PC MAGAZINE

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FUTURE VISION
SOLIDLIGHT TABLETOP

© LIGHT FIELD LAB, INC.

HOLOGRAMS ARE (MAYBE, FINALLY) REAL: LIGHT FIELD LABS' SOLIDLIGHT

We got a sneak peek at holograms built by San Jose–based Light Field Lab, which expects companies to begin debuting large-scale versions of its holographic display next year.

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STUDYING SAFER: HOW TO EDUCATE YOUR KIDS ABOUT ONLINE SECURITY

Kids in the US are back at school, and parents need to help them create good computer habits with a firm focus on online safety. We interviewed an expert to find out how.

Hello, Windows 11

@cmangis

It's finally here: Microsoft's newest iteration of its ubiquitous operating system. Needless to say, this is a big deal for PCMag and our readers (well, most of them!). So we've been speculating, trying betas, compiling tips, investigating the TPM requirement, and breaking all the news for months while we waited for launch day.

Our November issue is dedicated to Windows 11 (and we hope you enjoy our *Spinal Tap*–reference cover art). You'll find our exhaustive review of the new OS along with lots of advice on installing and using it. We've also reviewed a couple of new Microsoft devices that run Windows 11 out of the box—the Surface Laptop Studio and Surface Go 3 tablet.

Note that our website, PCMag.com, has the latest news and analysis on everything tech, including the new Windows. We are as current as possible here in the Digital Edition, but technology can change very quickly and usually does—even within the couple of weeks the PCMag Digital Edition requires for layout and publication. Bookmark our website so as not to miss new developments and information.

Enjoy this issue, and let us know what questions and opinions you have of Windows 11!

carol_mangis@pcmag.com
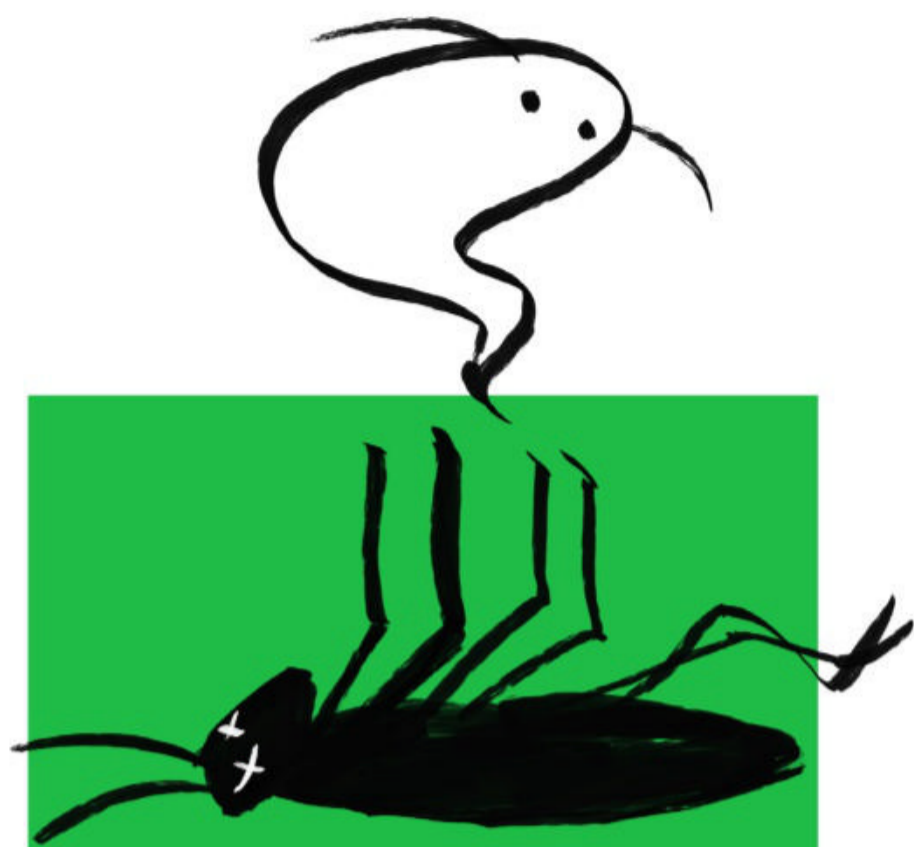
Your Comments

After reading our October issue, readers responded with concern about Norton swallowing up the antivirus universe. Swollen batteries also caused some stress, and we got a clue to Starlink's massive popularity.

IS NORTON PLANNING TO KILL FREE ANTIVIRUS?

I am concerned that the Avast products will disappear into the nebulous Norton products regardless of their assurances. If this happens, I will have to find another AV product, as I have had bad experiences with Norton AV products and will not return to them.
—*Michael Walker*

Reducing the number of good guys and gals who are chasing the bad guys and gals' worst efforts is not a good thing. That might be the real downside to this merger and subsequent layoffs.
—*MHCLV*

It should be noted that Avira completed its acquisition of UK-headquartered BullGuard in February of 2021, giving NortonLifeLock a fifth brand to use in their portfolio.
—*Aryeh Goretsky*

There is also a Sophos Home. It also has Clam AV. With the transition to Linux, these antiviruses offer total protection.
—*darebeograd*

Windows Defender is perfectly fine when combined with using one's brain instead of downloading foolishly and opening mail without thinking.
—*Stamford Guy*

HOW TO DEAL WITH A SWOLLEN LAPTOP BATTERY

Don't try to replace a swollen battery on a modern MacBook! The battery is fastened inside by a glue that requires application of a toxic solvent to remove the battery. Why did Apple 'design' MacBooks as an ecological nightmare, instead of using more typical small screws to fasten the battery to the chassis? Ask Tim Cook, or chalk it up to the rapid planned obsolescence built into Apple products.
—*Ben Myer*s

Had a Samsung tablet plugged in, and one day, I saw it had bulged open. The battery was swollen. I realized that keeping it plugged in may have caused it, and I don't do that anymore. Now it has been confirmed.
—*adlai*

DEMAND FOR SPACEX'S STARLINK SATELLITE INTERNET PUSHES WAIT TIMES TO 2023

It's almost like people are tired of dealing with ISPs.
—*AgentOtter*
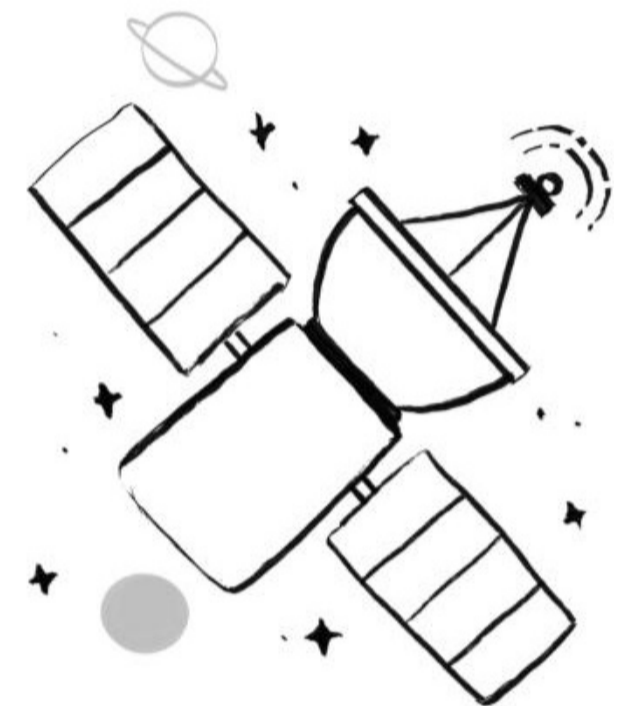
Ask us a question!

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.

Microsoft Offers TPM 2.0 Bypass to Install Windows 11 on Unsupported PC

BY MICHAEL KAN

Credit: Microsoft

For months, Microsoft has been telling customers that Windows 11 requires your PC to have a special security chip called TPM 2.0—but you can actually skirt the restriction. Ironically, the company itself posted official guidance on its website detailing how to circumvent the TPM 2.0 requirement.

The process involves taking your Windows 10 machine and changing the registry key values in the OS to ignore the check for TPM 2.0. But the bypass applies only to PCs that have at least TPM 1.2, which has to be enabled. This can usually be done by going into the machine's BIOS settings on startup.

Warning:

- Microsoft recommends against installing Windows 11 on a device that does not meet the Windows 11 minimum system requirements. If you choose to install Windows 11 on a device that does not meet these requirements, and you acknowledge and understand the risks, you can create the following registry key values and bypass the check for TPM 2.0 (at least TPM 1.2 is required) and the CPU family and model.

- Registry Key: HKEY_LOCAL_MACHINE\SYSTEM\Setup\MoSetup

- Name: AllowUpgradesWithUnsupportedTPMOrCPU

- Type: REG_DWORD

- Value: 1

- Note: Serious problems might occur if you modify the registry incorrectly by using Registry Editor or by using another method. These problems might require that you reinstall the operating system. Microsoft cannot guarantee that these problems can be solved. Modify the registry at your own risk.

The Microsoft-provided bypass should also enable a Windows 11 installation on PCs that have a CPU older than the official system requirements; for example, an AMD Ryzen 1000 processor or an Intel 7th-generation Core chip. The company's webpage notes: "An image install of Windows 11 will not check for the following requirements: TPM 2.0 (at least TPM 1.2 is required) and CPU family and model."

To add a registry value in Windows 10, click the Start button, search for "Registry Editor," and launch the app. Then navigate to "**HKEYLOCALMACHINE\SYSTEM\Setup\MoSetup**" and add a new **REG_DWORD** entry with the name **AllowUpgradesWithUnsupportedTPMOrCPU** and set the value to 1.

If you do change the registry values, be careful to type the values correctly—otherwise, you risk corrupting the OS. Once the registry key values are changed, you can begin manually installing the operating system using the Windows 11 media creation tool, which can create the installation files on a USB drive.

You can then proceed with a clean install of Windows 11 or perform an upgrade to the OS, which will keep your old files on the PC. If you want Windows 11 on an unsupported CPU, you should use the Windows 11 Disk Image installation process.

Be aware that using this bypass comes with caveats. Microsoft's instructions link to a page that warns installing Windows 11 on an unsupported PC could lead to malfunctions arising from compatibility problems.

The company also states: "Devices that do not meet these system requirements will no longer be guaranteed to receive updates, including but not limited to security updates." If you're denied Windows updates, you'll have to download and install the patches manually.

Holograms Are (Maybe, Finally) Real: Light Field Labs' SolidLight

BY MICHAEL KAN

Credit: Light Field Lab

In front of me is a wristwatch. Somehow, it's floating in the air. It's shiny, spotless, and seemingly solid. Light reflects across the metal timepiece like it's on display at a jewelry store, ready to be handled and bought. But then I get closer and try to touch the floating watch. My hand passes through it and feels only air.

In reality, I'm staring at a wave of light that's converging and scattering in mid-air. A display behind the watch is simply beaming the light in a way my eyes can't help but interpret as real. I'm staring at a hologram, the first of its kind, according to San Jose-based Light Field Lab. The watch is actually an image made up of 2.5 billion pixels. All those pixels are now in my line of sight, making me wonder: Did I just glimpse the future?

I won't be alone in witnessing the technology, which is called SolidLight. Light Field Labs says it plans to debut the holographic displays as soon as next year. "We can show that this is real. We can start building this," said CEO Jon Karafin.

USING LIGHT TO CREATE IMAGES IN MID-AIR

The word "hologram" may cause you to roll your eyes. Go to a technology trade show, a concert, or YouTube, and you can find plenty of holograms. But they usually have a major limitation. The hologram may be contained in a glass box, rely on fan blades embedded with LEDs, or simply use giant mirrors to reflect a ghostly image on a thin polyester screen.

These approaches essentially try to dupe your eyes into thinking a 2D image exists in 3D. Light Field Lab, on the other hand, says its SolidLight display technology involves no elaborate tricks. According to Karafin, the company harnesses the established principles of how our eyes see objects and replicates the same process with technology.

It reminds me of a scene in the sci-fi film *The Matrix,* in which the character Morpheus discusses how humans perceive reality. "If you're talking about what you can feel, what you can smell, what you can taste and see, then 'real' is simply electrical signals interpreted by your brain," he says.

You can apply the same statement to human eyes. What we see is simply photons bouncing off objects and being interpreted by our brains. Take a bird, for example. "You don't see in the real world that wing of this bird," Karafin said. "You see it because those photons will strike and interact with that finite point (the bird's wing) and create a wavefront that your eye is able to focus on."

> *According to Karafin, the company harnesses the established principles of how our eyes see objects and replicates the same process with technology.*

SUBMODULES TO PANELS

28" DIAGONAL | 2.5 BILLION PIXELS

SOLIDLIGHT
SURFACE PANELS

So with a machine capable of controlling light, you could emit photons and re-order them to create images—even though the object itself isn't there. That's essentially what Light Field Lab has achieved using today's display technology. The company has mastered how light can be beamed to recreate 3D floating objects that appear like their real-life counterparts would.

A standard TV generally has millions of pixels beaming the light in only one uniform direction. Light Field Lab's holographic tech changes this by sending the photons into a central area, where the light can converge and then scatter, forming images visible to the human eye.

"It has been thought of as the holy grail of displays. It has been thought of as the impossible," Karafin said. But the company cracked the code through a custom 28-inch display it can produce for customers. The panel is capable not only of scattering photons into discernible images but can also do so through an insanely high 2.5 billion pixels.

SEEING THE HOLOGRAMS FOR MYSELF

Of course, seeing is believing. Last week, Light Field Lab invited me to their offices in San Jose. That's where I encountered "Cammy," a holographic chameleon, inside a dimly lit room. SolidLight's display generated the digital lizard across a 12-by-12-inch floating image.

It wasn't flawless. The company's display could generate the chameleon only at over 100 nits of brightness. Hence, the hologram was best viewed in movie theater-like conditions. Nevertheless, for a moment, from a distance of about 2 or 3 meters, the chameleon looked almost real. It also seemed to have weight and volume as I moved my head from side to side, inspecting the critter from various angles.

Once I got closer, I began to notice the swarm of pixels fizzing across Cammy's skin. The chameleon warped and blipped out of existence the moment I stepped out of the display's 100-degree field of view. I tried to touch Cammy, but of course, felt nothing. The photons simply continued to beam the hologram around my fingers.

Light Field Lab then condensed the 2.5 billion pixels into an even smaller 2-by-2-inch image of a wristwatch. This was the demo that really impressed me. The image was small, but the hologram's density was nearly indistinguishable from
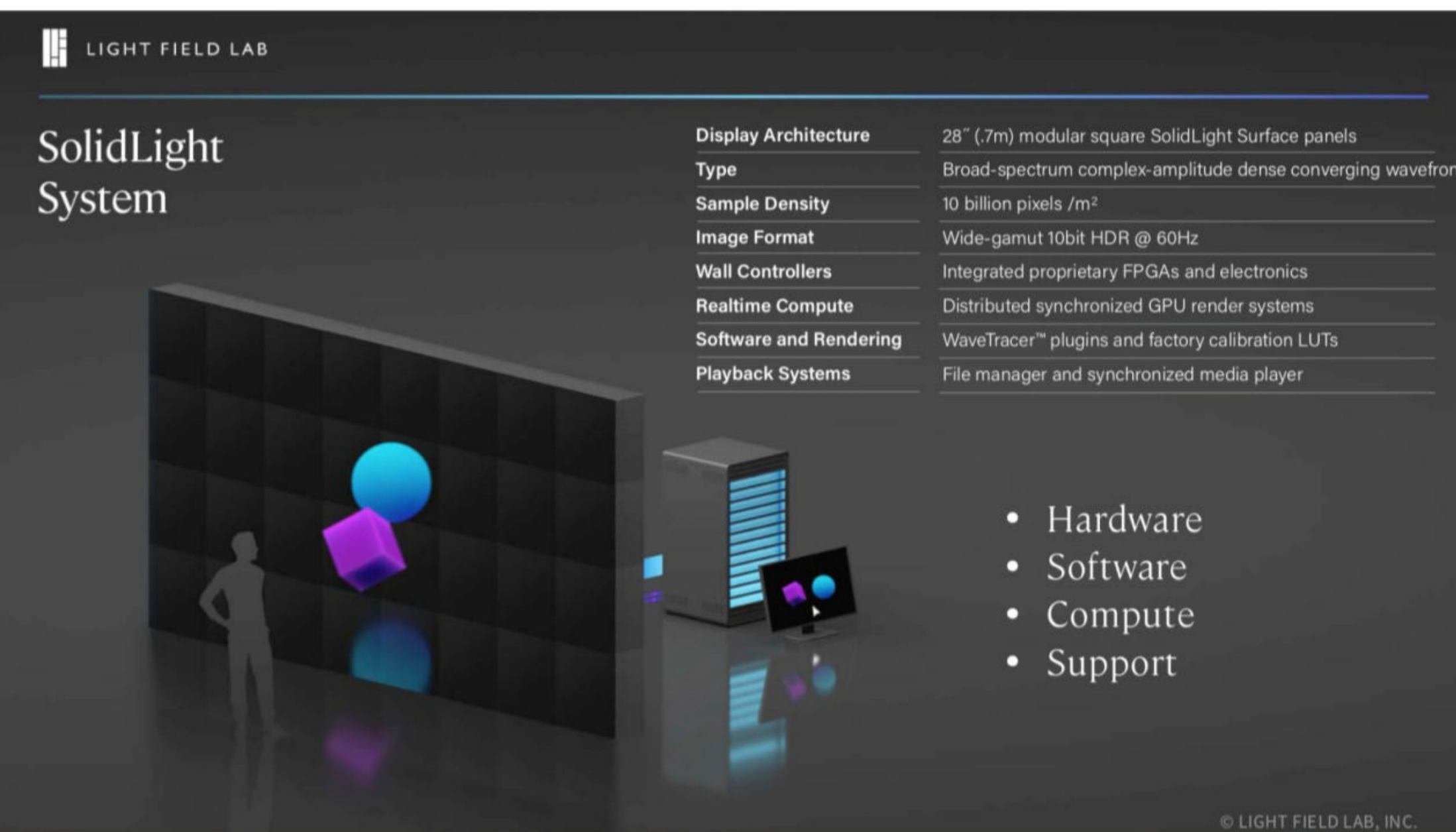
reality. It was only when I was about a foot away from the hologram that I saw the pixels percolating across the watch's metal band.

If only everyone could experience what I saw. The problem is that a 2D picture or a video can't quite capture the feeling of seeing a 3D hologram in mid-air. Light Field Lab asked me not to take any photos of what I saw over worries that publishing the pictures might underwhelm readers.

Still, the company said it'll just be a matter of time before consumers begin to see SolidLight technology in action. The 28-inch display from Light Field Lab is actually a modular product, meaning you can stack them like bricks to create a larger holographic screen.

WHY HOLOGRAPHIC DISPLAYS COULD BE IN OUR FUTURE

Light Field Lab has already been producing larger 90-, 120-, and 150-inch displays, and beyond. Its first enterprise customers are expected to begin debuting them as soon as next year, although a more conservative estimate is within a "one- to three-year" timeframe.

The larger displays cost several million dollars and currently rely on a server feeding them 3D digital content. So for now, the technology will likely first pop up in entertainment venues such as theme parks, where they'll beam 3D images of things—dolphins, sharks, or dinosaurs—that approach the audience.

"Ultimately, the goal is, you won't even know you saw a hologram when you walk through an experience," Karafin said. "I want people to say, 'Wow, that actor was amazing.'"

I experienced a mere taste of the company's technology. The demos I saw were restricted to depicting cute creatures and a wristwatch. But I can't help but wonder what a person would look like on the holographic display. Might it be akin to meeting the person in real life?

Karafin seems to think so. In a concept image, he showed the company's display tech both sending and receiving holographic images over a video-conferencing call. "That experience can in fact be identical to feeling like you look through the wall and you see another room across the world—right there," he said.

So it's not hard to imagine the same displays one day popping up at the office or at your home. A video call with a friend or a PC game might feel more real than ever. The same technology could also be placed across walls, creating a Star Trek–like Holodeck that's capable of beaming holograms, no matter the angle.

"There are many hundreds of other applications, and our belief is that there is no other technology that could touch so many different markets and applications than a holographic display," Karafin added.

Getting there will take time. Like other next-generation TV tech such as 8K, Light Field Lab estimates it'll take several years to bring down SolidLight's manufacturing costs. The company will also need to work with industry partners to create a content ecosystem for the holographic displays. This will be no easy task, but Light Field Lab already counts Samsung, Verizon, and Comcast among its investors. In the meantime, SolidLight is starting to accept display system pre-orders.

Perhaps, the real test is whether the holograms will impress the public or be perceived as a mere gimmick. All I can say is, I want to see more.

Sascha Segan

How US Carriers Are Slowing 5G iPhones Down

The iPhone 13 reviews fried my brain. I've reviewed more than 1,000 cell phones, and I've been reviewing iPhones since the very first one, but they always stress me out. Apple's iPhones are the most popular and the most scrutinized phones in the US, and there are dozens of bloggers, vloggers, and reviewers who have a more passionate connection to the line than I do.

It was especially tough for me to review the iPhones this year because I couldn't find differences in network performance. That led, though, to my realizing there's a gap right now between what 5G phones can do and what US 5G networks can do. 5G has been around for more than two years now, and we're going to see the first fourth-generation Qualcomm X65-based 5G phones in about four months. But it's hard to find anywhere in the US where having better than an X55 matters for performance (although the iPhone 13's Qualcomm X60 does seem to be much more power efficient, and that matters a lot).

In my reviews, I always try to spin this as "new 5G phones look to the future," and that's not wrong, but it also means the present is letting us down.

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.

Throughout 2G, 3G, and 4G, new handset capabilities and new networks went hand in hand. With previous 4G iPhones, each year they'd ratchet up their carrier aggregation or MIMO level, and each year we'd see a jump in performance on Verizon or AT&T. But both Verizon and AT&T absolutely flatlined on performance between 2020 and 2021, whether on iPhones or anything else, and you can get T-Mobile's great new mid-band just as well on an iPhone 12 as on an iPhone 13.

What am I waiting for? Bullet points are a good way to organize my thoughts:

- Reliable, low-latency, standalone 5G networks for remote control, cloud-centric, and AR applications

- Network slicing that can offer guaranteed quality to home internet and enterprise wireless applications

- 5G that offers a difference from 4G for the two thirds of US subscribers who aren't on T-Mobile

I asked around a bit, and there are four predictable answers:

1. We're still reeling from former FCC head Ajit Pai's mistakes. Unlike in nearly every other country, he didn't prioritize making mid-band spectrum available for 5G, and that set us back by at least a year. Still though, Verizon and AT&T's 2022 C-band networks can (and will) be handled by devices with 2020's X55 modems.

2. The chipset shortage is having an even deeper effect than is obvious, with carriers unable to get the components they need to set up new capabilities such as standalone 5G cores.

3. That whole standalone 5G core thing, which is needed to evolve to the next phase of 5G, turned out to be much more complicated than everyone thought it would be in 2020.

4. Network slicing and some other features rely on 5G Release 16, and that network hardware just became available this year (and it isn't very available; see point 2).

I don't think this means "5G is doomed," but it certainly makes reviewing new 5G phones less thrilling for the moment.

On a positive note, I just booked my ticket to Qualcomm's upcoming Snapdragon Summit in December, which will be my first conference since February of 2020. I'm really hoping to get some good network news there.

> "I don't think this means "5G is doomed," but it makes reviewing new 5G phones less thrilling for the moment.

Windows 11 Needs a Windows 10 Mode

Windows 11 is here. As with every previous mega-update to the desktop operating system of record over the years, the new interface has been met with dissent. It's no surprise that Twitter is full of outrage over the redesign—and, it must be admitted, some praise, too. The record will show that I've never been a hater of new Windows features. I even found things to like in the disastrous Windows 8 release. I was an avid Cortana user, at least while she could still do useful things, such as shut down the PC or control music.

Michael Muchmore is PCMag's lead analyst for software and Web applications. He got his start in computing when he wrote a BASIC program for a Radio Shack TRS-80.

But a significant difference is that, at least with Windows 8, Microsoft was creating something original and new. I know that software and all other forms of art borrow from others' recent work, but the Windows 11 interface design is nearly a clone of Chrome OS rather than anything original. Don't interpret that to mean that Windows 11 is a complete rip-off—Microsoft's desktop OS has far more capabilities and even some slickness not found in Google's OS.

This is my take on how we got here: Microsoft saw Google's lightweight Chrome OS laptop and desktop operating system cutting into its market share. First, the company decided to create a new competitor to that OS favored by schools, which got us the ill-fated Windows 10X. At some point,

people at Microsoft decided that everyone who uses Windows should get a Chrome OS-like interface, not just the markets the company was trying to win back from Chrome OS. Lots of Windows users are happy with the Windows 10 interface, so it doesn't seem to make sense for them to have the new one imposed on them.

It's a similar scenario to what spawned Windows 8: Microsoft saw the Apple iPad taking over the world and decided it must turn its main operating system into a tablet operating system. That did about as well as Windows Phone, in the end. Though I will say that, believe it or not, I prefer Windows 10 on a tablet to iPadOS, especially because of the functionality with swiping in from the edges of the tablet (now gone in Windows 11's "tablet posture").

Windows 10 will be around at least until 2025, but if you ignore Windows 11, you miss out on its non-drastic but pleasant new features, including Snap Layouts, and attractive design materials such as Acrylic, Mica, and Smoke. Rounded corners don't excite me that much, but I'd have no problem with them as long as I could keep the more informative Taskbar, Start menu, and Action Center as they are in Windows 10.

It wouldn't be a huge lift for Microsoft to offer Windows 10 settings for these three key interface elements in Windows 11—the underlying OS code wouldn't need to change much. After all, the company had planned to maintain Windows 10 and a separate 10X OS, so simply offering alternative UI options shouldn't be too big an ask. Apple manages to maintain three OSes for desktop, tablet, and phone, after all. I just don't

see the logic of forcing existing users who are content with Windows to adapt to new procedures to use their PCs.
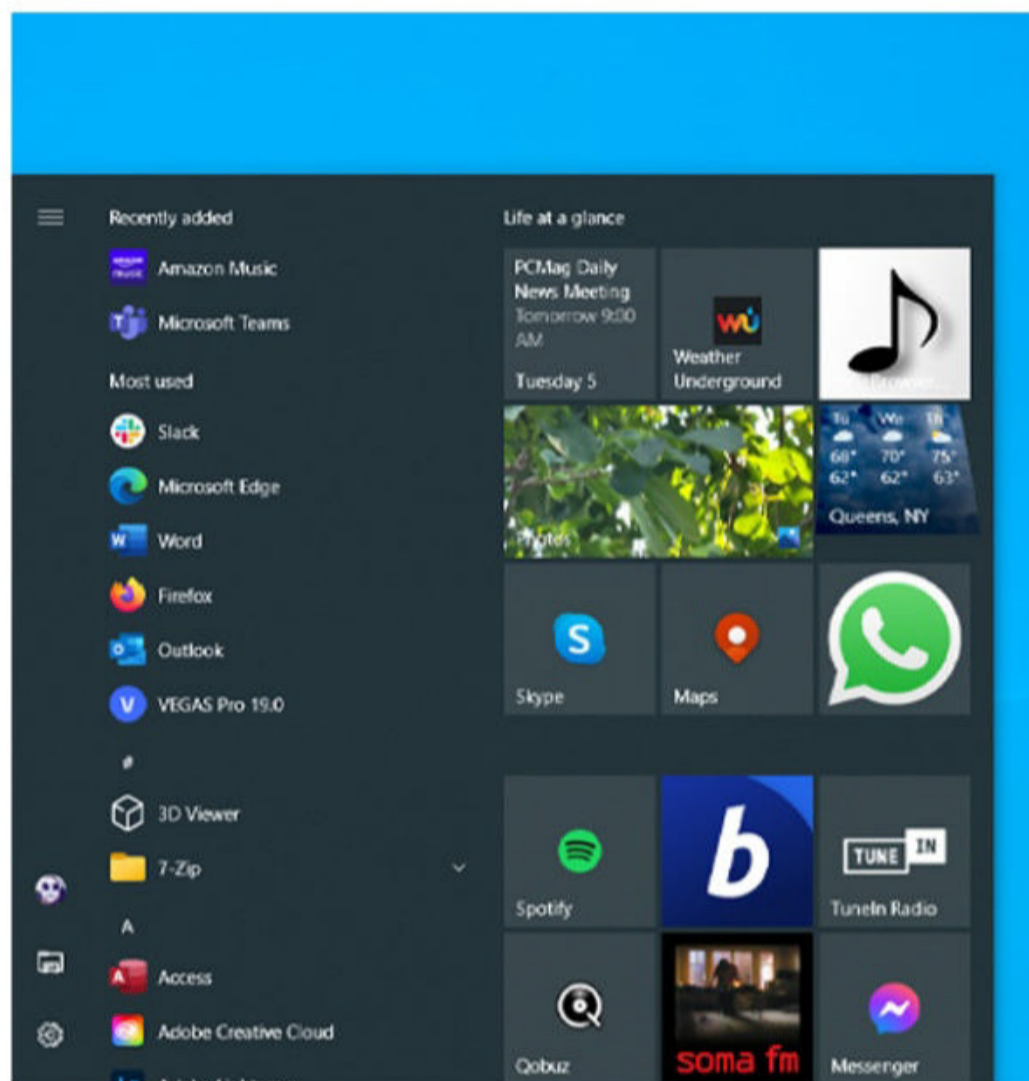
or
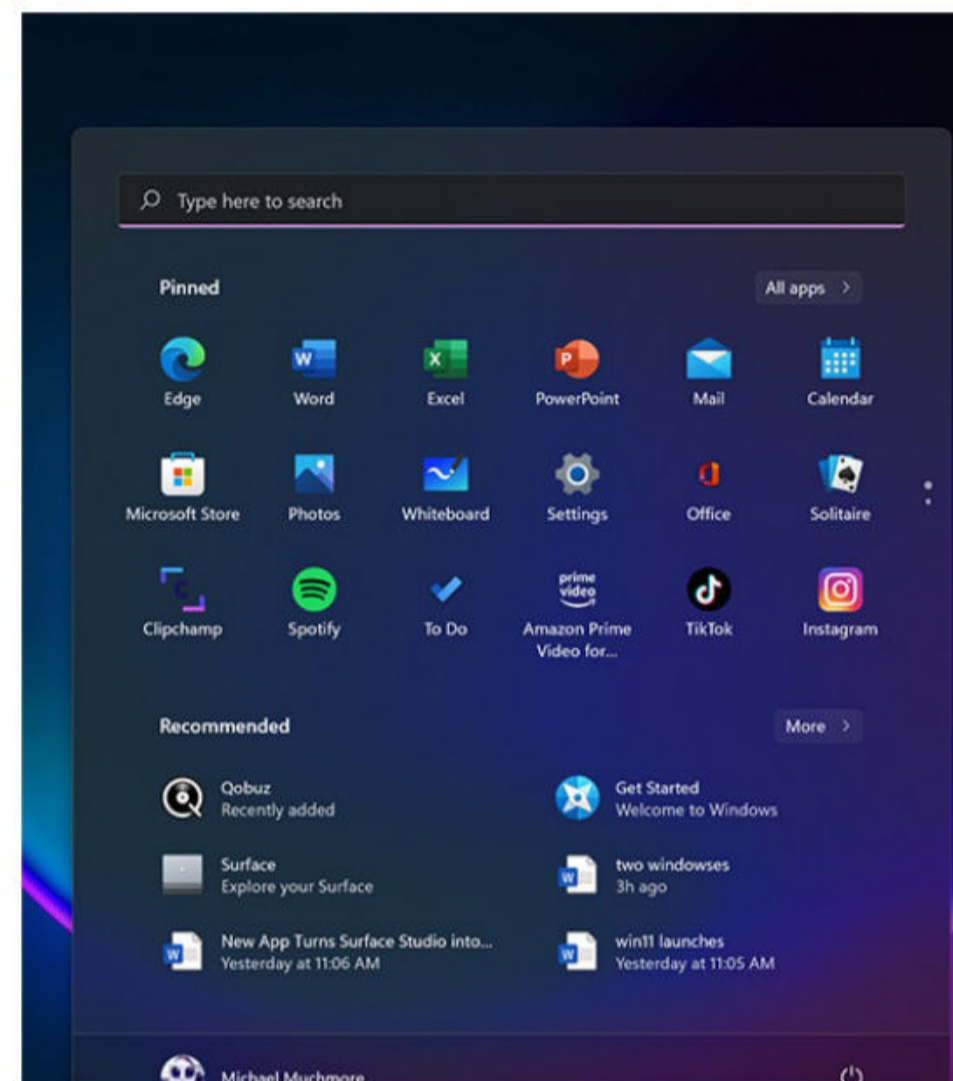
Here are a couple examples of why the Windows 10 Start menu is more efficient: The Start button (as well as the search box) is always in exactly the same place in Windows 10. In Windows 11, if you open more apps, the button moves to the left. (Yes, there's a setting to keep it on the left in Windows 11, but it's not the default, nor is it very obvious.) Also, you see the list of all apps installed on the computer with one press of the Start button; getting to them in Windows 11 takes another click.

Windows 10's Action Center keeps everything together in a well-organized panel with notifications in the top and quick settings in the bottom. In Windows 11, these are separated in a more Chrome OS–like layout. It can be unintuitive: For example, pressing the Battery icon doesn't just display power info, nor does pressing the speaker icon just show sound settings, as in Windows 10.
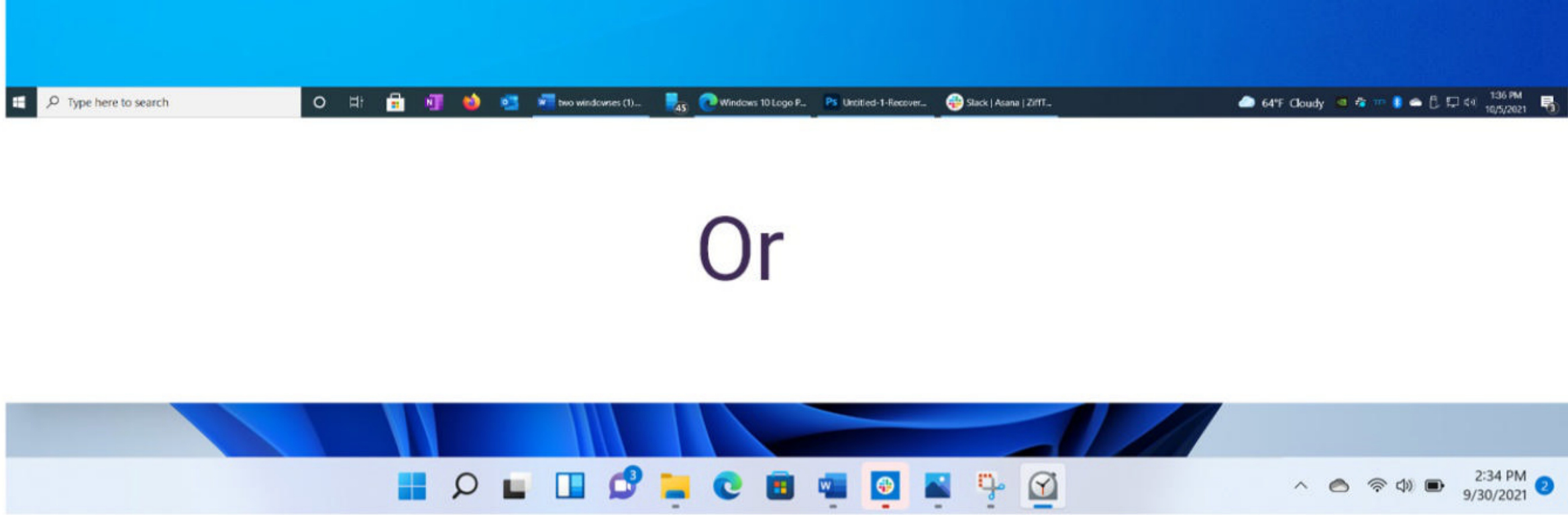
Or

The Taskbar in Windows 10 more clearly shows which apps are running. In my setup, running apps get a long taskbar button, and those are shaded to show which app currently has the focus. In Windows 11, you have, basically, the same uninformative Dock you get in Apple macOS (though at least you don't have the confusion of two different sections or classes of icons).

Microsoft has decided to abandon much of its own years of interface design knowledge in favor of chasing a new competitor. Chrome OS has under 3% of desktop OS market share, and Windows has over 75%, according to StatCounter, so it's a mystery as to why Microsoft is emulating Chrome's interface and trashing years of design experience.

My simple plea: Give us an option to continue taking advantage of that well-honed interface.

Credit: Apple

Starts at $799.99

EDITORS'CHOICE **Rating:** ●●●●◐ **EXCELLENT**

Apple iPhone 13: A Battery-Life Beast

BY SASCHA SEGAN

The Apple iPhone 13 is a battery-life beast, with far greater longevity than previous midrange smartphones. While we appreciate the greater pocketability of the iPhone 13 mini, unimpressive sales of the iPhone 12 mini taught us that most people prefer long battery life to a petite form factor. So even though other upgrades from the previous generation are nearly

unnoticeable here, the battery boost is so profound that it's definitely worth the $100 premium over a standard-size iPhone 12. And if you're upgrading from an earlier iPhone, you'll find a lot of welcome enhancements in power and camera quality. That makes the iPhone 13 the best bet for most buyers, as well as a winner of our Editors' Choice award.

DESIGN: SUBTLE IMPROVEMENTS

The iPhone 13 looks a lot like the iPhone 12. At 5.8 by 2.8 by 0.3 inches (HWD) and 6.1 ounces, it's pretty much the exact same size as the iPhone 12, but it's a third of an ounce heavier. Because of slightly different side-button positioning, some cases designed for the previous model work, and others don't.

There's one difference to note on the front and one on the back. On the front, the "notch" at the top for Face ID is slightly smaller—20% smaller, according to Apple. On the back, the two camera lenses are slightly larger and staggered diagonally rather than stacked vertically.

iPhone 13

PROS
Long battery life. Fast, smooth performance. Camera makes it easy for anyone to take good photos.

CONS
Not much of an upgrade over the iPhone 12.

BOTTOM LINE
The Apple iPhone 13 delivers the best blend of performance, camera quality, and battery life at the right price for most people.

Like the iPhone 12, the iPhone 13 has a gorgeous 6.1-inch, 2,532-by-1,170-pixel OLED display with a wide color gamut and Apple's True Tone color management. Apple says typical brightness is now 800cd/m2, compared with 625cd/m2 on the iPhone 12. I can't see a difference when eyeballing it; we'll rely on DisplayMate Labs' testing to double-check that number when their results come out.

One of the differences between the standard iPhone 13 and the iPhone 13 Pro is that the 13 has a 60Hz display, while the Pro phones have 120Hz displays. If you've never experienced a 120Hz display, this won't be a big deal. 60Hz displays have been standard for many years, and the iPhone 13's display is fluid and smooth. But I've been using 120Hz displays on OnePlus and Samsung phones for nearly a year now, and I found dropping back to 60Hz a bit disconcerting; scrolling web pages felt like they were tearing a bit as I read through news articles. But again, unless you're used to using a recent flagship phone, you probably won't think twice.

PERFORMANCE: IPHONE IS AS IPHONE DOES

Apple's A15 CPU is made on the same 5nm process as the previous A14. Apple says that its 6-core CPU and 4-core GPU have the fastest performance ever.

On the Geekbench benchmark, I saw only an 8% improvement in single-core CPU performance and a 13% improvement in GPU performance over the iPhone 12. But I did see a much bigger improvement in the real-world Basemark web browser benchmark, which jumped from 766.86 to 1042.93 as the phone sped through web page loads.

The fact is, Apple's tight integration between hardware and software always leads to new iPhones having impeccable performance, at least at the start. It's years down the road when they may run into trouble. Nothing I could throw at the iPhone 13 in its first week fazed it, from Microsoft Office to Genshin Impact.

The iPhone 13 and 13 mini have the same performance. The 13 Pro and 13 Pro Max both add a fifth GPU core, which, in our benchmarks, also led to disproportionately better test performance. But if apps run just fine with the four GPU cores, why do you need the fifth core? It's for the 120Hz screen, one of the difference-making features offered by the pricier Pro series.

BATTERY: THIS IS WHY YOU'RE HERE

Apple made a major jump in battery management and capacity with the iPhone 12 series, but a lot of that got lost in real-world usage with the transition to power-hungry 5G. The iPhone 13 series rights the ship, giving true full-day battery life with the iPhone 13 base model and two-day battery life with the 13 Pro.

In this case, it's not about battery size. We don't have the technical details of the iPhone 13's battery capacity, but it's not much larger than the 12's. But the new A15 processor and X60 modem appear to be much more efficient than the A14 and X55 in the iPhone 12 series, leading to much longer video playback time and much longer real-world usage time.

Now, even the iPhone 13 mini is better than the standard iPhone 12. But there's still a huge delta between the 13 mini and the standard 13, and I think that's the main reason you'll end up wanting to buy a standard 13.

After using the iPhone 13 for a weekend as my primary device, I felt no battery anxiety. It was pretty much

> The IPhone 13's new A15 processor and X60 modem appear to be much more efficient than the A14 and X55 in the iPhone 12 series.

always ready to go, unlike my Samsung Galaxy Z Fold 3, which frequently ran down. That shows the confluence of Apple's efficient hardware and software. One of Apple's "secrets" over the years has been that iPhones bleed much less battery while in standby than Android phones typically do.

The phone somewhat fast-charges, just like the iPhone 12 does. When you hook its Lightning port up to a 20-watt USB-C PD power adapter, you can get relatively fast charging speeds; it's also compatible with 7.5W Qi wireless charging and with the 15W magnetic MagSafe charging introduced with the iPhone 12 series.

RADIOS: THE SAME, BUT DIFFERENT

The iPhone 13 uses the Qualcomm X60 modem, the same as in the Samsung Galaxy S21 Ultra and other leading smartphones this year. It has Wi-Fi 6, just like the iPhone 12, and Bluetooth 5.0.

There's not much to say about the iPhone's call quality, which has been fine for several generations now. The iPhone supports all of the voice codecs and calling strategies (such as voice-over-Wi-Fi and voice-over-LTE) that all three US carriers support, and its speakerphone is relatively loud and clear. I used the iPhone 13 extensively with Jabra and Plantronics Bluetooth headsets and didn't get skips, pops, or dropouts.

The phone has one physical SIM slot and can load either one eSIM subscription or two. (If you're going with two eSIMs, the physical SIM is disabled.) To load an eSIM, you need to get a QR code from your wireless carrier—you can't just pick the carrier from a menu like you can on the iPad.

In testing, I couldn't find a reliable difference in performance on today's networks between the iPhone 12 and iPhone 13. That said, I think the X60 upgrade is part of the equation leading to the iPhone 13's superior battery life.

If you're upgrading from a model before the iPhone 12, as most people will be, you'll find huge performance differences from the iPhone 11 and earlier. For one, 4x4 MIMO, present on the iPhone XS and 11 Pro but not the XR or standard 11, dramatically improves 4G data performance in many circumstances. And while 5G really matters only for T-Mobile subscribers right now, our Fastest Mobile Networks tests showed that 5G is a huge benefit for T-Mobile subscribers, and it's likely to have similar effects for AT&T and Verizon subscribers starting next year.

SOFTWARE: IOS 15 IS SMOOTH AS BUTTER

The iPhone 13 runs iOS 15 as of this writing, although by the time you buy it, the 13 might be running iOS 16, 17, or 18. That's one of the iPhone's strengths: It's going to be supported in software for at least five years. So iOS 15 isn't a differentiator for the iPhone 13—you'll get the same OS features on an iPhone 12, 11, or XR.

In brief, iOS 15 isn't a huge change from iOS 14. The most aggressive change I found is Apple's constant attempts to destroy third-party apps' reliance on targeted advertising.

Compared with Android, I'm struck by how smooth the

iOS interface continues to be, especially in scrolling and task switching. But it's more difficult to use than Android when it comes to sorting and dealing with notifications, sharing information between third-party apps such as multiple photo/video editors, and arranging useful information on your home screen.

As always, the more deeply you bake yourself into Apple's ecosystem, the better. Apple iPhones want you to back up your photos and data on iCloud, play games on Apple Arcade, and listen to Apple Music—all for a $14.95-per-month Apple One subscription. You can certainly populate an iPhone primarily with Google or Microsoft services, but you may have fewer options to easily share your content and will find your cloud services less closely enmeshed with the OS.

CAMERAS: TOUGH TO SEE A MAJOR DIFFERENCE

Let me be clear: I take a lot of photos with my phones, but I'm not filming Hollywood movies or viral TikToks, and I generally take photos to mark memories, not to create art. I mostly want my photos to be clear, in focus, and effortless—and as far as that's concerned, I think I'm in line with most iPhone owners.

Apple has improved a lot of specs in the iPhone 13's camera, but I had real trouble seeing those specs translate into better images. The new hardware consists of a bigger sensor that captures 47% more light than the iPhone 12's, as well as better sensor-shift optical image stabilization for videos.

Like the iPhone 12, the iPhone 13 has two 12-megapixel cameras on the back: a main f/1.6 camera and a 120-degree ultra-wide f/2.4 lens. On the front is a 12-megapixel camera with LiDAR depth mapping for Face ID and augmented reality. Video recording goes up to 4K at 60fps on both the front and back.

Flagship smartphones reached a level of basic perfection a few years ago when it comes to outdoor photography in decent light. Take a look at this skyline shot taken with an iPhone 13, an iPhone 12, and 2018's iPhone XR. I can't tell the difference. So if you mostly take photos in good light at 1x, you've basically been solid since 2018.
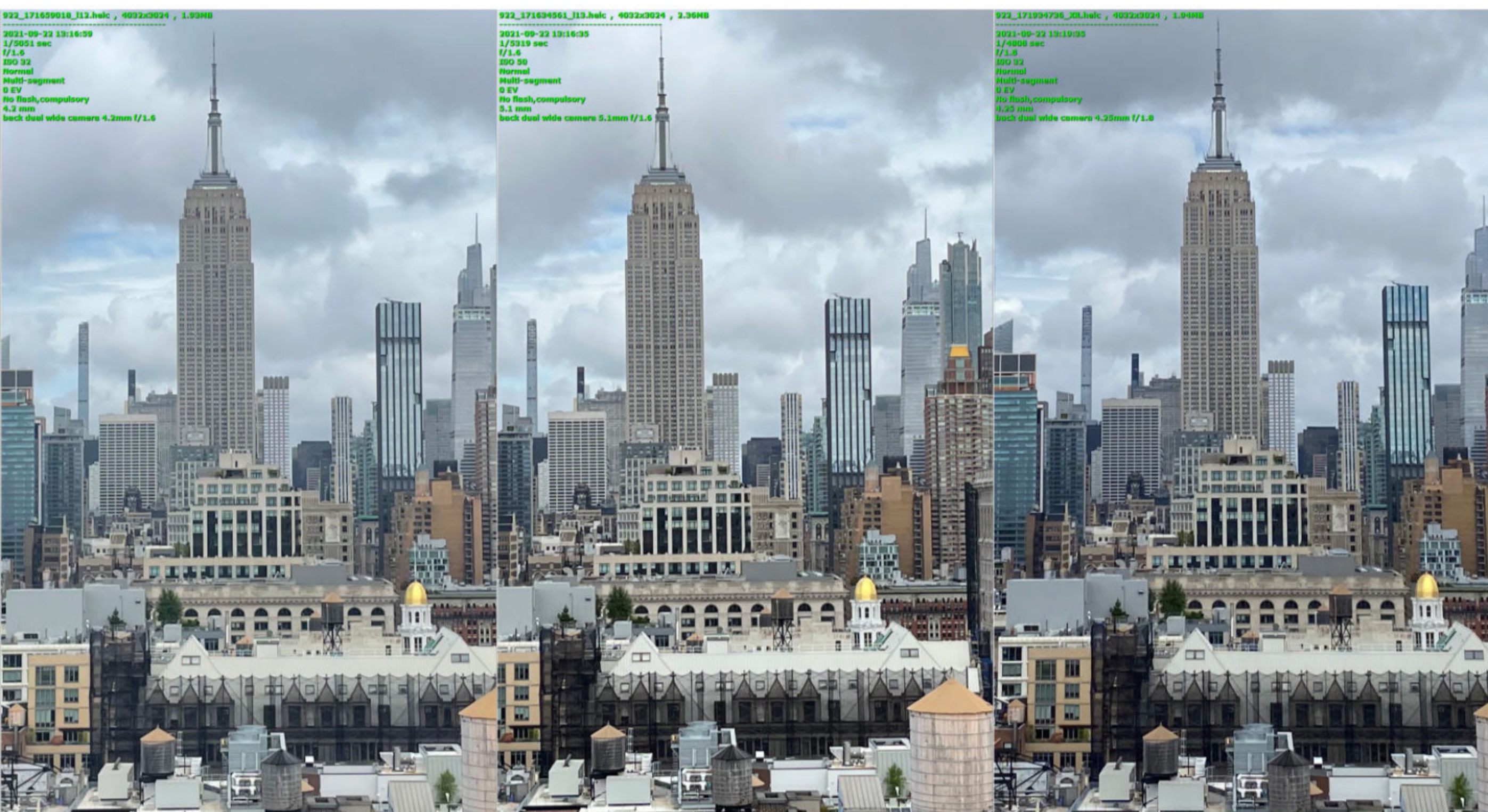
Low-light performance is very important to many people. There's good news: Apple has made at least subtle improvements to low-light performance every year. The big jump was between the iPhone XR and 11, when Apple started its computational night mode,

which literally makes light out of darkness. Between the iPhone 12 and 13, low-light differences are pretty subtle. Mostly, there's less noise on the iPhone 13. That's nice but not a "run out and get this" kind of feature.

In terms of zoom, the iPhone 13 (like the iPhone 12) falls down on the job. The 13 has two lenses, a standard wide and an ultrawide, which most of the competition has moved past by now. To get the 3x zoom that's common on Android competitors, you have to step up to the $999 iPhone 13 Pro.

With the ultrawide lens in good light, colors are truer than on the iPhone 12—sometimes, not all the time—and edge distortion is about the same. Neither phone has the cool edge distortion correction that the OnePlus 9 Pro has.

In terms of video, the big new feature is "cinematic focus," which supposedly shifts focus between different subjects in a video. Like "photographic styles," which are amped-up filters, I couldn't find much use for this feature. It seems to be aimed at people making complex, narrative videos, and I just don't have the subjects or mindset for that.

But I don't want to downplay the iPhone's video excellence here. With many phones available to me, I frequently turn to iPhones to make my own professional videos because I trust its focus decisions more than those of other devices, including the Samsung Galaxy S21 Ultra. I just don't see much of a difference between the iPhone 12 and the iPhone 13.

Along with a zoom lens, the other things you give up by not going Pro are ProRes video—an arcane format used by professionals—and macro photography. Macro is another thing I just don't get; I've never felt the need to take a close-up picture of a flower, although if that's your thing, get the Pro model; the regular 13 cannot focus at sub-6-inch distances.

SHOULD YOU UPGRADE TO THE IPHONE 13?

If you've been annoyed with your iPhone 12 mini's battery life, first of all, I personally apologize to you for recommending it, and second, this is your solution. The iPhone 13 is a reasonably sized iPhone with enough battery life to go the distance.

If you have an iPhone 11 and you're on T-Mobile, you really need 5G. Our 30-city Fastest Mobile Networks tests this year showed massive performance improvements with mid-band 5G on T-Mobile, and low-band 5G on T-Mobile now extends rural coverage. You should trade up.

> "
> **Along with a zoom lens, the other things you give up by not going Pro are ProRes video—an arcane format used by professionals—and macro photography.**
> "
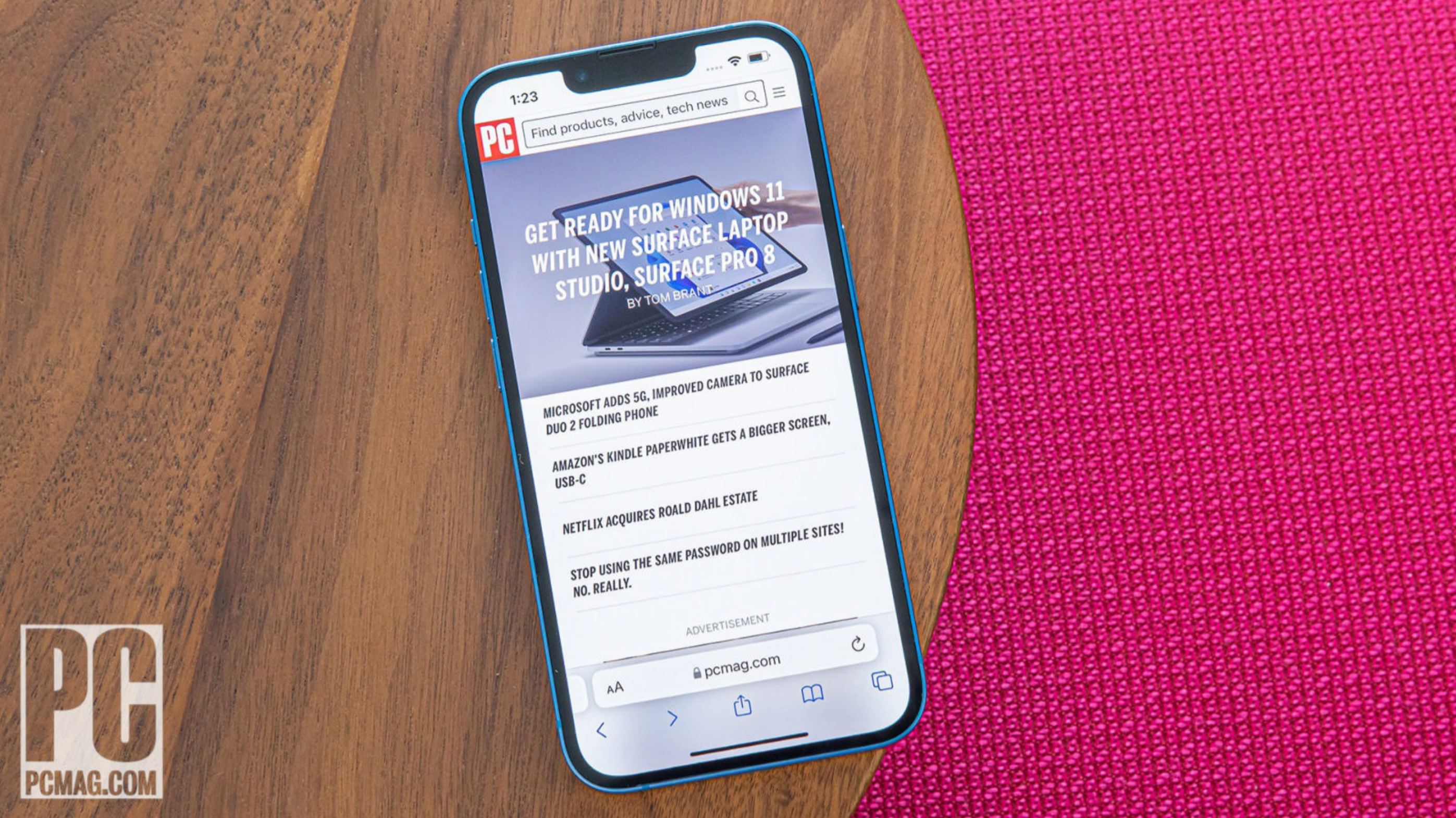
If you have an iPhone 12, or an iPhone 11 on AT&T or Verizon, you can wait for a year.

If you have anything earlier than an iPhone 11, the battery improvements and the camera night mode here are strong reasons to upgrade. Really, the difference in low-light shots between an iPhone 13 (or 12) and an XR (or earlier) is just immense.

SHOULD YOU SWITCH TO THE IPHONE 13?

If you're an Android user and nothing has won you over to iOS yet, the iPhone 13 won't be the phone that does. There are a lot of great Android options, most notably the Samsung Galaxy S21 Ultra, the OnePlus 9 Pro, and the upcoming Samsung Galaxy S21 FE and Google Pixel 6, and they're often offered with deep discounts or great trade-ins.

Apple has two major advantages over these otherwise-leaders. First, Apple's cameras are always just a bit more responsive and reliable; they typically load more quickly and have more guaranteed focus than even the best Android cameras. And second, Apple's data management practices tend to be a bit more circumspect than Google's.

But the iPhone 13 isn't new on any of those fronts. It doesn't have any key elements that would change your personal decision if the iPhone 12 didn't.

NOT GROUNDBREAKING, BUT IT'S BEST IPHONE FOR MOST PEOPLE

The iPhone 13 is a refinement, not a revolution. Compared side by side with the iPhone 12, it's not going to shock you with anything other than stellar battery life. That said, the additional juice is absolutely worth the $100 premium over the still-on-sale iPhone 12 or the iPhone 13 mini, making the standard iPhone 13 our Editors' Choice winner. It's about having less stress, and in 2021, nobody needs more stress. The iPhone 13 Pro Max, meanwhile, should be the choice for professional and wannabe-pro content creators who rely on iPhones to add beauty and entertainment to the world. Its additional zoom lens, big screen for viewing and editing content, and nearly immortal battery life makes it a true "pro" content creation studio. So this year, go big. You won't regret it.

> The additional juice is worth the $100 premium over the still-on-sale iPhone 12 or the iPhone 13 mini, making the standard iPhone 13 our Editors' Choice winner.

$54.99 | Rating: ●●●●◐ EXCELLENT

Amazon Fire TV Stick 4K Max: Excellent Media Streamer

BY WILL GREENWALD

Wi-Fi 6 is capable of higher speeds and better performance than the Wi-Fi 5 we're used to, especially in crowded network environments, and Amazon's Fire TV Stick 4K Max is the first media streamer under $100 we've seen to support the standard (the $180 Apple TV 4K also uses it). The $54.99 Fire TV Stick 4K Max is just like the $49.99 Fire TV Stick 4K, but with a Wi-Fi 6 radio and a slightly faster

processor. For just $5 more, it certainly seems like a good deal, but 4K video can be improved by bandwidth only to a certain extent, and Wi-Fi 5 already exceeds that. So unless you have a Wi-Fi 6 router, an incredibly fast internet connection, and optimal wireless conditions, the standard Fire TV Stick 4K will suit you just fine and remains our Editors' Choice winner.

THE SAME STICK

Physically, the Fire TV Stick 4K Max is identical to the Fire TV Stick 4K. It's a plain, rectangular black stick measuring 3.9 by 1.2 by 0.6 inches (LWD), with an HDMI plug sticking out of one end. The side of the stick holds a micro USB port, just like the Fire TV Stick 4K. A newer USB-C port would have been nice as it's easier to plug in, but since it's used only for power, it's understandable that Amazon didn't bother to even change the stick's plastic casing to accommodate a different port. There are no other connections on the device, and no indicator lights or controls.

While it doesn't feel any different, the Fire TV Stick 4K

Max has some small upgrades over the Fire TV Stick 4K on the inside. A Wi-Fi 6 radio (801.11a/b/g/n/ac/ax) is the most obvious addition, but it's a bit more powerful as well. It features a 1.8GHz CPU and a 750MHz GPU compared with the Fire TV Stick 4K's 1.7GHz CPU and 650MHz GPU, and has half a gigabyte more memory, for a total of 2GB. For comparison, the $119.99 Fire TV Cube, which offers hands-free Alexa voice control, has dual CPU cores (2.2GHz and 1.9GHz) and an 800MHz GPU.

The stick is intended to be powered by the included USB-to-micro USB cable and wall adapter. Amazon doesn't recommend trying to run it off of your TV's USB ports, which might be underpowered. Aside from the power cable and adapter, the stick includes a short HDMI extender, in case the ports on your TV are too tightly packed.

The included remote is standard Fire TV fare, a flat black wand with a prominent circular navigation pad near the top. Power and Alexa buttons sit above the pad, along with a pinhole microphone. Menu, playback, and TV volume controls can be found below it, with dedicated service buttons for Amazon Prime Video, Disney+, Hulu, and Netflix farther down. The remote can directly control your TV's audio over HDMI-CEC.

> "While it doesn't feel any different, the Fire TV Stick 4K Max has some small upgrades over the Fire TV Stick 4K on the inside."

FIRE TV FUNCTIONALITY

As a Fire TV device, the Fire TV Stick 4K Max is loaded with apps and features, built around a friendly but visually dense tile-based interface. All of the major video-streaming services are here, including Amazon Prime Video (of course), Apple TV, Disney+, HBOMax, Hulu, Netflix, Paramount Plus, Peacock, Twitch, and YouTube. For those who use their TV's audio or any speakers connected to it, most big music-streaming services are also available, including Amazon Music, Pandora, SiriusXM, Spotify, Tidal, and YouTube Music. There are also thousands of additional smaller apps and services spanning many different interests and regions. Some games are available too, and you can pair a Bluetooth controller with the stick. If you really want to play games on the device, though, consider getting an Amazon Luna Controller and the Amazon Luna game-streaming service for much better options than the overwhelming number of simpler, adapted-from-mobile games in the Fire TV store.

The home screen's content recommendations are predictably Amazon-centric, with an occasional row of suggestions from HBO Max and other services thrown in as you scroll down. Fortunately, content searches aggregate multiple services outside Amazon, so you can probably find whatever movie or TV show you want to watch when you ask Alexa for it. And if an app is on the Recent Apps bar on the home screen, content suggestions will appear below it when you move the
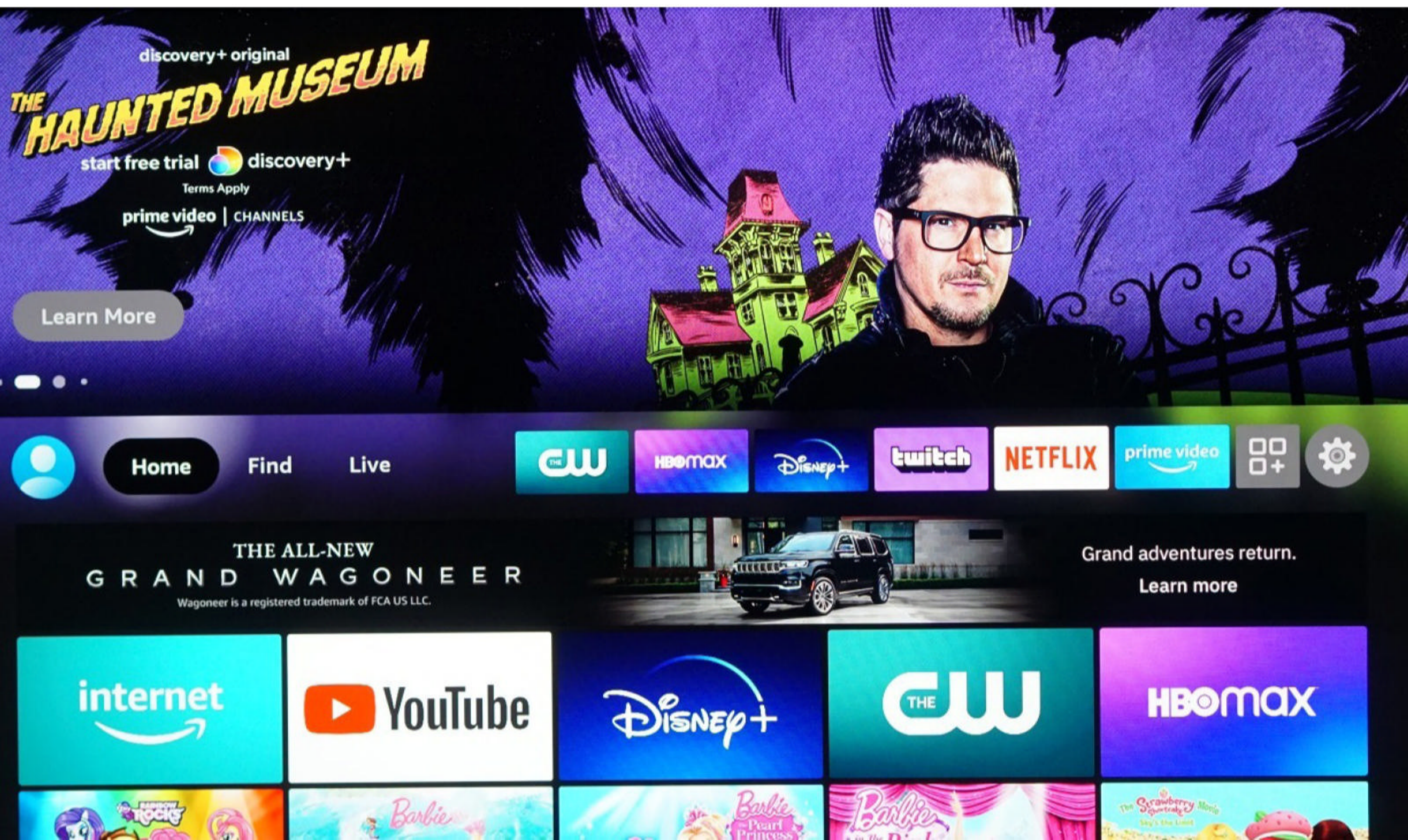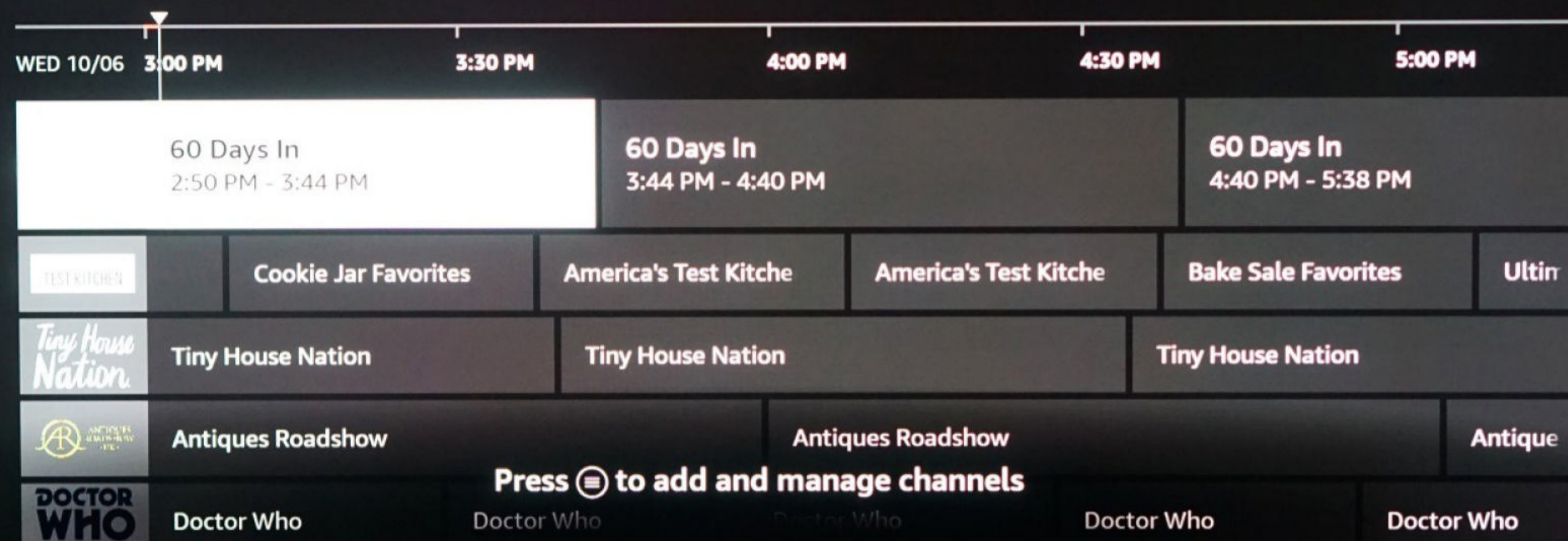
cursor over its icon. The Live menu on the home screen and the program guide
accessible through it shows free live-streaming channels with movies and TV
shows, along with news and sports feeds. You can also add live TV services such
as Hulu, Sling TV, and YouTube TV to the guide and customize your listings
with your favorite channels.

Like all Fire TV devices, the Fire TV Stick 4K Max lets you use the Amazon
Alexa voice assistant. Just press and hold the blue Alexa button on the remote
and talk into it, and Alexa answers your question or fulfills your command.
Alexa can provide information such as weather reports and sports scores,
search for content, and control compatible smart home devices.

It can even pull up live feeds of Alexa-compatible security cameras and video
doorbells, which illustrates a small edge the Fire TV Stick 4K Max has over the
Fire TV Stick 4K: live picture-in-picture viewing. You can bring up a live feed of
a networked camera without interrupting what you're watching. It's a very
minor benefit, as you can still check your cameras with other Fire TV devices
without picture-in-picture.

For screen mirroring, Fire TV is the weakest smart TV platform available. You
can mirror your mobile device or Windows PC screen with Miracast or WiDi,
but that's it. It has no Google Cast, as on Android TV and Google TV, and no

Apple AirPlay, as on Apple TV and Roku. This means iOS devices can't mirror to the Fire stick at all, and newer Android devices will probably require a third-party Miracast app to work.

WI-FI 6: DOES IT IMPROVE ANYTHING?

The Amazon Fire TV Stick 4K Max can stream 4K video with support for high dynamic range (HDR) content in HDR10 and Dolby Vision. It also supports Dolby Atmos for audio. These capabilities are identical to those of the Fire TV Stick 4K and the Fire TV Cube.

The faster CPU and GPU and increased RAM of the Fire TV Stick 4K Max are nice upgrades on paper, but their effects aren't readily apparent in real-world usage. Menus are quick to navigate, and content loads quickly, but this all applies to the regular Fire TV Stick 4K as well. I didn't notice a difference in performance between the two devices.

Of course, Wi-Fi speed is more important for streaming media than processing power, and this is where the Fire TV Stick 4K Max has an advantage—again, on paper. It supports Wi-Fi 6 (802.11ax), which can potentially get more than three times faster than Wi-Fi 5 (802.11ac). It also uses Orthogonal Frequency-Division Multiple Access (OFDMA) modulation, which lets up to 30 devices share a single channel, improving performance in congested networks. It's a better Wi-Fi standard across the board.

There's a big caveat for Wi-Fi 6, though: To take advantage of it, you need a Wi-Fi 6 router such as the TP-Link Archer AX50 or Amazon's own Eero 6 Pro mesh Wi-Fi system. If you got your router more than a year ago, or if you're using one supplied by your internet company, you probably don't have Wi-Fi 6.

You also need an internet connection fast enough to make Wi-Fi 6 worthwhile. Consumer-level fiber connections generally top off at gigabit speeds, and even then, subscribers won't regularly see their speeds reach gigabit rates. Wi-Fi 5 has a maximum speed (with a 5GHz connection) of nearly 3.5Gbps with four simultaneous data streams (twice that for eight, the current maximum on the standard). That's more than enough to handle your gigabit fiber connection. Wi-Fi 6 can reach up to 10Gbps under the same conditions. On one hand, that's almost three times faster. On the other hand, both are far faster than gigabit to begin with.

Wi-Fi environments are usually far less than ideal, with multiple networks crowding the same area and factors like distance and architecture affecting signal strength. Wi-Fi 6 can theoretically improve performance with network congestion, so it's something to consider if you're surrounded by other heavy Wi-Fi users. But I've maintained consistent connections and fast speeds over Wi-Fi 5 both in my apartment building in Brooklyn and in PC Labs in Manhattan.

If the Fire TV Stick 4K Max was a computer or a mobile device, we could run extensive tests on Wi-Fi performance in both Wi-Fi 5 and Wi-Fi 6. But options with a media streamer are much more limited. Because of this, we can run only speed tests with the stick, and even then, it brings us back around to the limitations of internet connection speeds and interference from building architecture.

My home network is Wi-Fi 5 on a gigabit Fios connection, and I used it to test the Fire TV Stick 4K Max. Using Ookla's Speedtest.net page through Amazon's Silk browser on the stick, I measured a speed of about 250Mbps. (Editors' Note: Ookla is owned by Ziff Davis, PCMag.com's parent company.) For comparison, I recorded a download speed of around 410Mbps on my laptop, which is about 15 feet farther away from the router. The difference in speed between the two devices can be due to any number of factors, including simply the physical size of my laptop allowing a larger antenna or that it's positioned slightly more line-of-sight with the router than the Fire TV Stick is. Regardless, both devices see a drop from the 1Gbps maximum of my internet connection, and are far lower than the top speeds of Wi-Fi 5.

Location aside, while the difference between those speeds is certainly important for downloading large files, it's effectively irrelevant for streaming media. To watch 4K video in HDR, every major streaming service that supports it recommends connection speeds of around 25Mbps to 50Mbps.

This performance follows what we've seen with the Apple TV 4K, the only other media hub that has Wi-Fi 6. Basically, we simply don't notice any difference, and Wi-Fi 5 already offers the best possible streaming quality to begin with.

> **Wi-Fi 6 can theoretically improve performance with network congestion, so it's something to consider if you're surrounded by other heavy Wi-Fi users.**

AN EXCELLENT STREAMER, BUT YOU WON'T NOTICE THE UPGRADES

The Amazon Fire TV Stick 4K Max is the fastest Fire TV device in terms of potential Wi-Fi speeds. But unless you have a Wi-Fi 6 router, it's nearly identical to the Fire TV Stick 4K, and even then, you'd need a fast enough internet connection and optimal Wi-Fi conditions to take advantage of any potential performance gains. (And there isn't really any content that benefits from the higher speeds you might get.)

It's still an excellent media streamer, but we recommend that you save your $5 and stick with the Fire TV Stick 4K unless you already have a Wi-Fi 6 router. Or consider a Chromecast With Google TV ($49.99) for a more Google-oriented media streamer with Google Assistant and Google Cast. And if you're simply looking to breathe new life into an old TV, Amazon still offers the 1080p-only Fire TV Stick for $39.99 and the Fire TV Stick Lite (which is the same as the Fire TV Stick except that its remote lacks TV controls) for $29.99.

Credit: Microsoft

Starts at $1,599; $2,699 as tested
Rating: ●●●●○ **EXCELLENT**

Microsoft Surface Laptop Studio: Great for Creative Pros BY TOM BRANT

Perhaps you're a software developer by day and a gamer by night. Or maybe you game and code simultaneously by night, and by day, you sleep. In either case, your laptop of choice might have once been a Razer or an Alienware, but now there's a new kid on the block: the 14-inch

Microsoft Surface Laptop Studio. It advances the state of the art of mobile computing for creative pros in a big way, with a haptic touchpad and a 120Hz screen that pulls forward so you can lay it completely flat on top of the keyboard. It's not particularly powerful, and it's pricey, but it's still impressive.

THE MOST ADVANCED SURFACE LAPTOP

The Surface Laptop Studio was conceived as a successor to the Surface Book 3, another innovative device for creative professionals that Microsoft will continue to sell for the time being. Like the Book 3, the Laptop Studio has a convertible touchscreen. Unlike the Book 3, which is a tablet that can detach from its included keyboard base, the Laptop Studio is a non-detachable laptop. Yes, Microsoft already offers a non-detachable (a.k.a. clamshell) laptop with a touchscreen, the aptly named Surface Laptop. What makes the Studio version different is that its screen can be pulled forward to create an easel, or pulled forward even farther to lay flat on your desk as a digital canvas on which to spill your thoughts or draw your masterpiece with a digital pen.

The concept has been tried before, in the form of the Acer ConceptD 3 Ezel and a few other devices. But Microsoft's take is by far the most polished we've seen. Whereas the ConceptD 3 Ezel is slightly overweight and chunky-looking, the Laptop Studio is as sleek a Surface as there ever was. With a familiar magnesium-gray chassis and reflective Microsoft logo on the display lid, it measures 0.75 by 12.72 by 8.98 inches (HWD) and weighs 4 pounds. By contrast, the ConceptD 3 Ezel's 0.9-inch thickness is unbecoming of such an innovative form factor.

Like the ConceptD 3 Ezel, the Surface Laptop Studio has a 14-inch screen, a new sweet spot toward which more and more laptops are gravitating, whether they're

Microsoft Surface Laptop Studio

PROS
Unique pull-forward touch screen. Excellent keyboard. Groundbreaking haptic touchpad. Robust digital stylus support, including magnetic holder. 120Hz screen refresh rate. Long battery life.

CONS
Disappointing performance, even with upgraded Core i7 and RTX 3050 Ti. Only two USB ports. Pricey.

BOTTOM LINE
Packed with innovative features, Microsoft's Surface Laptop Studio presages a new breed of laptop for creative pros who are pen-input devotees. One big quibble: Performance isn't nearly class-leading.

ultra-thin biz machines like the Lenovo ThinkPad X1 Carbon or powerful gaming rigs like the Razer Blade 14. It's the latter—an outstanding laptop in its own right—that is perhaps the chief competition for the Surface Laptop Studio, as it seeks to win the hearts and wallets of its target market: people who consider themselves coders, gamers, and digital artists (and participants in many other creative fields of the 21st century) simultaneously.

If that's you, Razer wants to win you over too, of course, and both companies dole out considerable sums for product placement in content you're likely to consume: Surfaces in Marvel's *WandaVision* and the Razer logo plastered on seemingly every electronic device in Apple TV's *Mythic Quest*. Yes, as brands go, Razer is arguably cooler than Microsoft, but both the Blade 14 and Surface Laptop Studio are considerable investments, so coolness is far from the only decision point.

Instead, if you're considering the Laptop Studio as one option among a few buzzworthy 14-inch PCs to hit the

> "Like the ConceptD 3 Ezel, the Surface Laptop Studio has a 14-inch screen, a new sweet spot toward which more and more laptops are gravitating.

market this year, it really comes down to priorities. Do you value performance above all else, or are you drawn to the innovative pull-forward design that Microsoft has implemented surprisingly well with the Surface Laptop Studio? Spoiler alert: You can't have both, so let's dig deeper into both the features and performance aspects of the Laptop Studio to see how it stacks up.

EASY CONVERSION TO STAGE OR CANVAS

One of the main complaints about the Surface Book 3 is that its tablet functionality is not as robust as its laptop functionality. In the 15-inch version of the Book 3, the Nvidia GPU and one of the two batteries are located in the keyboard base, which means that before you detach it, you have to close any apps using the GPU and prepare yourself for much shorter battery life.

The Surface Laptop Studio doesn't suffer from this problem, of course, since its screen doesn't detach. You never have to worry about closing apps or drastically reducing battery life (which is excellent—it clocked in at 14 hours in our testing). To pull the screen forward, you simply grasp the upper-right or upper-left corner of the screen and twist your wrist gently. The magnetic middle hinge, made of woven fabric with embedded power and data cables that supply the screen, detaches. The display lid then folds along the middle hinge. You pull the screen toward you, slowly closing the bottom hinge, until the bottom edge of the screen is aligned with the gap between the keyboard and the touchpad. Another row of magnets snaps it into place.

In this arrangement, which Microsoft calls "stage mode," you've got a rock-solid surface on which to write or draw with a stylus. It's far sturdier when the Laptop Studio's screen is in conventional laptop mode, since there are two points of support instead of just one. As a result, there's no screen bouncing, something that nearly every other convertible and clamshell laptop suffers from when you tap, write, or draw on the screen.

Although tapping on the touch screen is much more satisfying when the Laptop Studio is a stage than when it's a laptop, the most useful part of the stage orientation is presenting content, not creating it. For instance, you can watch videos or play games (using a console controller) more enjoyably without the keyboard in the way.

For more serious writing or drawing sessions, you'll want to convert the Laptop Studio into a canvas: Grab the corner of the screen and apply slight pressure again to release the magnetic bond and move the display to the fully flat position, where it will again magnetically

lock. Now, the Laptop Studio is essentially a digital version of a pad of paper, and the only real difference between it and a detached tablet such as the Surface Book 3 or even smaller convertible 2-in-1s like the Dell XPS 13 2-in-1 is that it's too heavy to hold in your hand.

GETTING SMOOTH WITH 120HZ

Conventional laptops like the Blade 14—which lacks even a touch screen—can't do any of this, of course. And the reason it's surprising that Microsoft is able to pull off the pull-forward screen so well is two-fold: First, because the concept has been tried before but plays a faint second fiddle to the Lenovo Yoga-style convertible 2-in-1s that dominate the market. And second, because Microsoft has added a few features to the Laptop Studio's touchscreen experience that almost no other similar offering has.

The first is a 120Hz screen refresh rate. Outside the gaming laptop and flagship phone markets, screen refresh rates above 60Hz are rare. But they're essential to making what you see on the screen look more like real life. Gaming laptops need them to give esports players a competitive edge, while flagship handheld devices like the Apple iPhone 13 (see the review in this issue) employ 120Hz-screens to make scrolling and other on-screen animations appear smoother. (The Blade 14 can be fitted with a 165Hz screen).

The Surface Laptop Studio benefits from these usual advantages over the standard 60Hz laptop refresh rate, of course, but Microsoft has another, more niche reason for introducing a high-refresh-rate screen: It enables more realistic writing and drawing experiences, whether you're using your fingertip or a digital stylus. The higher refresh rate means the pixels can keep up with your motion better. If writing on a 60Hz screen feels like, well, writing on a screen, then writing on a 120Hz screen feels much closer to (albeit still far from) writing on a piece of paper.

The Surface Laptop Studio's second ingredient for success is an optional extra: the new Surface Slim Pen 2 ($129). This digital stylus should really be included in the box with the laptop, since the two fit together perfectly. When used with the Laptop Studio, the Slim Pen 2 adds tactile feedback to even more closely mimic the feel of writing on paper. Apply more pressure to the screen, and the tiny haptic motor in the Slim Pen 2 vibrates, evoking the friction you get when you dig a sharp mechanical pencil into a drafting pad. It's hard to notice until you turn up the sensitivity in the Windows 11 Settings app, and it's likely more gimmicky than useful unless you're a digital artist with precise stylus-control skills. But now that I've experienced it, it will be difficult to go back to using a non-haptic stylus.

The Slim Pen 2 and Surface Laptop Studio also fit together literally. You can attach the pen to a notch beneath the front edge of the laptop, where strong magnets hold it in place and charge it.

IMPROVED WINDOWS HELLO WEBCAM

The Surface Laptop Studio's unique screen features make it an ideal digital canvas, but it's also a pleasure to look at. The HDR display measures 14.4 inches on the diagonal, with a 3:2 aspect ratio and a resolution of 2,400 by 1,600 pixels (between full HD and 4K). It has slimmer bezels than both the Surface Laptop 4 and the 13-inch Apple MacBook Pro have, giving it a decidedly modern look. In a curious twist, the corners of the screen are rounded, not squared, which softens the aesthetic but also means that a few pixels in the corners of full-screen apps will be lopped off.

In our testing, the Laptop Studio managed to display the entire sRGB color gamut and 86% of the DCI-P3 gamut, which puts its color accuracy on par with the Blade 14 and is a noteworthy improvement over the Surface Book 3. The Laptop Studio's backlight is also plenty bright enough for nearly any indoor

viewing situation. We measured its maximum brightness at 485 nits, a few above the Book 3's maximum and significantly better than the Blade 14's 357 nits.

In the thin top bezel lies a Windows Hello webcam, a familiar Surface feature that lets you log in to your Windows account via face recognition instead of typing in your password. Microsoft has improved the low-light performance of Windows Hello significantly with the Surface Laptop Studio's camera, which also captures startlingly crisp video and still images thanks to an improved image signal processor and a 1080p sensor. As far as reliably logging me in every time, though, the Laptop Studio's camera still falls short of Face ID on my iPhone—its accuracy is 100% when I'm not wearing a face mask.

The Surface Laptop Studio's keyboard and touchpad are also the best I've ever used on any Surface Device. The most significant improvement is the touchpad, which uses haptic motors instead of a physical hinge, affording your fingertips the pleasure of a uniform clicking sensation whether they happen to be in the corner or the center of the pad. Other Windows laptop makers have experimented with haptics, including Lenovo on the Yoga 9i and ThinkPad X1 Titanium Yoga, but only the Surface Laptop Studio implements the feature as well as we've come to expect from the haptic trackpads of the MacBook Pro and MacBook Air.

DON'T EXPECT TO PLUG IN LOTS OF PERIPHERALS

For a laptop that starts at $1,600 and is aimed at creative pros, the Laptop Studio's port selection is disappointing. There are just two oval-shaped USB-C ports, a headphone jack, and the Surface Connect port, which is where you plug in the AC adapter. Compare

> "In the thin top bezel lies a Windows Hello webcam, a familiar Surface feature that lets you log in to your Windows account via face recognition.

that with the Blade 14's respectable complement of I/O options, which include two USB Type-A ports, two USB-C connectors, and an HDMI output. Pros need port options, even if it's only to plug in a USB-A gaming mouse, and the Laptop Studio lets them down.

As a consolation prize, both of the Surface Laptop Studio's USB ports support Thunderbolt 4, something the Blade 14 and the Surface Book 3 lack. And if you're looking to charge a USB-A device, you'll find a power-delivery port on the Laptop Studio's stylish black AC adapter. The port is for charging only and can't transfer data to and from the laptop. The upgraded configuration uses a 95-watt power supply that's necessary for running the Core i7 and RTX graphics, while the Core i5 base configuration comes with a smaller 60-watt adapter. Both have USB charging ports. Wireless connectivity includes Wi-Fi 6 (802.11ax) and Bluetooth 5.1.

With quad speakers and dual microphones, the Surface Laptop Studio's audio quality is excellent. Output is rich

> **Pros need port options, even if it's only to plug in a USB-A gaming mouse, and the Microsoft Laptop Studio lets them down.**

and startlingly loud at maximum volume; the only aspect I found lacking is the bass that comes from a dedicated woofer, and that's something we don't expect from a 14-inch laptop.

SURFACE STUDIO CONFIGURATION OPTIONS

It's quite clear that Microsoft has a design win on its hands with the Surface Laptop Studio, from the added features compared with conventional 14-inch laptops to the usability improvements over the Surface Book 3. But what about performance? As mentioned above, it's somewhat of a disappointment. We tested a higher-end configuration, which features an Intel Core i7-11370H processor, an Nvidia GeForce RTX 3050 Ti, 32GB of memory, and a 1TB SSD. Compare that with the 16GB of RAM and 256GB SSD of the Core i5-powered base configuration, which lacks a discrete Nvidia GPU and instead relies on Intel integrated graphics.

While it's true that RTX is Nvidia's flagship GPU brand, and the H-series Core CPUs are Intel's flagship laptop processors, they're not all created equal—not even close.

The Core i7 in the Laptop Studio has just four cores and a 28-watt minimum power draw, which puts it closer to Core i7 models designed for ultraportable laptops than to the six-core, 45-watt models that make up the upper end of the H-series range. Likewise, there's a significant drop in graphics capabilities when you step down from the RTX 3060 (itself a mid-range card) to the RTX 3050 Ti, which has just 4GB of video memory and can range anywhere from 35 watts to 80 watts, depending on the laptop.

As a result, the Surface Laptop Studio falls into a predictable performance pattern. It sails through everyday tasks such as web browsing (as any laptop in this price range must), but on more demanding tasks, it falls short of true power laptops that are designed for gaming or content creation, such as the Dell XPS 15, the Lenovo ThinkPad X1 Extreme, and the Blade 14.

You can see the specs of these laptops as we reviewed them in the chart below, along with those of the Laptop Studio and Book 3.

> **The Surface Laptop Studio sails through everyday tasks such as web browsing, but on more demanding tasks, it falls short of true power laptops.**

Test System Configurations

	PROCESSOR	GRAPHICS	RAM	STORAGE
Microsoft Surface Laptop Studio	Intel Core i7-11370H (3.3GHz)	Nvidia GeForce RTX 3050 Ti (4GB)	32GB RAM	1TB SSD
Dell XPS 15 OLED (9510)	Intel Core i7-11800H (2.3GHz)	Nvidia GeForce RTX 3050 Ti (4GB)	16GB RAM	512GB SSD
Lenovo ThinkPad X1 Extreme Gen 4	Intel Core i7-11800H (2.3GHz)	Nvidia GeForce RTX 3060 (6GB)	16GB RAM	512GB SSD
Microsoft Surface Book 3 (15-Inch)	Intel Core i7-1065G7 (1.3GHz)	Nvidia GeForce GTX 1660 Ti (6GB, Max-Q)	32GB RAM	512GB SSD
Razer Blade 14	AMD Ryzen 9 5900HX (3.3GHz)	Nvidia GeForce RTX 3070 (8GB)	16GB RAM	1TB SSD

The first group of benchmark tests we run simulate both everyday tasks (UL PCMark and Primate Labs Geekbench) and more complex real-world workflows, including 3D rendering (Maxon Cinebench), video transcoding (Handbrake), and image editing (Adobe Photoshop). On PCMark and Geekbench, the Laptop Studio finished ahead of the Book 3, but behind all three of the other competitors, a pattern that bears itself out repeatedly on the other tests.

A deficiency of a few hundred points on the PCMark 10 overall test hardly makes a difference when all the scores are above the 4,000 mark that represents excellent performance. But when the Surface Laptop Studio takes 12 minutes to complete a video transcode that the Blade 14 can do in 7 minutes, eyebrows start to go up. Transcoding video using Handbrake is a CPU-intensive task, as is compiling code, so software developers will likely find this result disappointing. The Blade 14 uses an AMD Ryzen 9 56900H CPU with eight cores and a 45-watt default power rating. (See how we test laptops).

GAMING PERFORMANCE AND BATTERY LIFE

Microsoft wants the RTX-equipped version of the Surface Laptop Studio to moonlight as a gaming platform, and here, the benchmark results are slightly kinder. Performance on the 3DMark gaming graphics simulation is on par with the XPS 15, which Dell intends to serve a similar purpose (content creation as

bread and butter, a bit of casual gaming at lower resolutions and detail settings to relax at the end of the day). We normally run a second graphics simulation called GFXBench, but it failed to launch on the Laptop Studio, more likely due to a software glitch than a problem with the laptop.

When it comes to AAA games with stunningly detailed graphics that can truly tax a GPU, however, the Laptop Studio is simply not up to the task. The differences between the RTX 3070-equipped Blade 14 and the RTX 3050 Ti Laptop Studio on the in-game benchmarks we tested (F1 2021, Assassin's Creed Valhalla, and Rainbow Six: Siege) are stark reminders that not every RTX laptop is created equal. Yes, you can get better performance if you select low quality and turn on Nvidia's DLSS feature in games that support it, but it's still far less than what you can expect from an RTX 3070-equipped machine.

As mentioned above, Surface Laptop Studio battery life and display performance are excellent. You can compare the Surface Laptop Studio's color, brightness, and video battery rundown performance to competitors in the chart below. It's especially impressive that it manages to come within two hours of the the Book 3's result despite having more powerful components and one fewer battery.

STILL GROUNDBREAKING, DESPITE PERFORMANCE PITFALLS

There's no doubt that the Microsoft Surface Laptop Studio is groundbreaking. We've come to expect such things from the Surface lineup, so it's always nice to see a product that exceeds our expectations. The pull-forward laptop-screen concept has been tried before— but never in a device that's so stylish and packed with innovative features including a haptic touchpad and robust digital stylus support.

The once-sparse market segment for compact power laptops is growing crowded, however, and many companies besides Microsoft have seen the potential of 14-inch PCs that pack a punch. Razer's less expensive Blade 14 just happens to pack a lot more punch, thanks to its Ryzen 9 and RTX 3070. Of course, the Blade 14 doesn't offer haptics or a pull-forward screen—it doesn't even offer a touch screen.

So creative pros are right to get excited about the Surface Laptop Studio, but they're faced with a conundrum: to get a stunning digital canvas or to get as much power as possible from a small laptop such as the excellent Blade 14. We suspect they'll gravitate toward the latter, especially those who tend to spend more of the day (or night, or both) gaming than creating with a stylus.

Credit: Microsoft

$399.99 | Rating: ●●●◑○ **GOOD**

Microsoft Surface Go 3: Best Budget Windows 2-in-1 Tablet

BY TOM BRANT

Although it runs Windows 11 and can be used with an optional keyboard, the Microsoft Surface Go 3 is a tablet designed to compete with Chromebooks and the Apple iPad, not traditional laptops. A compelling starting price coupled with the refined style and high-quality construction we've come to expect from the Surface product family make this the best inexpensive Windows-powered 2-in-1 tablet you can buy. But with few improvements over its predecessor and computing performance that remains

lackluster, the Surface Go 3 is also a slightly disappointing third-generation revision to Microsoft's most affordable tablet, given the advances we're seeing on other platforms. Also, our Core i3-based tester comes in at $629.99, and that's without Microsoft's compatible keyboard accessory, which adds at least another Benjamin.

DESIGN: IT'S MOSTLY A GO 2

The Surface Go 3 follows a familiar design formula: It's a rectangular touch-screen tablet with an integrated kickstand. Weighing just 1.2 pounds and measuring 0.33 by 9.7 by 6.9 inches (HWD), it's equally at home in your hands or propped up on a table. That distinguishes it from most other 2-in-1 convertible laptops, which typically weigh at least twice as much and have permanently attached keyboards that make them less natural to use as true tablets.

Like the more expensive Microsoft Surface Pro 8 tablet, the Surface Go 3's functionality skyrockets when you magnetically attach the optional Surface Type Cover, which adds a keyboard and touchpad to transform the tablet into something that can pass for a laptop. Though Chromebook tablets and the iPad can also be attached to external keyboards, the Surface Go 3's advantage is that it runs a full version of Windows 11, not the internet- and app-centric iPadOS or Chrome OS.

This unique combination is what makes the Surface Pro 8 (like other, similar premium tablets) such a compelling do-it-all device. But the Surface Go 3's uninspired computing experience robs it of some of the advantages of the more expensive Pro 8 flagship. A CPU bump from an Intel Core m3 in the top-end Surface Go 2 to an Intel Core i3 in the uppermost Surface Go 3 configuration doesn't help the Go 3 perform meaningfully better than its predecessor, let alone

Microsoft Surface Go 3

PROS
Low starting price. Lightweight. Sunny display with vivid colors. Windows Hello webcam with 1080p video support. Integrated kickstand. SD card reader for easy storage expansion. Long battery life.

CONS
Keyboard cover not included. Only one USB-C port. Optional extras pump up price quickly. Disappointing computing performance, even with Core i3 upgrade.

BOTTOM LINE
Microsoft's Surface Go 3 is the best budget Windows 2-in-1 tablet, but its performance and value are a bit below expectations for a third-generation product that competes against Chromebooks and the Apple iPad.

match the power of the Apple A14 silicon in the iPad Air. We're reviewing the premium Go 3 here, which also comes with 8GB of memory and a 128GB SSD. The $399.99 base model uses an Intel Pentium processor with just 4GB of memory and a 64GB SSD—stay clear of that even-more-underpowered configuration if you can.

We'll look more in-depth at performance below, but suffice to say that the Surface Go 3 isn't for anyone who needs to run complex apps such as Adobe Photoshop, and its day-to-day computing experience is a bit laggy compared not only with Windows laptops but also with better-equipped Chromebooks and iPads. While it's true that many Chromebooks and iPads come with just 4GB of RAM, iPadOS and Chrome OS have limited multitasking capabilities or other memory-hungry requirements.

DISPLAY: BRIGHTER THAN YOUR AVERAGE BUDGET PANEL

Besides more-pedestrian computing components than flagship tablets and laptops offer, the Go 3 also has a smaller, lower-resolution screen. The 10.5-inch display has a resolution of 1,920 by 1,280 pixels in a 3:2 aspect ratio, which is the equivalent of a full HD resolution. It's fine for watching movies, but if you're editing documents or scrolling through web pages, you'll definitely notice some fuzzy text that is absent on the higher-resolution screens of the Pro 8 and the iPad Air.

Still, the Surface Go 3's screen is not only adequate for watching videos and participating in Zoom calls, but it's also ideally suited for those types of tasks. The screen is brighter and offers more accurate colors than equivalent laptop screens in this price range. In our testing, the Go 3 managed to display the entire sRGB color gamut and 77% of the P3 color gamut. Further helping image quality is the surprisingly bright backlight, which registered a maximum 424 nits of brightness on our display tests.

While rich color and bright backlights can also describe the iPad Air's screen, you typically can't find those traits on clamshell laptops or 2-in-1 convertibles in the Surface Go 3's price range. Lenovo's IdeaPad Flex 5i 14, for instance, peaks at just 257 nits of brightness and can display only 64% of the sRGB color space. The Go 3 misses out on a few more display features, such as the 120Hz refresh rate and narrower screen bezels of the Surface Pro 8, but overall, this is an excellent tablet viewing experience for the money.

> " The Surface Go 3's screen is not only adequate for watching videos and participating in Zoom calls, but it's also ideally suited for those types of tasks. "

Above the screen, housed in one of the long bezels surrounding the Go 3's display, is an above-average webcam. This 5-megapixel, 1080p shooter is an improvement over most laptop webcams, which typically employ low-quality sensors with 720p resolution that result in grainy video quality even when the room is brightly lit. In addition to the front-facing camera, which includes IR sensors for face-recognition Windows Hello logins, the Go 3 has a rear-mounted 8-megapixel autofocus camera that also shoots 1080p video.

Audio quality is excellent too, for a tablet. In listening to a few tracks and participating in a Zoom call, I discovered the Go 3's stereo speakers rival the audio quality of many larger laptops. Room-filling sound ensures that even the most soft-spoken student in the class is understandable.

KEYBOARD: PLAN TO SHELL OUT FOR ACCESSORIES

Available in a platinum shade with a magnesium finish, the Go 3 looks identical to its Go 2 predecessor, which is a good thing. It's too bad more colors aren't offered, but this tablet looks sleek and modern whether or not the integrated kickstand is extended.

If you do want to add a splash of color to your Go 3, you've got some options with the keyboard cover, which Microsoft calls the Type Cover. Options include Ice Blue, Poppy Red, Platinum, or Black. All except the last option use the

Surface's signature Alcantara fabric for a pleasingly soft-touch feel
when your palms are resting below the keys. The colorful models are $129.99, and the Black Type Cover is $99.99.

While the Type Cover is well engineered and offers a passable typing and clicking experience, it doesn't compare with the comfort of a full-size keyboard that 2-in-1 convertible laptops such as the IdeaPad Flex 5i offer. As a Windows device, the Surface Go 3 presents many opportunities that require a touchpad and keyboard for maximum flexibility, from entering spreadsheet data to resizing application Windows. It would be nice if Microsoft offered the Type Cover standard with the Surface Go 3, but that part of our wish list has gone unanswered through many different Surface devices and generations over the years.

> " While the Type Cover is well-engineered and offers a passable typing and clicking experience, it doesn't compare to the superior comfort of a full-size keyboard. "

On the other hand, if you're on the strictest of budgets and have no room left over to spend money on a keyboard cover, that's OK—it's possible to perform basic tasks on the Go 3 without the keyboard or touchpad. In fact, I tested the Go 3 without using the Ice Blue Type Cover that Microsoft sent along with our review unit, just to see if I could rely entirely on the touch screen. I certainly wouldn't use the Go 3 in tablet mode as my main PC, but especially for watching videos and even dragging files between folders, a keyboard and touchpad aren't necessary.

In addition to shelling out for the Type Cover, you may also need to spend money on special adapters and cables for your accessories, since the Surface Go 3 offers just a single USB-C port and a headphone jack. You can opt for a Microsoft dongle or adapter to plug into the proprietary Surface Connect port (which is also where you plug in the Go 3's AC adapter), or use a cheaper third-party USB dongle. At least there's a microSD card reader for easy storage expansion (hidden beneath the kickstand for additional protection) and a headphone port for wired audio connections, both of which other tablets increasingly lack.

The Surface Go 3's standard wireless-connectivity slate comprises Wi-Fi 6 (802.11ax) and Bluetooth 5.0. Previous Surface Go generations have offered optional LTE versions, and Microsoft plans to offer an LTE-equipped version of the Go 3 later this year.

While the Surface Go 3 is compatible with digital stylii, it offers neither an integrated holder nor full support for the latest Surface stylus, the Surface Slim Pen 2. So if you're an aspiring digital artist, we recommend stepping up to the Surface Pro 8, which offers both of these features.

> **In addition to shelling out for the Type Cover, you may also need to spend money on special adapters and cables for your accessories.**

TESTING: CORE SNORE

At $629.99—and that's just for the tablet without the Type Cover keyboard— the fully kitted-out version of the Go 3 reviewed here lands just above the $600 mark that we usually consider to be the upper limit for budget laptops. In this range, you'll find 2-in-1 convertibles including the IdeaPad Flex 5i, as well as premium Chrome OS tablets such as the HP Chromebook x2 (newly updated for 2021) and the entry-level configuration of the Editors' Choice-winning Apple iPad Air.

Somewhat discouragingly, these and other similarly priced devices are likely to offer a smoother experience than the Go 3 does on everything but the simplest tasks. I found occasional lag and sluggishness while installing apps as well as when opening and closing menus. And sluggishness occurs with more frequency when switching between two apps that are already running. It's a similar experience to what we found when testing the Go 2 last year, except that the lag behavior is less excusable now considering the Go 3 has an upgraded CPU and runs Windows 11.

That said, one of the apps I tried to install and use is Adobe Photoshop, which is notoriously demanding on a PC's resources. The Surface Go 3 is certainly not the tablet for hardcore Photoshop users. And there are positive aspects of the Go 3's computing experience when compared with laptop alternatives. Most important, the Go 3 doesn't need a cooling fan, so it's similarly silent as the iPad under heavy computing loads, situations when a larger laptop might sound like a miniature vacuum cleaner.

As for benchmark testing, it's unsurprising that the Go 3 doesn't acquit itself well within this comparison group, both because of the lackluster everyday

> **Most important, the Go 3 doesn't need a cooling fan, so it's similarly silent as the iPad under heavy computing loads.**

computing experience it offers and because you just won't find that many competitors with similar prices and specs for a fair comparison. I'll compare the Go 3's performance on our benchmark tests with the iPad Air, the IdeaPad Flex 5i, the Surface Pro 8, and another premium Windows tablet (from Lenovo), the ThinkPad X12 Detachable. The specs of that competitive set are below:

Test System Configurations

	PROCESSOR	GRAPHICS	RAM	STORAGE
Microsoft Surface Go 3	Intel Core i3-10100Y (1.3GHz)	Intel UHD Graphics 615	8GB RAM	128GB SSD
Apple iPad Air (2020)	Apple A14	Apple A14	4GB RAM	64GB SSD
Lenovo IdeaPad Flex 5i 14 (2021)	Intel Core i5-1135G7 (2.4GHz)	Intel Iris Xe Graphics	16GB RAM	512GB SSD
Lenovo ThinkPad X12 Detachable	Intel Core i5-1130G7 (1.8GHz)	Intel Iris Xe Graphics	16GB RAM	512GB SSD
Microsoft Surface Pro 8	Intel Core i7-1185G7 (3.0GHz)	Intel Iris Xe Graphics	16GB RAM	256GB SSD

We shouldn't expect the Surface Go 3 to outperform any of these other devices, all of which either cost more or (in the case of the IdeaPad) are significantly larger laptops. Indeed, the Go 3 finishes dead last on the all-important PCMark 10 and Geekbench tests, which are comprehensive benchmarks designed to reflect everyday tasks such as videoconferencing, word processing, and browsing the web. (The iPad is absent from many of these tests since some are Windows-only trials and not supported by iPadOS.)

The Go 3 also finishes last in this lot on more-demanding content-creation workflows including transcoding a 4K video using Handbrake or rendering a 3D image in Maxon's Cinebench app. The tablet couldn't even complete our Adobe Photoshop image-editing trial, although its failure here could have more to do with a software glitch, since it otherwise meets the minimum system requirements.

Finally, the Go 3's integrated graphics processor, the Intel UHD Graphics 615, is far from prepared to handle demanding 3D games. To be fair, though, none of the other systems represented here could moonlight as a gaming laptop.

On the other hand, the Surface Go 3's battery life is excellent. The tablet lasted for 11 hours and 34 minutes on our video rundown test, which involves playing a locally stored 720p video file at 50% screen brightness with Wi-Fi and Bluetooth turned off. The result slightly exceeds Microsoft's rating of 11 hours of typical battery life usage.

IF YOU NEED WIN 11 ON A BUDGET

As refreshing as it is to see a lower-priced Windows tablet, the Surface Go 3 nevertheless feels like an update with little improvement over its older kin. Unless you need Windows or want to try the new OS in tablet format for a budget price, you'll probably be better off with an iPad or a detachable Chromebook tablet.

If you do need Windows, it's probably because you want to go beyond the limitations that iPadOS or Chrome OS impose on multitasking and app compatibility. But with scarcely enough power to enjoy a robust computing experience, the Surface Go 3 isn't necessarily the best detachable tablet for the job. The Surface Pro 8 isn't cheap (starting at $1,099.99), but with its more-powerful components and larger screen, it's a better choice for classic Windows tasks, unless you're on the strictest of budgets.

Credit: Microsoft

Free

EDITORS'CHOICE **Rating:** ●●●●○ **EXCELLENT**

Microsoft Windows 11: A Radically Modernized Design ⊞

BY MICHAEL MUCHMORE

Many people thought there would never be a Windows 11—understandably, after Microsoft announced in 2015 that Windows 10 would be the operating system's last version number. New competition from Chrome OS likely made the case for a more significant interface update, though, and Windows 11 borrows heavily from Google's lightweight desktop design. Despite its drastically new look, Windows 11 remains nearly functionally identical to Windows 10, with some new features and conveniences added. After six years of ho-hum upgrades, a major overhaul to the world's most popular desktop operating system is welcome news: Windows fans finally have something to get excited about.

Despite the OS's new look, we're surprised that using it doesn't feel that different from using Windows 10. Windows 11 looks nicer, with rounded corners for all windows, the Taskbar icons in the middle, simpler icons, and more elegant Settings dialogs, but it doesn't feel totally alien or require a whole new process the way Windows 8 did. The new interface is attractive, but if you prefer the more familiar Windows 10-style look, you can stick with Windows 10.

SYSTEM REQUIREMENTS

Much has been made over the system requirements for Windows 11, but they're very low—a 1GHz CPU, 4GB of RAM, and 64GB of storage. You'll also need a computer with a TPM security chip and Secure Boot capability. Those are less of a problem than some pundits are making them out to be, as they've been standard on most PCs for the last six or so years. The real limiter is the CPU model, which has to be from about the last four years. Microsoft recently re-released the tool that assesses your PC's ability to run Windows 11, the PC Health Check app.

Word is out, though, that the CPU requirements may be more like recommendations than hard requirements—and that Microsoft will allow systems powered by older processors to run the software. The company stopped feature updates on the Windows 11 preview installed on some systems using older CPUs, but we can hope this situation improves.

Anyone with one of the newer chips should have no trouble installing Windows 11 via Windows Update. Microsoft has made a downloadable ISO disk image file for the beta Insider version available for installing Windows 11, allowing in-place upgrades or clean installations on a PC or in a virtual machine. I expect a similar installation option to be available for the release

version of Windows 11 via a web page similar to the Download Windows 10 page. Some sources have reported that installing the OS this way bypasses the system requirements that have bedeviled some would-be testers.

As with Windows 10, there's both a Home and a Pro version of Windows 11. You must sign in to an online Microsoft account to upgrade to Windows 11 Home, a fact that's raised the ire of some commenters, though I really don't think it's worth getting worked up about. Those who are gung-ho about not setting up the OS are likely to be running the Pro edition anyway. If you don't want to pay for that, and you object to signing in with an online account for your operating system, may I suggest Ubuntu?

A final note about installation is that you'll be able to roll back to Windows 10 for 10 days after upgrading, if you decide you prefer the older OS version. Microsoft has announced support for Windows 10 through 2025.

A NEW LOOK (AND MORE) FOR WINDOWS

Those details out of the way, let's look at what's new in Windows 11. Most of the work went toward redesigning the interface rather than building new features,
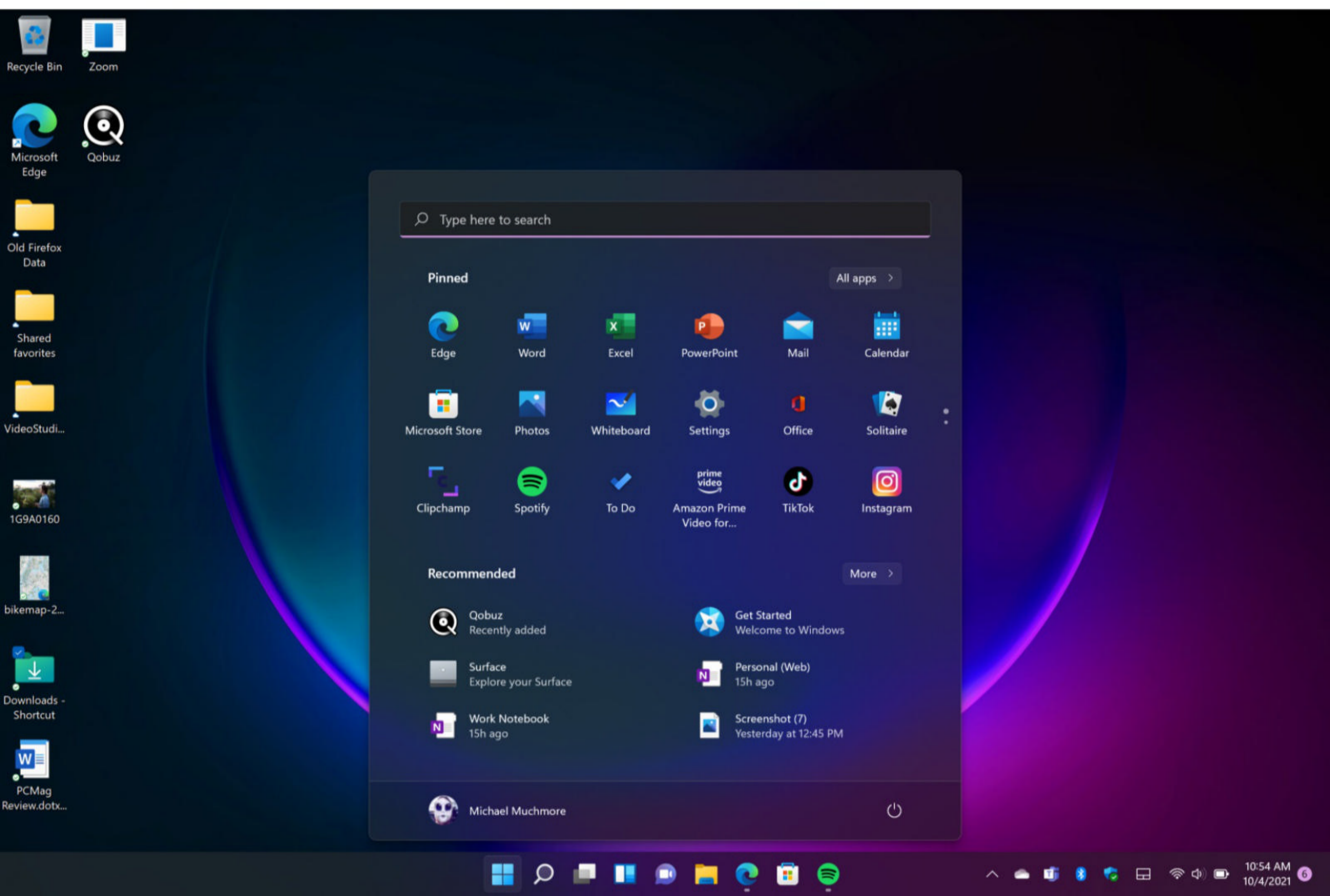
so—as I mentioned above—Windows 11 is more familiar than you may expect. It borrows ideas from Chrome OS, though you can still place app icons on the desktop background, which Google's lightweight desktop OS doesn't allow.

Windowing and multitasking remain far more advanced in Windows, too. The interface gets rounded corners (like those in macOS) for all windows, which is not a significant change but does give the OS a smoother look. Much of the new design brings a welcome new slickness and consistency to the Windows interface, but there are a few changes of which I'm not a fan, as you'll see below.
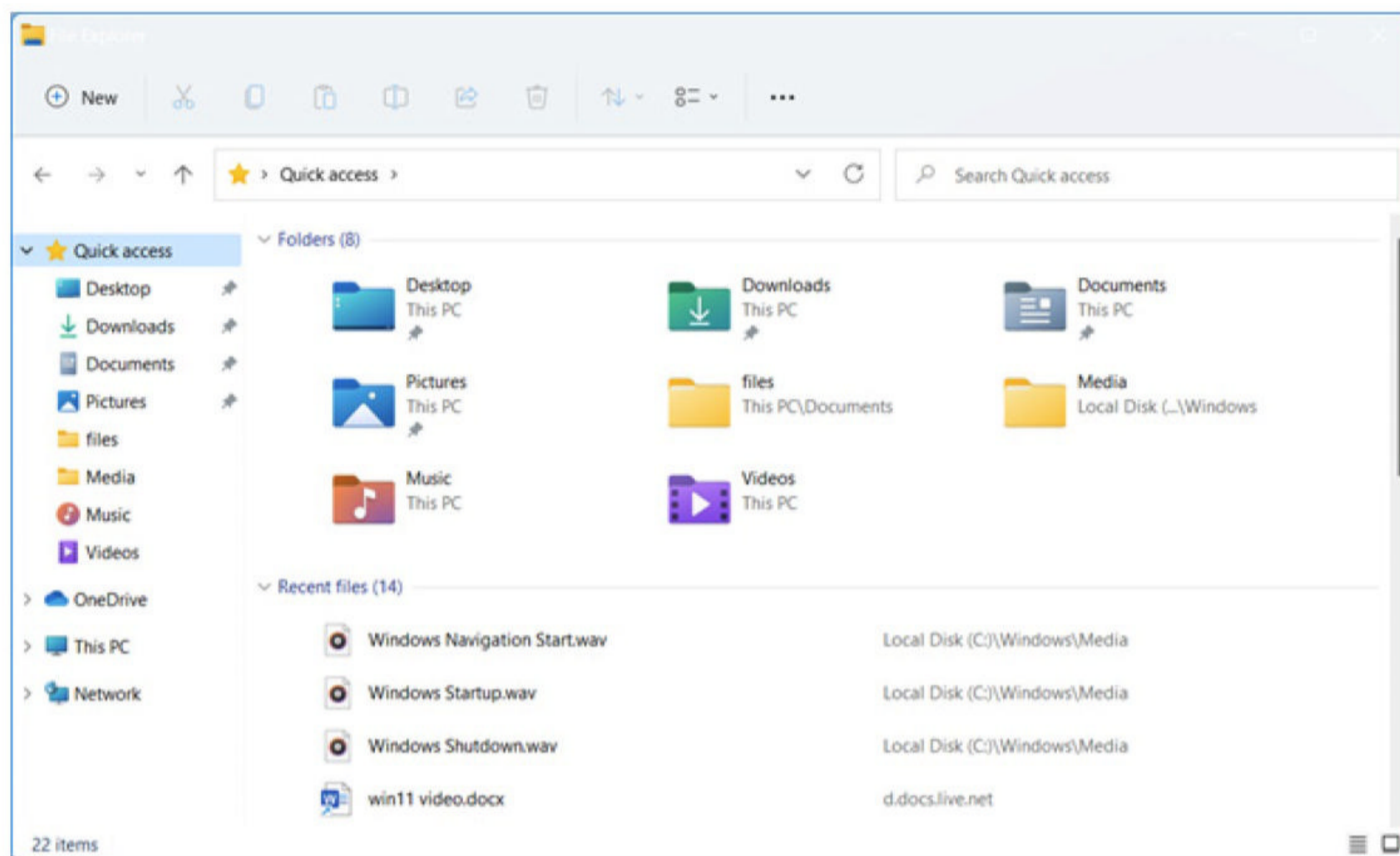
TASKBAR, START MENU, AND FILE EXPLORER

For decades, the Windows Start button has lived in the lower-left-hand corner of the screen. So small detail though it may be, getting used to it being at the left edge of centered icons could be one of the bigger adjustments you have to make. The issue for me is that the Start menu has heretofore always been in the exact same place. Now, when you run more programs, it moves a bit more to the left. Not having to think about the Start button's position was a plus in Windows versions going back more than 20 years. Happily, a Taskbar alignment option lets you move the Start button back to its position in the left corner.

I'm also not crazy about the new Taskbar itself, with its smaller, less informative buttons. With Windows 10, it's totally clear which programs are running, as Taskbar buttons for running programs are wider if you choose not to combine them in Settings. Thankfully, you can still hover over the buttons to see a

thumbnail of the app window and right-click to open the Jump List showing recent documents or other common actions for the app.

The Start menu gets a major overhaul in Windows 11. Pinned app buttons (they're larger than icons but smaller than Windows 10's tiles) are at the top of its panel. Recent and frequent apps and documents are in a section below them. The Start menu's new mini-tiles are still good for touch input, but you lose info that live tiles offer, annoying as those could sometimes be. Another quibble I have with the new Start menu is that it's harder to get to the All Apps view than in Windows 10. With that version of Windows, you can see all installed apps as soon as you open the Start menu; they're in a list on the left while tiles for your pinned apps are on the right.

File Explorer is a good example of Windows 11's new look, particularly its updated left panel controls and folder icons. Note the simplified ribbon along the top, which is far less busy and distracting than the previous File Explorer's. The New button at the top-left works for new folders or documents supported by your apps, and the same viewing options (list, details, differently sized icons) for files are available. The overflow menu offers file compression, selection, and Properties options, as well as the old Folder Options dialog. The right-click context menus, which have grown longer and longer over the years, get shorter, smarter, and clearer in Windows 11. They now show only the most often-needed options.

WIDGETS

One of the few actual new features in Windows 11 is this Widget panel, which shows you tiles for news, weather, stock quotes, sports scores, and more. It's not entirely new, since the News and Interests Taskbar popup that

> **The Start menu's new mini-tiles are still good for touch input, but you lose info that live tiles offer, annoying as those could sometimes be.**
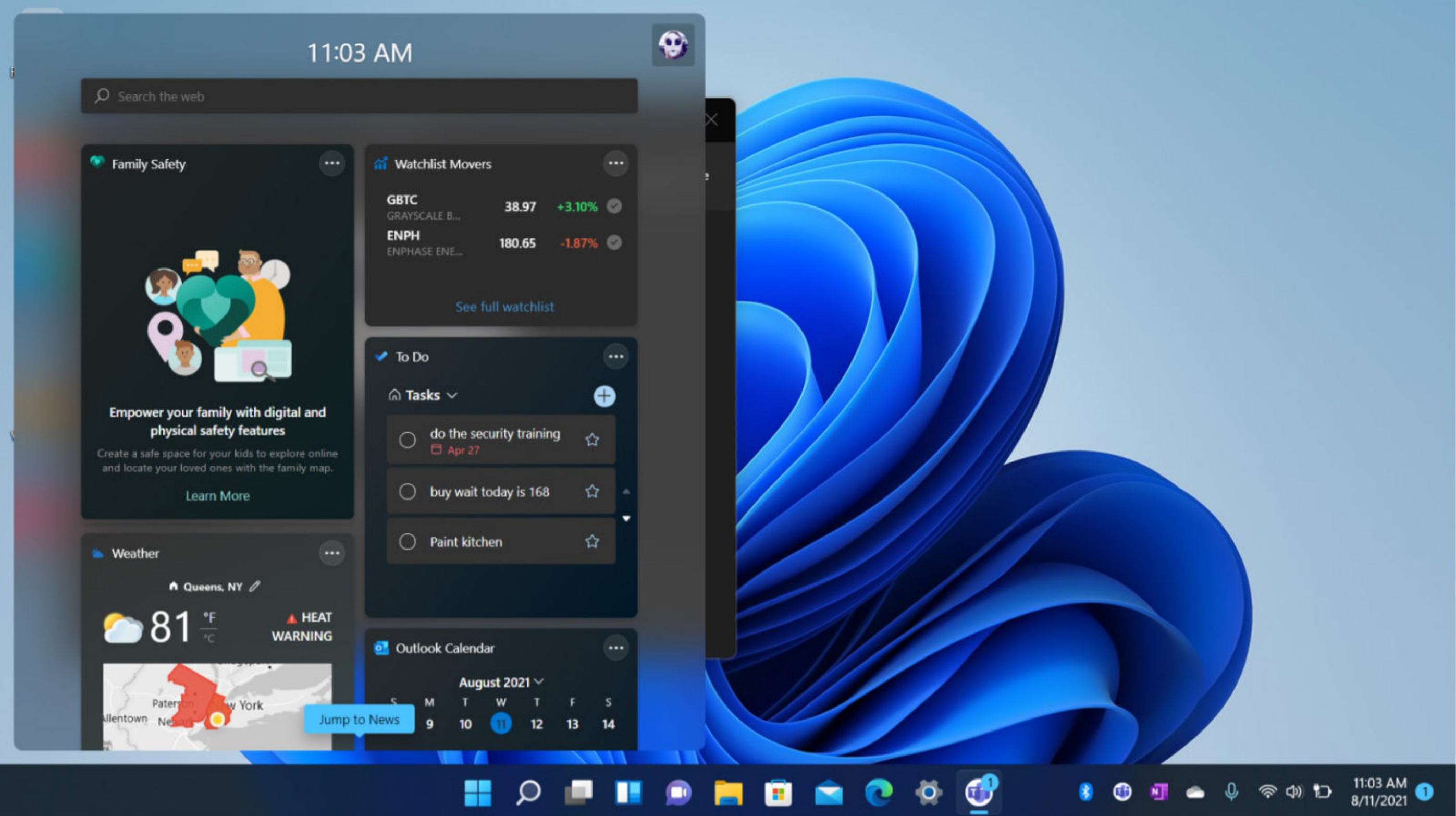
arrived in Windows 10 recently does nearly the same things. I've gotten used to having the News and Interests weather indicator always in the Taskbar in Windows 10. To see the same info in Windows 11, you have to click on the Widgets icon in the Taskbar. In addition to Microsoft-produced first-party tiles, third-party developers can offer content through Windows 11's widgets, too. Touch-screen users can easily swipe in from the left to open them, and you can full-screen the widget panel for a bigger view.

An Entertainment widget surfaces new movies and TV shows, and the Family widget is quite useful for those who use Microsoft Family Safety parental controls tools.

NOTIFICATION AND QUICK SETTINGS

Microsoft has split the Windows 10 Action Center into two separate panels and tap targets. This resembles Apple's revamped macOS notification area, which used to be a clean, simple, single panel but is now a collection of smaller popups. The Windows 11 version isn't quite as bad as the macOS one, but I still prefer the single Action Center panel for notifications and quick settings. I appreciate the circled number—similar to those on some mobile app icons—that shows how many notifications you have. Touch users can swipe in from the right to display the Notifications panel.

The Quick Settings panel opens when you click on or tap the Wi-Fi, speaker, or battery icon. By default, it shows buttons for Wi-Fi, Bluetooth, Airplane mode, Battery Saver, Focus Assist, and Accessibility, along with sliders for audio volume and screen brightness. A Pencil icon lets you customize what buttons appear, with a choice of Connect (for external displays and audio), Keyboard layout, Nearby sharing (like AirDrop for PCs), Night light, and Project. You can still hover over each of the three icons in the Taskbar to see their status, but I prefer to have just sound settings pop up when I hit the speaker and just Wi-Fi options to appear when I hit the Wi-Fi icon.

SETTINGS

One of the more irksome things about Windows 10 is its inconsistent settings windows and dialogs. Sometimes you uninstall a program in the new Settings app, sometimes in the antiquated Control Panel. That inconsistency goes away in Windows 11—almost entirely. For some detailed controls, such as sound devices, you still see the content in the old style, though the window uses the new design.

Light and Dark mode settings are still in the Personalization > Colors setting area, and the modes look much better than in Windows 10, particularly the dark mode, which uses transparency effectively. Dark mode can now hold its head up proudly when compared with that of macOS.

You can still change system sounds in Settings, but the new Windows 11 default set of sounds is slick, quick, and modern.
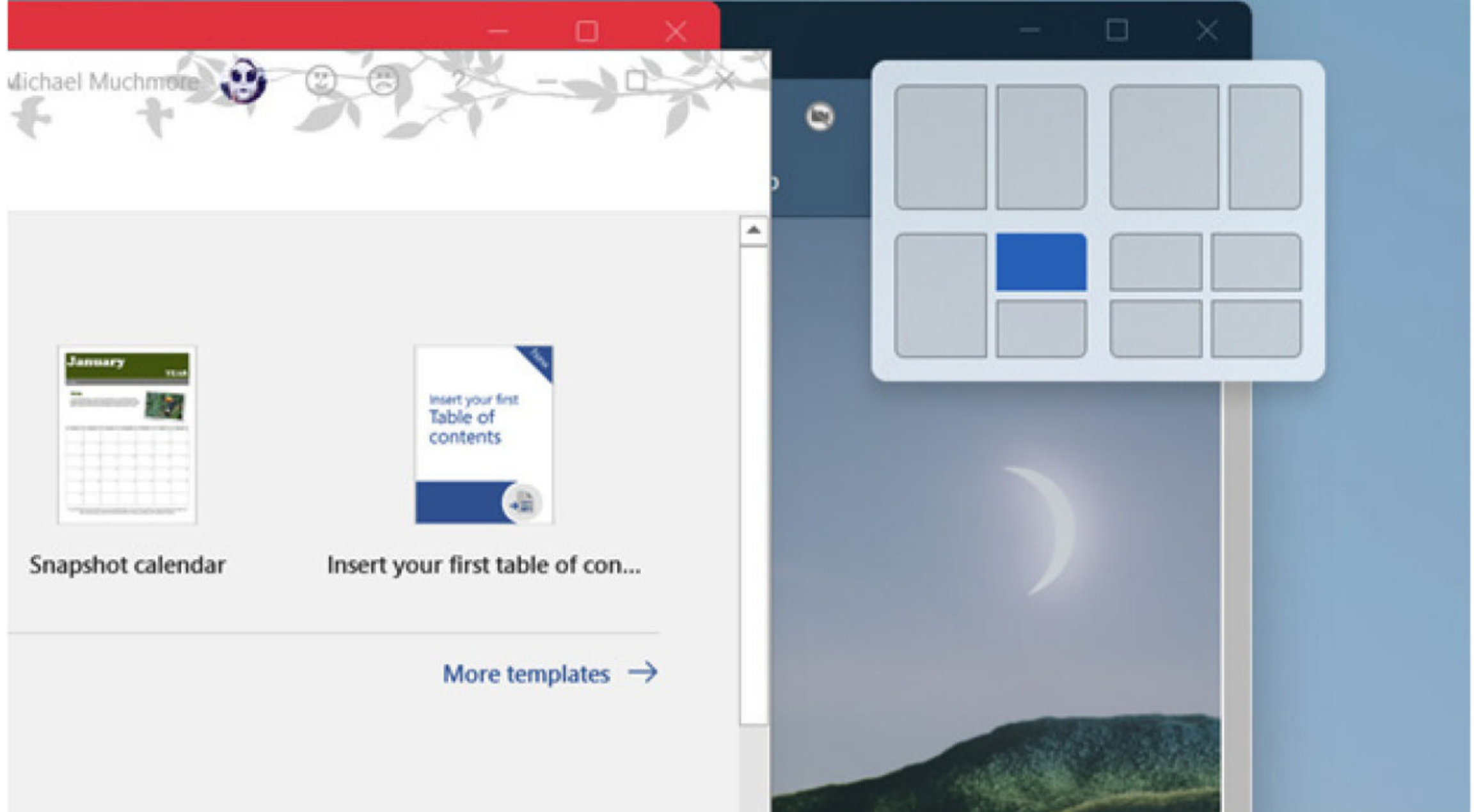
LAYOUTS AND MULTITASKING

Windows has long surpassed macOS in the way it lets you arrange app windows on-screen, and the gap grows wider with Windows 11's new Layouts option. You get to this tool by hovering the cursor over the maximize button at the top right of any window—this seems a bit hidden to me, and I hope and expect Microsoft surfaces the capability more somehow. When you do hover over the maximize button, you see a choice of layouts—two windows side-by-side, three with one large and two small, and so on.

Layouts appear as options in the Taskbar, so that you can either open the group of apps or the single app. You also see layouts preserved when you open a group of apps on an external monitor multiple times.

Windows still offers multiple virtual desktops, something I find incredibly useful for separating work apps and websites from personal ones. I either hit **Ctrl–Windows Key–Arrow** to move back and forth between them or the **Windows Key–Tab** keyboard shortcut to choose one from Task View. With Windows 11, you can now use a four-finger swipe to move back and forth, something Mac users have long enjoyed,
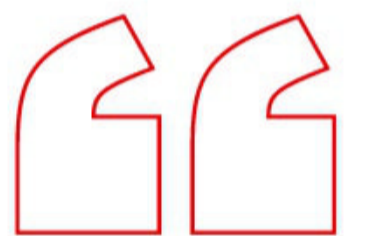
> "Windows has long surpassed macOS in the way it lets you arrange app windows on-screen, and the gap grows wider with Windows 11's new Layouts option.

though only via trackpad rather than right on the screen. Also new is the ability to set different desktop backgrounds (aka wallpapers) for each desktop.

TEAMS CHAT INTEGRATION

Microsoft's Teams chat and video conferencing app is prominently in the center of the Taskbar by default. This move makes sense in some ways: With the increasing importance of virtual meetings, maybe Microsoft can grab some of that video-conferencing market. Teams grew phenomenally during the COVID-19 pandemic, from 20 million to 145 million active users, but it remains unclear as to whether Teams can become as ubiquitous as Microsoft would like. Adding a Skype Meet Now button to Windows 10's notification area didn't have that effect. (Skype remains an excellent, highly capable communication tool nevertheless.) But maybe once Window 11 becomes the dominant version, the operating system's ubiquity will accelerate Teams chat's adoption.

To get started, click the chat icon. A welcome experience prompts you to grant the app access to your Microsoft account and its contacts. When you subsequently tap the icon after this initial setup, you see a list of all your contacts. Click on one to start a chat. Your contacts are likely not using Teams chat yet, so the app sends along an invite to join Teams (it's free for personal use) along with that first message. One strange thing about the interface is that, once you're in a video chat, you see a second Taskbar icon for Teams along with
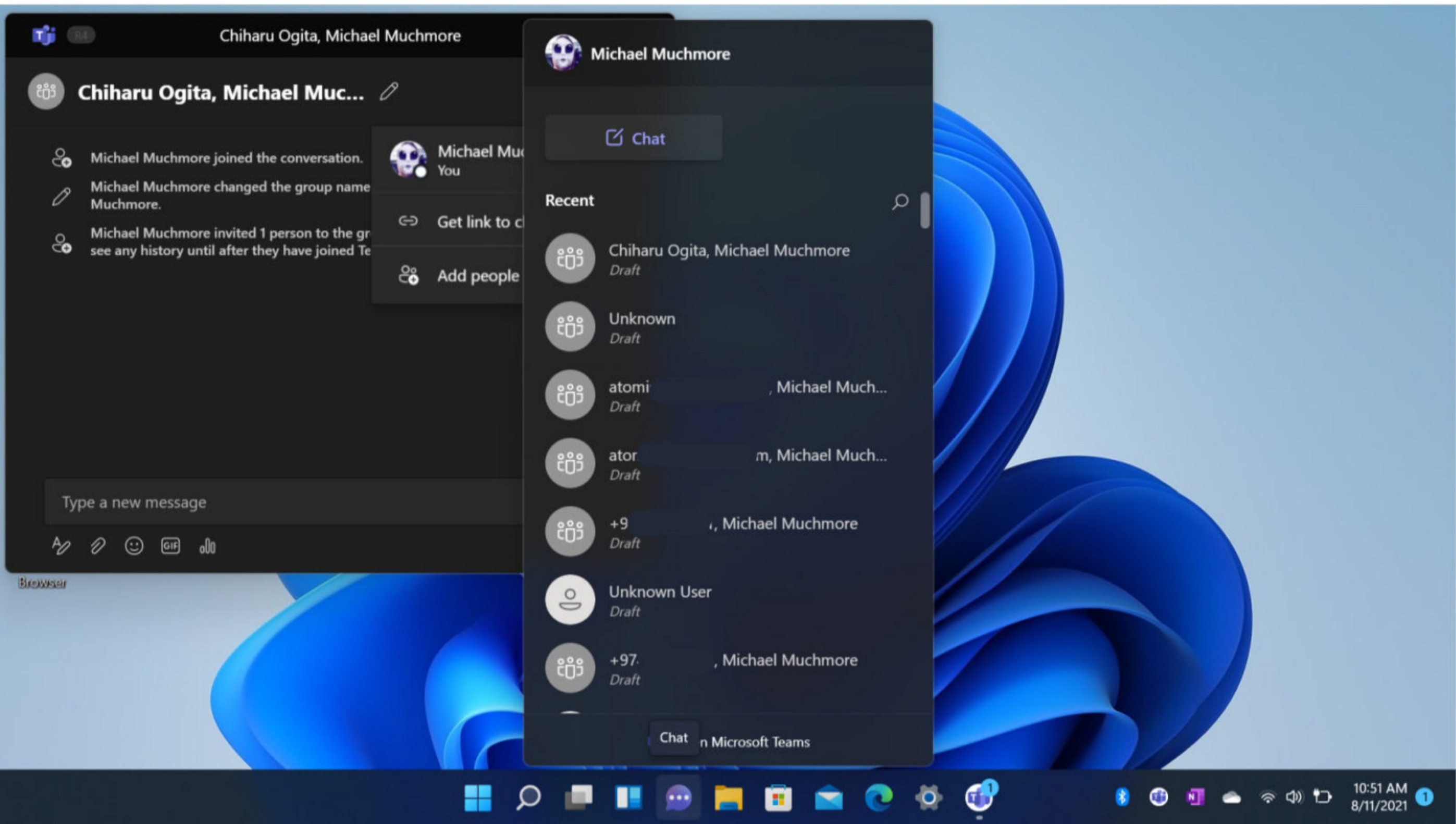
the centered chat icon; this seems like an unnecessary duplication to me. A killer feature of Windows 11's Teams app, though, is that it lets you converse from your PC with anyone using a cellphone via SMS—at no charge!
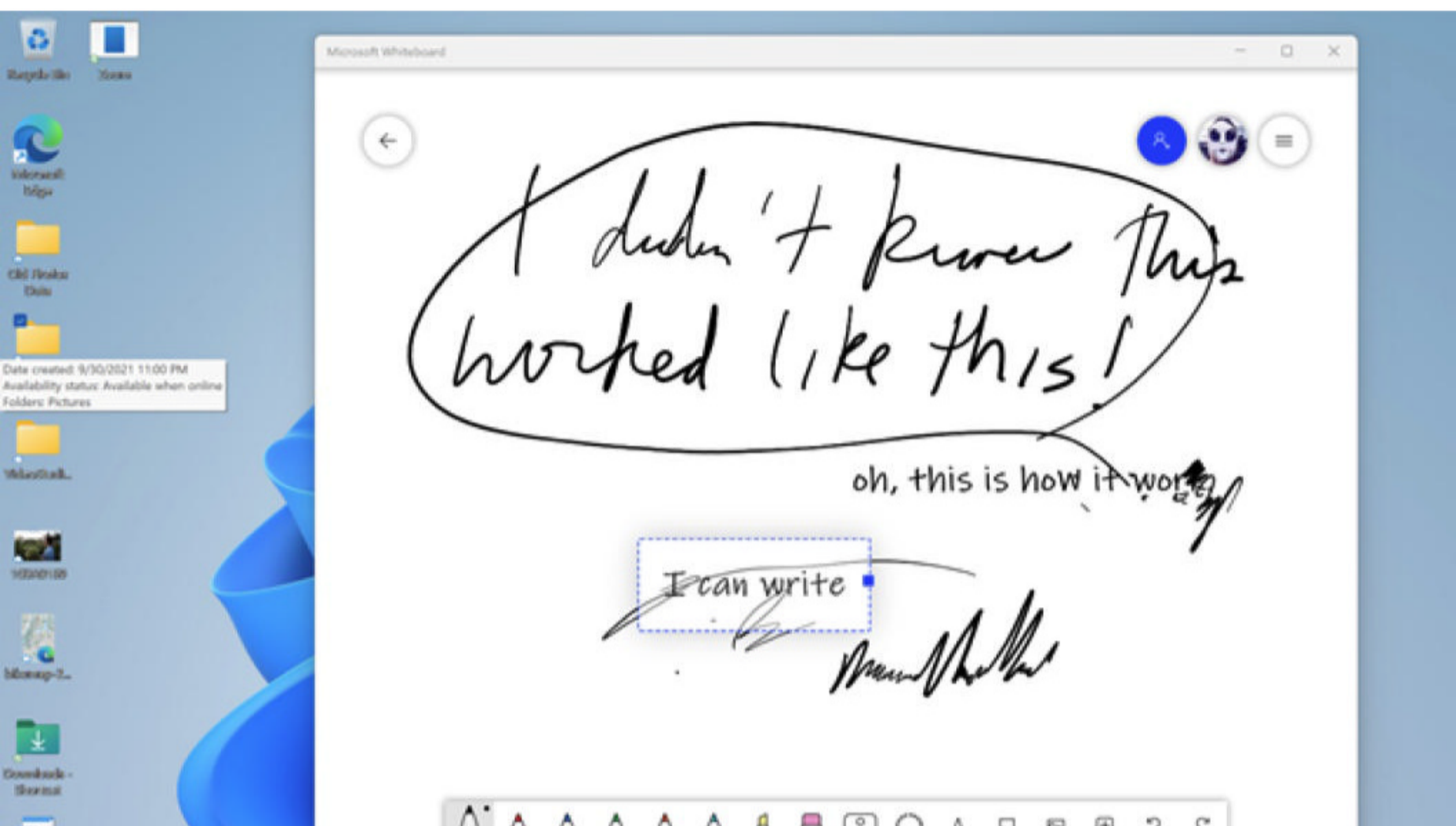
WINDOWS 11 ON TABLETS

Windows 11, unfortunately, ditches a couple of its best tablet- and touch-friendly features. Most importantly, you can no longer swipe in from the left to open the task-switching view, a gesture I use all the time on my Surface Go tablet. You can no longer swipe down from the top to close an app, either. This omission is less of a big deal because you can still hit the X in the window's upper right corner as you'd do in desktop mode. Again, though, for a handheld device, the down-swipe is more direct and requires less dexterity. There are, however, new three-finger swipe gestures to show the Task View and to minimize (but not close) an app on the desktop. A sideways three-finger swipe switches you between running apps. And you can, of course, use the Task View button in the Taskbar, but that's not as immediate as a swipe of the thumb. I'd argue that switching tasks is more important to tablet users than accessing Widgets, the new result of that gesture, too.

> "A sideways three-finger swipe switches you between running apps. And you can, of course, use the Task View button in the Taskbar.

On the plus side, tablet users get new stylus options and on-screen touch keyboard tricks. The new Surface Slim Pen 2 has haptic feedback—always a plus. This latest-generation pen (available on Surface Pro 8 and Surface Laptop Studio) buzzes in your hand, for example, when you delete previously written text and when you tap the Back button to open the Whiteboard app. In that app, you can experience the full digital inking experience, which has gotten to the point of feeling exactly like writing with ink. You can, for example, highlight text, write freehand (albeit sloppily), and sketch diagrams. You can even convert what you write to digital text. The on-screen keyboard supports swipe text entry and offers a healthy selection of emoji and gifs, and it now lets you choose custom backgrounds.

Voice typing (which is useful for both tablets and non-tablets) is the new name for Windows 10's fantastic speech dictation tool. Windows' voice-to-text feature has improved remarkably in recent years and now uses machine-learning algorithms to correct its guesses and punctuation. As with the previous dictation feature, you hit the Windows Key–H keyboard shortcut or press the on-screen touch keyboard's mic icon to launch the tool. Then you simply dictate the text you want to enter in the on-screen text area.

NEW APP STORE WITH ANDROID SUPPORT COMING!

Like the rest of the interface, the Store gets a slick design refresh. In addition to apps, the Store offers movies and TV shows as well as games. A marquee upcoming feature is Windows 11's ability to run Android apps, though with some caveats. You'll either have to install them via the Amazon Appstore running inside of Windows' Microsoft Store or as a sideloaded APK. Android apps aren't yet available in the initial Windows 11 release, however.

> " You can, for example, highlight text, write freehand (albeit sloppily), and sketch diagrams. You can even convert what you write to digital text. "
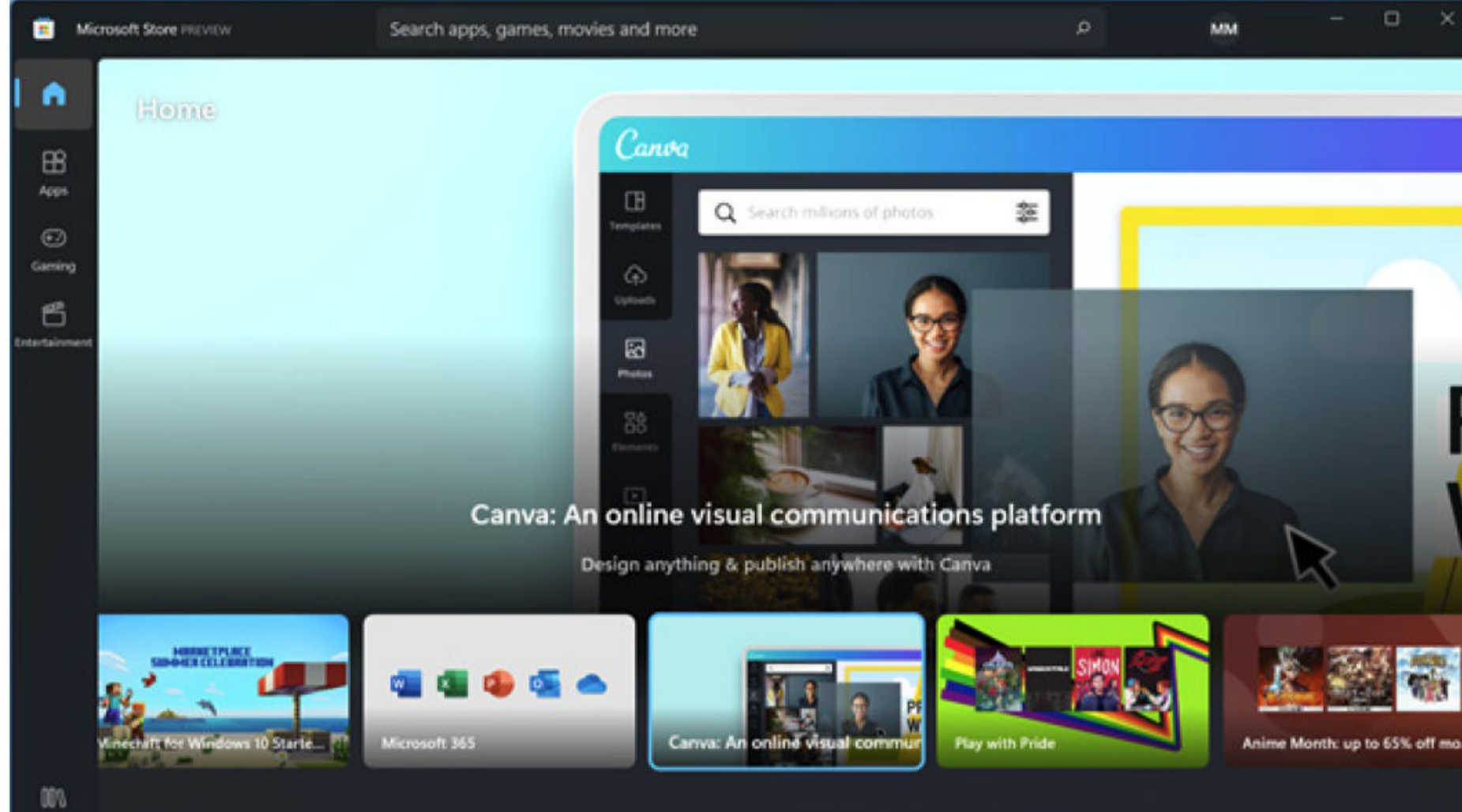
Perhaps even more significant for the store is that developers no longer need to code with the UWP app type in order to be included. Even Microsoft's own gargantuan Visual Studio development program is in the store now. Microsoft also announced that Progressive Web Apps, which are actually websites with some extra code that bestows app-like qualities upon them, will also find their way into the Store.

In addition to apps you can get in the Store, you also get all the standard apps, including Photos (updated for Windows 11), the (FLAC-capable) Groove Music player, Voice Recorder, two Paint apps (3D and a redesigned classic Paint), Mail, Calendar, and so on. We can hope for the last two mentioned to be greatly improved as Windows 11 development progresses. In the initial release, we still have the existing apps, albeit with rounded corners, but new versions will be based on the excellent Progressive Web App versions of Outlook.com. Microsoft has already teased an updated Paint app (though I've started to enjoy the modern Paint 3D), as well as new versions of Notepad and the Calculator.

Of special note is the updated Clock app, which now offers Focus timers to help you complete tasks. It still offers alarms, timers, and a world clock, but its Focus Sessions integrate with Spotify to give you appropriate background music for your tasks and with the To Do app, so you can check off those tasks when you complete them.

GAMING AND NEW TECHNOLOGIES

PC gamers are never forgotten in major new Windows updates, and Windows 11 is no exception. Two areas benefit: game selection and technologies. For the first, the Xbox app built into Windows 11 offers access to the Xbox Game Pass collection of video games. This includes such titles as Halo Infinite, Twelve
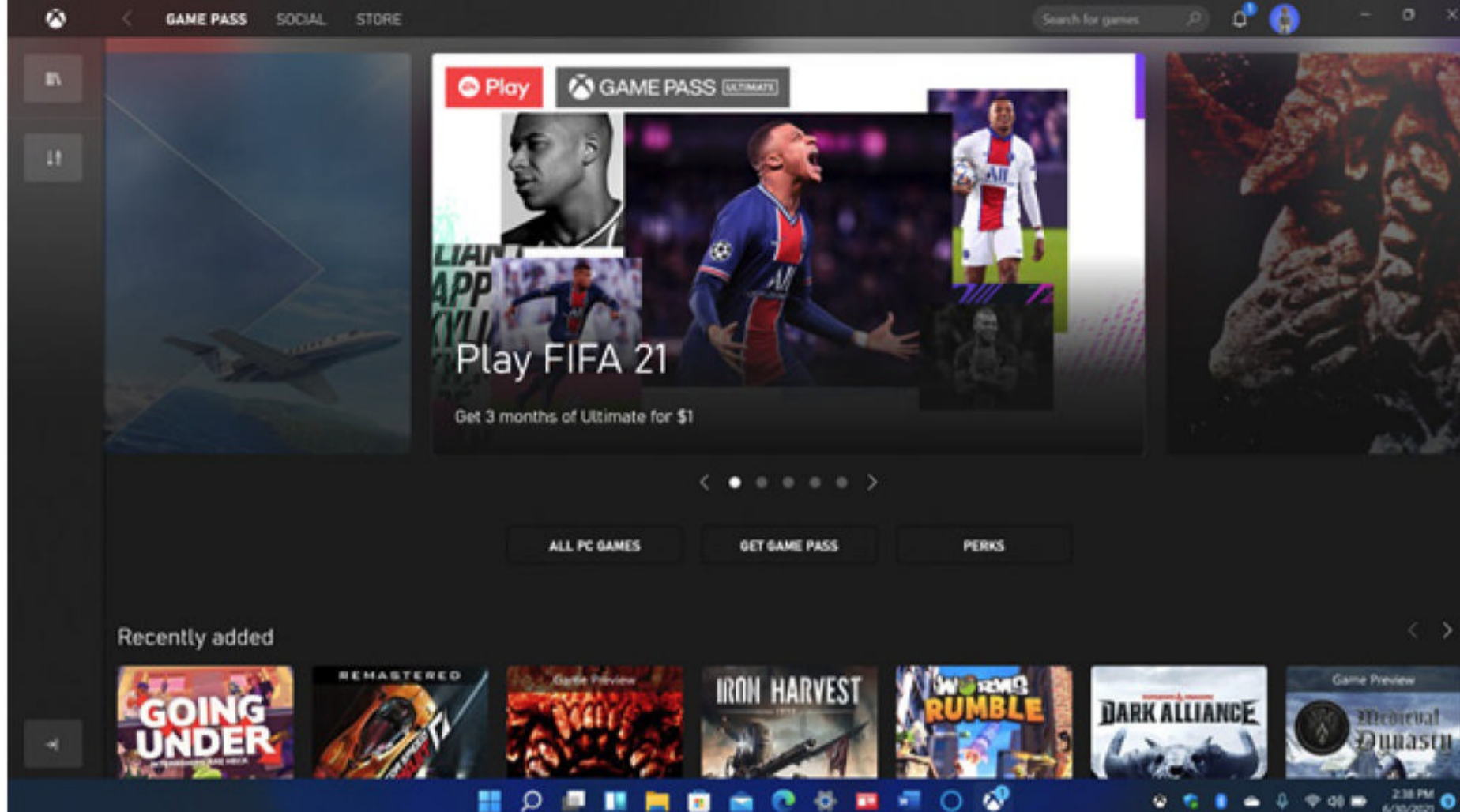
Minutes, and Age of Empires IV. The app also enables Xbox Cloud Gaming, Microsoft's streaming game platform.

As for new gaming technology, Windows 11 introduces Auto HDR and DirectStorage. The first expands the color space to reveal superior clarity even with non-HDR game titles. The second technology, DirectStorage (a subset of the Xbox Velocity Architecture) can speed up game loading times by bypassing the CPU and allowing graphics memory to load directly.

Other technical advances in Windows 11 include Dynamic Refresh, which can save laptop battery life by decreasing a screen's high refresh rate when it's not needed. The OS also supports the much faster Wi-Fi 6E standard. The requirements of TPM and Secure Boot are part of Microsoft's beefing up the OS's security technology, a topic worthy of a whole separate article. You'll be able to find Lead Analyst Neil Rubenking's story, "Windows 11 Is Ultra-Secure, Don't Mess It Up" at PCMag.com by the time this issue is published.

BEYOND ACCESSIBILITY

In a follow-up blog post to the one announcing the new OS, Microsoft detailed new accessibility features in Windows 11 to join existing ones like Narrator, Magnifier, Closed Captions, and Windows Speech

> "For accessibility, Windows 11 has new Contrast themes, redesigned closed caption themes, and AI-powered Windows Voice Typing."

Recognition, along with support for third-party assistive hardware and software. For example, Windows 11 has new Contrast themes, redesigned closed caption themes, and AI-powered Windows Voice Typing. The new OS also adds APIs for programming assistive apps, and even the Windows Subsystem for Linux (WSL) now has accessibility options.

WHAT'S GOING AWAY IN WINDOWS 11?

It only makes sense that some legacy features no longer fit in with the new approach of Windows 11. A couple of windowing conveniences that I like, but are apparently seldomly used, are going away. Aero Peek and Aero Shake are turned off by default in Windows 11, but you can re-enable them in Settings.

The Cortana AI voice assistant isn't preinstalled on Windows 11 systems by default, but it's still available in the app store. Live tiles are gone, too, with Widgets replacing their functionality. Tablet mode is replaced by what Microsoft calls "new functionality and capability...for keyboard attach and detach postures." Another casualty is the Windows 10 Timeline—although the Start menu's Recommended section still your recent documents and apps.

TIME FOR A NEW WINDOWS

Minor complaints aside, we like to see Microsoft giving its marquee software some attention. For the last few years, the company has focused more on its Azure cloud-computing services—justifiably, given that business's profitability. Windows 11 brings slick new looks, useful new tools, updated default apps, extra capabilities, and performance advances. Perhaps that's enough to lure away some Chrome OS or Mac users. Regardless, it's still early days for the desktop OS that's used on 1.3 billion PCs, so we look forward to Microsoft fine-tuning and perfecting Windows 11's design in future updates.

Windows 11 retains most of the vast feature set of Windows 10 and enhances the operating system with more attractive, modern interface touches and new conveniences like Snap Layouts and Widgets. For those reasons, despite some early growing pains and the unfamiliarity it presents, Microsoft Windows 11 remains a PCMag Editors' Choice-winning desktop operating system, though at a slightly reduced score of four stars. It's early days for Windows 11, however, and we expect Microsoft to make a steady stream of improvements. The currently more polished Apple macOS is also a PCMag Editors' Choice winner.

CAN MY PC RUN WINDOWS 11? ⊞

BY TOM BRANT

With rounded corners for all windows, relocated taskbar icons, and more elegant Settings dialogs, Windows 11 is a significant visual refinement of Windows 10. It's also a free update, which means you're probably keen to install it on your existing PC.

The good news is that if you're planning to buy a mainstream desktop or laptop or if you've bought one in the past four years, it's probably compatible with Windows 11. But the requirements for the new OS aren't straightforward. Microsoft made things more confusing with a problematic compatibility checker tool called PC Health Check, which it withdrew just a few days after its release.

The PC Health Check app is back and is significantly improved (find it at https://www.microsoft.com/en-us/windows/windows-11—scroll to the bottom of the page). If it detects any incompatibilities with your PC, it will list them individually. But you can also prepare for an upgrade to Windows 11 by checking your PC's hardware and software capabilities yourself. This approach is especially helpful when you use a home-built PC that may have a Trusted Platform Module (TPM) installed but not enabled. So grab your current PC's specs and follow along as we go over the extensive lists of requirements that Microsoft has published.

WINDOWS 11 HARDWARE REQUIREMENTS, EXPLAINED

As with any new piece of software, the most important compatibility concerns for Windows 11 are whether your PC has the basic computing resources to run it. Here is what Microsoft requires—at a minimum—for memory, storage, main processor, and graphics processor:

- At least 4GB of system memory (RAM).
- At least 64GB of available storage.
- One of Windows 11's officially approved processors (CPUs), currently found on three lists for AMD models, Intel models, and Qualcomm models.
- A graphics processor that is compatible with DirectX 12 and Windows Display Driver Model (WDDM) 2.0 or greater.

You can check whether your current Windows 10 PC meets these minimum standards using two built-in apps. First, open the DirectX Diagnostic Tool by typing dxdiag into the Taskbar search box and pressing Enter. Once the tool is open, you'll see your processor name, maximum RAM amount, and DirectX version listed on the System tab. Make sure the name of your processor is present on one of the three lists above. To check which WDDM version you've got, click on the Display tab, and look in the Drivers section.

The final hardware check is determining how much storage your boot drive has. To do so, open a File Explorer window and click on This PC in the left-hand menu. In the Devices and Drives section, you should see the boot drive listed—typically, it's named "Windows (C:)." The graphic below the name depicts how much drive space you've used and how much remains.

In addition to these basic hardware requirements, Microsoft also notes that you'll need an internet connection and a display at least 9 inches in size (measured diagonally) and capable of displaying 720p resolution or greater. To verify your display resolution, open **Settings > System** and see the Display tab. The
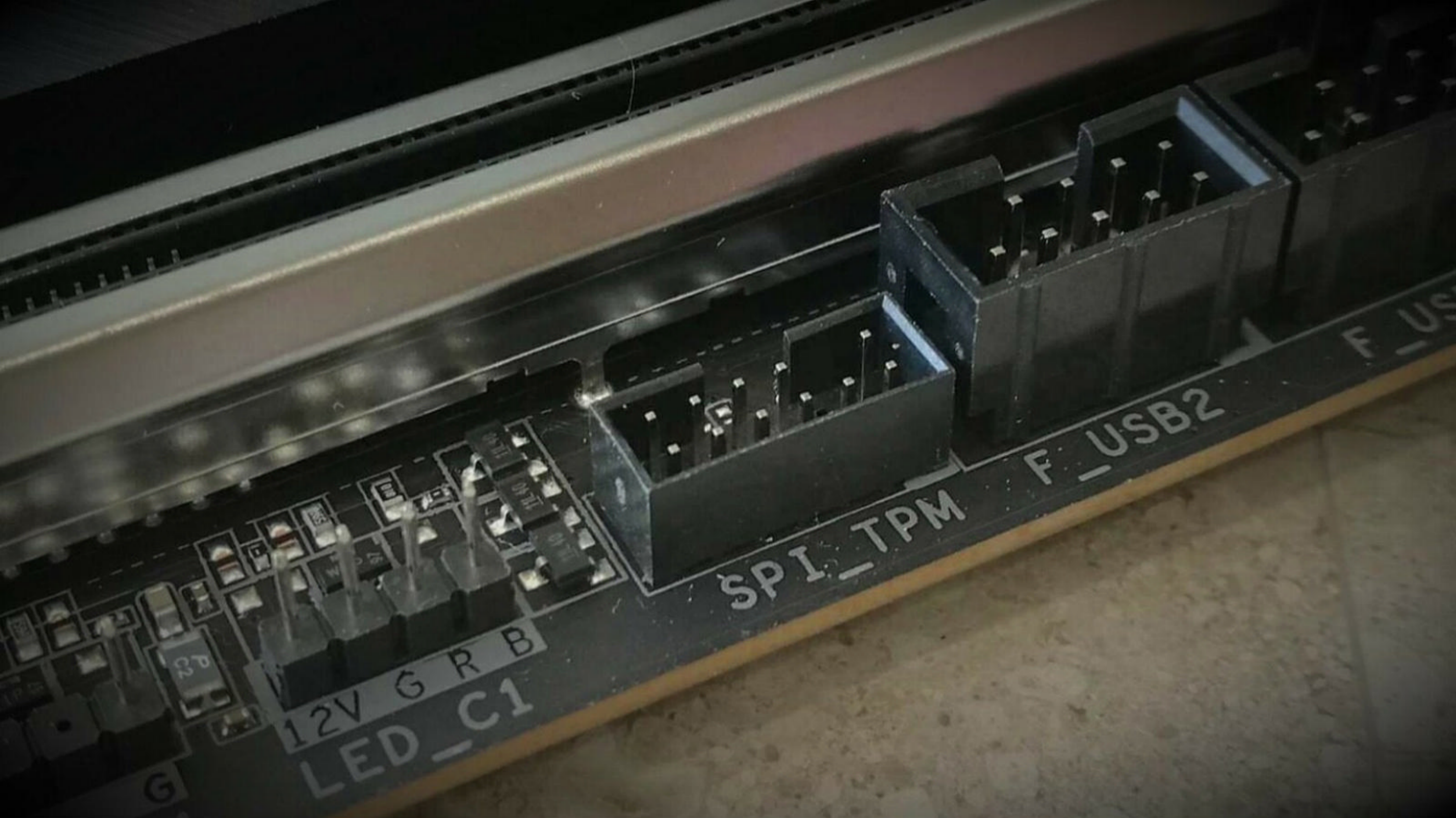
drop-down menu under Display Resolution will show a recommended resolution; as long as it's 1,280 by 720 pixels or higher, you're ready for Windows 11.

DO I NEED A TPM TO RUN WINDOWS 11?

Now that you've confirmed your basic hardware specs, you'll have to make sure your computer has an additional security feature that's a new requirement in Windows 11: Trusted Platform Module (TPM) support. The TPM supplies a unique code called a *cryptographic key* when you turn on your computer. If everything is normal, the drive encryption is unlocked, and your computer starts up. If there's a problem with the key—perhaps a hacker stole your laptop and tried to tamper with the encrypted drive inside—your PC won't boot up.

TPMs come in two forms: a physical chip that's separate from the main processor or a piece of firmware that's built into it. Finding out whether your PC uses one isn't straightforward, but if your computer meets the hardware requirements above and is less than five years old, it probably has a TPM. (You can also check

Settings > Update & Security > Windows Security where a "Device security" module offers security processor details.)

HOW TO ENABLE THE TPM IN YOUR PC'S BIOS

While most recent computers have TPMs, they might not be turned on or otherwise configured so that Windows 11 will recognize them. Adjusting TPM settings is typically done in the BIOS, which is the firmware that your PC's motherboard uses. Every BIOS is different, even among the same manufacturer, but the general steps for checking TPM status are similar. For this example, we'll use a desktop Asus ROG Z590 motherboard for Intel CPUs.

First, launch the BIOS immediately after starting up your PC by pressing the Delete key repeatedly as soon as you see the Asus or ROG logo on the screen. Once the BIOS is loaded, select the Advanced tab with your keyboard arrow keys or your mouse cursor. Next, go to the PCH-FW Configuration page, and enable PTT.

> *While most recent computers have TPMs, they might not be turned on or otherwise configured so that Windows 11 will recognize them.*
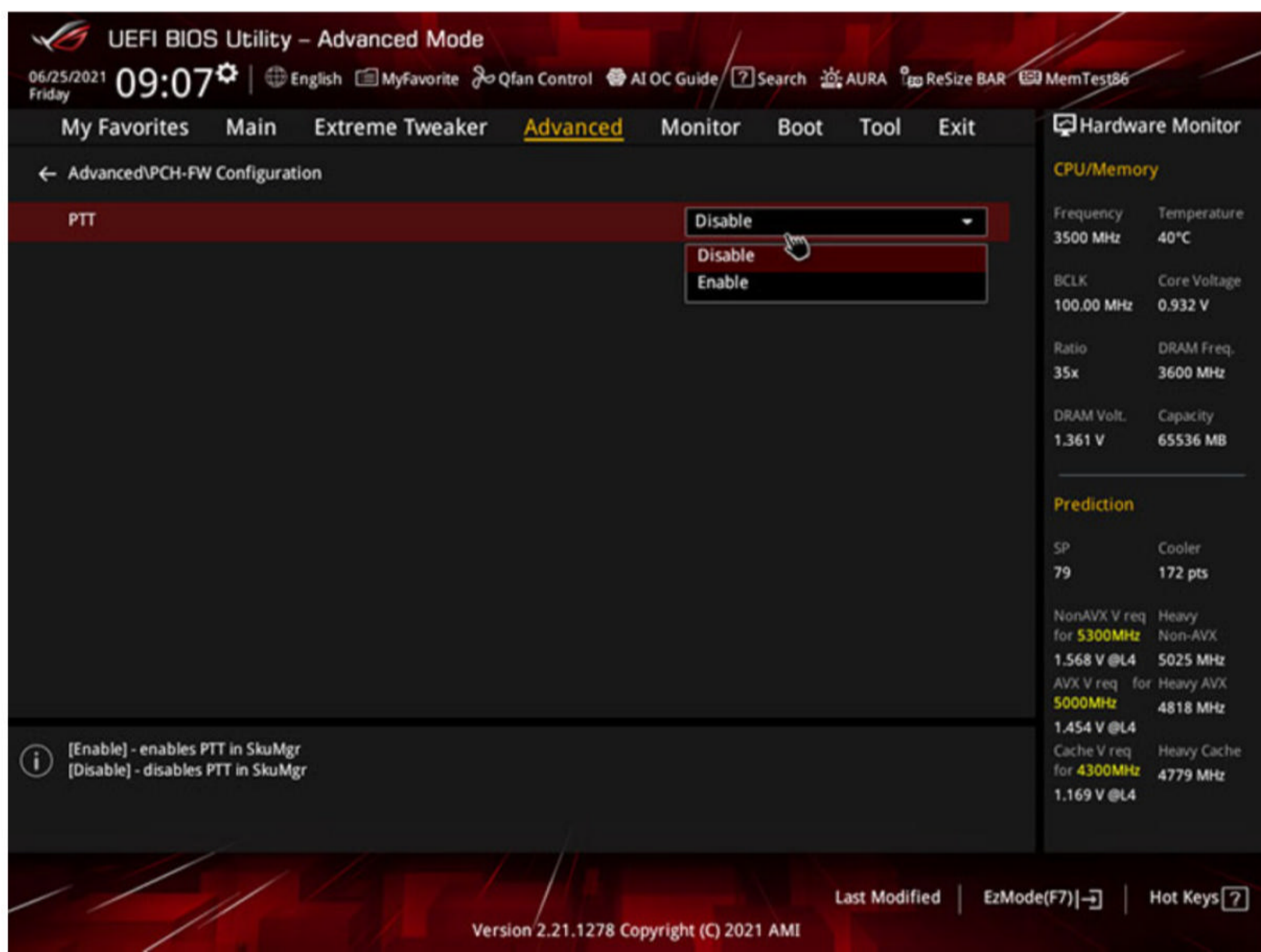
You'll then see a dialog box explaining that PTT is Intel's name for a hardware implementation of a TPM 2.0 module. The box also warns you that if the firmware TPM key is ever lost for any reason, your PC will no longer boot up. Click OK to continue, then exit the BIOS and restart your computer.

There are many other requirements for certain optional parts of Windows 11 to function. For example, 5G support requires a 5G-capable modem. And your screen will need to support HDR to use the Auto HDR feature, which expands the color space to reveal superior clarity even with non-HDR game titles.

WHAT IF MY PC CAN'T RUN WINDOWS 11?

If your PC doesn't meet one or more of the requirements above, it can't officially run Windows 11. If that's the case, you've got two main options. For one, you can keep using Windows 10. Microsoft's current operating system is already excellent, and the company has committed to support it through at least 2025, which means your Windows 10 PC will continue to get security and feature updates for years to come.

Of course, you could also buy a new PC that supports Windows 11 right out of the box. Most Windows 10 PCs on sale today will be able to upgrade to Windows 11, according to Microsoft. A "free upgrade to Windows 11" phrase should be appearing in marketing materials for new PCs. Check our website, PCMag.com, for in-depth reviews of current PCs.
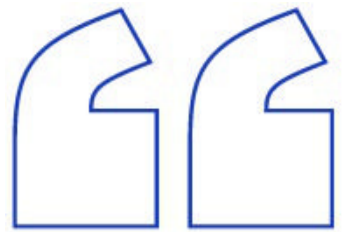
> **Your screen will need to support HDR to use the Auto HDR feature, which expands the color space to reveal superior clarity even with non-HDR game titles.**

HOW TO SET UP AND CUSTOMIZE YOUR WINDOWS 11 INSTALLATION

BY LANCE WHITNEY

The Windows 11 setup process is similar to that of Windows 10, but there are a few surprises when it comes to account access, privacy, security, and other features. And installing the new OS is only half the battle. Afterward, you have to go through a host of setup screens to customize and configure Windows 11 the way you want it.
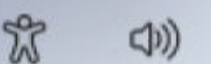
INITIAL SETUP

First, you install Windows 11 via your preferred method—a dedicated PC, a dual-boot system, or a virtual machine. Follow the on-screen instructions to install the OS, at which point the setup screens appear. You'll be asked to designate your country or region, followed by keyboard layout or input method. Confirm the correct ones and click **Yes**.

The next screen asks if you want to add a second keyboard layout. If you plan to add another language in Windows 11 with a different keyboard layout, click **Add layout** and choose the one you want. Otherwise, click **Skip**.

Windows then checks for available updates. Review the license agreement and click **Accept**. You are then asked to name your Windows 11 PC; Microsoft offers a few guidelines and requirements. The name can't start with a number or be longer than 15 characters, and it can't include spaces or certain special characters.
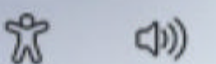
If you plan to install Windows 11 on just one PC or one place, you can go with a generic name, such as Windows11. If you'll be installing it on multiple computers or places, give it a more unique name with the PC make or model, such as Win11LenovoT14 or Windows11HP. After typing the name, click **Next**.

SELECT ACCOUNT TYPE

You're then asked what type of account you want to use. Choose **Set up for personal use** if you're installing Windows 11 on your personal PC and plan to use it with a Microsoft account or a local account. If you're installing Windows 11 on a PC for your organization or school and plan to use it with your business or school account, select **Set up for work or school**. Once you make a choice, click **Next**.

If this PC is for personal use, you will then need to enter the email address for your Microsoft account. A local account is no longer supported for Windows 11 Home edition (without some serious workarounds), but it will still work with Windows 11 Pro and other editions.
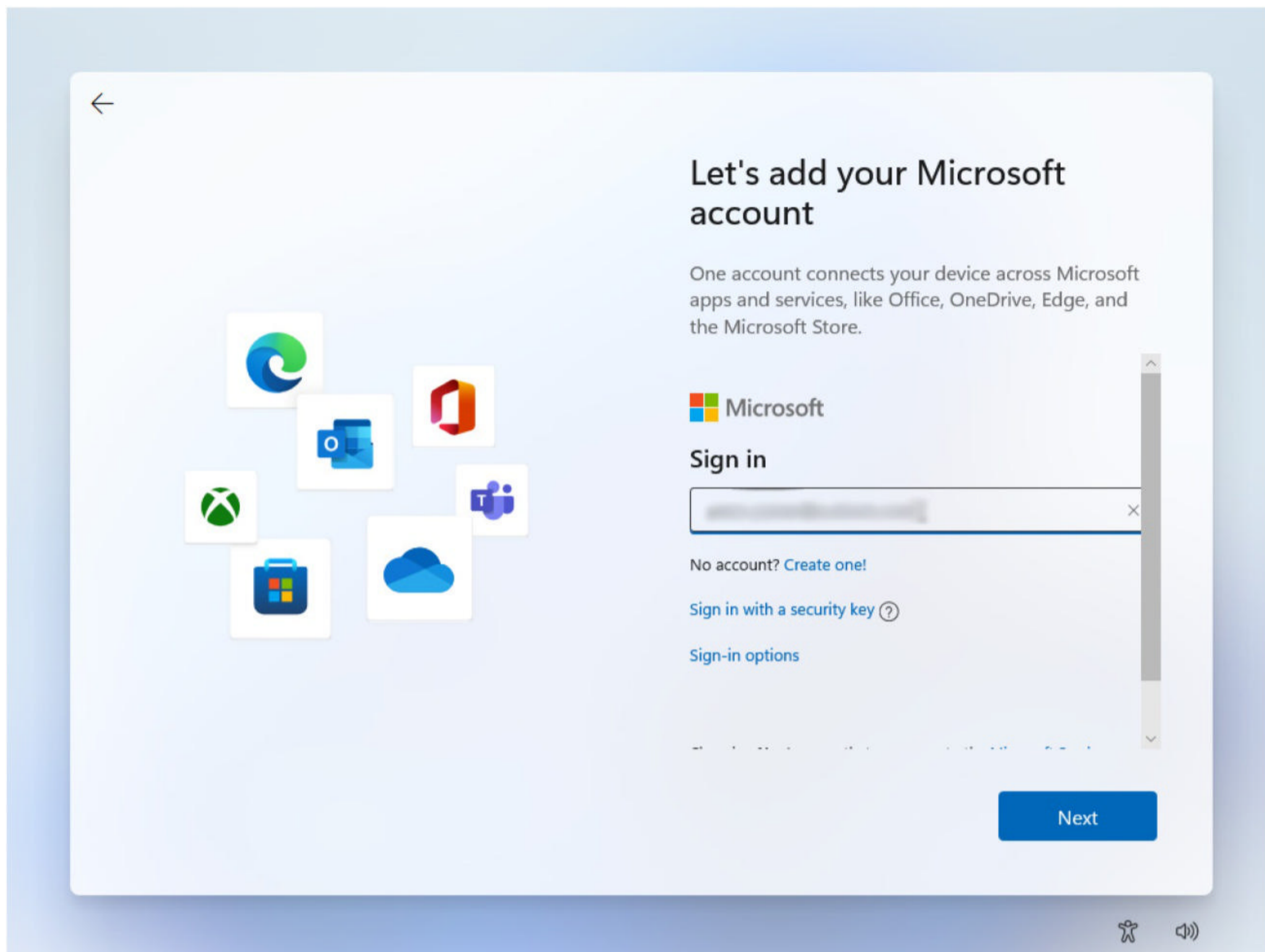
SET UP WITH A MICROSOFT ACCOUNT

If you're signing in with a Microsoft account, enter the email address and password associated with it. If you don't have a Microsoft account, click **Create One** and follow the steps to create it.

Once the Microsoft account is entered, you're prompted to create a PIN as an alternative means of signing into Windows beyond just your Microsoft account. Click **Create PIN**.

Then, check the box next to **Include letters and symbols** if you want to use more than just numbers for your PIN. (The **PIN requirements** link offers guidelines for creating a PIN.) Type and then retype your PIN and then click **OK**.
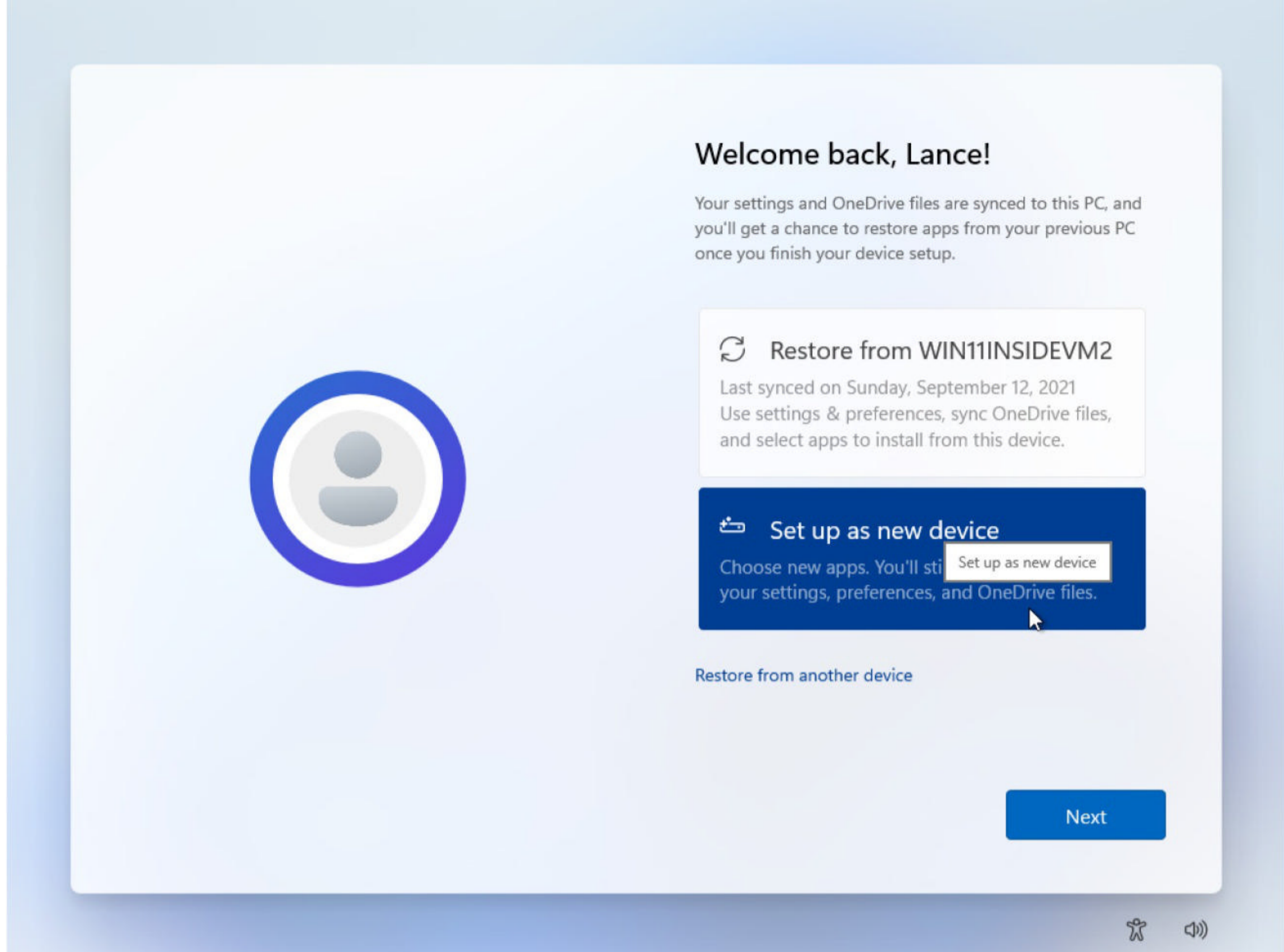
If your account has already installed and set up Windows 11 on a different PC, Microsoft will recognize you and ask if you want to restore Windows from the other PC or set it up as a new device. If you wish to duplicate the environment from another computer, choose **Restore from [PC name]**. If you'd rather keep your new Windows 11 environment fresh and unique, choose **Set up as new device**. After choosing, click **Next**.

The next screen asks you to choose your privacy settings. Read each setting to determine whether you want to keep location and diagnostic data enabled or disable it (click the **Learn more** link for details on these options). After choosing which settings to change, click **Accept**.

You can then customize your experience by choosing how you plan to use Windows—Entertainment, Gaming, School, Creativity, Business, or Family. The choice you make determines what types of ads and recommendations you might see associated with your Microsoft account. Click the appropriate category if you wish; otherwise, click **Skip**.

Your next step is to determine whether you wish to back up your files to OneDrive. To automatically back up and sync your Desktop, Documents, and Pictures folders to OneDrive, select **Back up my files with OneDrive**. Otherwise, pick **Don't back up my files**. Click **Next**.

SET UP WITH A BUSINESS OR SCHOOL ACCOUNT

If you selected an account with your business or school, the process jumps from the authentication screen to the privacy settings screen. From there, a screen pops up asking whether you want to set up Windows Hello with your account. Click **OK**.

You're asked to set up a PIN. Type and then retype a PIN, then click **OK**. You can then set up any other supported Windows Hello feature, such as fingerprint recognition or facial recognition.

SET UP WITH A LOCAL ACCOUNT

If you prefer to use a local account, click the **Sign-in options** link at the screen prompting you to add your Microsoft account. At the next screen, click the **Offline account** option.

Windows does its best to try to steer you into using a Microsoft account, even going so far as to use confusing language to trick you and to explain what you'll miss out on if you proceed. Click **Skip for now** to continue setting up a local account.
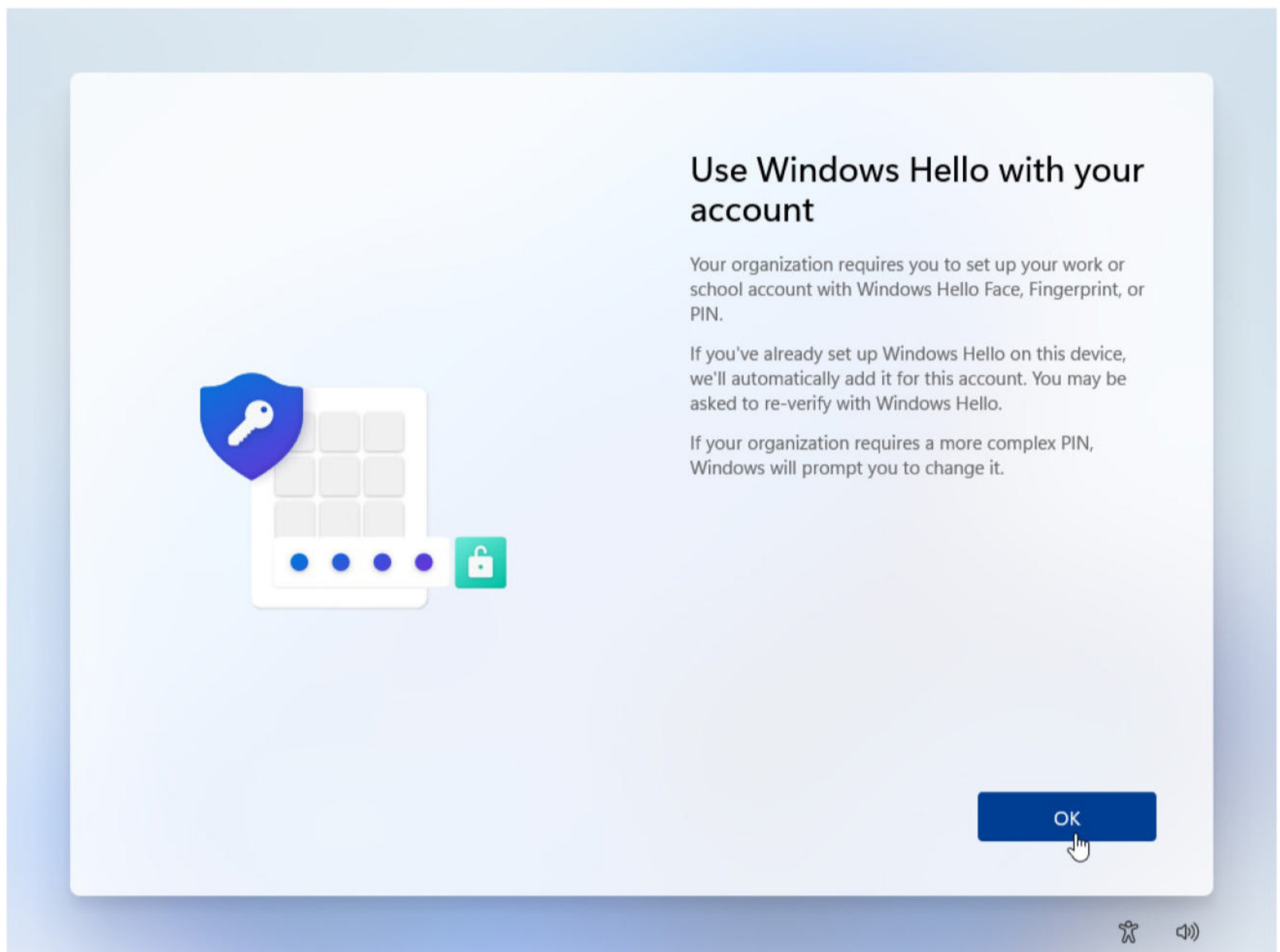
You will then be asked to enter the name you wish to use and create a password for the account. Ignore Microsoft's prompts to set up an online account.

Windows then prompts you to create security questions and answers for your local account. Choose each security question and then type an answer. Click **Next** at each screen.

The next screen asks you to choose your privacy settings. Enable the settings you wish to change and click **Accept**.

FINALIZE SETUP

The process converges from here, whether you chose a Microsoft account, local account, or account for work or school: Windows will check for available updates and download them for you. While this process runs, Microsoft takes you through some of the new features in Windows 11.

Once the update process is finished, Windows will restart, welcome you to the new version of the operating system, and automatically sign you in. The next time you start or reboot your computer, you'll be prompted to type your password at the login screen.
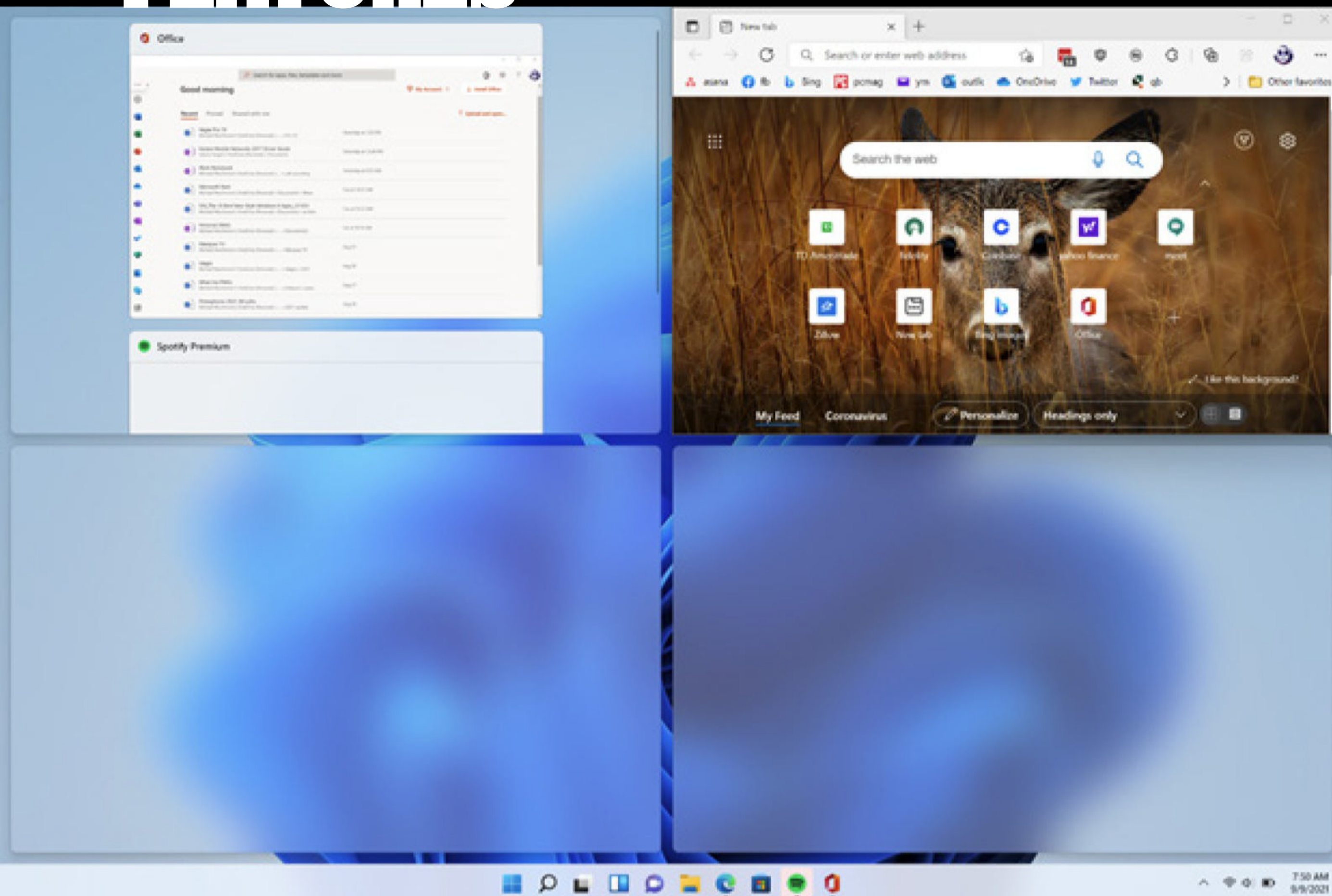
HOW TO USE SNAP LAYOUTS IN WINDOWS 11 ⊞

BY MICHAEL MUCHMORE

Windows 11 may be better known for its centered taskbar and rounded window borders, but the new Snap Layouts feature (sometimes also called Snap Assist) might be a more useful UI innovation. Windows, as its name implies, has long been excellent at managing and rearranging program windows, but Snap Layouts elevate the operating system (OS) to the next level.

HOW DO SNAP LAYOUTS WORK?

To get started with this new productivity tool, you simply hover the mouse over the **Maximize** icon in a program window's upper-right corner. You'll see a choice of layouts, like this:
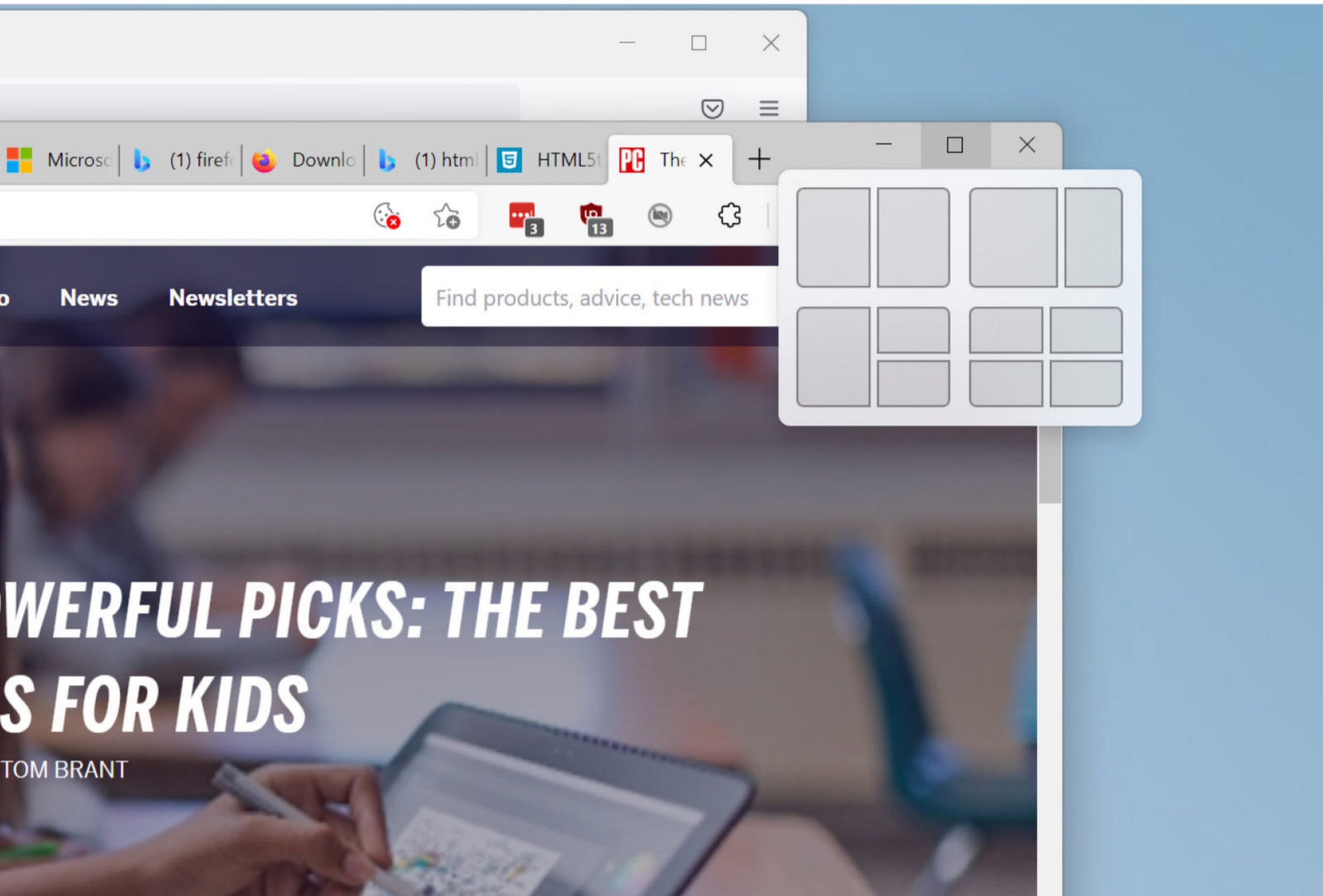
Note that not every application supports this feature. In my testing, the Firefox and Spotify programs showed only the old Maximize option. But you can still position them within a Snap Layout after starting the process with an app that supports the feature.

The available options depend on your screen dimensions. On my test PC, a 15-inch Surface Laptop 3 running Windows 11 Insider Preview Build 22000.176 with the display scale set to the recommended 150%, I was offered only the four choices shown above, with arrangements of two, three, and four windows. Microsoft recently announced a new layout option, three equal windows side-by-side or stacked, but that didn't appear on my laptop, since it's designed for large screens of over 24 inches only.

You then hover your cursor over the layout diagram onto the shape you want to fit your current application into. The spot will highlight with a color. Here, it's the default blue, but it uses whatever color you chose in **Settings > Personalization** for your Accent color.

After you tap on the spot where you want the current window to live, you see the full layout on-screen with the other available spots shown using Fluent design Acrylic effects that blur the background. All other running apps are shown as options for filling the placeholders.

Tap on the app you want in each box in succession, or simply return to your resized window to leave the desktop as it was. Note that, as with Windows 10, you can resize snapped windows and the neighboring window shrinks or fills the resulting area to keep everything neat. You can't drag the thumbnails to another spot. Instead, Windows has you fill each spot one at a time. After you populate all the spots, your screen will something look like this:

An alternative way to use Snap Layouts is via the keyboard. Use Windows Key–Right Arrow (or whichever direction you want to snap the window towards) to move and resize a window in half. If you don't want a half-screen snap, you can use the Windows Key–Arrow combination on the next screen. For example, to get a window to fit exactly in the top right quadrant of the screen, use Windows Key–Right Arrow followed by Windows Key–Up Arrow. This actually already works in Windows 10, but in Windows 11, you get the new Snap Layout look and the feature mentioned next.

Also as in Windows 10, you can drag a window title bar to a corner or edge of the display to take up exactly a half or a quarter of the screen real estate—but with Windows 11, you don't have to drag it all the way to the edge or corner: An Acrylic outline of the snap position appears well before you get there.

After you create a Snap Layout, you can see an app's position within that arrangement (as long as the app supports Snap Layouts) via its Taskbar thumbnail, along with icons for the other apps in that Group:
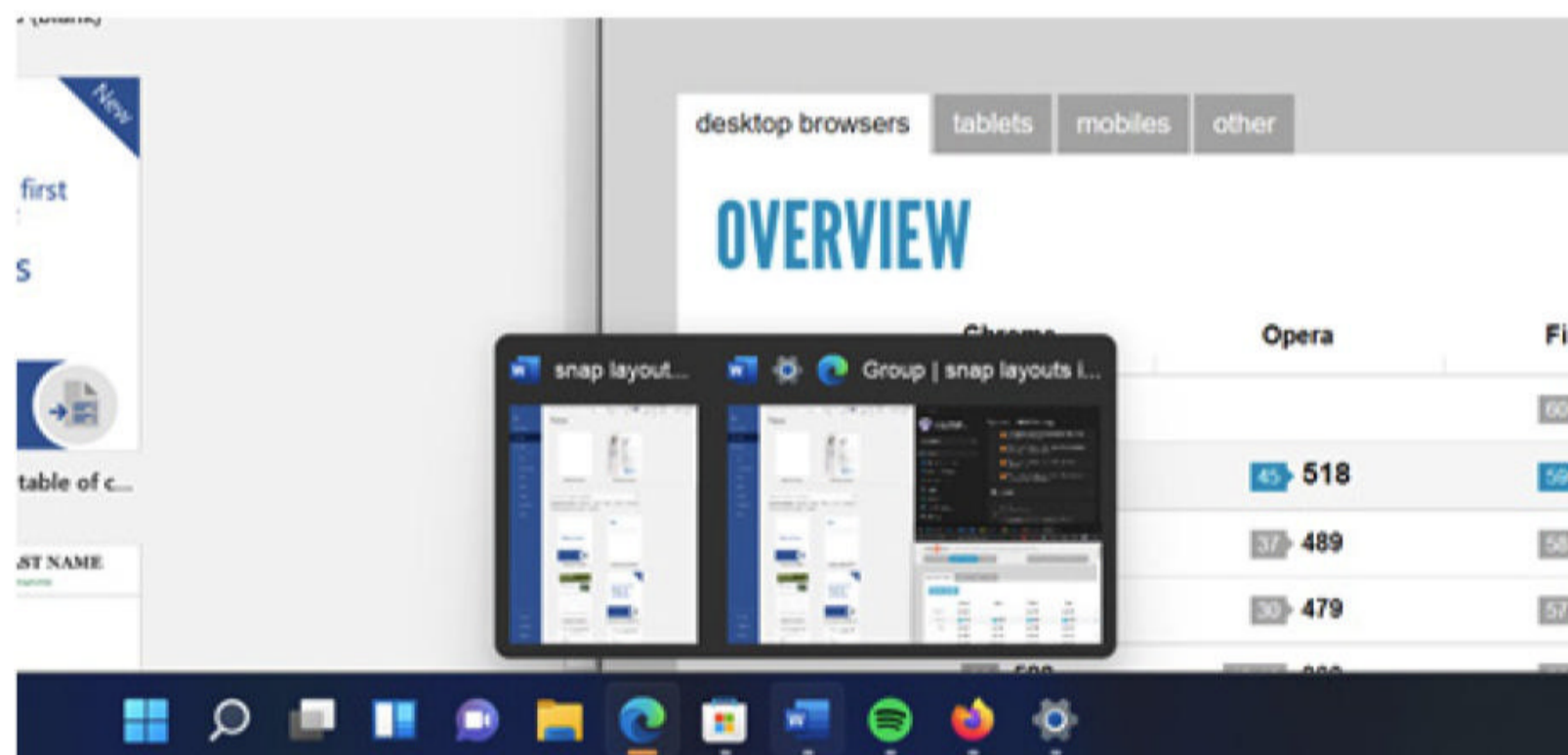
> **To get a window to fit exactly in the top right quadrant of the screen, use Windows Key–Right Arrow followed by Windows Key–Up Arrow.**

HOW DO YOU TURN OFF SNAP LAYOUTS?

If you can't stand Snap Layouts, head to **Settings > System Multitasking**. Here, you can configure settings for Snap Layouts, including completely disabling them and going back to the windowing conventions of Windows 10. Note that you don't get the ability to snap windows to the sides or corners with Windows key keyboard shortcuts.

You can also turn off all the individual features mentioned above via a series of checkboxes (below), such as the "When I drag a window, let me snap it without dragging all the way to the screen edge" option.
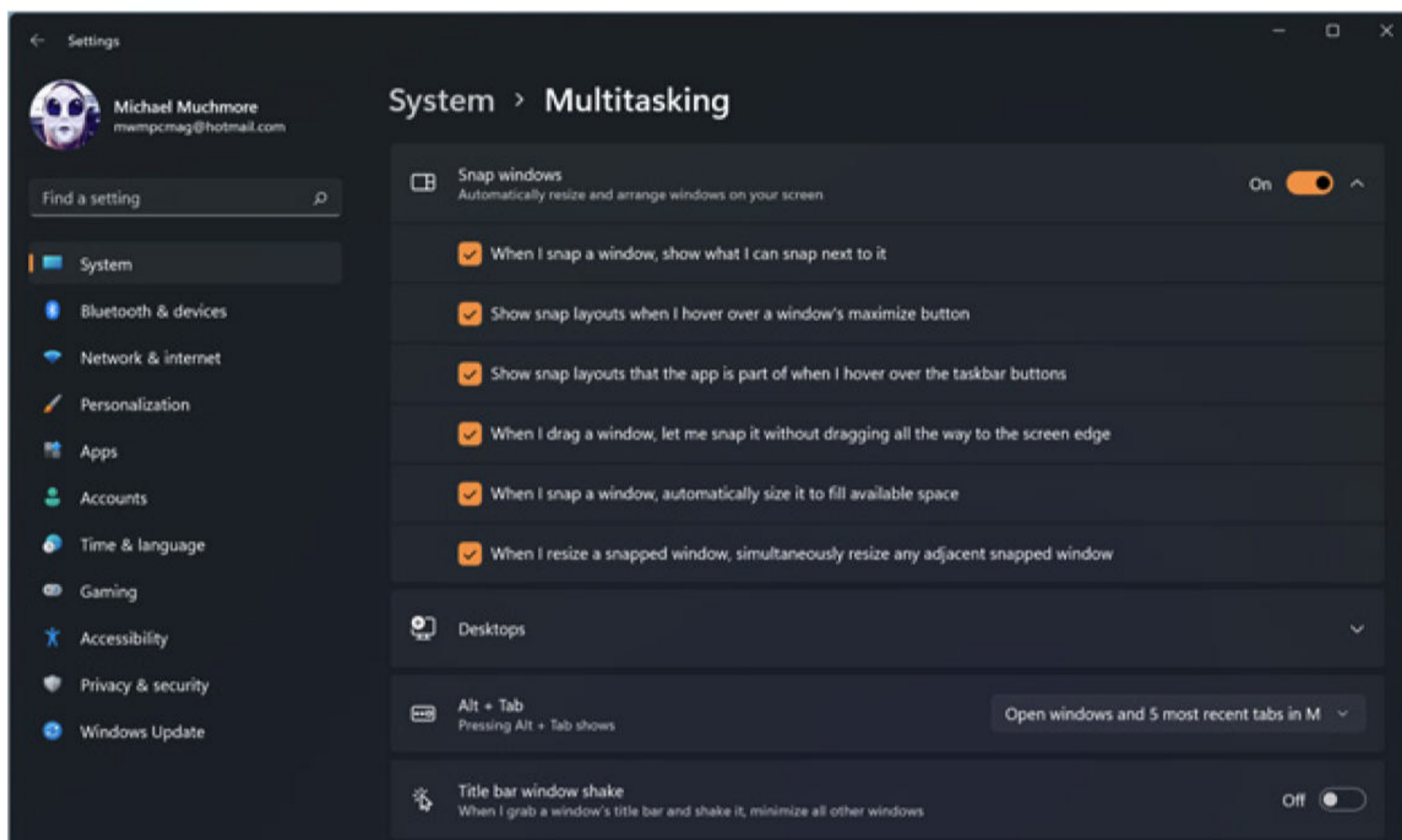
One drawback is that there's no way to use Snap Layouts via a touch screen. I like simply tapping something on the screen rather than moving a mouse or trackpad to aim it on a button. Since Microsoft is also big on touch screens, including them on all Surface devices, I hope the company will address this issue at some point.

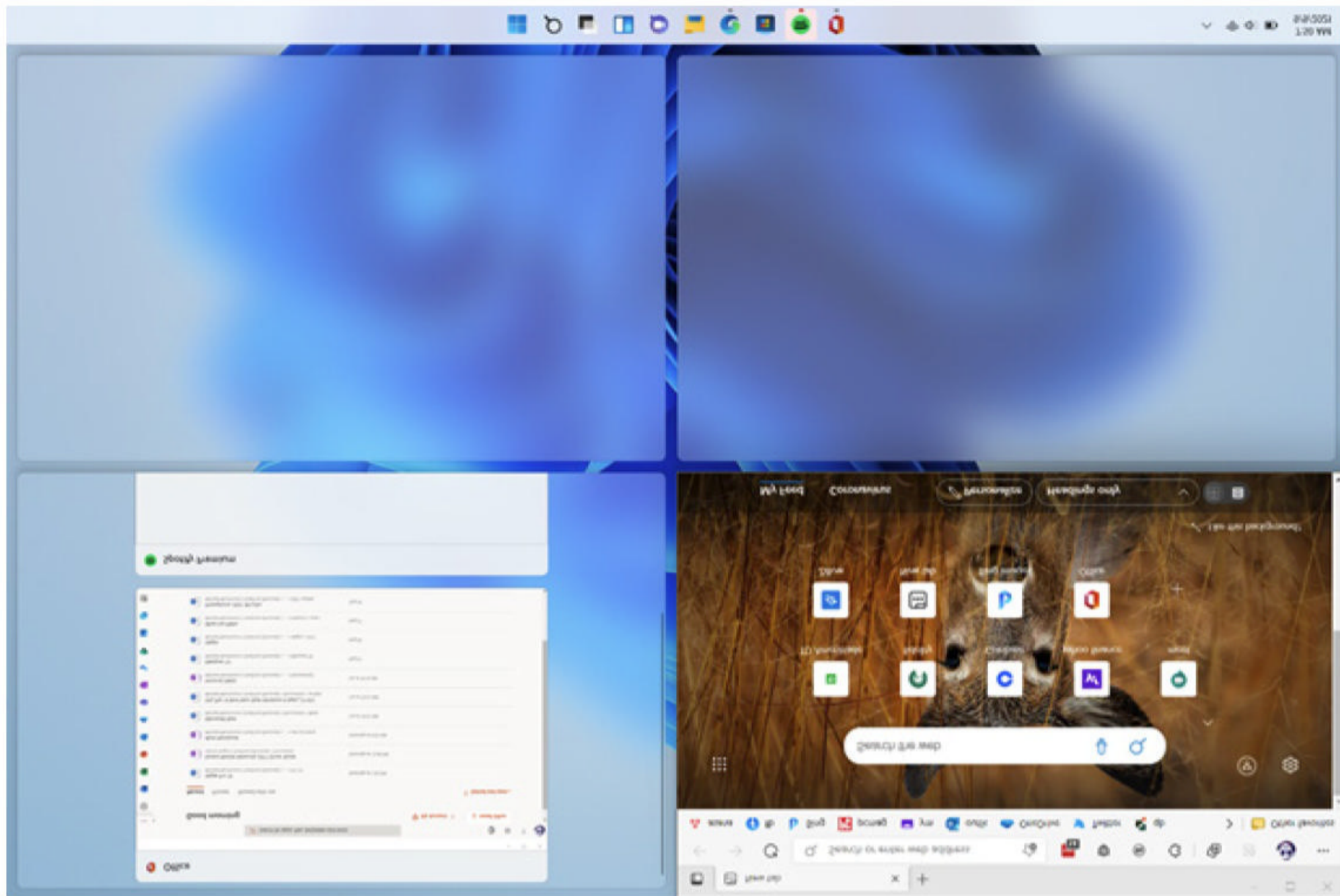A related update in Windows 11 is that when you arrange windows the old way, by dragging a window

title bar to the side or corner of the screen, it has a new, more helpful look, too. As you can see below, when you drag a window title bar onto a corner of the screen, you see the four-up layout complete with a Fluid design acrylic effect:

A final windowing note on the plus side: I'm thrilled that Microsoft is offering users the ability to enable Title Bar Window Shake—a feature formerly known as Aero Shake and one I use several times a day. It seemed like Microsoft was abandoning this capability with Windows 11, but you can see the option to turn it on in the Settings screenshot above.

FOR ADVANCED TINKERERS

If Snap Layouts don't offer enough customization for you, or you want similar functionality in Windows 10, check out Microsoft PowerToys (you can find it at https://docs.microsoft.com/en-us/windows/powertoys/). This experimental suite of utilities offers a tool called FancyZones, which pretty much duplicates the Snap Layout with even more customization.

After installing PowerToys, FancyZones is enabled by default, and you can just hold down Shift while dragging a window to get the layout choices. You're able to customize the keyboard or mouse actions that trigger FancyZones and can even create custom layouts.

Studying Safer: How to Educate Your Kids About Online Security BY KIM KEY

Chances are, you read about a major cybersecurity incident somewhere in the world today. What you may not know is that students and schools get targeted every day, too. While someone opening a credit card in your child's name or tricking them into giving up private information may not make the news, such attacks can be just as devastating for kids as they are for companies—maybe more so.

Now that your kids are either back at school or back to learning from home—or some combination of the two—it's imperative that they understand the risks associated with learning online. From implementing ransomware protection to using a password manager correctly, the right online habits can keep your student safe online.

SCHOOLS—AND STUDENTS—ARE TARGETS

I spoke with Dr. Davina Pruitt-Mentle about ways to get kids interested in forming good cybersecurity habits. She is the Lead for Academic Engagement of NICE, the National Initiative for Cybersecurity Education at the National Institute of Standards and Technology (NIST). Dr. Pruitt-Mentle has more than 20 years of experience in getting kids ready for and interested in joining the cybersecurity workforce. She said younger students have long been targets for online fraud.

"I can remember preaching this back in 2000, 2001," she stated. "Schools are still a high target, especially K-12. Because you don't even realize that anything is a problem until you start applying for scholarships or internships."

According to a 2018 study by Javelin, over one million children were victims of identity fraud in 2017. This led to $540 million in out-of-pocket costs to families, as they had to pay to restore their accounts, credit, and identities to good standing. Children may be tech-savvy, but many of them aren't aware of the dangers of the world and will offer up information such as Social Security and credit card numbers over the course of regular online communication or other exchanges.

So what can you do to keep your student safe while letting them learn online? Dr. Pruitt-Mentle says chatting about who and what is online is key, as well as practicing good habits yourself.

> From implementing ransomware protection to using a password manager correctly, the right online habits can keep your student safe online.

BE A GOOD ROLE MODEL

Children are always watching the adults in their lives and emulating their actions. If you want to raise a student who is aware of cybersecurity threats and willing to do the work to keep them at bay, you have to show off your good online security habits.

This means, as the adult in their lives, you have to remember to keep your software, operating systems, and apps up to date. Use two-factor authentication and a password manager. Use a VPN while you browse online. Most important of all, let your kids see you doing these things so they will incorporate smart practices into their own internet routines while they browse, play, and learn online.

LET STUDENTS HAVE THEIR OWN TECH SPACE

Pruitt-Mentle advised parents to maintain a separate computer or even a separate network for students, to avoid any risk to the computer parents use for sensitive transactions.

Kids are bound to make mistakes. Sometimes those mistakes can be costly. It's a good idea to let kids, especially teens, have their own computer for homework or leisure time. Whether they're using an inexpensive and relatively indestructible Chromebook or a gaming PC with all the bells and whistles, separate your student's activities from the computer where you conduct important business—like work and financial transactions. That way, if your child stumbles upon some malware, it has less potential to affect everyone in the family.

If another computer just isn't in the budget, create a separate system account just for your student's schoolwork, and be sure they use it.

> **As the adult in their lives, you have to remember to keep your software, operating systems, and apps up to date. Use two-factor authentication and a password.**
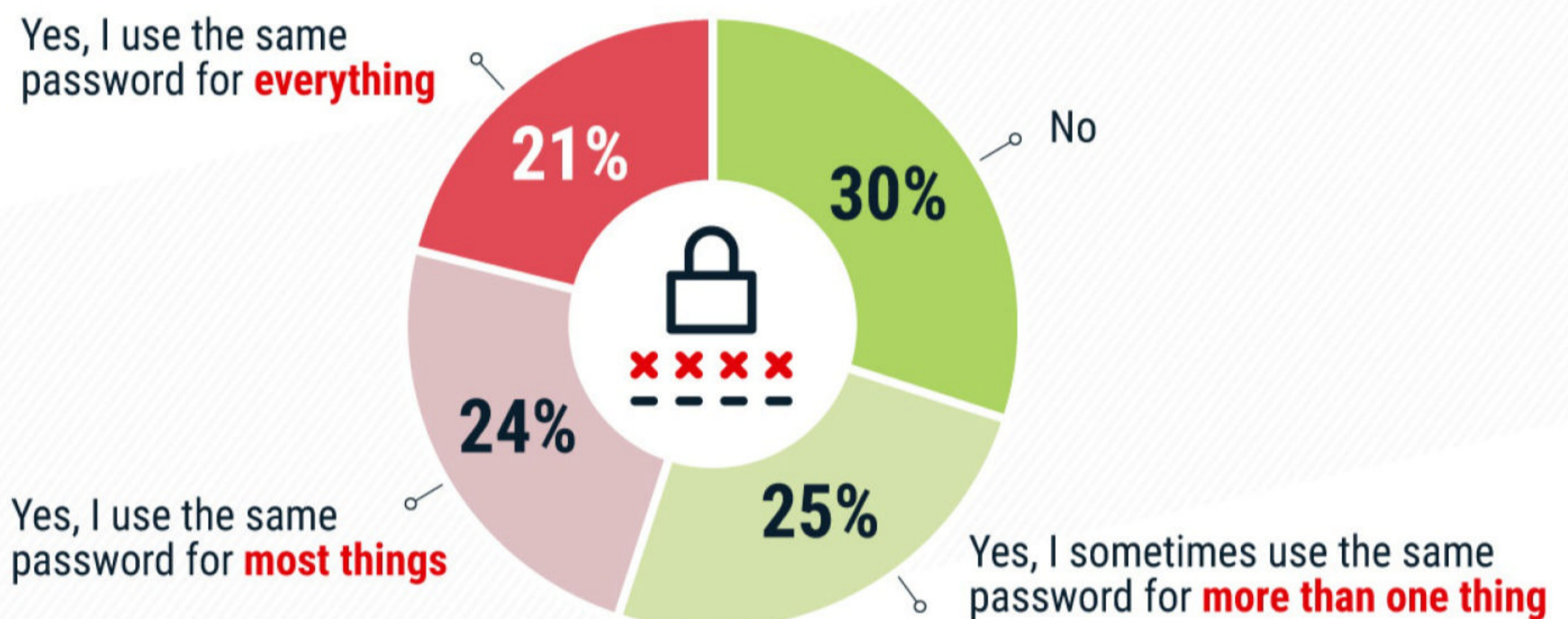
Stop Using the Same Password on Multiple Sites—Really!

BY ERIC GRIFFITH

At PCMag, we're constantly reminding readers to take cybersecurity seriously. Yet a large swath of the populace ignores best practices— especially when it comes to passwords.

The numbers from our recent survey of 1,041 adults age 18 or older in the US say it all. A full 70% of respondents admitted they use the same password for more than one site or service—sometimes (25%), most of the time (24%), or all the time (21%). If you don't know why that's bad, read on: When someone steals your password for just one service, they have your password for everything. Since most online accounts assign your email address as a username, it doesn't take Mr. Robot to crack that code.

Do you use the same password for more than one service or site?

Yes, I use the same password for **everything** — 21%

No — 30%

Yes, I use the same password for **most things** — 24%

Yes, I sometimes use the same password for **more than one thing** — 25%

Data collected from July 16-18, 2021 of 1,041 US respondents aged 18+.

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How would a cyber-crook get your passwords, you wonder? Thirty-six percent of our respondents said they physically write down passwords, and 24% keep them in notes stored electronically. Both of these methods make stealing passwords too easy—say, witnessed out of the corner of some criminal's eye.

Of course, you can't beat memorizing. Almost half of those surveyed said that's their preference. It's the most secure method of all, unless you're afraid of having the info tortured out of you, Bond-style. In that case, we highly recommend you use a password manager. Sadly, only one-third of respondents said they use a password manager—a software program that stores and even creates strong passwords for you. But we'll continue to trumpet their use until that number goes up. (The numbers above don't add up to 100%, since people use a mix-and-match approach to tracking passwords.)

> **Sadly, only one-third of respondents said they use a password manager—a software program that stores and even creates strong passwords for you.**
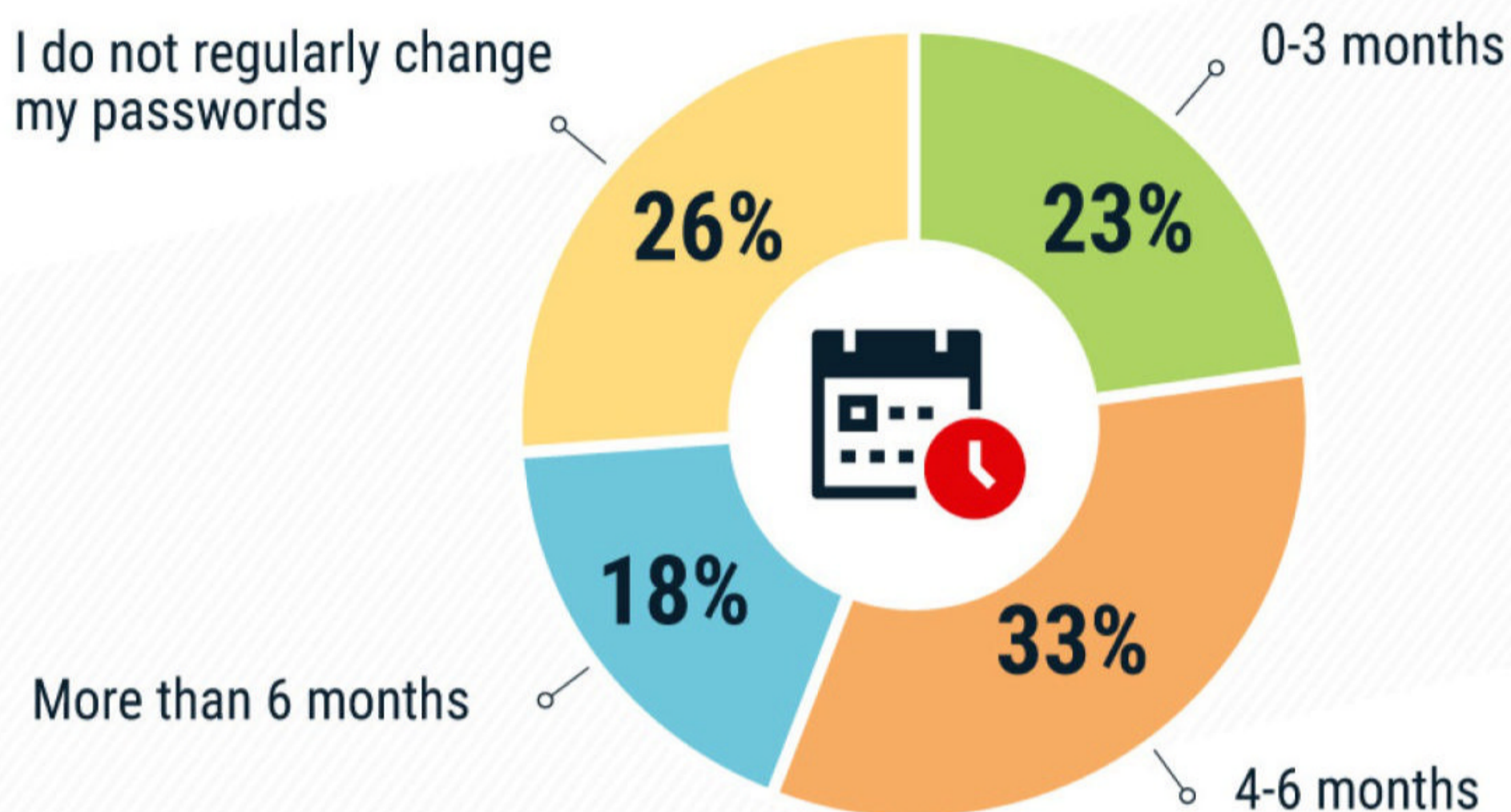
How do you keep track of your passwords?
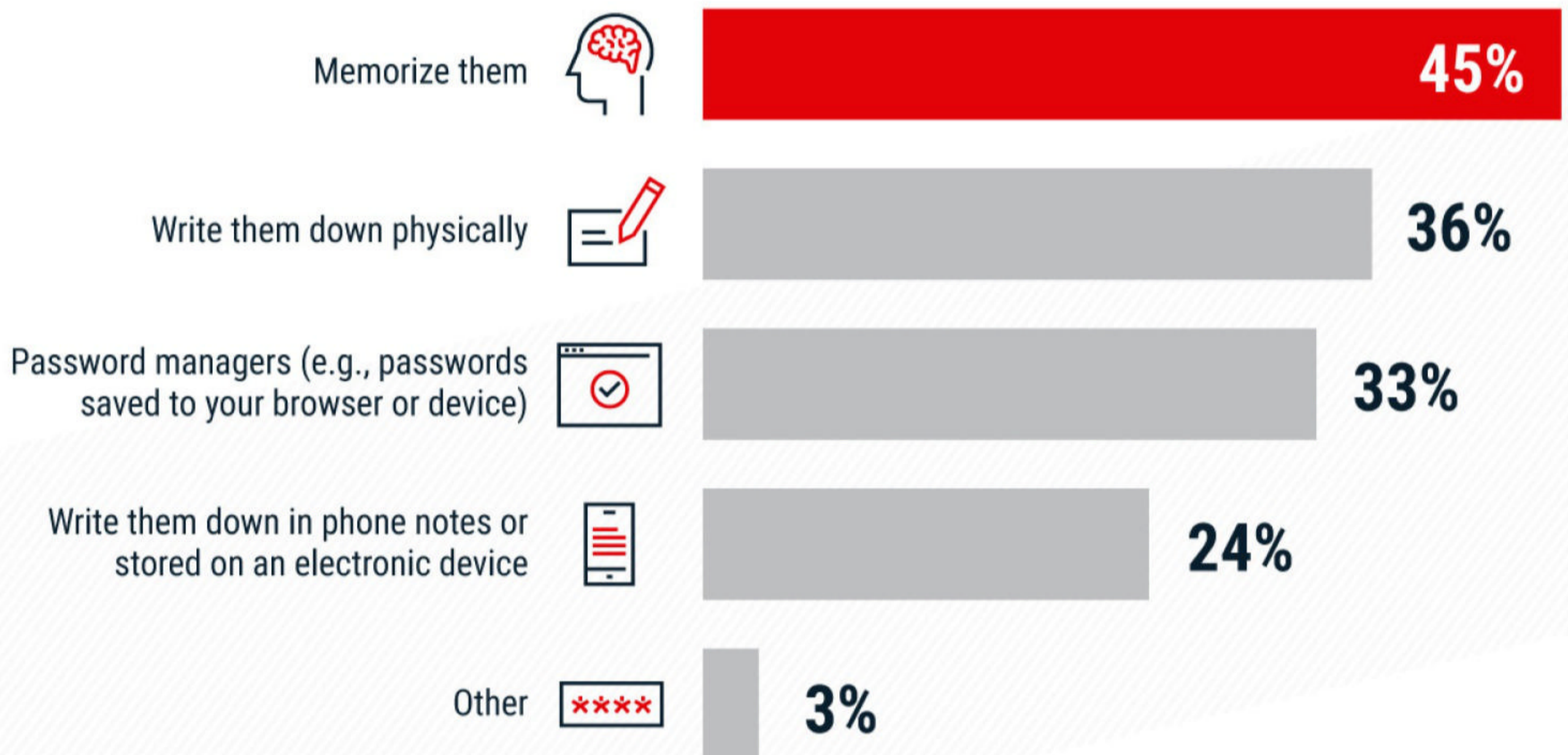
Method	Percentage
Memorize them	45%
Write them down physically	36%
Password managers (e.g., passwords saved to your browser or device)	33%
Write them down in phone notes or stored on an electronic device	24%
Other	3%

Respondents were allowed multiple choices. Data collected from July 16-18, 2021 of 1,041 US respondents aged 18+.

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Another reason to use password managers is they make it very easy to change weak passwords into something stronger. The majority of survey respondents said they change passwords every four to six months. Our guess is that anyone saying they do this even once a year has had it forced upon them rather than done it by choice. The 26% claiming they don't regularly change passwords are likely being the most honest.

On average how often, if at all, do you change your password(s)?

I do not regularly change my passwords — 26%

0-3 months — 23%

4-6 months — 33%

More than 6 months — 18%

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Microsoft is moving people away from passwords entirely. This strategy may catch on with other services, but it's not necessarily an improvement, since it's simply removing the first factor of authentication (the password) in favor of the second (an authorization code). That means if someone steals your phone, they can get access even more easily to your Microsoft account (assuming they have the PIN for your phone). But that's a whole different article.

We asked the respondents not only about their passwords but also how many had been victims of cybercrime. Although 46% said they'd never been a victim, the other 54% said they had. The breakdown for cybercrime victims: credit card fraud, 27%; malware, 18%; ID theft; 17%; phishing attacks, 16%; and ransomware, 9%. Did a bad password pave the way for all these crimes? That's no more likely than leaving your doors unlocked means you'll be burgled, but why tempt fate?

Finally, we asked about what kinds of protection people use online. It was a relief to see that 53% use antivirus software, even though Windows has it built into the operating system. The number should be much higher, though—unless everyone taking the survey happens to be on Macs or iPhones only. Chances are that the majority of respondents are probably using antivirus without even realizing it.

VPNs and privacy-focused browsers/modes made a good showing too, though. And hopefully, stats like these will drive a few more people to make more security-conscious tech decisions.

How, if at all, do you protect yourself while browsing online?

Protection	%
Antivirus software	53%
VPN	27%
Privacy-focused web browsers (e.g., DuckDuckGo, incognito modes)	27%
None of these	22%
Other	6%

Respondents were allowed multiple choices. Data collected from July 16-18, 2021 of 1,041 US respondents aged 18+.

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