

PC MAGAZINE



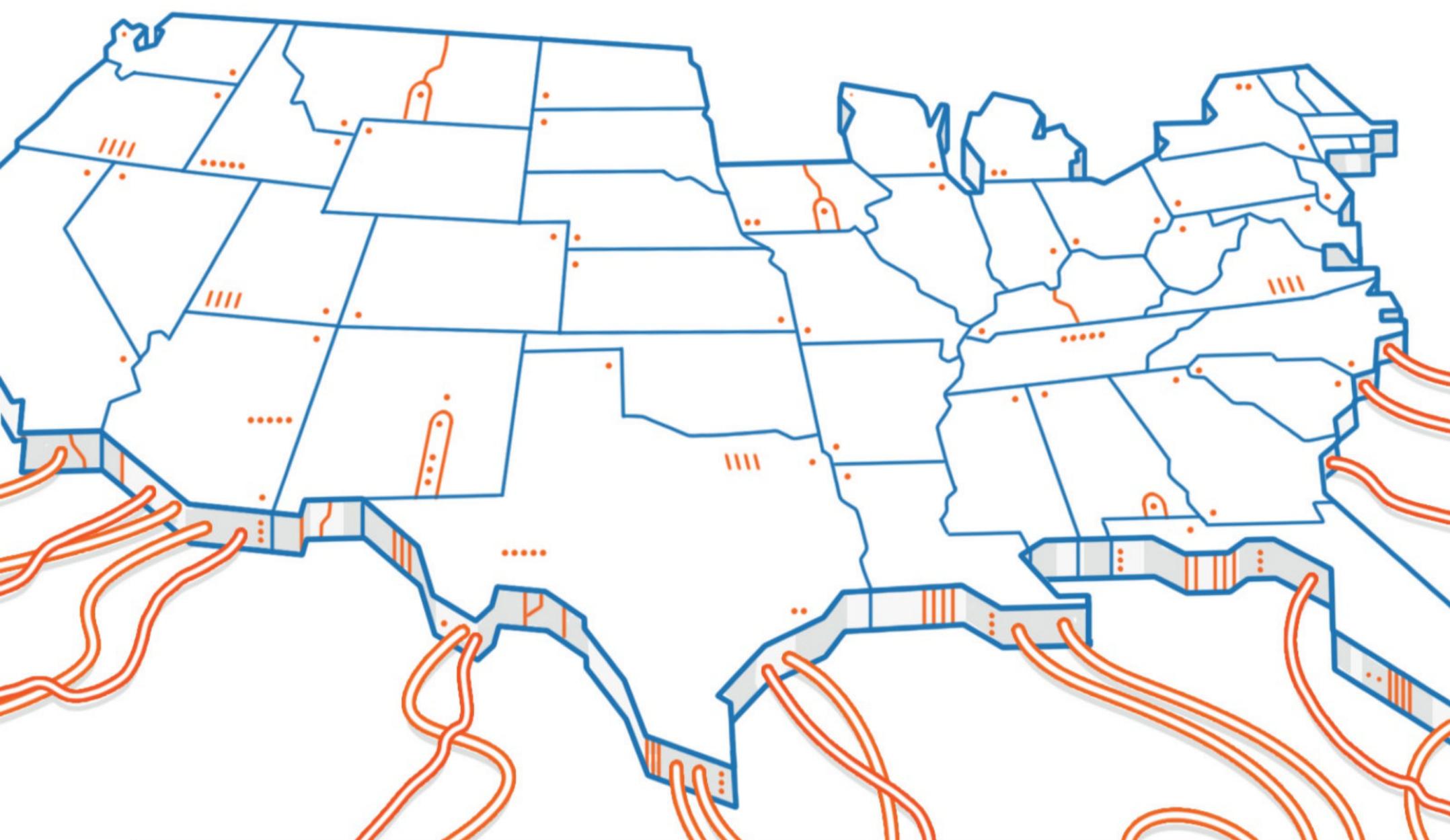
SILICON, USA:

TECHNOLOGY MADE IN AMERICA

COVER STORY

SILICON, USA

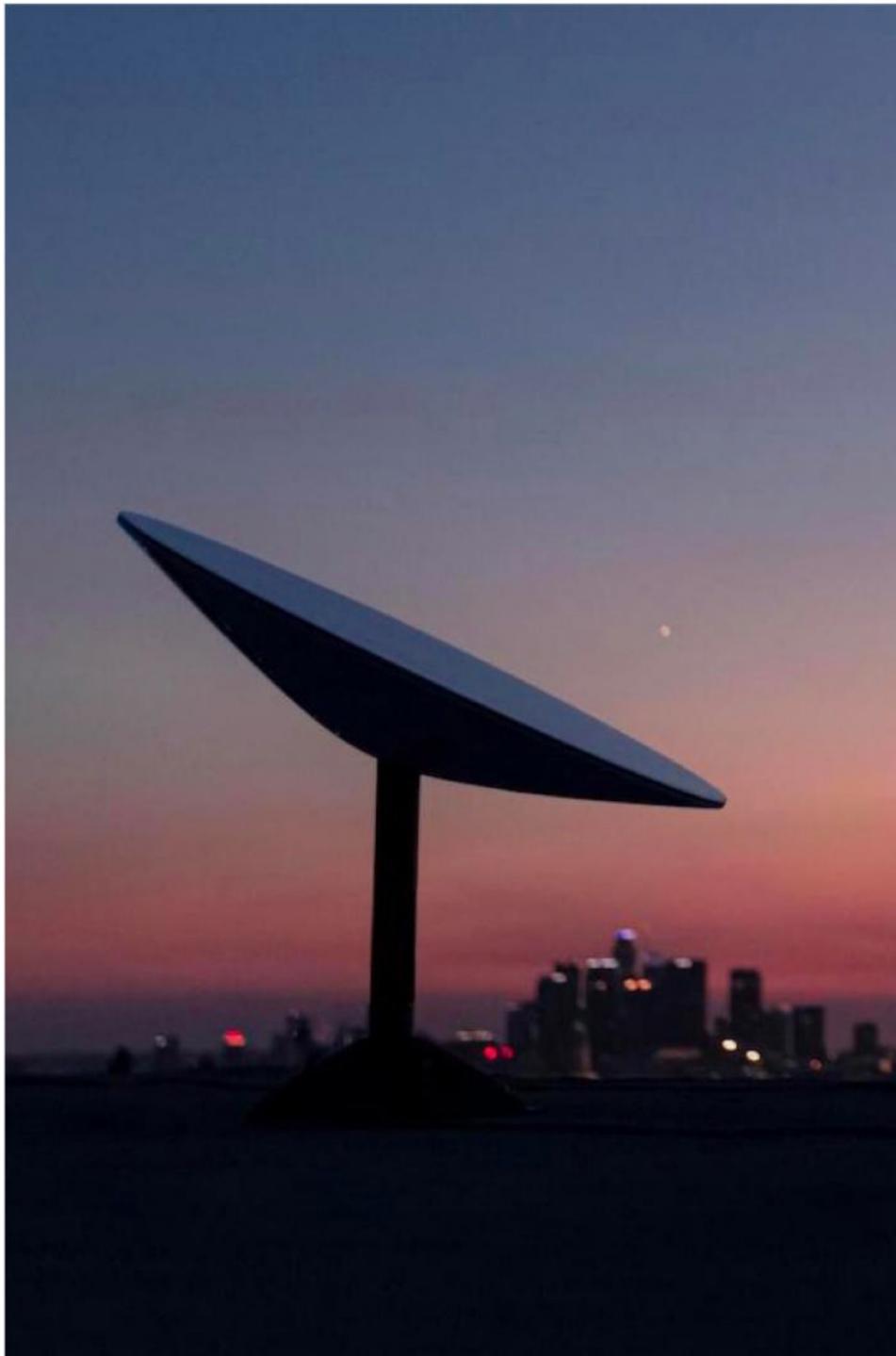
Technology That's Made in America



Ever tried to buy a computer made entirely of US parts and assembled here? You can't. But we found 46 companies making high-quality tech products in the United States.



WHAT'S NEW NOW



DATABASE REVEALS OVER 200K PEOPLE INVOLVED IN POSTING FAKE REVIEWS ON AMAZON

Can you trust the reviews that appear for products offered by third-party vendors on Amazon? An open database discovered on Amazon's servers reveals you can't, and it poses a big problem for the company.

DON'T TRY TO PIRATE MOVIES ON SPACEX'S STARLINK

One Starlink subscriber was curious if SpaceX enforces its policy against downloading copyrighted content. And turns out, it does. The subscriber, "substrate-97," posted the piracy warning notice he received from SpaceX on Reddit.



REVIEWS

CONSUMER ELECTRONICS

Shark IQ Robot Self-Empty XL R101AE

Apple AirTag

HARDWARE

Razer Blade 15 Advanced Edition (2021)

MSI Cubi 5 10M

iStorage DiskAshur M2

Razer Orochi V2 Wireless Gaming Mouse

SOFTWARE & APPS

Mural

PBS Video

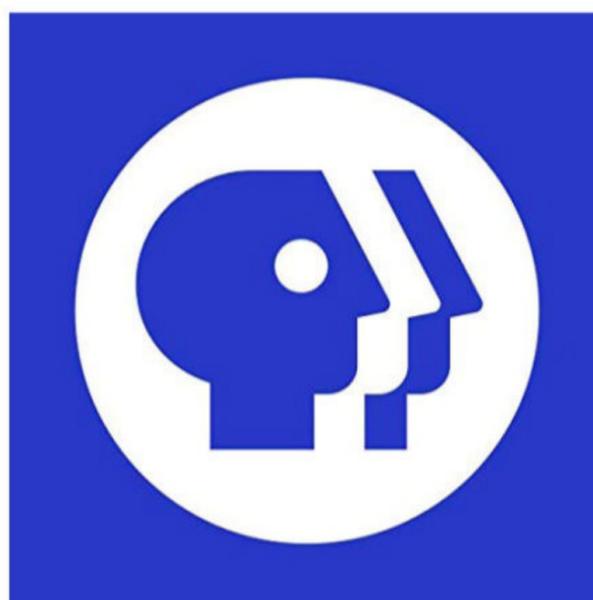


Apple AirTag



MSI Cubi 5 10M

PBS Video



OPINIONS

CAROL MANGIS

**First Word: Home-Grown
Technology**

READER INPUT

Your Comments

SASCHA SEGAN

**Simple Phones: Still Great
After All These Years**

JORDAN MINOR

**Pokemon Games Never
Change: For True Evolution,
Play the Spin-Offs**

TIPS & HOW TOS



**HOW TO CHECK YOUR
HARD DRIVE'S
HEALTH**

**TIPS TO HELP YOU
MASTER GOOGLE
MEET**

**APPLE AIRTAGS:
EVERYTHING YOU
NEED TO KNOW**



Home-Grown Technology

When you shop, do you try to find products that are made in the US? A lot of us do, for multiple reasons. We believe in the quality of American-made goods, we want to support American companies, and we want to keep jobs here in the US as well as create new ones.

But when you're shopping for a new computer, phone, peripheral, or other tech product, finding one that's made in America isn't always so easy. The rise of global manufacturing means that some or all of the components of your new gadget could have been created elsewhere. Sometimes the only thing "made" in the US is the assembly, and lots of times, not even that. But how do you know?

Lots of companies disclose the origin of their devices and components on their websites and elsewhere, but many don't. We decided to reach out to top American-based manufacturers to find out what they actually manufacture here. Most of the companies we contacted responded to our questionnaire, and you'll find those companies listed here in our "Silicon, USA" issue, along with what they make. It's a heartening list, and it's actually a bit longer than I expected. And with the Biden-Harris administration's push to invest in American companies, we'll likely see it grow in the next few years.

@cmangis

Meanwhile, what about the tech you already own? Our mission here at PCMag, along with reviewing new products, is to help you get the most out of your devices, software, and web services. We always include a variety of tip stories and how-tos in our Digital Edition. But I'd love to know how useful these stories are for you and what kinds of tech hacks you're interested in reading. So drop me an email and let me know!

carol_mangis@pcmag.com



Intel, Are You Listening?

Readers have advice for Intel, proffer opinions on vaccine passports, and are cleanly divided on Apple versus Android.

AFTER 'ROCKET LAKE,' 5 THINGS INTEL MUST DO ON DESKTOP TO GET ITS CPU MAGIC BACK

Intel must replicate what Apple has done. The Apple M1 is the first ARM-based system on a chip designed by Apple Inc. as a central processing unit for its line of Macintosh computers. It was inspired by their ARM A14 chip. It is deployed in the MacBook Air, Mac mini, and the MacBook Pro. It is the first personal computer chip built using a 5nm process. Apple claims that it has the world's fastest CPU core.

—Richard Keyes

.....

It is past time for Intel to move its chip design to at least 10nm, achieving all of its economies in circuit density and power consumption, especially when TSMC and Samsung are already at 7nm. It boggles the mind that Intel has been stuck on 14nm for so long.

—Ben Myers

.....

Stop underhanded back-channel deals that prevent legitimate competition. Your products should stand on their own, and you should not have to issue kickbacks to prevent OEMs from using AMD. This kind of trash has bred a lot of resentment.

—Contel

VACCINE PASSPORTS ARE DESTINED TO FAIL

Aside from the obvious creation of a two-class society, which is totally against the fabric that created the US culture and success, this vaccine ‘passport’ is step one in creating a Chinese CCP–type path to the government controlling our movement, activity, lives, and behavior. The article says: “In fairness, Apple and Google’s solution appeared to put privacy first and did a good job of insulating individuals from any sort of data collection by the contact tracing apps.” If you believe the tech giants who will implement this for the current administration are trustworthy, just ask the 533,000,000 people who are now exposed by the raid on Facebook data.

—*Stan K.*

How much for a fake ‘passport’? Would the back-end services for the ‘passport’ always be available? Exactly, how long would a ‘passport’ be valid? Would a ‘passport’ guarantee I’m CV-19 free? Oh, and what about privacy?

—*bobket*

I am a doctor and know full well how important it is to contain infectious diseases as quickly as possible. Yet this concept of an electronic ‘Where’s

Waldo’ vaccination app is one step too far in achieving a victory over COVID-19 at the cost of our personal freedom.

—*Doctor_GOP*

Blockchain is simply a ledger system to prevent data from being manipulated or changed. By itself, it is not intended to maintain privacy or PHI [protected health information], but it can when combined with other technologies. As for the COVID-19 passport debate—yes, as an American, I have the right to not be sickened or killed by another. I have the right to have my health and that of my family sensibly protected. Why is this even a debate? How is this a debate?

—*DontBeStupid*

APPLE iMESSAGE IS A LOCK-IN ABOMINATION

I originally started with Apple back in the day. I soon switched to Android after my first iPhone experience. After 10 years and a number of Android devices, I switched back to Apple. I hear and understand your complaints; however, with my numerous struggles with the inferior Android universe, I am back with Apple for the long, foreseeable future. The grass indeed isn’t greener on the other side.

—*Dr. Movado*

I had an iPhone many years ago but could not put up with [Apple's] lock-in business. I want an open world where software integrates, you have your choice of hardware from many manufacturers, and accessories don't cost an arm and a leg. I am an Android user and won't go back. Having come from an IT background, I understand that most people don't realize the points above and will probably keep using iPhone.
—*Ken Mann*

Why does PCMag continue to strain to find article ideas on issues that real users really don't care about? IMessage is hardly a reason I would or wouldn't consider an iPhone. I don't have any Apple products because they are overpriced and too restrictive, and I prefer the Android ecosystem for many reasons (both technical and personal).
—*Guest*

You can still message people through text on all other platforms. If it's so important to have the same type of features, use a cross-platform product. Apple has every right to keep the 'Blue Bubble' to [itself]. ... For you tech-heads, stop thinking the world wants all this customizability. They don't! They want something that simply works.
—*MJB*

It would take a lot more than a messaging app to get me to switch back to Android.
—*Warren*

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.



Database Reveals Over 200K People Involved in Posting Fake Reviews on Amazon

BY MATTHEW HUMPHRIES



Photo credit: Marcos del Mazo/shutterstock.com

Can you trust product reviews for third-party vendors on Amazon? The discovery of an open database on Amazon's servers reveals you can't, and it poses a big problem for the company.

The cybersecurity experts at SafetyDetectives recently discovered an open AWS ElasticSearch database that contained a “treasure trove” of data related to organized fake reviews on Amazon. The database consisted of over 13 million records and 7GB of data, including direct messages between Amazon vendors and customers who provided fake review scores. In total, over 200,000 people are involved. The evidence points to this being an operation run out of China and targeting both the US and Europe.

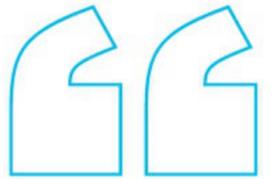
So how does it work? Amazon vendors involved in the scheme produce a list of products for which they want to generate five-star reviews. Customers sign up to take part, then purchase those items on Amazon and wait a few days after receiving them before posting a review. A message is then sent to the vendor along with a link proving the review is live and details of a PayPal account. The vendor then rewards the customer by refunding the purchase but allowing the customer to keep the product.

Because the customer's refund is handled through PayPal, Amazon has no record of it occurring, and therefore has no reason to question the validity of the review. As far as its system is concerned, a legitimate purchase was made, and a review was posted in a timely manner. But customers considering purchasing the same product are being deceived.

Amazon does moderate reviews, but the vendors performing this deception are well aware of the process and checks. The database also contained messages where customers are given rules to follow when creating a review. For example, a specific word count must be exceeded; and in some cases, a video is requested to accompany the text to make it look authentic and avoid a red flag from moderators.

Unfortunately for Amazon, and all online vendors for that matter, the fight against fake reviews can only ever be managed rather than solved. But data leaks like this certainly help show how organized the process is and the techniques used to avoid detection, which hopefully helps improve moderation systems.

In a statement, Amazon said it has “clear policies for both reviewers and selling partners that prohibit abuse



Because the customer's refund is handled through PayPal, Amazon has no record of it occurring.



of our community features, and we suspend, ban, and take legal action against those who violate these policies.” “Our objective is to ensure customers see authentic and relevant reviews so they can make better informed purchasing decisions,” Amazon continued. “To do this, we use powerful machine learning tools and skilled investigators to analyze over 10MM review submissions weekly, aiming to stop abusive reviews before they are ever published.” The company recommends that those who suspect a review is fake should use the “Report abuse” link.

Meanwhile, ReviewGeek noted that the majority of products sold by popular brands Aukey and Mpow have suddenly become unavailable to purchase on Amazon. Although there’s no direct link established between the fake reviews and these brands, the timing suggests the removal may be in response to them.

Amazon declined to comment on specific brand removals but said “We work hard to build a great experience for our customers and sellers and take action to protect them from those that threaten their experience in our store. We have systems and processes to detect suspicious behavior and we have teams that investigate and take action quickly.”

Don't Try to Pirate Movies on SpaceX's Starlink

BY MICHAEL KAN



Photo credit: SpaceX

If you try to openly pirate movies on SpaceX's satellite internet service Starlink, be prepared to receive a warning from the company demanding that you stop.

One Starlink subscriber was curious whether SpaceX enforces its policy against downloading copyrighted content. Turns out, it does. The subscriber, "substrate-97," posted the piracy warning notice he received from SpaceX on Reddit in May.

“We must insist that you and/or others using your Starlink service refrain from illegal downloads of copyrighted content,” the notice said. “Downloading copyrighted materials without a license may lead to suspension or termination of your service, and put you at risk of legal action by the content owner.”

Substrate-97, who is based in the US, said on Reddit that they were deliberately torrenting over Starlink to see what would happen. A file download for a “CBS show” ended up triggering the warning.

“Been doing it since I got Starlink, so like two months,” substrate-97 added. “It’s been pretty low key stuff though. Finally downloaded something from a Fortune 500 company and my assumption was that it was specifically that.”

The notice also reveals that Starlink tries to stop piracy in the same way some ground-based internet service providers do: If the ISP becomes aware you’re downloading a bootleg movie, it can send a warning to the offending subscriber. This can occur when the copyright holder is tracking torrent downloads for a movie file. The copyright holder can supply the ISP with a list of IP addresses associated with the pirated movie file and demand it take action.

Still, it’s not hard to mask your real IP address. Although we don’t condone piracy, it’s well known that you can prevent a broadband provider from logging your internet traffic by using a VPN, which encrypts the connection. A VPN can also change your computer’s IP address. So a Starlink user can still theoretically pirate content on the service as long as they don’t do it openly.

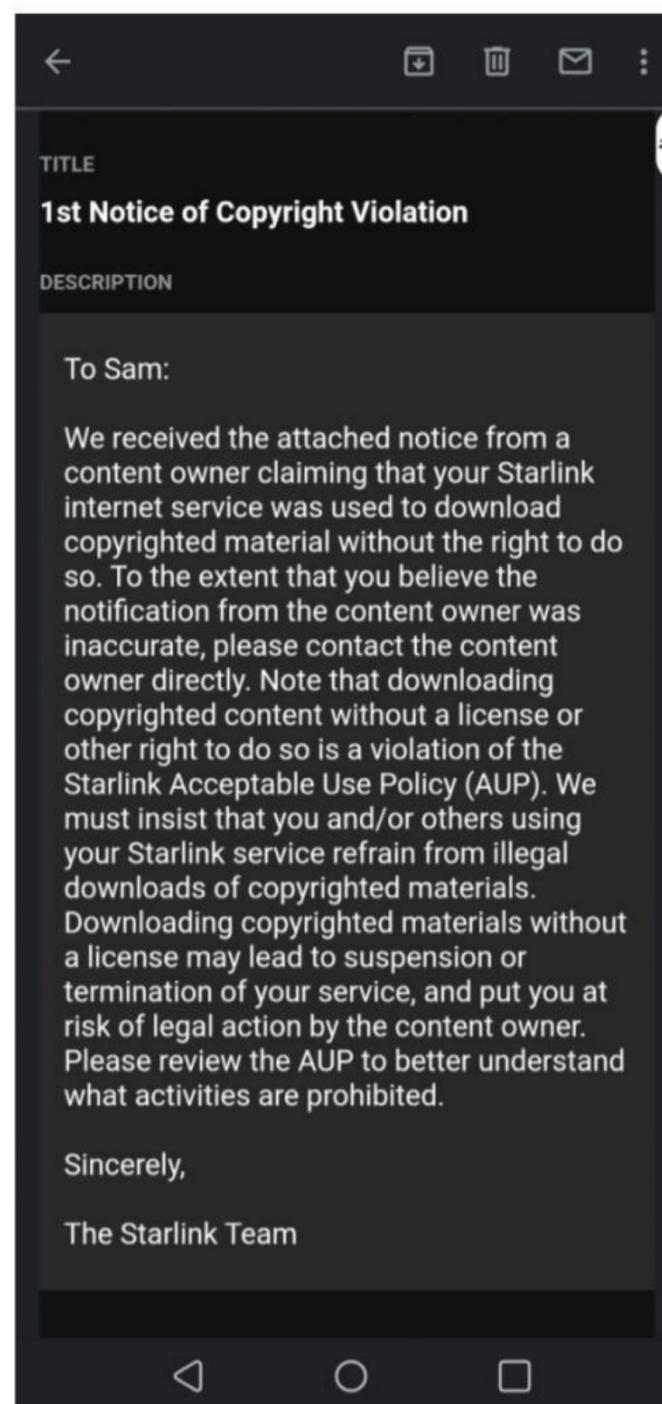


Photo credit: Substrate-97

Simple Phones: Still Great After All These Years

I've been steeping myself in simple voice phones, which feels like getting back to my roots. Back when I first joined PCMag in 2004, reviewing bar phones and flip phones was a big part of my job. Now, they're just a sideshow in a smartphone-dominated market.

These streamlined handsets are predominantly owned by people age 65 and over and people who make less than \$30,000. According to Pew, 85% of Americans own smartphones, and only 12% own voice phones. But 12% of the population is still millions of people, and pretty soon, they'll all be shopping for new phones. Carriers are ditching old 2G and 3G networks because they use airwaves less efficiently than 4G does, and that's going to turn a lot of older voice phones into doorstops. So I decided to go all in with testing the latest and, in some cases, greatest voice phones.

I took a look at the inexpensive Nokia 225 4G (\$49.99), Nokia 6300 4G (\$69.99), and Nuu F4L (\$79.99), and the costlier Sunbeam F1 (\$195) and Punkt MP02 (\$349). Waiting on my desk is the Kyocera DuraXE Epic (\$269.99). I've also, in the past, liked the Sonim XP3 (\$240) and the Kyocera DuraXV Extreme (\$240).



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.

These phones generally fit into three categories: low-end basic phones, such as the Nokias and the Nuu F4L; classy “digital disconnecter” models, such as the Light Phone II (\$350), the Punkt, and the Sunbeam; and beefy ruggedized phones from Kyocera and Sonim.

Unfortunately, many inexpensive 4G voice phones tend to be sluggish, sloppy, and buggy. One of the phones I tested, the Jethro SC490, wanted to send my location data to China. If you want quality, you’ll have to pay for it. My favorite voice phone so far, the Sunbeam F1, runs on hand-crafted American software, but it costs \$195. If you’re on a really tight budget, though, the Nokia 225 4G isn’t bad, and the Nokia 6300 4G is pretty good.

So what’s stopping phone manufacturers from putting out inexpensive, functional voice phones for the low-income people who want them? Right now, it’s the software, which is both too modern and not modern enough.

Low-power older OSes designed for voice phones can’t handle high-quality synchronous voice calling over packet-based 4G networks. Most voice phones run variants of Android and other smartphone operating systems that demand a huge amount of power for the seemingly simple task of making a call. They can usually manage only about 6 hours of talk time before running out of juice.

For some reason, all the Android-based voice phones I tested recently use Android 8.1. (I asked Google why this might be the version of choice for

voice phones; the company didn't have a response.) And the texting app built into Android 8.1 has no idea what group texts are: It can read them, but it will reply directly to a message's sender only. Since most people use group texts at least occasionally, that's a big problem.

A company can invest in its own operating system (say, Sunbeam's BasicOS or Nokia's Series 30+) or custom apps (such as Punkt's Pigeon implementation of Signal), but that costs money. So at the discount end of the market, you get Android 8.1 phones that struggle with calling and texting. And since the whole point of voice phones is that they mostly can't run apps or get onto the internet, there's not much reason left to own one. That's going to remain the case until someone figures out an inexpensive way to bring voice phone software into the era of 4G and 5G.



**Low-power
older OSes
designed for
voice phones
can't handle
high-quality
synchronous
voice calling.**



Pokemon Games Never Change: For True Evolution, Play the Spin-Offs

For a franchise all about monsters who evolve into superior forms, Pokemon is pretty stagnant. While Nintendo is very conservative when it comes to updating its beloved games, it also recognizes when it's time to do something cool and experimental, like send Mario to space or turn Zelda into an open-world masterpiece. But core Pokemon games, the role-playing games that serve as the backbone for the entire enterprise, never get to be that radical.

The Pokemon Company argues that because these games primarily appeal to children—any Pokemon game will be some generation's first Pokemon game—there's no need to overcomplicate the proven 25-year-old formula. Whether or not you buy that reasoning, it's hard not to feel like it excuses laziness. I think fans would've accepted cutting down the number of Pokemon in Sword and Shield if those games had higher production value.

But Pokemon endures as an institution that's arguably bigger than gaming itself because of its richly realized world that teems with fantastical life, a world people of all ages want to become a



PCMag Software analyst Jordan Minor was senior editor for Geek.com and a PCMag intern before that. He has written for Kotaku, The A.V. Club, and Cards Against Humanity.

part of. It's bristling with potential for awesome, innovative gameplay ideas, just not in the core games. Instead, for the Pokemon games that truly change and push things forward for the better, play the spin-offs.

NEW POKEMON PERSPECTIVES

This year saw the return of one of the most imaginative Pokemon spin-offs with New Pokemon Snap. Where main Pokemon games get snarky criticism for being kid-friendly dog-fighting simulators, New Pokemon Snap is fully committed to non-violence. It uses the bones of a rail shooter to create a first-person photo-safari adventure. Players snap pictures of Pokemon in their natural habitats, not battling anyone for the humans' entertainment.

As a game about photography, New Pokemon Snap places a huge emphasis on visuals. And thanks to its relatively small environments, the game has gorgeously detailed graphics that put traditional games in the franchise to shame. Using the full HD power of the Nintendo Switch, New Pokemon Snap renders legendary Pokemon such as Lugia and Xerneas in all their majestic splendor. Watching baby Grookey and Pichu sleep in the grass is as adorable as it needs to be. New Pokemon Snap is a fantastic example of how spin-offs are free to offer fascinating new perspectives on the Pokemon world that RPGs simply can't.

Before it made New Pokemon Snap, Bandai Namco made the bonkers Pokemon fighting game Pokken Tournament. Using ideas from Namco's own Tekken series, Pokken ditched traditional

turn-based fighting to instead let players act out the action-packed, real-time battles we previously only saw in the anime. Who doesn't want to pull off electrified wrestling moves with Pikachu Libre or burn opponents as the haunted chandelier Chandelure? Like New Pokemon Snap, Pokken presents the pocket monsters with far more visual detail than we're used to seeing. Of course Lucario is covered with fur—it's a psychic dog.

Other developers have also found success putting a Pokemon wrapper on a surprising genre. Pokemon Conquest mixes strategic monster battles with actual Japanese history. The Pokemon Mystery Dungeon series makes the infamously punishing roguelike more tolerable. We've seen Pokemon puzzle games, pinball games, and racing games. Soon, we'll get a Pokemon MOBA mashup with Pokemon Unite. And although there are far too many Pokemon fan games to list here, one of my favorites from back in the day was an extremely clever Pokemon tower-defense game. There's far more creativity in this franchise once you branch beyond the RPGs.

YES, IN MY BACKYARD

We want Pokemon to be real. We want to have a partner Bulbasaur, Charmander, or Squirtle of our very own. We want to see Trubbish on the street, not a regular, non-living bag of trash. The best Pokemon spin-offs fulfill our desire to see Pokemon as plausible living creatures, as actual animals and not just a collection of stats for RPG battles. Hey You, Pikachu! may barely be a video game, but letting you talk to Pikachu with a microphone is an incredible pitch.



The best Pokemon spin-offs fulfill our desire to see Pokemon as plausible living creatures.



Just look at the unprecedented success of Pokemon Go. That's another game where the gameplay is very thin and arguably pretty bad (despite having some hidden depth if you know where to look), but it doesn't matter. Turning on your phone, walking down the street, and seeing Pokemon pop up in front of you and your friends is an experience too powerful for anyone with a heart to resist. It single-handedly justifies augmented reality as a new form for consumer technology. This is Pokemon in the real world.

The movie *Pokemon: Detective Pikachu* is extremely not a video game (despite sharing its title with another charming left-field Pokemon spin-off), but it delivers this need to see Pokemon in the real world unlike anything else. Laugh all you want about disturbingly realistic Mr. Mime, but witnessing an entire society where live-action humans and CGI Pokemon interact is what dreams are made of. It's Blade Runner for children. Beyond the mind-blowing aesthetics, Detective Pikachu's plot respects Pokemon lore, from Cubone's dead mother to the implications of Ditto's body-morphing to Mewtwo's elaborate backstory. Its characters take things just seriously enough for the world to have real weight, however light, alongside wacky hijinks with superpowered pets.

CHANGE TAKES TIME

Of course, the reason these spin-offs can take big chances the mainline games can't is because they don't have to shoulder the risk. They don't have to prop up the brand. They can take their time, because they don't need to synchronize with the anime, trading cards, and other merchandise that needs to stay on a strictly profitable schedule. We get a new Pokemon generation about every three years. Meanwhile, New Pokemon Snap came out 20 years after the original game.

Even if progress happens too slowly, innovation eventually trickles into the core Pokemon RPGs. They have 3D graphics now, not 2D sprites. Pokemon Let's Go Pikachu and Eevee integrated smart ideas from Pokemon Go into its Pokemon Yellow remake. Pokemon Black and White had an honestly intriguing story that interrogated the very morality of harnessing Pokemon for battle. And for all its unpolished issues, Pokemon Sword and Shield introduced the open-world Wild Area that teased the most exciting leap forward for the franchise yet.

I can't wait to see how that open-world concept finally evolves into the upcoming full-blown action-RPG spin-off *Pokemon Legends: Arceus*—the *Pokemon* game fans have envisioned in their heads for years. Whether or not Game Freak can execute on the idea, it's at least promising that the team recognizes that taking ideas from *Breath of the Wild* is the right radical direction for modern mainline *Pokemon* games.

GOTTA SPIN 'EM OFF

Adults and hardcore gamers who play *Pokemon* should probably come to terms with the fact that they'll never be *Pokemon*'s target audience. The RPGs will never ask you to care about esoteric mechanics like EVs, IVs, or whatever, and they shouldn't.

But just because these games aren't difficult and complicated doesn't mean they can't be fresh and original. If you want weird, entertaining, and unexpected *Pokemon* gameplay experiences, don't play the games about catching them all. Play the games about taking pictures of them all, fighting them all, or walking past them all on the street.



\$599.00 | EDITORS' CHOICE Rating: ●●●●○ EXCELLENT

Shark IQ Robot Self-Empty XL R101AE: True Hands-Free Robot Vacuum

BY ANGELA MOSCARITOLO

The point of using a robot vacuum is to cut down on your housework, but most of these devices need to be emptied and cleaned often, adding at least one more chore to your list. A lower-maintenance option, the Shark IQ Robot Self-Empty XL R101AE works quickly and efficiently, rarely gets stuck, and has a large dustbin in its base station that needs to be emptied only about once a month. You can control the robot from your phone or with your voice and set up cleaning schedules so it gets to work when you want it to. The vacuum maps your home as it cleans, so you can send it to specific rooms and create virtual no-go zones (features you don't get with the similarly priced iRobot Roomba i3+). It's also a compelling option for pet owners thanks to a self-cleaning brushroll and enough power to suck fur from carpeting. All of these features earn the R101AE our Editors' Choice award.

HANDS-OFF CLEANING

The IQ Robot XL (R101AE) is the most expensive model in Shark's lineup and features a bagless base that holds up to 30 days' worth of dirt and debris. A more affordable alternative, the Shark IQ Robot (\$449) has a smaller base that holds around two weeks' worth of debris but is otherwise the same as the XL model.

As recently as a couple of years ago, you'd be hard-pressed to find a sub-\$1,000 self-emptying robot vacuum, but the prices for these models have been dropping. Last year, iRobot introduced the aforementioned Roomba i3+, which at \$599 is the company's most affordable model with a self-emptying dustbin. Other self-emptying vacuums in this price range include the Ecovacs Deebot Ozmo N8 Pro+ (\$699; it also works as a mop) and the Neabot NoMo (\$599), both of which we plan to test.

Most self-emptying robot vacuums empty the contents of their bins into a bag, so you never have to come into contact with dust and debris. The downside is that you eventually have to buy more bags when you run out.

The IQ Robot XL, on the other hand, has two dustbins: one in the robot itself and a larger one in the base station. Each time the Robot XL returns to its dock after cleaning, it makes a loud noise as the contents of its bin are transferred to the base station. A transparent window on the left side of the base dustbin lets you check the fill level.

When it's full, you simply press a release button on the top of the base, slide out the dustbin, hold it over a trash can, then press the Empty button on the side. The bottom of the dustbin opens, and the contents fall out into the trash. It's a relatively clean process, though if you have severe allergies to dust, you might prefer a bagged model.

Shark IQ Robot Self-Empty XL R101AE

PROS Features a bagless self-emptying base and self-cleaning brushroll. Maps your home and supports scheduling, area cleaning, and virtual no-go zones. Works with Amazon Alexa and Google Assistant. Comes with a physical boundary strip. Never got stuck in testing.

CONS Average battery life. Can get loud.

BOTTOM LINE The Shark IQ Robot Self-Empty XL R101AE vacuum holds up to a month's worth of dust and debris in its base station, and features a self-cleaning brushroll and lots of smart features for a truly low-maintenance experience.

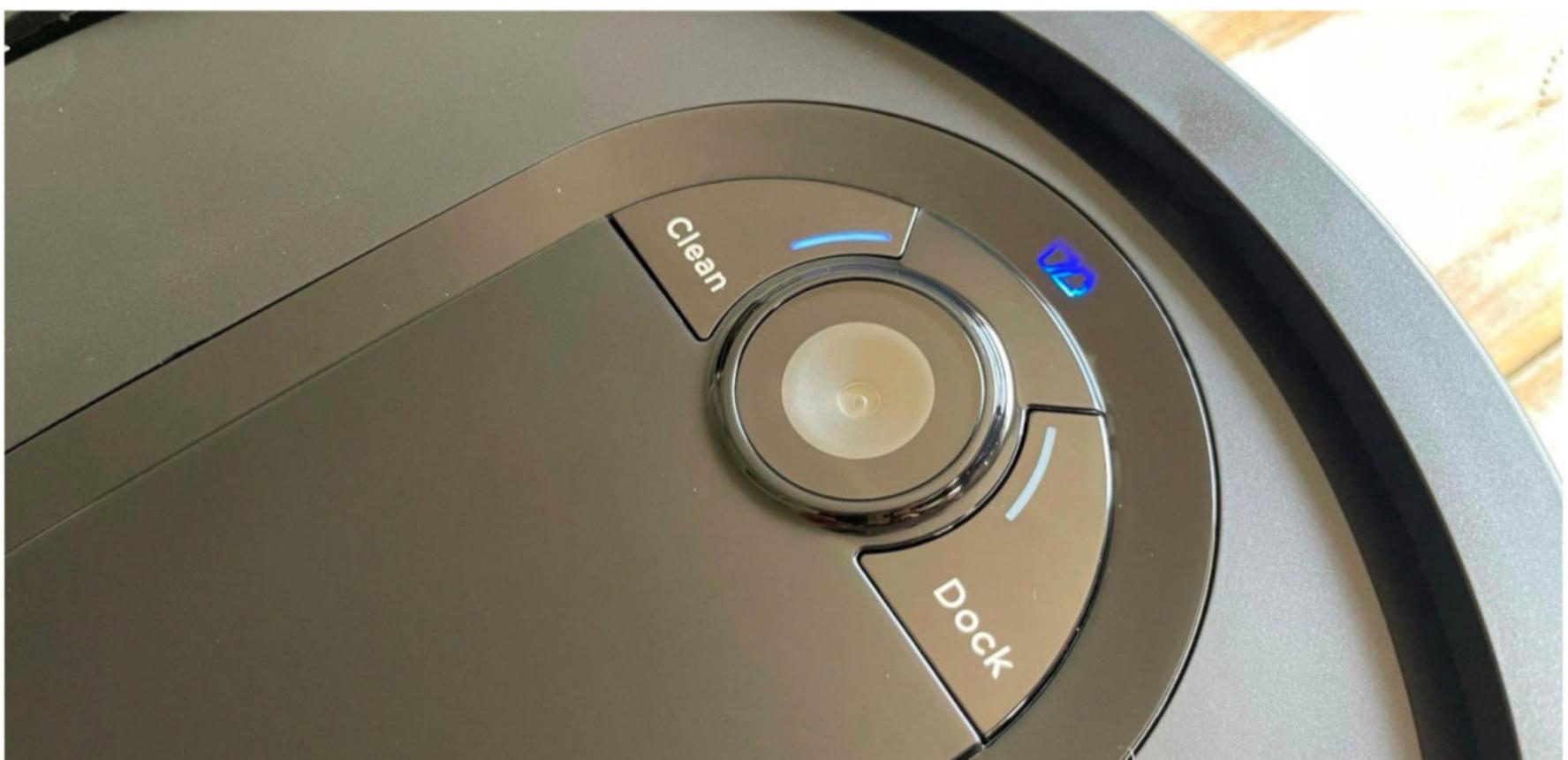
R101AE DESIGN AND FEATURES

The IQ Robot XL has an all-black utilitarian design. It measures 12.9 by 12.6 by 3.5 inches (LWH) and weighs 5.87 pounds. The base is about 15 inches tall. It won't win any style awards, but what a robot vacuum looks like is less important than whether it works well, and this one does.

The vacuum doesn't come with a remote, but you can control it with the physical Clean and Dock buttons on the top of the unit, with your phone via the SharkClean app (available for Android and iOS), and with voice commands via Amazon Alexa or Google Assistant. Situated between the Clean and Dock buttons is the IQ Navigation module, which allows the robot to map your home and assess its location. Inside the robot's dustbin is a high-efficiency filter that captures airborne dust, dander, and allergens as it vacuums.

On the bottom, the IQ Robot XL features two side brushes and a self-cleaning brushroll, which constantly filters pet and human hair into the dustbin so it doesn't get wrapped around the roll—a common problem with robot vacuums. A Shark spokesperson says the brushroll is able to do this because it features fins and bristles that “comb through the hair and actively remove it.”

The IQ Robot XL has three power levels: Eco, Normal (the default option), and Max. As its name suggests, Max offers the most suction power, but also drains the robot's battery the fastest. Eco offers the least suction power but drains battery the slowest. Some robot vacuums, including the Ecovacs Deebot Ozmo T8 AIVI (\$799) and the Proscenic M7 Pro (\$499), automatically increase their suction power when cleaning over carpets and heavily soiled areas, but the IQ Robot XL doesn't.



The robot has a Recharge and Resume feature, which is turned off by default but recommended for homes larger than 1,500 square feet. When enabled, the IQ Robot XL returns to its base to recharge when it's running low on battery power, then picks up where it left off. To enable/disable Recharge and Resume, press and hold the Clean button for 15 seconds.

It also offers a feature called Evacuate and Resume, meant for homes with pets. When enabled, the robot returns to its base to empty the dustbin after 30 minutes so it doesn't get overly clogged with pet hair, then resumes cleaning where it left off. Shark says you shouldn't enable this feature if your home is smaller than 1,000 square feet. To enable or disable Evacuate and Resume, press and hold the Dock button for 15 seconds.



SIMPLE TO SET UP

To start using the IQ Robot XL, simply remove all the protective film from the robot and base, attach the side brushes to the posts on the bottom, and flip the switch on the side of the robot to turn it on.

Next, locate a spot for the base. Shark recommends setting it up at least 3 feet away from anything on either side and 5 feet across from anything. For the best results, set up the base on a bare floor; if you need to place it on carpet, use the included plastic mat. Then plug the base power cord into an electrical outlet, flip the power switch on the back to turn it on, and a small green light on the left side of the base illuminates, indicating it has power.

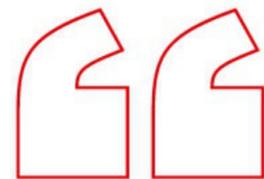
From there, pick up the robot and put its back side up against the base. When it starts charging, you'll hear a beep, and a blue charging-indicator light on the base pulses. When the robot is fully charged, the light turns solid blue. Shark suggests charging it for 6 hours the first time.

While you're waiting for the vacuum to charge, it's a good idea to prep your home. Shark recommends clearing any cords and removing objects such as toys, clothing, and drapes from the floor, and opening the doors to areas you want cleaned and mapped. For best results, Shark recommends running the robot in well-lit conditions. The company also says to avoid moving the robot or the base, as doing so can impact its ability to map your home.

The robot comes with a physical boundary strip that prevents it from cleaning areas you want it to avoid, such as pet bowls or power cords, though you can also use the map in the app to do this to some extent. Like most floor-cleaning robots, the IQ Robot XL features cliff sensors that prevent it from falling down stairs.

When you connect the robot to its SharkClean companion app, it builds an interactive map of your home, allowing you to select specific rooms for area cleaning. The app also lets you create a cleaning schedule, remotely control the robot from wherever you are, check its battery level, and view cleaning reports.

After downloading the app, follow the on-screen instructions to create and verify your account. When you're ready to connect it to the app, press and hold the Dock and Clean buttons simultaneously until the robot's Wi-Fi indicator light begins to blink blue, indicating it's in setup mode. The first time I tried putting it in setup mode, nothing happened, so I turned the robot on and off, and it then worked.



When you connect the robot to its SharkClean companion app, it builds an interactive map of your home.



When you see the flashing blue Wi-Fi indicator, press Continue in the app, then tap OK when prompted to allow SharkClean to connect to other devices on your local network. Next, select your home Wi-Fi network from the list, enter your password, press Continue, and you should be good to go. After you've successfully connected your robot to the app, it asks you to name the vacuum and gives you the option to enable the Evacuate and Resume feature.

R101AE CLEANING PERFORMANCE

The IQ Robot XL moves quickly and efficiently, cleaning in straight lines instead of haphazardly ping-ponging from wall to wall, as some cheaper robot vacuums do. On its first test run, the IQ Robot XL cleaned for 88 minutes in Normal mode before successfully returning to its docking station to empty its dustbin and recharge. When setting up the robot, I enabled the Evacuate and Resume feature—so 30 minutes into its first test run, the IQ Robot XL navigated back to its base station, emptied its bin, then resumed cleaning right away.

On its second test run, the robot cleaned for 97 minutes in Normal mode, beating the Roomba i3+, which lasted 90 minutes in testing, but falling far short of the Deebot Ozmo T8 AIVI, which cleaned for 170 minutes, the longest of any robot vacuum we've tested. Close to 100 minutes is a decent battery life result, but we've tested a number of models that cross the 100-minute mark.

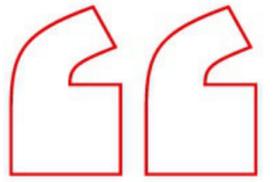


In testing, the Robot XL always successfully maneuvered around furniture and traversed area rugs, carpeting, and hard flooring with ease. On its first two runs, it never once got stuck, even on places that have tripped up other robot vacuums in the past, such as the cords under my bedroom dresser.

After each test run, my floors looked noticeably cleaner. I have a pitbull named Bradley who sheds, and the IQ Robot XL did an excellent job of collecting his fur from my floors. A high concentration of dog hair usually collects on the floor around my living room couch, where Brad likes to relax during the day. When I checked this area after the IQ Robot XL cleaned, it was completely free of dog hair. It also left behind no trace of hair from the white rug in my office.

After those first two test runs, I could already see some debris through the docking station's fill window. Though it wasn't nearly all the way full, I emptied it early for testing purposes and was pleasantly surprised to see how much dirt, debris, and dog hair the robot had collected.

Next, I checked the brushroll on the bottom to verify Shark's claim that it can clean itself. I'll admit, I was a bit skeptical, but it actually works. After two cleaning sessions, the brushroll on the bottom of the robot was hair-free. As someone with long hair, one of my biggest problems with robot vacuums is that after a few runs, hair gets wrapped around the main brush. I then have to remove the brush and cut away the hair, a seriously icky task. You still might have to do this at some point with the IQ Robot XL but less frequently than with other robot vacuums. That's a big perk if you have long hair or live with someone who does.



On its first two runs, it never once got stuck, even on places that have tripped up other robot vacuums in the past.

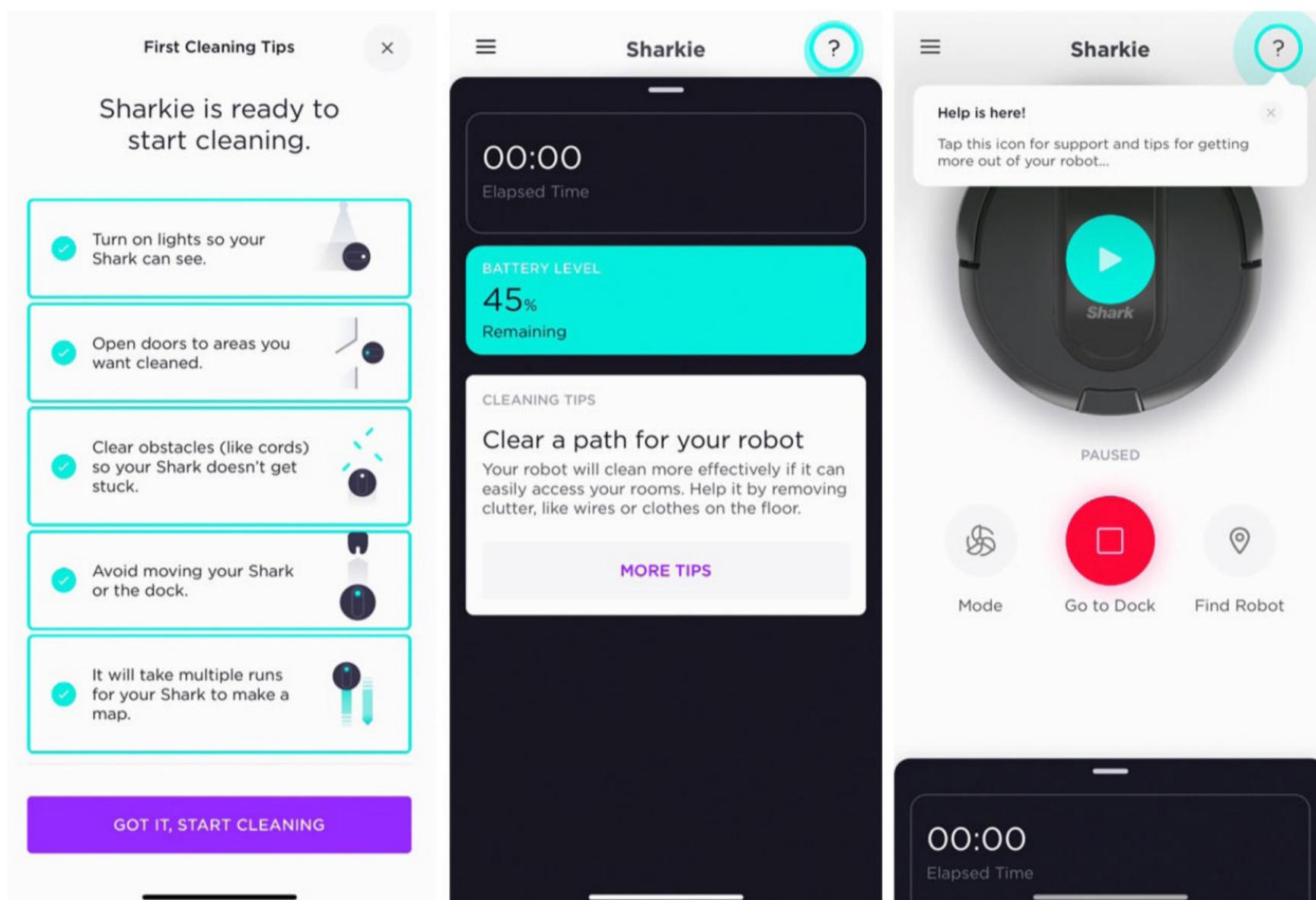


My one gripe is that the IQ Robot XL can get a bit loud, especially when it's working over hard flooring. In Normal mode, it operates at around 57dB over hard flooring and 53dB over carpet, according to readings from the NIOSH Sound Level Meter app taken in the same room. In Max mode, it gets even louder; Eco mode is the quietest option. The CDC says that 60dB is about the volume of a normal conversation or air conditioner.

The SharkClean app is well designed and makes it easy to control the IQ Robot XL and take advantage of its smart features. In the middle, there's a purple Clean button; just tap that to send the robot on its way. In testing, the robot always quickly responded to app controls.

While the robot is cleaning, the app keeps track of how long it's been working and lets you view the remaining battery level. You can use the app to change modes or to cut the job short and send it back to the dock. A Find Robot button can help you locate your vacuum if it goes missing.

Shark says that it might take the IQ Robot XL multiple runs to generate an interactive map of your home. In testing, it took only one run to map my roughly 1,000-square-foot main level. Shark says the robot will continue to refine the map as it completes additional runs.



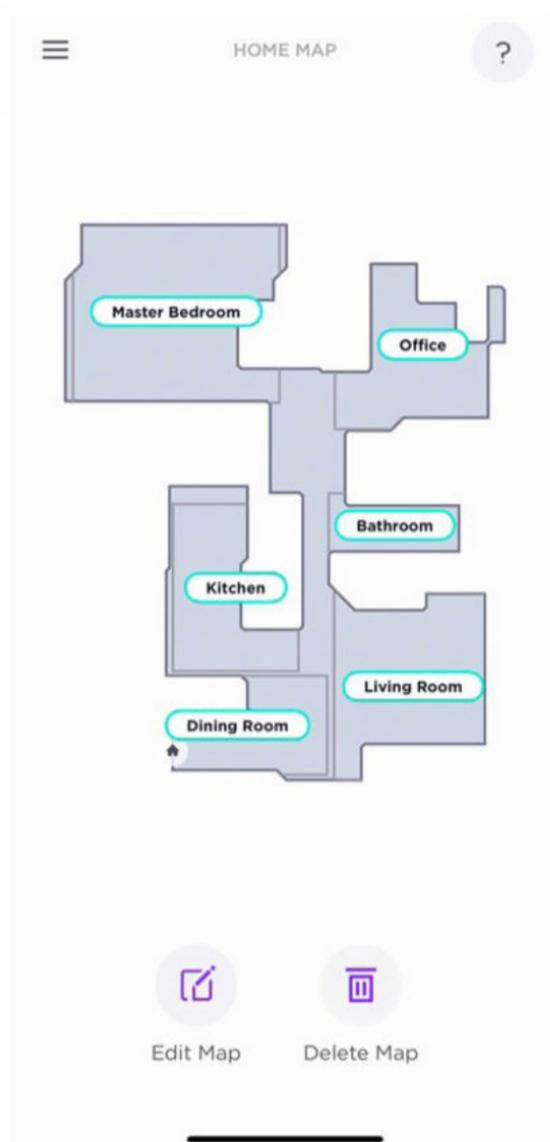
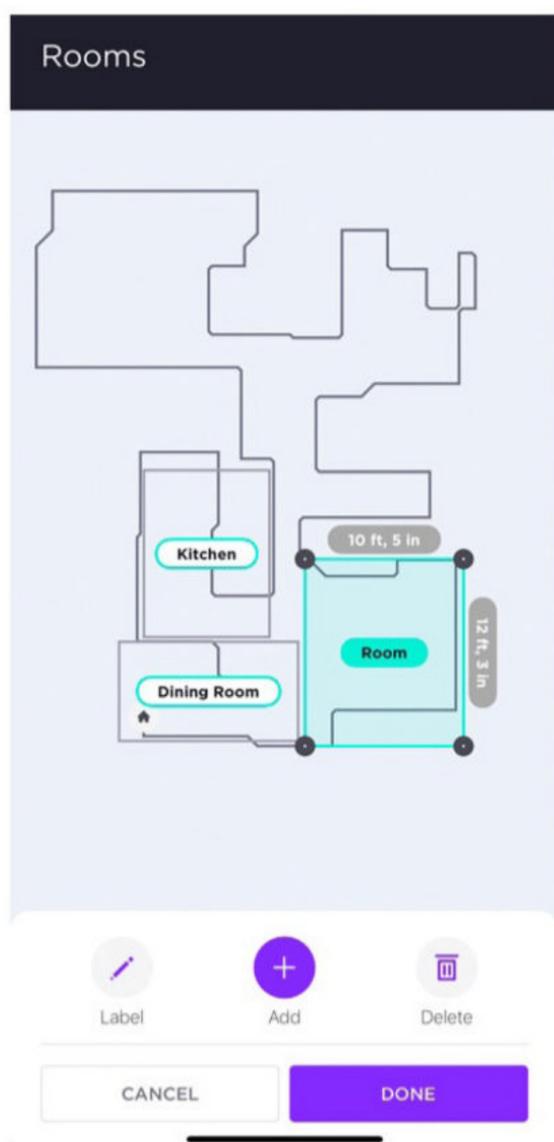
With a few clicks, you can change the orientation of the map, label each room, and create virtual no-go zones. After you label your rooms, you'll be able to select which ones you want cleaned, and the robot goes straight there.

The app also makes it easy to create a cleaning schedule so the robot gets to work at a specific time on certain days. To create a schedule, you select the days you want it to clean and set a start time. You can repeat the same schedule for each day of the week or have it clean at different times. A large toggle lets you quickly disable or enable all scheduled cleaning jobs. In testing, the robot successfully adhered to the schedule I created.

At this point, it isn't possible to schedule the IQ Robot XL to clean a specific room, a feature that is available on the \$249 Wyze Robot Vacuum. And you can't schedule it to run multiple times per day—just once. Shark says it may add these features in the future.



With a few clicks, you can change the orientation of the map, label each room, and create virtual no-go zones.



In testing, I had no problem connecting the vacuum to Amazon Alexa (just search for and enable the Shark skill in the Alexa app). Once connected, the robot responded to voice commands such as, “Alexa, tell Shark to start cleaning,” and, “Alexa, tell Shark to pause cleaning.”

Getting the vacuum connected to Google Assistant took a few tries, as the Shark app didn’t appear when I went through the usual process of linking a new device with the voice assistant via the Google Home app on both an iPhone and Android handset. I got it to work via the Google Assistant app on my iPhone following a method I found on Reddit: Tap the compass icon in the lower-right corner, then search for Shark, and you should be able to link your accounts that way. I was then able to control it with voice commands such as, “Hey Google, start cleaning with my Shark,” and “Hey Google, stop cleaning with my Shark.”

TRUE HANDS-FREE CLEANING

Using a robot vacuum can sometimes feel like trading one chore for another: You no longer have to vacuum your floors, but you have to clean your robot all the time. The Shark IQ Robot Self-Empty XL R101AE, however, is more self-sufficient than most of the competition. It can store up to 30 days’ worth of dust and debris in its bagless base, so you need to empty it only about once a month, and it features a self-cleaning brushroll that prevents hair from getting wrapped around it. In testing, the vacuum delivered strong suction power, effectively cleaning dust, debris, and pet hair from hard flooring and carpet, and it never got stuck. It offers a number of useful smart features, including home mapping for targeted room cleaning and virtual no-go zones, perks you don’t get with the comparably priced Roomba i3+.

Allergy sufferers might prefer the Roomba i3+, which empties its bin into an AllergenLock bag so you’re not exposed to dust. The IQ Robot XL’s bagless design is more convenient and wallet-friendly, however, since you don’t have to buy replacement bags. Unless you’re allergic to dust, we recommend the IQ Robot XL—this convenient and powerful robot vacuum is well worth the price and is our Editors’ Choice winner.



\$29.00 | EDITORS' CHOICE Rating: ●●●●○ EXCELLENT

Apple AirTag: Great for iPhone Users

BY SASCHA SEGAN

You'll never lose your keys in the couch cushions again. Apple's AirTag leverages tight iOS integration and the world's huge network of iOS devices to create Bluetooth trackers that are uncommonly easy to set up, use, and locate—especially compared with Tile, the current giant of the industry. For those with an iPhone or an iPad, the AirTag is a sleek and delightful way to track your lost devices, and that makes it worthy of our Editors' Choice award.

ITEM TRACKERS

There's a decent industry of trackers for people, vehicles, and stuff. Samsung has the SmartTag and SmartTag+ for owners of Samsung phones and tablets. For iPhone and iPad users, the AirTag really competes against one giant of the industry, Tile, which has made its entire brand on low-cost Bluetooth trackers that let you beep them when you lose your keys.

(A quick note: The AirTag is compatible with any iPhone or iPad running iOS or iPadOS 14.5 or later. We refer to iPhones throughout this review for the sake of simplicity, but any up-to-date iPad will work just as well for pairing with and finding AirTags.)

AirTags are easier to set up than Tiles, have better directional finding powers, and can be found from farther away. Tiles come in more form factors than AirTags do, and you can summon your phone from the Tile as well as the other way around. But their range maxes out at about 30 feet, and the range on AirTags is functionally infinite as long as there's someone with an iPhone nearby.

You can get one AirTag for \$29 or pay \$99 for four. In addition, you'll need to buy holders for them: Unlike the Tile and the SmartTag, the AirTag lacks a lanyard hole. Apple sells a leather key ring in blue, brown, or red for \$35; a leather loop holder in brown or red for \$39; and a silicone loop holder in blue, orange, white, or yellow for \$29. This being Apple, there's already a huge third-party ecosystem: You can get basic versions of the keychain and loop holder from Belkin for \$12.95, and Amazon has dozens of no-name keychains and loop holders starting at \$2.99.

Apple AirTag

PROS Accurate and reliable. Gives directional cues. Can send location from a distance. Replaceable battery.

CONS No Android compatibility. No way to ping a phone from the tag. No hole for a lanyard or keyring. Anti-stalking features are limited.

BOTTOM LINE Apple AirTag tells your other Apple devices exactly where to find your lost objects, even if they're miles away.



The tags themselves are little metal discs with a shiny silver side and a white side. Apple offers free printing of a monogram or emoji on each tag, which lets you tell them apart and designate them for particular uses.

An AirTag is unnoticeable when dropped in your jeans pocket. At 1.26 inches in diameter and 0.31-inch thick, it's a bit thicker than either the Tile Mate or Tile Pro and much thicker than the Tile Slim. It's considerably slimmer and smaller than the Samsung SmartTag, though. The difference between the AirTag and the Tile Slim mostly comes into play when you're trying to track your wallet, as an AirTag will make it bulge more than a Tile Slim will. But the tiny little tags easily vanish into a backpack, a coat pocket, or a suitcase, and they look great in one of Apple's keychain holders.

Apple says the AirTag has about a year's worth of battery life using a replaceable CR2032 battery.

The tags are durable enough, though I wouldn't run them over with a car. They're rated IP67 and water resistant for up to 30 minutes, so they can be dropped in a pool—but if your wallet sinks to the bottom of a creek, you'll need to act fast.

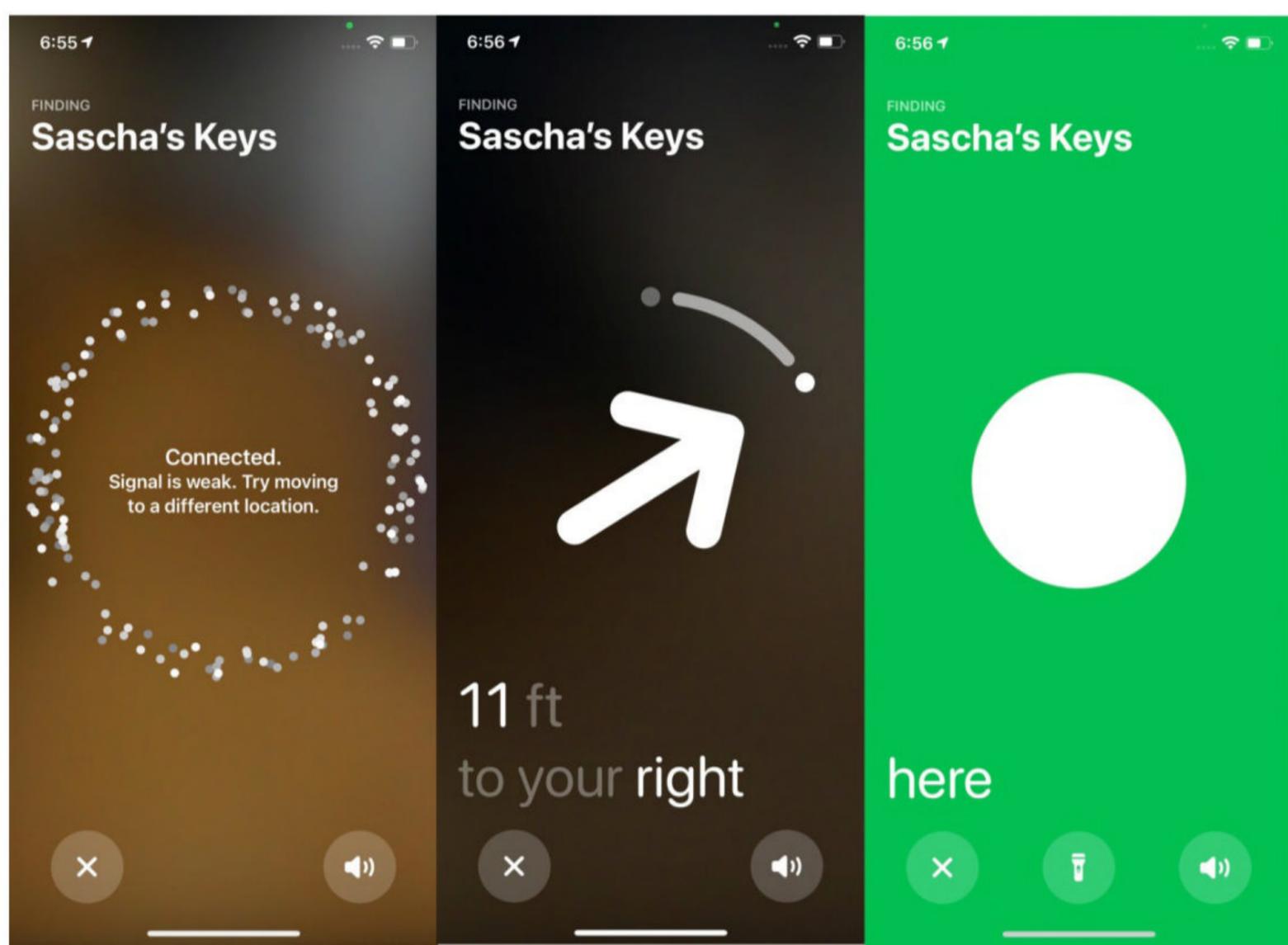


In classic Apple fashion, AirTags are prettier than the competition. They're shiny and smooth, and the personalized printing is a nice touch. The keychain and strap accessories look like fashion items rather than technology items. My AirTags' shiny sides didn't get scratched up while I was using them, even though I shook one in a plastic bag with keys for about 30 seconds. Your mileage may vary; I know some other reviewers say their tags got scratched up, so they may have sharper keys.

MAGIC FINDING POWERS

Setup and basic finding feel like magic. Hold a new AirTag up to your iPhone or iPad, and it is automatically detected. You can name it, and then the Find My app will start tracking it. To find the AirTag, you can tell it to make a little piping sound or play a game of hot-and-cold with distance. My AirTags said they were "connected" within about 45 feet, and a distance indicator appeared when I was within about 30 feet. If you have an iPhone 11 or higher, that distance indicator is accompanied by a helpful directional arrow, thanks to the ultra-wideband (UWB) directional protocol. Tile doesn't have any UWB tags yet; if you want UWB in a Samsung tag, you have to get the \$39.99 SmartTag+ as opposed to the basic SmartTag.

Another nice touch: If your iPhone is near the AirTag, you haven't found it, and it's dark, you can tap a flashlight icon right in the app to turn on your phone's light.



The AirTag's piping sound is noticeably quieter than the Tile Mate—78.3dB vs. 99dB at six inches—but I could still hear it from about 20 feet, or when the AirTag was wedged between my couch cushions. It might be tougher to hear buried deep in a bag, though.

The killer difference here is that Apple's Bluetooth connection is much more reliable than Tile's. I have several Tiles that I use daily to track my keys and wallet, and their Bluetooth connection is annoyingly unreliable and intermittent. The AirTag worked every time I tried it.

One of the AirTag's few flaws is that you can't use it to ping your linked iPhone or iPad. Competing trackers do offer this feature. If your phone is what you're most likely to lose, a Tile might be a better choice.

FROM NEAR TO FAR

If AirTags are more than 30 feet from your phone, they leverage Bluetooth connections with strangers' Apple phones to tell you where they are. Apple says that these connections are end-to-end encrypted and nobody, not even Apple, knows the location or identity of any AirTag.

It's important to note the limits of the AirTag. It's not a true GPS tracker, as it relies on being within 30 feet of someone's iPhone to deliver its location to the network. This works well in dense cities full of iPhone users, but it's much less useful in rural areas. Both Tile and Samsung also leverage third-party device networks. Tile currently claims to have 7,302 users within about 10 miles of me; Samsung, like Apple, doesn't give a number.

If you need to track an object or child where no phones go, take a look at the Jiobit, which uses GPS and its own cellular connection.

I left an AirTag, a SmartTag, and a Tile at the local coffee shop and went home to "find" them. After 19 minutes, Find My told me the AirTag had been found, but the app thought it was around the corner from the shop. Another 22 minutes later, it zeroed in on the correct address and stayed there. I got an accurate SmartTag location from Samsung within 36 minutes. Tile, on the other hand, took more than seven hours to tell me where my tag was.

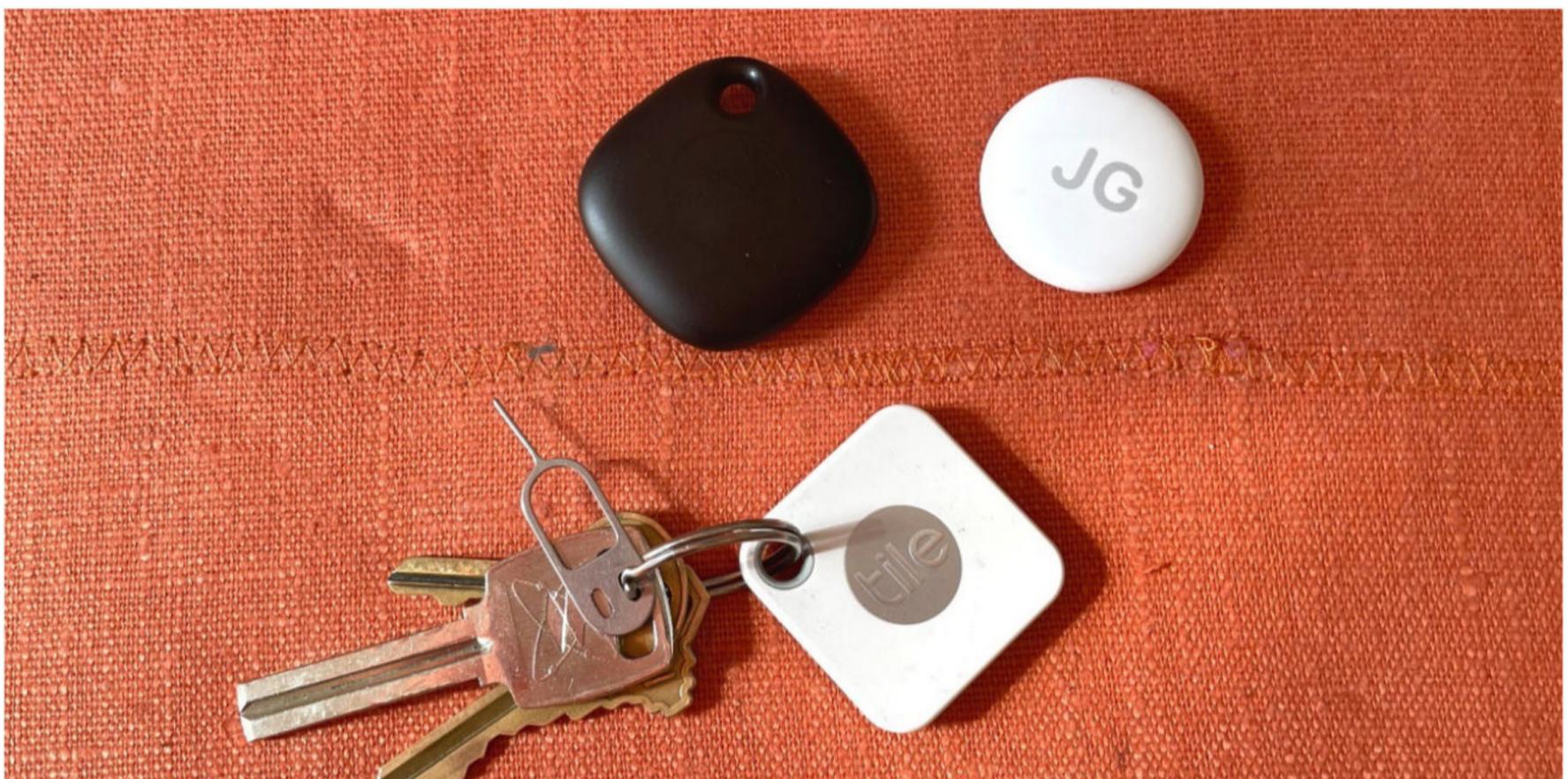
TRACKING ME, TRACKING YOU

With the AirTag being so small, so affordable, and connected to a global network, you might be understandably concerned that someone could slip one in your bag or car and use it to track your movements. Other trackers, of course, can also be used this way.

There's a tricky balance between making it difficult to stalk someone with a tag and making the tag useless for tracking lost or stolen items. If your backpack is stolen, obviously you don't want the thief being immediately alerted to the tracker. That's why AirTags separated from their owners wait three days before starting to beep. Unfortunately, that means a person being tracked with an AirTag may be unaware of it.

My daughter slipped an AirTag into her back pocket before she went to the craft store. Starting after about 20 minutes, it gave me an update every 5 to 15 minutes, with a rough location within a block or so. She had no idea the device was being pinged; it didn't make a sound or alert her phone.

Apple's anti-stalking features are a little complex. If you have an iPhone with OS 14.5 or later and there is a "foreign" AirTag (one not paired with your device) traveling with you, Apple says you will get an alert at the end of the day or when you return to your home location as indicated in Apple Maps or Contacts. Otherwise, as mentioned, an AirTag separated from its owner will begin to beep after three days.



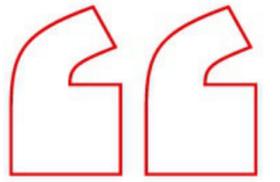
I set up AirTags on two different Apple accounts with two different home addresses, but I couldn't make the foreign AirTag alert happen, even when taking a long walk with an iPhone and an AirTag that were unpaired. That said, I might have been stalking myself wrong. I didn't have three days to test the tags, and all of my phones know that they stay at my house a lot of the time.

As far as we can determine, AirTags can be used to unnoticeably track people you live with throughout the day, as long as they return to you at night. This is also possible with a Samsung tag (unless the tracked person has a properly configured Samsung phone and actively searches for foreign tags), and the only reason it's less possible with a Tile is that Tile's network isn't nearly as good. Jiobits and other GPS trackers can be used similarly.

If you're really concerned about being tracked by gadgets, consider buying an inexpensive RF bug detector, which will tell you what's emitting signals near you. (We haven't tested those devices and can't make particular recommendations.)

What about legitimately lost AirTags? Hold a found AirTag up to an NFC-compatible iOS or Android device to get a web page with its serial number and instructions on how to disable it (remove the battery). If you lose one of your AirTags, use the Find My app to put the tag in Lost mode. Anyone who finds it and checks it will see your phone number and a message.

We tested lost-tag scanning with a Samsung Galaxy S21 Ultra and an iPhone 12, and it worked well. It's important to note that you don't use the Find My app to scan a foreign tag; rather, you tap the tag against the very top edge of your iPhone when you're on the home screen.



**We tested
lost-tag
scanning with
a Samsung
Galaxy S21
Ultra and an
iPhone 12, and
it worked
well.**



APPLE MAKES LOSING THINGS LESS ANNOYING

Apple doesn't generally invent product categories; it takes other people's ideas and makes them less annoying. The iPod wasn't the first MP3 player, and the iPhone wasn't the first smartphone, but both products smoothed out edges of setup and adoption and vaulted their whole categories forward.

The same thing is happening with the AirTag. By tightly integrating the tag with iOS, Apple has made a Bluetooth item tracker that "just works," with absolutely delightful UWB direction-finding and no connection errors. AirTags also have the fashion-not-tech look that Apple has been so good at popularizing.

There's still room for other trackers in the market. SmartTags and Tiles don't need you to spend money on accessories. The Tile Slim and Tile Sticker go on things that can't easily fit an AirTag or AirTag holder, like slimline wallets and remote controls. JioBit and other true GPS trackers are much better for finding things and people that go wandering across less-populated areas. But if you have an iPhone and often lose your keys in the house, you need one of these. Both stylish and functional, the AirTag is thoroughly deserving of our Editors' Choice award.



Starts at \$2,499.00

EDITORS' CHOICE Rating: ●●●●○ EXCELLENT

Razer Blade 15 Advanced Edition (2021): Portable, Powerful, and Slick

BY MATTHEW BUZZI

The Razer Blade 15, a perennial favorite among gaming laptops for its premium metal chassis and slick, slim design, has reached new heights this year. The 2021 Blade 15 Advanced Edition (starts at \$2,499; \$2,899 as tested) now carries Nvidia's GeForce RTX "Ampere" 30 Series GPUs, unlocking a new level of gaming performance—and our test unit's RTX 3080 can leverage the fast 240Hz refresh rate of its desktop-caliber 1440p display. Add a Core i7 CPU, 1TB of solid-state storage (both present in all models), 32GB of RAM (in our tester), a useful complement of ports, and nearly nine hours of battery life, and there's a whole lot to love. Yes, it's expensive, but this Razer represents the best of the best in the premium gaming space, earning an Editors' Choice award for its reasonable portability, high build quality, and screaming speed.

RAZER THIN: A SLIM METAL MONSTER

A few years back, Razer modernized the Blade 15 with a squarer look and thinner screen bezels. Since then, it's had only a few iterative changes, but that's no cause for complaint. The Blade 15's svelte build remains one of the sleekest among gaming laptops in terms of style, quality, and portability, all while ramping up the power under the hood. The all-black paint job, sharp edges, and clean look create a striking silhouette that several competitors have mirrored in their more recent designs.

The Blade 15 was one of the first high-end gaming laptops to be reasonably portable in a world of hefty slabs. This iteration measures 0.67 by 14 by 9.3 inches (HWD) and weighs 4.4 pounds, plenty thin and relatively light while packing more power than before. (It's actually slightly thinner than the previous version, which was 0.7 inch thick.)

Slim competitors, including the MSI Stealth 15M, match this profile, while the Alienware m15 R4 focuses more on power. And you can find more-compact laptops that really double down on portability, our favorite being the 14-inch Acer Predator Triton 300 SE. Worth noting is that Razer's power adapter is a reasonable size versus the bricks that accompany some gaming laptops, furthering the portability proposition.

While this trendsetter may have been beaten on portability by some rivals since its debut, I'd say it remains the most premium-feeling. The metal chassis is satisfyingly hefty in hand and solidly built, and it boasts what I believe to be the best touchpad on a Windows laptop—it's roomy, scrolls incredibly smoothly, and evokes the same high-end feel as Apple's superb MacBook touchpads.

Razer Blade 15 Advanced Edition (2021)

PROS Sleek, slim design with premium metal build. 1440p panel, with formidable GPU power to leverage its 240Hz. Plenty of ports and 1TB of storage. Superior touchpad. Long battery life.

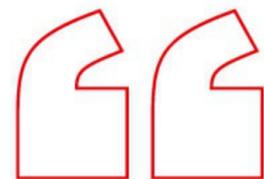
CONS High starting price.

BOTTOM LINE The 2021 revamp of the Razer Blade 15, now equipped with Nvidia GeForce RTX 30 Series GPUs, is simply the peak of today's premium gaming laptops. Portable, powerful, and slick, it's an unmistakable object of envy.

The keyboard may not be field-leading, but it's nice. It has a balanced amount of travel and feedback, neither too mushy nor too resistant, and the keys are individually backlit with customizable RGB lighting. The included Razer Synapse software lets you change each key's color and visual effects to create appealing patterns or useful highlights. The keyboard hasn't changed much in the last few iterations, but like the touchpad, that's fine with me.

The display, on the other hand, has seen some exciting changes. High-refresh-rate screens have become common among gaming laptops over the past two years. This has usually been in the form of full HD (1080p) panels with 144Hz refresh rates, especially on more affordable systems, while pricier options offer 240Hz or even 300Hz full HD displays.

The new Blade 15's screen, though, is one of the first laptop panels to combine 1440p (2,560-by-1,440-pixel) resolution and 240Hz refresh. Desktop 1440p monitors have become familiar as more powerful GPUs have been able to push high frame rates at this more demanding resolution, but until Nvidia's "Ampere" launch, that was too big a reach for mobile systems. The GeForce RTX 3070 and 3080 have changed that.



The keyboard hasn't changed much in the last few iterations, but like the touchpad, that's fine with me.





You should expect to see this resolution-and-refresh-rate combination on more high-end gaming rigs as 2021 progresses, even if 1080p resolution remains more common overall. Our Razer review model, as mentioned, features an RTX 3080, making it a prime candidate to make the most of this sophisticated screen for various types of gaming. (We'll see how sophisticated in the performance section a bit later.) The screen quality itself is impressive, with vivid colors and sharp images, and the thin screen bezels contribute to the overall sleek appearance.

Despite its thin frame, this laptop has plenty of ports. The left flank holds two USB 3.1 Type-A ports, a USB-C port with Thunderbolt 3 support, a headphone jack, and the power connector. On the right is another USB-A 3.1 port, another USB-C port (without Thunderbolt), an HDMI video output, and an SD card reader. That's enough ports for both peripherals and secondary displays, so there's not much to complain about on the connectivity front. The system also includes support for Wi-Fi 6 and Bluetooth wireless connections, and it has a 720p webcam on the top bezel.

COMPONENT CHECK

In addition to the lovely new display, the core components are the exciting draw of this Advanced Edition update. (Razer also sells a Blade 15 Base Edition, but it's a functionally separate laptop with a thicker chassis.) All Advanced Editions utilize Intel's Core i7-10875H CPU and a 1TB SSD, but graphics, memory, and display options vary. While the starting price is high, it's still nice that you get 1TB of storage across the board, as gaming laptops (even pricey ones) too often skimp to half that, while game install sizes have ballooned.

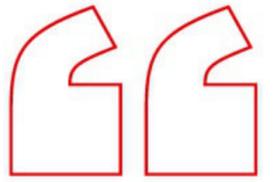
The Razer Blade 15 Advanced Edition now starts at \$2,499, which nets you an RTX 3070 GPU and 16GB of RAM along with the 240Hz QHD screen. Our review model costs \$400 more, bringing an RTX 3080 and 32GB of memory. That's a mouth-watering combination for enthusiast gamers, especially considering the slim chassis design. Of course, whether it's worth it will come down to the performance.

One note before we get into the results: This system is equipped with Nvidia Optimus, which is meant to switch dynamically between the CPU's integrated graphics and the discrete Nvidia GPU as needed. Optimus mode saves power and battery life for when you're just clicking around on your desktop or web browsing and aren't doing anything graphically intensive. Part of this power-saving is achieved by capping the refresh rate at 60Hz, so make sure the dedicated GeForce GPU is active when gaming to take advantage of the display.

When plugged in, the laptop will switch modes automatically as appropriate (as when you launch a game), defaulting to Optimus mode on battery power. You can manually force one or the other on through the Nvidia Control Panel, but don't be alarmed to see the 60Hz refresh in Windows' settings while Optimus is active. Razer also informs me that you can no longer switch modes within the Synapse software as you could with past models.

PERFORMANCE TESTING: TRUE AAA AND HIGH-REFRESH GAMING

We ran the Blade 15 through our usual suite of benchmark tests and compared the results with a host of competitors. Below you'll find the names and specs of the rival machines I selected, so you can see which components the latest Razer is up against.



We ran the Blade 15 through our usual suite of benchmark tests and compared the results with a host of competitors.



Test System Configurations			
	PROCESSOR	GRAPHICS	MEMORY & STORAGE
Razer Blade 15 Advanced Edition (2021)	Intel Core i7-10875H (2.3GHz)	Nvidia GeForce RTX 3080 (8GB)	32GB RAM; 1TB SSD
Acer Predator Triton 300 SE	Intel Core i7-11375H (3.3GHz)	Nvidia GeForce RTX 3060 (6GB)	16GB RAM; 512GB SSD
Alienware m15 R4	Intel Core i7-10870H (2.2GHz)	Nvidia GeForce RTX 3070 (8GB)	16GB RAM; 1TB SSD
MSI GE76 Raider	Intel Core i7-10870H (2.2GHz)	Nvidia GeForce RTX 3080 (16GB)	32GB RAM; 1TB SSD
Razer Blade 15 Advanced Edition (2020)	Intel Core i7-10875H (2.3GHz)	Nvidia GeForce RTX 2080 Super (8GB, Max-Q)	16GB RAM; 1TB SSD

There are a lot of different combinations, which should provide all the context we need on the Blade 15's performance. The Alienware m15's GeForce RTX 3070 is one of the best 30 Series performers we've seen, even outpacing some RTX 3080 laptops, and the MSI GE76 Raider shows what an RTX 3080 can do in a thicker 17-inch chassis. The Acer Triton 300 SE is the smallest RTX 30 Series system here, and its RTX 3060 represents the gap between the top and bottom of the Ampere stack. Finally, the Blade 15 Advanced Edition from last year, the lone GeForce RTX 20 Series system here, shows how much difference "Ampere" makes.

It's extra important to test each GPU against one another, because we've found lots of variation among RTX 30 Series laptops. This is true even between two RTX 3070s or two RTX 3080s, and we've even seen one of Nvidia's new GPUs outperform another that outranks it on paper. The bottom line is that individually testing each system is vital, as you can no longer assume exact relative results from pure specifications.

Productivity, storage, and media tests: PCMark 10 and 8 are holistic performance suites developed by the PC benchmark specialists at UL (formerly Futuremark). The PCMark 10 test we run simulates different real-world productivity and content-creation workflows. We use it to assess overall system performance for office-centric tasks such as word processing, spreadsheet jockeying, web browsing, and videoconferencing. PCMark 8, meanwhile, has a storage subtest that we use to assess the speed of the system's boot drive. Both tests yield a proprietary numeric score; higher numbers are better.

Given that there are only three different processors in these five systems, results here are very similar. The new Blade 15 lands in the middle of the pack, but in terms of real-world use, these are all very snappy laptops for home and office tasks. With a system fast enough for gaming, everyday multitasking is no sweat. Similarly, all of these notebooks' SSDs ensure fast load and boot times, a now-commonplace boon for gaming.

Next is Maxon's CPU-crunching Cinebench R15 test, which is fully threaded to make use of all available processor cores and threads. Cinebench stresses the CPU rather than the GPU to render a complex image. The result is a proprietary score indicating a PC's suitability for processor-intensive workloads.

Cinebench is often a good predictor of our Handbrake video-editing trial, another tough, threaded workout that's highly CPU-dependent and scales well with cores and threads. In it, we put a stopwatch on test systems as they transcode a standard 12-minute clip of 4K video (the open-source Blender demo movie *Tears of Steel*) to a 1080p MP4 file. It's a timed test, and lower results are better.

We also run a custom Adobe Photoshop image-editing benchmark. Using an early 2018 release of the Creative Cloud version of Photoshop, we apply a series of 10 complex filters and effects to a standard JPEG test image, timing each operation and adding up the total. Lower times are also better here.

As with PCMark 10, there isn't a lot of separation in these tests (with Cinebench a possible exception). The two thicker laptops, with room for better thermals, are the quickest, while the 2021 Razer edges the two others on average. None is a specialized media-editing workstation, but their gaming-class processors make them better choices than general-use laptops for occasional content creation or rendering.

Graphics tests: 3DMark measures relative graphics muscle by rendering sequences of highly detailed, gaming-style 3D graphics that emphasize particles and lighting. We run two different 3DMark subtests, Sky Diver and Fire Strike, which are suited to different types of systems. Both are DirectX 11 benchmarks, but Sky Diver is more suited to midrange PCs with integrated graphics while Fire Strike is more demanding and lets high-end and gaming PCs strut their stuff. The results are proprietary scores.

Next up is another synthetic test or gaming simulation, this time from Unigine Corp. Like 3DMark, the Superposition test renders and pans through a detailed 3D scene and measures how the system copes. In this case, it's rendered in the eponymous Unigine engine, offering a different 3D workload for a second opinion on each laptop's graphical prowess.

All of these gaming-ready GPUs flexed their muscles here, but there are definitely some differences. The Blade 15 performed well, but the Alienware's RTX 3070 has more raw power, as does the RTX 3080 in the beefy MSI Raider. The new Blade 15 handily outperformed last year's GeForce RTX 2080 Super version, as it should. It also looks more potent than the RTX 3060 by a healthy margin, but let's try some real games before drawing conclusions.

Real-world gaming tests: Synthetic tests are helpful for measuring general 3D aptitude, but it's hard to beat full retail video games for judging gaming performance. Far Cry 5 and Rise of the Tomb Raider are both modern, high-fidelity titles with built-in benchmarks that illustrate how a system handles real-world gameplay at various settings. We run them at 1080p resolution at the games' medium and best image-quality presets (Normal and Ultra for Far Cry 5 under DirectX 11, Medium and Very High for Rise of the Tomb Raider under DirectX 12). We also tried them at the new Razer's native 1440p resolution.



The outcome here is meaningfully different than that in our synthetic tests. The 2021 Razer looks much better in comparison to the Alienware here, pulling close in Far Cry 5 and pushing more frames in Rise of the Tomb Raider. It also stayed close to the MSI, on paper the more powerful rig in the group, as well as beating the RTX 2080 of last year's Blade 15.

That's a relief for the should-be-superior GeForce RTX 3080 of the new Razer, as most potential buyers will be more concerned with actual gaming frame rates than theoretical 3D power. Of course, this also shows that results can swing from game to game, so don't take our numbers as gospel. Still, the Advanced Edition's AAA gaming performance is sitting pretty.

As for the system's 1440p native resolution (citing the maximum-quality presets only), the 2021 Razer averaged 95fps in Far Cry 5 and 101fps in Rise of the Tomb Raider. Stepping up from 1080p to 1440p resulted in respective drops of 12% and 24% in the two games. Considering the sharper appearance, that may be worth it for many gamers.

These are older titles, though, and we'll be updating our gaming test suite soon, so I also booted up Assassin's Creed Valhalla at 1440p and saw 75fps and 61fps at the medium and ultra-high presets, respectively. A mere 61fps with max settings may fall short of your fantasies, but this is an extremely demanding game with all the bells and whistles turned on. Given the results at the medium preset and the option of dialing down resolution to 1080p, you have a lot of options to choose from.

HIGH-REFRESH MULTIPLAYER GAMING

Speaking of refresh rates, AAA titles like the above are not the kind to push a high-refresh screen to its limit. That's more the realm of competitive multiplayer and esports titles, where ultra-high frame rates not only look better but give a competitive advantage. I tried the in-game benchmark of Rainbow Six: Siege using the Low and Ultra presets (both at 100% render resolution) at both 1080p and 1440p. At the lower resolution, the Blade 15 averaged 221fps on Low and 195fps on Ultra. At 1440p, it averaged 171fps and 154fps, respectively.

Those are objectively strong results, especially since 144Hz is arguably the best high-refresh bar to reach—240Hz and 300Hz displays are nice, but frankly not everyone can see a difference beyond 144Hz, and you begin to hit diminishing

returns in terms of practical significance. Esports professionals may disagree, but reaching 144fps or more is enough to earn our stamp of approval for high-refresh gaming.

That said, the difference between 1080p and 1440p may be felt more keenly with these games, because this is a genre where an extra dozen frames per second are exactly what hardcore players seek. Smoother performance gives you an edge, so squeezing out more frames without suffering big swings or hitching is important. If you're determined to utilize this laptop's 240Hz display, maybe you're best off playing *Rainbow Six: Siege*, *Apex Legends*, and *League of Legends* at 1080p and saving 1440p for AAA titles and your web browser.

Heat check: Gamers are usually concerned with laptops' heat output during long sessions. The Blade 15 uses a vapor cooling chamber, a necessary solution given its thinness. It definitely gets warm—downright hot in certain spots. The keyboard and deck on either side of the touchpad are mostly just toasty, but the area above the top row (where, fortunately, you don't need to touch) and the underside of the laptop get hot enough to hurt when you leave your fingers there for a few seconds. This isn't a major issue, as it doesn't seem to affect performance, and you'll very likely have the system on a desk instead of your lap. But it's not ideal.



As far as fan noise, the Razer does a good job of keeping the fans from revving up too loudly. They were relatively quiet and maintained the same volume throughout most of my testing when running 3D apps, though I found their higher pitch more grating than their volume.

Overall, the new Blade 15 is an extremely capable high-end gaming machine for all types of titles. It may not deliver the chart-busting frame rates you imagine when you hear the words “RTX 3080,” but it meets the new bar for mobile gaming in an impressively thin chassis.

Battery rundown test: To test battery life, after fully recharging the laptop, we set it up in power-save mode (as opposed to balanced or high-performance mode) when available and make a few other battery-conserving tweaks in preparation for our unplugged video rundown test. (We also turn Wi-Fi off, putting the laptop in airplane mode.) In this test, we loop a video—a locally stored 720p file of the same *Tears of Steel* short we use in our Handbrake test—with screen brightness set at 50% and volume at 100% until the system quits.

It’s a relief to see a long runtime—8 hours and 46 minutes—since a short one would have undermined the portability draw. Only the tiny Triton 300 SE lasted longer, while the new Blade raises the bar for 15-inch gamers. Part of this is due to the power savings of Optimus mode, which is fine for video viewing. (I retried the battery test with the Nvidia GPU active, and the Razer lasted only 3 hours and 23 minutes.)



THE CREAM OF THE CROP FOR MOBILE GAMING

The Razer Blade 15 is a perennial champion among elite gaming laptops, and this newest version is a clear reminder of why. The design is of uncommon quality in both look and feel, including functional aspects like the best-in-class touchpad, and the system is as slim and portable as any 15-inch competitor. The latest parts back up the style with ample substance in terms of benchmark performance. You can play whichever type of game you like at comfortably high frame rates.

This style and speed comes at a high cost. But when you're shopping in this category, that's no surprise. It's difficult to refute that the Blade 15 Advanced Edition is as good as it gets, particularly if portability is important to you.

The Alienware m15 R4 delivers comparable or better performance at a lower price, so a value argument can be made for it, but it loses out in terms of bulk. When you're mostly concerned with performance per dollar, the Alienware remains a great pick, but there's no denying the Razer's envy-inducing combination of power and style. Its overall excellence earns it our Editors' Choice award as the best, most portable super-premium gaming laptop.



The design is of uncommon quality in both look and feel, including functional aspects like the best-in-class touchpad.





Starts at \$509; \$629 as tested

Rating: ●●●●○ EXCELLENT

MSI Cubi 5 10M: Peppy, Quiet Mini PC

BY MATTHEW ELLIOTT

Call it a tale of two mini PCs. In many ways, the MSI Cubi 5 10M is the opposite of the Lenovo IdeaCentre Mini 5i we tested just before it. The Lenovo offers an attractive design complete with fabric top panel; the Cubi 5 looks like an OEM part that MSI grabbed off the shelf. The IdeaCentre uses a Core i5 processor from Intel's desktop series; the Cubi's Core i5 is a mobile chip. To keep its CPU cool, the Lenovo relies on a fan that whirs nonstop. With a more efficient laptop processor, the MSI is able to keep its thermals in check with much less fan noise. Unless you need a mini PC for media editing, the Cubi 5 is the better pick for office work. It's smaller, quieter, and more than capable of providing a smooth Windows 10 experience for basic productivity tasks. Its advantages in size and acoustics also make it the better pick for a living-room media streamer.

A MINI AMONG MINIS

Our Cubi 5 test configuration features a Core i5-10210 CPU, 8GB of RAM, and a 512GB solid-state drive. If you're eyeing it as a media streamer only, either of MSI's \$509 models should fit the bill with a Core i3 CPU, the same amount of memory, and either a 1TB hard drive or a 256GB SSD. The top-end model costs \$860 and combines a Core i7 CPU and 16GB of RAM with the 512GB SSD.

All of the processors are mobile parts from Intel's 10th Generation "Comet Lake" series, and each model features the same generic enclosure. The system is matte-black with a small silver MSI logo on the top panel and a glossy black stripe on the front panel where the front ports and power button are located. The top and sides are made from a single piece of plastic, and the bottom panel is metal. MSI includes a mounting plate that you can attach to the bottom panel to secure the system to a wall or the underside of a desk.

MSI Cubi 5 10M

PROS Highly compact for the level of performance. Runs fairly quietly.

Plenty of ports. Some internal expansion room.

CONS Drab design. No SD or microSD card slot. Keyboard and mouse not included.

BOTTOM LINE Tiny and quiet, MSI's Cubi 5 10M preconfigured mini PC is a versatile if plain-looking option that's a good fit for offices and living rooms.



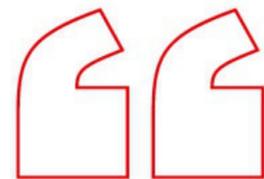
While it won't win any design awards for its appearance, the Cubi is not without its charms. It's vented on five of its six sides—all but the front panel—to help keep cool without an overreliance on the cooling fan. The fan spins while the system is active, but its whir is soft and quiet; you have to be sitting right next to the system to hear it. The fan kicks off when the system is idle and goes into sleep mode.

Whether or not you use the mounting plate, you should have no trouble finding a spot for the Cubi 5. It's petite even among mini PCs, measuring 2.1 inches high by 4.9 inches square. The rival Azulle Byte4 is more compact, at 1.5 by 5.1 by 3.8 inches (HWD), but it's an underpowered gadget with a Celeron processor and 4GB of RAM meant for media streaming rather than a full Windows 10 experience. The fabric-faced Lenovo IdeaCentre Mini 5 is larger (1.6 by 7.6 by 7.2 inches), while the HP Slim Desktop mini-tower looks positively huge by comparison at 0.6 by 3.7 by 11.9 inches.

EXPANSION INSIDE AND OUT

When not mounted, the Cubi 5 rests on four small rubber feet. Inside each foot is a screw that you can remove to access the system's interior. Any expansion room at all in such a tiny PC is impressive.

In our test system, one of the two laptop-style SO-DIMM slots is filled with an 8GB RAM module, leaving a free slot for easily doubling the system's memory. The lone M.2 slot is occupied by the 512GB NVMe SSD (a standard-size 80mm-long drive), but there's a free SATA port for adding a 2.5-inch SSD or hard drive. MSI includes the requisite cables should you want to expand the Cubi 5's storage capacity that way. A 2.5-inch drive would mount on the inside of the bottom cover.



Whether or not you use the mounting plate, you should have no trouble finding a spot for the Cubi 5.





Despite its trim dimensions, the Cubi 5 does not skimp on ports. It supplies both USB Type-A and Type-C ports, as well as HDMI and DisplayPort connections. On the front panel are two USB 3.2 ports, one Type-A and one Type-C, along with separate headphone and microphone jacks. Around back, you'll find two more USB-A 3.2 ports, two USB 2.0 ports, the HDMI and DisplayPort video outputs, and an Ethernet jack. A flash memory card slot for quick storage expansion would have been nice but didn't make the cut. Two other things that aren't included are a keyboard and mouse; you'll need to supply your own input peripherals.

PERFORMANCE TESTING: SMALL BUT RELATIVELY MIGHTY

As mentioned, our MSI Cubi 5 10M is based on Intel's Core i5-10210U, a quad-core mobile CPU with a base clock speed of 1.6GHz and max turbo frequency of 4.2GHz. With a TDP of only 15 watts, this efficient chip is a great fit for a compact mini PC.

For our performance tests, we stacked up the Cubi against other budget mini desktops and one mini-tower PC. The other minis are the Lenovo IdeaCentre Mini 5, which eschews a mobile chip for a 35-watt desktop Core i5-10400T; the Azulle Byte4, which features a humble mobile Celeron processor; and Apple's Mac mini, which features the M1 processor also found in the latest MacBook Air, MacBook Pro, and 24-inch iMac. We included the Mac mini even though it's the priciest of the bunch at \$699. Rounding out the charts is the HP Slim Desktop, a budget-priced compact tower with a dual-core AMD Athlon Gold mobile CPU.

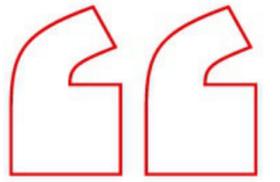
Productivity, storage, and media tests: PCMark 10 and 8 are holistic performance suites developed by the benchmark specialists at UL (formerly Futuremark). The PCMark 10 test we run simulates different real-world productivity and content-creation workflows. We use it to assess overall system performance for office-centric tasks such as word processing, spreadsheets, Web browsing, and videoconferencing. PCMark 8, meanwhile, has a storage subtest that we use to assess the speed of the system's boot drive. Both benchmarks yield a proprietary numeric score; higher numbers are better.

The Cubi 5 finished just ahead of the HP Slim Desktop in PCMark 10, with the latter's higher CPU clock speed largely offsetting the additional processing cores of the Cubi 5's Core i5. The Lenovo and its six-core desktop Core i5 led the way.

Next is Maxon's CPU-crunching Cinebench R15 test, which is fully threaded to make use of all available processor cores and threads. Cinebench stresses the CPU rather than the GPU to render a complex image. The result is a proprietary score indicating a PC's suitability for processor-intensive workloads.

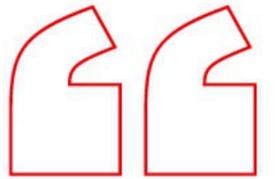
The Cubi 5 was able to put its four cores and eight processing threads to greater use here. The IdeaCentre Mini 5i again had a clear advantage over the systems with mobile processors, but the Mac mini and its M1 chip took top honors even running a non-M1-native version of Cinebench.

The Cinebench test is often a good predictor of our Handbrake video editing trial, another tough, threaded workout that's highly CPU-dependent and scales well with cores and threads. In it, we put a stopwatch on test systems as they transcode a standard 12-minute clip of



For our performance tests, we stacked up the Cubi against other budget mini desktops and one mini-tower PC.





The little Cubi 5 is capable of handling video-editing tasks, but you might not want to make them a regular practice.



4K video (the open-source Blender demo movie *Tears of Steel*) to a 1080p MP4 file. It's a timed test, and lower results are better.

Here, the Cubi 5 again finished behind the IdeaCentre and Mac mini but ahead of the HP Slim Desktop and the underpowered Azulle. The little Cubi 5 is capable of handling video-editing tasks, but you might not want to make them a regular practice.

We also run a custom Adobe Photoshop image-editing benchmark. Using an early 2018 release of the Creative Cloud version of Photoshop, we apply a series of 10 complex filters and effects to a standard JPEG test image, timing each operation and adding up the total. As with Handbrake, lower times are better here. The Photoshop test stresses the CPU, storage subsystem, and RAM, but it can also take advantage of most GPUs to speed the process of applying filters, so systems with powerful graphics chips or cards may see a boost.

The Cubi 5 turned in an impressive result in our Photoshop test. It finished much closer to the Lenovo and Apple than to the HP, which illustrates that it can be a small but mighty photo-editing machine.

Graphics tests: 3DMark measures relative graphics muscle by rendering sequences of highly detailed, gaming-style 3D graphics that emphasize particles and lighting. We run two different 3DMark subtests, Sky Diver and Fire Strike, which are suited to different types of systems. Both are DirectX 11 benchmarks, but Sky Diver is more suited to laptops and midrange PCs, while Fire Strike is more demanding and made for high-end PCs to strut their stuff. The results are proprietary scores.

All five systems here rely on the integrated graphics built into their CPUs, and their 3DMark scores fell well short of suitability for gaming.

MAKING THE RIGHT MINI PC COMPROMISES

The MSI Cubi 5 10M strikes a near-optimal balance among size, performance, and acoustics for a mini desktop. It's more capable than underpowered mini PCs meant to be hidden in your home theater to stream media and do little else. With its mobile Core i5 CPU and 8GB of RAM, our test configuration provides enough muscle for a smooth Windows experience for productivity apps and even occasional media editing. Yet it's compact and quiet enough to operate as a home theater PC.

Acoustics play an outsized role in mini PCs not only in the living room but also in office settings, because they'll likely be placed on or mounted under a desk rather than stashed on the floor and out of earshot. The Cubi 5 doesn't offer the most attractive design, but trading a modicum of looks for better acoustics is an exchange most shoppers will be happier with long-term. It's not a silent, fanless system, but its fan noise is well within the acceptable range, even when it's sitting right next to you. If you can get past its plain look, the MSI Cubi 5 10M will serve you well as a space-saving office desktop or a powerful addition to your home theater.



Starts at \$142 for 120GB, \$275 for the 1TB version we tested

EDITORS' CHOICE Rating: ●●●●○ EXCELLENT

iStorage DiskAshur M2: A Wealth of Security Features

BY TONY HOFFMAN

The DiskAshur M2 from iStorage excels at the primary mission of any security-focused SSD: making sure that no unauthorized person can ever get their hands on your data. It succeeds thanks to hardware encryption, PIN authentication, and what is, in effect, a self-destruct mechanism should anyone breach its housing. This SSD is impervious to water and dust, and it's shockproof and crushproof. Like most security-centric external SSDs, the M2 isn't particularly fast, and you pay a premium for its protective features, but it's not as dear as many similarly equipped SSDs we've reviewed. That fact and the feature set tip the scales in favor of the DiskAshur M2 as our latest Editors' Choice winner for secure external SSDs.

BOXES WITHIN BOXES

Unboxing the M2 proved an apt visual metaphor for the drive's security—simply getting to the product was like opening a set of Russian nesting dolls. It arrives in a 6.5-by-4.5-by-2-inch cardboard box, illustrated with pictures of the drive and its case and providing brief descriptions of key features. When you open the box, in addition to finding a quick-start guide and two cables, you see a cardboard cradle that holds a hard-plastic carrying case—imprinted with the iStorage name—that contains the drive. The case has a looped strap for easy carrying, and it unzips to reveal a black slab, also stamped with the product name, with a silver base.

This monolith is a sleeve that protects the drive. When you pull the sleeve and (tightly fitting) base apart, the DiskAshur M2 reveals itself as a slightly smaller black rectangle measuring 4.2 by 1.8 by 0.48 inches (HWD). An alphanumeric keypad with three status lights adorns its side. As with most external SSDs, you never see the actual drive mechanism—in fact, if you were to break open the M2 to get to the chips and the PCB inside, it would be damaged beyond repair. It's designed to be physically uncrackable.

The quick-start guide instructs you on how to set an Admin PIN before first use and how to unlock the drive with it. PINs must consist of between seven and 15 characters, and a Shift key lets you toggle between letters and numbers. You can also set individual User PINs, and if a user forgets their PIN, the drive can be unlocked using the Admin PIN. The administrator can then let the user set a new User PIN. The administrator can also set a self-destruct PIN that's very much a “nuclear option.” Once that kill-PIN is entered, the data, the encryption key, and all PINs are deleted, lost forever.

iStorage DiskAshur M2

PROS AES-XTS 256-bit full-disk hardware encryption. IP68 ruggedness rating. Compatible with Windows, macOS, Linux, Chrome, Android, and more. Supports an administrator PIN, plus separate user PINs. No software to install. Aggressively priced for a security-focused SSD.

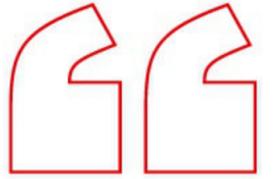
CONS More expensive per gigabyte than standard external SSDs. Much slower transfer rates than less-security-minded drives.

BOTTOM LINE The iStorage DiskAshur M2 portable SSD packs a wealth of security features to protect your data—and it's a proper value, too. It is impervious to the elements, can survive being run over, and costs less than similar security-focused SSDs.

Both the administrator and the user can configure the DiskAshur M2 as a read-only (write-protected) drive. If configured by the admin, the drive cannot be modified or disabled by the user, allowing the admin to provision a drive with pre-loaded content as read-only for the user.

Then there's the physical proofing. An ingress protection (IP) rating of IP68 means that the M2 is highly resistant to water—indeed, most anything short of high-pressure cleaning or a steam jet. The drive can survive a dunking in 1.5 meters of water for 30 minutes, and it's also impervious to dirt, sand, and dust.

This is the highest IP rating of any drive I have tested, and it matches that of the general-purpose ADATA SE800. But the M2 brings still more ruggedness to the table. It is shockproof—able to survive a drop of 4 meters onto a concrete surface—and crush-proof, able to withstand being run over by a 2.7-ton vehicle. (We'd have liked to have borrowed a pickup truck to test that last claim, but we will have to take iStorage's word for it.)



We'd have liked to have borrowed a pickup truck to test that last claim, but we will have to take iStorage's word for it.



The M2 is also compliant with FIPS 140-3 Level 3, a set of federal standards that describe security protocols for use by US government contractors and vendors. Meeting these standards requires that steps be taken to protect not just the data stored on the drive but also the hardware itself. This encompasses the tamper-proof case mentioned earlier. The M2's internal components are encased in epoxy resin, and any attempt to pry inside to get to the chips will result in their destruction.

The M2 employs AES-XTS 256-bit hardware encryption, which is even more secure than the AES 256-bit hardware encryption that is often found on standard external SSDs. AES-XTS is particularly good for full-disk encryption.

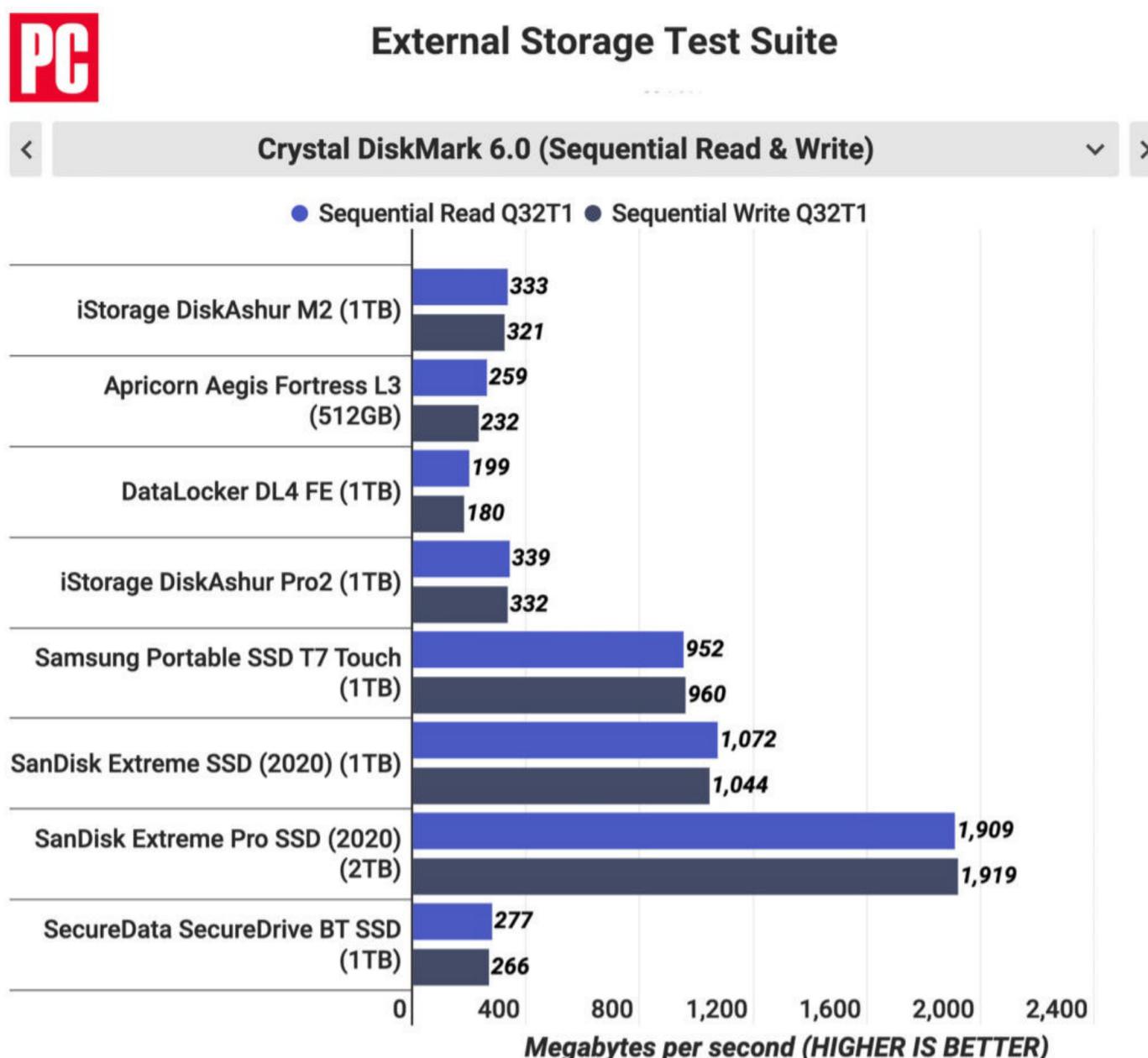
A great thing about the M2 is that because its encryption is hardware-based, the drive is operating-system- and host-independent, so you can use it on most any system with a USB port without having to install software. (Of the two USB cables included with the M2, one connects to a computer's USB Type-C port, the other to a USB Type-A port.) According to iStorage, the drive is compatible with Windows, macOS, Linux, Chrome, Android, thin clients, zero clients, embedded systems, Citrix, and VMware. To lock the drive, you simply unplug it from the computer. (Just be sure that any data transfer in progress completes before you do so.)



TESTING THE DISKASHUR M2: SECURITY OVER SPEED

We ran our usual suite of SSD tests on the M2, comprising Crystal DiskMark 6.0, PCMark 10 Storage, BlackMagic's Disk Speed Test, and our own folder-transfer test. The M2 is rated at 370MBps for both sequential read and write speeds. As we don't have a huge pool of secure hard drives to compare it against, we broadened our selection based on some key criteria. The drives included for comparison have at least two of the following features: strong (at least 256-bit AES) hardware encryption, some other notable security attribute (such as PIN authentication from an onboard keypad or fingerprint authentication), and ruggedness features including an IP rating.

Even within these categories, not all attributes are equal. For instance, the Samsung Portable SSD T7 Touch earned our Editors' Choice award largely on the inclusion of a fingerprint reader that can be used instead of its password authentication, but while fingerprint authentication is the height of convenience, it is not particularly secure. And although both the SanDisk Extreme Portable SSD V2 and SanDisk Extreme Pro Portable SSD V2 have some ruggedness cred, their ingress protection ratings of IP55 fall short of the DiskAshur M2's IP68, and they are not as shock-proof, let alone crush-proof, as the M2.



The drives most similar to the M2—which I think of as armored or lockbox drives—are the Apricorn Aegis Fortress L3, the DataLocker DL4 FE, iStorage’s earlier DiskAshur Pro2, and the SecureData SecureDrive BT. Think of these as our core group of comparison drives.

The test results above are split into two tiers, with the top tier being the conventional SSDs and the lower scorers being the lockbox drives. Compared with the others in its group, the M2 did rather well, coming in first or second on each of the tests. It fell short of its speed ratings of 370MBps for both read and write; in Crystal DiskMark 6.0 sequential read/write testing, it scored 333MBps for read and 321MBps for write. Still, these scores were faster than all of the other lockbox drives we tested except for the DiskAshur Pro2, which scored barely better at 339MBps for read and 332MBps for write.

VERDICT: A RARE ‘VALUE’ SECURITY SSD

The M2 bears a lot of similarities to the Apricorn Aegis Fortress L3, which we reviewed in February 2020. There are actually two Apricorn drives by this name, one a spinning hard drive and the one we reviewed, which is SSD-based. Our main gripe with the Aegis L3 was its exorbitant price, about 70 cents per gigabyte. Although the L3 SSD has come down somewhat in price, it is still expensive, costing 50 cents per gig from Apricorn and 47 cents per gig through Amazon at this writing.

In contrast, the 1TB version of the M2 costs a little over half of that (28 cents per gig, for example, through Amazon at our test capacity), has similar security features, and is rated as even more rugged than the L3. And it served up higher Crystal DiskMark sequential-speed scores for both read and write. The DiskAshur M2 thereby earns its place as our latest Editors’ Choice winner for secure external SSDs.



\$69.99 | Rating: ●●●●○ GOOD

Razer Orochi V2 Wireless Gaming Mouse: Game on the Go

BY MIKE EPSTEIN

Pocket mice are typically associated with productivity, given their portable, lightweight designs that let you work in an airport, coffee shop, or office. The Razer Orochi V2 offers that same capability, but for gaming. It's a small, wireless mouse, but with the sensor and software support of a Razer gaming mouse. The Orochi V2 isn't a full-on replacement for a standard-size gaming mouse, but it's convenient as a backup input device for your laptop bag.

DIMENSIONS AND BUTTONS

Measuring 1.4 by 2.4 by 4.2 inches (HWL), the Orochi V2 is shorter and thinner than your average gaming mouse. Even with my average-size hands, my thumb

and pinky naturally drag along the mouse's surface, which isn't ideal for responsive play. Unlike Razer's other shrunk-down designs, such as the DeathAdder V2 Mini and Viper Mini, the Orochi has a somewhat ergonomic chassis that creates support for your hand, so playing with a palm grip works, albeit imperfectly.

Aside from its small size, the Orochi V2 is a basic six-button gaming mouse. It has four buttons on top: two click panels, a thumb wheel, and a DPI cycle in the center column. The usual back and forward buttons live on the mouse's side. The mouse is made of matte-black plastic; there's no textured side panels or grips. There's also no RGB lighting, though that might be for the best if you plan to use the mouse in a public space where swirling lights may be deemed distracting.

On the mouse's underside, you'll find a three-setting power switch that lets you toggle between 2.4GHz and Bluetooth wireless connectivity. As usual, the dongle-based 2.4GHz connection provides a more stable, responsive signal that makes it better for gaming. Bluetooth, however, is compatible with more devices that lack a USB port, such as phones and tablets, and takes less toll on the battery.

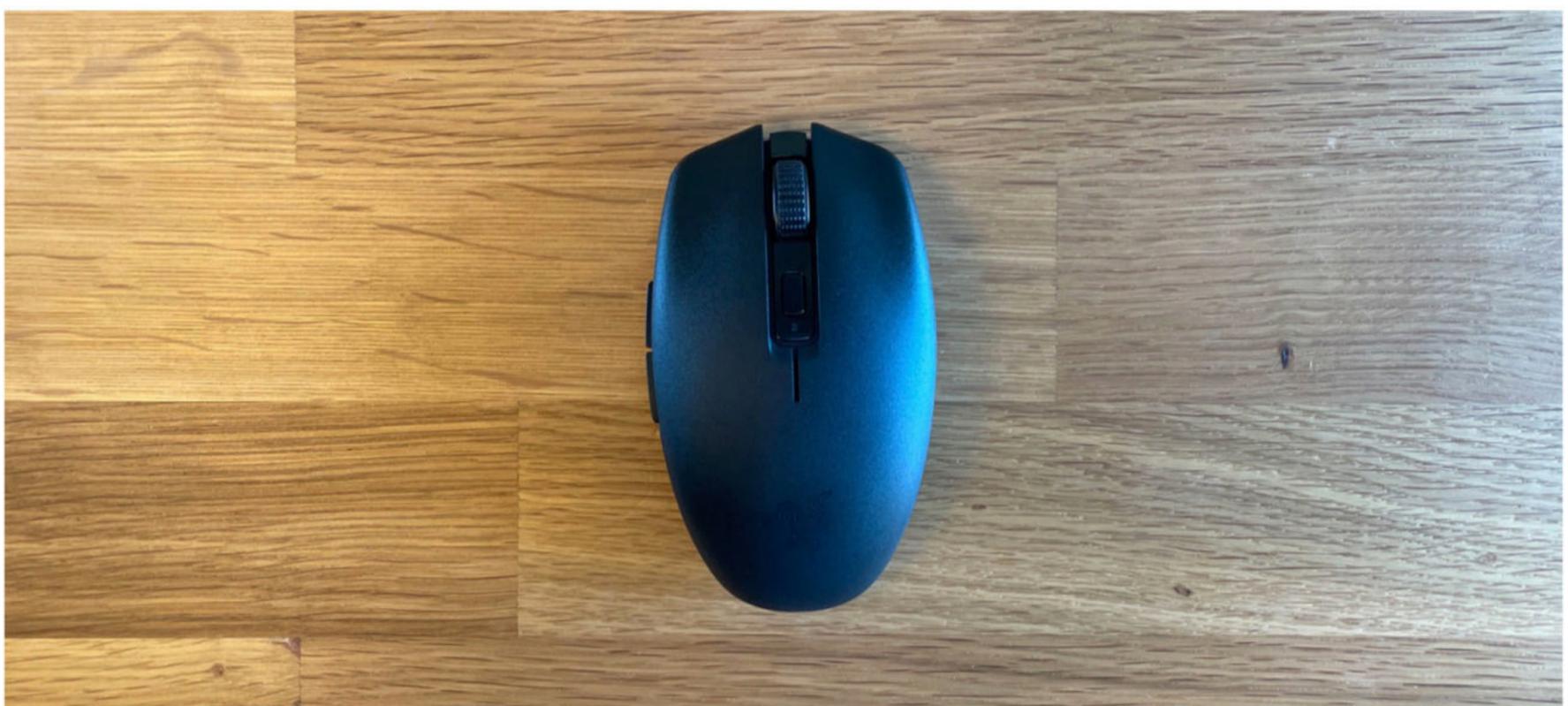
Razer Orochi V2 Wireless Gaming Mouse

PROS Lightweight. Bluetooth and 2.4GHz wireless support. Has HyperSpeed multi-device support. Supports AA and AAA batteries. Dongle storage.

CONS Can't add a AA and AAA at the same time for max battery life. Small design is still less comfortable than a regular-sized mouse. Lacks RGB lighting.

BOTTOM LINE

Featuring a lightweight design and HyperSpeed multi-device wireless support, the Razer Orochi V2 is a solid choice for when you want to game on the road. It could use better hand support, though.





Flip the mouse back over, and you'll find a removable chassis panel. Under the hood are slots for a AA battery and AAA battery. You can use only one battery type or the other; you can't use a AA and AAA battery together. The idea is that you can choose between the heavier but longer-lasting AA battery for general use and the lighter but quicker-draining AAA battery for high performance. There's also a storage slot for the 2.4GHz dongle, so no need to worry about the two pieces getting separated in transit.

It's cool that Razer gives you battery options, but the trade-off is a little lopsided. The weight difference between the two battery types is small: 2.5 ounces with a AA battery versus 2.2 ounces with a AAA battery. Competitive players will appreciate the option to maximize ease of movement, but both weights are light enough to tip the Orochi V2 into the esports mouse category.

On the other hand, there's a big difference in battery life. According to Razer, the Orochi should last for up to 425 hours on a 2.4 GHz connection or 950 hours using Bluetooth with a AA battery, and about one third that time—142 hours over 2.4 and 317 hours on Bluetooth—while using a AAA battery. Razer states that putting in both batteries at the same time doesn't enhance battery life in any way, so you're just adding needless weight by combining them.

THE RAZER SYNAPSE CONFIGURATION SOFTWARE

The Orochi V2, as with other Razer gear, has software support from Synapse, the company's configuration app. Using Synapse, you can create custom mouse profiles with remapped inputs, including custom macros, custom mouse sensitivity and DPI presets, and tweaked power-related settings. Many of these settings may seem a bit superfluous for a six-button mouse, but Synapse makes alterations a simple task.

The Orochi V2 has one interesting wrinkle on the software side: It's the third Razer device to offer HyperSpeed, multi-device wireless support via its 2.4 GHz dongle. That means, in theory, you can plug in one wireless dongle to connect the Orochi, a wireless keyboard, and possibly another compatible Razer device to your PC. It's a feature that frees up the system if you use Razer products. That said, the feature has limited functionality to the point where it isn't especially useful—at the moment. As of April 2021, there are only two other compatible devices, the DeathAdder V2 Pro mouse and the Blackwidow V3 Wireless keyboard. So, basically, unless you also have Blackwidow V3, this new functionality won't change anything for you.

POCKET MOUSE

The Razer Orochi V2 is essentially a gaming-focused counterpart to Logitech's MX Anywhere 3, a similarly small productivity mouse that you can easily carry. Neither is truly a replacement for their larger, high-end counterparts, but both fit the bill when you need to work away from your desk. The MX Anywhere 3 has several useful features that set it apart from the average mouse, but the Orochi V2, with its powerful sensor and Synapse support, make it a better fit for gaming. At \$69.99, the Orochi V2 isn't cheap for a piece of gear that's best suited as a backup mouse, but it proves convenient when you travel a lot. If you're looking for an esports mouse with more hand support and RGB lighting, check out our Editors' Choice pick, the HyperX Pulsefire Haste.



Starts at \$16.00 per user, per month

Rating: ●●●●○ EXCELLENT

Mural: Collaborative Whiteboard-Style Brainstorming

BY JILL DUFFY

Mural is a collaboration app for team brainstorming and mind-mapping. You use it to make virtual canvases and whiteboards where a team of people can draw, add notes, pin images and files, and otherwise interact with one another in real time. We like its broad file support and excellent templates, too. Among Mural's drawbacks are its price—which is on the high side—and its missing support for interactive charts and reports.

HOW IS MURAL DIFFERENT FROM THE COMPETITION?

Mural is a fast and flexible app for collaboration, but some of its closest competitors offer more than just a virtual whiteboard space and have special differentiating features.

For example, Prezi is not only a collaborative brainstorming tool but also a deluxe presentation app. In fairness, you can use Mural for presentations, but it's not as full-featured as other software in that category. Another example is Visme, which includes a rich set of templates for designing digital marketing assets, in addition to collaborative canvassing features. There is also very capable and specialized mind-mapping software, such as Mindomo, and flowchart and diagramming software such as Lucidchart and Draw.io. People tend to use mind-mapping and flowchart software differently than whiteboarding software, but there is some overlap.

Miro, Mural's closest competitor among the apps we've tested, is our Editors' Choice winner for whiteboarding and collaborative canvassing software because it is slightly more intuitive (especially for new users); it includes tools for making interactive diagrams, charts, and tables, which Mural doesn't have; and it costs a little less. Still, Miro and Mural's scores differ by only half a point, and the choice between them may come down to personal preferences.

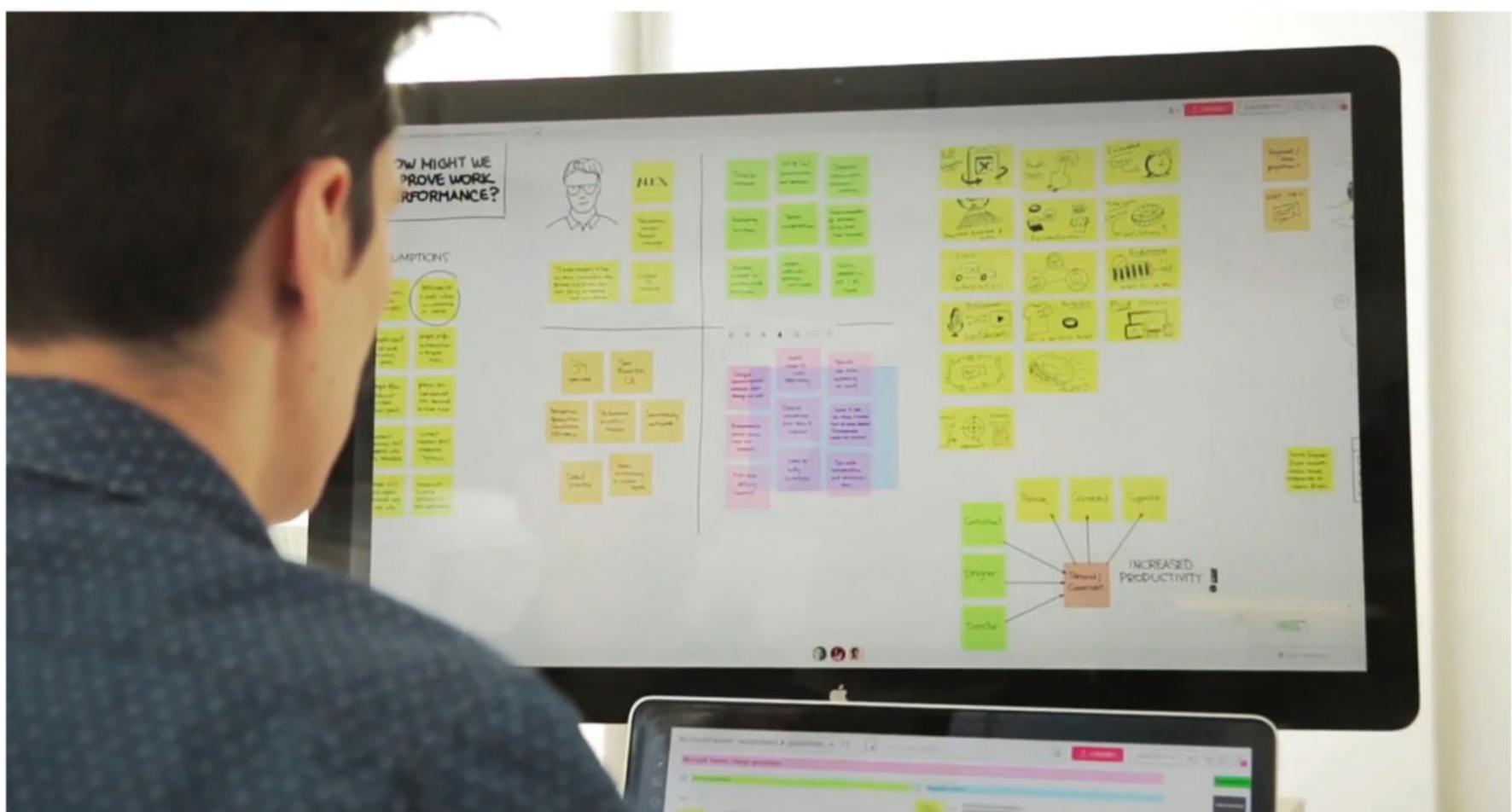
Mural

PROS Fast, real-time collaboration. Quick to set up and easy to use. Whiteboards support many file types. Varied collection of templates.

CONS Doesn't let you create interactive charts, reports, or tables. No support for video calls. Slightly pricier than closest competitor.

BOTTOM LINE

Whether you start with a blank canvas or a well-crafted template, collaboration app Mural helps you and your team brainstorm, plan, and share ideas.

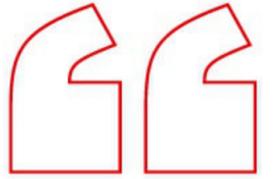


PRICING

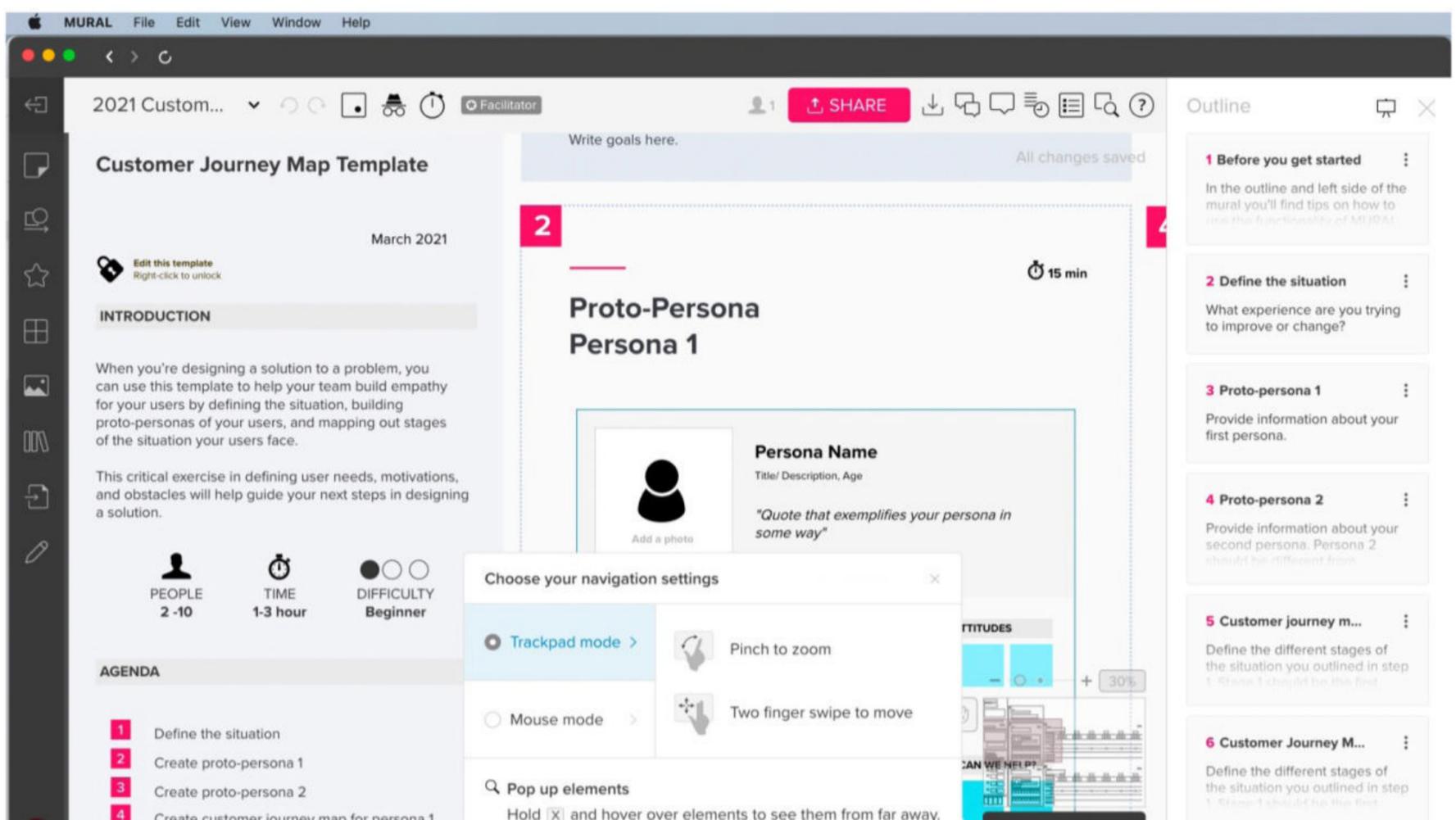
Mural has two membership plans for teams of up to 50 people and an Enterprise offering for larger groups. The company offers a free 30-day trial of its software but no permanent free-account level. You also have to sign up for a paid membership to access any of the content you made during the trial period.

The Starter membership (\$16 per person, per month or \$144 per person, per year) includes all the core features of Mural and places no limits on the number of Murals (canvases) you can make. Subscribers to this tier can invite Visitors via a shared link to view anonymously or edit a single canvas, too. Visitors don't have to create an account to access the file.

The Plus plan (\$240 per person, per year with no option to pay monthly) includes everything in Starter as well as priority support, additional learning resources, and a SAML single sign-on (SSO) option. The Plus account also lets you invite Guests, which differ from Visitors. Guests are collaborators whom you invite into your Mural group and get their own accounts. You can give Guests access to view or edit whichever Rooms (including private ones) and files you choose.



You use it to make virtual canvases and whiteboards where a team of people can draw, add notes, pin images and files, and interact.



The Enterprise account, which has custom pricing, adds centralized controls in a customer dashboard, the ability to make custom templates, self-serve SSO options, and other standard enterprise-grade features. Enterprise accounts have access to API endpoints to de-provision users, and some customers have access to the activity logs API as well. No other API access is offered at this time, though a Mural representative says the company has plans to expand API endpoints for other uses in the future, such as provisioning and SCIM.

For all accounts, Mural handles storage, and there is no option to use your own storage resources at this time. Miro and Prezi do the same. While it's convenient for these apps to provide storage, some organizations may prefer to handle their own. I think it should be an option for enterprise accounts, at the least.

Mural is available on the web and for Windows and macOS systems. It offers mobile apps for iPad, iPhone, and Android devices too, but they aren't quite as full-featured as the desktop and web apps. For instance, while you can view and edit Murals, create stickies, draw, and run polls and timers, you don't get every feature for adding content to your canvas. The mobile apps are more than sufficient for viewing content and participating in a brainstorming session, but when you're doing heavy-duty work with Mural, you're better off using one of the desktop or web apps.

HOW DO MURAL'S PRICES COMPARE?

Mural costs about the same as other apps for mind-mapping, diagramming, and collaborating. Miro, for example, is only slightly cheaper at about \$10 to \$16 per person, per month. Mind-mapping app Mindomo costs around \$5.50 to \$13.50 per person, per month. That's also a little less than Mural but still in the same ballpark. Mindomo uses a sliding scale, so large teams may pay an even lower per-person rate.

The collaborative diagramming app Lucidchart starts at \$5.95 per month for a single person, while Pro and Team accounts cost between \$9.95 and \$24 per person, per month, with discounts for paying annually. Prezi, the unconventional presentation app mentioned earlier, offers too many plans to detail here—but to get the best features, you end up paying between \$180 and \$228 per person, per year.

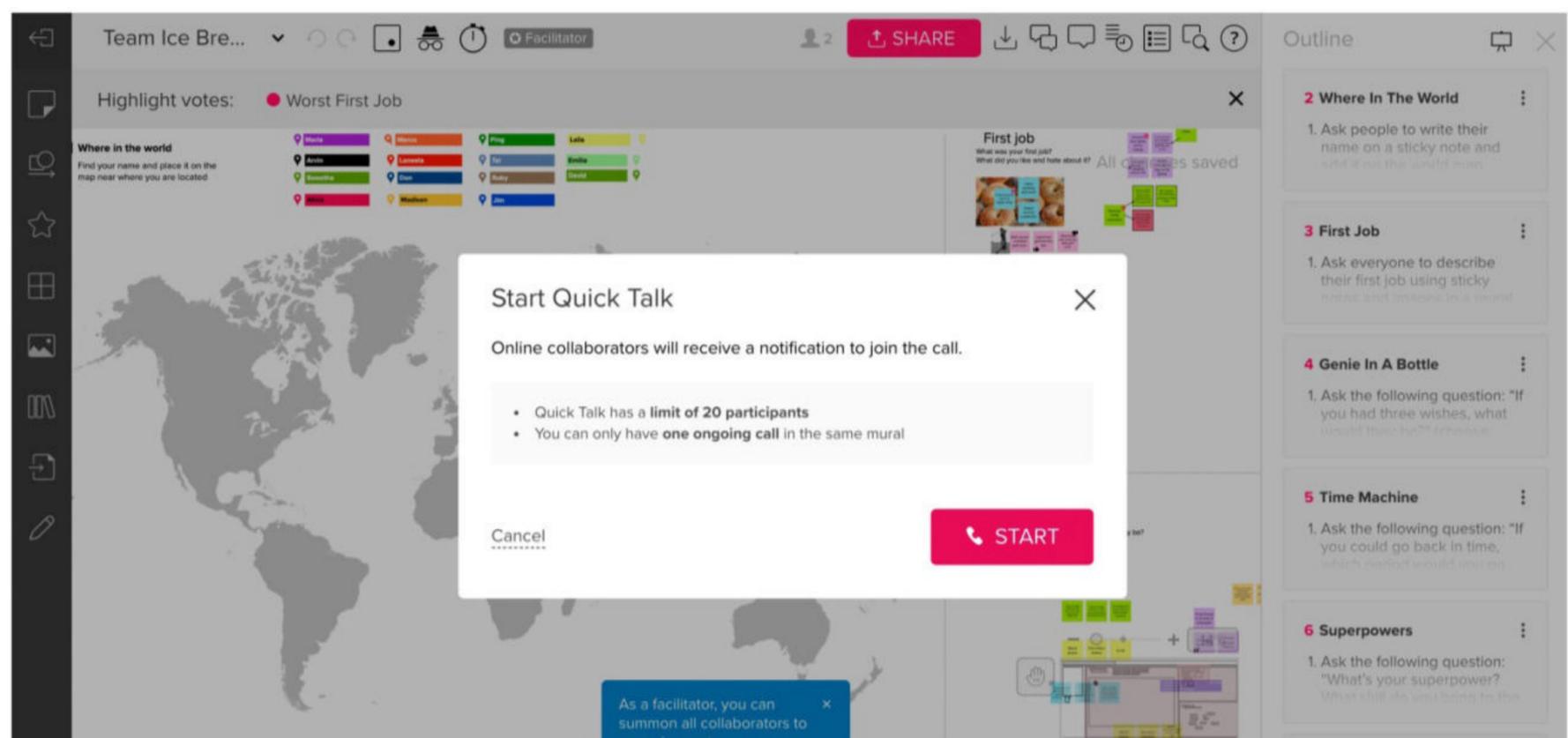
Many of the best video-conferencing services, including Zoom Meeting (paid accounts start from \$14.99 per month), have built-in collaborative whiteboards for real-time brainstorming. That's different from being able to save, reuse, and build out your canvases, the way you can with Mural. Microsoft Teams is another app that integrates with a collaborative whiteboard experience.

GETTING STARTED

To get going with Mural, you create an account with an email address. If Mural detects a Google account during the signup, it will ask if you'd rather authenticate using Google than create a separate set of login credentials.

Inside the app, the layout is straightforward. On the left, a navigation rail provides quick templates, learning resources for using the app, your favorite Murals, and Rooms, which are like folders for organizing your work. Rooms can be private or open for others in your account to join. The main section of the interface includes a button for creating a new Mural, plus any other files that are available to open.

The learning resources are excellent and may help you explore some of the tools that aren't highly intuitive. For example, you must be co-editing or viewing a Mural to start an audio call with your fellow collaborators. There's no option for video calls—a representative for Mural said that was a deliberate choice so as not to detract users' focus from the canvas. Competitor Miro, on the other hand, offers both audio and video calls. Mural also has a feature for drawing frames around content on a canvas to group and label it; you can get a sense of this feature from many of Mural's templates, but it's hard to learn how to use it correctly without the tutorial.



CREATING AND EDITING A MURAL

Mural's design makes it easy for people to jump into a canvas either alone or with others and quickly create and contribute. The simplest level of interaction is to create sticky notes on the canvas to jot down an idea. Making those notes in different colors, resizing them, and changing the point size of the text on them is all really easy.

Making sticky notes is so easy, in fact, that you may find yourself doing it accidentally and often. Stickies show up by default when you double-click the canvas. Here's what happens, especially in the first few days of getting acquainted with Mural: You try to select an item to move it or multiple items to group them, for example, or double-click an item to edit the text on it, and you accidentally create a sticky note. It might also happen while you're trying to pan or zoom, depending on what other apps you're accustomed to using. Once the rogue sticky is on the canvas, you have to select it to delete it. Over the course of testing Mural for about a week, the problem with stickies never subsided. I didn't have this same problem with the competing app Miro, because it uses two different cursors for panning (hand) and selecting items (arrow). Over time, most people who use Mural regularly will become accustomed to its controls, but I found it an annoying hump to get over.

Mural does let you change the input actions for panning and zooming to make it more user-friendly for trackpad or mouse use. For example, if you're a trackpad user, you can choose a pinch-zoom and double-finger swipe to pan.

When you explore Mural, you'll find assets that you can pull onto the canvas, such as arrows, lines, shapes, and icons. You can search for images to include without leaving the canvas. Mural also gives you frameworks, which are similar to templates (which I discuss in more detail below) but are treated as objects on your canvas, whereas templates are canvases with objects already on them. An example of a framework is a monthly calendar.

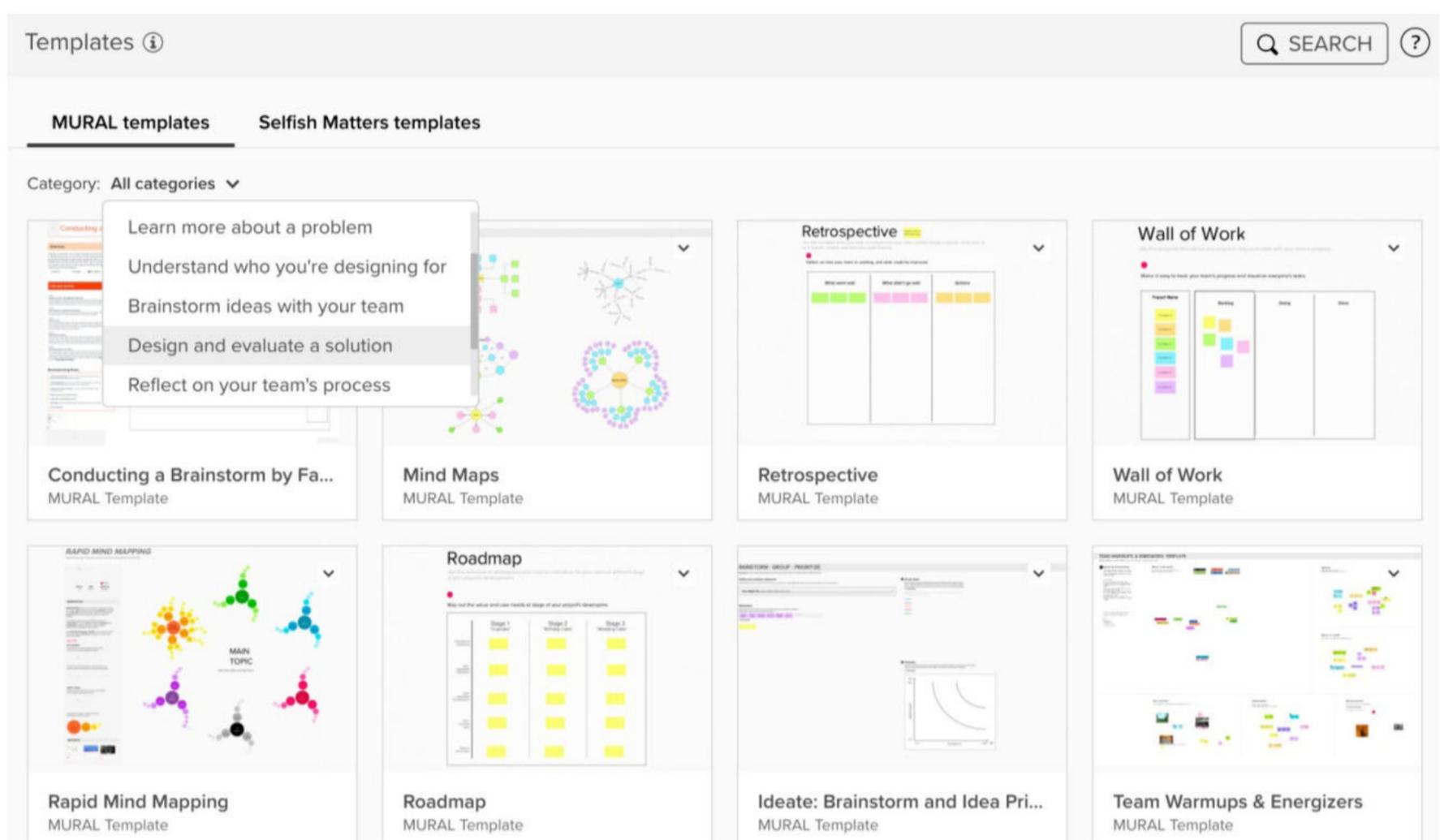
Features Mural doesn't have that Miro does are charts, graphs, and tables. In Miro, these are objects that you can add to your canvas and customize. For example, Miro lets you drag a sample chart onto your canvas and populate it with data. The data resides in cells, making it easy to update them. Mural doesn't include those kinds of assets. With Mural, you can upload a custom image of a chart or graph and even save it to reuse on other canvases, although that leaves you with a static image.

WORKING WITH MURAL'S TEMPLATES

Mural has more than 200 templates across a variety of categories, such as Agile, Brainstorm ideas with your team, and Plan a sprint or project. With an Agile template called Weekly Team Retrospective, team members track what went well during the previous week and what could be improved, and otherwise reflect on their work progress. There's a Customer Experience Journey template for brainstorming about the customer experience, a common activity for both marketing and project development teams.

Nearly all the templates are designed to be used interactively with a team. They focus on brainstorming, idea generation, thinking through problems, and team building. For the most part, Mural's templates are not sample diagrams, like a template for a mobile app design. You do get diagram-style templates in competitor Miro, however, and they are the focus of flowchart and diagramming software, such as Lucidchart.

In learning how to use Mural, these templates are quite helpful in suggesting not only what kind of files you could create but also how to interact with your team members while making them. For example, a series of templates designed as icebreaker activities contains instructions for going around the virtual canvas and inviting participation; they have the feel of virtual tabletop games.



One template that I played with in testing asked for each team member to place a marker on a world map to show where they live. Another activity on the same canvas asks each team member to share their first job and add a note about the best and worst parts of it.

COLLABORATING IN MURAL

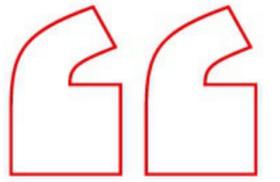
When you collaborate in Mural, everyone with access to a canvas can view, contribute to, and edit it in real time. These interactions happen fast, which is one of Mural's greatest strengths.

There are permission levels for managing collaborators, including view-only permissions, as mentioned in the pricing section. In addition, canvases can have Facilitators. A Facilitator is something like a meeting host. This person can, for example, turn on a timer to limit how long people add content to the canvas before discussing it. Facilitators can also view canvas Outlines, which are notes that go along with sections of your canvas, similar to how a presenter of a presentation might have presenter notes.

Another feature in Mural designed to improve collaboration is the ability for a Facilitator to Summon people. It is what it sounds like: Other collaborators are summoned from other parts of the canvas to be closer to the Facilitator. It prevents collaborators from getting lost or distracted when the Facilitator wants them to focus on a specific area of the canvas. If that's not enough, the Facilitator can also Take Control: lock the canvas quickly to all collaborators and temporarily turn them into view-only participants.

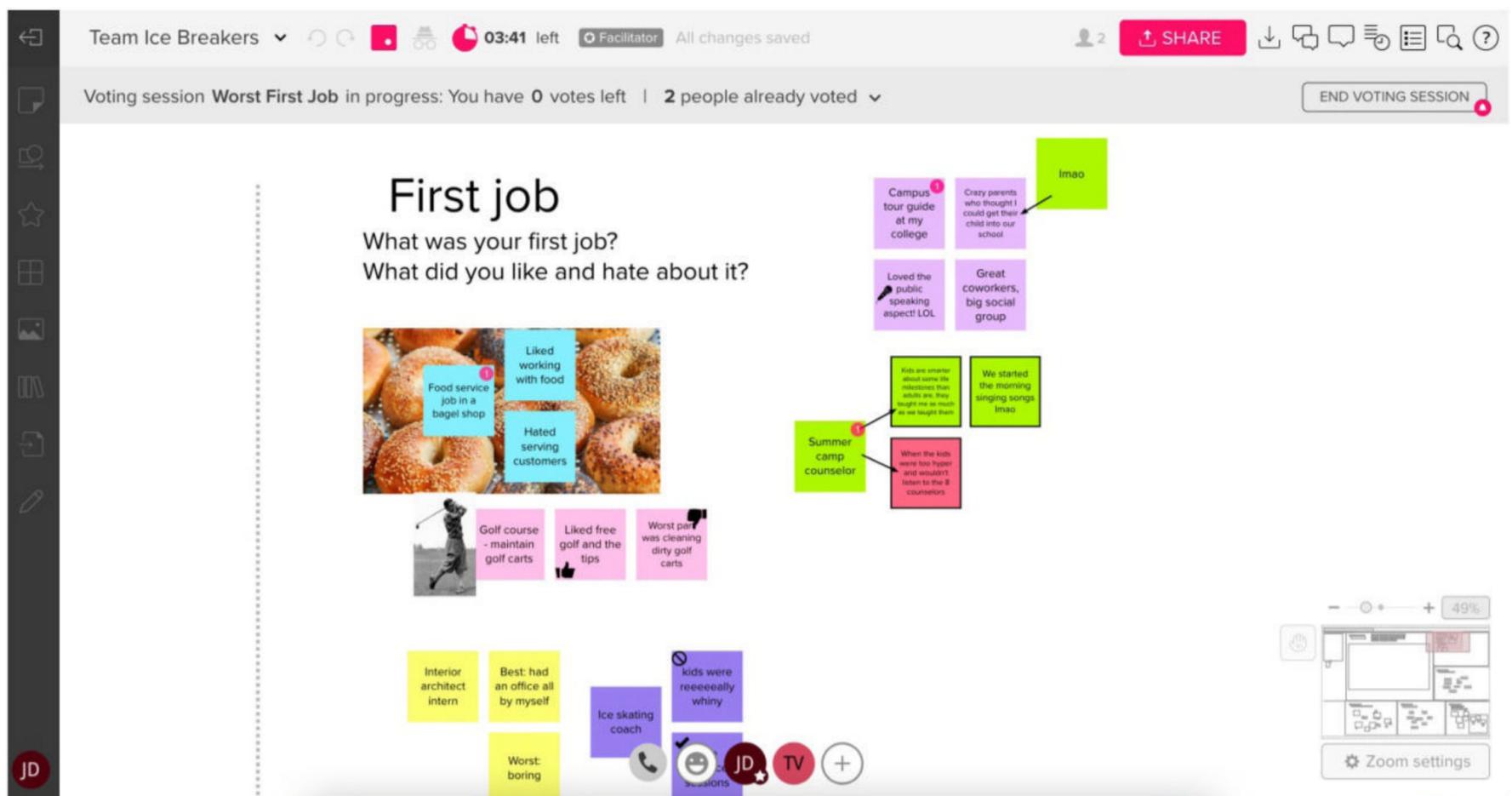
FILE TYPES AND INTEGRATIONS

Mural supports a long list of file types that you can upload and add to your canvas. All common image files work, including animated GIFs. You can add not



When you collaborate in Mural, everyone with access to a canvas can view, contribute to, and edit it in real time.





only major office files (such as DOC, XLS, and PPT) but also PDFs and ZIP files. If you add a link to a canvas, Mural generates a preview image. You can also add links from YouTube and watch videos right on your canvas.

With Mural, you can integrate other apps and bring some of their assets onto your canvas. Two that get a lot of mileage for technical teams are Jira and GitHub. There are integrations for Adobe Creative Cloud to pull in art assets, as well as Slack for notifications. For those who use Microsoft Teams, there's an integration for Windows devices that allows you to share and view Mural canvases to that app. Mural offers additional integrations too, though most of them must be routed through Zapier.

Mural supports exporting your canvas and the items on it, too. You can turn an entire canvas into a PDF or PNG, or snag some code to embed it on a web page. You can also download a ZIP file of all the files the canvas contains. And you can save any canvas as a template of your own. You can also export an area of any canvas as a PDF or PNG.

When you have specific content on your canvas that you want to isolate, such as issues from GitHub or Jira or plain text, you export just that part.

ACCESSIBILITY AND LANGUAGE SUPPORT

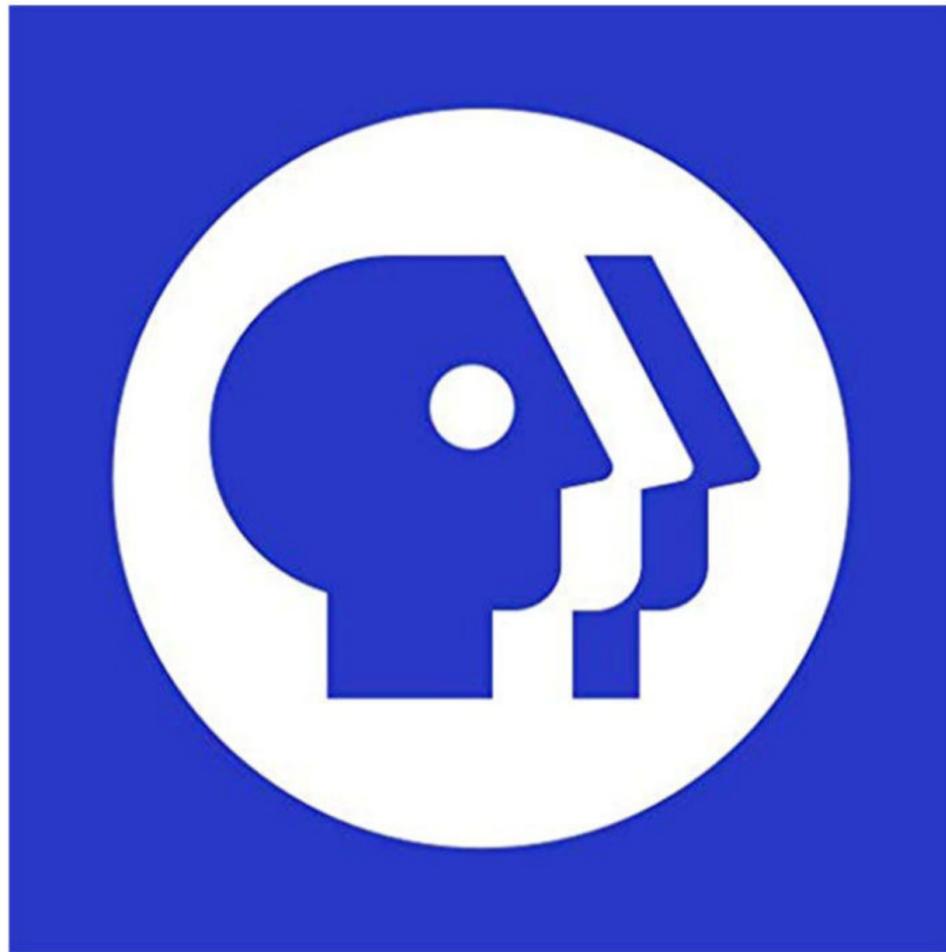
Mural has accessibility initiatives that at this stage appear to be in a healthy state of progress toward meeting Web Content Accessibility Guidelines compliance. The most recent self-audit, which the company makes publicly available on its website, indicates areas where compliance has been met and lists specific features of Mural that require updates to become compliant.

As for language support, Mural's interface and support pages are currently available only in English. The best you could do for additional language support is use a web browser plugin to translate them.

FAST AND USEFUL FOR TEAM COLLABORATION

Because it facilitates real-time co-editing and is fairly easy to use, we recommend Mural to teams looking for a tool to support team brainstorming. In its templates and features, Mural emphasizes collaboration and team-building much more than its competitors. It doesn't offer as much as competitors when it comes to tools and templates for making diagrams and flowcharts, though.

Miro offers a few advantages over Mural, including a cheaper price and a better set of tools for creating charts and graphs, so it has earned our Editors' Choice.



Free | Rating: ●●●○ GOOD

PBS Video: Substantial Free Streaming

BY KIM KEY

PBS's video streaming service does what the channel does best: It reflects the culture and history of our country and the wider world. The free service provides access to thousands of hours' worth of on-demand programming from flagship PBS series, such as PBS NewsHour and Frontline, plus many of Ken Burns' documentaries. PBS Video also features a live TV streaming component: Subscribers can watch feeds of local PBS broadcast channels. Note that the best PBS shows (and many episodes from top series) are locked behind a paid subscription—albeit a reasonably priced one. Our biggest issues with the service are that PBS Video places unskippable ads during programming and does not let you download titles for offline viewing on mobile devices.

You can experience PBS programming in three ways, outside of watching your local TV station. The PBS Video app lets you watch live feeds from PBS stations around the US as well as select on-demand entertainment, news, and documentary films and shows. PBS Video offers a premium tier called PBS Passport, available to donors who contribute at least \$60 a year or \$5 a month to their local PBS station. With PBS Passport, you can access new and additional episodes of PBS favorites from its vast catalog, such as *Finding Your Roots*, *Masterpiece*, *Nature*, *Nova*, plus additional Ken Burns documentaries.

Finally, PBS Documentaries is an Amazon Prime Channel. That channel, which costs \$3.99 per month, is home to popular PBS documentary series and such films as *Prince Philip: The Plot To Make A King* and *The Black Panthers: Vanguard Of The Revolution*. Note that there is some overlap in content between PBS Documentaries and PBS Passport, though the former focuses specifically on long-form features.

WHAT CAN YOU WATCH?

The PBS Video app is home to over 4,000 news, culture, entertainment, science, and nature shows. Kanopy, another free service, may be more robust with its collection of over 30,000 films, but PBS has a lot of flagship programming with loyal followers.

If you love muslin gowns and elaborate headwear, the Masterpiece productions listed under the Winter Dramas category will be of particular interest. In the Masterpiece section, you can watch period dramas including *All Creatures Great and Small*, *The Long Song*, and *Miss Scarlet and the Duke*. Beloved miniseries such as *Pride and Prejudice*, starring a young Colin Firth and Jennifer Ehle, and 2008's BBC

PBS Video

PROS Free. Varied on-demand streaming library. Includes access to live streams from local PBS broadcast stations.

CONS Paid PBS Passport subscription required to watch the most popular PBS shows. No support for offline downloads on mobile devices. Most programming is available only in the US.

BOTTOM LINE PBS Video gives you a substantial on-demand streaming library and access to live, local PBS broadcasts for free, but you need to pay to watch the network's most popular programming.

hit *Sense and Sensibility*, an adaptation of Jane Austen's classic novel, are available as well.

PBS Video hosts tons of great documentaries. You can watch selections from *American Masters*, *America Reframed*, *NOVA*, and *PBS NewsHour*, as well as some of Ken Burns' documentaries (the rest are on PBS Documentaries).

LIVE PBS STREAMS

Local news, sports, and culture shows broadcast by your local PBS affiliate are also available for streaming. For example, because I live in Atlanta, Georgia, the local station's offerings were from the ATL PBA channel.

If you don't like your local station's programming, you can check out others. To change stations, visit the Settings tab, choose Change Station, and then enter the zip code for another area. When you return to the home menu, you'll see local shows from that location. PBS Video allows you to watch livestreams from over 100 local PBS stations. Note that the live feed from your member station may not follow the same schedule as the on-air broadcast in that area, and that you can watch livestreams from only those PBS channels near your location.



In a similar way, Paramount+ includes access to select local and national CBS broadcast streams. You can also watch live local PBS programming with both YouTube TV and Locast.

PRICING

PBS Video is free to access and doesn't even require you to sign up for an account. But sometimes accounts are useful for personalized streaming recommendations and account preferences. If you do set up an account, you can either authenticate with an existing Google, Facebook, or Apple account, or you can sign up for PBS Video directly with an email address and password.

Some other free video-streaming services don't require you to create an account. Kanopy and Peacock, our top choices for the category, do require you to set up accounts, however.

If you're already a PBS donor, you can link the email address associated with your account to your PBS Video login. If you're not already a donor, simply click the Become a Member button to set up your recurring donation and then link your accounts afterward.

PBS Passport, at \$5 per month, is cheaper than most mainstream video-streaming services, but its price is in line with many documentary-streaming services. For comparison, Netflix starts at \$8.99 per month, and Disney+ is \$7.99 per month. CuriosityStream's cheapest tier is only \$2.99 per month, and MagellanTV charges \$6.99 per month.

The PBS Video app is available on the web, mobile platforms (Android and iOS), media-streaming devices (Android TV, Apple TV, Chromecast, Fire TV, and Roku), and Samsung's smart TVs. PBS Video does not offer apps for gaming consoles, however. I tested the service on an Apple TV and an iPhone.

APPLE TV INTERFACE

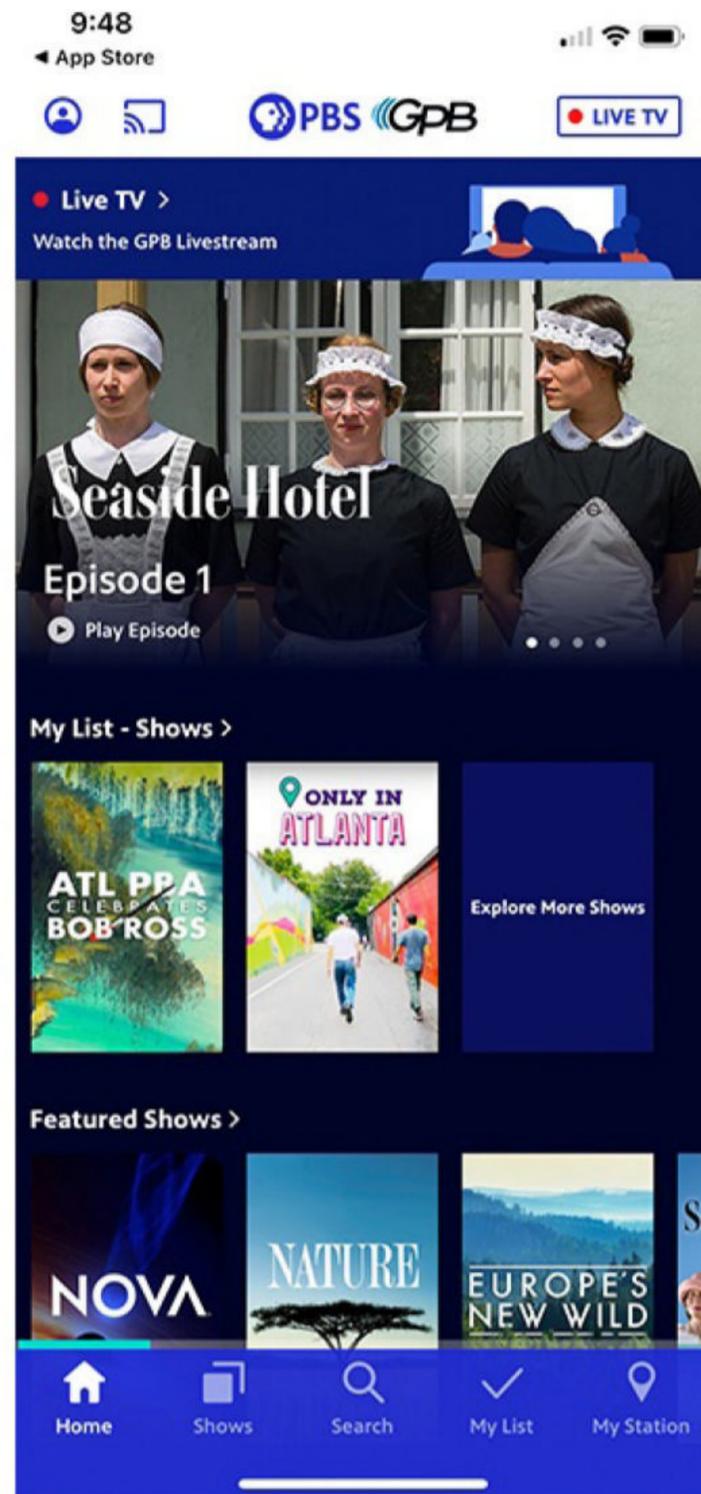
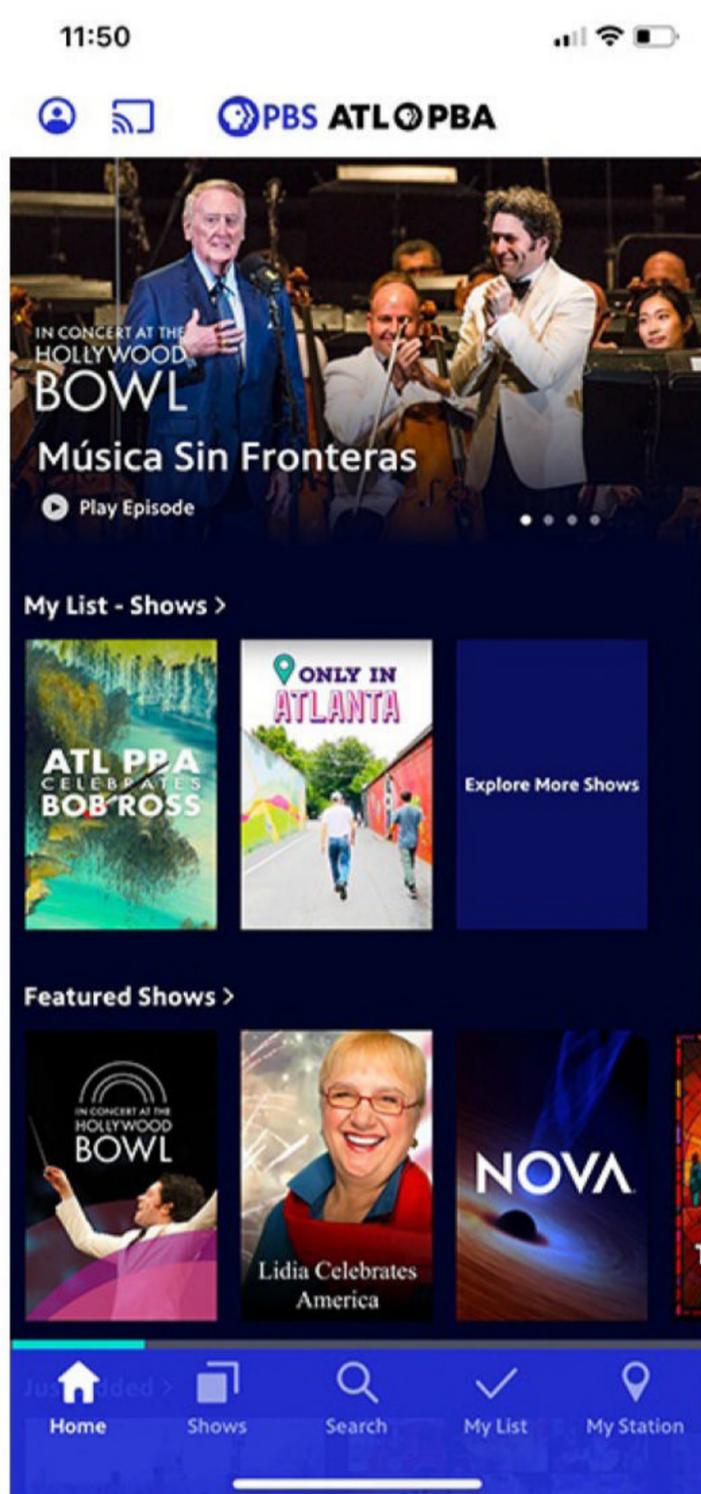
PBS Video's layout is very easy to navigate and features a dark-blue background with bright, colorful thumbnails. Once you find something to watch, just click on the thumbnail to see a brief description, trailers and extras, and a list of related titles.

If you see something you'd like to watch later, add it to the My List section. To do this, tap or hover your mouse over the video's thumbnail, and click the My List button. If you don't have time to finish watching something in one sitting, PBS Video adds the last video you watched to the Resume Watching category on the Home tab.

I'd like PBS Video to add some kind of group-watching feature. Several mainstream video-streaming services, including Amazon Prime Video, Disney+, HBO Max, and Netflix, offer this capability. Co-watching options make streaming more fun and interactive, and who wouldn't want to gather the gang together to watch *Antiques Roadshow* on a Friday night?

MOBILE

I downloaded the PBS Video app on my iPhone XS running iOS 14.4 to try out the mobile experience and didn't encounter any performance issues with the app. The mobile app retains the same navy-blue background and vibrant thumbnails but looks even more at home on my phone's smaller screen.



Streaming on-demand video and the live feed from a local PBS station is painless. Just tap the thumbnail of what you want to watch, and the app takes you to the playback screen. You can use the Picture-in-Picture (PIP) function to watch videos while doing other things on your phone. Unlike indie and art-house streaming service Ovid.tv (and most every other video-streaming service), you can't download programming to watch offline. This is a serious limitation, and one that you don't find in PBS Documentaries.

PLAYBACK EXPERIENCE

One of the service's drawbacks are the unskippable ads. When I watched a 52-minute episode of *Antiques Roadshow* on my mobile device, I encountered a 30-second ad to start the show but didn't run into any others. It's nowhere near as bad as Hulu's over-2-minute ads, and PBS ads don't appear on every show or every movie, but their presence is noticeable. If you're looking for no-cost, ad-free documentary programming, check out Kanopy.

PBS Videos' playback interface is fairly straightforward. You get standard playback controls and the ability to scrub through the video's timeline, along with a 10-second rewind button on the web player and 15-second rewind and fast forward controls on the mobile app. You can enable and customize closed captions from the playback screen on the web player and select the playback resolution. If you're watching on Apple TV, you can lessen sudden noises by going to the Video and Audio menu and toggling Reduce Loud Sounds.

I tested the app's streaming performance over a Gigabit Ethernet connection and a Wi-Fi connection (450Mbps download) on mobile. I watched a short video called *Only in Atlanta: Midtown* on the Apple TV app without any problems, as well as an episode of *Antiques Roadshow*. I resumed playback on my mobile phone part way through the latter show without issue.

ACCESSIBILITY AND PARENTAL CONTROLS

You can adjust the closed-captioning settings directly from the PBS Video's playback screen as well as choose the language. Available adjustments include font size, family, and color, as well as the opacity of the text, window, and background. The service doesn't support audio descriptions as do Amazon Prime Video and Apple TV+. When enabled, this accessibility feature provides an audible narration of things happening on screen that would not be discernible from the dialog alone.

PBS Video doesn't have any parental-control functions, but its programming is generally suitable for all ages. You can download the separate PBS Kids Video app for Android and iOS for a more targeted library. Disney+ also includes very kid-friendly shows and movies, but it lets you create specific profiles for younger viewers. Kanopy offers an entire section of kid-centric streaming content, too.

VPN

A VPN can help protect your privacy online and spoof your location, but some video-streaming services block VPN traffic to enforce regional streaming rights. To test whether PBS Video works with a VPN, I connected my iPhone to a ProtonVPN server based in the Netherlands. While my phone was connected to the VPN, I was unable to play certain videos on the app, including Passport videos. The app simply said that video was not available in my region. When I switched to a US-based VPN server, I was able to watch everything that was unavailable over the other server connection.

Even if you do find a VPN that works with every one of your video-streaming services, that harmony might not last. The services are constantly finding new ways to detect and restrict VPN traffic. We recommend you choose a VPN based on other factors, such as its value, features, and privacy stance.

THE BEST OF PBS, FOR A PRICE

PBS Video offers both on-demand streaming shows and live feeds of local PBS stations for free and without requiring you to create an account. The premium Passport tier, which unlocks substantially more of PBS's vast library, is very affordable. Drawbacks to the service include the inability to download titles for offline viewing and that the majority of the streaming catalog is available only for US residents.

Netflix continues to be our Editors' Choice winner for on-demand video streaming because of its exceptional library of originals and movies. Hulu, another Editors' Choice pick, is a flexible streaming option with both a robust on-demand library and an excellent live TV channel lineup. Editors' Choice winner YouTube TV dominates the live TV market with an intuitive interface and top-notch features.

FEATURES



SILICON, USA:

TECHNOLOGY MADE IN AMERICA

BY SASCHA SEGAN

Ever tried to buy a computer made entirely of US parts and assembled here? You can't. But here are 46 companies making high-quality tech products in the United States.

“Designed by Apple in California.” The tag is in every iPhone box, asserting the primacy of thousands of minds in Cupertino feverishly inventing the latest technology. But once they come up with the plans for an AirTag or an iMac, those get shipped overseas. It's been decades since Silicon Valley, the heart of American computing, made many of its own devices.

A recent Reuters-Ipsos survey shows that Americans want to buy more US-made products, as long as they don't have to pay more for them. The poll found that 69% of people said an item being US-made was at least somewhat important, but that 63% wouldn't be willing to pay more than a 10% premium for something to be American-made.

Manufacturing jobs tend to be good jobs; at least, they're better than just selling imported products. According to the Bureau of Labor Statistics, “assemblers and fabricators” earn an average of \$37,550 per year, while “retail sales workers” make \$29,010.

“Our nation is falling behind its biggest competitors on research and development (R&D), manufacturing, and training. It has never been more important for us to invest in strengthening our infrastructure and competitiveness, and in creating the good-paying, union jobs of the future,” the Biden administration stated in a recent executive order.

Manufacturing is also about national autonomy, tech leaders told us. US factories are subject to US laws, and they're physically proximate to US customers. Even when our products are made in allied countries, such as Mexico or South Korea, we lose the ability to affect everything from working conditions to consumer rights when we cross borders.

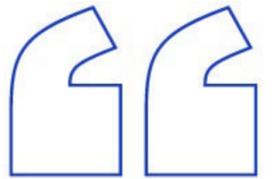
“If all the manufacturing is in Asia...what if those switches go off?” Intel VP and Senior Director of Global and Regulatory Affairs Greg Slater asked. “Qualcomm and Apple and others should be concerned. If a switch goes off in Taiwan, for whatever reason, you’re stranded.”

US manufacturing has become an even hotter topic in tech because of the current chipset shortage, which is affecting everything from T-Mobile’s new home internet routers to iPads and cars. New Intel CEO Pat Gelsinger has pledged \$20 billion to build two new chip-manufacturing facilities in Arizona; Taiwanese firm TSMC now plans to open a \$12 billion chip factory in Arizona in 2024; and Samsung may be planning a \$17 billion chip plant in Texas to be built in Q3 of this year.

“There’s an opening here for Joe Biden to really be a ‘Made in America’ president,” Alliance for American Manufacturing (AAM) President Scott Paul told CNN.

To survey the current state of American high-tech manufacturing, we found 46 companies across the country that are building technology devices in five categories: chips, PCs and servers, consumer electronics, home audio, and electric vehicles. The list isn’t exhaustive; we have only included companies for which we could verify US manufacturing.

These companies are large and small, with factories in California, Vermont, and in between. Generally, American electronics manufacturing is about making high-value, high-quality products with a focus on customer support. But that means the affordable gadgets that stock Walmart shelves, by and large, will be made abroad into the future.



US

**manufacturing
has become an
even hotter
topic in tech
because of the
current
chipset
shortage.**





Photo credit: Maxx-Studio/shutterstock.com

WHY COMPANIES BUILD IN AMERICA

Politicians can tell you why we should build things in America: national security and jobs. But the companies we spoke to had other reasons for sticking around in the US.

One, of course, is sheer pride and community feeling. U-Turn Audio's Ben Clark "always wanted to build a company here in Massachusetts and employ people from our community," he said, and Clark now has 21 people building turntables in Woburn.

But in large part, it's about responsiveness. Most of the companies we spoke to wanted to be physically closer to their customers, letting them be more responsive in delivery or customer service. The audio and PC builders we spoke to, especially, said that bringing design, assembly, and support under one roof makes for a higher-quality product with better customer satisfaction.

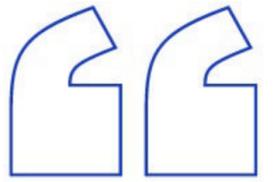
"Having manufacturing and R&D co-located in our own facility allows us to test new iterations and upgrades and bring products to market faster than if our manufacturing was outsourced. In addition, due to shipping restrictions and workforce complications in Taiwan in 2020 from COVID-19, having the manufacturing brought back to our facility in Washington allowed us to stay on schedule and launch our u8 Terminal in Q4 of 2020," said Jon Maron, VP of marketing for Kymeta, which makes satellite dishes.

MSI may be a Taiwanese company, but it brought production to the US so it could be nimble when responding to American consumers' needs. "MSI is known to be one of the fastest-launching partners whenever a new generation [of tech] comes out," system product management director Clifford Chun said. "By producing in the USA, we are able to have all available parts in stock and 'air in' whatever is newest. [Ship] transportation from Asia has gone up in time from 3 weeks to over two months, these days."

Manufacturing locally is more environmentally friendly, cable manufacturer OFS pointed out. According to UK newspaper *The Independent*, cargo ships are an environmental disaster, burning "heavy and toxic" fuel made from the "dregs left over at the end of the refinery process." Building heavy things such as cars or spools of fiber-optic cable near where the customers are helps reduce manufacturing's impact on the Earth.

For Flir, which makes infrared camera sensors, there's another reason: Many of its products are used by government agencies. Those agencies tend to have "buy American"—or at the very least, "don't buy Chinese"—requirements. "Some of the products Flir makes are defense-related, and due to government regulations, we need to manufacture them within the US, typically with certain US components," said Flir spokesman Paul Clayton.

Drone maker Skydio called out the US's "asymmetric advantages" in certain areas, such as AI, as a reason to build here. "Skydio benefits from America's leadership in artificial intelligence. Our founders met as graduate students at MIT," the company said. Flir agreed, pointing out that Goleta, CA has been a center of excellence in IR technologies since the 1960s.



**MSI may be a
Taiwanese
company,
but it
brought
production
to the US so
it could be
nimble.**



US CHIPMAKERS AND COMPONENT MANUFACTURERS

The following represent a sample of the companies still making chips and components in the US.

- Corning Gorilla Glass, made in Harrodsburg, KY, covers the screens of your favorite mobile phones.
- Ericsson's Smart Factory in Lewisville, TX, is building 5G base stations for US wireless carriers.
- GlobalFoundries makes chips and wafers in upstate NY and VT for AMD, the automotive industry, and others.
- Intel's processors are made in the US.
- Micron produces DRAM and NAND flash memory at two locations in the US.
- OFS makes giant spools of fiber-optic cable for internet connections.
- PNY, based in Parsippany, NJ, assembles flash drives.
- Qorvo makes some of the RF chips that go into iPhones.
- Skyworks is Qorvo's top competitor for board space in iPhones.
- TI makes a range of chips at its plant in Richardson, TX.

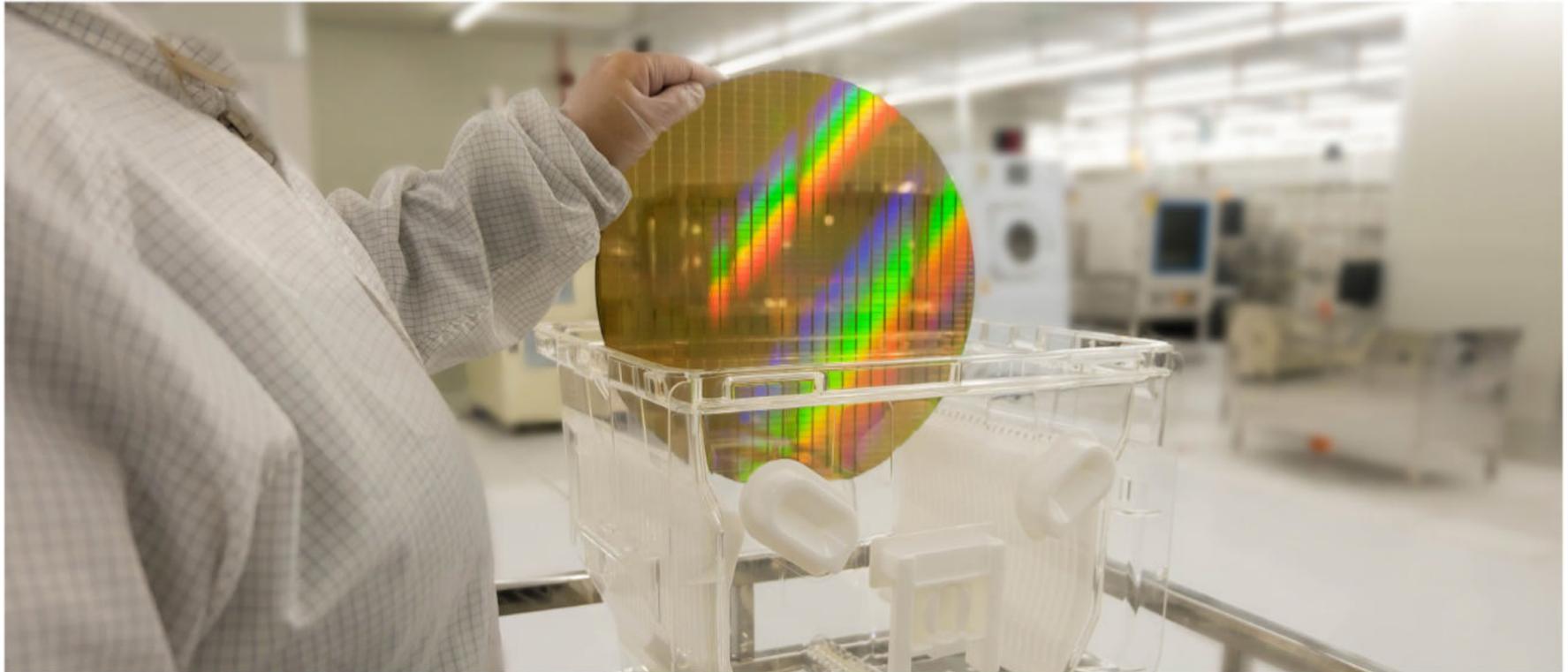


Photo credit: MS Mikel/shutterstock.com

THE CHIPS ARE DOWN

About 12% of chips are made in the US, down from 37% in 1990, said analyst Bob O'Donnell in USA Today. Chipmaker jobs are good ones, and there tend to be a lot of them. We spoke to Intel, with plants in Oregon and Arizona, and GlobalFoundries, in upstate New York and Vermont; TI makes chips in Texas.



The US punches far above its weight in chip design, as opposed to manufacturing—but that doesn't create manufacturing jobs.



The Semiconductor Industry Association (SIA) said that a new fab (factory) generally requires 3,000 to 6,000 employees. It takes about two years to build a fab and another year and a half to bring it up to speed, said Intel's Slater. So why are we so far behind on manufacturing? "The governments and companies of Taiwan and Korea understood that investing in homegrown fabs was a long-term way for them to continue to grow their tech sectors and manufacturing capabilities," said analyst Anshel Sag of Moor Insights.

The US punches far above its weight in chip design, as opposed to manufacturing—but that doesn't create those manufacturing jobs. The SIA said in a report that US companies are responsible for 45% to 50% of global semiconductor sales, but they mostly contract out to foreign foundries now. Qualcomm Technologies Inc. (QTI) is a perfect example of this split. The world's second-largest mobile chipset manufacturer is a mainstay of the San Diego economy, but it's "fabless," meaning it doesn't build any of its chips itself.

"Integrated fabless manufacturing enables QTI to produce modern processors which are optimized for price, performance, and power efficiency, through sourcing multiple foundries at various process nodes," the company said in a 2014 white paper.

Sag said that US investors have "traditionally seen fabs inside chip companies as a liability more than an asset," and so have encouraged the decoupling of US chipmakers from the actual manufacturing. "It's extremely capital-intensive, depreciation is significant, and there is very little incentive to build capacity beyond demand," he said.

As the industry decoupled, the new foundries weren't built in the US. The SIA report said 38% of chips are now made in third-party foundries, but only 7% are made in the US.

“As much as 40% to 70% of the higher cost for US-based fabs is directly attributable to much lower incentives than those currently provided in China, Taiwan, Singapore, and other countries,” according to the SIA. These “incentives” can take many forms. While the US is really good at giving tax breaks, the SIA said, Taiwan gives massive subsidies for construction and equipment and has lower labor costs, and those make more of a difference.

“Leading-edge fabs require a \$10-billion to \$20-billion investment and significant support from the government. By some estimates, it costs two to three times more to build an advanced fab in the US than in Taiwan,” Strategy Analytics analyst Sravan Kundojjala said.

The SIA estimates that a \$50 billion incentive program would vault the US up to producing 24% of the world's chips, with 19 fabrication plants. We'll also need to train workers to run them.

“There's a significant gap in terms of skilled workers that are needed to run these fabs,” Sag pointed out. Kundojjala estimated it would take five to 10 years of education for the US to match the leaders in terms of a semiconductor manufacturing workforce.

US COMPUTER AND SERVER MANUFACTURERS

It's impossible to build a PC entirely without foreign parts, but these firms handle primary assembly in the US.

- Apple makes some Mac Pro models in TX.
- Datto builds backup servers in CT.
- DigitalStorm produces gaming PCs in CA.
- Falcon Northwest has been building high-end PCs in OR since 1992.
- HP Enterprise builds some servers in WI.
- Lenovo has a small assembly operation in NC.
- Origin PC makes all of its computers in FL.
- Supermicro servers for the US are often made in CA.
- Every Velocity Micro PC is assembled by hand in VA.

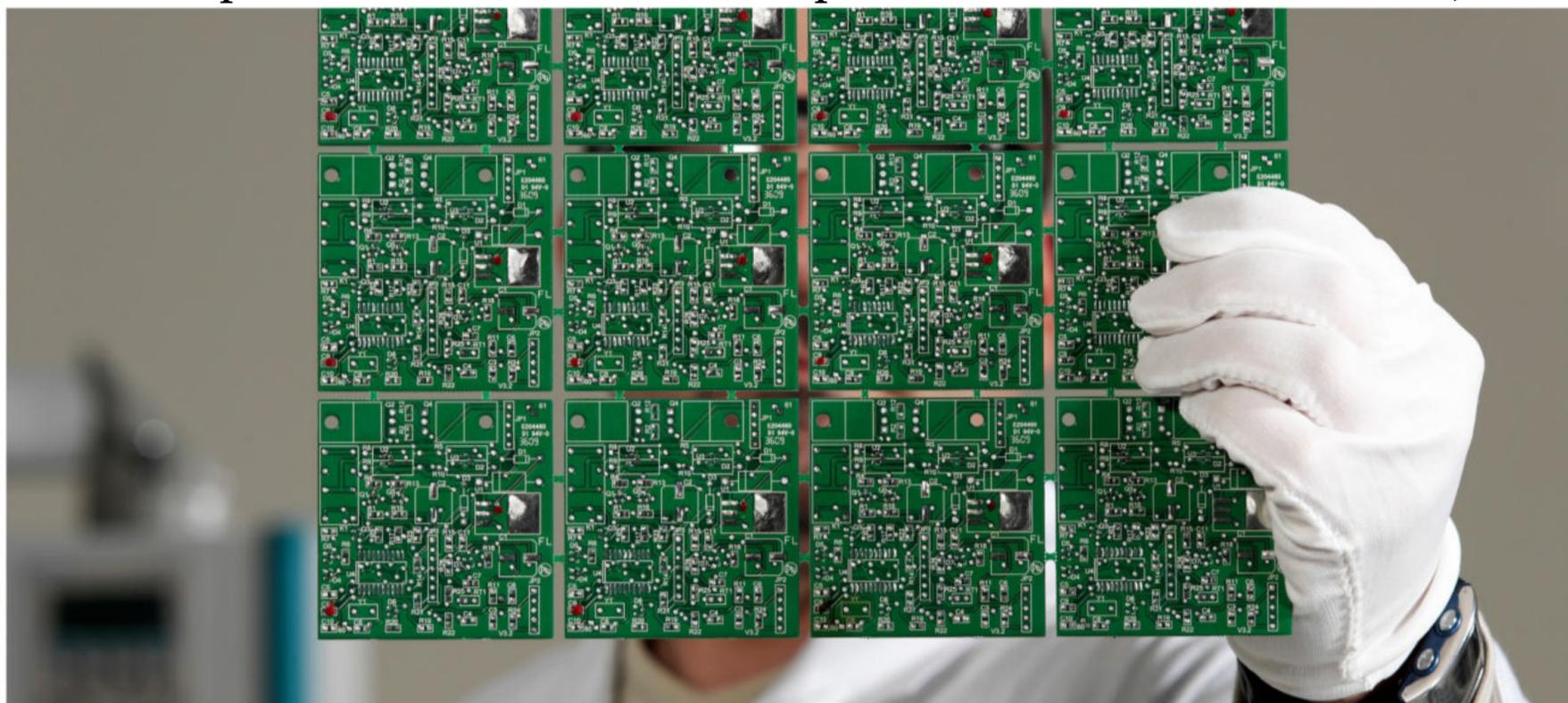
AN ALL-AMERICAN PC? NO SUCH THING

PCs are absolutely built in the United States, but it's impossible to build them solely from US components. That's true of all of the complex electronics in our study and is unlikely to change, according to experts. "PCB [printed circuit board] manufacturing and assembly is a very low-margin business and is largely located in Asia. It comes down to access to low-cost labor, a vast ecosystem of factory infrastructure, and flexibility. It is hard to replicate the ecosystem in the US today," said Kundojjala.

Velocity Micro's Josh Covington agrees. "With the exception of a few processors, the majority of components still have overseas origins. Taiwan, China, and Japan are so far ahead of us in terms of manufacturing infrastructure and cheap labor, it's virtually impossible for component manufacturers to bring production back to the US and still be price-competitive," he said.

In general, PCs built in the US are higher-end, lower-volume models, such as Apple's premium Mac Pros and Origin's gaming PCs. A 2019 *New York Times* report explained why: "Apple has found that no country—and certainly not the United States—can match China's combination of scale, skills, infrastructure and cost," the report said, citing the massive existing infrastructure of everything from screw vendors to assembly lines in China.

American workers cost more and demand better working conditions than Chinese ones do, according to the *Times* report. That raises the prices and lowers the potential volume of American products. When we looked at PC,



consumer electronics, and electric bike manufacturers in the US, we found that in general, they produce high-cost, high-quality, high-performance products, not the inexpensive gear on the shelves of your local big-box store. If we want PCs made by high-wage US workers who live in average suburban US homes, we're going to have to come to terms with the cost of making that happen.

“Consumers need to adjust their pricing expectations. We've all become so accustomed to cheap tech over the past few decades, but the truth is that tech is cheap because overseas production is cheap. We also need more companies willing to innovate and invest in production here, despite those higher costs,” Covington said.

CONSUMER ELECTRONICS AND AUDIO

Many higher-end audio brands are still made at least partially in the US, and some other higher-end consumer electronics are made here, too.

- Audeze headphones are assembled in CA.
- Clark Blumenstein handcrafts wooden speaker cabinets in WA.
- Dan Clark Audio makes its headphones in CA.
- Flir builds infrared camera sensors in CA.
- Grado headphones have been made in NY since 1953.
- Some Klipsch speaker cabinets are still carved by hand in AR.
- Kymeta produces satellite dishes in WA for off-the-grid Internet access.
- McIntosh Labs audio products are all made in NY.
- Planar builds “video walls” of multiple LCD panels in OR.
- RED cameras are assembled in CA.
- Seura's televisions disappear into attractive wall mirrors; they're made in WI.
- Shinola is a mainstay of the “new Detroit,” MI.
- Skydio is the top US manufacturer of drones, located in CA.
- Starlink builds consumer satellite terminals in WA and is considering making many more in TX.
- Sunbrite TVs are made for the outdoors in sunny southern CA.
- U-Turn Audio turntables have always been made in MA.

THE FAKERS

Not everything that says it's “made in America” is, in fact, made in America. Companies may slap the label on to play at patriotism, but it's more likely that they're doing it to play for subsidies.

Element Electronics sells TVs through Walmart and claims it has “the only mass assembly television factory in the United States. The Winnsboro, South Carolina, factory employs over 400 workers and delivers more than 1 million televisions each year.”



Photo credit: LdF/Getty.com

But in 2014, the Alliance for American Manufacturing discovered that Element’s “assemblers” were just taking a Chinese-made TV and inserting a Chinese-made memory card into it. That led to a Federal Trade Commission complaint, which foundered on quibbles over what a “substantial transformation” of a product means.

Element is still playing the same game, South Carolina–based *FITSNews* reported. The company has received millions in government subsidies and property tax breaks for its US factory, which *FITSNews* said really just checks and repackages Chinese products: “We have spoken with sources who have been inside Element’s Winnsboro, SC facility as recently as last month who tell us its ‘screwdriver’ manufacturing process remains in place. Specifically, they claim the ‘mechanical testing’ consists entirely of plugging the televisions into an outlet and turning them on ... that’s it.”

The International Trade Administration said a “substantial transformation” must involve “a fundamental change ... which adds to its value,” and that “a new article of commerce—normally one with a different name—is found to result.” Sticking a memory card in a TV does add to its value, but it doesn’t create a device with a different name, and it wouldn’t pass most people’s smell tests.

We have two TV manufacturers on our list—Seura and Sunbrite—and there’s a third, Skyvue, which could have been listed as well but hasn’t replied to our emails. The difference between these companies and Element’s reported “transformation” is huge. No TV panels are made in the US; they’re all imported. But the “real” US TV makers then turn the units into something different, by incorporating them into mirrors or pumping up the backlights and installing them in weatherproof housings.

The dream of US LCD panels (and more than that, US jobs) led the Trump administration and the Wisconsin state government into a 2017 deal with Foxconn to build a huge plant with 13,000 jobs in Mount Pleasant, Wisconsin. But as a massive Verge investigation revealed in late 2020, Foxconn betrayed all its promises. It never built an LCD factory, it played fast and loose with hiring requirements, and did very little manufacturing. The company promised it would invest \$10 billion, but had invested only 3% of that number. This April, the project crashed to Earth with a new deal in which Foxconn says it will deliver fewer than 1,500 jobs, according to CNN; it currently only has “several hundred.” The company still won’t explain what it plans to make at the site.

The future of US electric cars looks exciting whether or not Foxconn’s vaporware ever turns into anything real. GM, Nissan, and Tesla already make mass-market electric cars here, and they’ll soon be joined by Lordstown and Rivian, electric-truck startups that are repurposing old auto plants in the Midwest to build next-generation vehicles. The first Rivian SUVs will hit the streets this summer, and Lordstown said it’s targeting late September for its trucks. And just as this story went to press, Ford revealed its electric F-150 pickup truck, which will be built in Michigan. (The company builds its Mustang Mach-E in Mexico.)

ELECTRIC VEHICLES

Finally, we wanted to spotlight some of the electric-vehicle companies developing in the US.

- Chevrolet’s electric Bolt and the upcoming GMC Hummer EVs are built in MI.
- The Electric Bike Co. builds beautiful electric bicycles in CA.
- All of Harley-Davidson’s Livewire electric motorcycles are made in PA.
- Lordstown Endurance is a new electric truck manufacturer in OH.
- The Nissan Leaf electric car is built in TN.

- Rivian’s electric cars will be built in IL.
- Tesla’s huge factory in northern CA churns out electric cars daily.
- Zero Motorcycles’ electric motorbikes are made in CA.
- Ford has pledged to build its new F-150 Lightning truck in MI.

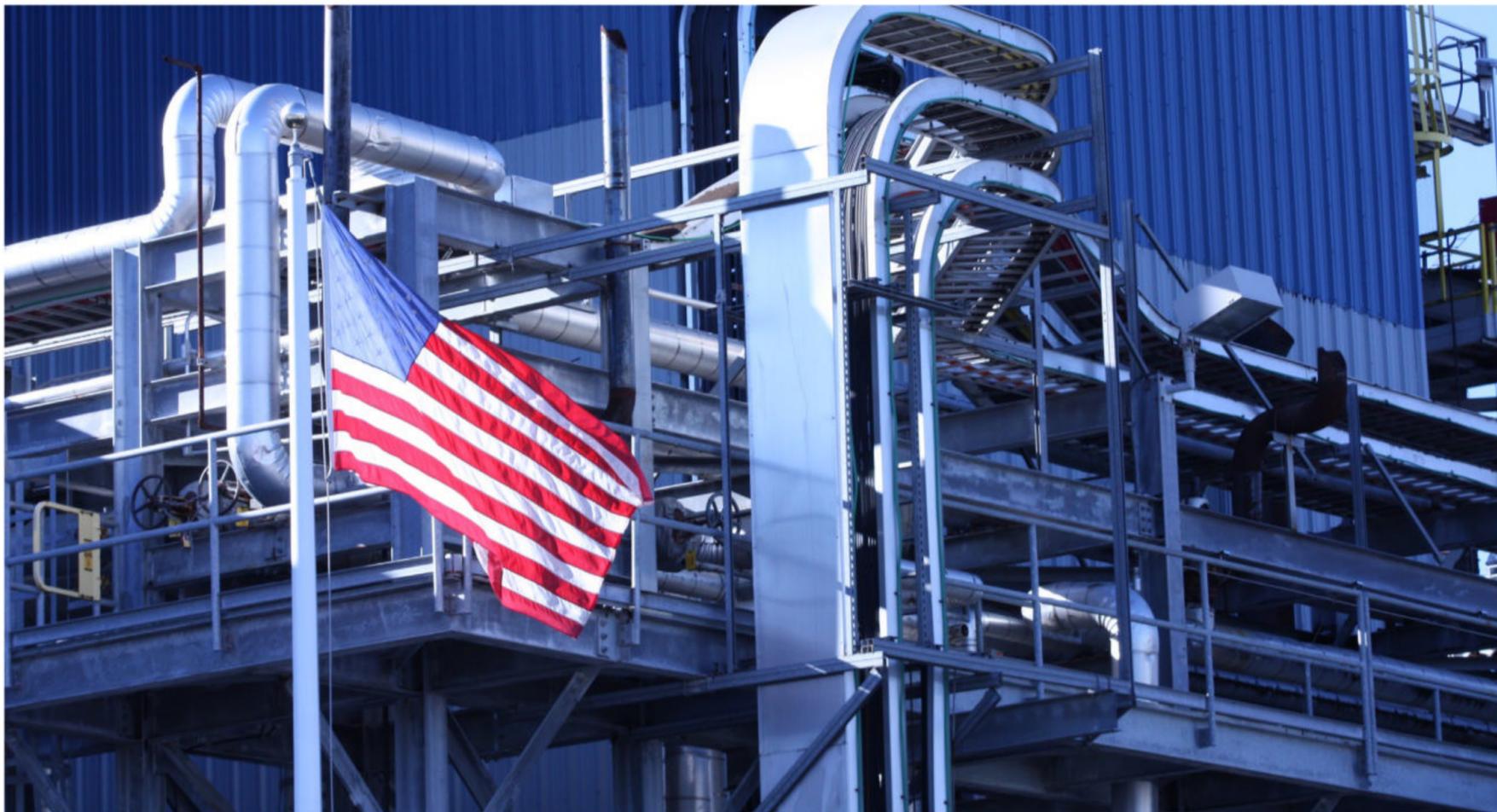


Photo credit: Amanda Wayne/Getty.com

BRINGING MANUFACTURING BACK TO THE USA

Figuring out how to breathe life back into American high-tech manufacturing has been a focus of both the Trump and Biden administrations.

Under Trump, much of the action was around tariffs. According to the AAM’s Scott Paul, “Trump took action. He imposed tariffs on some imported steel. He renegotiated NAFTA and withdrew from entering the Trans-Pacific Partnership trade agreement. For a few months, he jawboned at companies that were offshoring jobs. He negotiated an agreement with China and has kept tariffs on many Chinese imports.”

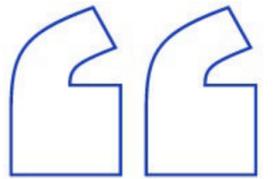
But Paul ultimately saw Trump’s moves as a lot of rhetoric with few results. “His grandiose rhetoric and erratic policies on trade and manufacturing didn’t usher in a new era of prosperity for factory towns. Many are in fact worse off than when he entered office,” Paul concluded.

President Biden's approach appears to be more around investment; more carrot than stick. Biden let loose with an executive order assessing "America's supply chains" on Feb. 24 and a detailed jobs and workforce development plan on March 31.

Biden's "American Jobs Plan" asks for a slew of investments: \$52 billion for domestic manufacturers, \$31 billion for small business incubators and access to credit, \$20 billion for 10 "regional innovation hubs," \$46 billion of direct purchases of products such as American-made electric cars, and \$50 billion for an office at the Department of Commerce dedicated to investing in critical US supply chains.

For the semiconductor field, the biggest deal is the Creating Helpful Incentives for Producing Semiconductors (CHIPS) for America Act. Passed last year but not funded, this new legislation authorizes the Department of Commerce to provide semiconductor makers with \$3 billion subsidies each.

Biden's current infrastructure proposal would fund the CHIPS Act with \$50 billion "in semiconductor manufacturing and research" over several years, according to *EE Times*, but it's stuck in a partisan battle over Biden's legislative agenda. *EE Times* quotes an analyst as saying that even if the plan succeeds, "The amount proposed by President Biden would probably still fall short of the amount necessary to get the US back in the game."



This new legislation authorizes the Department of Commerce to provide semiconductor makers with \$3 billion each.



SILICON, USA: THE COMPANIES THAT BUILD TECHNOLOGY IN AMERICA



Samsung

Factory location: Austin, TX

Products produced in US: 14nm-65nm chips

Samsung opened operations in Austin in 1997, and it now has several factories in its Austin complex. It employs about 10,000 people total, according to the *Austin American-Statesman*; about 3,000 are Samsung employees, and the rest are contractors.

ExtremeTech estimates that Samsung Austin produces about 5% of the world's volume of 300mm wafers. Using 3D FinFET technology, the Austin foundry primarily focuses on 11nm/14nm and 28nm/32nm technologies, with customers and applications including SSD controllers, Tesla vehicle chipsets, and Qualcomm radio-frequency chips.

The company recently submitted papers to the Texas government asking for tax incentives to build a new \$17 billion chip factory, which will employ 1,800 more people with an average starting salary of around \$66,000.



Corning

Factory locations: Harrodsburg, KY, among others

Products produced in US: Gorilla Glass, optical fiber and cable, Valor Glass, labware products, ceramic substrates for automotive

Corning is a 170-year-old firm based in upstate New York that has always been at the leading edge of glass and ceramic technologies. US customers, for Corning, means US manufacturing: “Corning strategically locates our facilities closest to our customers to facilitate efficient supply for their immediate manufacturing needs and provide us access to global markets,” the company said.

In terms of consumer tech, Corning’s star plant is in Harrodsburg, Kentucky, a 65-year-old factory where Gorilla Glass is made. The plant previously made glass for LCDs, but as the LCD industry shifted to Asia, Corning reinvented itself as a “glass-melting technology center of excellence.” The Harrodsburg plant had nearly 1,000 employees as of 2017, according to Corning.



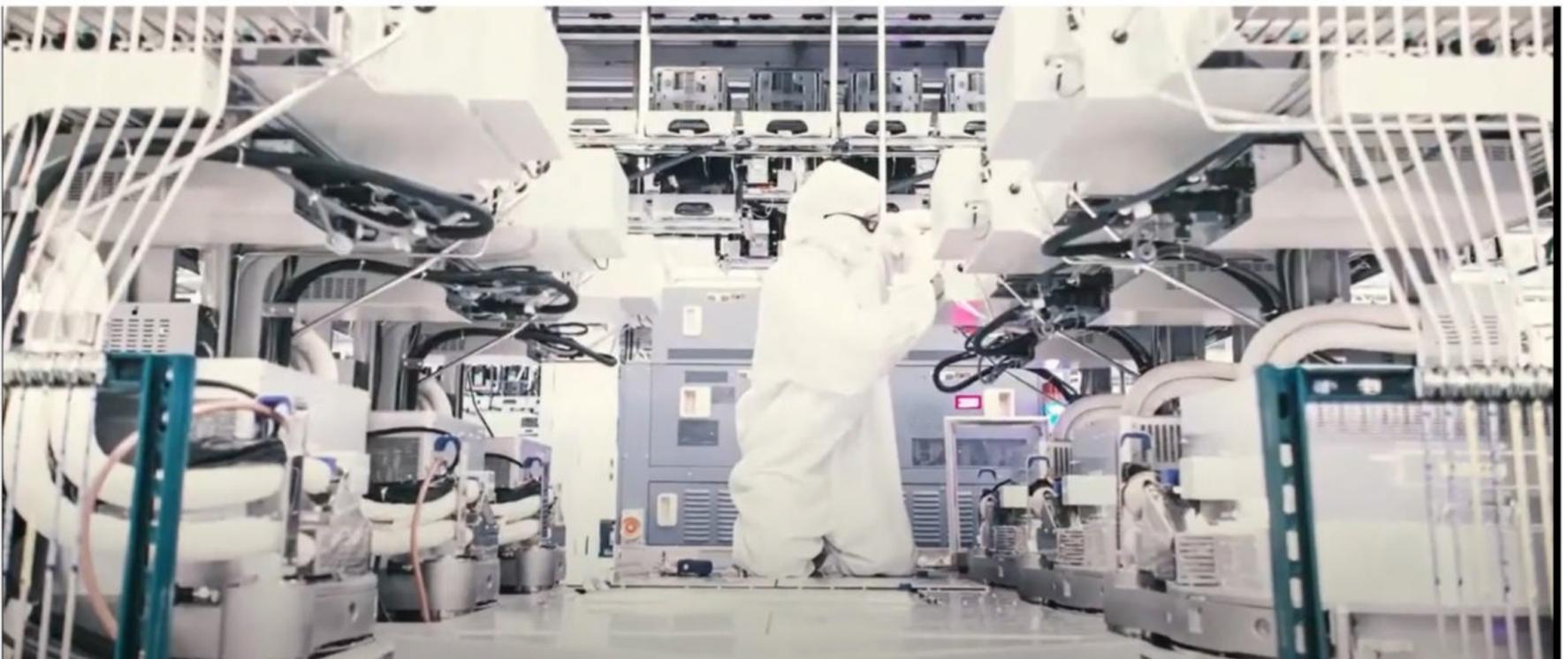
Photo credit: Highsmith, Carol M.

Intel

Factory locations: Hillsboro, OR; Chandler, AZ

Products produced in US: Semiconductors, 300nm to 7nm.

If you want a US-made CPU, choose Intel. The company makes most of its cutting-edge chipsets in Hillsboro or Chandler. Intel just announced a major expansion in Arizona, with two new factories on the way to produce chips both for itself and for outside clients. Intel has close to 21,000 employees in Hillsboro, according to the company.



GlobalFoundries

Factory locations: Malta, NY; Essex Junction, VT; East Fishkill, NY

Products produced in US: Semiconductors

GlobalFoundries is a chipmaker spun out of AMD's former manufacturing arm.

The company makes chips for clients such as Broadcom and Qualcomm, with manufacturing capabilities down to 12nm nodes. It also produces components for AMD's Ryzen, Threadripper and Epyc CPUs, although some elements of those processors must be made in more capable factories in Taiwan.

GlobalFoundries employs more than 7,000 people across the US and has invested \$15 billion in US semiconductor development, the company said.



OFS

Factory locations: Carrollton, Ga; Norcross, Ga; Avon, Conn; Sturbridge, Mass

Products produced in US: Optical fiber

The internet runs on fiber; OFS makes it. Because fiber spools are big and heavy, and take weeks to transport overseas, it's smarter and faster to make fiber near where the customers are—and many of the customers are in the US. Making products in the US also helps secure contracts that contain restrictions such as "Buy American," the company said. OFS employs about 800 people in the US to make its fiber, some of whom are unionized.



Photo credit: <https://www.landmarkbuilders.com/portfolio/qorvo-office-building-construction/>

Qorvo

Factory locations: Greensboro, NC; Hillsboro, OR; Richardson, TX
Products produced in US: RF switches, filters, power amplifiers, antenna tuners, RF front-ends, and more

Qorvo was founded in 2015 by the merger of RF Micro and TriQuint, and it makes semiconductors around the world. Its number-one client is Apple, which uses many of its RF chips; its gallium nitride chipsets also go into 5G base stations. Qorvo makes UWB chips, too: Both Samsung and Apple have made “ultra wideband” positioning technology mainstream in their phones this year.

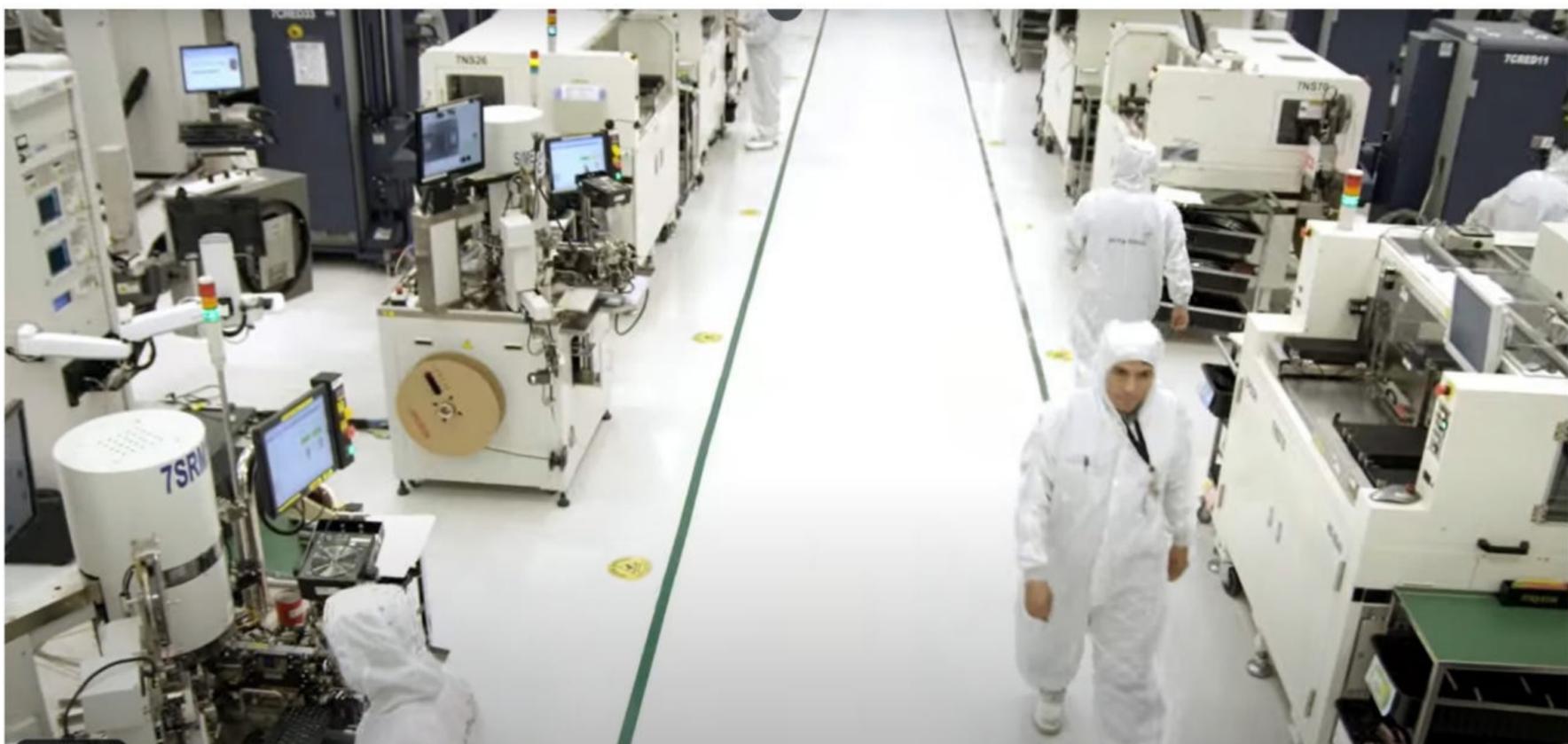


Texas Instruments

Factory locations: Richardson, TX; South Portland, ME
Products produced in US: Chips

Richardson, Texas, is home to TI's "RFAB," where the company makes 300mm wafers of chips largely for the automotive industry. The company is doubling down on Richardson with an \$850 million investment announced last year for another plant that will start production in 2024, according to the Dallas Morning News.

South Portland, Maine, is home to factories for both TI and ON Semiconductor, formerly known as Fairchild. According to Glassdoor, the South Portland factory starts technicians at \$11 an hour, maintenance specialists at \$17 an hour, and process development engineers at \$49,000 a year.



Skyworks

Factory locations: Adamstown, MD; Newbury Park, CA; Woburn, MA

Products produced in US: RF and microwave components, switches, amplifiers, and silicon wafers

Skyworks is Qorvo's major competitor in supplying RF chips for Apple iPhones. It also makes chips for aerospace, defense, medical, and industrial devices. Most of its chips are switches, amplifiers, and RF components. Skyworks' largest manufacturing facility is in Mexico, but it does some manufacturing at three locations in the US.



PNY

Factory location: Parsippany, NJ

Products produced in US: Product assembly, testing, and packaging

PNY employs more than 500 people in its New Jersey offices, which, according to the company, are focused more on assembly, testing, and packaging than straight-out manufacturing. The company makes Nvidia-branded graphics cards, as well as a wide range of SSDs, memory, and USB flash drives.



Ericsson

Factory location: Lewisville, TX

Products produced in US: 5G and Advanced Antenna Systems radios

Ericsson's 5G Smart Factory in Lewisville, Texas, is part of the next generation of manufacturing—but that means it may not offer a lot of jobs. The 300,000-square-foot smart factory has more than 200 employees and over 200 robots. Most of the humans are either programming the robots or double-checking their work. Ericsson's radios go into all three of the major US carriers' networks. The photo above is of Kyle Malady, Verizon's CTO, holding a US-manufactured Ericsson 5G base station.

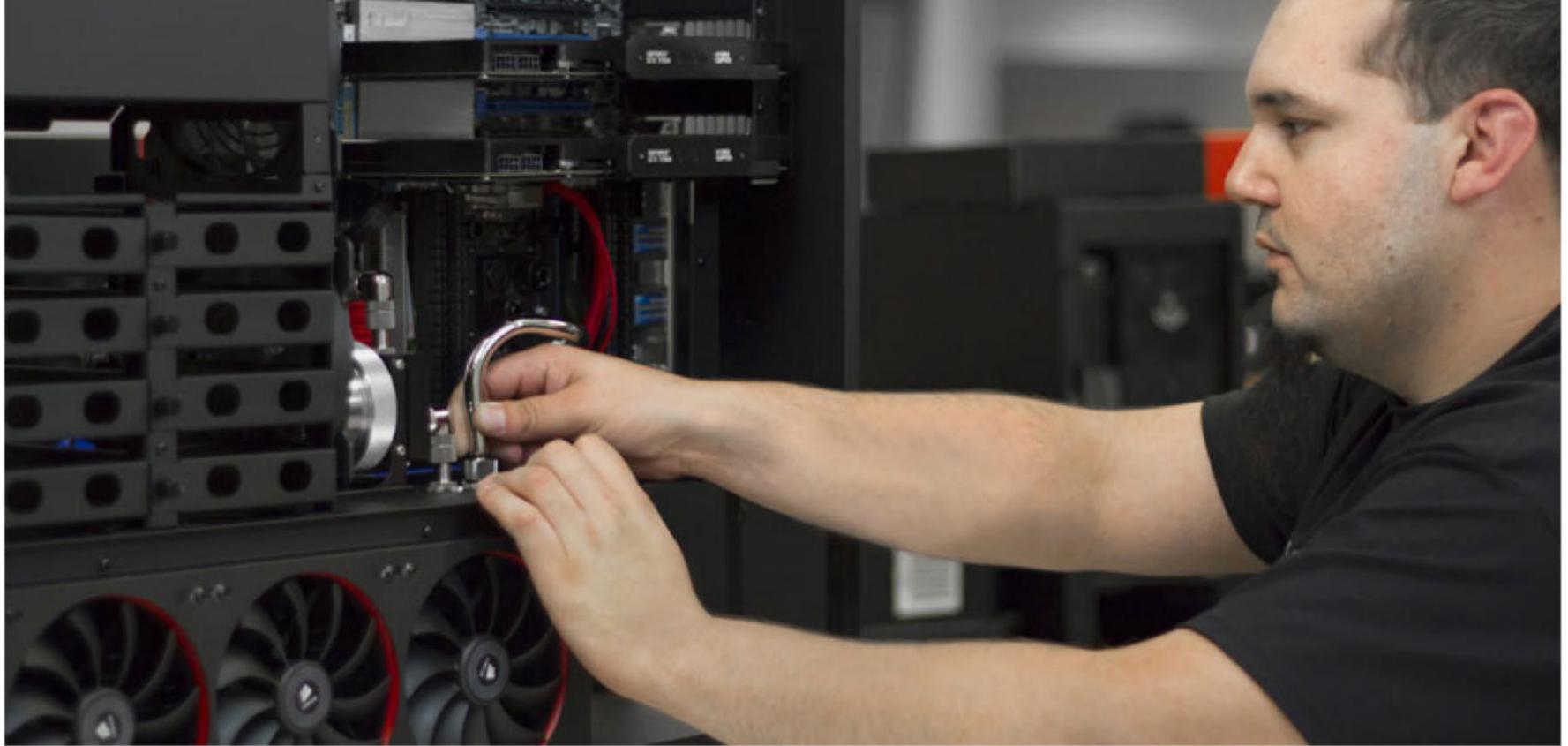


Micron

Factory locations: Boise, ID; Manassas, VA

Products produced in US: DRAM, NAND Flash memory

Memory company Micron is at the heart of Boise's tech industry. Its factories in the area are all surrounded by streets with fun, related names: Terabyte Lane, DRAM Drive, Memory Road, and Silicon Way. It makes DRAM and NAND Flash memory at its two locations in the US, although it has just decided to sell a third location in Utah that was devoted to 3D Xpoint memory.

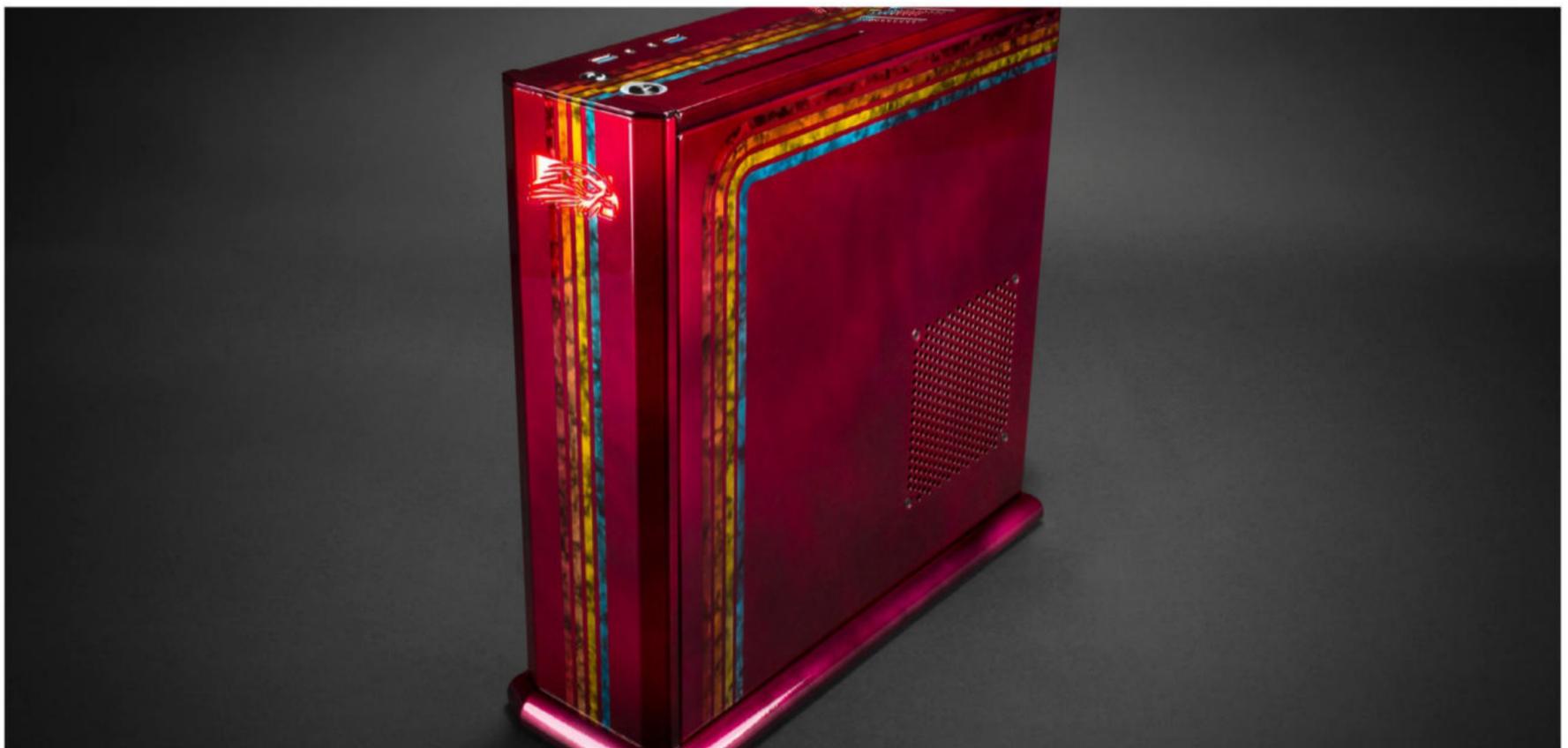


Digital Storm

Factory location: Gilroy, CA

Products produced in US: PCs

Digital Storm declined to answer our questionnaire, but the company confirmed that it assembles PCs in Gilroy, California, in an unassuming facility right behind the Gilroy Premium Outlets shopping mall. As with other US PC “manufacturers,” Digital Storm’s PCs are built in the US of largely foreign components, but many of the parts are custom-designed, and finishes are applied in the US facility.



Falcon Northwest

Factory location: Medford, OR

Products produced in US: Desktop PC assembly; PC design, sales, and tech support

Falcon Northwest is a custom PC builder that, like other US-based PC builders, largely gets parts from overseas but designs, assembles, tests, and supports its systems from its offices in Oregon; it also offers US-based tech support. CEO Kelt Reeves said he'd love to source more parts made in the US if they became available. Falcon does a lot of custom painting and finishes on its PCs, such as the one shown above.



MSI

Factory location: City of Industry, CA

Products produced in US: Infinite R/RS, Aegis R/RS/ZS/SE, and Codex R/Z/ZS desktop PCs

MSI is a huge Taiwanese manufacturer—so why build premium desktops in the US? It's all about speed. Company product-management director Clifford Chun explained that travel times by ship from Asia are longer than they used to be, so it's much faster to keep basic parts in the US, ship in a few elements by air, and assemble in California to ship to US consumers.



Origin PC

Factory location: Miami, FL

Products produced in US: PC assembly and support

Origin PC does all of its manufacturing and assembly in Miami, but as with other US PC assemblers, the machines are largely made of foreign components. The art and craft comes in how high-end internal components are combined, machined, and enhanced to create unique systems entirely focused on gaming.



Velocity Micro

Factory location: Richmond, VA

Products produced in US: Gaming and workstation PCs

Velocity Micro has been building PCs in Richmond since 1997, with dozens of

builders on site putting together both affordable and premium PCs. Managing Director Josh Covington told us the company has to rely on foreign components, because “Taiwan, China, and Japan are so far ahead of us in terms of manufacturing infrastructure and cheap labor.” But making PCs in the US lets Velocity Micro focus on quality assurance to a level that it would never be able to do by outsourcing to a foreign factory. “Yes, production would be cheaper, but we’d be selling an inferior product, which we’re not interested in doing,” he said.



Lenovo

Factory location: Whitsett, NC

Products produced in US: N/A

Lenovo has 320 manufacturing employees in Whitsett, North Carolina—far fewer than it has in China or Mexico, where most of the company’s products are made, but still more than nothing. While the company has previously said it assembled some ThinkCentre desktop machines and ThinkPad laptops in Whitsett, it would not confirm specific models to us.



Apple

Factory location: Austin, TX

Products produced in US: Mac Pro

Details: Apple assembles its top-of-the-line desktop PC, the Mac Pro, in Austin, Texas. The company uses “computer processors from Arizona and Oregon and graphics processors from New York,” it said, which refer to other companies on our list—Intel in the first case and GlobalFoundries in the second. Apple is building a massive new campus in Austin that will open in 2022 and initially employ 5,000 workers; it currently has about 7,000 workers in Austin.



Supermicro

Factory location: San Jose, CA

Products produced in US: Servers

Supermicro makes enterprise servers, and according to the company, almost all of its products are made in the US. The company does parts manufacturing and final assembly at its San Jose campus, and it's working on a "Made in the USA" certification program for the future. US-focused manufacturing lets Supermicro be more nimble in terms of fulfilling customers' requests, the company said.



Datto

Factory location: Monroe, CT

Products produced in US: Backup servers

Datto makes backup servers for "managed service providers," companies that contract with small businesses to manage their IT infrastructure. You wouldn't buy a Datto server for yourself, but it might save your bacon in the event of a disaster. The company procures global components and then assembles, tests, and images the servers in Connecticut, with a staff of 35 engineers.



HP Enterprise

Factory location: Chippewa Falls, WI

Products produced in US: Servers

HP Enterprise bought a factory in Chippewa Falls in 2016 and expanded in the area when it bought Cray, a supercomputer maker based there. According to local news site WEAU, the company now employs 486 full-time workers and 200 contingent workers in the area, with average yearly wages for full-time workers at \$78,000.

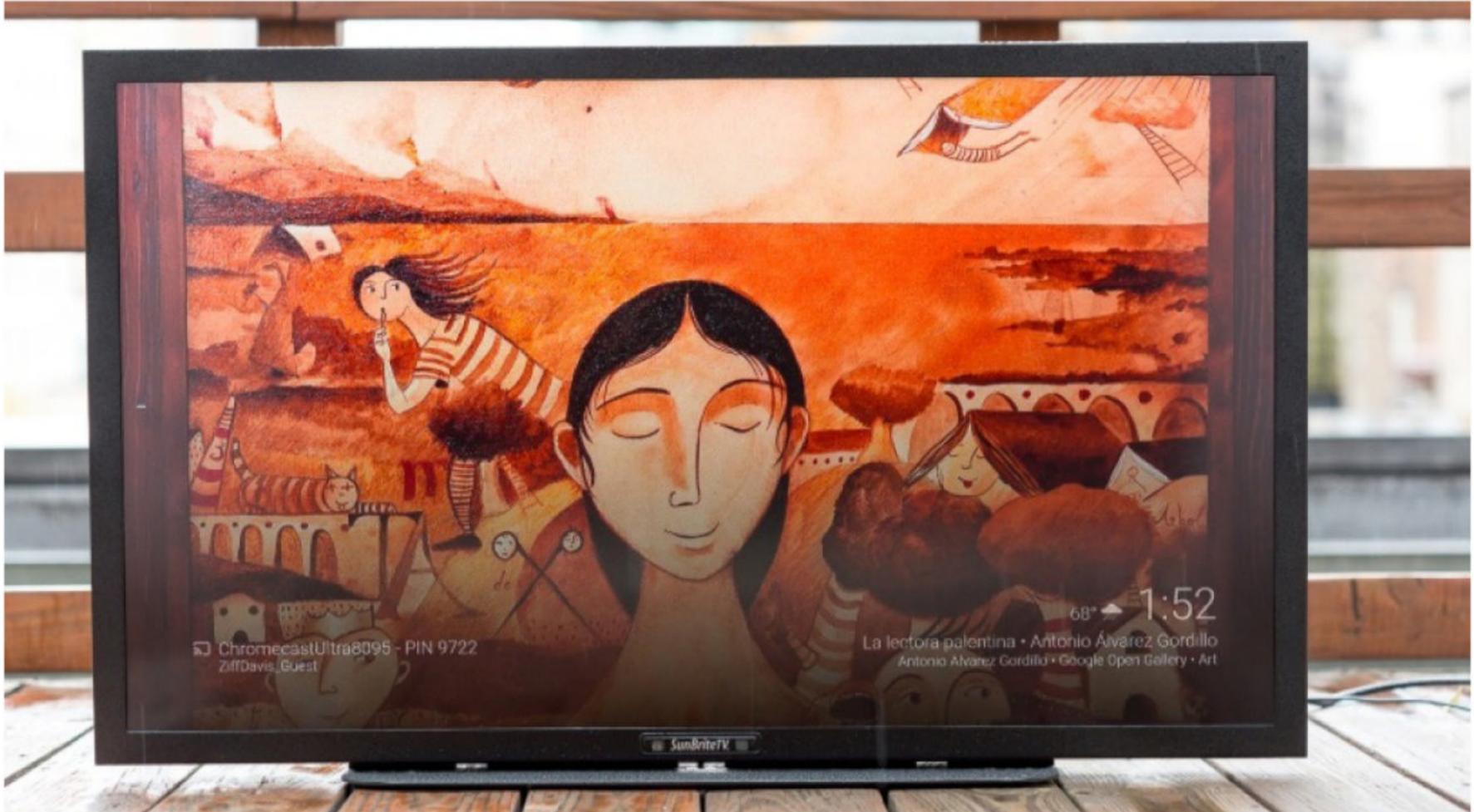


Seura

Factory location: Green Bay, WI

Products produced in US: TV Mirrors

Seura's TV mirrors are built-to-order and not cheap; its 55-inch living-room unit costs \$8,000. As with Sunbright, no actual TV panels are made in the US; the US manufacturing here involves turning the TV into something that vanishes into your home decor when not in use.



Sunbrite TV

Factory location: Charlotte, NC

Products produced in US: Pro series and Signature series televisions

Both TV makers on our list are more “TV enhancers” than anything else. Because, like Seura, no actual TV panels are made in the US, a true US TV maker such as Sunbrite is about turning foreign-sourced raw materials into something unusual—in this case, super-bright, weatherproof TVs for outdoor use. Sunbrite has three weatherproof product lines with different brightness levels for different amounts of sunlight; the backlight is pumped up for the outdoor experience.



Kymeta

Factory location: Redmond, WA

Products produced in US: Satellite dishes

Kymeta makes flat-panel satellite dishes that don't need to be steered and are suitable for mounting on vehicles. It sells primarily to business and government clients; it sells its own broadband service, which aggregates multiple satellite providers, but it doesn't sell the service at retail.

All of Kymeta's products are designed and manufactured by its 200-odd staff in Redmond, Washington. "Having manufacturing and R&D co-located in our own facility allows us to test new iterations and upgrades, and bring products to market faster than if our manufacturing was outsourced," CMO Neville Meijers said.



Photo credit: Vytautas Kielaitis/shutterstock.com

Starlink

Factory locations: Austin, TX; Redmond, WA

Products produced in US: Satellites and satellite dishes

SpaceX is building a "state of the art factory" for "millions of consumer devices" in Austin, Texas, CNBC reported in March. The factory would presumably build dishes and routers for Starlink's satellite internet service. CNBC also said the current equipment is built in Redmond, Washington.



Planar

Factory location: Hillsboro, OR

Products produced in US: LCD video wall systems

Planar was founded in Oregon in 1983 and produces video walls—those eye-catching multi-panel displays that you see behind corporate reception desks or in airport terminals. Like the “TV” companies on our list, Planar doesn’t make the actual panels (no LCD panels are made in the US). Rather, it assembles and configures these unique systems to have slim bezels and reliable performance across their multiple panels.



Photo credit: 26ShadesOfGreen/shutterstock.com

RED

Factory location: Lake Forest, CA

Products produced in US: Professional digital cinema cameras

RED makes high-end professional digital video cameras; its most affordable model, the Komodo 6K, starts at \$6,000. According to the company, its “world

class manufacturing facility” is in Lake Forest, California, outside Los Angeles. A thread on the RED bulletin boards shows photos of cameras being assembled from components in the California facility.



Skydio

Factory location: Redwood City, CA

Products produced in US: Drones

Skydio is the major US manufacturer of drones, which gives it a built-in market of law enforcement and other groups with “Buy American” regulations. The company develops its software in-house and sources its processors from US companies. Not all of the 208 parts for each drone can be US-sourced—plastics, battery cells, and cameras, for example—but it does all it can. A blog on Skydio’s Medium page explains its assembly process.



General Motors

Factory locations: Detroit, Hamtramck and Lake Orion, MI; Spring Hill, TN

Products produced in US: Chevy Bolt cars, future GMC Hummer EVs, future Cadillac LYRIQ SUVs

Detroit lives. GM produces the current Chevy Bolt in Lake Orion, just north of Detroit. It's preparing to produce the new Hummer EV in Detroit and Hamtramck, Michigan, and the upcoming Cadillac Lyriq will be built in Spring Hill, Tennessee. The company sold 20,754 Chevy Bolts in 2020, it said, a 26.9% jump over 2019. This is traditional, old-school American car manufacturing, with 1,056 union manufacturing employees in Lake Orion. GM's power and weight got LG to move a battery factory from Korea to Hazel Park, Michigan, to supply batteries for the Bolt line.



Nissan

Factory location: Smyrna, TN

Products produced in US: Nissan Leaf

Nissan builds its all-electric Leaf cars at its plant in Smyrna, Tennessee, where it employs 7,000 workers (although that number includes many workers who aren't on the assembly line). The factory itself employs about 4,300 non-union workers and produces 640,000 cars annually. The Leaf doesn't make up a large percentage of production, though; although sales rose 43% from 2019 to 2020, Nissan sold only 4,641 Leafs in the fourth quarter of 2020, according to *Inside EVs*—5% of Nissan's total car sales.



Lordstown Motors

Factory location: Lordstown, OH

Products produced in US: Upcoming electric pickup trucks

Americans love trucks, and there's a race on now among various US startups—Lordstown, Rivian, Tesla, and the bigger firms—to be the first major electric-truck manufacturer. Startup Lordstown Motors will build its trucks at a former Chevrolet plant in Ohio, where Lordstown Motors CEO Steve Burns said he plans to employ 600 workers initially to make the first 20,000 trucks, eventually ramping up to 4,000 to 5,000 workers. That would be far fewer than the 10,600 staffers GM employed in the plant's heyday, the *Detroit Free Press* reports, but about the same number GM employed to make the Chevrolet Cruze in the 2010s. The *Freep* said the jobs will pay around \$17 an hour.



Rivian

Factory location: Normal, IL

Products produced in US: Upcoming electric trucks

Rivian is building battery-electric trucks and SUVs in a former Mitsubishi plant in Normal, and the local newspaper said the company employs 800 people right now. Rivian has a deal to supply delivery trucks to Amazon, is building its own network of fast-charging stations, and is setting up a Tesla-like mobile service operation.



Photo credit: Felix Mizionnikov/shutterstock.com

Tesla

Factory location: Fremont, CA

Products produced in US: Electric cars

Tesla's success as a US-based electric-car manufacturer is well known. The company's Fremont main factory employs 10,000 people, where it builds every Model S, Model X, and Model 3. With batteries such a key part of Tesla's business, it also produces its own batteries at its "gigafactories" in Sparks, Nevada, and Buffalo, New York. Like other auto manufacturers, Tesla needs to get some parts from abroad.



The Electric Bike Company

Factory location: Newport Beach, CA

Products produced in US: Electric bikes

All of The Electric Bike Company's classic-looking e-bikes are made in California. The Electric Bike Company employs 30 bike-builders, seven engineers, and five painters who assemble bikes from 720 different components. As with our other vehicle builders, some things just can't be sourced in the US. "We paint all customer frames, forks, fenders, chain guards, baskets, racks etc. here in our factory. We hand-make wooden fenders and chain guards; we build each wheel (front and back). We assemble our own battery packs, and build each and every bike from the frame up per the customers' design," Sales Director Blake Garcia said.



Harley-Davidson

Factory location: York, PA

Products produced in US: LiveWire electric motorcycle

All Harley-Davidson motorcycles sold in the US are made in the US, and that includes the company's electric LiveWire bike. The LiveWire looks like a motorcycle, not a scooter, and goes from 0 to 60 in 3 seconds. But several reports said that it hasn't been selling well, in large part because its high cost (\$29,799) doesn't appeal to younger buyers. In this case, though, don't blame American manufacturing costs for the issue. Motorcycle journalists say that electric bike aficionados are instead turning to Zero Motorcycles, another US manufacturer—one that makes a more stripped-down, affordable product than the luxurious LiveWire.



Zero Motorcycles

Factory location: Scotts Valley, CA

Products produced in US: Electric motorcycles

Zero Motorcycles have been made in Santa Cruz County since 2006. Its sleek, stripped-down smart bikes cost less than half the price of an electric Harley, with the company's basic Zero S coming in at a mere \$11,000.



Ford

Factory location: Dearborn, MI

Products produced in US: Ford F-150 Lightning electric truck

Ford has pledged to build its upcoming F-150 Lightning at its Rouge complex in Dearborn, MI starting in 2022. The company's previous electric car, the Mustang Mach-E, is built in Mexico, so this will be Ford's first "made in America" mainstream consumer electric vehicle. Ford says that it's investing \$700 million into its Rouge Dearborn manufacturing complex and adding 500 jobs to help produce the new F-150 line. The F-150 has been America's best-selling vehicle since the 1970s.

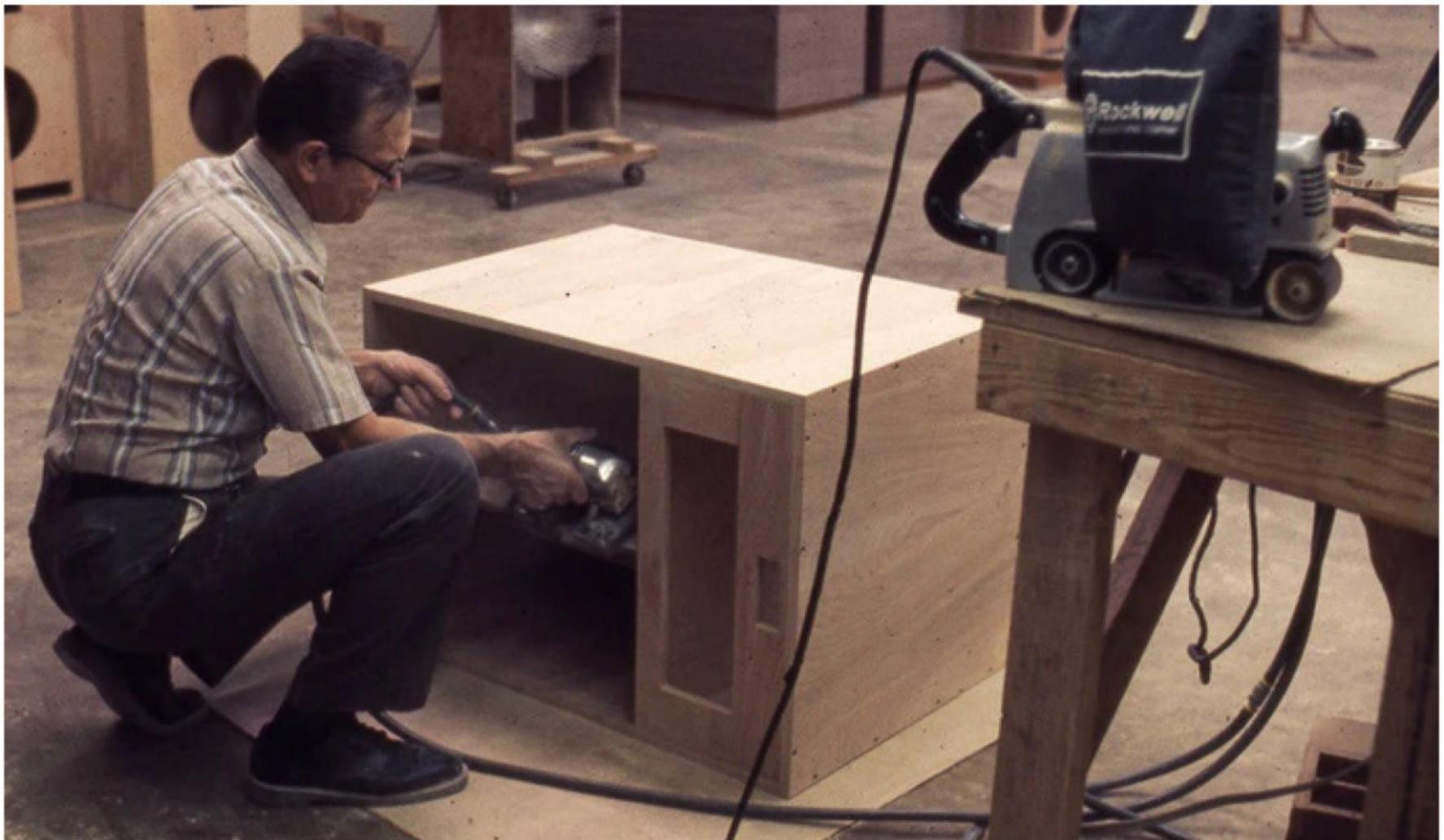


U-Turn Audio

Factory location: Woburn, MA

Products produced in US: Turntables and preamps

U-Turn co-founder Ben Carter wanted to start a company in Massachusetts, and now he has 21 people assembling, testing, and packaging turntables in Woburn. It takes about an hour to put together a turntable, he said; they aren't that complex, but the parts need to work perfectly together, so "quality control and testing is incredibly important." Keeping design, assembly and support under one roof lets U-Turn "keep a very close eye on product quality."



Klipsch

Factory location: Hope, AR

Products produced in US: Klipschorn, La Scala II, Cornwall III, Heresy III, and other speakers

Klipsch Heritage Series speakers, as well as many of its professional models, are all assembled in Hope, Arkansas. (The company's many other products are not made in the US.) In general, what's made in the US is the wooden cabinets, which Klipsch said are "assembled, outfitted, and finished by hand and never with the assistance of robotics." Speakers take anywhere from 40 minutes to 12 hours to build, the company said. The company said it builds professional speakers in the US to be closer to and more responsive to enterprise clients.



Blumenstein Audio

Factory location: Seattle, WA

Products produced in US: Speakers and amps

Founder Clark Blumenstein told us his small company's single-driver speakers, subwoofers, and wall mounts are made by hand in Seattle, Washington.

Blumenstein said his speakers are "very popular with the PC crowd."

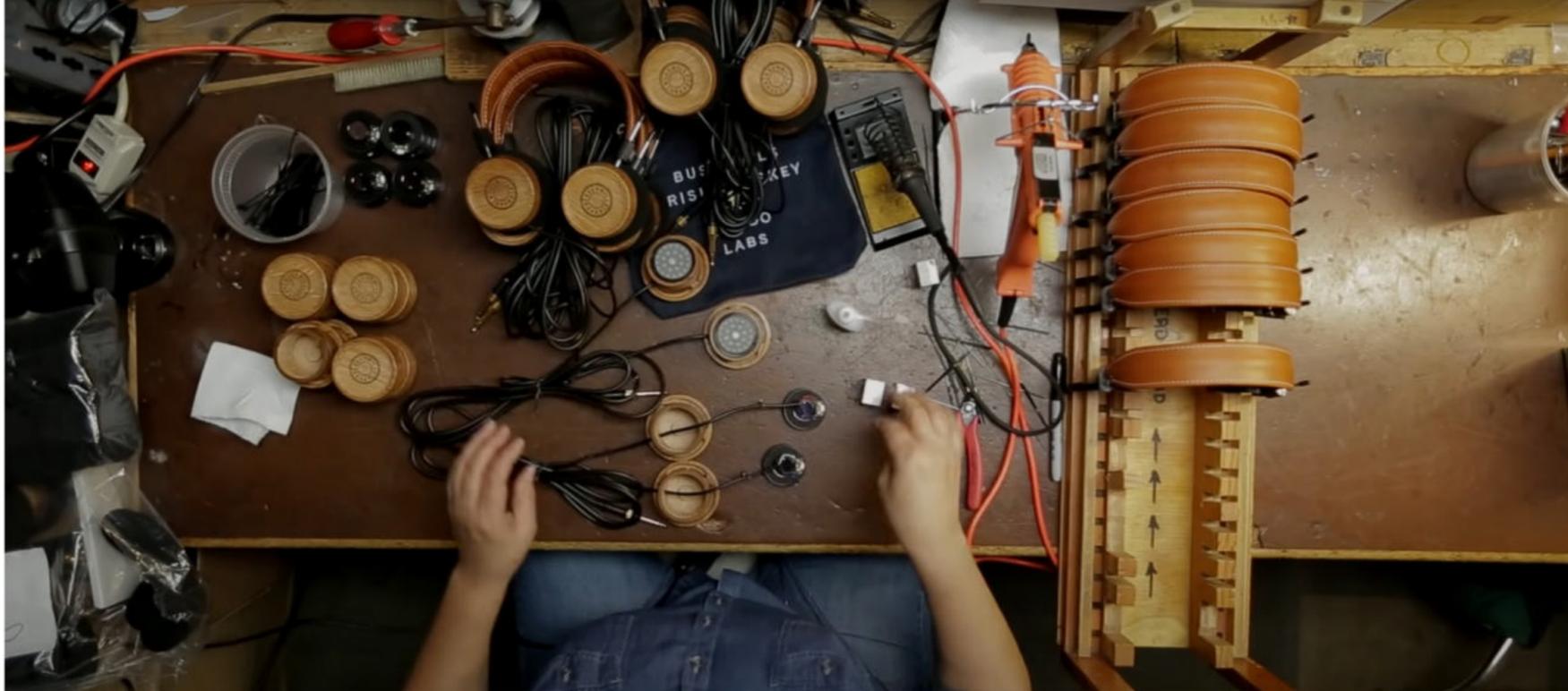


McIntosh Labs

Factory location: Binghamton, NY

Products produced in US: Amplifiers, speakers, turntables and other home audio products

McIntosh representatives confirmed that its home audio products are made in Binghamton, New York, but didn't supply more details. A detailed description on its website shows the company's manufacturing process. One of the big differences between McIntosh and some of the other US-made home audio brands appears to be that McIntosh does its own PCB building and soldering, as well as hand-winding output transformer, glass, and metal fabrication, all in Binghamton.



Grado

Factory location: Brooklyn, NY

Products produced in US: Wired headphones and phono cartridges

Grado is a family-owned business that's been making audio products in Brooklyn since 1953. As with other audio examples on this list, not everything it sells is made in the USA. The wired headphones are, but the wireless ones aren't. The company has been profiled many times for making hand-built headphones in New York; spokesman John Chen said it's "set up for manufacturing" and doesn't intend to change.



Audeze

Factory location: Costa Mesa, CA

Products produced in US: Drivers and LCD branded headphones

Audeze has 32 manufacturing staff putting together made-to-order, premium headphones at its headquarters in southern California. LCD is Audeze's main wired-headphone brand (it doesn't stand for the display technology), and those are manufactured and assembled on site, the company said. Gaming headphones are assembled in China of US and foreign parts, and the true wireless earbuds are not made in the US. The US-made LCD headphones start at \$400 and go up to about \$4,000.



Shinola

Factory location: Rockford, MI (power supplies only)

Products produced in US: Power supplies, for the purpose of this story, but a lot of other things, too

Shinola is an American manufacturer that makes many different things, including leather products, watches, clocks, and power strips. We're spotlighting the power strips here because they're a PC accessory. They're made by Byrne Electric in Rockford, Michigan, and they're beautiful, as most Shinola products are. "Shinola believes in American manufacturing and the meaningful jobs the industry creates. We believe that products should be built to last, and we stand behind the quality American craftsmanship of everything we make," a spokeswoman told us. Around 100 employees work at Shinola HQ, but the company also subcontracts to other American manufacturers, such as Byrne.



Dan Clark Audio

Factory location: San Diego, CA

Products produced in US: Headphones

Dan Clark Audio designs and assembles all of its headphones at its headquarters in San Diego. Like all of the other manufacturers in our list, there are some parts it can't get domestically and thus has to order from abroad—in this case, China.



Flir

Factory locations: Goleta, CA; also Oregon, Montana, Tennessee, New Hampshire, and Massachusetts

Products produced in US: Infrared sensors and camera cores

Goleta, California, is a center of infrared sensing expertise thanks to the presence of the Santa Barbara Research Center, Flir GM Paul Clayton told us, and there are a bunch of IR-related firms in town. This company has maintained a heavy US manufacturing presence in part because it has many defense-related clients—so it needs to manufacture and sometimes assemble devices in this country because of security regulations. The Goleta factory also produces the sensor, but not the housing, for the Flir One consumer thermal camera.

How to Check Your Hard Drive's Health

BY WHITSON GORDON



Photo credit: By kirill_makarov/shutterstock.com

Your hard drive hasn't been acting the same lately. It's starting to make clicking or screeching noises, it can't seem to find your files, and it's moving really slowly. Every hard drive dies eventually, and when it's near death, you'll see the signs: Strange noises, corrupted files, crashes during boot, and glacial transfer speeds all point to the inevitable end. This is normal, especially if your drive is more than a few years old. On older spinning drives, moving parts such as the motor can degrade over time, and a drive's magnetic sectors can go bad.

Newer solid-state drives (SSDs) don't have moving parts, but their storage cells degrade a little every time you write to them. That means they, too, will eventually fail (though SSD reliability is much better than it used to be).

Unless your drive experiences excessive heat or physical trauma, it'll probably fail gradually. So even if your drive isn't making strange noises, you should check its health once in a while—that way, you can prepare for death before it happens. Here's how to do that.

CHECK YOUR DRIVE'S S.M.A.R.T. STATUS

Most modern drives have a feature called S.M.A.R.T. (Self-Monitoring, Analysis, and Reporting Technology), which monitors different drive attributes in an attempt to detect a failing disk. Your computer can notify you before data loss occurs, and the drive can be replaced while it still remains functional.

In Windows, you can manually check the S.M.A.R.T. status of your drives from the Command Prompt. Just type “cmd” into the search bar and open the application. In the pop-up box, run:

wmic diskdrive get model,status

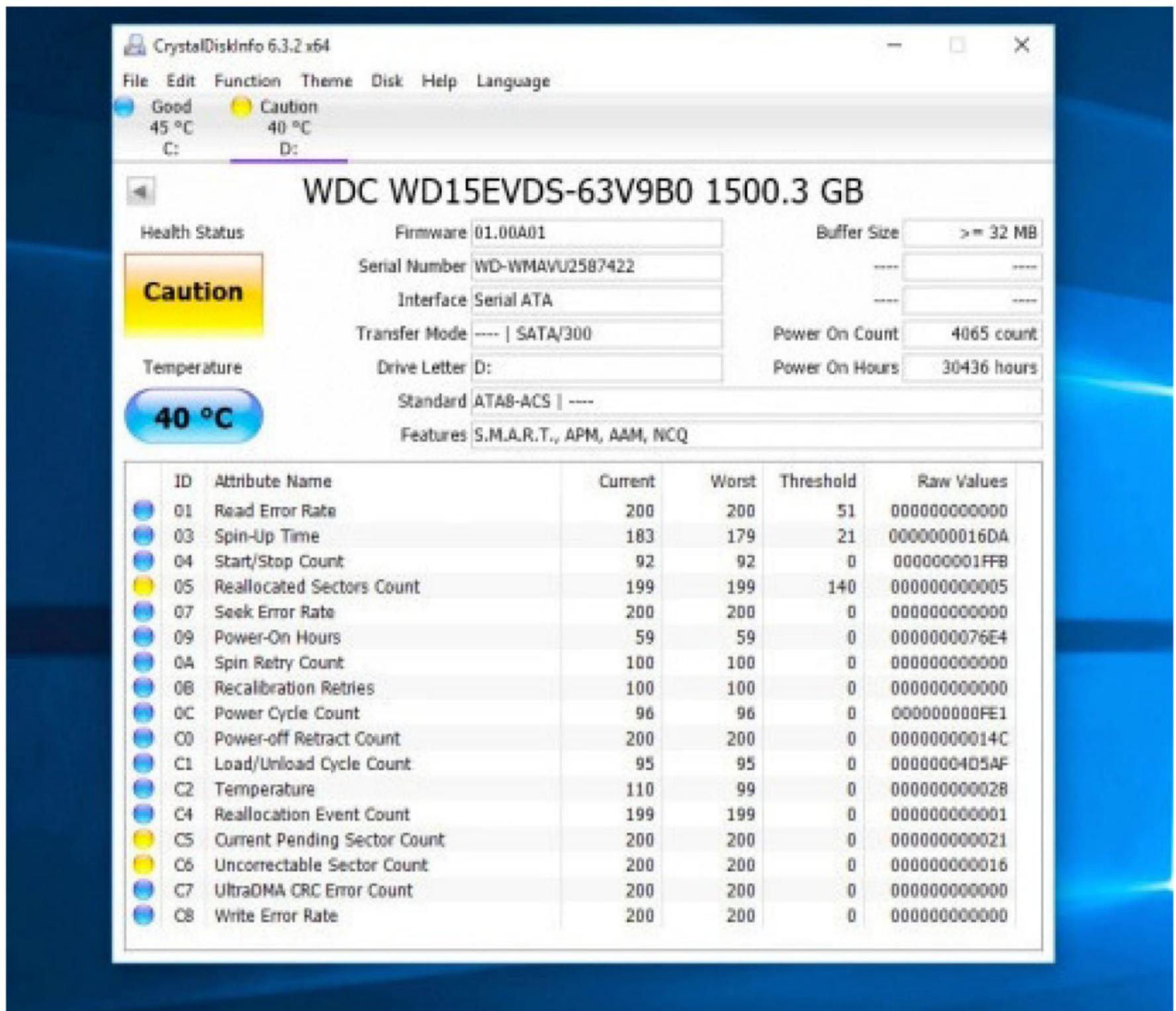
If your drive's death is imminent, it'll return **Pred Fail**. If it thinks the drive is doing fine, it'll return **OK**.



Your computer can notify you before data loss occurs, and the drive can be replaced while it still remains functional.



On a Mac, open Disk Utility from /Applications/Utilities/, click on the drive, and look at S.M.A.R.T. Status in the bottom left, which will either read Verified or Failing.



This basic S.M.A.R.T. information can be misleading, though. You'll know when your drive is near death, but you can start to experience problems even when the basic S.M.A.R.T. status is okay. For a closer look, I recommend downloading CrystalDiskInfo for Windows (free), or DriveDx for macOS (\$20 with a free trial), both of which will offer up more detailed S.M.A.R.T. information than your computer provides on its own.

Instead of saying your drive is "OK" or "Bad," like the built-in tools do, CrystalDiskInfo and DriveDx have more intermediary labels—Caution or Warning, respectively. These labels apply to hard drives and SSDs that are starting to wear down but aren't necessarily near death.



The Caution label is usually a good indicator that you should back up the drive and think about replacing it soon.



For example, my drive (pictured above) has a few bad and reallocated sectors, but I haven't run into any issues—probably because those bad sectors weren't housing any actual data. But if even one bad sector lands on a file you need, it can be rendered corrupt. So that Caution label is usually a good indicator that you should back up the drive and think about replacing it soon, even if you aren't having problems yet.

For a deeper, more accurate picture into your drive's health, check its manufacturer's website for a dedicated tool. For example, Seagate has SeaTools for its drives, Western Digital has Western Digital Dashboard for its drives, and Samsung has Samsung Magician for its SSDs. These tools can sometimes take into account certain technologies specific to their hard drives and SSDs. But CrystalDiskInfo can give you a decent ballpark recommendation for just about any drive.

IF YOUR DRIVE IS DEAD (OR ALMOST DEAD)

Drives with Caution or Pred Fail status won't necessarily fail tomorrow. They could chug along for a year or two or be dead as a doornail in a week. But if you're getting warnings, you should back up your files before your drive kicks the bucket.

Now is not the time for a full backup: You don't want to stress the drive with too many reads, or it could fail on you while you're backing up. Instead, plug in an external drive and copy your most important files onto it—family photos, work documents, and anything else that can't easily be replaced. Once you know those are safe, try doing a full drive clone with a program such as EaseUS Todo Backup Free (Windows) or Carbon Copy Cloner (Mac).

When your hard drive has already stopped working, things get a lot tougher, and you'll probably need a professional data recovery service such as DriveSavers, which can cost \$1,000 or more. But if you have irreplaceable family photos on the drive, it may be worth the price to you.

PREPARE FOR DRIVE FAILURE NOW

It's not a matter of "if" your hard drive will fail, it's a matter of "when." All hard drives fail eventually, and to avoid losing all your important files, you absolutely have to back up your computer regularly—including when the drive is healthy. I know, you've heard it before, but are you actually doing it?

Take some time tonight to set up an automatic, cloud-based backup, like Backblaze. It takes only 15 minutes and it is one of the best things you can do to protect yourself from heartache later on. If you can't stomach the \$6 monthly price, then at least back up to an external drive using Windows' built-in File History tool or your Mac's built-in Time Machine feature. But just know that won't protect you in case of fire or theft, and the peace of mind you get from cloud-based backup is priceless.

Yes, good backup costs money, but it costs a heck of a lot less than getting your data professionally recovered. And with a backup, you'll never sweat the small stuff. Even if your drive fails catastrophically with no warning, you can get back up and running in no time.

Tips to Help You Master Google Meet

BY JILL DUFFY



Photo credit: metamorworks/shutterstock.com

Video-calling apps have seen plenty of use since the COVID-19 pandemic began, as so many of us are spending more time at home. To keep up with demand, Google gave every Google account holder access to Google Meet for their video calls. So Meet isn't included only in paid G Suite plans—anyone with a Gmail address can use it, though free account holders are limited to 60-minute calls.

With so many schools, businesses, and groups of friends using Google Meet, it's worth taking a few minutes to learn how to get the most out of the app.

RECORD A MIC AND CAMERA CHECK

Google Meet has excellent tools for checking your camera and microphone before you join a call. In fact, it features one of the most thorough A/V checks we've seen in a free video-calling app.

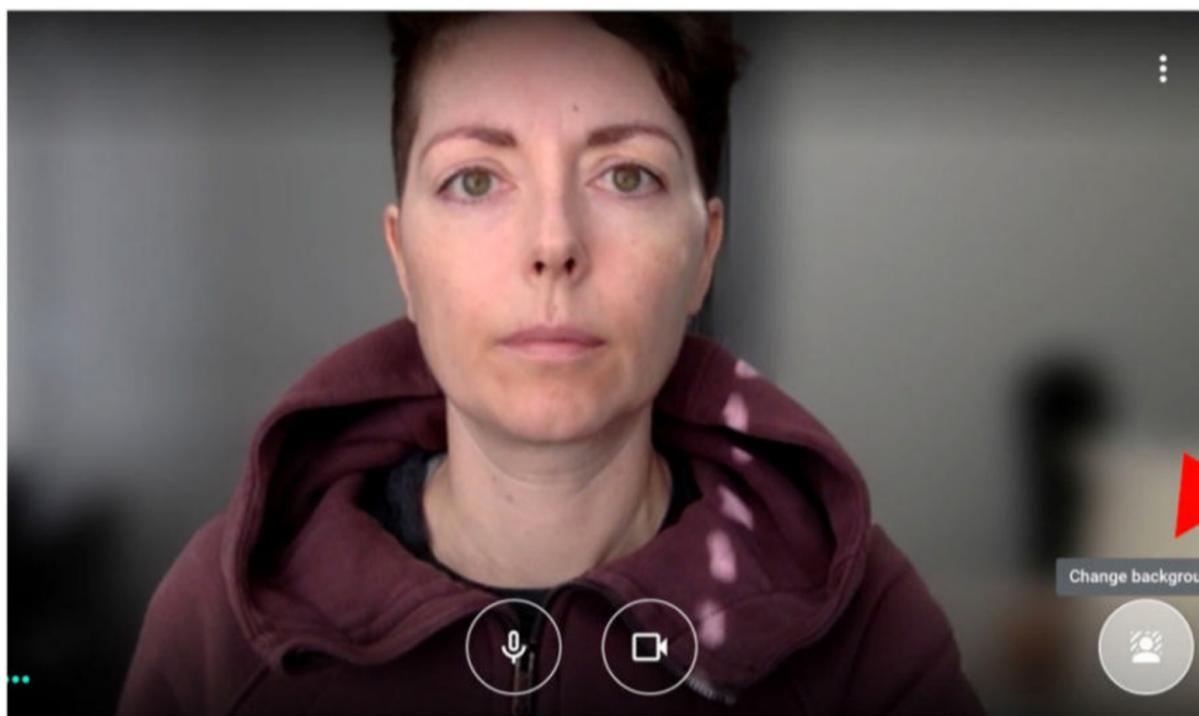
Before you join any call, even one that you host, Google Meet shows a preview of your video. At the bottom is a button that says, "Check your audio and video." When you click that button, you see the input and output sources for your audio, microphone, and camera, and you can change them if you need to. Then, when you click or press Next, the app gives you an option to record a short video of yourself speaking that you can play back. What better way to know how you'll look and sound than to see and hear it for yourself?

CHANGE OR BLUR YOUR BACKGROUND

For your privacy or just for fun, you can change what appears behind you on a Google Meet call. Some apps call this feature a virtual background. With Google Meet, you can blur the background lightly or heavily, choose a background image from the app's library, or upload one of your own.



You can blur the background lightly or heavily, choose a background image from the app's library, or upload one of your own.



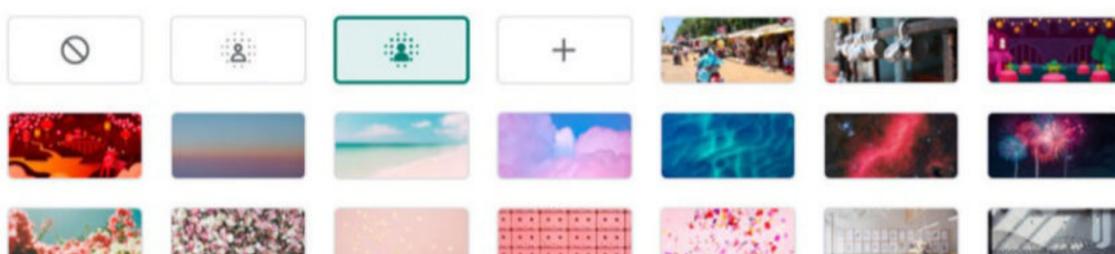
Ready to join?

No one else is here

Join now

Present

Cast this meeting



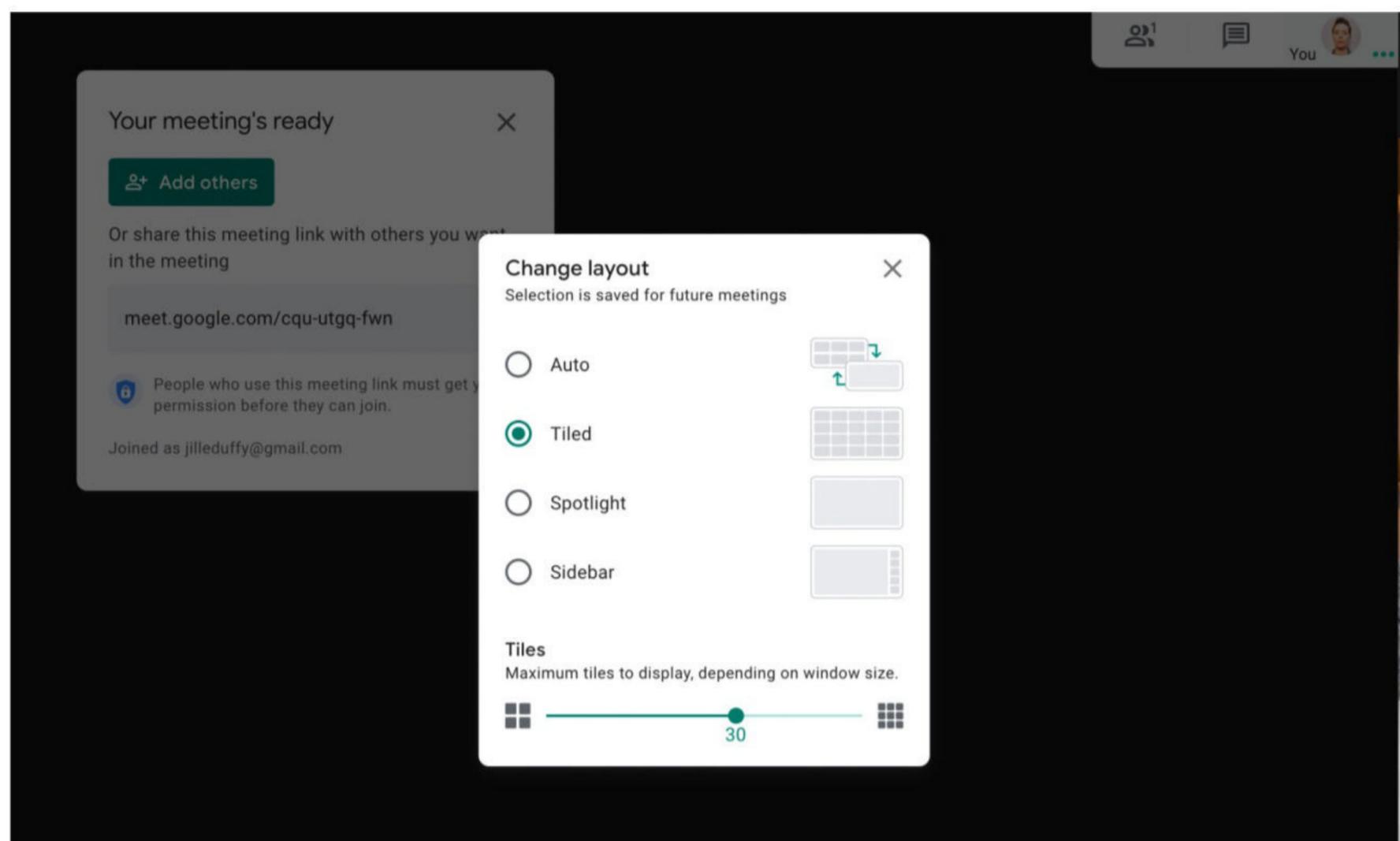
To change your background before joining a meeting, click to join a meeting and look for the Change Background button on the preview screen. Then choose whether to blur your background, pick an image, or add an image.

When you're creating an instant meeting, you won't see the preview screen, but you can always change your background during a meeting. Click the three stacked dots in the lower-right corner and select Change Background.

CHANGE THE LAYOUT

Depending on what kind of call you're on, you may want to see everyone at once or just the person speaking. Change the display of people's faces by clicking the three stacked dots in the lower-right corner and choosing Change Layout. Your options are Auto, meaning the app picks the layout for you; Tiled, which puts everyone's window (or as many as can fit) on screen at once (called Gallery View in other apps); Spotlight, which dynamically shows whoever is speaking at the moment; and Sidebar, which puts the active speaker in a large central window and shows everyone else in smaller tiles on the right. There's also a slider bar to adjust how many faces you see on the screen at once in different views.

Don't want to see your own face? Click the tile-removal icon on your own window or in the tiny preview of your video in the upper-right corner.



PIN THE MOST IMPORTANT SPEAKER

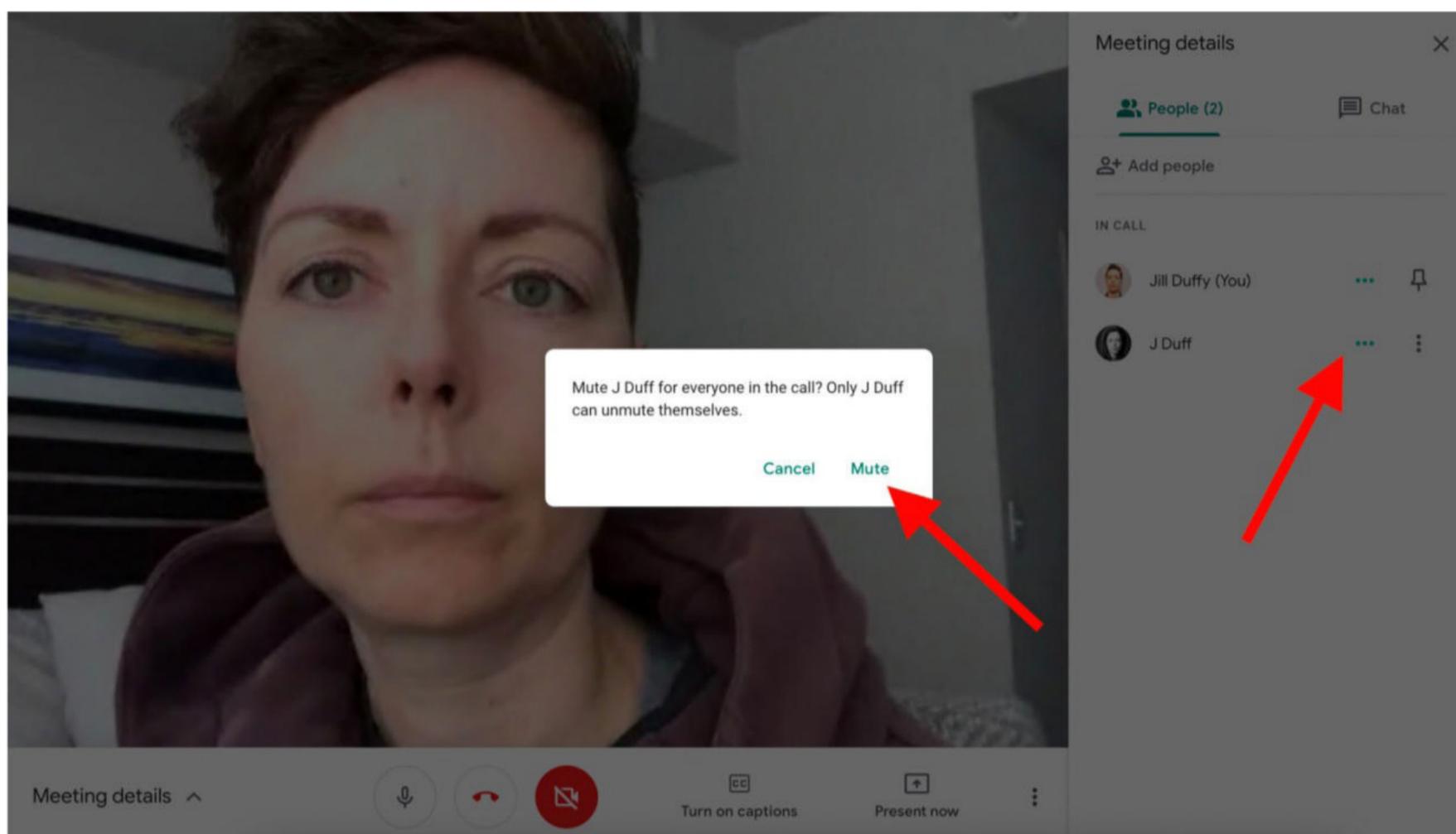
When you want one person's video feed to be front and center, you can pin it. Place your pointer over the person's video window, and you'll see a pop-up menu with three icons: a pin, a microphone, and a no-entry symbol. Click the pin to keep that person visible, and click it again to unpin them. The same menu can be accessed on mobile devices by long-pressing the person's window.

You can also access pinning from the Meeting Details panel. Find the person you want to see and click the pin icon. To undo this setting, click in the same place; the option now says Unpin.

MUTE PARTICIPANTS

You have the power to mute other participants, which allows you to control unwanted noise and interruptions. To mute a participant, open the Meeting Details panel, which appears on the right side of the screen (it's the icon of a person's head and shoulders; when you mouse over it, it says Show Everyone). You can tell who's noisy by looking for activity in the three horizontal dots next to their name and profile picture. Click those three dots and an option to mute them appears.

You can also mute someone by putting your cursor on their video or long-pressing it on mobile, then clicking the microphone icon on the pop-up menu.



WHAT IS AVAXHOME?

AVAXHOME-

the biggest Internet portal,
providing you various content:
brand new books, trending movies,
fresh magazines, hot games,
recent software, latest music releases.

Unlimited satisfaction one low price

Cheap constant access to piping hot media

Protect your downloadings from Big brother

Safer, than torrent-trackers

18 years of seamless operation and our users' satisfaction

All languages

Brand new content

One site



AVXLIVE . ICU

AvaxHome - Your End Place

We have everything for all of your needs. Just open <https://avxlive.icu>

A participant can always unmute their own microphone. If someone continues to be problematic, you can kick them out of the meeting by clicking on the three vertically stacked dots near their name in the Meeting Details panel and selecting Remove From Meeting or by clicking or tapping the Remove icon in the pop-up menu.

TURN ON CAPTIONING

Google Meet has automatic captioning in English, French, German, Portuguese (Brazilian), and Spanish (European and Latin American). When you turn on captioning, you see a transcription of what each person says on the screen. It's not perfect, but it works better than you might expect.

The option appears at the bottom of the screen. If you don't see it, just jiggle your cursor and it should appear. When you first enable captions, your default language will appear, and when you click on it, you can switch to another supported language.

CAST YOUR MEETING TO ANOTHER DISPLAY

You can view your video call on other displays that support Google Meet, such as a Nest Hub Max or a Chromecast. Click the three vertically stacked dots on the bottom of the screen and choose Cast This Meeting. Your available devices appear in the browser, at the top right. Choose the one you want, and your meeting screen appears on it.

This option doesn't use the camera or audio input from the device you've cast your call to when they are included, as is the case with a Nest Hub Max, for example. The instructions for joining meetings from a Nest device are different. By default, you'll still be recording your video and audio from your primary device (your laptop, computer, or mobile device).



You can view your call on other displays that support Google Meet, such as a Nest Hub Max or a Chromecast.

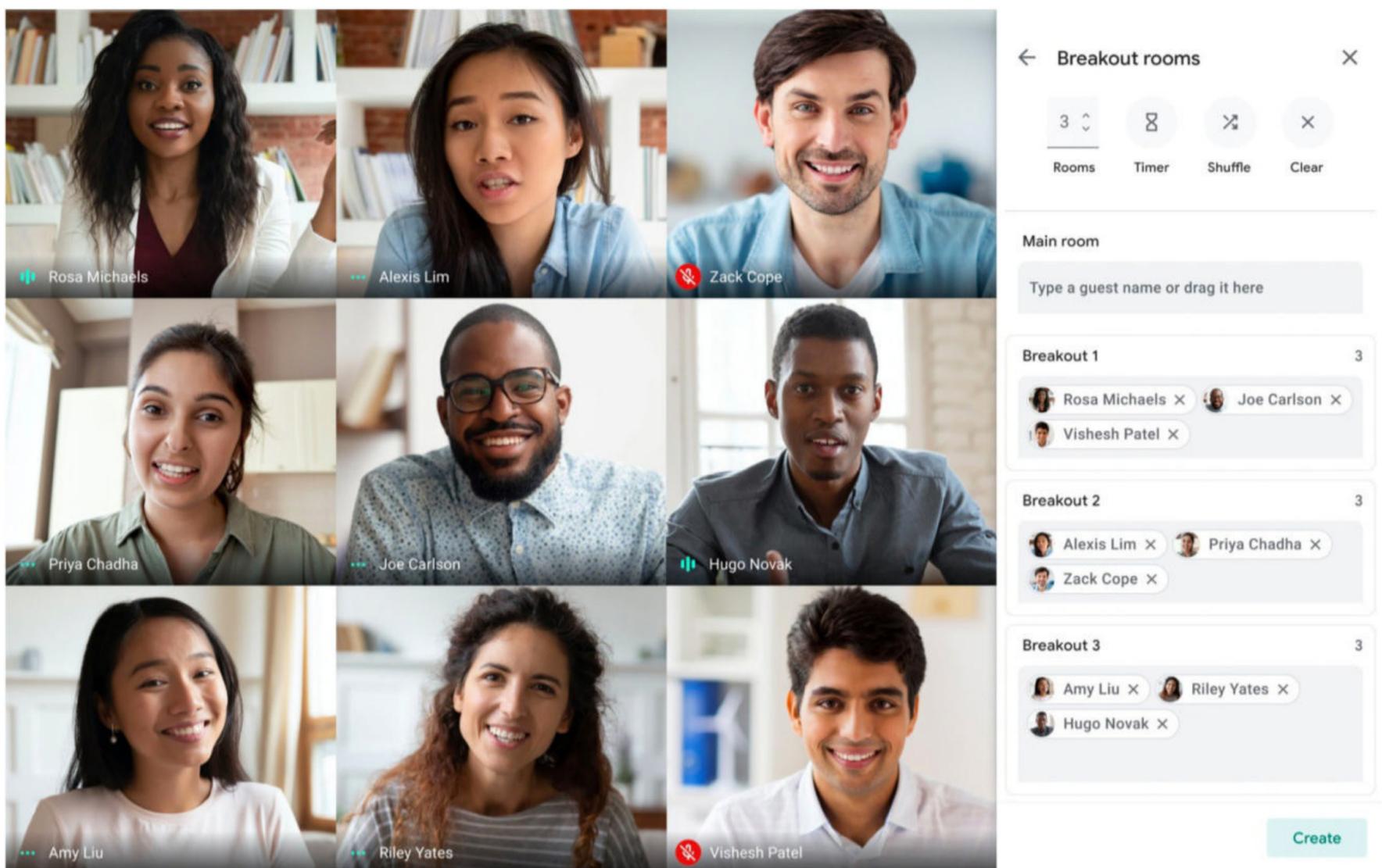


SEND PARTICIPANTS TO BREAKOUT ROOMS

In late 2020, Google Meet launched Breakout Rooms, but only for certain account types. Breakout rooms allow groups of meeting participants to break away from the main meeting to discuss something privately. At the end of a breakout session, all participants can rejoin the main meeting. This feature is available to most education and business customers, as long as the account administrator has enabled the correct account privileges for it.

Once all that is set, start a video call and click Activities in the top right. Choose Breakout Rooms. A Breakout Rooms panel appears, and you can choose the number of rooms you want to create, the maximum being 100. You can then assign people to breakout rooms or let Google Meet assign them randomly.

Finally, click Open rooms for the breakout sessions to start. Participants can ask the host for help, and the host can pop in and out of different rooms as needed. Account types supported are G Suite Business, Workspace Essentials, Business Standard, Business Plus, Enterprise Essentials, Enterprise Standard, Enterprise Plus, and G Suite Enterprise for Education with permissions enabled.



The screenshot displays the Google Meet interface for creating breakout rooms. On the left, a 3x3 grid of nine participants is shown in their respective video feeds. The participants are: Rosa Michaels, Alexis Lim, Zack Cope (top row); Priya Chadha, Joe Carlson, Hugo Novak (middle row); and Amy Liu, Riley Yates, Vishesh Patel (bottom row). On the right, the 'Breakout rooms' control panel is visible. It includes a back arrow, a close button (X), a dropdown menu set to '3' rooms, and buttons for 'Timer', 'Shuffle', and 'Clear'. Below this, the 'Main room' section has a text input field 'Type a guest name or drag it here'. Three breakout rooms are listed: 'Breakout 1' with 3 participants (Rosa Michaels, Joe Carlson, Vishesh Patel), 'Breakout 2' with 3 participants (Alexis Lim, Priya Chadha, Zack Cope), and 'Breakout 3' with 3 participants (Amy Liu, Riley Yates, Vishesh Patel). A 'Create' button is located at the bottom right of the panel.

TROUBLESHOOT A POOR CONNECTION

First, you can downgrade the quality of the video and audio from high definition or automatic to standard. It usually causes the video to look grainier but typically helps resolve problems related to a poor connection. Click the three stacked dots in the bottom right and choose Settings. Navigate to Video. Where it says Send Resolution and Receive Resolution, change them to Standard Definition (360p) or Standard Definition (360p).

Another option is to check your computer's internet connection and CPU usage, which Google Meet has built into the app. Click the three stacked dots and choose Troubleshooting & Help. You should see two icons, one for Network Stability and one for System Load. You also get two real-time bar graphs that give you more insight. Follow the tips here to improve the connection. Try, for example, moving closer to the Wi-Fi router, stopping other streaming or high-bandwidth activities, and closing tabs in your browser.

INSTALL EXTENSIONS

Because Google Meet runs in a browser, it's easy to increase its functionality with third-party extensions. The Chrome Web Store in particular has plenty of extensions for Google Meet. For example, you can add a timer to help you keep track of a video call. And you can look for more general "enhancement" extensions that add features such as attendance, capture, quizzes, and polls.

Keep security in mind when you're installing extensions. Be sure to look at the extension's privacy policy, and don't install any extension that wants to capture your data.

Apple AirTags: Everything You Need to Know

BY TERRANCE GAINES



Apple's latest smart device is the AirTag, a small, puck-shaped tracker that can help you locate misplaced or stolen items with the Find My app. AirTags costs \$29 for one or \$99 for a pack of four and can be engraved with letters or an image of your choosing for free. Accessories such as keychains, luggage tags, and loops, which hold the device, are sold separately.

AirTags use ultra-wideband technology (UWB) and take advantage of Apple's existing network of devices, which work as crowdsourced beacons to ping one another and determine a missing item's location. Here's what to know before you slap an AirTag on everything you own.

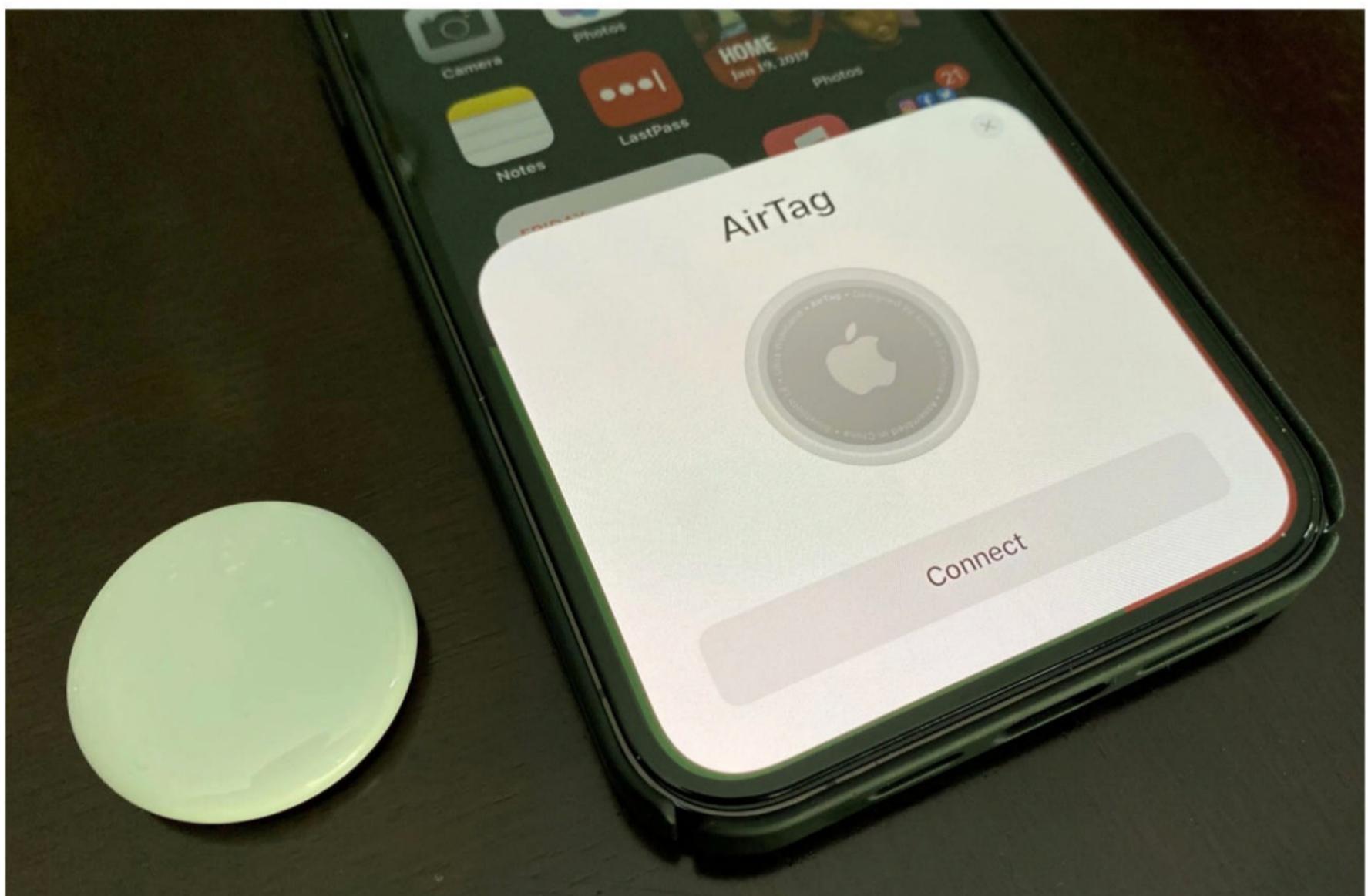
WHICH IPHONES AND IPADS WORK WITH AIRTAGS?

Compatible iPhones and iPads can use the Find My app to identify the approximate location of a missing AirTag-equipped item. To track an AirTag, you must be running iOS 14.5 or above on your iPhone or iPadOS 14.5+ on your tablet. (That update is compatible with iPhone 6s and up, including the first- and second-gen iPhone SE, and most iPads). Update by going to **Settings** > **General** > **Software Update**.

To use Precision Finding, which can guide you to your device via on-screen instructions, you need an iPhone 11 or 12. These models use the camera, ARKit, accelerometer, and gyroscope for a more “directionally aware finding experience,” according to Apple.

HOW DO I SET UP AN APPLE AIRTAG?

Setup is simple. Take the AirTag out of the box and pull out the tab to activate it. Hold it near your compatible mobile device, which will detect the tracker and prompt you to set it up, similar to AirPods or a HomePod device. You can name your AirTag after the device it will be in charge of tracking. The AirTag is then registered to your Apple ID—that’s it.



DO I NEED TO CHARGE MY AIRTAG?

No. According to Apple, the AirTag battery lasts one year before it will need to be replaced. Surprisingly, the battery isn't some Apple-specific proprietary purchase; AirTags use a basic CR2032 battery, which can be purchased at various online and brick-and-mortar stores. Remove the battery by pushing down and twisting the AirTag's back plate.

DO AIRTAGS USE MY LOCATION?

If you're skeptical about Apple tracking your location and have disabled location services on your devices, you won't be able to use AirTags. Apple needs your location to tell you where your lost item is located. To enable Find My location tracking, open **Settings** > **Privacy** > **Location Services**, then flip the switch at the top of the screen to On. Scroll down to Find My in your list of apps and make sure it is set to While Using the App.

HOW DOES APPLE FIND LOST AIRTAGS?

AirTags don't include a GPS chip, as your iPhone does. Instead, Apple has used its proprietary U1 chip with ultra-wideband technology to create a peer-to-peer network that taps into the 1.65 billion Apple devices out in the wild to nail down the location of an AirTag.



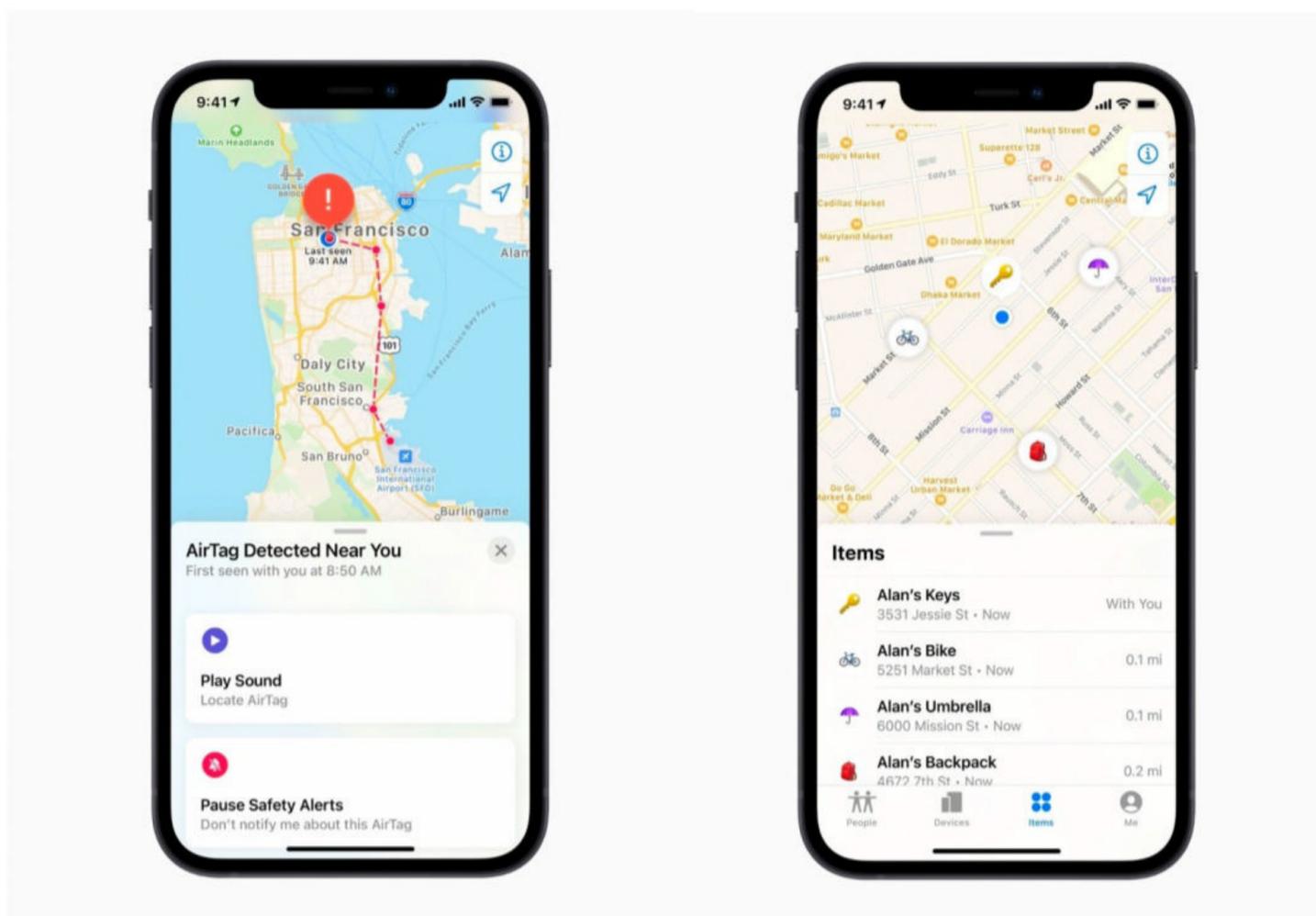
HOW DO I FIND MY AIRTAG?

Open the Find My app on your Apple device to see the tracker's location on a map. You can use the app to play a sound from the AirTag, which will help you locate the item, if you're nearby. With an iPhone 11 or 12 model, you can tap Find and turn to Precision Finding. This will tell you how far you are from the object and guide you to it via on-screen directions.

If you can't locate the tracker, there's an option in the Find My app to place it in Lost Mode and create a custom message to be displayed when your AirTag is found by another user. When they hold the AirTag near their phone, your message—say, your contact details—will appear on their device, and the Good Samaritan will hopefully get in touch. This will work on any device that has NFC enabled, meaning Android owners can help return lost AirTags, too.

CAN I SEE DEVICES NEAR MY AIRTAG?

AirTags use the devices connected to Apple's network in order to locate missing devices, but according to Apple, "no location data or location history is physically stored inside AirTag. Communication with the Find My network is end-to-end encrypted so that only the owner of a device has access to its location data, and no one, including Apple, knows the identity or location of any device that helped find it." In other words, an AirTag owner can only determine the location of their own AirTag, not any other nearby Apple devices.



CAN I SHARE AIRTAGS VIA FAMILY SHARING?

Family Sharing allows up to five family members to share purchases from iTunes, the App Store, and Apple Books, and also includes an Apple Music family subscription and iCloud storage. You can share your location via Family Location Sharing and help family members find lost Apple devices with the Find My app. So you might think it would be helpful if your family member could also help you locate an AirTag from their own device. But alas, AirTags are locked to one Apple ID to prevent unwanted tracking, so only you have the power to track down your AirTag.

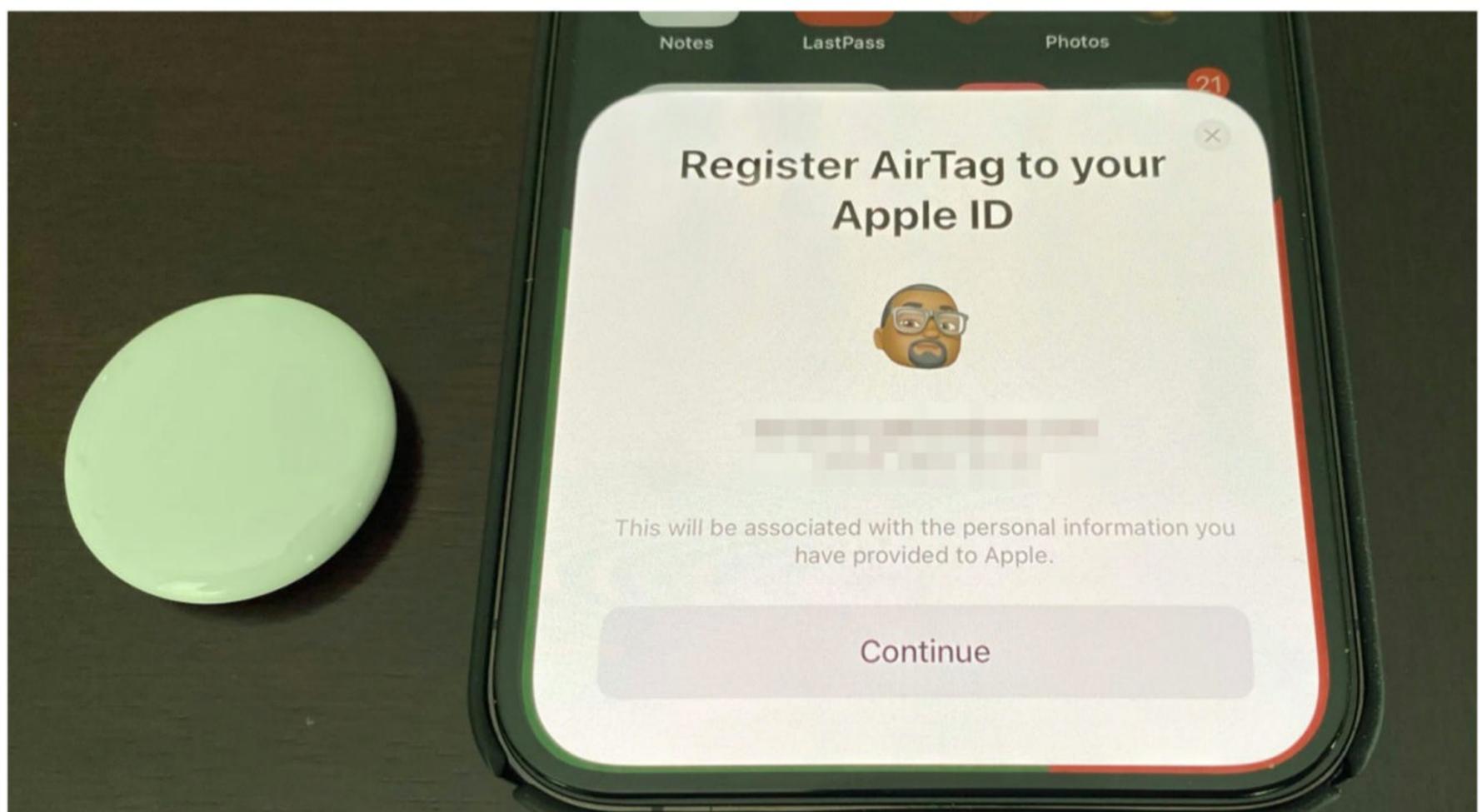


You can share your location via Family Location Sharing and help family members find lost Apple devices.



HOW DO I REMOVE AN AIRTAG FROM MY APPLE ID?

Since your AirTag is registered to your Apple ID during setup, it can be removed only by you. Open the Find My App, tap the Items tab, and select the AirTag from the list. Tap Remove Item to free it up for someone else to use. This means if your AirTag (and the device it's attached to) is ever lost or stolen, the person who finds it cannot simply link it to their device.



CAN AIRTAGS BE USED TO TRACK ME?

A prime concern about AirTags and other tiny tracking devices is that they will be used to track people, not devices. AirTags are small, so they won't weigh down keyrings or backpacks, but that also means they're easy to slip into someone's bag. In theory, a stalker or abusive partner could then keep tabs on a person's whereabouts from their own Apple device.

To address this, the Find My app will alert you on your Apple device if it detects a AirTag not attached to your Apple ID—and separated from its owner—traveling with you. You're then given the option to disable that AirTag or to play a sound so you can locate it. Your device will need to be running iOS 14.5+, though.

This, of course, won't be helpful for Android users who have an AirTag slipped into their belongings. Apple says the AirTag will automatically play a sound if it's been separated from its owner “for an extended period of time,” which is currently set at three days.

“As far as we can determine, AirTags can be used to unnoticeably track people you live with throughout the day, as long as they return to you at night,” we wrote in our AirTag review. “This is also possible with a Samsung tag...and the only reason it's less possible with a Tile is that Tile's network isn't nearly as good. Jibits and other GPS trackers can be used similarly.”

ARE AIRTAGS COMPATIBLE WITH ANDROID DEVICES?

Android users can't register an AirTag with their device, but as mentioned, the NFC functionality in Android phones allows them to connect to lost AirTags and display any Lost Mode messages so they can return it.



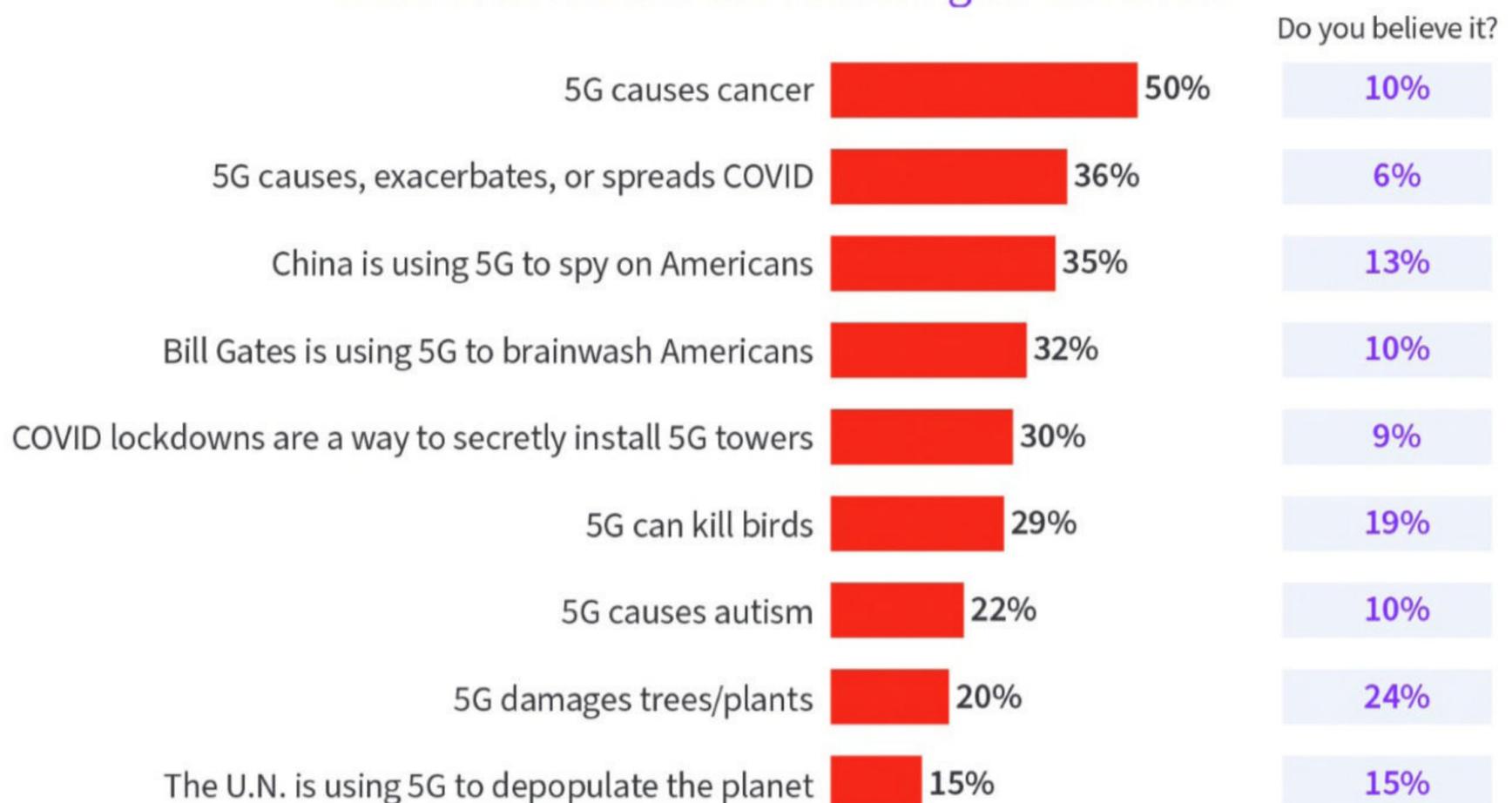
A prime concern about AirTags and other tiny tracking devices is that they will be used to track people.



5G Conspiracy Theorists Are Embracing New Wireless Technology Called... 5G

BY ERIC GRIFFITH

Have You Heard of the Following 5G Theories?



We've all seen crazy conspiracy theories on the internet. And in the last couple of years, baseless conspiracy theories about 5G technology have skyrocketed, despite there being so many other worthwhile topics to be paranoid about. (I mean...have you heard about this Starlink thing? That's gotta be Elon's scheme to take over the world, right?)

We joke, but things have become pretty serious. A bomb was set off in Nashville, Tennessee, last year because of one man's belief that 5G had killed his father. The people at InMyArea.com, which helps you find local TV and internet providers, put their research team to work with a survey of 991 people to find out how many buy into 5G conspiracies.

The top “theory,” which half the people surveyed had heard, is that 5G causes cancer. That’s not surprising, since cancer scares arise along with most new technologies, especially when radio waves are involved. More disturbing is that 10% of those people believe it.

Things go downhill from there as far as those surveyed having heard about theories, but the percentage of people believing them becomes even more concerning. Of the 35% who heard China is using 5G for spying, 13% believe it; almost as many think Bill Gates is brainwashing people. Of the 29% who heard 5G kills birds, 19% believe it. And 10% heard it damages trees and plants; almost one-quarter of them believe it.

The report notes that two in three respondents heard their first 5G conspiracy in just the past year, and the most likely place they found one is an online community. The second-most-likely place is from a friend or family member who shared it. Men who identified as conservative were more likely to believe than women leaning right; conservatives, in general, were more likely to have heard the conspiracies.

InMyArea.com also asked people about a lot of other general conspiracy theories that have been around for decades, such as the “fake moon landing” (65% had heard it, 8% believe it), that iPhone apps record you without permission (60% heard, 46% believe), and that Big Oil is trying to kill electric cars (39% heard, 44% believe).

Only 30% of survey respondents have made the switch to using 5G networks on their phones. Seven out of 10 who haven’t switched yet said they probably would in the next year.

The most amazing data point: 40% of those who believe the conspiracy theories above are currently using 5G. Thanks a lot, bird killers.

EDITOR-IN-CHIEF, PC MAGAZINE NETWORK Dan Costa

EDITOR Wendy Sheehan Donnell

MANAGING EDITOR, DIGITAL EDITIONS Carol Mangis

PRODUCTION DESIGNER José Ruiz

NEWS & FEATURES

EXECUTIVE EDITOR Chloe Albanesius

FEATURES EDITOR Eric Griffith

SENIOR FEATURES WRITER Chandra Steele

ASSOCIATE EDITOR, HELP & HOW-TO Jason Cohen

SENIOR NEWS EDITOR Matthew Humphries

NEWS REPORTER Michael Kan

REVIEWS

EXECUTIVE EDITOR John Burek (hardware), Oliver Rist (business)

MANAGING EDITORS Sean Carroll (software, security), Alex Colon (consumer electronics), Rose Fox (mobile), Jeffrey L. Wilson (software, gaming)

LEAD ANALYSTS Jim Fisher (digital cameras), Michael Muchmore (software), Neil J. Rubenking (security), Sascha Segan (mobile)

SENIOR ANALYSTS Tom Brant (hardware), Max Eddy (software, security), Will Greenwald (consumer electronics), Tony Hoffman (hardware)

ANALYSTS Matthew Buzzi (hardware), Kim Key (security), Jordan Minor (software, gaming), Ben Moore (software, security), Angela Moscaritolo (consumer electronics), Chris Stobing (hardware), Mike Williams (software, gaming), Steven Winkelman (mobile)

INVENTORY CONTROL COORDINATOR Joseph Maldonado

ART, MEDIA, & PRODUCTION

SOCIAL MEDIA MANAGER Pete Haas

STAFF PHOTOGRAPHER Zlata Ivleva

PRODUCER Emily Zoda

SENIOR VIDEO PRODUCER Weston Almond

VIDEO PRODUCER Raffi Paul

CONTRIBUTORS

John R. Delaney, Jill Duffy, Tim Gideon, Ben Z. Gottesman, Eric Grevstad, William Harrel, Edward Mendelson, Stephanie Mlot, M. David Stone, Lance Whitney, Kathy Yakal



ZIFF DAVIS LLC

CHIEF EXECUTIVE OFFICER (J2 GLOBAL) Vivek Shah

PRESIDENT Steven Horowitz

CHIEF FINANCIAL OFFICER Brian Stewart

CHIEF TECHNOLOGY OFFICER (J2 GLOBAL) Joseph Fortuna

GENERAL MANAGER, ZIFF MEDIA GROUP Mike Finnerty

EXECUTIVE VICE PRESIDENT, INTERNATIONAL Geoff Inns

SENIOR VICE PRESIDENT, CONTENT; EDITOR-IN-CHIEF, PCMAG.COM Dan Costa

SENIOR VICE PRESIDENT AND GENERAL MANAGER, ACCOUNTING Fredrick Rolff

SENIOR VICE PRESIDENT, BUSINESS OPERATIONS Jason Steele

SENIOR VICE PRESIDENT, CHIEF TECHNOLOGY OFFICER Josh Butts

SENIOR VICE PRESIDENT, CHIEF REVENUE OFFICER Eva Smith

SENIOR VICE PRESIDENT, OPERATIONS Megan Juliano

SENIOR VICE PRESIDENT, RETAIL & BRAND SOLUTIONS Lauren Cooley

VICE PRESIDENTS Valerie Gayol (marketing), Lori Ing (product development), John Mark (sales), Wendy Sheehan Donnell (content), Kelley Smith (sales)

THE INDEPENDENT GUIDE *PC Magazine* is the Independent Guide to Technology. Our mission is to test and review computer- and internet-related products and services and to report fairly and objectively on the results. Our editors do not invest in firms whose products or services we review, nor do we accept travel tickets or other gifts of value from such firms. Except where noted, *PC Magazine* reviews are of products and services that are currently available. Our reviews are written without regard to advertising or business relationships with any vendor.

HOW TO CONTACT EDITORS We welcome comments from readers. Send your comments to letters@pcmag.com. Please include your email address or daytime telephone number. We cannot look up stories from past issues, recommend products, or diagnose problems with your PC.

PERMISSIONS, REPRINTS, CONTENT, AND TRADEMARK RIGHTS For permission to reuse material in this publication or to use our logo, contact us at Brand_Licensing@ziffdavis.com. Material in this publication may not be reproduced in any form without written permission. Copyright © 2021, Ziff Davis LLC. All rights reserved. Reproduction in whole or in part without permission is prohibited.