. Check out Plex’s Plexamp FAQs if you run into any issues or interface questions.

Tautulli, SyncLounge, and Sub-Zero (For Plex) are other community add-ons that extend functionality. Tautulli, for example, gives you powerful analytics and monitoring tools. You can even dive into the details of who watched what on what platform and send out newsletters about new media uploads. SyncLounge lets you watch content in sync with other users. If you wanted to watch a movie with a friend across the country, for example, this is likely the best way to do so. Sub-Zero (For Plex) can help you get the best subtitles for your content.



PLEX ON ANDROID

For testing, I installed Plex on my Google Pixel running Android 9.0. I had no trouble signing into my account, and all my media showed up without too much of a delay. From the left-hand menu, you can access most of the same settings as you can on the web application. On the bottom, bar, you can switch between media types, including Podcasts, News, Photos, and Music. As with most modern streaming apps, a Chromecast icon sits in the upper-right corner of the interface.

I also installed the Plex app on an Amazon Fire TV device. Unlike Kodi, Plex is available as an official download from the Apps section. Emby also offers an app on the store. Signing in is simple: Download the app, and select the sign-in button on the bottom to access your account. After you enter the generated code to link your device, Plex takes you to your collection of media libraries.

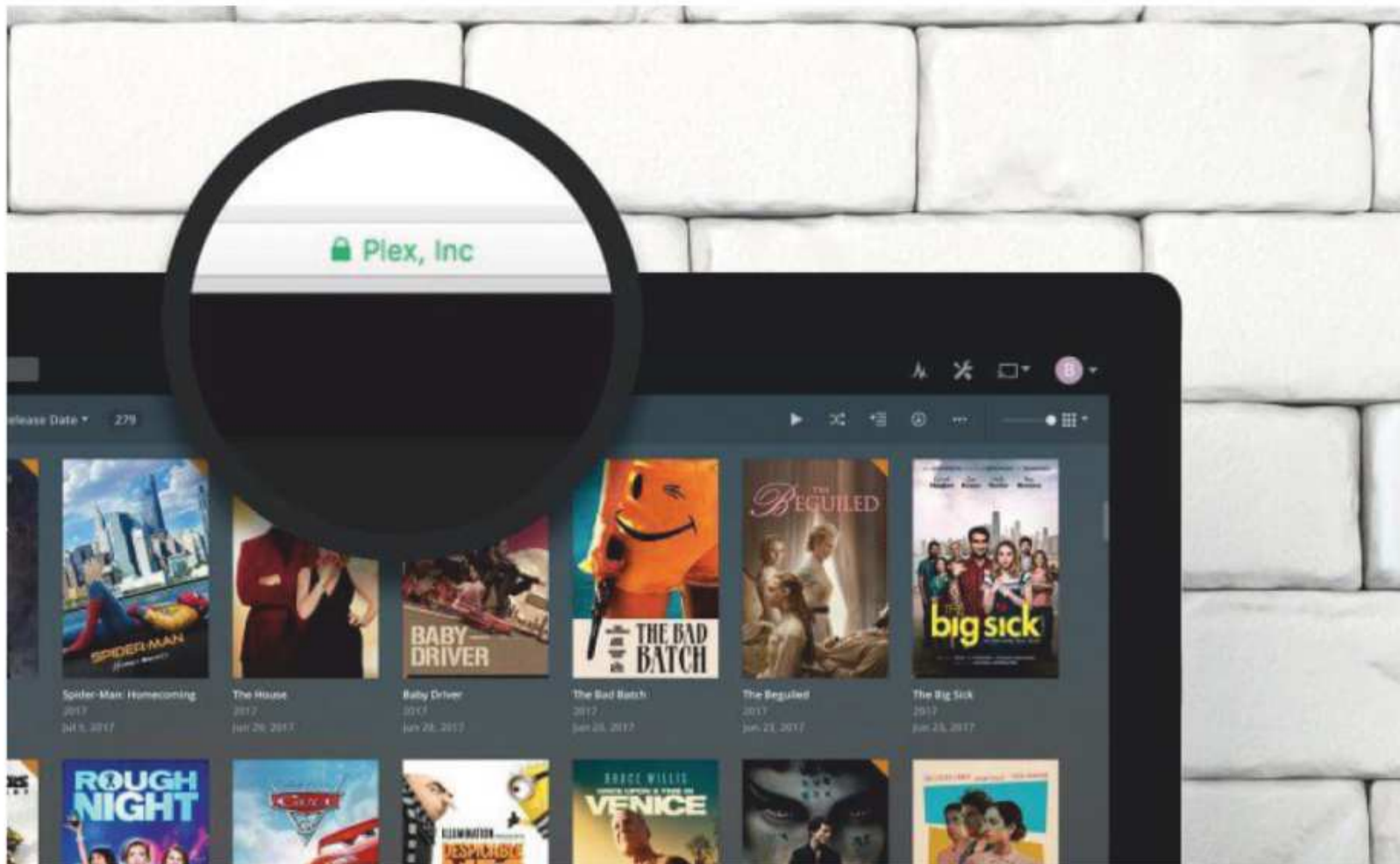
SECURITY AND PRIVACY

Plex suffered a data breach in 2016 that exposed user data from the forums and has rightfully faced backlash in the past for its data-collection policies. You should read Plex's current privacy policy for yourself to find out what information the service collects.

Unfortunately, disabling personal-data collection isn't straightforward, nor does it seem possible to completely opt out. From your main account page, you can scroll down to the Privacy > Privacy Preferences page, but this gives you only the option to disable playback data collection. Plex needs to do a much better job at giving users, especially Plex Pass subscribers, options to easily disable data collection.

In terms of security, Plex says it “partner[s] with DigiCert to provide publicly trusted TLS certificates for end-to-end encrypted connections among all of our servers” and uses “hashing and encryption technologies” to store and protect passwords. Payment information is stored off-site and managed by Braintree, a service of PayPal.

If you install Plex on a system with a VPN, you may have connection issues. Plex recommends you disable your VPN during the connection phase and then enable it again directly afterward.



“Disabling personal-data collection isn’t straightforward, nor does it seem possible to completely opt out.”

Common sense goes a long way toward protecting your media server. For example, if you intend to share your Plex server with another user, you should verify that you have the correct account information before sending out the invite. Otherwise, someone with sufficient privileges could remove content from your server without your approval.

PLEX IS A MEDIA POWERHOUSE

As a way to access your local content on a wide range of platforms, Plex is likely the slickest solution. With great interfaces across devices and an intuitive setup, you won’t feel overwhelmed by the prospect of hosting your own media server. To top it all off, Plex’s free version covers much of the functionality that most users need. But privacy-conscious users may not be comfortable with Plex’s data-collection policies, and some may prefer the completely open-source Kodi instead.

BEN MOORE

**Apple macOS
Mojave**

Free



Apple macOS Mojave: A Spectacular-Looking and Security-Conscious Update



Mojave is an excellent macOS upgrade, with dozens of new conveniences for managing documents and media files, iOS-style apps for Stocks, News, and Voice Memos, and significant new security and privacy protection. Like every recent macOS update, Mojave deepens integration with mobile devices, so you can now paste a picture to a document on your Mac simply by taking a photo on a phone running iOS 12. Unlike any previous upgrade, Mojave gives you an option to change the whole look of macOS by switching on a new Dark Mode. This new mode displays white text on a dark background in the Finder and apps, and lets you work on your document without bright-colored distractions from the app and the operating system that you're working in. Dark Mode is one of many enhancements in Mojave that help you pay more attention to your work—or play—and less attention to your computer.

The QuickLook previewer—the preview image that pops up when you select a file and press the spacebar—also adds features that let you focus more on documents and images and less on apps. QuickLook now displays larger images than before, and it displays one or more icons that launch a new feature called Quick Actions. Quick Actions can create or combine PDFs from images, or trim audio and video files, without opening the file in a separate application. I hoped that QuickLook might also let me select text from a document and copy it to the clipboard, but Apple still hasn't added that feature. The Finder gets a new Stacks feature that cleans up your desktop by combining icons into stacks of images, screenshots, documents, PDFs, Zip archives, and so on. You can scroll through a stack by swiping with the trackpad or mouse.

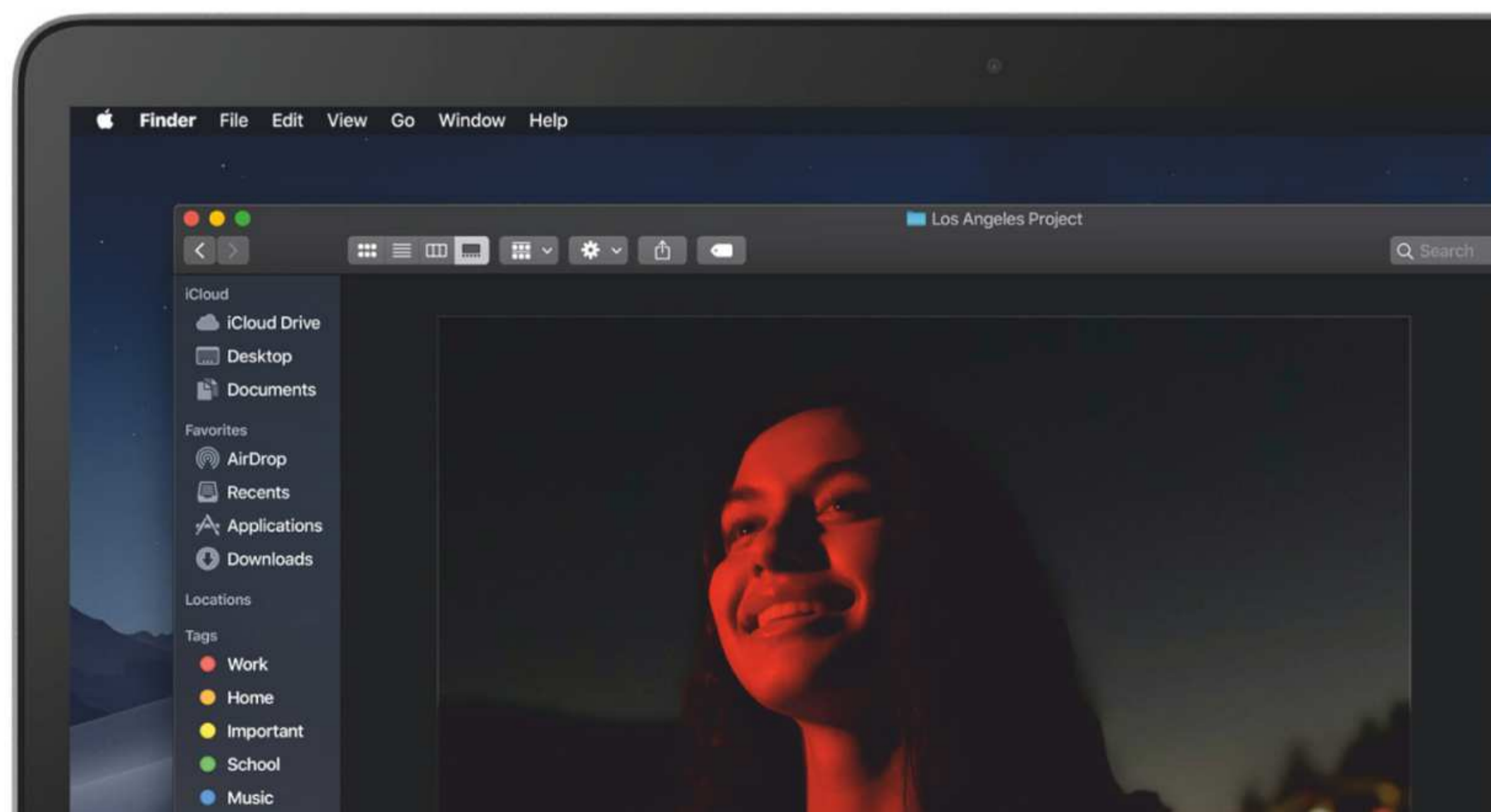
MACOS VS. IOS

Apple is standing fast on its policy of keeping macOS separate from iOS. Microsoft, in contrast, uses the same version of Windows 10 for both desktops and tablets, and Google's Chrome OS lets users run Android apps on the desktop, though the implementation isn't perfect. Despite its strict policy, though, Apple keeps adding iOS apps and features to macOS and vice versa. For example, Mojave brings four iOS apps—Stocks, News, Home, and Voice Memos—to the Mac.

Apple macOS Mojave

PROS Beautiful Dark Mode. New Finder conveniences. Image-management features built into QuickLook. Stacks help organize cluttered desktops. New Mac apps based on iOS counterparts. More informative App Store. Tightened privacy and security. Easier screenshots.

CONS Stacks feature could use more customization options. Increased security means you have to give apps permission to do things they've been doing all along.



Mojave is the first stage in Apple's plan to let third-party developers port their iOS apps to the Mac; this feature will likely arrive in 2019. Meanwhile, some long-term macOS developers will have to scramble to update their old 32-bit apps before that 2019 version arrives, since Mojave is the last macOS version that will run 32-bit apps at all. Until that 2019 deadline, when you launch a 32-bit app for the first time under Mojave, you'll get a warning message (like the ones that began popping up when running a 32-bit app in High Sierra), but the app will then run normally.

WILL MY MAC RUN MOJAVE?

Mojave runs on any Mac that supports Apple's Metal graphics-acceleration framework, which means, in effect, any Mac desktop or laptop from mid-2012 or later. The only exception is the Mac Pro line: all models from late 2013 are supported, but 2010 and 2012 models require Metal-capable graphics cards. Like its predecessor, High Sierra, Mojave uses the new, efficient Apple File System (APFS) by default, and finally makes APFS compatible with the Fusion Drives in some desktop Macs—hard drives that use flash storage for a small part of the drive and spinning platters for the rest. (APFS has always been compatible with flash-only and platter-only drives.)

APFS adds reliability and speed, and you'll be especially grateful for it when you make a copy of a large file, an operation that seems to take forever in older file systems, including Windows' NTFS, but takes just a few seconds with APFS.

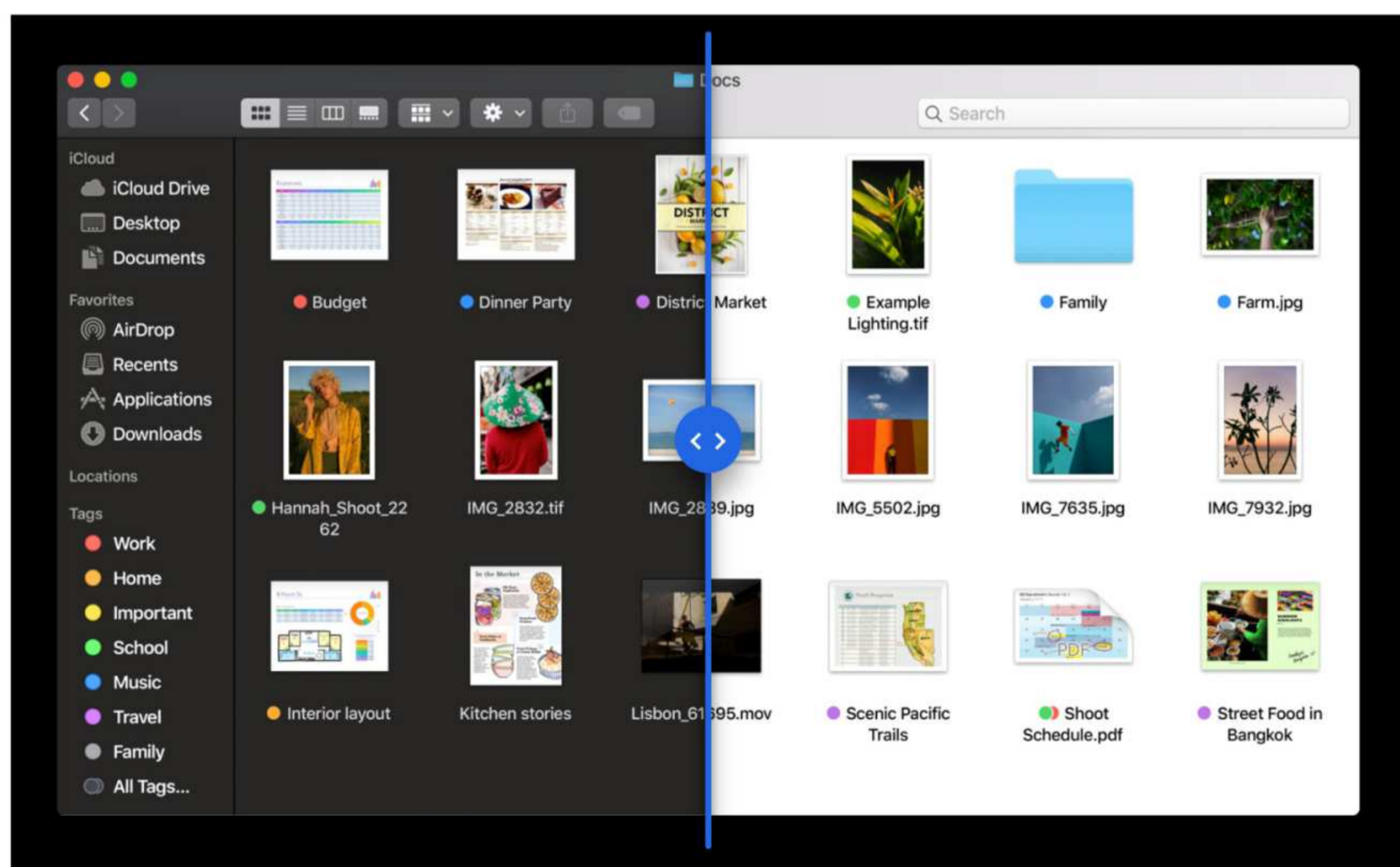


If you want to try out Mojave before upgrading an existing High Sierra system, and you're using an APFS-formatted solid-state drive with at least 20GB of free space, you can use macOS' Disk Utility to create a separate, automatically resizable APFS "volume" on your existing disk and install Mojave on it without interfering with your High Sierra system. Forget everything you might remember about the inconvenience of partitioning and resizing hard disks in the pre-APFS era, because APFS does the job automatically and invisibly.

GETTING STARTED WITH MOJAVE

Mojave's initial installation is identical to previous versions until you reach the new menu, on which you choose between the familiar light display mode and the new Dark Mode, with thumbnail images of each. If you don't choose Dark Mode here, you can always switch to it later from the General pane in System Preferences. That said, you may never feel inclined to switch back after choosing the Dark Mode, since it's more restful to the eyes, makes text easier to read, and generally looks a lot cooler.

If you've edited photos in Apple's Photos app, you've had an advance taste of Dark Mode, because the edit mode in Photos uses a black background with white lettering, making it easier to see your image in its true colors. Mojave's Dark Mode uses the same effect in all apps supplied by Apple, including the ones built into macOS and separately downloaded ones. Dark Mode also works with any other app that uses Apple's standard color schemes.





**In Light Mode,
the default
image of the
Mojave Desert
in the desktop
background
changes over
the course of
the day.**



Every new macOS release strives to be more visually dazzling than the last. With Mojave, Apple came up with an especially splendid visual effect for the desktop. In Light Mode, the default image of the Mojave Desert in the desktop background changes over the course of the day, with different images for dawn, midday, sunset, and night. It looks cool, but some may find it distracting.

Furthermore, Apple hasn't revealed the image-changing mechanisms to third-party developers who might want to create their own time-of-day-responsive desktops, though it's only a matter of time before someone figures out the secret.

I've complained for years about the blindingly bright blue folder icons in macOS; they're still blinding in Light Mode, but Dark Mode adds some gray shading to the folder icons so they're a lot less distracting.

HOW DOES MOJAVE STACK UP?

The other new desktop feature, Stacks (accessible via the Finder menu), gathers all the random icons on your desktop into a few neat stacks at the right edge of the screen and organizes everything into categories such as documents and images. You don't need to expand a stack to see what's in it—just use a two-finger swipe on the trackpad to make each icon in a stack appear in turn at the top. A submenu lets you organize stacks by date rather than by kind, so you can have stacks of files labeled Today or Yesterday.

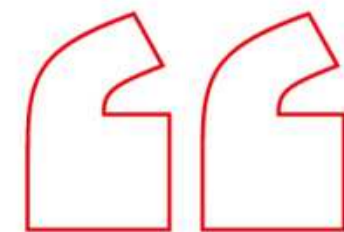
This feature is available only on the desktop, so it won't work in a Finder window. Furthermore, Stacks lacks some customization options. For example, shortcuts to apps, Zip archives, and other miscellaneous icons get grouped by default in a Stack called Other. If you want customized stacks with unique names, you need to use the Finder's Tag feature to organize a set of items, then choose the option to group stacks by tags.

FINDER FINESSE

The Finder gets its own visual overhaul to match today's high-resolution monitors. The old CopyFlow view is gone, replaced by a spacious Gallery view that displays large-scale preview images, with relevant metadata listed in a sidebar on the right. The sidebar includes a menu for functions such as rotating or marking up images, so you can perform many tasks directly from the Finder without opening files in another application.

Until Mojave, macOS had a full-featured screen-capture tool called Grab. But if you wanted a quick screenshot on a Mac—the equivalent of holding the top or side button and clicking Home on an iPhone—you were limited to two key-combinations: Shift-Command-3 for full-screen and Shift-Command-4 to capture a window or draw a rectangle for capturing. Mojave adds a Shift-Command-5 shortcut, which opens a toolbar with all three screenshot options (full screen, window, or rectangle) plus a new option to record a video of the entire screen or a rectangular selection. The old Grab tool is gone, but a new ScreenShot app displays all the new options in case you don't remember the keyboard shortcut.

Even better, when you take any screenshot, a thumbnail opens on the lower-right corner of the screen, and a context menu lets you save the screenshot to the desktop (the default) or your Documents folder or clipboard. Alternatively, you can open the screenshot in Mail, Messages, Preview, or Photos, or mark it up on the spot. The one missing feature is an option to save the screenshot with a descriptive name instead of the automatic generic name that includes the date and time, which you always change anyway.



The old CopyFlow view is gone, replaced by a spacious Gallery view that displays large-scale preview images.





The App Store now shows a spacious view of your previous purchases, but you still can't sort them alphabetically. They always appear in reverse chronological order of the purchase date. And iTunes-like cloud icons replace the gray "Install" or "Download" buttons from older versions.

PRIVACY AND SECURITY IN MOJAVE

Beneath its dazzling surface, Mojave makes important but invisible advances in privacy and security. In Safari, for example, it's harder than ever for advertisers to track you. Apple points out that if you are logged into a social media site, Facebook-style Like and Comment buttons can track you everywhere online even if you don't click on them. In Mojave, Safari blocks that tracking. If you click on one of those buttons, Safari asks your permission before it transmits your response. Mojave also anonymizes the system information (such as your screen size and installed fonts) that many web-tracking sites request from your browser so that they can "fingerprint" your system and send targeted ads. All this makes the web a lot less creepy.

Mojave can also function as a password manager: The new OS automatically creates and stores strong passwords when you use Safari to sign up to a website—no more "12345" unless you insist on it. (You shouldn't.) For sites that send one-time passcodes via text message when you try to sign in, Safari automatically plugs them in as AutoFill suggestions, reducing confusion and errors when your non-technical relatives try to type in the SMS number of the remote site instead of the password.

In Safari's Passwords preference pane, alert buttons appear next to passwords you've used on more than one site. When you click on the alert, a button prompts you to change the password—and offers to take you directly to the site's password-change page. This feature alerted me to a few passwords that I had used twice.

Mojave also tightens security in thousands of third-party AppleScript apps that use Finder and other internal macOS features to automate complex procedures. These AppleScript apps still run in the same way they did before, but the first time you run them under Mojave, macOS will ask permission to let the apps access these features. If you click OK, the system won't ask again. The slight inconvenience is worth the added security, but inevitably, some users will think that their apps are doing something new instead of getting permission to do what they've always done. Those users may refuse permission and then wonder why the app isn't working. Fortunately, the same app will ask again the next time you run it, and you can click OK once and for all.

IMPROVED CONTINUITY

With every new OS release, Apple tightens its ecosystem to make the Mac work more closely with mobile hardware, and Mojave is no exception. My favorite new feature is Continuity Camera. When you're working in a document or message on your Mac and want to insert a photograph or scanned document, simply Ctrl-click in the document. The resultant pop-up menu includes a Take Photo option, which lets you snap a picture on your mobile device, and Scan Documents, which straightens and crops a photo that you take of a receipt or similar document. Take the photo on your phone, click a "Use Photo" item that appears below the image, and the picture pops instantly into your document.



The four apps imported from iOS—News, Stocks, Voice Memos, and Home—look like more spacious versions of their iOS counterparts and translate well to the desktop. The Home app is a lot easier to manage on a desktop screen than on a cramped phone display. The News app automatically recognizes newspaper sites that you’ve signed in to via Safari and displays subscription-only content without making you sign in again. None of these apps looks entirely macOS-like, but that will bother only purists. What bothers me slightly are the large-type headers such as “Top Stories” that waste real estate onscreen instead of using subtler visual features to distinguish between top stories and lesser ones. Apple will sort out these design issues sooner or later. Meanwhile, I’m glad to have all these apps, and they’ve already reduced my temptation to grab my phone when I should be working.

THE NEW MACOS APP STORE

When Apple excitedly announced a makeover for the App Store, I hid my yawn behind my hand—only to find that the makeover mostly justifies the hype. The new store has a spacious layout with plenty of detail about individual apps and, if the developer provides them, video previews and detailed background information. In previous versions, you could Ctrl-click on your purchased apps and pop up a menu with an option to hide your purchase. Mojave replaces this with a three-dot icon that appears when you hover the listing for the app. Click on the icon, and a menu pops up where you can hide the purchase or send a link to it via Messages, Mail, and more. One long-standing annoyance still hasn’t been fixed: The list of your purchased products is still sorted in reverse chronological order, with no option to sort it any other way.

Both Windows 10 and Ubuntu feature growing and evolving app stores, so it’s important that Apple continues to innovate in this area.



The Home app is a lot easier to manage on a desktop screen than on a cramped phone display.



WHEN TO UPGRADE

One promised Mojave feature wasn't ready for this first release, and Apple vaguely promises it for "later this fall." The missing feature is Group FaceTime, which will let you send out invitations for a video or audio chat with up to 32 people at the same time. Chat participants can connect via a Mac or an iOS device or (with audio only) an Apple Watch. Until this feature shows up in a developer beta for an interim release, I won't be able to try it, but Apple says that your Mac or phone will show a larger image of the person currently speaking, with the others displayed as smaller images in the FaceTime window. Apple's publicity screenshot shows a dozen deliriously happy teenagers grinning at one another while they chat, but grinning presumably won't be required in the released version.

Every initial (point-zero) release of macOS has some minor glitches that get sorted out in the first update. As a rule, I wait for the first update before upgrading the machine I use for work and play, but that's because I prefer to be extra cautious. Apple's beta-testing left me impressed with its efficiency and thoroughness. Early in the beta period, I used my Apple Developer account to report bugs in two deeply obscure macOS features, which I use in a few Applescript apps that I've written over the years. (If you must know, the two features are PostScript-to-PDF command-line conversion and file access through a background program called a launch daemon.) These were low-priority issues, but Apple fixed them promptly and completely, which is a lot better than my experience when reporting bugs to some other major software vendors.



Testing the release version of Mojave on a 2017 MacBook Pro, I experienced only one minor hiccup that fixed itself when I restarted the machine. I was testing the Continuity Camera feature; when I clicked Take Photo from the pop-up menu in Pages, a dialog box told me that I needed to enable two-factor authentication for this Mac and offered to take me to the iCloud Settings to enable it. When I clicked on the Continue button, I was taken to the iCloud Settings, but not directly to the Security tab—which means that non-expert users will be thoroughly confused by what to do next. When I opened the Security tab, it showed that two-factor authentication was already enabled, so the original error message made no sense at all.

After repeating this frustrating sequence of messages and clicks a few more times, I finally gave up and restarted the Mac—and Continuity Camera then worked exactly as it was supposed to. The good news is that this issue is by no means a show-stopper, and it's the only problem I encountered.

AN ENVIABLE OS

No one's going to choose between macOS and Windows 10 by comparing features (since your hardware determines your OS), but Mojave should give Mac users plenty of reasons to be glad they chose Apple. Mojave's elegance and convenience will likely even tempt some among the Windows faithful.

I use both macOS and Windows every day; Windows for work and the Mac for pleasure. Some of the apps I rely on are better on Windows—for example, the unmatched ABBYY FineReader Pro app for OCR and PDF editing and Microsoft Office with its richer set of Windows-based keyboard shortcuts. I admire both systems, but I reach for my Mac when I have a choice. Mojave makes the decision easier.

EDWARD MENDELSON

THE HOW-TO ISSUE

A computer monitor is shown at an angle, displaying a color calibration target. The target consists of a white square with a black border, containing a color checker chart with various colored squares. A color calibration device, which is a small, rectangular, silver and black device with a lens, is positioned over the target. The device is connected to a cable. The background is a dark blue gradient.

**HOW TO
COLOR CALIBRATE
YOUR MONITOR TO
YOUR PRINTER**

BY WILLIAM HARREL

Since the early days of desktop publishing, photo editing, and graphic design, professionals, budding professionals, and hobbyists alike have had to deal with color shifts—seeing one color on a monitor but getting different results when the document, photograph, or artwork prints. Red fruit on a monitor, for instance, comes out orange, chartreuse, neon, or plastic-looking bright red.

Why? The simplest answer is that monitors and printers see colors differently. In other words, they use different color models to produce the same hues. Monitors combine red, green, and blue (RGB) to display the colors you see, while most printers combine cyan, magenta, yellow, and black (CMYK) to reproduce colors.

It's important to note that many photo printers start with the basic CMYK process color model but deploy as many as 12 ink colors. The more colors you tack on to your color model, the wider the range of colors (known as the color “gamut”) the device can reproduce, and the more difficult it becomes for monitors and printers to output matching colors.

YOUR EQUIPMENT

Whether you're a professional desktop publisher, photographer, graphic artist, novice, or hobbyist, the quality of your equipment is important. In fact, if you're a professional—and your living is dependent on the quality of your work—you should buy the best equipment you can afford.

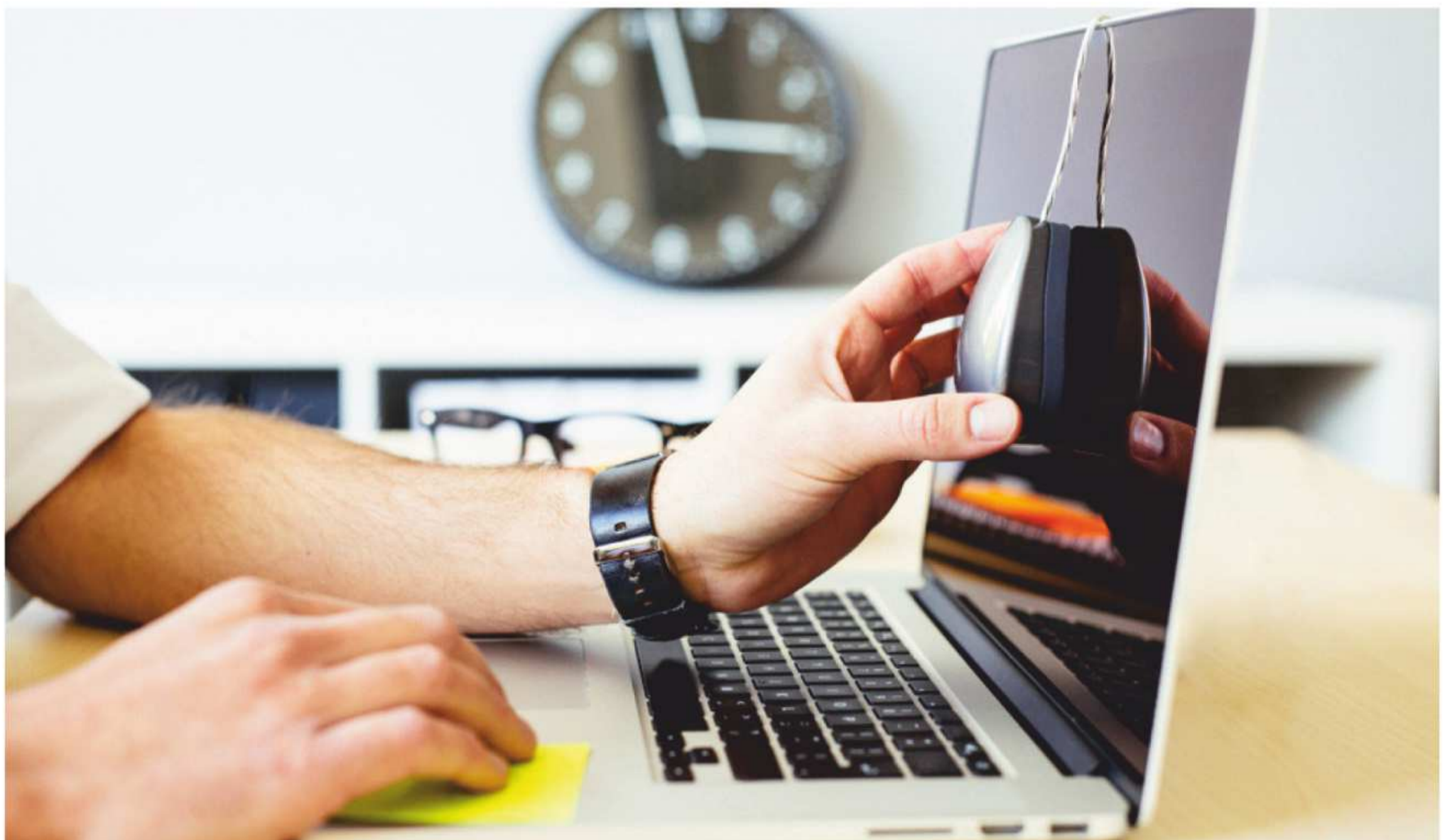


Everyday displays that cost \$200 to \$500 aren't really designed for photo editing and design work. Their manufacturers assume that you'll be doing mostly basic office tasks, such as running Microsoft Office programs, reading and writing emails, and following social media.

The more high-end your monitor is, typically, the more controls it has for adjusting display parameters, such as brightness, gamma, saturation, individual RGB levels, and so on. My 30-inch graphic design monitor, for instance, comes with more than 10 presets, including RGB, sRGB, and Adobe RGB, with the ability to edit, create, and save others, as well as the ability to adjust color levels, gamma, hue, saturation, gain, and much more. Having all those controls allows me to do some rather intricate color tweaking. The multiple presets allow me to calibrate the monitor to several different work environments and variables and easily switch between them as needed.

START CALIBRATING

Generally, there are two ways to calibrate your monitor: with software or by using special calibration equipment. Monitor calibration kits and monitor-printer calibration kits have been around for some time now, and many of them work quite well. They range in cost from just less than \$100 to more than \$500. Without question, hardware calibration is the most accurate method.



But each product handles the calibration process a little differently, to the extent that I can't walk you through the hardware calibration routine in this story. Besides, calibration kits come with their own instructions. Suffice it to say, though, in my opinion, professionals should invest in a calibration device or colorimeter. One of the greatest benefits of hardware calibration of each device in your workflow (the monitor, printer, and even scanner) is that they allow you to create device-independent ICC (International Color Consortium) profiles.

With ICC profiles, each device creates colors based on its own color spaces, and each color space uses specific values to reproduce colors. Since colors are created from values and percentages in the various devices' ICC profiles, the idiosyncrasies of each individual device shouldn't (theoretically) affect the way each one outputs colors.

WINDOWS COLOR MANAGEMENT

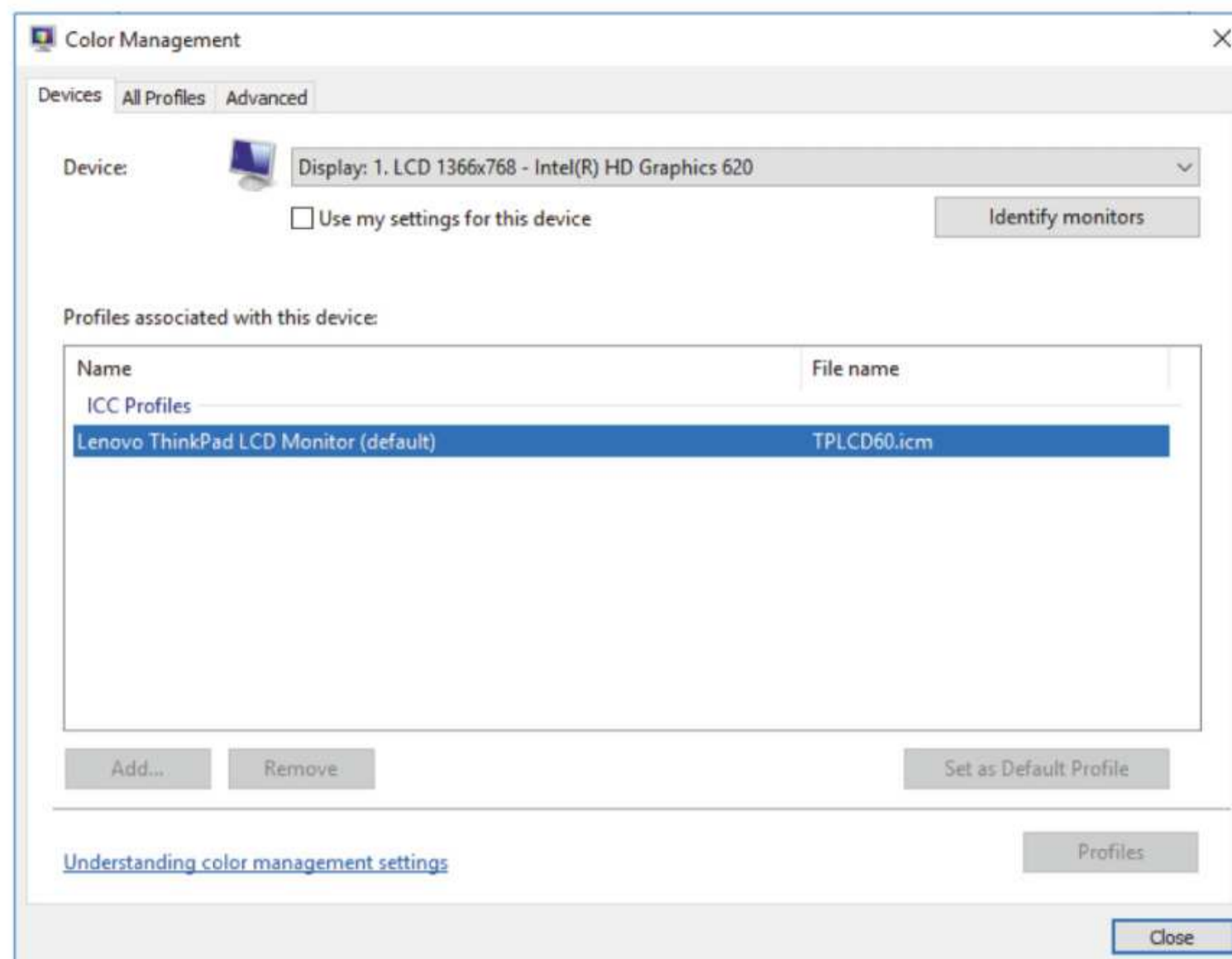
Using calibration hardware or colorimeters isn't the only way to get ICC profiles. When you install your printer and monitor drivers, often that includes installing manufacturer-generated ICC profiles. In Windows 10, where color management is built into the core of the OS, most applications reproduce colors based on the models in these profiles. High-end applications such as Adobe Photoshop and Illustrator, however, get their instructions for displaying colors from Windows ICC profiles unless you tell them to do otherwise.

It's important, then, to make sure that both your monitor and your printer are using the proper ICC profile. You can see and change these profiles from the Windows Color Management dialog box. To get there, follow these steps:



When you install your printer and monitor drivers, often that includes installing manufacturer-generated ICC profiles.



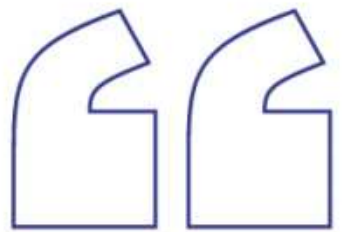


- Click the Windows Search or Cortana icon in the lower-left corner of your screen.
- Type Color Management.
- Click the Device drop-down menu.
- Choose your monitor from the list.

Note that if you did not install the drivers that came with your monitor, Windows may recognize and install its own profile for your display. Some inexpensive displays may not come with ICC profiles and draw their calibration info from one of Windows' several generic profiles. And as mentioned, a good number of monitors come calibrated for office settings; so the monitor may require some additional tweaking to get colors to match more closely to what comes out of your printer.

As for your printer's ICC profile, nearly all modern printers come with them. Programs such as Photoshop, Illustrator, and InDesign load and read as soon as you select the device from the printer list in the application's Print Settings (or equivalent) dialog box. You can also pick up ICC profiles from the hardware manufacturer's website or by contacting the company directly. When you have the profile in hand, you can install it in Windows in two steps:

- Right-click on the ICC profile file (it has a .icc file extension)
- Click Install profile.



An advantage of calibration kits—some of them, anyway—is that they allow you to create profiles for different scenarios.



PROFILING YOUR PAPER

Another important part of the calibration process is choosing the right paper. First, don't bother trying to calibrate to inexpensive, everyday copy paper. No matter what you do, color-rich graphics and photos won't look great. Also, different types of papers display colors dissimilarly.

Another advantage of calibration kits—some of them, anyway—is that they allow you to create profiles for different scenarios, including various paper types. Most paper mills have profiles available for their midrange and premium papers.

If all this sounds too complicated (it's not, really, and the web is loaded with info on working with ICC profiles), there are professionals who will help you calibrate your equipment.

PREPARING YOUR ENVIRONMENT

No matter which calibration technique you use, for your monitor to display colors consistently, your work environment should be darkened but not necessarily dark. The goal is twofold: One, to make sure that the monitor isn't picking up glare from any light sources—a window, an overhead light, or a desktop lamp—and, two, that your environment maintains the same ambient light throughout your work hours.

It's also important that you keep your display as clean as possible. Yeah, I know that monitors don't stay clean more than a day or two, which is how often you should clean your monitor. The slightest bit of dust or film on the screen changes the way colors display.

It's also important to turn the monitor on and let it warm up for about 20 to 30 minutes to bring it to its normal operating temperature. (Be sure to turn off power management settings that might put it to sleep after short periods of inactivity.) Next, set your monitor's resolution to its native ppi, which is usually the highest setting.



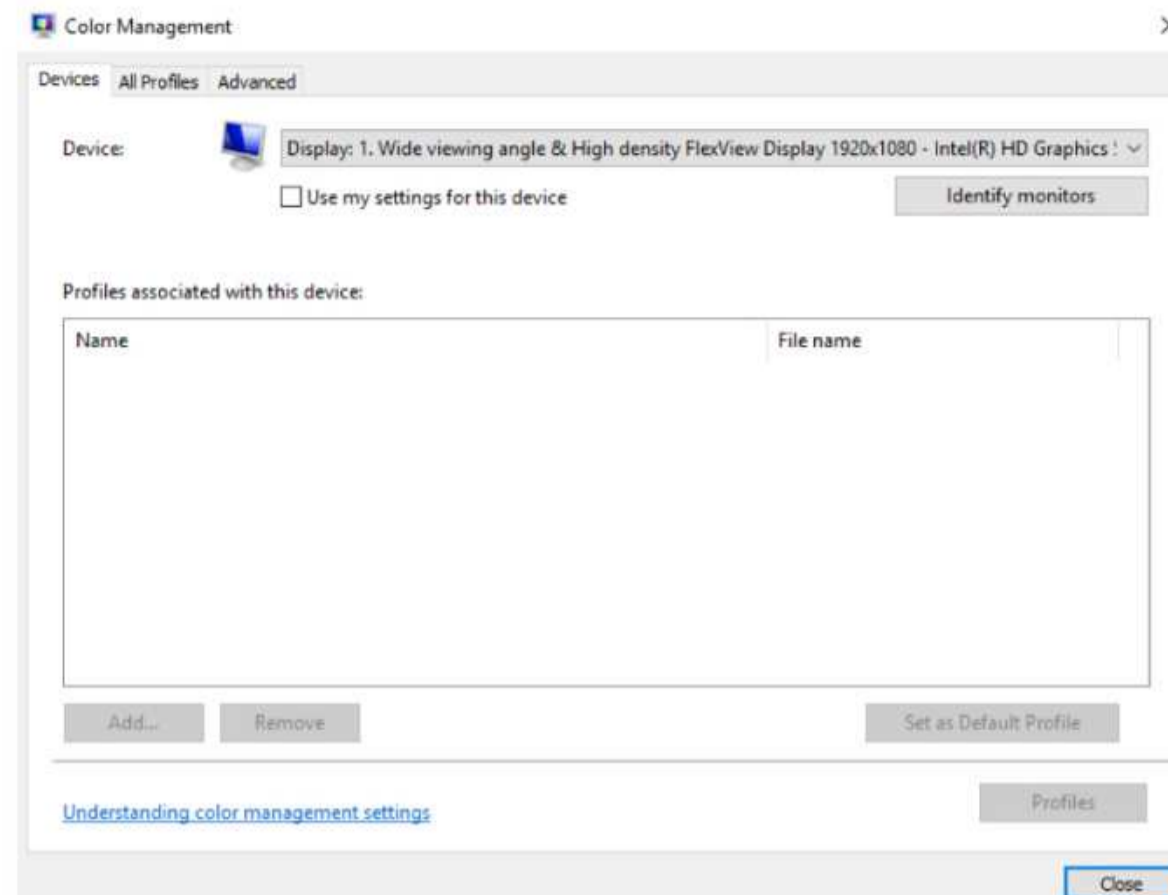
VISUAL CALIBRATION WITH SOFTWARE

Most people don't know this, but both Windows and macOS come with monitor calibration built in and in many cases, help to decrease the color shifts, as will most third-party commercial or freeware monitor calibration software. I'll get to those in a moment.

The benefit of some third-party calibration programs is that they provide much more extensive controls than the software built into Windows and Mac operating systems. Some of them help you create ICC monitor profiles based on the output from your printer, and some, especially online calibration products that work (or at least start) inside your browser, are free.

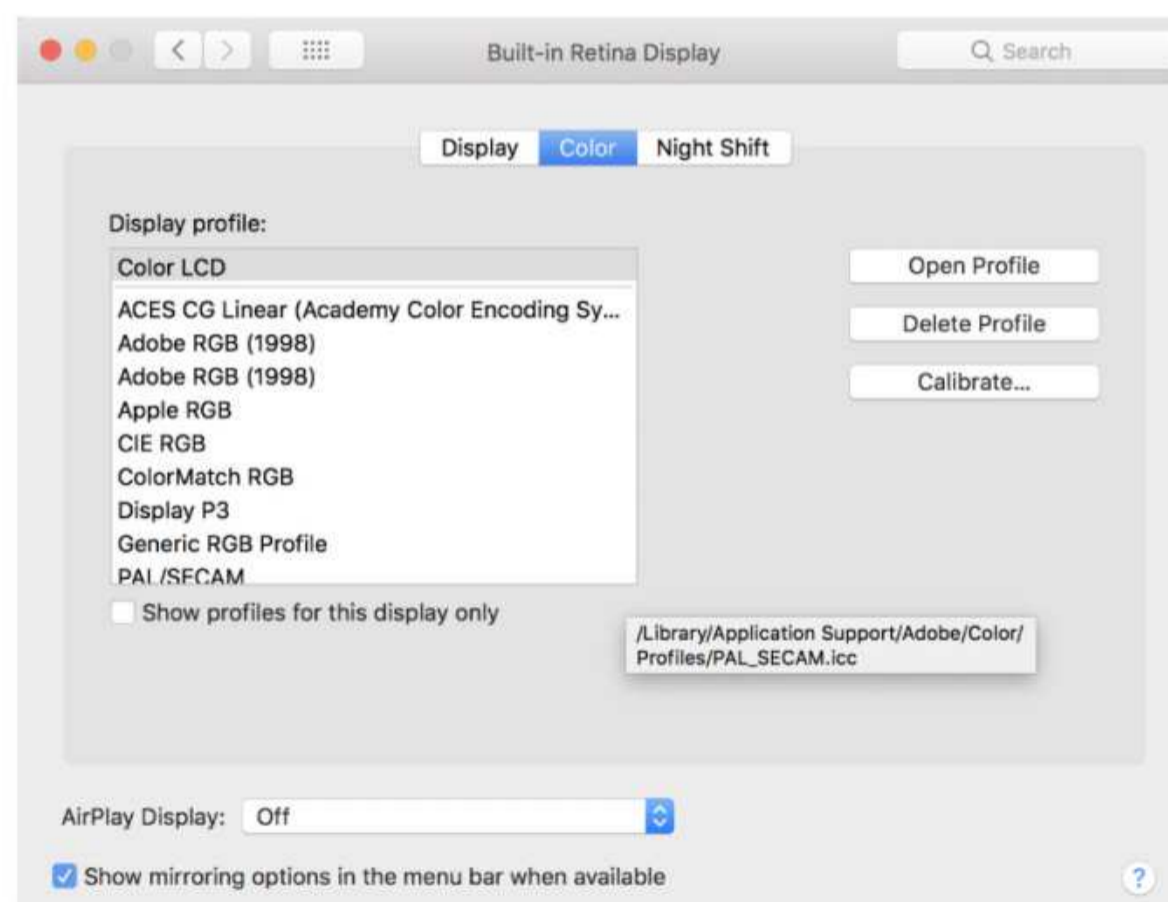
Without question, though, the simplest and among the least expensive (if not the most accurate) are the routines built into your computer's operating system. Since each one has explicit instructions (though you will need to familiarize yourself with your monitor's controls, such as adjusting brightness and contrast), I'll stop at telling you how to get the calibration routines started.

Windows or macOS will walk you through these relatively short processes.



Calibrating your display in Windows 10:

- Click Search or Cortana in the lower-left corner of your display.
- Type “Calibrate Display Color.”
- Select Calibrate Display Color from the flyout menu to open Display Color Calibration.
- If your system has more than one monitor, move the Display Color Calibration application window to the display that you want to calibrate, and then click Next.
- Follow the instructions as they walk you through calibrating your monitor.



Calibrating your display in macOS:

- Open the Apple menu and select System Preferences.
- Select Displays from the flyout menu.
- Select Color from the Displays menu.

- Select Calibrate to initiate the Display Calibrator Assistant.

The Display Calibrator Assistant walks you through calibrating your monitor, and then it generates an ICC profile and associates it with your display.

WHICH CALIBRATION ROUTINE IS RIGHT FOR YOU?

Again, professionals whose livelihood depends on the accuracy and quality of their work should choose one of the several colorimeter hardware options. Here's another reason to use hardware: When I tried to run the Windows' calibrator on my high-end, 30-inch graphics monitor, immediately after clicking the first Next button, I got a warning that the display already has a "wide-gamut" color profile and that using Display Color Calibration on it would create a conventional gamut, which would be a poor fit for the display and result in distorted color appearance.

That doesn't sound promising, does it? If you've already spent the money on high-end equipment designed to help you succeed in your creative endeavors, spending a little more on calibration equipment to ensure the accurate displaying and printing of color is wise. The OS calibration tools, especially the Windows tool, are designed more for entry-level, midrange, and laptop displays, as are several of the third-party software solutions.

The good news is that adjusting your monitor's settings won't hurt it; you can easily return it to factory settings. Some other good news is that the makers of graphics and photography monitors as well as desktop-publishing pundits recommend calibrating your monitor every two to four weeks—and in mission-critical environments, as often as weekly or even daily.



Makers of graphics and photography monitors recommend calibrating your monitor every two to four weeks.



THE HOW-TO ISSUE

H O W T O

R E M A P

Y O U R

K E Y B O A R D

BY WHITSON GORDON

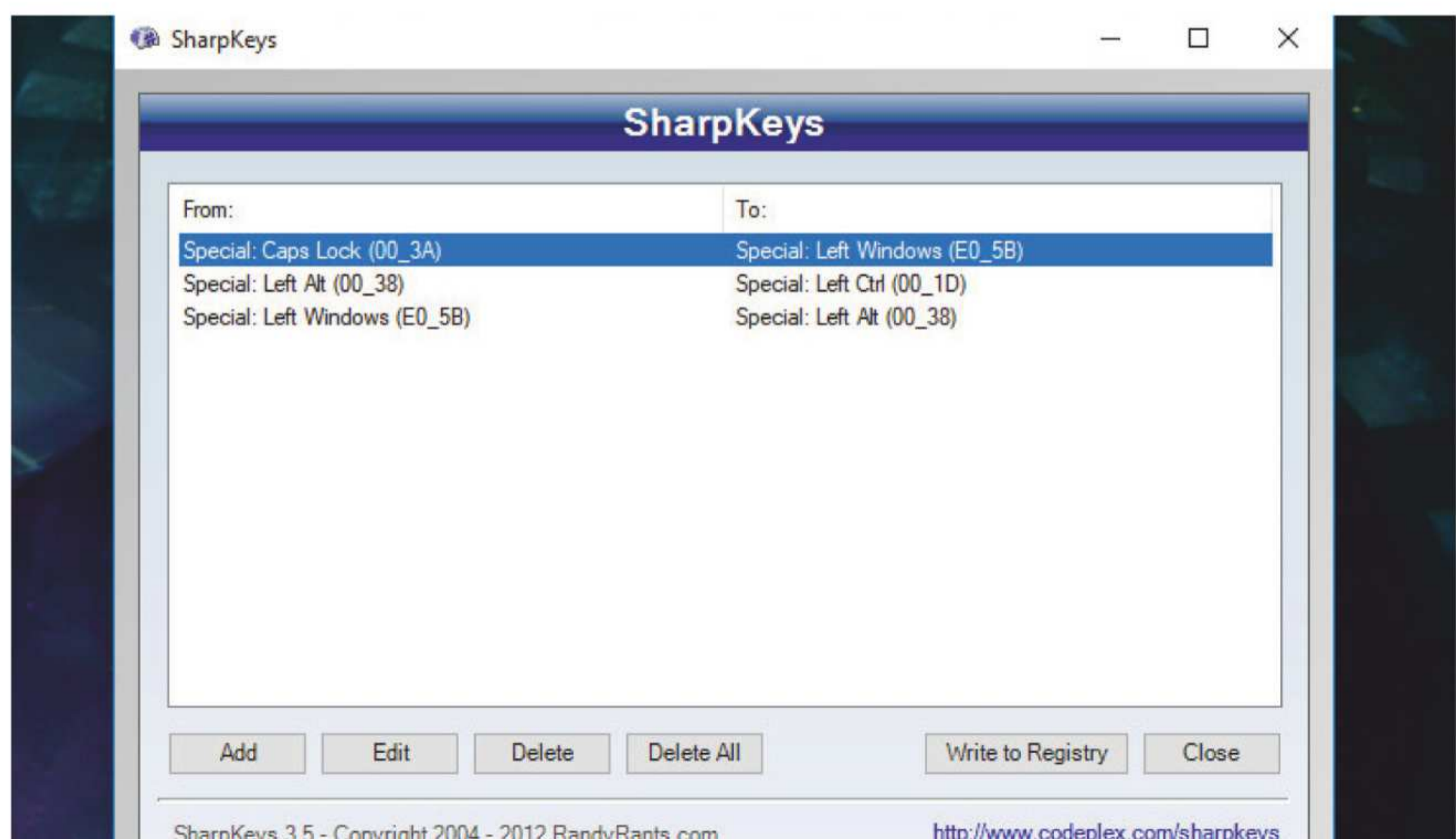
The standard Windows keyboard layout hasn't changed much in the past few decades, and there's a chance you don't use every key on your keyboard. If you think the Caps Lock key would better serve you with a different function or wish you could open up Windows' Task Manager with one keystroke, you can remap unused keys.

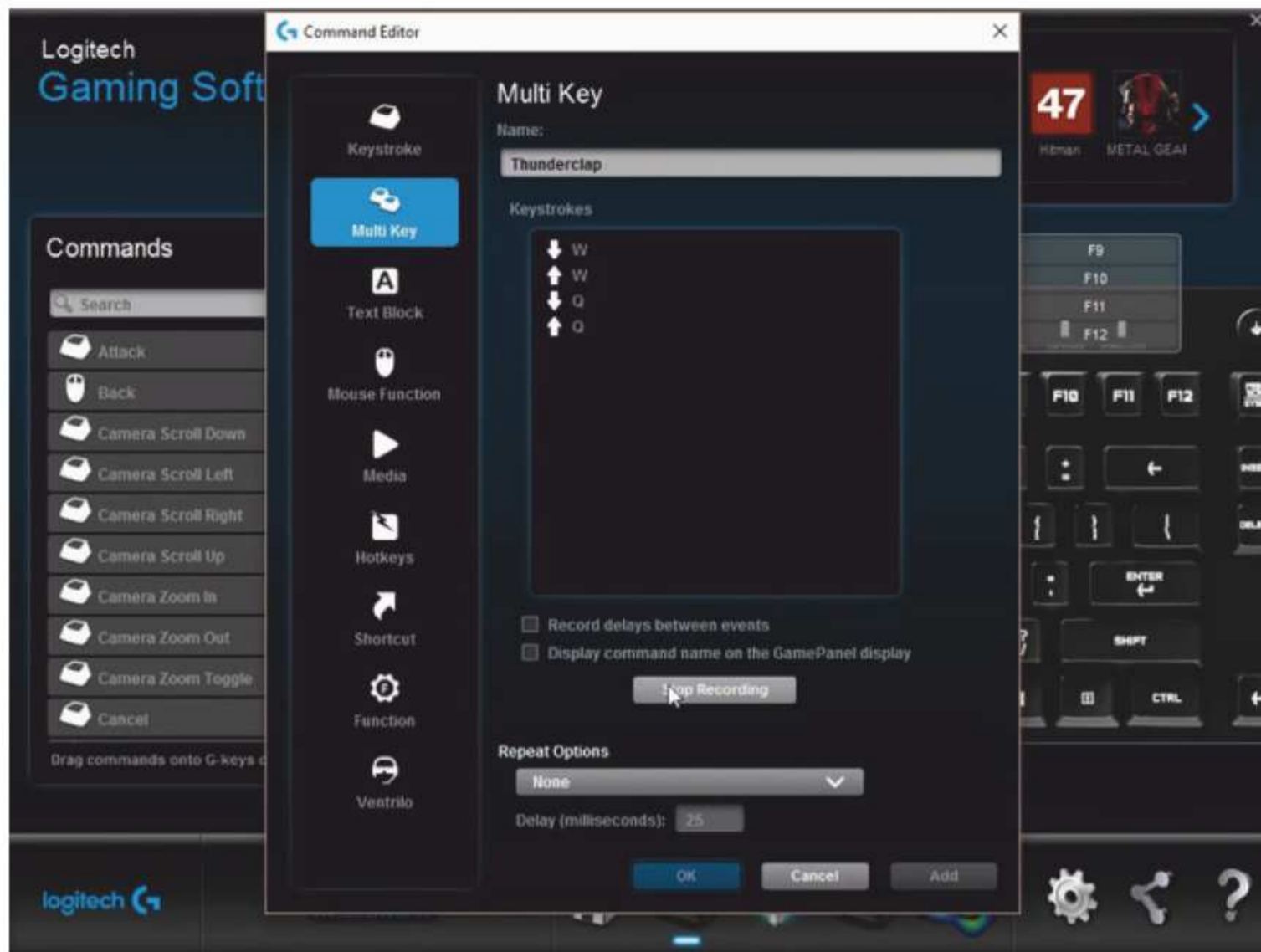
REMAP KEYS WITH SHARPKEYS

If you merely want to remap one key to another, SharpKeys is a simple, open-source program that can do so using the Windows registry. For example, I use SharpKeys to make my Alt key act as the Ctrl key and my Caps Lock act as the Windows key.

Since SharpKeys writes this information directly to the Windows registry, it's the best option for these kinds of one-to-one key remappings—you don't have to rely on some other software as a middleman, and you'll run into the fewest compatibility issues, since Windows itself is interpreting the keystrokes as you've told it to.

Download the program (I recommend the portable ZIP version, which doesn't require installation), and start it up. To remap a key, click the Add button and choose your keys from the two columns. The left column denotes the key you'll press (for example, the Caps Lock key) and the right column denotes the action that key will take (for example, acting as the Windows key). You can also press the Type Key button and press a key on your keyboard if you have trouble hunting it down in the list.





When you're done, click OK. Repeat this process for any other remappings, then click the Write to Registry button. Close the program and restart your computer, and you should find your keys have taken on their new roles. You can delete SharpKeys when you're done; the program is merely a user-friendly interface for the Windows registry, so once the changes are made, you won't need it anymore.

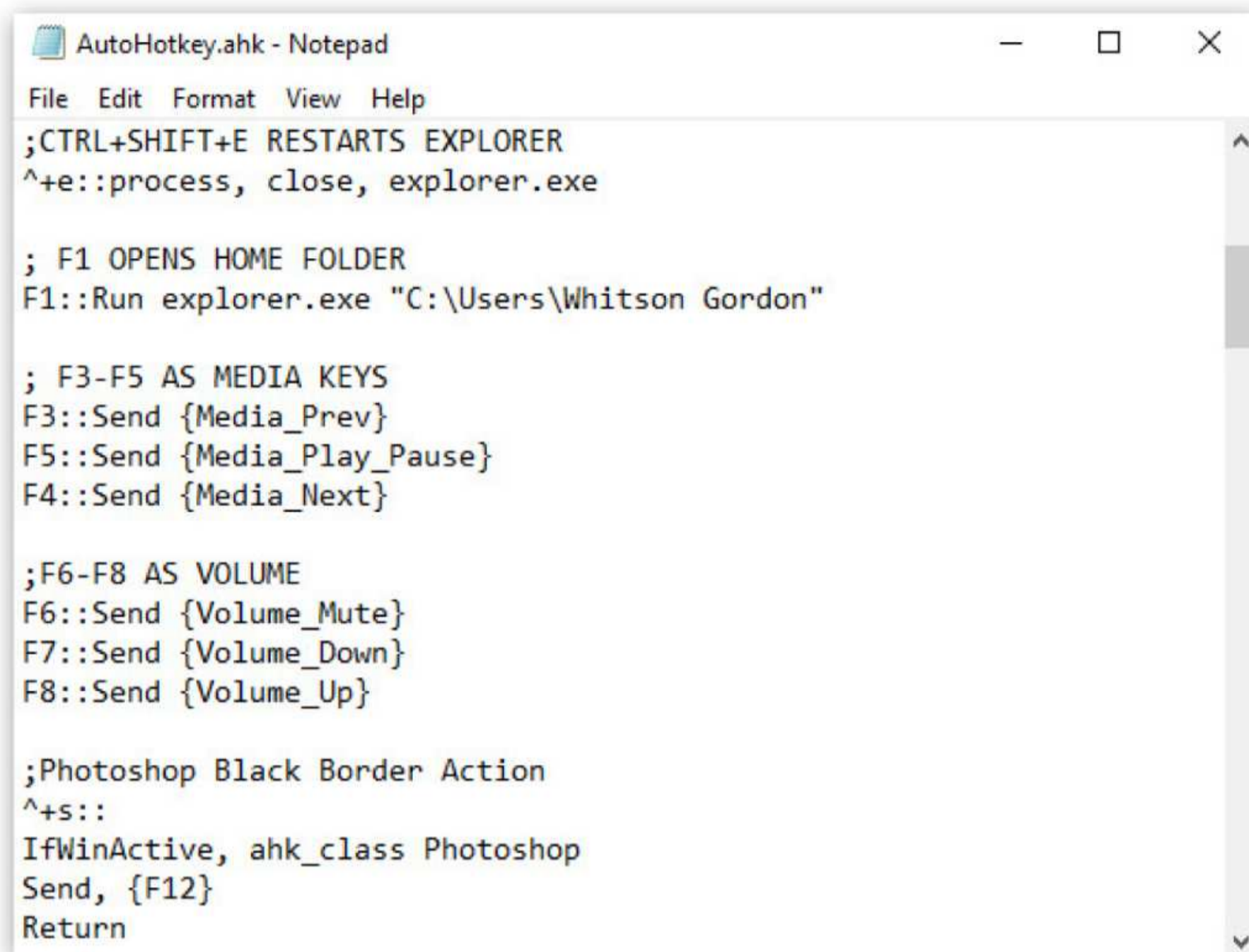
CUSTOMIZE HOTKEYS WITH YOUR KEYBOARD'S SOFTWARE

If your keyboard comes with advanced software, like Logitech's Gaming Software, Corsair's iCUE, or Razer's Synapse, you may have some key-remapping features already present on your system.

Not only can you remap keys, but also, many of these programs also let you create multi-key shortcuts, insert blocks of text, and create individual profiles for each of your games. Some will even let you "record" macros, allowing you to create complex shortcuts just by recording your actions and assigning them to a hotkey.

Each of these programs is a bit different, but the gist should be the same across manufacturers: Download the software, select your keyboard, and look for the option to create new hotkeys, macros, or actions. When in doubt, check the support page for your specific keyboard, and you'll find tutorials on how to get it done.

Your mileage may vary with these—I've found certain programs to be jankier than others. But if you already have it on your system, it may be able to do exactly what you want without your having to install any other software, so give it a shot.



```
AutoHotkey.ahk - Notepad
File Edit Format View Help
;CTRL+SHIFT+E RESTARTS EXPLORER
^+e::process, close, explorer.exe

; F1 OPENS HOME FOLDER
F1::Run explorer.exe "C:\Users\Whitson Gordon"

; F3-F5 AS MEDIA KEYS
F3::Send {Media_Prev}
F5::Send {Media_Play_Pause}
F4::Send {Media_Next}

;F6-F8 AS VOLUME
F6::Send {Volume_Mute}
F7::Send {Volume_Down}
F8::Send {Volume_Up}

;Photoshop Black Border Action
^+s::
IfWinActive, ahk_class Photoshop
Send, {F12}
Return
```

CREATE COMPLEX SCRIPTS WITH AUTOHOTKEY

If neither of the above options suits your needs, you can create extremely powerful hotkeys with AutoHotkey, a free program that comes with its own little scripting language for you to describe the actions you want your hotkeys to take. It's a bit more difficult to use than the software you get with gaming keyboards, but if your keyboard doesn't come with its own remapping program, it's your next best bet.

After installing AutoHotkey, you can create your hotkeys by right-clicking anywhere in Windows Explorer and choosing New > AutoHotkey Script. Right-click on the resulting file and open it in Notepad.

You can create basic hotkeys by adding a line like this: Capslock::LWin

This remaps Caps Lock to the right Windows key. You can add a comment above it using a semicolon (;) to remind you of what that hotkey does or why.

Again, SharpKeys is a better choice for a simple remapping like this, but let's say you wanted to do something slightly more complicated—say, remap Caps Lock to Ctrl+Shift+Esc, so you can see the Windows Task Manager with one keypress. You would create a line in your script like this: `Capslock::^+Escape` where ^ corresponds to Ctrl and + to Shift.

This is where AutoHotkey becomes more powerful. You can create hotkeys to type certain lines of text, run a program or batch file, or create shortcuts for specific programs. You can even have one hotkey perform multiple actions in a series, giving you robust control over your shortcuts.

Once you've finished adding your hotkeys to the script, save the file and double-click on it. This will launch AutoHotkey in the system tray, and it will run in the background interpreting your hotkeys for you. You can quit the program at any time to set your keys back to their default actions. (I recommend adding your .ahk script to Windows' startup folder, located at `%APPDATA%\Microsoft\Windows\Start Menu\Programs\Startup`, so it will automatically run every time you turn on your computer.)

There's more to AutoHotkey than we could ever fit into one small article, so check out the AutoHotkey documentation and forums for more advanced instructions and ideas. If you can imagine it, there's almost certainly a way to make AutoHotkey do it.



You can create hotkeys to type certain lines of text, run a program or batch file, or create shortcuts for specific programs.



THE HOW-TO ISSUE



HOW TO
**COPY YOUR
WINDOWS
INSTALLATION
TO AN SSD**

BY WHITSON GORDON

Are you still using a traditional spinning hard disk on your computer? You're missing out. Swapping it for a solid-state drive (SSD) is one of the best upgrades you can make in terms of speeding up your computer. Your computer will boot faster, programs will launch instantly, and games won't take so long to load.

You could reinstall your Windows installation from scratch and start new with a fresh, squeaky-clean system. Although that seems simpler, it's actually more of a hassle. As long as you follow these instructions to the letter, you should be back up and running in no time, with all your data intact.

WHAT YOU'LL NEED TO GET STARTED

An SSD: Obviously, in order to upgrade to an SSD, you'll need to, well, buy an SSD. Make sure to buy one big enough to fit all your data—if you have a 500GB hard drive now, you should probably spring for a similarly sized SSD. The only exception is when you're on a desktop computer and have room for multiple hard drives. In that case, you could store Windows and your programs on the SSD while putting your music, movies, and other data on a second, larger hard disk.

A USB-to-SATA Dock: During this process, you'll need both your SSD and your old hard drive connected to your computer at the same time. If you're using a laptop with only one hard drive slot, that means you'll need an external adapter, dock, or enclosure that can connect your bare SSD to your computer over USB. (Desktop users may not need this if they have room for two drives inside their PC—you can just install it internally alongside your old hard drive.)

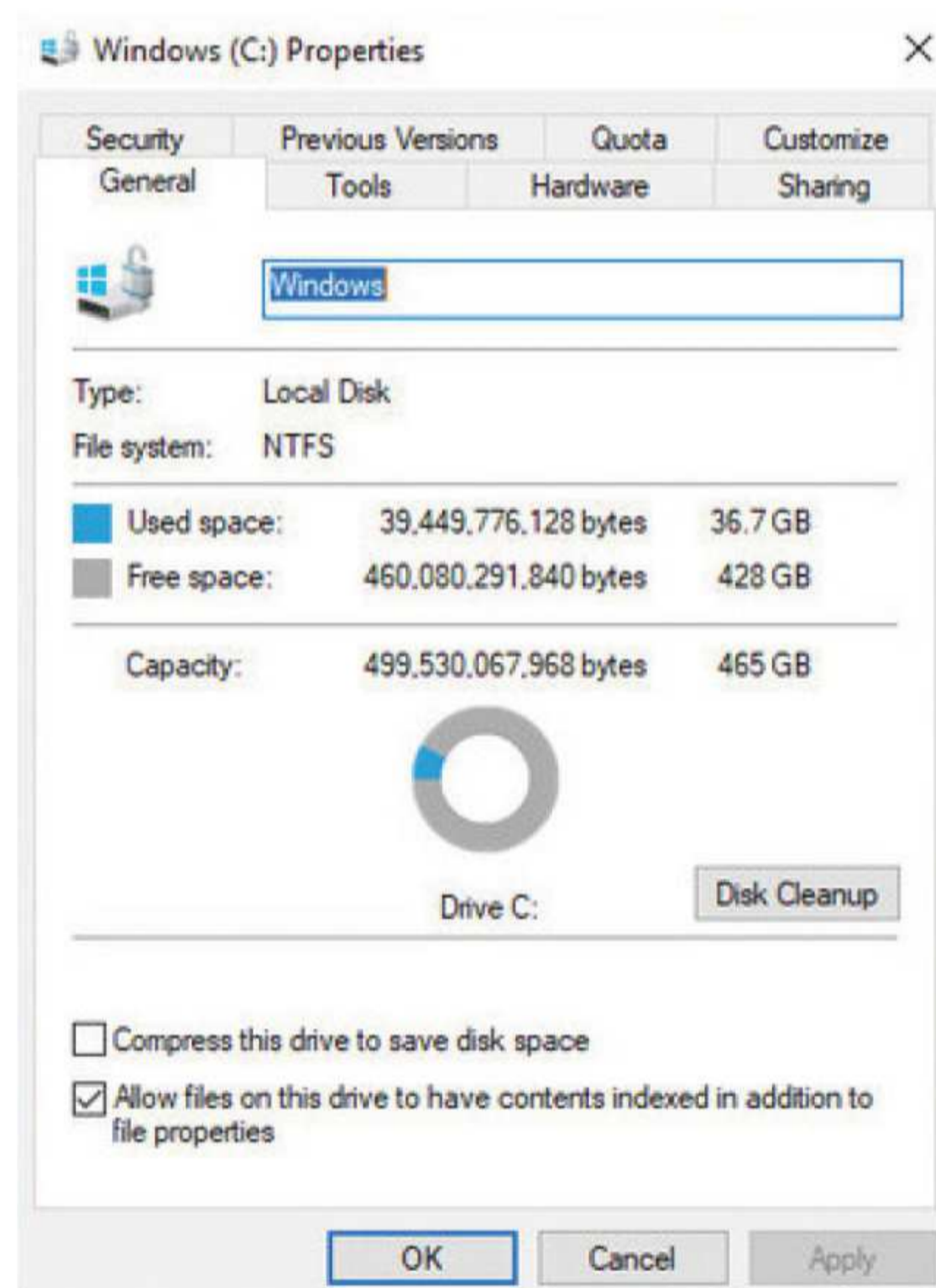


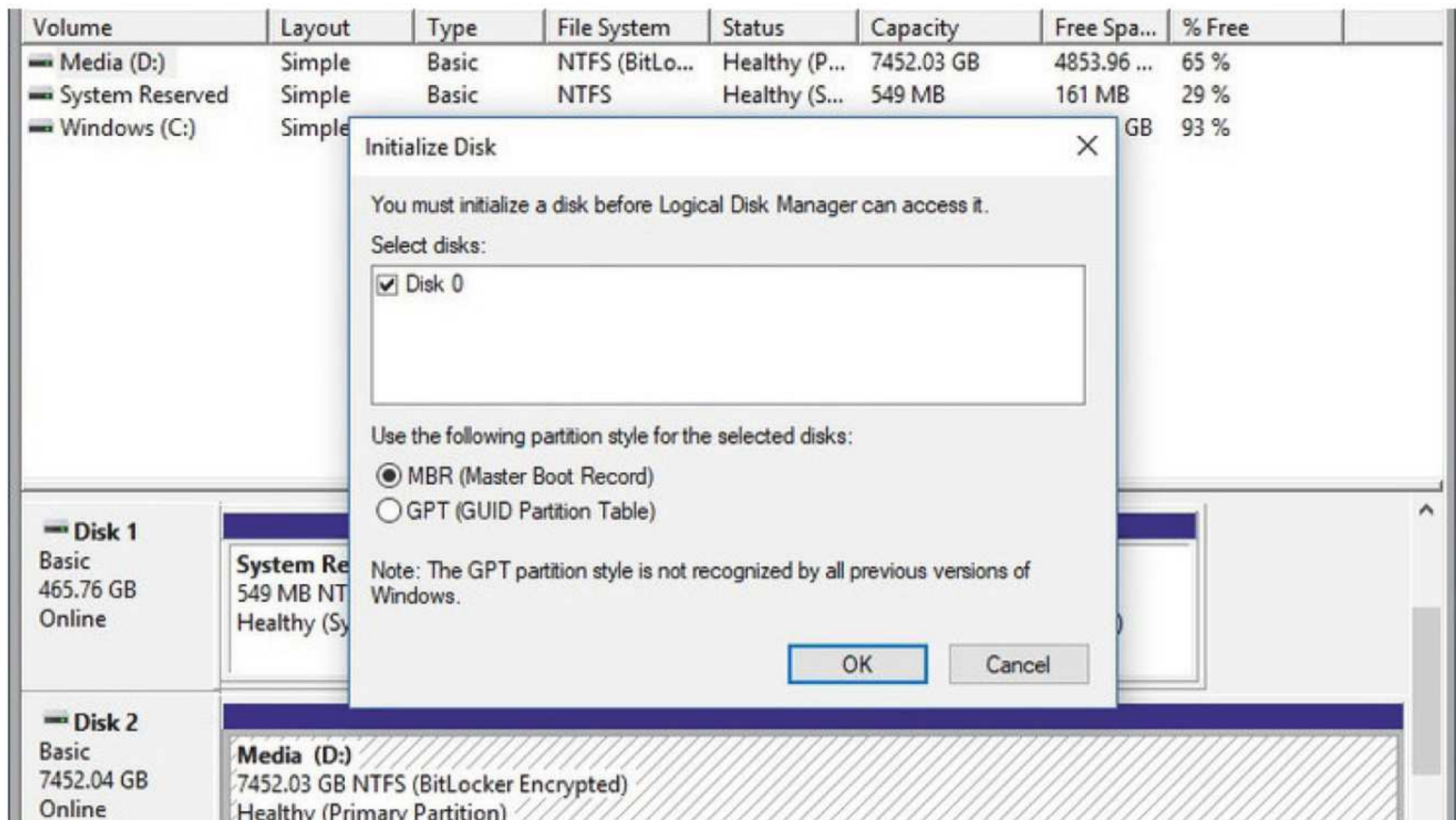
EaseUS Todo Backup for Windows: There are many different drive-cloning tools on the market, but for cloning a hard drive to SSD, I recommend EaseUS Todo Backup. Download the free version, enter your email, and subscribe to the newsletter to get the download link—the program is worth it, and you can unsubscribe later if you wish. When installing, don't worry about setting your default folder for backups—we won't be using that feature, so you can put it anywhere for now. It'll bug you a few times to upgrade to the paid home version, but just tell it to stick with the free version. That's all you'll need.

BACK UP YOUR DATA (AND FREE UP SPACE)

Before you start messing with drives and formatting partitions, it's absolutely necessary to back up your data first. A simple misclick can result in you erasing everything, so do not continue until you've backed up all of your data. If you aren't backing up your computer regularly, you should be—though for today's purpose, copying your important data to an external drive will do.

If you're upgrading to an SSD that's smaller than your current hard drive, you'll want to take extra care. This isn't as common as it once was, thanks to bigger, less expensive SSDs, but if that's the case for you, you'll need to delete some files and free up space on your hard drive before cloning it—otherwise, your data won't fit. In that case, I recommend making sure that data is backed up to an external hard drive before you continue, unless you're okay with deleting it all permanently. Once your data is safe and secure, continue to the next step.



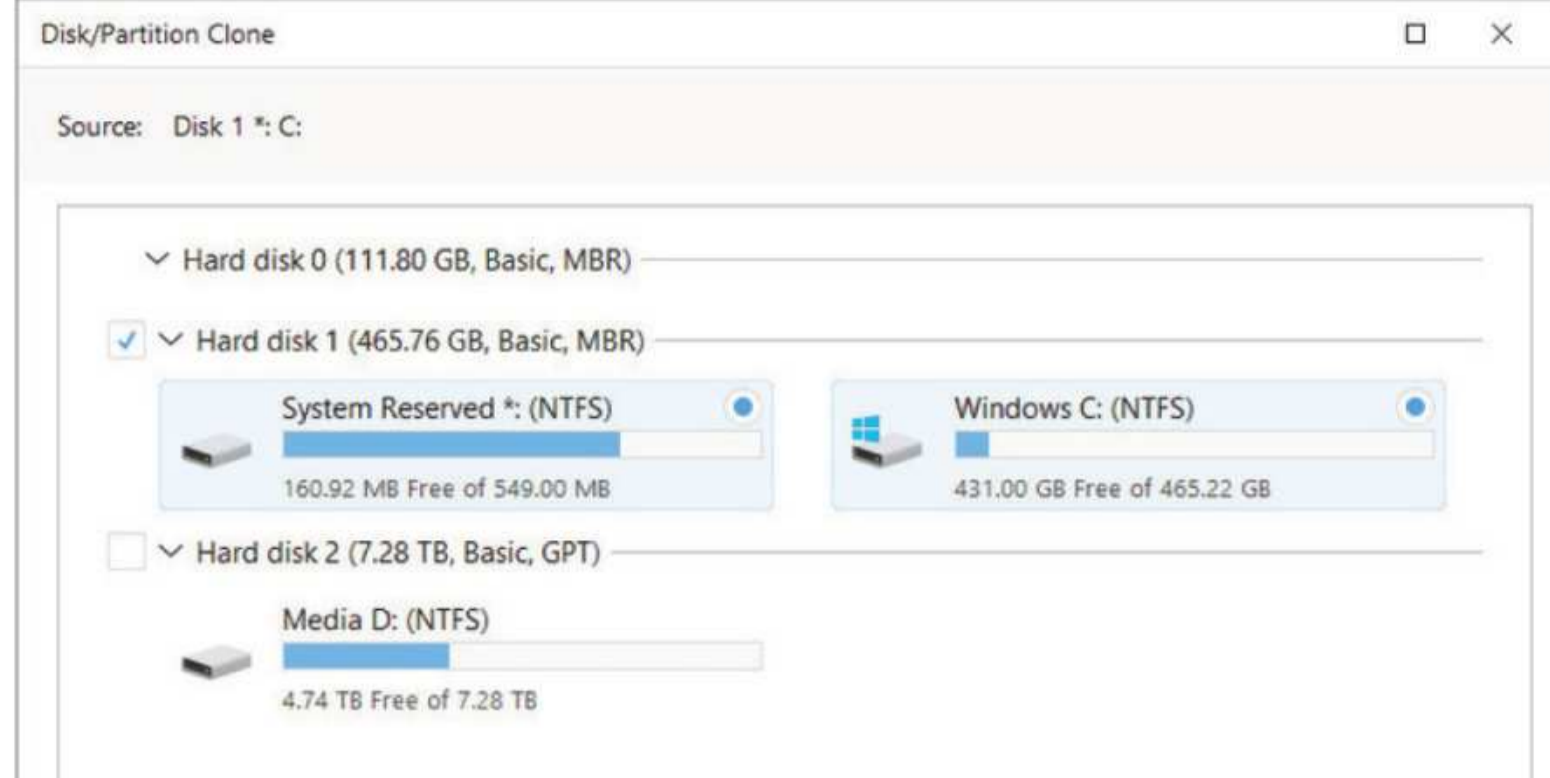


PLUG IN AND INITIALIZE YOUR SSD

Plug your SSD into the SATA-to-USB adapter, and then plug that into your computer. If it's a brand new drive, you probably won't see the drive pop up in Windows Explorer, but don't worry; it just needs to be initialized first. Open the Start menu and type "partitions" in the search box. Click the "Create and format hard disk partitions" option, and Disk Management will open. It'll prompt you to initialize the drive using either the GPT or MBR partition table. I'll be using MBR for my SSD, since I have an older motherboard in this PC that doesn't have UEFI and thus can't boot from GPT disks. If you have a newer PC, you might be able to use GPT, but when in doubt, use MBR.

If you aren't prompted to initialize the drive and don't see it in Disk Management, double-check that it's properly connected to your computer and that the enclosure or dock is turned on (if necessary).

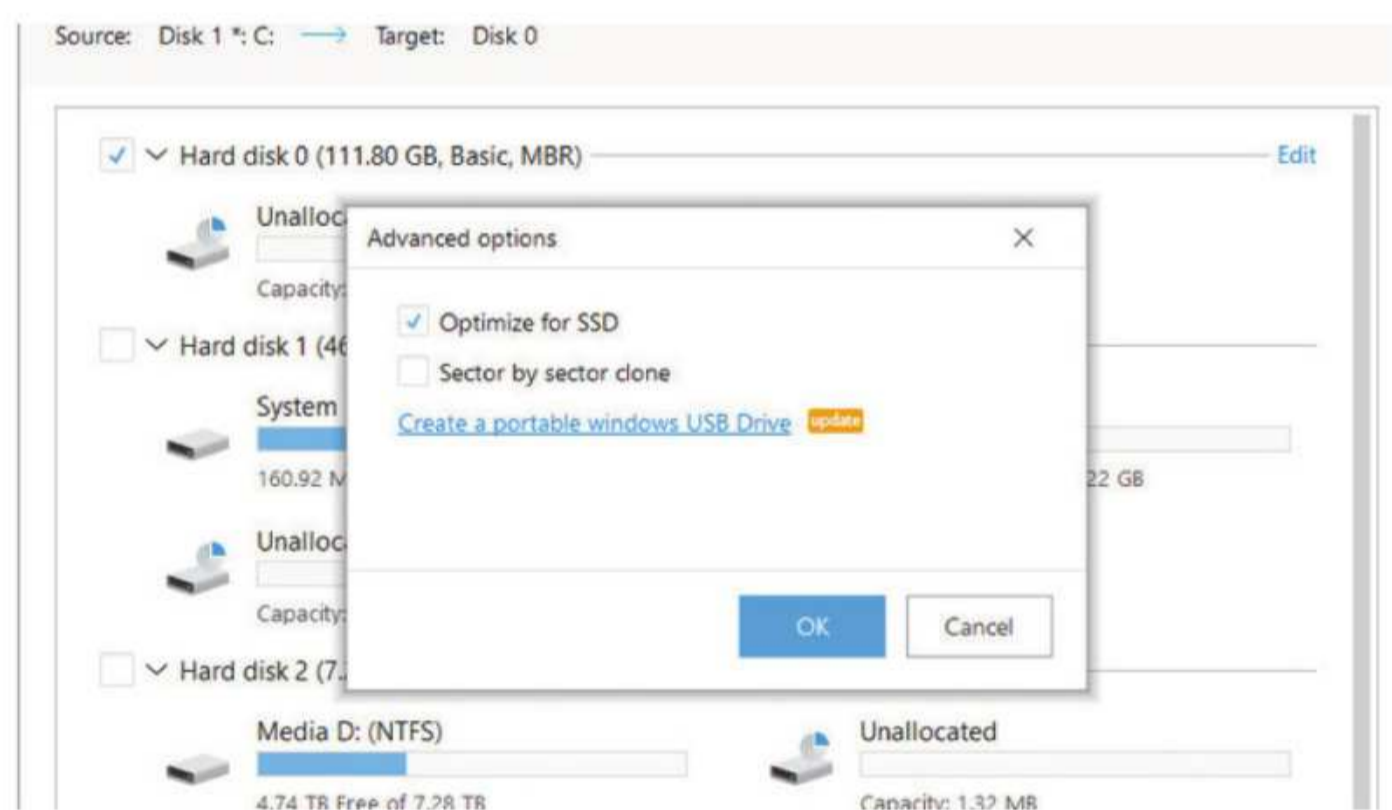
Once the drive has been initialized, you should see it show up in the bottom pane of Disk Management as unallocated space. You still won't see it in Windows Explorer, but that's okay, since EaseUS will be able to see it. Close Disk Management and continue to the next step.



CLONE YOUR HARD DRIVE

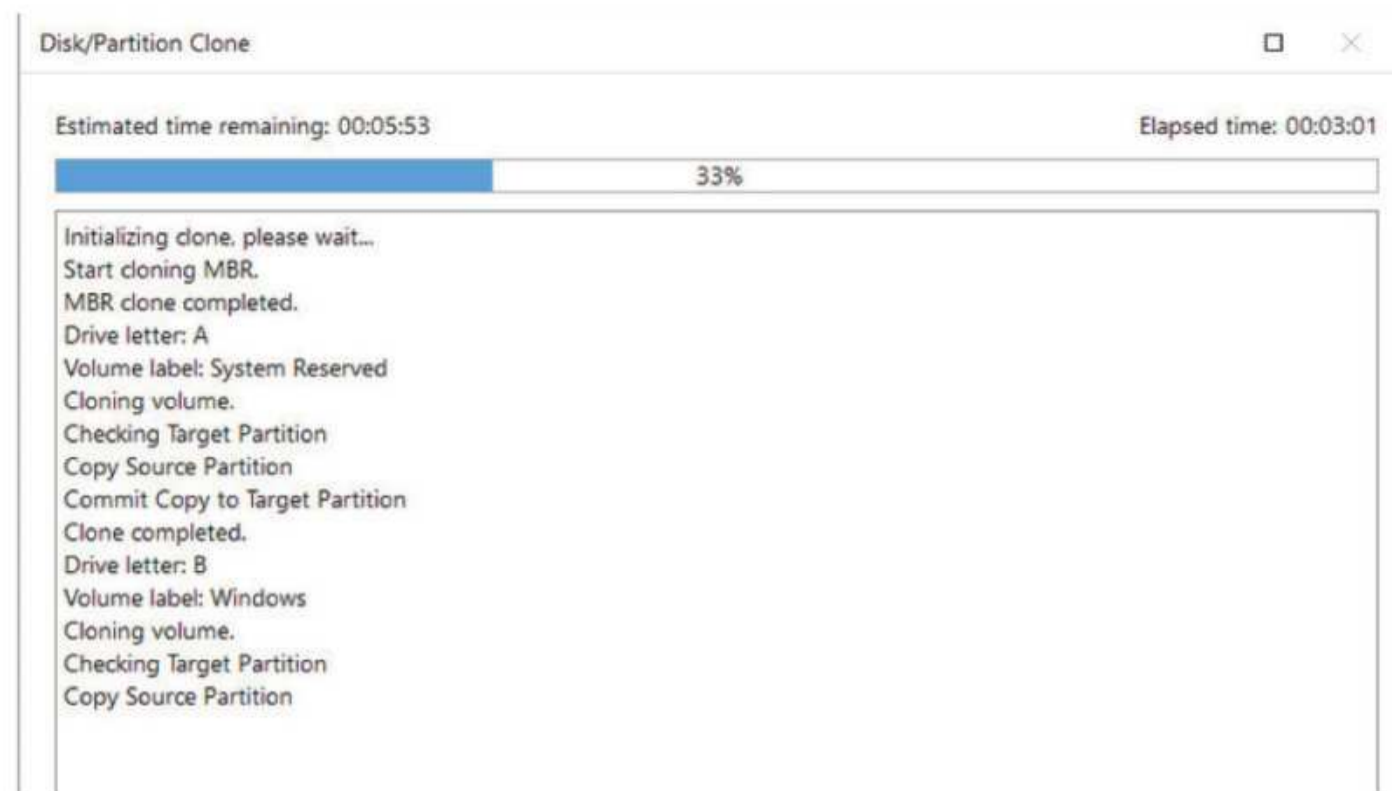
Open EaseUS Todo Backup, and you'll be greeted with an empty window. Click the "Clone" icon in the left sidebar—it's the one with two squares, near the bottom—and select the hard disk with your C: drive as the source. Be sure to check the box for the entire Hard Disk, not just the C: partition itself, since you'll need to clone the "System Reserved" partition as well. Click Next.

On the next page, you'll choose the target disk. In this case, that's your SSD. Again, select the entire disk by checking the box next to "Hard Disk," and make absolutely sure you're selecting the SSD, since whatever drive you select in this step will be erased. Thankfully, our SSD is empty, unallocated space, so we don't need to be worried about erasing anything important.



ALIGN YOUR PARTITIONS

Before you move on, click the "Advanced Options" button and check the "Optimize for SSD" button. This is important, since it'll align the partitions in a way that ensures you're getting the maximum speed out of your SSD. Click OK, then click Next. EaseUS will ask to confirm your choice and give you a preview of how much space will be taken up on your SSD. Click Proceed to begin the process.



WAIT...AND WAIT, AND WAIT

This may take a few hours, especially when your hard drive and SSD are large. So go binge-watch some Netflix for a while. When it's done, click the "Finish" button. You should see your new SSD in Windows Explorer, complete with all your data.



INSTALL YOUR SSD

Next, shut down your computer. It's time to install that SSD in your computer permanently. For a laptop with only one hard drive slot, you'll need to remove your old hard drive and replace it with your SSD. This is a bit different on every laptop, but you can get a general idea of the process with our guide here. For a desktop PC with more than one hard drive slot, you can leave your old hard drive in as extra storage and install your SSD alongside it.

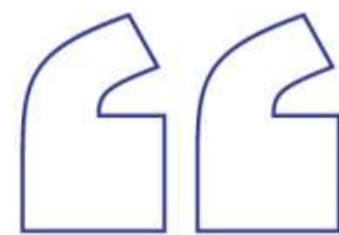
Boot Sequence

		Help Item
1st Boot Device	[SATA:3S-APPLE]	Specifies the boot sequence from the available devices.
2nd Boot Device	[2.2TB Infinity]	
3rd Boot Device	[SATA:4M-WDC WD]	device enclosed in parenthesis has been disabled in the corresponding type menu.
4th Boot Device	[SATA:3M-SanDis]	
2.2TB Infinity	[Enabled]	
2.2TB Infinity Timeout	[Enabled]	
Boot From Other Dev	Options	
	SATA:3M-SanDisk SSD PLUS 120 GB	
	SATA:3S-APPLE HDD HTS545050A7E3	
	SATA:4M-WDC WD80EMAZ-00WJTA0	
	2.2TB Infinity	
	Disabled	

REBOOT FROM YOUR NEW DRIVE

Once you're finished installing the SSD, you'll need to tell your computer to boot from it. (This may not be necessary on laptops with just one drive, but if you experience problems booting, it can help on some PCs.) Turn your computer on and enter its BIOS/UEFI setup—this is a bit different on every PC, but it'll usually say something like “Press DEL to enter setup” on the boot screen, so you'll want to press the corresponding key as it starts up.

From there, look for your BIOS' boot options. Where they'll be depends on your computer, but once you find them, you'll want to select the option to change the boot sequence. Choose your SSD from the list as the first boot drive, then head back to the BIOS' main menu to exit, saving your settings. Your computer will reboot, and if all went well, it should plop you back into Windows faster than ever before. Open Windows Explorer and check to confirm that your SSD is, in fact, the C: drive. If everything looks good, you're ready to rock, and your computer should feel significantly snappier without having to reinstall a thing.



You're ready to rock, and your computer should feel significantly snappier without having to reinstall a thing.

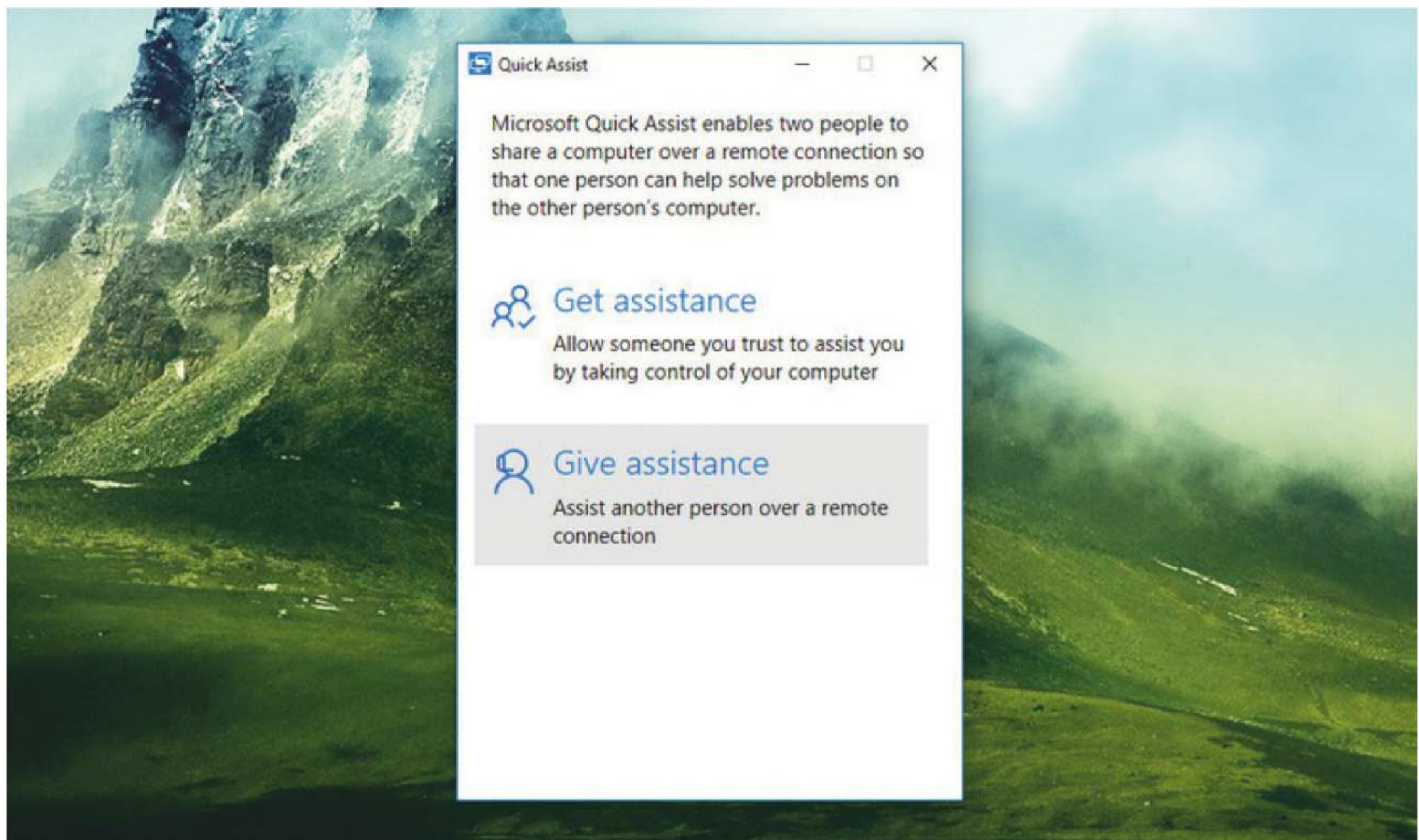




HOW TO PROVIDE
REMOTE IT
SUPPORT FOR
YOUR RELATIVES
AND FRIENDS

BY WHITSON GORDON

Being tech-savvy is both a gift and a curse. When you know how to fix computers, you become “the computer person” for everyone you know. But when you’re using the same platform as the person you’re helping—either Windows or macOS—then helping people with their tech troubles from a distance is simple, and you won’t need to install any extra software. Helping someone on a different platform gets a bit trickier, but we’ll give you the right tools for the job.

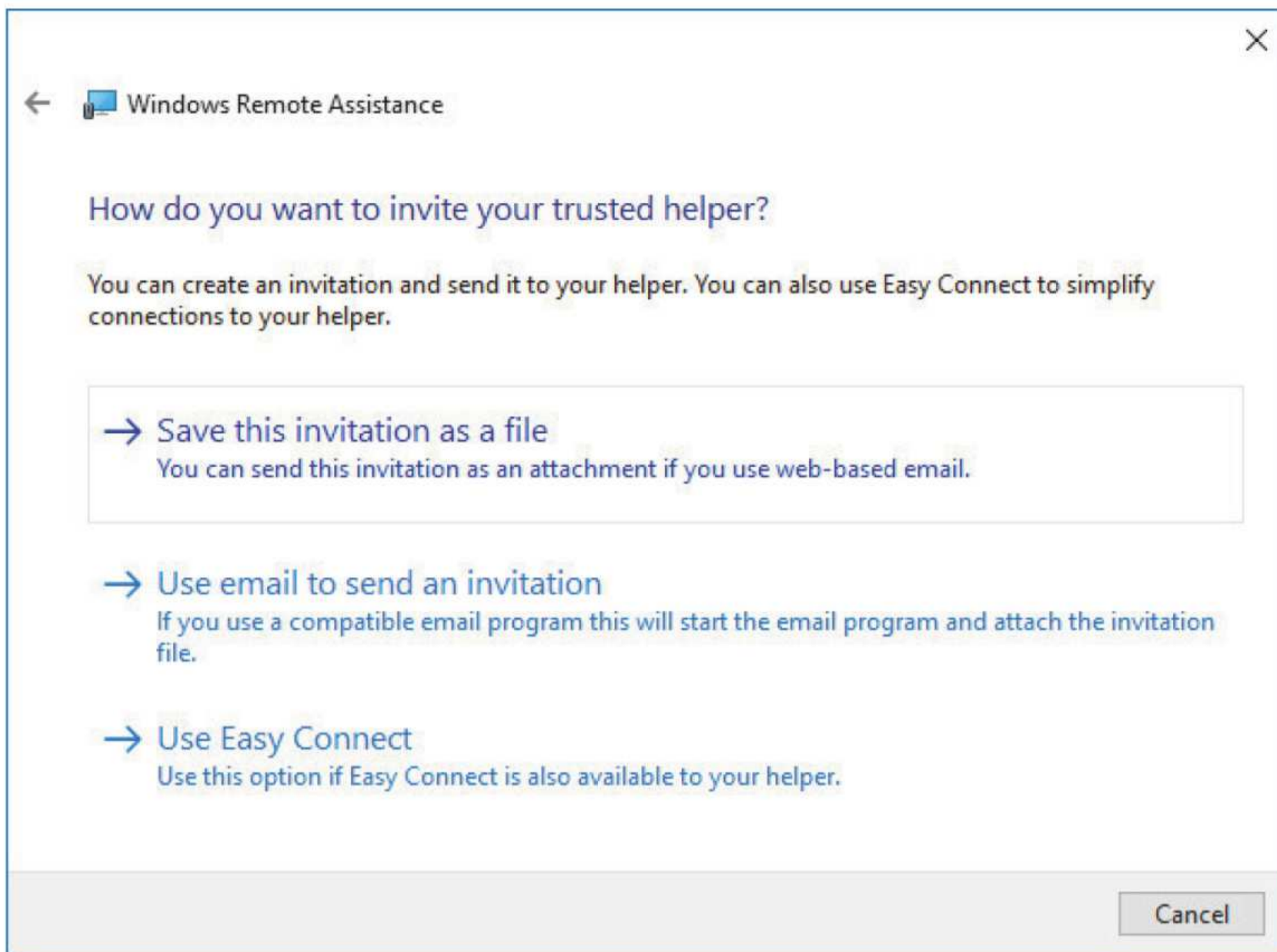


WINDOWS TO WINDOWS

Windows has two remote assistance tools built into the operating system: Quick Assist, which is new in Windows 10, and Windows Remote Assistance, which is available on Windows 7, 8, and 10. If both you and your friend are using Windows 10, use Quick Assist—as its name suggests, it’s quicker and easier than its older cousin.

Using Quick Assist: Open the Start menu and search for “Quick Assist,” or launch the app from the “Windows Accessories” folder in the Start menu.

In the window that appears, click the “Give Assistance” button. Sign in with your Microsoft account (you’ll need a Microsoft account, but your friend won’t), and you’ll be given a six-digit code that expires in 10 minutes.

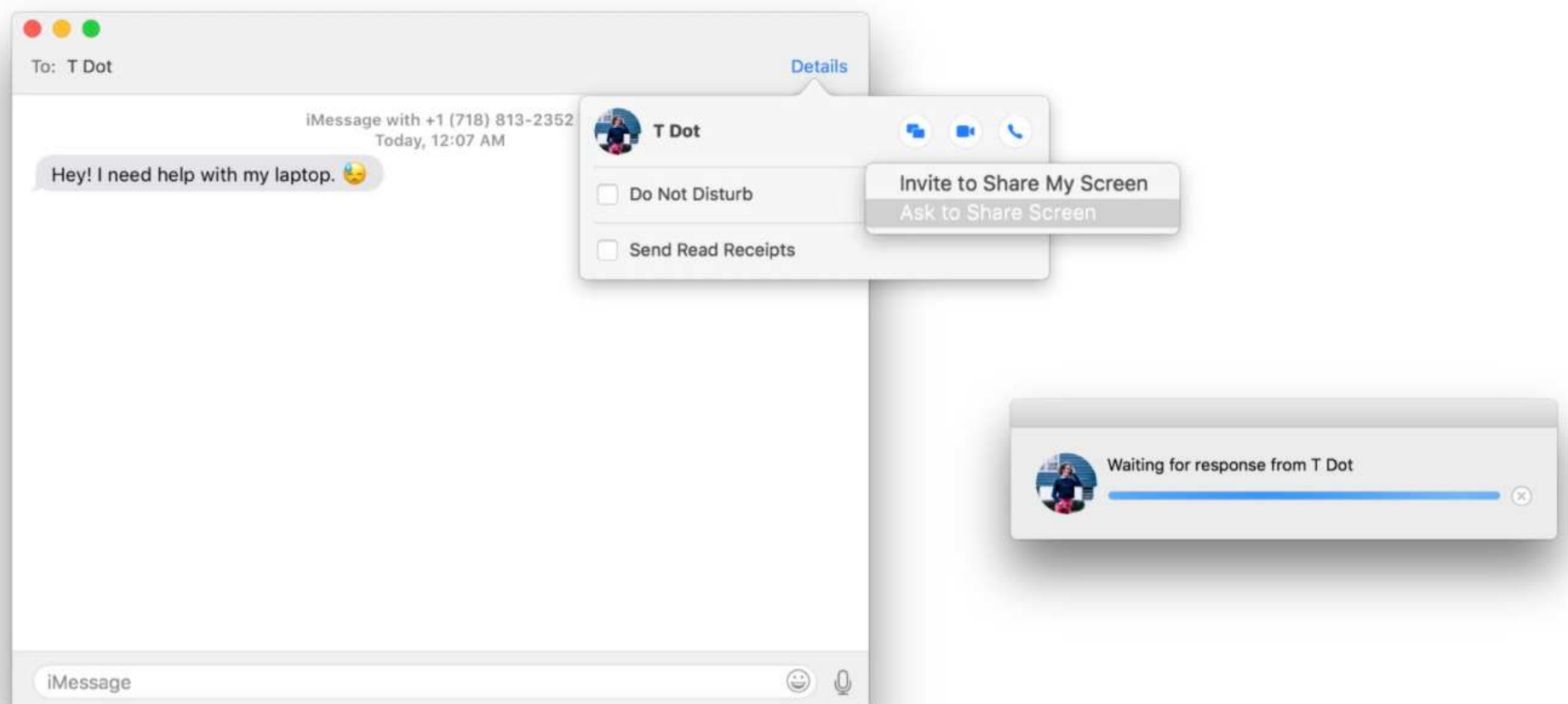


If you aren't on the phone with your friend already, give them a call—walking them through the process is much easier over the phone than via email. Tell them to launch Quick Assist, choose “Get Assistance,” and give them the six-digit code from your screen.

After entering the code, they'll be prompted to give you permission to access their screen. Once they do, you'll be able to use their computer as though you were sitting in front of it. You can even use the “Remote Reboot” option to reboot their computer and automatically re-initiate the Quick Assist connection. (Also known as turning it off and on again.)

Using Windows Remote Assistance: If your friend is still using Windows 7 or 8, you'll need to use the older Remote Assistance tool—it's similar but a bit clunkier. They'll need to head to the Control Panel and search for “Invite Someone to Connect to Your PC.” They'll send you a file over email that initiates the connection and then tell you the password that appears (preferably over the phone) so you can access their machine.

They may also be able to select “Easy Connect,” which requires them only to give you a password, but it might be grayed out in certain circumstances.



MAC TO MAC

Mac users can provide remote help using the Messages app. This feature launched in OS X 10.10 Mavericks, so anyone with a relatively recent, up-to-date Mac should be able to take advantage. You'll both need to be signed in to Messages with your Apple IDs as well.

Open the Messages app on your Mac and select the conversation with the friend you want to help—or start a new conversation. Right-click on the conversation and choose “Ask to Share Screen.”

They'll receive a popup asking permission to share their screen with you. Make sure they have the “Control My Screen” option selected, and click Accept. From there, you can control their computer and walk them through whatever problem they're having.

BETWEEN WINDOWS AND MAC

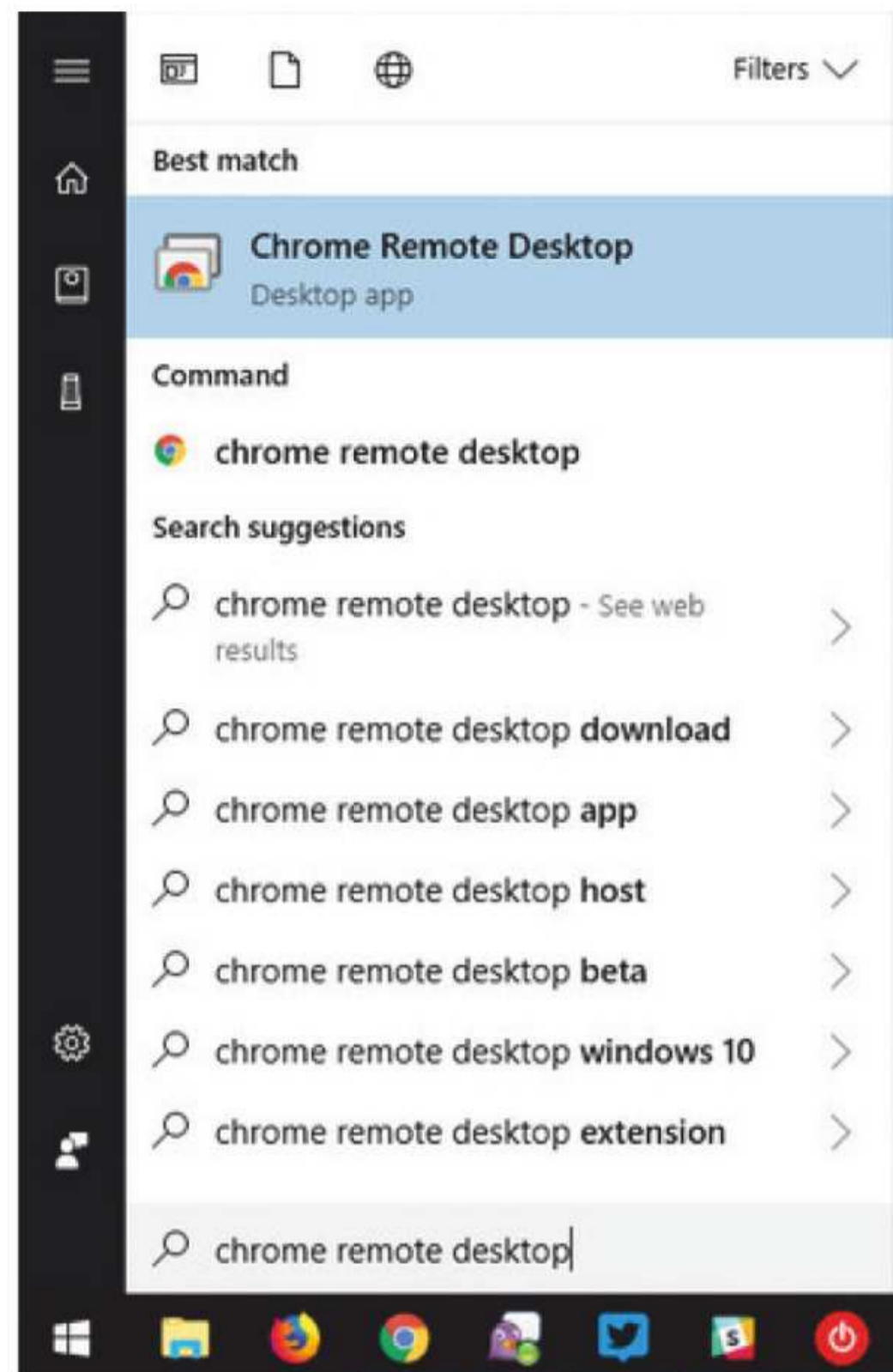
Unfortunately, neither the Windows nor macOS built-in options let you share screens with someone from the opposite platform. So you'll need to find something else.

Plenty of video chat apps, including Skype and Google Hangouts, let participants share their screen with the click of a button. They don't, however, let you control the other person's screen. In many cases, this may be fine, since you can just tell your friend what to click on as you walk them through the troubleshooting process.

Chrome Remote Desktop: If you absolutely need to control someone else's screen, your best bet is Chrome Remote Desktop, which doesn't come with the security issues that remote access tools such as TeamViewer have had in the past few years.

To use Chrome Remote Desktop, you'll both need to launch Google Chrome and install the app. Then launch Chrome Remote Desktop like any other app, by searching for it in your Start menu (on Windows) or Spotlight (on a Mac). Tell your friend to do the same.

The app's window will appear. Click the "Get Started" button under Remote Assistance, and choose "Access." Instruct your friend to click the "Share" button. (The first time they do so, they'll have to install a helper app—yep, another app.)



They'll be given a 12-digit access code to give to you, which you'll type on your screen before clicking "Connect." Your friend will then need to grant you permission. After that, you'll be able to control their computer and help them solve their problem.

If this process seems convoluted, that's because it is—but unfortunately, that's par for the course when you have to install another piece of software (especially one that requires Chrome). But in our experience, it's the best option, especially once you get through those first few steps. Future remote sessions should be much easier to initiate.



How to Access Your Windows PC From iOS and Android

BY LANCE WHITNEY



Want to view and control your Windows PC from your smartphone or tablet? There's an app for that. Microsoft's Remote Desktop tool lets you access one computer from another, and with the Remote Desktop app for iOS and Android, you can tap into your PC, view the screen, and work with your computer as though you were in front of it from a mobile device. Here's how.

First, you need to make sure your Windows computer is set up for remote access. To do this, open Control Panel. In the search field in the upper-right, type the word remote. From the search results, click on the link for "Allow remote access to your computer."

At the Remote tab for the System Properties window, make sure the option to "Allow remote connections to this computer" is enabled. You can also check on the box to "Allow connections only from computers running Remote Desktop with Network Level Authentication (recommended)." Then click OK to close the window.

FOR IOS

Those of you who want to access your computer from your iPhone, iPad, or iPod touch can download the Remote Desktop app. After installation, launch the app on your mobile device.

Tap on the + symbol to add the name of the computer that you wish to access. An "Add New" window pops up asking what type of device you want to add. Tap on the option for "Desktop."



The Desktop window prompts you to enter the name or IP address of the PC you want to access.

To grab the computer name in any version of Windows, open Control Panel. In the search field in the upper-right, type computer name. From the search results, click on the link to "See the name of this computer." You'll find the computer name displayed in the section for "Computer name, domain, and workgroup settings."

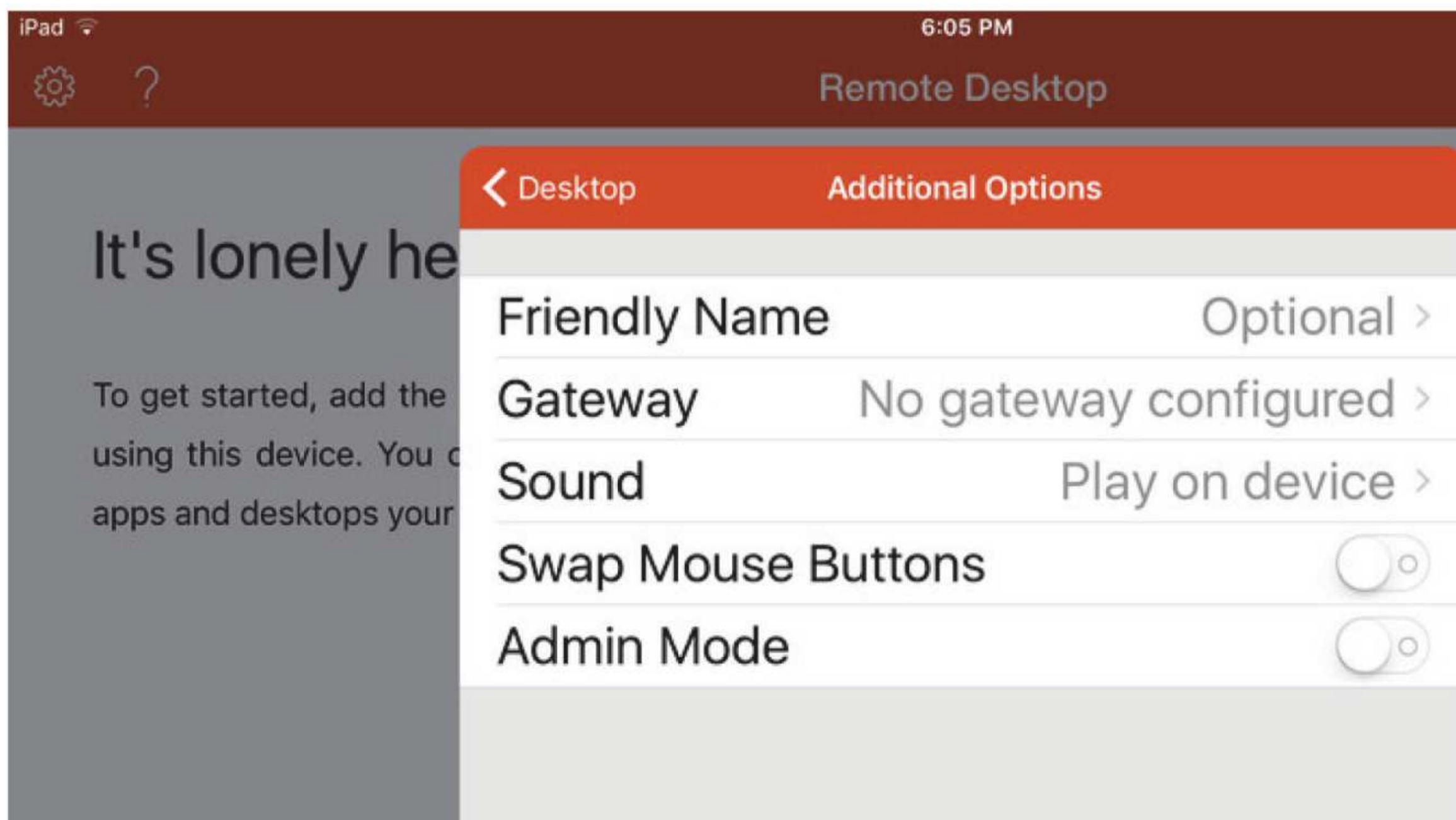
To see the IP address of your PC, open a command prompt. At the command prompt, type ipconfig. Then look for and note the IP address listed for IPv4 Address.

Return to the Remote Desktop app and tap the field for PC Name. Type either the computer name or IP address in the field for “Host name or IP address.” Then tap “Done.”

The next field refers to the user account that you want to use to access the remote computer. This would be an account on the computer itself, such as your own Microsoft account or a local account. If you want to enter the account name and password each time you open a remote connection, leave this field blank. Otherwise, tap on the “User Account” field. At the “User Accounts” window, tap on the option to “Add User Account.

At the “Add User Account” window, type the name and password of the account you want to use for remote access. Tap Save.

Next, tap on the field for “Additional Options.” Here you can add a friendly name for the connection if you don’t want to use the computer name. Unless you plan to use your mobile device to access your PC from outside your home network, you can bypass the Gateway field. The Sound field lets you choose whether to play sound on your mobile device or on your computer or not play at all.



The field to Swap Mouse Buttons allows you to swap the left and right mouse buttons. And the field for Admin Mode lets you connect to the PC as an administrator so you have greater control over certain features. When done viewing or setting any of these additional options, tap on the Desktop link to go back to the previous screen.

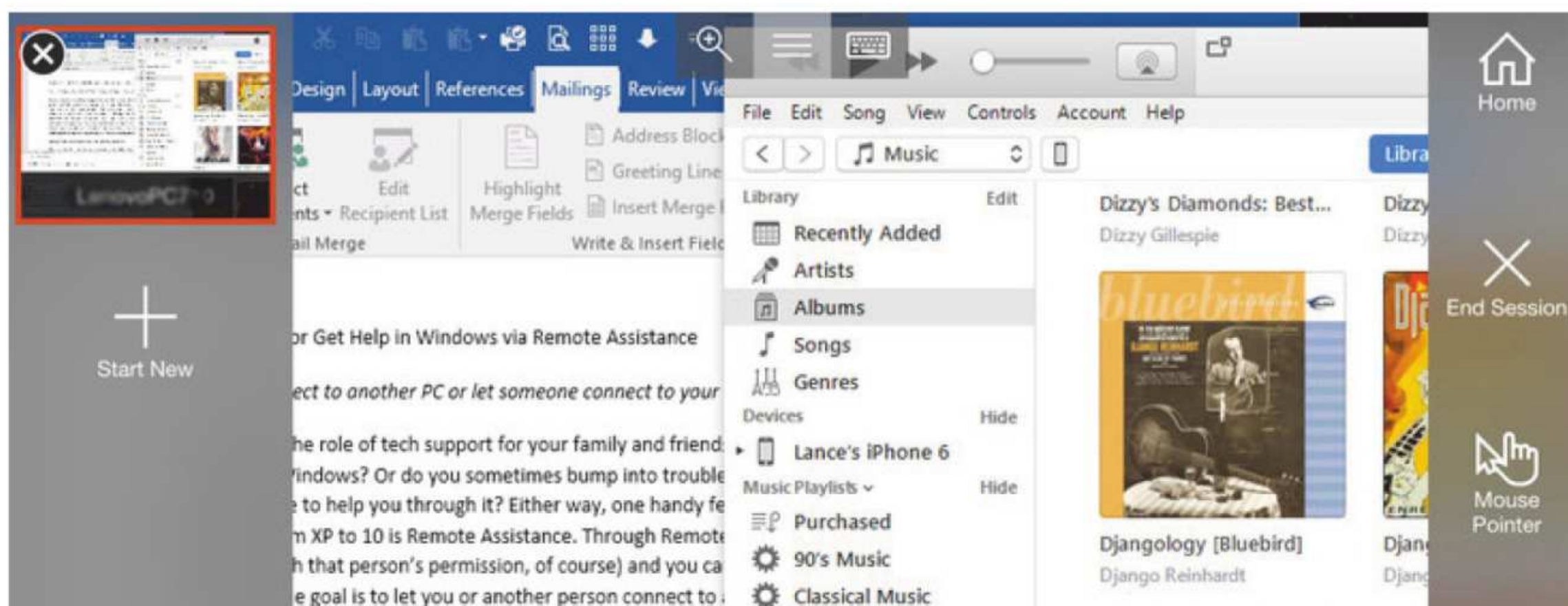
At the Desktop window, tap on the Save link.

Now tap on the name and icon of the computer connection you just set up.

The first time you try to access the computer, Remote Desktop may ask to verify the connection to that computer. Enable the option for “Don’t ask me again for connections to this computer,” and then tap Accept. You should then be connected to the computer in which case the computer’s screen will appear on your mobile device.

You can now open apps and windows, manage your desktop, and do just about everything you can do when you’re sitting in front of your computer. To help control your remote session, the app displays a small toolbar at the top. Tap on the magnifying glass icon to zoom in to the screen. Tap on it again to zoom back out. Tap on the keyboard icon to display your device’s keyboard.

Tap on the hamburger icon to display sidebars. On the left sidebar, you can tap on the “Start New” icon to start a new remote session with a different computer. On the right sidebar, you can tap on the Home button to return to the home screen of the Remote Desktop app. You can tap on the “Mouse Pointer” icon if you wish to display and control a mouse pointer on your remote session. And you can tap on the “End Session” icon to end the current remote session.



There's one major setting you may want to tweak. Tap on the End session icon to end the remote session. Then tap on the Gear icon in the upper-left corner. If at any point you need help, tap the question mark icon and tap on one of the Help categories. You'll be whisked away to a web page that provides information on using Remote Desktop with an iOS device.

A Settings screen appears. Tap on the setting for Display Resolution.

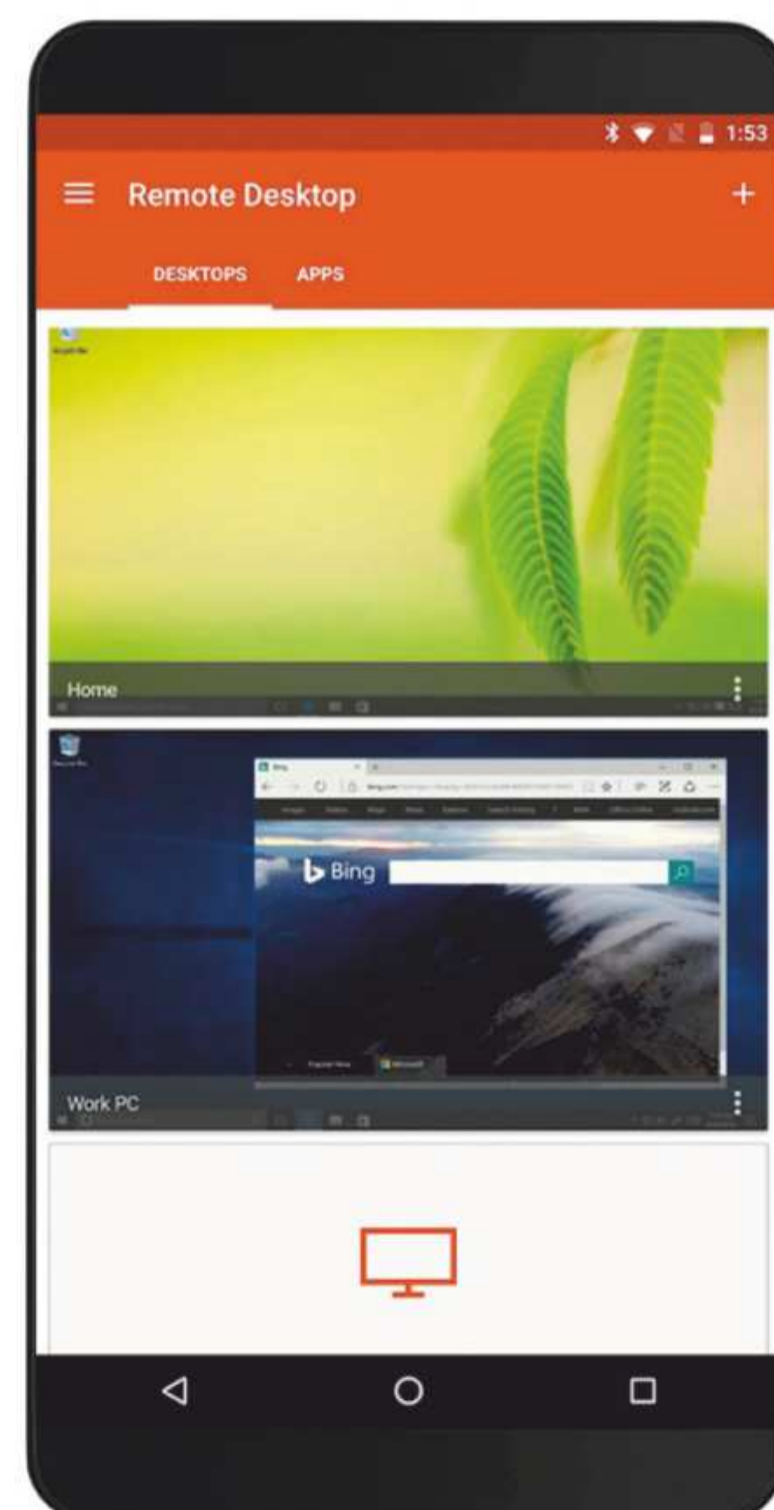
This controls how the screen of the remote computer appears on your mobile device. You can opt to keep the default resolution or switch to a resolution that matches your mobile device.

Tap on the setting for Custom. Here you can select a custom resolution and a custom scaling. You'll want to play around with these settings until you find the optimal resolution for your mobile device. When done, tap Save.

FOR ANDROID

Remote Desktop for Android works similarly to its iOS counterpart. Download the app and launch it. The first screen asks you to accept the license terms. Now follow the same steps described for the iOS app to add a new desktop setting for your remote computer by entering the computer name and the account you want to use to access the PC. Then tap on the setting for the computer to connect to it. Confirm the connection to the PC and tap on the checkbox to "Never ask again for connections to this PC" and then tap on Connect. You should then be connected to the computer.

Tap on the keyboard icon on the top toolbar to display the onscreen keyboard. Tap on the hamburger icon to display the sidebars. From there, you can tap on the "Start New" icon to start another remote session to a different computer, tap on the Home button to return to the app's home screen, and tap on the "Mouse Pointer" icon to display a mouse pointer. To disconnect the current remote session, tap on the X in the thumbnail window for your computer.



Back at the app's home page, tap on the hamburger to access different settings.

Tap on the General setting and change any options you wish.

Tap on the hamburger icon again and tap the Display setting. Here, you can adjust the resolution for your remote session.

Tap on the hamburger icon again. Unless you're using your device from outside your home network, skip the Gateway setting. Tap on the User Accounts setting. Here, you can add another user account for accessing the computer. Tap on the hamburger icon again. Tap the Help setting. The app takes you to a web page with information on how to use Remote Desktop on an Android device.

My Home Tech-History Museum

BY BENJ EDWARDS

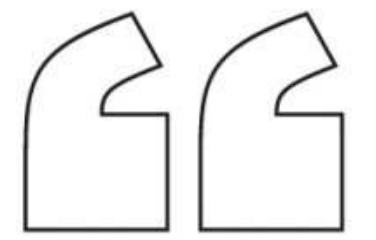


Born in 1981, I grew up on Atari consoles and Apple computers, then NES and beyond, and I never stopped loving the machines I'd used even as others threw them away. I realized that if everyone discarded these devices when they become obsolete, they would eventually be forgotten. So at around age 12, I set out to preserve tech history, and I began to collect as many computers and video game consoles as I could.

With the help of supportive parents early on, and later, my wife, I have amassed nearly 300 computers, 150 game consoles, and tons of accessories over the past 25 years. Gathering a collection like this today would require untold gobs of money, but I acquired most of these items for free or cheaply at times when no one else wanted them.

This collection has been my personal historical archive, a priceless reference that has guided my many written works on computer and video game history over the past 13 years. When I first started writing, you typically couldn't find these machines or literature about them in a local institution. Today, that is finally beginning to change, thanks to universities and museums getting into tech history, so I feel like I can relax my collecting impulse a little.

In fact, earlier this year, I found myself finally approaching a limit to the amount of stuff I could practically store—a peak in my collecting career—so it got me reflecting, looking back at the depth and meaning of my collection. So let's take a quick stroll through its history.



Earlier this year, I found myself finally approaching a limit to the amount of stuff I could practically store.



MY COMPUTER ROOM: 1994 TO 1995

The first old computers I collected as a kid were ones my family already owned: an Atari 400 and 800 and some old PCs. Then a friend gave me his TRS-80 Color Computer, and I was hooked. We were lucky enough to have a house with a spare bedroom that my dad let me use as a sort of playroom where I could set up my computers and video games.

This is that room when I was about 13 or 14 years old. It contained my BBS computer (just off-photo to the left) and various classics: a DEC VT-125 terminal, an Apple II Plus, a NES, a Commodore PET, an Atari Lynx, an Atari Jaguar, an Apple III (under the dust cover), and more. I stored the rest of my collection on a shelf or two inside a closet just off this room.



BEDROOM SHELVES: 1995 TO 1996

By the time 1995 and 1996 rolled around, I had accumulated many more computers from a variety of sources: family friends, flea markets, yard sales, and hamfests. I even bought a few things through the mail from people on CompuServe and the internet.

These are two screen grabs from a recently rediscovered home video, in which I gave a tour of the room seen in the previous photo. Apparently, I had two modular white plastic shelves to hold the bulk of my collection. Among the spoils: lots of Atari stuff, a C64c, a TRS-80 MC-10, a TRS-80 Color Computer, a ColecoVision, three TI-99/4A computers, and a shelf bulging under the weight of 11 disk drives.

I know I had more stuff at the time (I don't see my Atari 800, for example), so it must have been hiding in the closet—or hooked up under the TV set, as it often was.



THE FIRST MAC SHELF: 2003

I moved out of my parents' house in 1999 and moved into a small, one-story house with my brother as roommate. On my first day there, I set up several computers on the kitchen table. My brother said, "Wow, that didn't take long." Elaborate vintage computer setups tend to follow me wherever I go.

Fast forward a few years, and I had taken advantage of a unique architectural feature of that house—a high shelf in a vaulted room—to display my compact Mac collection. I bought most of those Macs at thrift stores around the year 2000 for \$10 each. I count only nine units up there; more were to come.

I left about half of my computer collection at my parents' house and half stuffed away in this house's closets, including the shelf over the washing machine in the laundry room. "Just for once," my brother told me, "I'd like to use that shelf for detergent."



GARAGE VIEW: 2007

In 2007, a year after I got married and moved into a new house, I (naturally) had already filled the house's one-car garage with computers. Here's a view of just one wall of that dark garage covered in shelves full of computer stuff. At the time, I still had almost everything in boxes, so it wasn't as pretty as it could have been. But hey, look at all those Macs! I count 15 compact Macs, which was the peak number for me before I had to start downsizing. Three other walls of the garage were just as full of stuff, and as new items came in, I had to make some very hard choices about what to keep and what to recycle.

Around this same time, I discovered the problems with humidity in a closed garage; I had to keep a dehumidifier running 24 hours a day to deter mold growth. The computers also shared the garage with several cats, which was definitely non-archival.



COLLECTION ANNEX: 2017

Ten years later, I was in yet another house—with a bigger garage. But even 18 years after I moved out of my parents' house, some of my computers still haunted their garage. This photo from 2017 shows the machines that remained, arranged neatly along a wall. Early in 2018, I finally removed most of this stuff, although I think there are still a couple things in there gathering dust. Time to mount a rescue mission.



THE ULTIMATE GARAGE: 2013 TO 2018

Finally, I had it made in the shade. In my two-car, climate-controlled garage and workshop, I covered nearly every inch of every wall with computer and video game hardware and software, displaying all of it for the first time in a fashion I felt was finally deserved by these important artifacts. It was well-lit and wonderful.

But in early 2018, I started to feel the squeeze of too much stuff. Then my wife told me she wanted to move to a quieter neighborhood. I agreed, and with downsizing in mind, I sent out a query on Twitter to see if anyone might want to purchase my collection. The response was overwhelming, and I even ended up on the front page of the local newspaper.

So far I have not sold my collection entirely, but I am beginning to thin it out. I am fairly sure my collection will never be that big again.



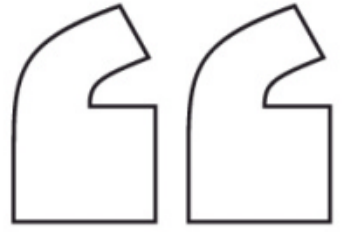
COMPUTER DUNGEON: LATE 2018

So here we are today. After spending nearly two months moving hundreds of computers, dozens of game consoles, thousands of pieces of software, and hundreds of boxes of accessories, I'm exhausted, physically and emotionally. I lost 15 pounds.

After things settled down a bit, I managed to line up some maze-like shelves of computers in my new garage (which is not nearly as well-lit) and snap some photos, christening it my “computer dungeon.” I get lost in it, on occasion. My goal now is to part with enough stuff to be able to safely walk through the garage without being eaten by a troll.

I’m sure I’ll always own some computers and video games—maybe not as much as I had earlier this year but enough to continue my study and appreciation of tech history. For now, the dungeon awaits.

All photos courtesy of Benj Edwards



My goal now is to part with enough stuff to be able to safely walk through the garage without being eaten by a troll.





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CONTRIBUTORS

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