INSIDE: **8 WAYS WINDOWS 11 IS BETTER THAN WINDOWS 10**

PCWorld

JUNE 2022

NUC SECRETS REVEALED!

HOW INTEL'S TINY PCs SPARKED A REVO-LUTION

WE VISITED INTEL'S NUC LAB TO SEE THE LATEST IN MINI COMPUTING


ad COUNCIL
American Lung Association
I think it's just vapor. It won't hurt my kid like cigarettes, right?
The vapor that's inhaled from e-cigarettes contains harmful chemicals that can cause irreversible lung damage.
And e-cigarettes have nicotine, a toxin that's addictive and can change your kid's brain. Those are the facts.
Talk to your kid about vaping. Get the facts at
TalkAboutVaping.org
GET YOUR HEAD OUT OF THE CLOUD

CONTENTS

PCWorld JUNE 2022

DEPARTMENTS

FEATURES

COVER IMAGES COURTESY OF INTEL

MASTHEAD

PCWorld

EDITORIAL DIRECTOR Matt Egan
EDITOR IN CHIEF, CONSUMER BRANDS Jon Phillips
DESIGN DIRECTOR Robert Schultz

EDITORIAL

EXECUTIVE EDITORS Brad Chacos, Gordon Mah Ung
SENIOR EDITORS Michael Brown, Mark Hachman
ASSOCIATE EDITOR Ashley Biancuzzo
STAFF WRITER Michael Crider
COPY EDITOR Gail Nelson-Bonebrake

DESIGN

ART DIRECTOR Steve Traynor
DESIGNER Rob Woodcock

ADVERTISING

SALES INQUIRIES foundryco.com/contact-us/

FOUNDERS

FOUNDER David Bunnell
FOUNDING EDITOR Andrew Fluegelman

INTERNATIONAL DATA GROUP, INC.

CHAIRMAN OF THE BOARD Walter Boyd
CEO, FOUNDRY Kumaran Ramanathan

REPRINTS AND PERMISSIONS

You must have permission before reproducing any material from *PCWorld*. Send email requests to permissions@pcworld.com; please include a phone number in your message.

BACK ISSUES

PCWorld back issues can be downloaded in digital format from www.zinio.com at $6.99 per issue.

SUBSCRIPTION SERVICES

Access your subscription account online—24 hours a day, 7 days a week. You can use online subscription services to view your account status, change your address, pay your bill, renew your subscription, get the answers to frequently asked questions, and more.

WEB pcworld.com/customer

EMAIL support@pcworld.zendesk.com

(Send your full name and the email address at which you subscribe; do not send attachments.)

QUESTIONS AND COLUMNS

Send material electronically to the appropriate online address listed below, or mail it to *PCWorld*. We reserve the right to edit letters.

MAILING LISTS

Occasionally we make our magazine subscribers' names available to other firms whose products may interest you. To have your name excluded from these mailings, send a request and your email address to PCWorld Subscriber Services at support@pcworld.zendesk.com.

CONTACT

PHONE 415/243-0500; FAX 415/442-1891

MAIL Editorial: 501 Second Street #600, San Francisco, CA 94107

STAFF ADDRESS To contact any *PCWorld* staff member, simply format the address as follows: *firstname_lastname@idg.com*

PUBLICATION INFORMATION

Volume 40, number 6

PCWorld™ (ISSN 0737-8939) is published monthly at $24.95 for one year (12 issues) by Foundry (formerly IDG Communications, Inc.)


YOU MAKE MONEY.
NOW MAKE IT WORK FOR YOU.
Learn how to save for your retirement at **WeSaySaveIt.org**.
WE SAY $AVE IT
AARP
ad COUNCIL

The 5 coolest things at Google I/O

Google shows us a world where we'll search store shelves with our phone and use glasses to talk to people in other countries. **BY MARK HACHMAN**

Google has become synonymous with powerful search, incredible hardware, and quirky, fun technology. Unfortunately, that includes stretching the limits of privacy and a reputation for giving up on its product lines too soon. But these negatives notwithstanding, Google is at it again at its Google I/O event near its company headquarters in Mountain View, Calif., enticing developers and consumers alike with a number of new hardware products, software and services.

Yes, Google just revealed new Pixel phones, including the Pixel 6A and the Pixel 7. But those weren't the coolest technologies Google showed off on Wednesday. The stuff below is even cooler.

(And for more coverage, check out our stories on Google's new privacy controls

IMAGE: GOOGLE

[fave.co/3w8qGor], the new Pixel Watch [fave.co/3st2BXp], and the new Immersive Mode in Maps [fave.co/3IclFF2].)

IMMERSIVE VIEW IN GOOGLE MAPS

Google Maps began life as a two-dimensional representation of streets and highways. Over time, Google Maps has added traffic (as reported by Google Phones), Google Earth (as recorded by satellites and low-flying planes), and Google Street View (imagery from cars and cameras). Now, Google has started putting it all together with Immersive View for Maps. Immersive View layers actual imagery on top of simulated buildings it creates itself.

Immersive View is the next generation of the 3D perspective that's already in your Android phone—try zooming in on a major city, then tapping the Layers icon in the upper-right corner, then the 3D control… and you'll see it's pretty awful. It's a sea of ghostly images superimposed on your phone's screen at only a certain zoom level. But Immersive View looks like it will bring color and life back to the 3D world of Google Maps.

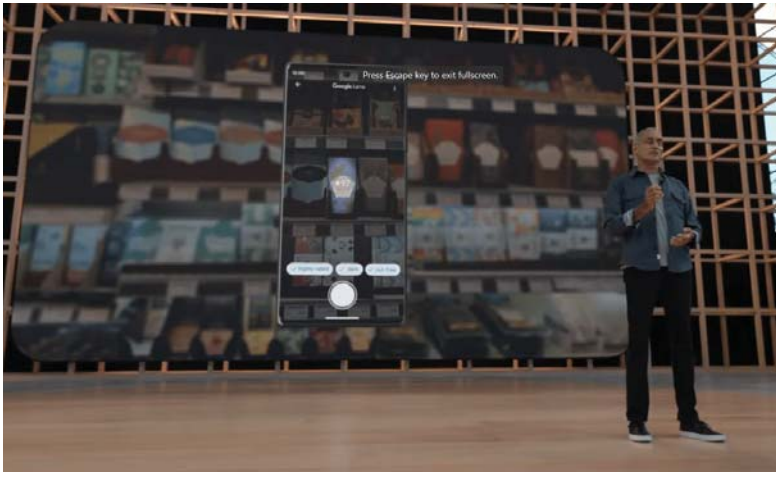
Ironically, there's a decent version of Immersive View already available. Try opening the Maps application on your Windows 10 or 11 PC, zoom in on a city, then select the small angled grid.

GOOGLE SEARCH VIA SCENE EXPLORATION

Scene Exploration is the next iteration of Google Search, mimicking how you yourself

Will Immersive View for Google Maps look as good as this when it's released?

visually search. Imagine walking through a grocery store, with your eyes scanning the shelves. On some level you know what those objects are, and possibly their relative worth and what their quality is.



Scene Exploration is like having a "supercharged Ctrl-F for the world around you."

That's how Scene Exploration will work: You'll pan your smartphone camera over a scene, and Google will scan the various items and ping the web for further information. The idea is that you'll approach the scene with a filter in mind: scanning a shelf full of wine, for example, to find a well-rated vintage or a chardonnay that was made by a Black-owned winery.

Unfortunately, Google didn't announce a timeframe on when Scene Exploration will become a reality.

GOOGLE DOCS TL:DR MODE

Some of us can read and process information very quickly; others need more time to absorb things. And many simply don't have the time to scrub through a story, let alone a couple hours of a YouTube video.

Using machine learning, automated summarization (or TL:DR Mode) will automatically pull out the key points of a document, providing a short summary of what's being discussed. What Google showed off at Google I/O has incredible potential, though you might be a bit leery of running your company's latest sales strategy document through Google's AI. And while summarization is going to come to "other products within Google Workspace," it will only be available for chat capabilities at first, "providing a helpful digest of chat conversations." Expect TL:DR mode to coordinate with Google's automated transcription and translation services, which are being added to Google Meet.

Will TL:DR Mode ever be better than a curated executive summary? And will it

Google's automated summary or TL:DR Mode for Google Docs.

work on PDF files? We're excited and intrigued, but still a bit wary. And there's no official word yet on when this feature will roll out.

IS GOOGLE GLASS BACK?

When Google killed Google Glass seven years ago, PCWorld wrote that it was down, not out (fave.co/3Mh8dvF). Apparently we were more prescient than we knew.

Google showed off an unnamed augmented-reality prototype at Google I/O with either extremely limited capabilities or an extremely focused perspective—how you see it is up to you. Either way, the new prototype (marked with PROTO-15 on the side of one demonstration model) is strictly focused on communication. Google Glass, with its focus on photos, video, and facial recognition, flopped hard. But the new Glass 2.0 simply listens for the voice of the person you're speaking with and projects a transcript of the conversation on the inside of the glass screens.

Google positioned this new Glass with examples of an immigrant mother and daughter who spoke different languages, and of a man who spoke Spanish but no English. It's hard to say what, or, if, these glasses will be, or whether they'll come to market. But even a "limited" version of Google Glass 2.0 will have utility.

Simple and to the point: this new version of Google Glass could work.

PIXEL WATCH

When Google bought Fitbit last year, you could be forgiven for thinking the eventual fate of the popular activity tracker might be a repeat of Intel's botched Basis buy (fave.co/39kZees). But Google appears to be serious about its acquisition, announcing and showing off the Pixel Watch (fave.co/3st2BXp) after months of leaks and speculation. Fitbit technology will be baked right in.

The Pixel Watch will debut later this year, when Google will announce features like its price, battery life, and so on. On Wednesday, Google showed off features such as sleep tracking and continuous heart monitoring—table stakes for activity trackers that debuted years ago. To be fair, the company has yet to announce the full breadth of the Pixel Watch's capabilities. We know, too, that Google intends that its smartwatch be more than just an exercise monitor, with payment and even home-control functions built in.

Samsung and Apple are the dominant players in smartwatches, with Fitbit and others providing more fitness-oriented bands. Can Google manage to pull off a unified device? We'll have to wait until the Pixel Watch formally launches.

The Pixel Watch will debut later this year.

10 ways to upgrade your work desk for less than $100

These comfy additions to your computer desk won't strain your wallet. **BY MICHAEL CRIDER**

Odds are good that if you have a desktop computer, you spend a lot of time sitting at your desk, either for business or for pleasure. So why shouldn't your desk be as comfy and efficient as possible? While upgrading your computer can often take serious dough (especially these days), you can spend a lot less to improve your workstation itself in some surprising ways.

Here are ten ways to improve your workstation for under $100, presented in no particular order. Most of these cost less than $50, and many are under $25!

1. A FANCY DESK MAT

No matter what kind of mouse you use or what kind of desk you use it on, you need something in between to protect both of them. A $10 mousepad will do just fine,

IMAGE: AFRICA STUDIO/SHUTTERSTOCK

though gamers probably want something bigger. But why stop with big when you can get something freakin' huge, like this 36-inch-wide Corsair mat (fave.co/3L95JxV) that goes under your keyboard and probably your lunch, too? It's only $20. I splurged a bit on this fancy-pants felt mat from Etsy (fave.co/39Yunoh), and it's so comfy I don't think I can ever go back to a normal one.


1.

2. GOOD SPEAKERS

If you're working in an area where you don't need to worry about disturbing others, a decent set of speakers is a great quality-of-life upgrade. The Edifier R1280T (fave.co/3yxy4eT) is a go-to for fantastic audio on a budget. At the time of writing it's on sale for $99.99, neatly fitting into our range. Our guide to the best budget computer speakers (fave.co/3LcGmLP) offers plenty of other top-notch options, too.

2.

3. A GOOD MICROPHONE

A ton of people have found themselves in more video calls these days. While you can get away with a subpar webcam, a bad microphone (or, heaven forbid, just using the one built into your laptop) can be a major hindrance to communication. You want a USB mic to be heard. Blue's Yeti Nano

(fave.co/3PfGttg) packs the same technology that made the original model the go-to for podcasters everywhere in a much smaller and cheaper package.

Our roundup of the best USB microphones for streaming (fave.co/3cuorkE) includes several other killer options for under $100.

3.

4. HEADPHONE/ CONTROLLER HOLDER

If you have a pair of bulky headphones and/or a game controller at your desk, you need a handy place to put them when they're not in use. The answer is, stick 'em underneath or on the side, out of the way but still easily accessible. I love this 3D-printed, double-stacked version (fave.co/3Nbf9uf) that hides underneath my desk surface.


4.

5. A MONITOR ARM

Your monitor takes up a lot of space. So does the stand holding it up. But it doesn't have to: Get a VESA-compatible arm (fave.co/3MoGmtm) in a variety of form factors, and clamp that sucker to the back of your desk. It's especially handy if you're using a multi-monitor setup (fave.co/2Zazegw) or a laptop. (Just make sure your monitor actually has a VESA mounting area on the back before you buy.) Reclaim that lost real estate, so you can use it for something like…


5.

6.

6. WIRELESS PHONE CHARGER

All recent iPhone models and most premium Android phones now come with Qi wireless charging. And if you buy a charger directly from your phone's manufacturer, they're stupid pricey. Since Qi is an open standard, you have tons of choices for charging pads and stands. Personally, I love this series of chargers from Target's house brand (fave.co/3wmzztH). They hide the charging pad in a nice-looking bamboo desk organizer (which comes in three sizes!) and include two bonus USB charging ports.

7.

7. MULTI-DEVICE CHARGER

Of course there are always going to be things you can't charge wirelessly (or times when you can't wait for Qi's inefficiency). To keep an outlet handy at all times, I've used this Belkin mini-surge protector (fave.co/3l9ONwl) for years. Not only is it an easy way to charge up laptops, tablets, and other gadgets (handily secured via Velcro to the edge of my desk), it makes a great travel companion too. Keep this in your bag and you'll be the most popular person at the crowded airport wall outlet.

8. USB HUB

Speaking of things you can never have too much of: USB ports. Desktop users can (and

8.

9.

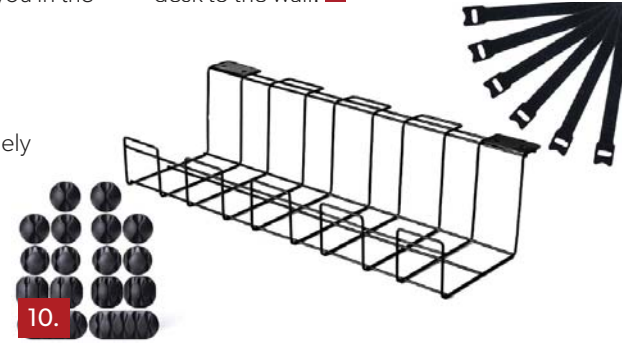
probably should!) expand their ports via PCIe cards, but everyone else could use a solid hub. This $23 one includes USB-A, USB-C, HDMI, and even flash card reader ports (fave.co/3sAuuwO). But there are practically infinite choices for cheap USB hubs, so feel free to shop around and find one that fits your needs. Our guide to the best USB-C hubs (fave.co/30z4JBG) can help point you in the right direction.

9. MONITOR LIGHT

Lighting every inch of your desk solely with the LEDs built into your keyboard actually isn't that great for your eyes. This $50 monitor lamp (fave.co/3wsLOF5) is sort of a 21st-century version of those old green accounting desk lamps. It'll illuminate everything in front of you comfortably, without shining glare directly into your eyes or onto your monitor, and it comes with a handy wireless controller.

10. CABLE ORGANIZATION

Look, I don't mean to be a snob. But all those cables spread all over your desk? They're really untidy. You need to clean 'em up pronto. Luckily it's both easy and cheap: Cable guides (fave.co/3yzJfDG), reusable Velcro ties (fave.co/3MeHcJp), and sleeves for big bundles are easy to find. One of my favorite upgrades for a standing desk is adding big trays in the back (fave.co/37G3nZO), perfect for a surge protector and all your wall-warts. Set it up right and you only need to have one power cord (and maybe an Ethernet cable) running from your desk to the wall.



10.

Microsoft's adaptive PC peripherals are some of its coolest ever

Who wouldn't want an Adaptive Mouse with a variety of custom "tails" that can be swapped out? **BY MARK HACHMAN**

It's very likely that the Microsoft Adaptive Mouse, Microsoft Adaptive Hub, and Microsoft Adaptive Buttons are the coolest PC peripherals Microsoft has ever made.

The three PC peripherals were introduced at Microsoft's Ability Summit, which showcases and elevates the ways the company is trying to make its technologies more accessible for those with disabilities. But what's so fascinating about the new peripherals is that they can be universally beneficial to a variety of users. For instance, the Adaptive Mouse is actually modular, so that it can be swapped between right-handed and left-handed users simply by switching the thumb support.

All three peripherals will be released later this year for an as-yet-undisclosed price, Microsoft said.

Like many Microsoft hardware designs, the new peripherals build on work Microsoft engineers have performed previously. In 2018, Microsoft debuted the Xbox Adaptive

IMAGE: MICROSOFT

Controller (fave.co/3sxXPYN) at that year's E3. The peripheral featured large, accessible buttons, as well as 20 3.5mm jacks on the rear of the device for users to plug in third-party accessibility controls. Last year, Microsoft announced the Surface Adaptive Kit (fave.co/3Nbn8HJ) alongside its Surface Pro 8. The Kit included keycap labels and stickers to highlight keyboard commands and indicate ports—useful for all users, not just those with disabilities.

Microsoft's Gabi Michel shows how the Microsoft Adaptive Mouse can slide into a "tail."

MICROSOFT ADAPTIVE MOUSE

In a demonstration in advance of the Ability Summit, Microsoft's Gabi Michel, director of accessible accessories, showed how the Microsoft Adaptive Mouse is really just the "front" of a typical mouse, with a squarish shape, two buttons, and a mouse wheel. The back is more of a structural addition, known as a "tail." At the bottom of the mouse is a small "eject" button that allows the back to come off.

Essentially, this allows the Adaptive Mouse to be clipped into any number of custom frames, or "tails"—even those a user can 3D print. The thumb support itself can be swapped to either side, providing the ergonomic benefits of a right-handed or left-handed mouse, but the flexibility of an ambidextrous device.

"When we developed and launched the adaptive controller…all of those learnings, all of that interface with the community continued even after launch," Michel said. "Over that time, we continued to listen to the community. And that all influenced what has become the new adaptive accessories for Microsoft: the mouse, the hub, and the buttons."

MICROSOFT ADAPTIVE HUB AND MICROSOFT ADAPTIVE BUTTON

The Microsoft Adaptive Hub serves as a control box of sorts, connecting wirelessly via Bluetooth to up to four Adaptive Buttons as well as standard 3.5mm assistive tech switches, Microsoft said.

The Microsoft Adaptive Button is as intriguing as the Microsoft Adaptive Mouse,

or even more so. While it looks like nothing more than a giant button, it's actually a control that can rock into any of eight directions. Those digital inputs can be used for multiple functions, as eight discrete inputs. Naturally, each input can be programmed for something as simple as a keyboard shortcut or as complex as a long macro.

The Button controller can also be "replaced" with a custom "topper," too. Toppers can include, say, a traditional or custom joystick or a two-button input, executives said.

The Adaptive Button hearkens back to the Surface Dial, another PC peripheral that could be used as an adjunct control for adjusting the zoom on a tablet like the Surface Pro 8 or Surface Studio. Microsoft now calls the Surface Dial the Surface Dial for Business (fave.co/3LbjWdX), priced at $100.

Microsoft's Ability Summit will also show some of the improvements that Microsoft has made to its software and operating system, including Narrator, Focus Sessions (fave.co/3n4ZuBp), and the newly introduced Live Captions feature. The latter capability, currently part of the Windows Insider Program, expands on the live captioning found within Microsoft Teams, YouTube, and elsewhere on the web, and applies it within Windows to videos that users have stored on a hard drive.

The Microsoft Edge browser, for its part, was designed with Immersive Reader to eliminate distractions, as well as a read-aloud feature; in February, Microsoft added the capability for Edge to auto-suggest alt-text captions describing images found on a webpage.

Still, it's the new Adaptive Mouse, Hub, and Buttons that are most intriguing. If a one-touch peripheral that can be used as a shortcut to various macros appeals to you, then Microsoft's new Adaptive hardware is worth keeping tabs on.

Microsoft Adaptive Hub (background) and the Microsoft Adaptive Button.

Dell has just unveiled the ultimate Zoom laptop

From webcam controls embedded in the touchpad to an automatic privacy shutter, the Latitude 9330 is tailored for videoconferencing. **BY MARK HACHMAN**

Today, Dell announced the Dell Latitude 9330, a 13.3-inch convertible laptop optimized for videoconferencing, with controls baked into the touchpad and a camera that slides shut when not in use.

The Latitude 9330, like many laptops, already includes universal mic controls in the row of function keys at the top of the keyboard. That key can be used to turn the mic on and off for all applications. But a secondary "key"—more like a region of the touchpad—can also be used to mute or unmute yourself during a video call. Three other webcam "buttons" can be used to open a chat window, share your screen, and enable or disable the camera.

The Latitude 9330 will be part of the new generation of laptops that use Intel's 12th-gen Alder Lake processor, including vPro options. Dell offers both Windows 11 Home and Pro, as well as a Windows 11

IMAGE: DELL

Downgrade option that is actually just a Windows 10 image.

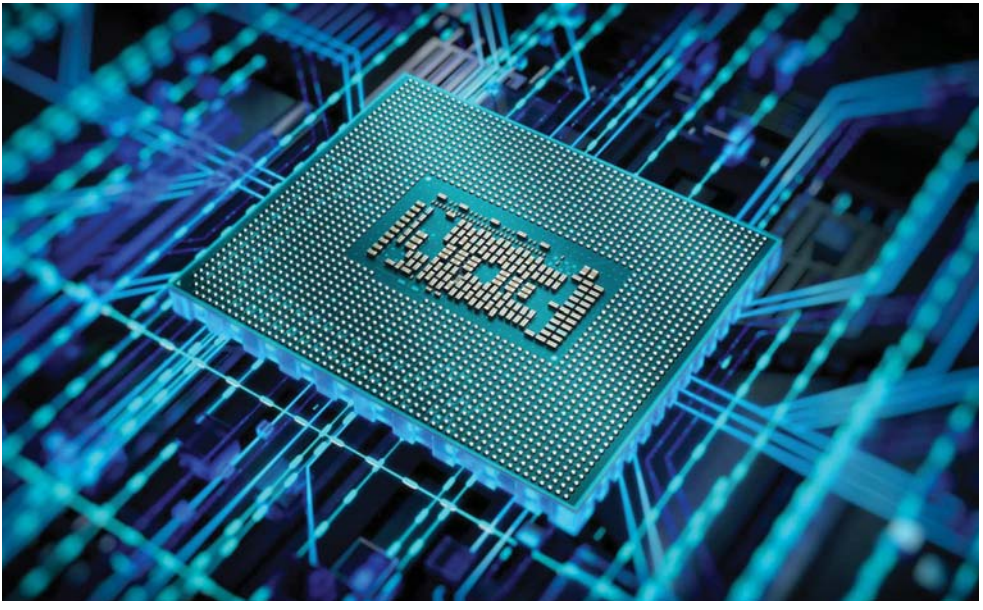
Otherwise, however, it's the videoconferencing experience that sets the Latitude 9330 apart. For one thing, the included webcam is full HD, recording a 1080p image as well as logging you in via Windows Hello. (If that's not enough, Dell is also one of the few vendors to sell a 4K webcam, the Dell 4K UltraSharp [fave.co/3L6APqn], one of our best webcams of 2022 [fave.co/3ldPmFL].) The laptop also includes Intel's IPU6 technology for improved clarity, assisted by four noise-canceling mics and four speakers, two of which fire up and down. What's rather nifty is what Dell calls SafeShutter, which uses an electromagnetic shutter to snap a physical barrier over the webcam when it's not actively being used.

The Latitude 9330 also includes what Dell calls Onlooker Detection, a technology that uses the webcam to detect when someone may be standing behind you, reading your screen—as well as Look Away Detect, where the webcam "sees" you looking away. In both cases, the laptop can either obscure your data or dim your screen, both for security and to save power. Dell has had a feature like the latter for a few years, which "looks" to see if you have looked away or walked away and turns off your display if so. Windows Hello is then used to unlock your PC.

Otherwise, the Latitude 9330 specs are dialed up a bit; the display isn't 1080p or even 1440p, but a 2560×1600 touch display, with Gorilla Glass 6 DX protecting it. The display also outputs 500 nits maximum, suitable for working outdoors—with or without the optional Qualcomm Snapdragon X20 LTE modem. Memory options range up to 32GB LPDDR5 (5200MHz) with up to a terabyte of M.2 storage or a 256GB self-encrypting drive.

Intel propels laptops to 16 cores with ferocious Core HX laptop CPUs

Move over, Core i9-12900HK. Intel is adapting its desktop processor to create the Core i9-12950HX. **BY MARK HACHMAN**



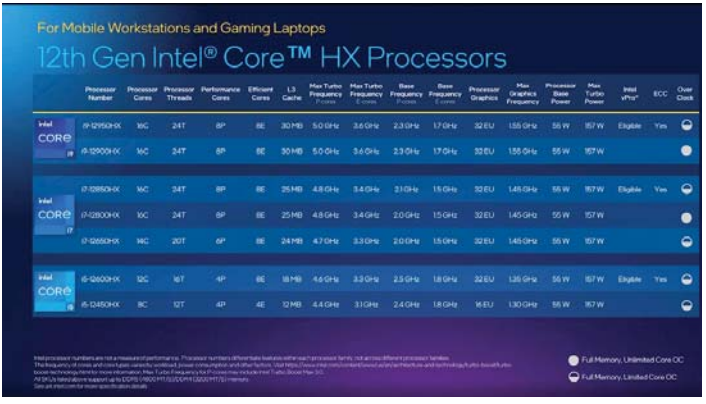
Intel has announced the 12th-gen Alder Lake-HX (12th-gen Core HX) processor series, splitting the difference between an extreme gaming processor and one designed for workstations and content creation. The flagship, the Core i9-12950HX, is the company's first 16-core chip designed for laptops and will run as fast as 5GHz across its eight performance cores and eight efficiency cores.

If the product designation sounds familiar, it should. AMD launched its own Ryzen 5900HX (fave.co/3I6kG9H) at CES in January, which they called the "world's best processor for gamers." While Intel isn't making a similar claim, the company is saying you'll see this chip in the most extreme gaming laptops as part of Intel's H-series chips for enthusiasts.

Daniel Rogers, senior director of mobile product marketing within Intel's Client

IMAGE: INTEL

Computing Division, said that the 12th-gen Core HX platform was "built specifically for professionals in the field who need low latency access to data for their entire working data set in their computer to do very computational tasks in the field." Rogers also said that the Intel Core i9-12900HK is "actually the world's best gaming processor" (see PCWorld's Core i9-12900HK review [fave.co/3sbkwCh] for more context), but the "HX is a great gaming processor as well."



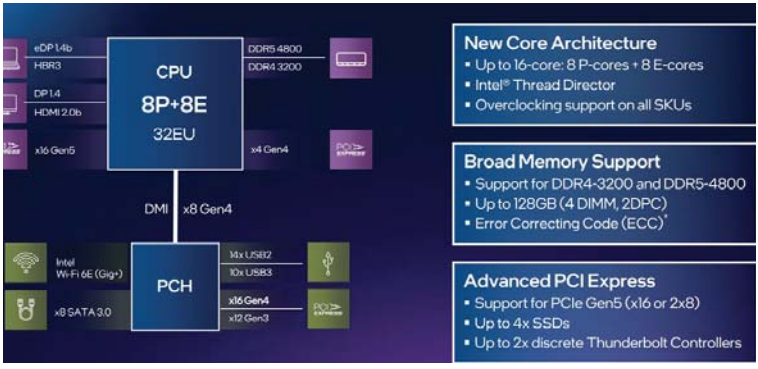
Intel's 12th-gen Core HX (Alder Lake-HX) processor lineup.

Performance-wise, the Core i9-12950HX is 17 percent faster in single-threaded performance than the Core i9-11980HK and 64 percent faster in multi-threaded performance using the SPECint_rate_base2017 benchmark. Expect to see the HX processors inside the Asus ROG Strix Scar 17 SE, the Gigabyte Aorus 15X/17X, the MSI GT77 Titan, the Lenovo Legion 7i, the Dell Precision 7670/7770, and the HP Omen 17.

INTEL 12TH-GEN CORE HX BASIC FEATURES

The 12th-gen Core HX platform isn't a single processor, but seven of them. Ranging from the 2.4GHz/4.4GHz (turbo) 8-core Core i5-12450HX on up to the 16-core Core i9-12900HX, all of the chips consume 55W. That's 10 watts more than the 12900HK. Like other Alder Lake chips, they use a mix of performance and efficiency cores, managed by Intel's Thread Director technology in Windows 10 and 11. In the Core i9-12950HX, for example, the chip runs at 2.3GHz base and up to 5.0GHz turbo with a mix of 8 P-cores and 8 E-cores for a total of 24 threads.

In fact, Rogers said that Intel adapted the desktop version of the Alder Lake chip to create the mobile HX family, eliminating the "lid" from the desktop package in favor of a laptop-friendly BGA package. Though it doesn't seem like much, Rogers said that it was necessary to reduce the height of the chip to fit it within a notebook complete with cooling. There's another sacrifice, too. Like



Intel is offering a different I/O scheme for the 12th-gen Core HX platform than what it had on the 12th-gen Core HK platform.

Intel's F-series processors, none of the HX processors includes integrated graphics.

All of the 12th-gen Core HX family is unlocked for overclocking, including memory (DDR4 and DDR5) overclocking, though some of the processor models come with their own restrictions.

"We can have absolute high frequencies for the best possible performance and the desktop form factor," Rogers said in a pre-recorded presentation. "And then we take the same CPU layout, but we optimize that both on the process and on the design side to deliver mobile class efficiency and performance together."

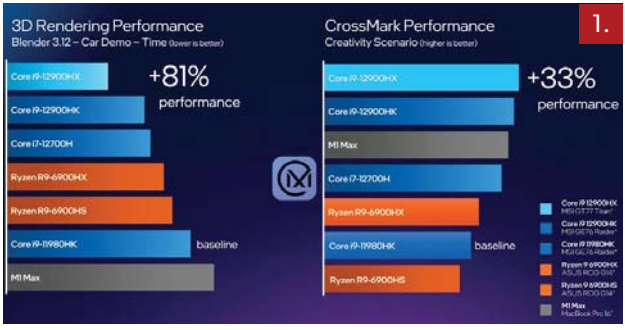
Interestingly, Intel didn't ship the "all performance core" chip that some were expecting. But Nick Blair, part of Intel's enthusiast laptop innovation team, said that the company had worked with developers like Creative Assembly to optimize games like *Total War: Warhammer III* to use both the performance cores and the efficiency cores at the same time.

The HX platform preserves the advanced features of the Alder Lake platform, including the x8 DMI data connection between the CPU and Platform Control Hub, as well as the 16 lanes of PCI Express 5 (plus four lanes of PCI Express 4) off the CPU. An additional x16 PCIe4 and x12 PCIe3 connection hangs off the PCH. That's somewhat different from Intel's Core i9-12900HK chip (fave.co/3IjREg4), which did not include PCIe 5 support—though Intel executives said the 12900HK was PCIe5 compliant. There are two other interesting differences.

First, the HX platform supports two discrete, external Thunderbolt 4 controllers, while the HK platform integrated them. But the HX platform includes up to 14 USB2 and 10 USB3 ports, which is far more than the older HK platform.

Some of the differences can be explained away by the target audience, which includes data analysts who need fast, error-free access

to data. Those PCI Express lanes enable four local SSDs for up to 16TB of local storage, which can be placed in a RAID configuration for even more performance or redundancy. Compared to the HK platform, memory options are slightly more limited with the option of either DDR4-3200 and DDR5-4800 (4 DIMMs up to 128GB at 2 DIMMs per channel). There's also the option of using Error Correction Code (ECC) memory.

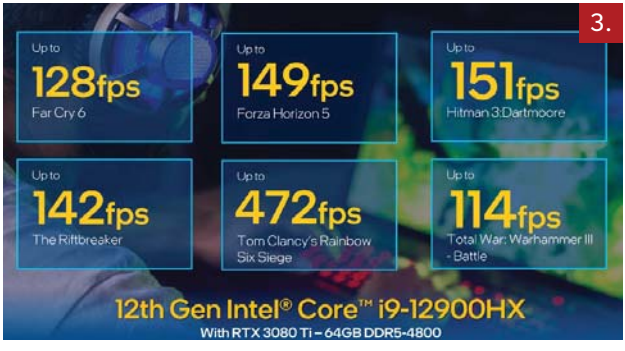


INTEL 12TH-GEN CORE HX PERFORMANCE

Intel believes the Core i9-12900HX is faster than the i9-12900HK, the i9-11980HK, and the Ryzen R9-6900HX. However, the company isn't saying exactly how much. Intel provided benchmarks from CrossMark (**1**), Blener, and Unreal Engine 5.0 (**2**).

Naturally, the Alder Lake-HX series is superb for gaming. Here, Intel didn't provide comparative benchmarks, but it's hard to argue that the chip won't offer silky-smooth gameplay with 400-plus frames per second on games like *Tom Clancy's Rainbow Six Siege* (**3**).

"We've sort of saved the best for last—bringing this brand-new HX processor to life," Rogers said.



Your Amazon Kindle can finally read ePub books

The Send to Kindle service now automatically converts ePub files to Amazon's proprietary format. **BY MICHAEL CRIDER**

Amazon might be feeling the competition in the e-reader market for the first time since… well, ever. Kindle e-readers use their own proprietary Amazon format to display e-books, AZW3, which keeps most users from loading up a bunch of copyright-free books in the most common ePub format. But thanks to a new software rollout, the underutilized Kindle Documents Service (fave.co/3svh5pJ) now automatically converts ePub files to Kindle-friendly AZW3.

Combined with the Send to Kindle tool (fave.co/3NfHpMA), that makes it much, much easier to shoot an ePub file over the local Wi-Fi network to your Kindle reader in a

IMAGE: AMAZON

few short seconds, either via the desktop or uploaded on the web. The change was spotted by Good E-Reader (fave.co/39lug5Z). It was previously possible to convert ePub files to another format, like Mobi, then manually transfer them to Kindle via USB or the Documents Service, without too much difficulty. But the new change means that you can do all of that without any third-party software.

Kindle refusing to allow easy use of the most common open digital book standard was a glaring downside to Amazon's mostly closed system. An analogy might be the Sony-branded MP3 players from the early 2000s which didn't *actually* play MP3s (fave.co/3MjxIwo), instead insisting users convert all their music to the proprietary ATRAC format. Amazon announced support for ePub files in the Send To Kindle and Kindle Documents Service earlier this year (fave.co/39lug5Z).

This is entirely speculative on my part, but it seems to me the widening market of ebook readers is making Amazon sweat a little. Kindle models have iterated in teeny-tiny increments for years, only gaining USB-C charging support (fave.co/3tYgr5x) on the latest models. Meanwhile competitors like Onyx (fave.co/3ywIKeS), Xiaomi (fave.co/3yBxInr), and Pocketbook (fave.co/3svZq12) have been offering tons of new tech and form factors. These more versatile devices generally run Android, meaning they can access Kindle libraries via Amazon's app on top of easily loading up DRM-free files. That's saying nothing of innovations like color e-ink and stylus support.

In the small but dedicated niche of ebook power users, Amazon is often the very last choice. Hopefully this change signals that Amazon is ready to stop relying on its market position and actually compete on features. Our roundup of the best Kindles (fave.co/3cc10wH) can help you find the perfect model for your needs.

Amazon's competitors, like Onyx (pictured here), have been offering loads of new tech and form factors.

5 things you need to know about AMD's Ryzen 7 5800X3D processor

Anyone considering this chip should first evaluate if it suits their needs. **BY ALAINA YEE**

The wait for AMD's Ryzen 7 5800X3D (fave.co/38tNIT9) and its exciting new V-Cache technology (fave.co/3owp5UE) is over. At long last, this revolutionary processor finally hit retail shelves on April 20. But unlike other Ryzen 5000 series CPUs, this particular chip shines in specific scenarios—and dulls a bit in others.

Last week's drop of independent benchmarks explains the full story, but you don't have to comb through endless charts to understand the situation. We've pulled out

VIDEO: **SHOULD YOU UPGRADE YOUR AMD RYZEN TO 5000?**
Watch now at fave.co/3MhigRk

IMAGE: FOUNDRY

the top pieces of information to get you up to speed quickly—and help you decide if the 5800X3D is for you.

The 5800X3D trades blows pretty well with Intel's Core i9-12900K, but the winner in individual game benchmark results varies.

IT'S FAST IN GAMES…

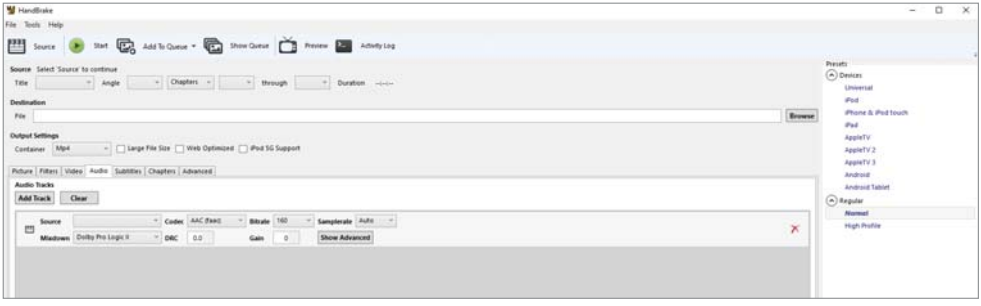
Among its fellow Ryzen 5000 CPUs, the 5800X3D takes the crown as the fastest of the bunch in gaming. At 1080p High or Ultra, it improves upon the standard 5800X's performance by as much as 44 percent, depending on the game. More commonly, the average gain falls between 22 and 28 percent. At 1440p, you're looking at an average improvement of around 11 percent.

This new processor also holds its own against Intel's top chip, the $589 Core i9-12900K (fave.co/3FgvPfZ). In fact, the battle between the 5800X3D and 12900K largely ends in a draw. That's not to say they offer equal performance. You'll often see a clear winner in individual games, but it shifts back and forth. For example, at 1080p, the 5800X3D might outpace the 12900K by 5 percent in one title, but in another, the 12900K comes out on top by 7 percent. The story is similar at 1440p, though the delta shrinks a little. Occasionally, 12900K will scrape out a double-digit advantage when paired with DDR5 memory. For all the nitty-gritty details, take a comprehensive tour of 5800X3D reviews across the web—for example, Tom's Hardware (fave.co/3Nawkw4), TechSpot (fave.co/38tNvdd), GamersNexus (fave.co/37lQTAC), and PCGamer (fave.co/3yCixKQ).

In aggregate, the benchmarks can give a small advantage (about 2 percent) to either chip, depending on the games used for testing. So in short, if you have a particular game that you play all the time, look into its benchmark results. Otherwise, the 5800X3D makes staying with AM4 and DDR4 still seem appealing—in specific scenarios, anyway. More on that in a moment.

…BUT SLOWER IN PRODUCTIVITY TASKS

While the 5800X3D screams in games, it's noticeably slower than its competitors when it comes to non-gaming applications. Think rendering, encoding, even Adobe Photoshop—situations where very often time is money.



The 5800X3D has slower performance in tasks like encoding compared to the standard 5800X.

In multi-threaded work, the Core i9-12900K (16 cores, 24 threads) and Ryzen 9 5900X (12 cores, 24 threads) leave the 5800X3D (8 cores, 16 threads) in the dust. Benchmark results can give a lead as big as 39 percent to the 12900K, and upward of 25 percent for the 5900X. Even when pitted against the standard 5800X, the 5800X3D shows a dip of 5 to 6 percent in performance. Single-core performance also drops, with the percentage ranging between mid-single digits to low teens.

IT CAN'T BE OVERCLOCKED

One of Ryzen's advantages over Intel Core processors has long been the ability to overclock any chip. Not so with the 5800X3D. You can't improve its performance in this manner (fave.co/3PjAFPw).

At the time of the reveal, Director of Technical Marketing Robert Hallock confirmed that the option to adjust voltage or frequency for the 5800X3D in a motherboard's UEFI interface would be locked out. He also explained that the feature was removed because of the chip's 3D V-Cache, which requires a hard-coded voltage limit.

So unfortunately, you get what you get with the 5800X3D. You can't coax out extra freebie performance and smooth out that difference between it and the standard 5800X in non-gaming applications.

IT COSTS MORE THAN A RYZEN 9 5900X

Yes, you read that right. At $450, the AMD Ryzen 7 5800X3D is currently more expensive than a Ryzen 9 5900X.

While that amount is the same as the standard 5800X's 2020 launch price, the street prices for the 12-core, 24-thread 5900X have dropped well below its MSRP of $550. As of late, the 5900X has been sitting at just under $400. In fact, at the time of this article's publish, Amazon is offering it for $394—and even briefly marked it down to $383 the week prior to compete with Antonline's eBay store price of $382 (fave.co/3wc1eyl).

The 5800X3D is also over $100 more than

Right now, you can buy a Ryzen 9 5900X for $50 less than the 5800X3D. Yep.

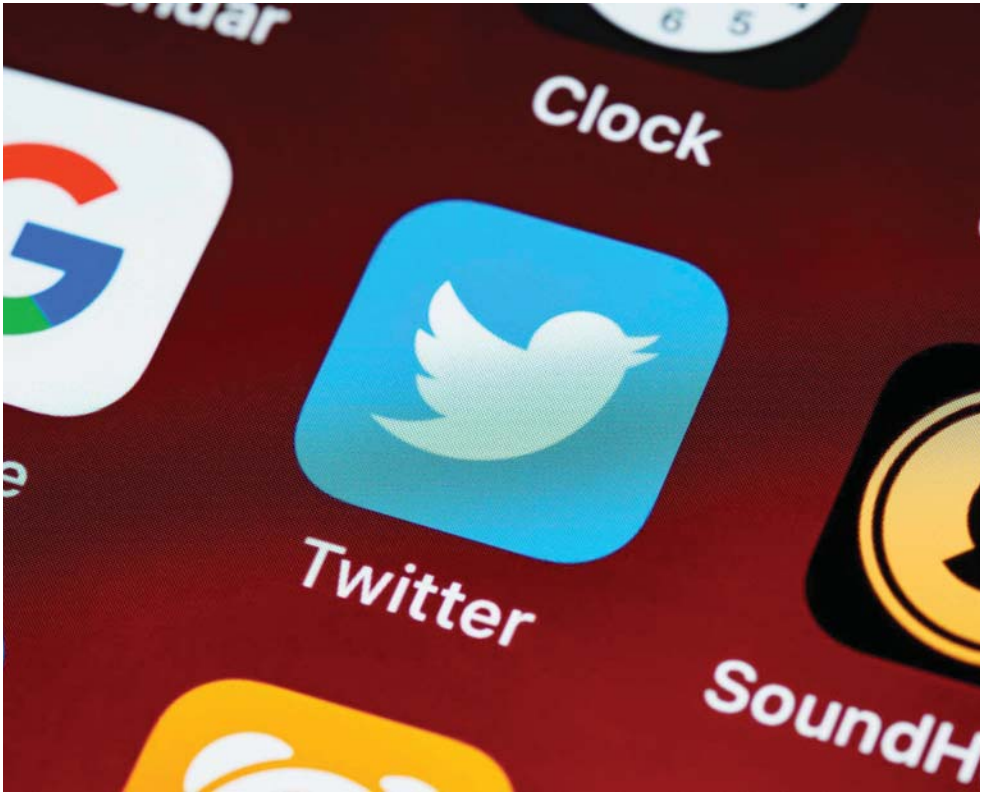
the current street price for the standard 5800X. Right now you can find it on Amazon and other retailers in the neighborhood of $340 (fave.co/3FOm22b). Price-sensitive builders will need to see 5800X3D's top-notch gaming performance as a priority for it to offer enough value to convince them.

IT'S BETTER FOR UPGRADES IN SPECIFIC CASES

You're not wrong if you're thinking at this point that the 5800X3D sounds like a bit of a niche chip. Because of its laser focus on gaming, this processor really works best for people in two camps. In the first group are those who can't afford the extra $100 for a Core i9-12900K but still want the best gaming performance possible—so much so that they're willing to ignore the cheaper $385 Core i7-12700K, which is only a little slower in games but performs more equally across the board.

In the other group are people with older Ryzen systems who could use a boost—anyone with a chip from the Ryzen 3000 series or earlier. (Spoiler: We might just have some data about that coming soon.) The real winners are people like PCWorld's very own Brad Chacos, who still has a Ryzen 7 1800X and a X370 board (fave.co/3NawEeg). Thanks to the magic of AMD's AM4 platform, first-generation Ryzen PCs can move up to gaming performance nearly on par with a 12900K at less than half the cost. Talk about a kickass reward for all the early Ryzen adopters out there.

Those who built first-gen Ryzen systems can supercharge their systems by swapping in a 5800X3D. (Above: PCWorld Exec Editor Brad Chacos' 1800X + X370 combo.)



3 practical reasons to use Twitter

This social media service isn't just for shouting into the void. **BY ALAINA YEE**

Twitter's reputation for being a place flooded with memes, hot takes, and abundant photos of meals isn't unfounded. But there's still a use for Twitter even if you don't love arguing with internet strangers or wading through endless jokes. In fact, it can save you time and headache when used judiciously. Here's how.

1. BETTER CUSTOMER SERVICE

Few things irritate (or spark full-on rage) as much as shoddy customer service. When chat or phone isn't connecting you to anyone who can help, try Twitter instead.

All kinds of businesses are easy to reach via Twitter, including banks and some

IMAGE: BRETT JORDAN / PEXELS

Check a company's tweets and replies to see if it has an active presence on Twitter—and how attentive the responses seem to be.

utilities. You should first check a company's tweets and replies to see if it responds to customer inquiries (and how quickly), but these days most companies do. Some even have dedicated Twitter accounts for customer service.

Seeking customer support in this manner has two benefits: First, you'll save time. You can fire off an @ reply or a direct message to the company, then go about your life as you wait to hear back. Generally responses are fairly quick. The human on the other end will often use direct language that addresses your concern, too, rather than following a script.

Also, Twitter-based support teams often have more leeway when helping with a problem. Even if you've already given the phone system or online chat a shot, reaching out over Twitter may resolve your issue more fully.

One note on security and privacy: For some businesses (like airlines, cell phone companies, and banks), you may be asked to confirm your identity by verifying account details over direct message. As always, treat that information with care—you're not obligated to share anything that makes you uncomfortable. If that prevents the rep from helping you further, ask for a more direct phone service line, or if you have a complicated issue, a method to contact higher tiers of support.

2. NEWS UPDATES

Twitter is a great tool for staying up to date—and not just with breaking news, but daily

Your area likely has an equivalent source for traffic and public transit updates.

commute info, advances in fields or topics that interest you, and public figures.

A fine line does exist between speculation and actual news, so choose the accounts you follow wisely. Local news agencies are a great place to start, as they provide updates on your area while also passing on the hottest national news. You can follow several outlets to get the kind of coverage you seek. Even radio stations have a Twitter presence—for example, KCBS, one of the SF Bay Area's best sources for regular updates on traffic and public transit, tweets out its valuable alerts (fave.co/3wkKzre).

Of course, you can hear the latest straight from the horse's mouth on Twitter, too. Continuing with the news and commute theme in California, our state's highway patrol posts information about traffic conditions, with specific accounts for different regions (fave.co/3FRRhcL).

Some people make it their livelihood to help you find the best deals and hard-to-get items. For example, Wario64 is an excellent source for PS5 and Xbox console availability.

When choosing accounts to follow, make sure you have the official account by looking for a verified mark next to the name. (It's a small checkmark inside a circle with scalloped edges.) Parody and duplicate accounts sometimes exist, so looking for that symbol ensures you've got the right agency or person, especially if you start keeping up with individuals like reporters and notable figures in science or medicine.

3. BARGAIN HUNTING

Many resources exist for finding the lowest prices on goods and gear—websites, forums, email newsletters, Reddit, Discord, and more—and you can include Twitter on that list, too.

All kinds of accounts are dedicated to spotting and passing on deals to the public. The platform aggregates a variety of sources: deal websites staffed by dozens of people, crowdsourced deal sites, individuals who always have the inside scoop. They're all gathered in this one spot. Businesses sometimes also advertise coupon codes and special promos through their Twitter accounts, too.

The best strategy for deal hunting on Twitter is to stay organized. At minimum, make use of Twitter Lists (fave.co/39nfnjh), so that you're not blasted by a firehose of nonstop information. Pair that with Tweetdeck (fave.co/37IU4Z8), a desktop-based interface that lets you see multiple lists at one time,

and you'll be able to skim through the information much more easily.

You can also enable push notifications for select accounts if you want immediate notice of every tweet (aka bargain), but that can get spammy—this strategy is best paired with a service like IFTTT, which you can use to filter for keywords and push only tweets that match those terms to you.

BONUS: TIPS FOR A BETTER TWITTER EXPERIENCE

Twitter Lists and Tweetdeck

As touched on in the bargain hunting discussion, you can avoid information overload when you're using Twitter through a couple of the service's features: Twitter Lists (fave.co/39nfnjh) and Tweetdeck (fave.co/37IU4Z8).

Twitter Lists allow you to group select accounts together for a curated view. You can have as many (or as few) accounts on a list as you like—and you can throw them together completely at will. If you want to make "tech reporters who cover CPUs and also share funny cat memes" a thing, you can have at it.

Tweetdeck then makes it possible to view multiple lists at the same time. This desktop interface, available via browser or a macOS app, lets you add lists and sort them in any order. You can then take in at a glance many different tweets at once, which makes it easier to skim for noteworthy ones.

Push notifications

For select accounts that don't tweet often—or who constantly tweet info you want to stay on top of—you can enable push notifications just for those accounts. First enable push notifications in your Twitter account settings, then go to the account you want them for and click on the bell icon. You don't have to follow an account to get notifications of its tweets.

A small sample of what Tweetdeck can look like when populated with your Twitter Lists.


WHEN THE GAMES BEGIN.
NEVER GIVE UP
UNTIL THEY BUCKLE UP.
VISIT SAFERCAR.GOV/KIDSBUCKLEUP
NHTSA
www.nhtsa.gov
Ad Council

TESTED IN PCWORLD LABS
WE PUT HARDWARE & SOFTWARE THROUGH RIGOROUS TESTING

Tested: Arc A370M, Intel's first discrete GPU to seriously battle Nvidia and AMD

Intel's entry-level discrete GPU holds its own against Nvidia's RTX 3050. **BY MATT SMITH**

It's finally happening.

After several years of teases, leaks, hints, and one extremely soft desktop graphics card (fave.co/3IwdUdD), Intel's debut Arc discrete GPUs are finally arriving in mainstream notebooks (fave.co/3If4i6Q) like the Samsung Galaxy Book2 Pro and Lenovo Slim 7i (fave.co/3wfxBMB).

But how well do they perform? To find out, I paid a visit to Intel's Jones Farm campus in Portland, Ore., where Intel invited me to put an Arc A370M reference laptop (based

VIDEO: **INTEL ARC A370M PERFORMANCE VS RTX 3050**
Watch now at fave.co/39jjBsl

IMAGE: INTEL

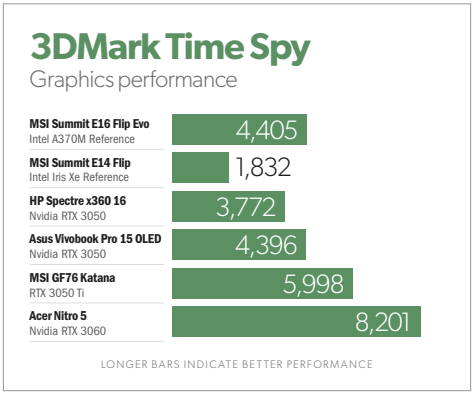
off MSI's Summit E16 Flip Evo) through the wringer. I was given a little more than an hour to test Intel's entry-level GPU using benchmarks of my choosing, in a similar arrangement to our recent early performance preview for 12th-gen Core i9 laptop processors (fave.co/3wg1xlw).

Bottom line? Intel might just be getting started in discrete graphics, but Arc's results are already impressive.

3DMARK TIME SPY

We start in 3DMark Time Spy, a classic synthetic graphics benchmark PCWorld frequently uses to judge the performance of anything that comes across our test bench.

The Intel Arc A370M posted a strong score of 4,405 in 3DMark Time Spy. This is almost two and half times quicker than Intel Iris Xe on its own, a significant uplift that certainly puts the Arc A370M in a different performance class.



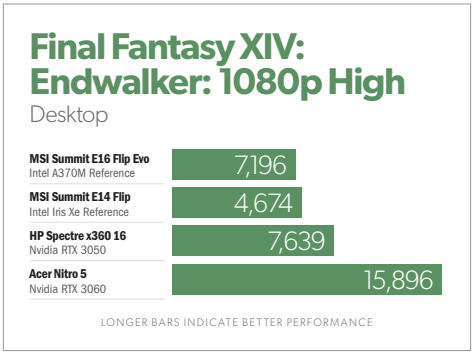
Of course, it's the entry-level discrete GPUs that provide the real challenge, and here the Arc A370M holds its own. It's roughly 15 percent quicker than Nvidia's RTX 3050, as tested in HP's Spectre x360 16, and essentially tied with the Asus Vivobook Pro 15 OLED (fave.co/3lf4nra), which again equipped an Nvidia RTX 3050.

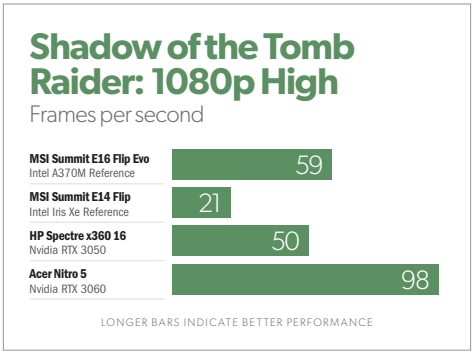
Perhaps unsurprisingly, the Arc A370M falls behind the more mid-tier discrete graphic options found in laptops that explicitly target gaming. The RTX 3050 Ti in the MSI GF76 Katana (fave.co/3yF9xVo) is just a bit less than 50 percent quicker, and the Acer Nitro 5 with an RTX 3060 nearly doubles the Arc A370M's performance in this benchmark.

FINAL FANTASY XIV: ENDWALKER BENCHMARK

The game tests begin with *Final Fantasy XIV: Endwalker*. This is not a test PC World normally runs but, given that the Arc A370M is an entry-level discrete offering, I thought testing an older, popular game with no cutting-edge features could provide some insight. After all, many people (myself included) spend more time in games like this than in *Cyberpunk 2077* or *Metro Exodus*.

This test pegs the Intel Arc A370M's performance a bit less than 50 percent above that of Intel's Iris Xe graphics with 96 EUs. It's a much smaller gain than in 3DMark Time Spy, but still large enough to substantially improve the real-world experience. The Iris Xe just gets





by at 1080p and High (Desktop) settings, while the A370M is rather smooth.

Intel's reference laptop with the Arc A370M falls slightly behind the HP Spectre x360 16 with RTX 3050 in this benchmark, but the margin of victory is so small that it's a hair away from being a tie. I doubt most players would see any real-world difference playing *Final Fantasy XIV* on each system.

Of course, the Acer Nitro 5 is in a different realm, as expected given its use of Nvidia's RTX 3060. This sort of mid-tier discrete GPU lets players set their sight well beyond 60 FPS and gain benefit from a high-refresh display.

SHADOW OF THE TOMB RAIDER

Shadow of the Tomb Raider is now four years old, but remains an excellent game for gauging how well a PC will handle the most attractive games of the "last-gen" console era.

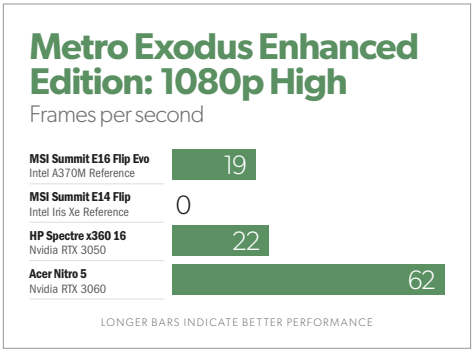
The Intel Arc A370M provides a beefy gain over the Iris Xe here, coming oh so close to an average of 60 frames per second. The Iris Xe can't really handle this game at 1080p and Highest settings, struggling along at an unacceptable average of 21 (with many dips into the mid-teens).

The Arc A370M also beats the HP Spectre x360 16 with the Nvidia RTX 3050 by more than 15 percent, a greater margin than I expected. That's a nice boost and shows that the Arc A370M can indeed beat Nvidia's entry-level graphics in some situations.

Once again, the Acer Nitro 5 with RTX 3060 shows the difference between a mainstream laptop with entry-level discrete graphics and a "real" gaming laptop, beating all competitors handily.

METRO EXODUS ENHANCED EDITION

We come last to *Metro Exodus Enhanced* Edition, the most demanding game I tested, and the only game I tested with ray tracing on. Even then, I used only the High graphics



preset, which sets ray tracing to its lowest "normal" setting and uses hybrid reflections instead of fully ray-traced reflections.

The Intel Arc A370M beats the Iris Xe by an infinite percentage because, well, the Iris Xe doesn't meet the game's minimum system requirements. *Metro Exodus Enhanced Edition* is unusual because ray tracing is required to run the game at all. That leaves the Iris Xe out in the cold of nuclear winter.

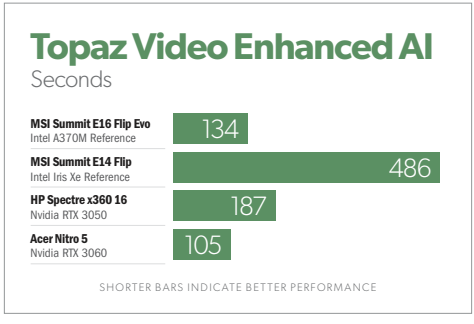
The Arc A370M slugs it out with the HP Spectre x360 16 with RTX 3050 graphics and ultimately loses by three frames per second. That reflects a 15 percent performance advantage for the RTX 3050, and hints that the Arc A370M may fall slightly behind in ray tracing relative to Nvidia's hardware.

Acer's Nitro 5 with an RTX 3060 once again stomps everything else in the field, beating both the Arc A370M and RTX 3050 machines by a threefold margin. This thumping may have something to do with the more limited 4GB of video memory available on the Arc A370M and RTX 3050, compared to 6GB on the RTX 3060. Ray tracing is notoriously memory intensive.

TOPAZ VIDEO ENHANCE AI

The last test is different—a content creation workload. Topaz Video Enhanced AI is a tool that can upscale or improve the quality of video clips. I've used Topaz Video Enhance AI to upscale videos for my own YouTube channel, Computer Gaming Yesterday (fave.co/3FLY4oo), and I've found discrete graphics can provide a serious lift in this app's performance.

One quirk to note is that I ran this test using Topaz's experimental multi-GPU support. Intel collaborated with Topaz to make this feature work with Intel hardware. Intel Arc systems can use both the Arc discrete graphics and Xe integrated graphics simultaneously, one of the unique and intriguing "Deep Link" features (fave.co/3If4i6Q) offered by Intel Arc laptops with Intel Core processors. I did try using this experimental feature with the Nvidia laptops I had for comparison, in which case the Nvidia



GPU was paired with Iris Xe integrated graphics, but it made performance significantly worse. So for those systems, the results below show performance when running only on the Nvidia GPU.

Comparing Intel's Arc A370M to the Iris Xe shows the advantage of using even entry-level discrete graphics for content creation. The Arc A370M cuts through the sample clip nearly four times faster than the Iris Xe laptop. This could literally save you hours if looking to upscale video files more than a few minutes in length.

The HP Spectre x360 16 was one of the systems we benchmarked.

The Arc A370M proved about 40 percent quicker than the HP Spectre x360 16 with Nvidia RTX 3050 graphics. That is a very significant win. The Arc scores a larger margin of victory over the RTX 3050 here than in other tests, which shows Intel's hardware is using the experimental multi-GPU support to its fullest.

HOW WE TESTED

These tests were performed on the Intel Arc A370M reference laptops located at Intel's Jones Farm campus. I was given access to not one but five identical reference systems, which meant I was able to repeat test runs multiple times to verify results. The results here are averages of systems tested.

Intel also provided an Alder Lake reference system, the equivalent of an MSI Summit E14 Flip, to provide comparison to Intel's Iris Xe graphics. The other systems benchmarked, including the HP Spectre x360 16 (fave.co/3FRY6v4) and Acer Nitro 5, are review systems not provided by Intel. The Intel reference platforms and HP Spectre x360 16 were set to performance power management, while the Acer Nitro 5 was at its default setting.

Here's the run-down on settings for each benchmark.

3DMark Time Spy: Time Spy standard demo at default settings.

***Shadow of the Tomb Raider*:** DX12 1080p Highest settings, Ray Tracing off, TAA on.

***Final Fantasy XIV: Endwalker*:** 1080p at Highest (Desktop) settings.

***Metro Exodus Enhanced Edition*:** 1080p at High benchmark settings.

Topaz Video Enhance AI: An eight-second 1080p MOV file was upscaled to 4K using the Artemis Medium Quality AI model.

VERDICT

What most gamers and enthusiasts want to know is simple: Can you buy a laptop with Intel's Arc and expect performance in league with Nvidia and AMD?

The answer, it seems, is yes.

These are strong results for Intel's Arc A370M. The quicker of Intel's two entry-level discrete GPUs appears to be an even match for Nvidia's GeForce RTX 3050 as implemented in a variety of mainstream professional and enthusiast notebooks (though initial Arc laptops cost much more [fave.co/3PAqt5t] than RTX 3050 notebooks). Intel Arc A370M can easily handle "last-gen" 3D games and can deliver a big boost in content creation apps that lean on the GPU.

The Arc A370M is no match for the Nvidia GeForce RTX 3060 in Acer's Nitro 5, but it's not meant to compete in that segment. That task will go to Intel's Arc A550M, which has twice as much memory (8GB versus 4GB) and twice as many Xe Cores (16 versus 8) (fave.co/3uSJzLM) when compared to the Arc A370M. We'll have to wait and see how the Arc A550M performs when it arrives this summer, but napkin math suggests it could be nipping at the heels of RTX 3050 Ti and RTX 3060 laptops.

I'm pleased with these numbers. Intel Arc provides a third option for people seeking a slim, portable Windows laptop to handle gaming and content creation. Now let's just hope Intel—and OEM system manufacturers—can turn the current trickle of Arc-equipped machines into a flood.

Intel's Arc A370M produced strong results.

Dell U3223QE: A winning debut for an IPS Black monitor

Using LG's IPS Black tech, this monitor delivers a top-notch experience. **BY MATT SMITH**

PCWorld EDITORS' CHOICE

The Dell U3223QE looks like any past Dell Ultrasharp monitor. But this one has a trick up its sleeve: It's among the first monitors to use LG's new IPS Black panel technology. IPS Black is a new iteration of IPS panel tech that promises to boost contrast by lowering the deepest, darkest shade of black the panel can achieve.

SPECIFICATIONS

The Dell U3223QE is part of the company's Ultrasharp line of business and professional monitors. Ultrasharp is not the very best Dell

IMAGE: DELL

offers in this field—that honor goes to Dell's far less common Ultrasharp PremierColor line—but it's a high-end display by most metrics. It has a 31.5-inch, 4K panel that promises to deliver up to 98 percent of the DCI-P3 color gamut.

Display size: 31.5-inch
Native resolution: 3,840x2,160
Panel type: IPS Black
Refresh rate: 60Hz
Adaptive sync: None
Ports: 1x HDMI, 1x DisplayPort-in, 1x DisplayPort-out, 1x USB-C with DisplayPort Alternate Mode and 90 watts Power Delivery, 1x USB-C upstream, 1x USB-C downstream, 5x USB-A 3.2 Gen 2, Ethernet
Stand adjustment: Height, tilt, swivel
VESA mount: Yes, 100x100mm
Speakers: No
HDR: Yes, VESA DisplayHDR 400

The Dell U3223QE has USB ports galore.

Price: $1,149.99 MSRP ($919.99 typical)

The monitor is also a USB-C hub monitor crammed to the gills with connectivity. This includes multiple USB-C ports, one of which can handle up to 90 watts of Power Delivery, five USB-A ports, and ethernet. That's as much as you'll find on any USB-C hub monitor sold today.

DESIGN

The Dell Ultrasharp U3223QE has a simple silver-gray plastic chassis that feels robust but lacks flourish. Even the textured finish found on some less-expensive Dell monitors is missing. At the front, you'll find slim bezels on four sides. The bottom bezel is so slim there's no room for the Dell logo, so it's been moved to the stand.

A sturdy rectangular base keeps the U3223QE supported. It's plain but compact, which is a plus. Competitors like LG and Samsung often use a wider base. A wide base might look more stable, but it's no better in practice, and consumes desk space you might want to use. Dell's simple yet effective stand is the better choice.

The stand adjusts for height, tilt, and swivel—features that shoppers expect at this price. However, it throws in a bonus: It can pivot 90 degrees for use in

The stand is simple in appearance, but does offer flexibility such as height, tilt, and swivel, plus the ability to turn 90 degrees for portrait mode.

portrait mode. This is rare for a 32-inch monitor, as most stands lack the height to allow it.

FEATURES AND MENU

You control the Dell Ultrasharp U3223QE with a joystick on the lower-right quarter of the monitor's backside. I found it easy to locate, though it may prove a reach for some users. A power button is located nearby, but Dell distinguishes it with a concave surface that differs from the joystick. This prevents accidentally hitting the power button instead of the joystick.

The on-screen menu is laid out in simple, logical groupings, and the joystick control feels intuitive when scrolling through options. Dell has a clear edge over competitors like Viewsonic and LG, which tend to have more opaque menu groupings. BenQ is the only brand that has Dell beat. Some BenQ monitors, including the DesignVue monitors that directly compete with Dell's Ultrasharp, have a bundled remote.

Menu options are extensive and clearly geared toward more discerning owners. The U3223QE offers three preset color gamut modes (sRGB, Rec.709, and DCI-P3), plus a healthy dose of gamma, color temperature, and color hue adjustments. These features will be more than enough for all but the most demanding professionals.

This is a USB-C hub monitor (fave.co/3xzdM48), and it's not kidding around about connectivity. There's HDMI and DisplayPort, of course, as well as USB-C with DisplayPort Alternate Mode and 90 watts of Power Delivery. The monitor also supports DisplayPort MST (fave.co/3LmFqEG) and has DisplayPort out, so you can daisy-chain a connection to additional DisplayPort monitors.

But wait, there's more! The monitor also has a second USB-C upstream port that supports USB3.2 Gen 1 speeds and delivers up to 65 watts of power. This is useful for connecting a second USB-C device for data only. There's also a USB-C downstream port for passing through data and a total of five USB-A ports that support USB 3.2 Gen 2 speeds.

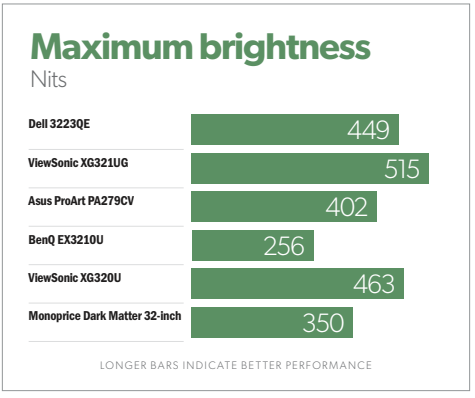
The U3223QE has an Ethernet port, supports Gigabit Ethernet speeds, and even has a LED light that indicates whether a connected device is operating at 1000Mbps or 100Mbps speeds.

Dell's U3223QE is stacked with features but it is missing one thing shoppers may expect: speakers. Dell tends to exclude them from a variety of monitors. That's okay, as monitor speakers tend to be bad, but shoppers should know this before buying.

IMAGE QUALITY

Let's get into the meat of it. The USB-C hub is excellent, but this monitor's defining feature is the IPS Black panel. Dell's U2723QE and U3223QE are the first to bring the technology to the North American market.

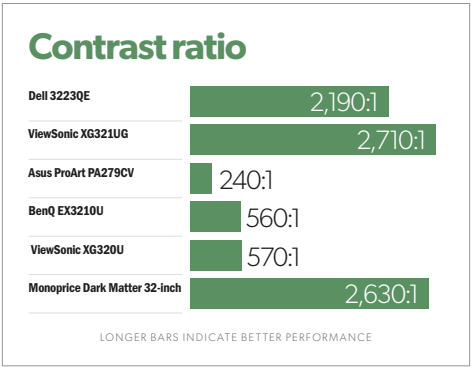
The first test, brightness, is not an area IPS Black promises to improve, but the U3223QE does well all the same. It hit a maximum sustained SDR brightness of 449 nits. This is an excellent result for SDR and among the highest I've observed in a monitor with a conventional edge-lit LED backlight.



In truth, the brightness is overkill, but it's good news for shoppers looking for a display that can handle an unusually bright setting.

Of course, contrast is the test monitor enthusiasts have been waiting to see, and it's good news. IPS Black does what it claims to. The monitor achieves a maximum contrast ratio of 2,190:1. That's roughly double what the best conventional IPS desktop monitors can provide.

I recorded a minimum luminance of 0.9 nits with the monitor at 50 percent of its

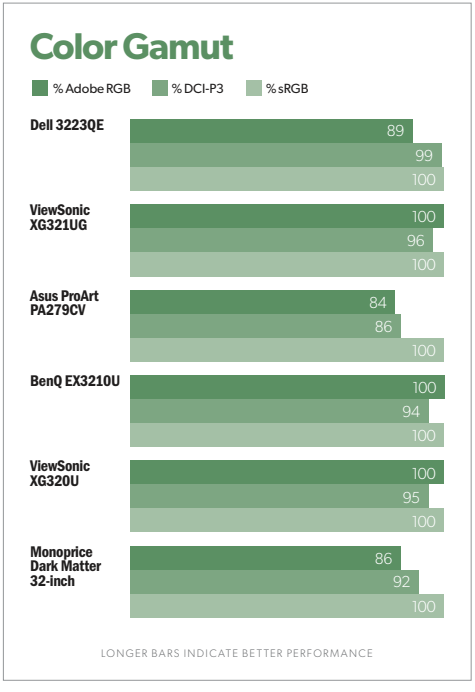


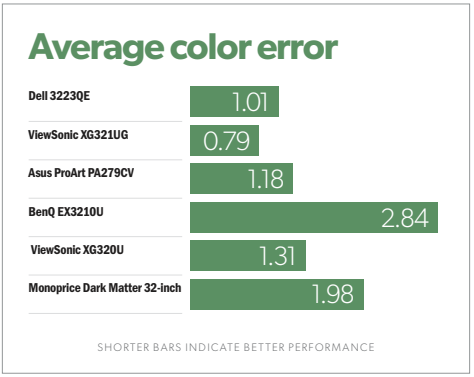
maximum brightness. Most conventional IPS panel monitors display a luminance between .16 and .28 in similar conditions.

Put simply, the IPS Black panel can achieve a deeper, more convincing shade of black than previous IPS panels.

Color gamut, the maximum range of colors a monitor can display, is another win for the U3223QE. It delivers up to 99 percent of the DCI-P3 gamut and up to 89 percent of AdobeRGB, as well as 100 percent of sRGB.

These figures are exceptional for any monitor. The U3223QE outperforms most of its IPS peers and nips at the heels of OLED.





I wrap up the graphs with color accuracy, where the U3223QE once again scores a solid victory. The monitor had an average color error of 1.01, which is a great (though not exceptional) result. The U3223QE is not beating its competition, but the vast majority of owners will find the monitor's color performance attractive.

As mentioned, the U3223QE includes preset color modes for the sRGB, Rec.709, and DCI-P3 color gamuts. Rec.709 is not a gamut I test for, but the sRGB and DCI-P3 modes were accurate and performed within the color and luminance range expected. The DCI-P3 mode was the most color accurate of the bunch with an average color error of 0.83.

There is just one significant weakness to note: luminance uniformity. Despite all its strengths, this is still an edge-lit LED panel, and that means the edges of the display are notably brighter than the middle in dark scenes. My review unit also had a couple

minor blotches of brightness, a problem typical of IPS monitors.

To its credit, the IPS Black panel seemed to make these spots dimmer and less distracting, but they're still there. This is an area where Mini-LED and OLED (fave.co/3rDPT6T) alternatives will put the U3223QE to shame.

The U3223QE is an excellent performer by the numbers. It's also a subjectively fantastic experience out of the box. The combination of a wide color gamut, accurate color, and above-average contrast creates a lavish, vivid experience with a wonderful sense of depth. Feed it high-quality content, such as uncompressed 4K or a cutting-edge 3D game, and you're in for a treat.

HDR QUALITY

Okay, so the Dell U3223QE is a superb SDR monitor. HDR, though? Forget about it.

Yes, the monitor can achieve an excellent maximum brightness of 507 nits. And yes, it has the color gamut to provide some extra oomph to HDR content. The IPS Black panel's added contrast should also, in theory, be helpful.

It's not enough. Though bright, the U3223QE's edge-lit backlight can't handle variations in luminance well enough to make HDR stand out. It can sometimes look less attractive than SDR, even when displaying bright scenes.

I also noticed odd behavior in the U3223QE's backlight. It seemed to ramp up noticeably in brightness when fed a bright full-screen image but then settle back down over several seconds. This was distracting and also caused my SpyderX colorimeter to report major color errors in HDR testing.

Don't buy this monitor for HDR. For now, those who want great (or even decent) HDR (fave.co/3qP3f19) must turn to a more expensive Mini-LED monitor like the Asus ROG Swift PG32UQX or Viewsonic XG321UG.

MOTION PERFORMANCE

The Dell Ultrasharp U3223QE is not meant for gaming and has a mundane 60Hz refresh rate. Fast motion looks okay and games capable of hitting a consistent 60 frames per second feel smooth enough, but it's no comparison to even a 144Hz monitor, never mind 240Hz and beyond. Adaptive Sync support is missing, too.

That's a bummer, though not as much of an issue as it seems. Competitive gamers don't use a large monitor, anyway, as they prefer smaller 24.5-inch screens. Driving 4K at a high refresh rate is also a challenge, so most competitive gamers stick to 1080p. Still, hardcore *Valorant* and *Counter-Strike* players should make no mistake: This isn't the monitor for you.

If you prefer more atmospheric games, however, or titles with limited fast movement, the U3223QE is a decent pick. The monitor's exceptional color, good contrast, and sharp

Dell's Ultrasharp U3223QE offers improved black levels and contrast.

4K resolution make it well suited to strategy titles like *Civilization VI* or open-world games like *Assassin's Creed Odyssey*.

VERDICT

The Dell Ultrasharp U3223QE is a great debut for IPS Black technology. It promises improved black levels and contrast, and that's exactly what it delivers. It also retains the great color performance high-end IPS panel monitors are known for, and, to sweeten the deal, provides crisp 4K resolution.

But there's more to the U3223QE than the panel. It's also a fantastic business, productivity, and professional monitor loaded with image-quality options and a king's buffet of connectivity. You can plug in a high-end laptop over USB-C and gain instant access to five more USB-A ports, DisplayPort out, and ethernet.

Lackluster HDR performance and the lack of any gaming-focused features do hold the monitor back slightly. Gamers are going to want to buy a gaming-specific monitor. However, if you only game occasionally, or aren't too concerned about motion clarity, the U3223QE will work fine.

The price is the kicker. Dell sells the U3223QE for $919.99 online (fave.co/3LpwBu0). That's not inexpensive but, given everything on offer here, it's a good value and an easy recommendation.

Dell U3223QE

★★★★☆

PROS

- IPS Black panel fulfills its promise.
- Accurate color with wide gamut.
- High brightness in SDR.

CONS

- Edges of display are noticeably bright.
- HDR performance disappoints.
- Only a 60Hz panel .

BOTTOM LINE

The Dell U3223QE uses LG's IPS Black tech to deliver a top-notch, professional-level, 31.5-inch 4K display with a built-in USB-C hub.

$1,149

GeForce Now: You bring the games, Nvidia streams the hardware

A free plan lets you test drive this game-streaming service. **BY KEVIN CASPER**

GeForce Now is Nvidia's cloud-based game-streaming service. For those who aren't familiar with this concept, it means that Nvidia provides the hardware firepower via its own media servers. Instead of you installing a game to your PC and needing an expensive GPU to get the most out of it, you just need a strong, stable internet connection and a subscription to Nvidia's service, which can range from free to $20 per month. Note: The games themselves are not provided at any subscription level—more on that point when we talk about games below.

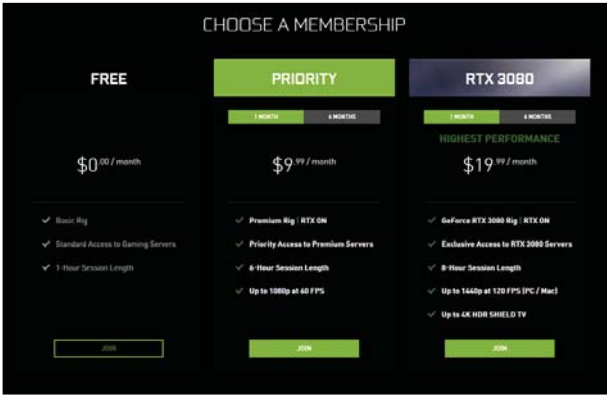
THE PLANS

GeForce Now currently offers three tiers: Free, Priority, and RTX 3080.

GeForce Now is currently the only major cloud gaming service offering a Free access plan. While many services offer a temporary free trial, the GeForce Now Free plan is full access to the service with no long-term limitations. However, there are some short-term ones.

IMAGE: NVIDIA

Each tier comes with a limit to how long you can be connected to a gaming session at a time. The Free tier is limited to one hour, Priority subscribers can play for up to six hours per session, and RTX 3080 subscribers get eight-hour sessions. There is no set limit to the number of sessions you can start in a day. The free tier also doesn't feature "RTX On," Nvidia's term for ray-tracing and DLSS support.



GeForce Now's membership options.

There's a priority component to the tiers, too, as Nvidia places limitations on the overall process and user loads on GeForce Now's regional data centers. Free members have the lowest priority in connecting to the service, which can mean waiting in line to connect to a rig at times. Priority and RTX 3080 have priority access to the queue, with RTX 3080 members getting access to systems that provide RTX 3080 GPUs. There may be times when an RTX 3080 rig is not available for a member, which will send that member to the Priority queue instead.

Beyond those varied limitations, GeForce Now advertises up to 1080p at 60 frames-per-second gameplay for its Priority members, and up to 1440p at 120fps for PC and Mac and 4K HDR on Shield TV for its RTX 3080 members.

In the U.S., where this review was done, the membership plans cost the following:

Free

Priority: $9.99/month or $49.99/6 months

RTX 3080: $19.99/month or $99.99/6 months

Additionally, there are internet bandwidth requirements and data usage conditions to consider. GeForce Now requires a minimum of a 15Mbps connection for 720p at 60fps, a 25Mbps connection for 1080p at 60fps, and a 35Mbps connection for 1440p at 120fps for the RTX 3080 plan. Additionally, GeForce Now does require a less than 80ms latency from an Nvidia data center, but recommends a less than 40ms latency.

GAME LIBRARY

At first glance, the GeForce Now game library (fave.co/3MdoYYF) is impressive—until you realize it's a list of games that are *playable* on the platform, not a list of games that are

provided to you through the subscription as you find on other cloud gaming services.

You have to own your own digital copies of the games you wish to play on GeForce Now—and specifically you have to own them on the correct platform for GeForce Now. This can be a bit messy if you're an existing PC gamer with a fairly large library on Steam or Epic Games Store, because you might own a game on one platform, but, although the game is available to play within GeForce Now, you might have it on the wrong platform to play within.

We ran into exactly this while testing with *Control Ultimate Edition*. Currently, only the Steam version of *Control Ultimate Edition* is available to play in GeForce Now, so if you own it on the Epic Games Store, you're out of luck. However, the original *Control* release is compatible with both Steam and Epic Game Store releases. None of that helped us, though, as our copy of *Control Ultimate Edition* is on GOG, which largely isn't supported by GeForce Now, with the exception of *Cyberpunk 2077* and a few of the *Witcher* games.

In addition to your owned game library, you can play many Free to Play games such as *Fortnite*, *League of Legends*, *Destiny 2*, *Path of Exile*, *Rocket League*, and more through GeForce Now. You do still need to set up your own account access on their relevant platforms.

If you're keen on the idea of owning your own game library or want to have some flexibility as to where you can game without having to lug around a gaming rig, this service is worth checking out.

USER EXPERIENCE

Getting started with GeForce Now is fairly straightforward. You just have to register yourself with an account, or if you have an existing Nvidia or GeForce account, you can activate GeForce Now on it.

Once logged in and connected, you can choose to access the games through a Chrome, Safari, or Edge browser to try out some games without installing anything. However, in our experience, it's preferable to try out the native app instead, as the experience seems to work a bit more smoothly in both the menu navigation and in-game compared to the browser experience. Nvidia agrees, and tries to push you to install its app instead of using the browser.

You can choose to sync your Steam, Epic Games Store, and Ubisoft Connect accounts to your GeForce Now account, which will help filter the game library you see in GeForce Now to the titles you own and the platforms you have access to them on. However, syncing your account here seems to just help manage the library, as you'll need to log in to the relevant platform again when you go to play a game.

When you go to launch a game, it may put you in a queue depending on how busy

The GeForce Now Library interface.

things are for your access level. In our testing, the Free access had a typical queue time of a couple of minutes, the longest being 8 minutes, but time of day and location will affect your experience. Once you're through the line, you'll launch into a full-screen view of what is effectively a very trimmed-down remote desktop environment. In there, you'll be prompted by the game's platform, such as Steam, asking you to log in to your account. Once logged in, your chosen game should launch right away.

All of the games within GeForce Now are installed and kept up to date on the service's end, so you won't need to wait for any patching or updates yourself. This seems to be standard to most cloud gaming services out there, but it's nice to not have to wait for the download and installation when starting up a new game.

As mentioned before, your play sessions do have a time limit, with the Free plan being only an hour. The one-hour session length can be frustrating when you have to log in, queue up, and end up in a longer *League of Legends* match, as the session might end before the game does. But it's enough time to work on some Destiny or Warframe dailies, or to get some piecemeal progress in *Far Cry 6* or *Life Is Strange*.

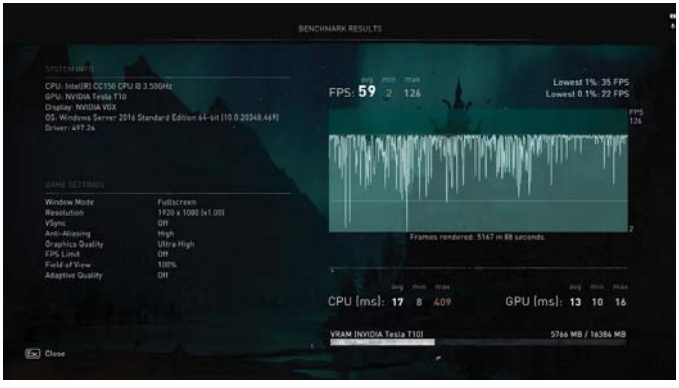
We did some testing to see if there were any short-term limitations on how many game sessions you could pop in and out of, though, and we didn't seem to hit any kind of blocker. Additionally, GeForce Now's own FAQ confirms that there is no daily limit on the number of sessions that you can play.

For some added flare, GeForce Now does support the Nvidia Highlights system (fave.co/3wvxwU7), which is a feature with GeForce Experience and Nvidia GPUs that allows you to capture clutch moments, victory streaks, and other key experiences from your gameplay for supported games. When you launch a game that supports this feature in GeForce Now, it will let you know and how you can take advantage of it while you're playing.

GAME PERFORMANCE

Honestly, we were very impressed. With the right internet connection, playing some games in GeForce Now wasn't much different from playing them on a local PC. In our testing, the only notable difference was the 1080p experience being streamed to our higher-resolution display, but that was expected.

For context, my testing connection has 400Mbps down, 25Mbps up, with a 24ms latency to Nvidia's Central U.S. server. Latency is one of the major concerns regarding cloud gaming services, understandably—particularly if you're not physically located near one of the service's server locations. Since my testing conditions were within GeForce Now's recommended guidelines, my experience was genuinely smooth when it came to the feel of playing the game. I tried a handful of games, from action to puzzle, such as a high-speed fast-clearing character in *Path of Exile*—an online-only action RPG with very chaotic moments and some very quick deaths. The gameplay experience was virtually identical to loading up the game locally on my gaming rig. Every game I tested had similarly smooth and responsive experiences.



Assassin's Creed Valhalla benchmark results on Priority plan.

Assassin's Creed Valhalla benchmark results on RTX 3080 plan.

I also took advantage of a few games that have benchmarks within them, including *Far Cry 5*, *Cyberpunk 2077*, and *Assassin's Creed Valhalla*. The results were all pretty much as advertised, with the Free and Priority tiers being virtually equivalent in performance.

Playing a game at any plan tier is a solid experience.

(Remember, however, your experience may vary depending on your internet connection and proximity to the servers.) Interestingly, I was able to modify some of the display settings in some games, so I did get a look at a *Far Cry 5* High versus Ultra benchmark, for example.

Some games were able to give me insight into the actual hardware running the GeForce Now systems. According to my tests, via *Assassin's Creed Valhalla*, the Free and Priority services seem to be running with Intel CC150 CPUs at 3.5GHz and the graphics are listed as Nvidia Tesla T10, which by my estimation would be the T10-8s, as those are the RTX series T10 cards for this kind of server environment. The RTX 3080 systems seem to be running AMD Ryzen Threadripper Pro 3955WX CPUs and Nvidia A10G GPU, resulting in an overall more impressive experience, both in resolution and performance.

VERDICT

Long story short, playing a game at any plan tier is a genuinely solid experience as long as your internet connection can handle it. While having to bring your own games may be a bit of a bummer compared to other cloud gaming options out there, the overall performance and quality of GeForce Now is impressive. At the very least, they have a Free plan, so give it a whirl if you can—especially if you've had trouble dredging up a new graphics card over the last year.

GeForce Now

★★★★☆

PROS

- Very smooth and responsive experience.
- The Free plan.

CONS

- Games are not included.
- Limited time on gaming sessions.
- Inconsistency in compatibility of games and platforms.

BOTTOM LINE

GeForce Now is a great option for gamers who are waiting out the GPU market crunch. As the only cloud gaming service with a solid Free plan (as opposed to a free trial), it's an excellent way to get your gaming fix—provided you have a compatible games library of your own. The paid plans are also good, with the same bring-your-own-games caveat.

From $9.99 per month

Lenovo Yoga 9i 14 (2022): The pinnacle of design

The Yoga 9i is a real gem. **BY MATT SMITH**

PCWorld EDITORS' CHOICE

A decade has passed since Lenovo introduced the first Yoga 2-in-1. Though Microsoft's Surface devices set the trend, it was arguably the high-volume Yoga line that became the true vanguard of mainstream convertible design. Lenovo's Yoga 9i 14-inch (2022) builds on this decade of experience in all the right ways. From the thin profile to the powerful internals, this year's model delivers blazing-fast performance in a tiny package. Although the

IMAGE: LENOVO

fan noise can be a bit loud and we feel as though it relies too much on USB-C, overall we were impressed with this machine.

SPECIFICATIONS

The Lenovo Yoga 9i 14-inch is among the first laptops with Intel's new 12th-Gen Core mobile processors targeting thin-and-light machines. Though thin, the laptop packs four performance cores and eight efficiency cores for a total of 12.

CPU: Intel Core i7-1260P

Memory: 16GB

Graphics/GPU: Intel Iris Xe (96 EUs)

Display: 3,840x2,160 IPS with HDR support

Storage: 1TB

Webcam: 1080p with IR

Connectivity: 2x USB-C 4.0 / Thunderbolt 4, 1x USB-A 3.2 Gen 1, combo headphone/mic

Networking: Wi-Fi 6, Bluetooth 5

Biometrics: Fingerprint reader

Dimensions: 12.57 inches wide x 8.53 inches deep x 0.64 inches thick

Weight: 3.02 pounds

The laptop's specifications are otherwise mundane, though certainly high-end for a 14-inch laptop of this size. It skimps on nothing, which makes the Yoga 9i's entry-level MSRP of $1,249 (fave.co/3sDZADI) justifiable, though our review configuration will set you back $1,450 at Best Buy (fave.co/39SuiCo).

DESIGN AND BUILD QUALITY

Lenovo doesn't get enough credit for its design. I can't think of another Windows laptop maker so consistently willing to go off script and the Yoga 9i 14-inch is a prime example of its willingness to depart from the norm.

From a distance, the Yoga 9i looks like most Windows 2-in-1s. It's a clamshell design with a rotating hinge that folds back 360 degrees, effectively turning the laptop into a tablet. Approach it, however, and you'll notice the laptop is adorned with round, gleaming chrome edges across the top and bottom half.

The Lenovo has round, gleaming chrome edges across its top and bottom half.

It's an eye-catching look with practical benefits. The rounded edges mean you never encounter a hard touch point while maneuvering the laptop. This will be a minor point for many. After all, it's not like other 2-in-1s will slice your finger. Still, the Yoga 9i is more inviting than the norm.

We were impressed by the Yoga 9i's keyboard.

The Yoga 9i's low weight and touchscreen further improves ease of use. It's a great machine to carry with one hand or spin around to share something with a friend or co-worker across a table. It's not small or light enough to be an iPad replacement, but the 9i comes as close as you can expect from a device without a detachable keyboard. That's good news if you need a 2-in-1 for use in cramped spaces or for travel.

KEYBOARD AND TRACKPAD

The Yoga 9i 14-inch offers a quality keyboard despite its thin profile. Key travel is good and has a firm, pleasant bottoming action. The layout is also excellent and makes full use of the laptop's 14-inch size. Key caps are reasonably sized yet there's plenty of space between keys.

Several unique keys can be found on the keyboard's right side. These include a key that turns the Windows systemwide dark mode setting on or off and one that flips through performance modes. Though a nice extra, they're not a must-have and won't change how most people use the 2-in-1. The keyboard has a backlight and uses a light sensor to automatically turn it on in a dark room (it can also be activated manually).

I appreciate the large touchpad. It measures about 5 inches across and 3 inches deep. This is a great size for a thin, portable 2-in-1 and provides plenty of room for Windows' multi-touch gestures. The touchpad does a good job of rejecting unintended input, which is important, as its large size means my palms came to rest on its surface.

DISPLAY, AUDIO

The base Yoga 9i 14-inch has a IPS touchscreen with 1,920x1,200 resolution, but my review unit had the upgraded OLED touchscreen with 3,840x2,400 resolution. This makes for a 16:10 aspect ratio, which provides extra vertical screen real estate that's useful when multitasking or viewing vertically scrolling content like web pages or PDF documents. Text clarity is excellent, as 323 pixels are crammed into each inch. Eagle-eyed users might detect a fine speckled pattern in bright white documents, a likely result of the OLED screen's particular subpixel layout, but I didn't find it distracting.

Image quality is otherwise excellent. The Yoga 9i's display has accurate color, a wide color gamut spanning up to 99% of DCI-P3, a high maximum brightness above 400 nits, and deep black levels thanks to the OLED display panel. Images and movies look vivid, crisp, and have a realistic sense of dimensionality that draws in your eye.

HDR is supported and Lenovo even offers support for Dolby Vision HDR in addition to the less capable HDR10 standard. It can't match the brilliance of Apple's Mini-LED MacBook Pro but has an advantage in crisp contrast and depth that becomes apparent when viewing in a dark room.

The display is glossy, so glare can be a problem. The maximum brightness of 400 nits allows use even beside a sunlit window, but some reflections will be obvious.

In another departure from the norm, the Yoga 9i leans hard into audio quality. The hinge doubles as a miniature Dolby Atmos soundbar. It works well, delivering a loud, throaty presentation that is suited to music and movies but still clear enough for podcasts. Maximum volume is high enough to fill an office, though this sometimes muddies the sound in bass-heavy tracks. This is an excellent sound system for a slim 2-in-1.

The 14-inch IPS touchscreen offers excellent image quality.

WEBCAM, MICROPHONE, BIOMETRICS

A 1080p camera standard on the Yoga 9i 14-inch. This is great to see on any premium Windows device and remains the exception, not the rule. It's an obvious upgrade over 720p, offering a big leap in sharpness and more accurate, vivid color. Exposure is still an issue in unevenly lit rooms, however, and using it at night will introduce a ton of noise. The camera offers a small physical privacy shutter, which is a nice touch.

The laptop's dual microphone setup performs as expected. It's usable from several feet away from the laptop. You can even speak from across a small room if you raise your voice. Quality is thin and distant, however, and distinctly different from using a real microphone.

Biometric login is offered through both a fingerprint reader and facial recognition. The fingerprint reader works well but, as always, it can be fooled by greasy or dirty fingerprints. Facial recognition through Windows Hello is the quicker, more reliable method. It works well even in a dark room.

The Lenovo's lack of wired connectivity may annoy some.

CONNECTIVITY

The Lenovo Yoga 9i 14-inch has a pair of USB-C 4/Thunderbolt 4 ports. These include DisplayPort Alternate Mode for connecting displays and can charge the laptop when connected to a USB-C power source. With the right adapters, these versatile ports can be used to attach a HDMI or DisplayPort display, connect to the Internet over wired Ethernet, or drive multiple additional USB ports in a USB hub.

There's only one USB-A 3.2 Gen 1 port for connecting legacy wired peripherals. It's joined by a 3.5mm combo audio jack for connecting a headset or external speakers. This makes for a slim selection of wired connectivity. Those who don't choose to go wireless for most peripherals will likely need to purchase a dock, which can range from $50 to several hundred dollars (depending on its capabilities).

While the lack of wired connectivity will annoy some, it's typical for the premium 2-in-1 space. Want more wired connectivity? You'll need to put up with a heavier, thicker machine.

Wireless connectivity is provided by Wi-Fi 6 (fave.co/3IkeCUI), along with Bluetooth 5.1. The wireless adapter provided very strong, reliable performance in my testing, dealing well with all corners of my home. Bluetooth was functional up to about 25 feet with walls between devices.

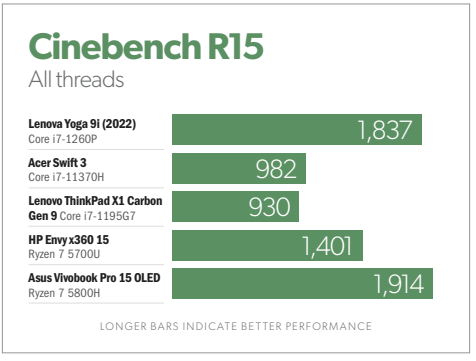
PERFORMANCE

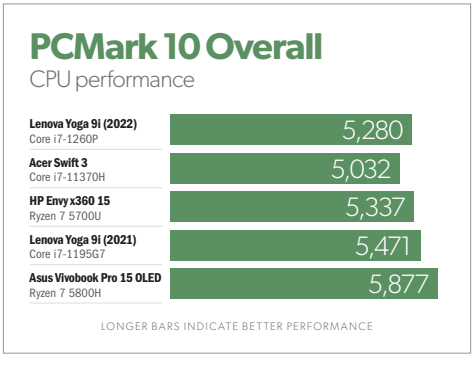
The Yoga 9i 14-inch is an interesting test of the Intel Core i7-1260P's capabilities. This new 12th-Gen Intel Core processor packs a total of 12 processor cores (four P-Cores, 8 E-Cores), plus Intel Xe graphics. It looks great on paper.

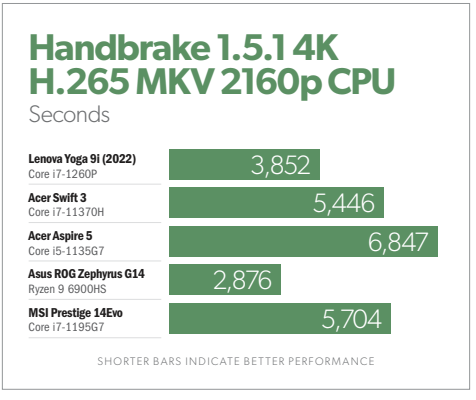
PCMark 10 gets the Yoga 9i with i7-1260P off to a mediocre start. The benchmark score of 5,280 is not bad, but it doesn't defeat the prior model with an Intel Core i7-1195G7 processor (fave.co/3FOEmlq). It also falls behind the Ryzen 5700U.

The heavily multi-threaded Cinebench R15 benchmark is a different story. It puts the cores to work for an outstanding score of 1,837. This absolutely blows away the prior Core i7-1195G7 and comes surprisingly close to the Ryzen 7 5700H. Intel's many-core approach pays off here.

This remains true in Handbrake, another heavily multi-threaded benchmark. Transcoding a 4K file of the short film *Tears of Steel* takes over an hour, which is a long time, but it's about a half-hour less than prior Intel processors. The Core i7-1260P does not







score as close to the Ryzen 7 5700H as in Cinebench, however.

Processor performance is a win for the Core i7-1260P. It scores very well in two out of three tests and, importantly, does its best work in multi-threaded workloads. That's important, because the bulk of demanding workloads a user will face in 2022 are heavily multi-threaded.

But what about graphics?

The Core i7-1260P offers many processor cores but doesn't make big changes to integrated graphics. That's fine, as Intel's Iris Xe with 96 execution units remains capable for its category. It delivered a score of 1,985 in 3DMark Time Spy. This is the match for the best Intel integrated graphics we've tested in the past and will match or beat most Ryzen mobile APUs as well.

Games from the Xbox One/PlayStation 4 era are typically playable at 30 frames per second or better, though the most demanding will require cuts in resolution and detail settings. Older games, like *Counter-Strike* or *League of Legends*, can sustain 60 FPS at 1080p.

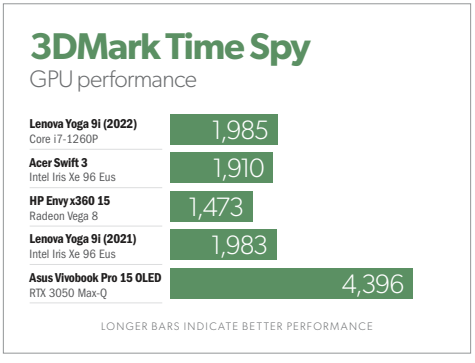
I'm impressed by the Yoga 9i's performance. The Intel Core i7-1260P is a winner in multi-threaded workloads and pulls off this victory without compromising in other areas. This achievement is even more impressive given the Yoga 9i's slim form factor.

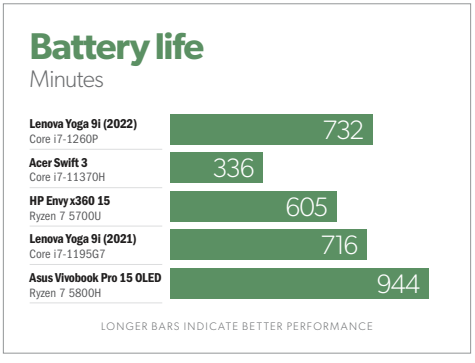
There's just one issue to be aware of—noise. The Yoga 9i is quiet at idle but a real whirlwind at full tilt. It's enough to annoy anyone in the same room if the laptop is left in the open. This is an area where Intel-powered laptops just can't compete with Apple's nearly silent MacBook line.

BATTERY LIFE

Lenovo squeezes a large 75 watt-hour battery into the slim Yoga 9i 14-inch—serious capacity for a 2-in-1 and good news for endurance.

The Yoga 9i lasted 12 hours and 12 minutes in our standard battery test, which





loops a local 4K video file until the laptop dies. This is far from a record and a bit less than the prior Yoga 9i model, but I'd still call it better than average.

Real-world observed battery life was not as impressive. The laptop averaged about seven hours of endurance in a workload of heavy web browsing, document editing, and occasional photo editing. The 4K OLED display is a likely factor, as these screens can be power-hungry at high brightness.

The Yoga 9i is an excellent all-round 2-in-1.

SOFTWARE

The Yoga 9i's product page (fave.co/3PITMs9) touts several partnerships, including Amazon Alexa for PC and three free months of Xbox Game Pass. Free stuff is nice, but it hints at a problem: There's a lot of bloatware.

Lenovo stuffs the Yoga 9i with several added icons and content. By far the most annoying is McAfee antivirus, which often interrupted my workflow with two to three back-to-back banner ads. It's not as bad as some recent Acer laptops but disappointing to see in a laptop priced well above $1,000.

VERDICT

Lenovo's Yoga 9i 14-inch is an excellent addition to the company's long line of capable premium 2-in-1s. It packs strong performance, a great OLED display, excellent audio, a pleasant keyboard, a large touchpad, and future-proof connectivity into one compact, versatile package. Though Intel's new Core i7-1260P is performant enough for many professionals and creators, the Yoga 9i's size and connectivity makes it ideal for travelers, students, and everyday users who want a premium Windows experience.

Lenovo Yoga 9i 14 (2022)

★★★★½

PROS
- Thin, attractive design.
- Supports USB-C 4 with all the extras.
- Vivid, rich OLED display.

CONS
- Relies heavily on USB-C.
- Fan noise can be annoying.

BOTTOM LINE
The Lenovo Yoga 9i 14-inch uses Intel's 12th-gen Core processors to deliver solid performance in a compact machine.

$1,449

Samsung T7 Shield portable SSD: Ultra-fast and built to last

Goodbye, fingerprint scanner, hello toughened outer skin—and speed. **BY JON L. JACOBI**

PCWorld EDITORS' CHOICE

If you've had your eyes on Samsung's fast USB 10Gbps T7 Touch (fave.co/3wx2D1J), but you weren't sure it was suitable for your rough-and-tumble environment, your conundrum is at an end. The latest iteration in the T7 series—the T7 Shield—is IP65 rated to withstand a wet weather and offers additional protection against shock (though admittedly, shock is a bigger deal for portable hard drives than it is for portable SSDs). This is another top-tier USB drive from Samsung.

DESIGN

The Samsung T7 Shield is a USB 10Gbps enclosure with an NVMe SSD inside. We're a bit surprised the latest version didn't opt for 20Gbps USB, though admittedly, such ports are pretty rare and will remain so until

IMAGE: SAMSUNG

full USB4 implementations become the norm (fave.co/3IpMBKJ). The T7 Shield is available in 1TB and 2TB capacities for $160 and $290 respectively, and you can buy them with blue, beige, or black silicone-like protective coverings.

The drive measures 3.5 inches long by 2.3 inches wide by 0.5 inches thick, and weighs just under 4 ounces. That's a little heavier than the T7 Touch, but considering that it's wrapped in a silicone protective sleeve, it's hardly surprising.

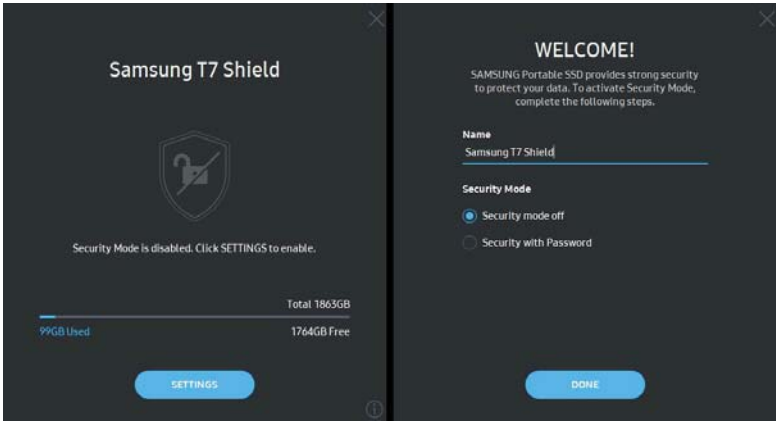
The extra weight is inconsequential in terms of transportability, and gives the T7 Shield a nice heft. Indeed, I contemplated hurling it against a wall to test shock resistance. I didn't, though I dropped it from about four feet onto a wood floor with no ill effects.

The T7 Shield's USB connector is Type-C and thoughtfully, Samsung includes both USB Type-A to Type-C and Type-C to Type-C cables.

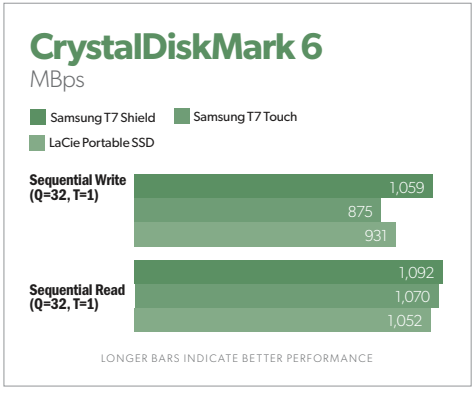
As to the IP rating, 65 is a bit unusual. Most devices claim 67. If you want the entire IP lowdown, read this article by yours truly on TechHive (fave.co/3a70n9R). But here's the gist of it.

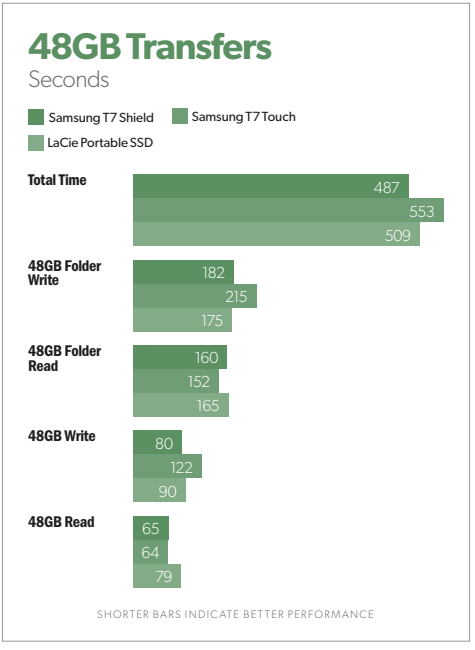
The first number, 6, means the T7 Shield can keep out just about any kind of particulate matter. The second number, 5, means you can spray it with water, but not immerse it. (7 would indicate that immersion is survivable). No doubt the Type-C port is the culprit for the lower liquid resistance rating, though we've seen them on plenty of Bluetooth speakers sporting the same port that claim IP67. Most cover the port with a captive plug, but not all.

Perhaps Samsung is just a little more conservative in its conclusions. I'm not saying drop the T7 Shield in the pool, but I wouldn't be surprised if it survived a short dip—as long as it's not connected and active. If it is, you've got other issues.



Samsung's Toolbox for its external drives. With the Touch you get fingerprint security. With the Shield you set the password and must have the software installed in any computer you wish to mount the drive on.





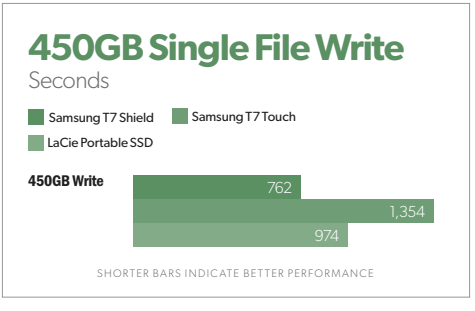
Though the Shield lacks the Touch's fingerprint reader, it can still be password secured using Samsung's Portable SSD software. Of course, you must then install said software on any computer you want to access the drive from. That's certainly not as handy as a simple finger scan, but workable.

PERFORMANCE

The Samsung T7 Shield showed a noticeable performance improvement over its T7 Touch predecessor, especially when it came to writing files. Then again, our Shield test unit was 2TB, where the Touch was 500GB. This will make a difference, especially during long writes as the drive can treat more NAND as single-bit/level, SLC secondary cache.

We recently switched to the latest CrystalDiskMark, version 8.04, and a new testbed so these charts are not direct comparable with those for previous drives.

The two drives the Shield is compared to below were retested, however. That said, CDM 8 demonstrates that noticeable write speed improvement I just spoke of. (Right-click on images and choose "Open image in new tab" to see full-size versions.)



Quicker writing was also largely responsible for the better overall performance in our 48GB transfers shown below. The older Touch actually proved a slightly faster reader.

Having 2TB instead of 500GB to play with was a boon for the T7 Shield when it came to writing our single large 450GB file. That said, the LaCie was also 2TB and not as quick. Samsung has obviously been upping its game (or components) since the last T7 iteration. There aren't many 10Gbps SSDs that will top the Samsung T7 in performance.

The Samsung T7 Shield showed a noticeable performance improvement over its T7 Touch predecessor.

External USB drive tests currently utilize Windows 11 64-bit running on an MSI MEG X570/AMD Ryzen 3700X combo with four 16GB Kingston 2666MHz DDR4 modules, a Zotac (Nvidia) GT 710 1GB x2 PCIe graphics card, and an Asmedia ASM3242 USB 3.2×2 card. Copy tests utilize an ImDisk RAM disk using 58GB of the 64GB of memory.

VERDICT

Though we'd like to see a bit better waterproofing, the Samsung T7 Shield is indeed a much better drive for harsh environs than the Touch. It lacks the convenience of fingerprint security that the Touch offers, but it's a better performer and you can still secure it via software. It's another great portable drive from Samsung, and comes highly recommended.

Samsung T7 Shield SSD

★★★★½

PROS
- Fast 10Gbps storage.
- Rugged outer skin for IP65 rating.
- Up to 2TB in capacity.
- Svelte styling.

CONS
- No 20Gbps.
- Not full immersion rated.

BOTTOM LINE
Faster than its Touch predecessor, the T7 Shield is also more rugged. It lacks fingerprint scanning, but is otherwise a faster, more durable external SSD.

$160

The best free antivirus for Android

How to play it safe on the cheap. **BY IAN PAUL**

Keeping your Android phone secure without security software is doable, but for some people it's just plain risky. That's especially true if you open a lot of files on your phone from email or messaging platforms, or if you are, shall we say, a little too liberal with the kinds of apps you're willing to install—even if they are from the Play Store.

If you want to make sure your Android device is secure from these threats and others, an antivirus app can help. In fact, there are a bunch of completely free ones in Google Play, but you want to make sure you're getting security from a known and reputable company. Because there's only one thing worse than getting pwned by an app you downloaded from Google Play: getting pwned by an antivirus app you downloaded from Google Play.

Luckily for us, almost every major antivirus maker has an Android app with the ability to

IMAGE: JR RAPHAEL, IDG

keep your device secure, and some of them are even free. And by free we mean really free. Not 30-day-trial free, but actually free for as long as you have it on your device. Some may have more restricted features (that is often the trade-off with free), but if you want to keep your device more secure without paying for a subscription you don't otherwise need, these are the apps we recommend.

For more smartphone fortification, check out our roundup of the best free VPNs for Android (fave.co/37RIxa7)—a great way to protect your privacy and guard your data when using public Wi-Fi.

1. AVIRA SECURITY FOR ANDROID

Price: Free from fave.co/3MnUNhz

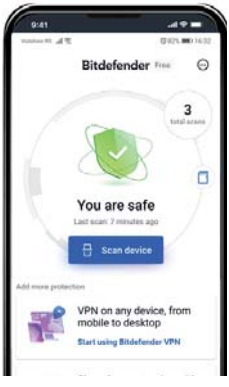
Our top pick is Avira for a few reasons. First, it gets top marks from both AV-Test (fave.co/3whnbMG) and A-V Comparatives (fave.co/3MzIrE0). From the former it earned 99.9 percent on both the real-time attacks and widespread malware tests in March 2022. Over at A-V Comparatives Avira got 100 percent detection using nearly 3,700 samples in the 2021 Mobile Security Review.

Avira also has more features. Beyond the virus scanner, it has 100MB of VPN usage per day, some storage-optimizing features, identity protection, and a permissions manager. It's a nice set, along with top-notch protection, as of this writing.

2. BITDEFENDER ANTIVIRUS FOR ANDROID

Price: Free from fave.co/3IhDaE9

If you want something much simpler that has equally good protection rankings, look no further than Bitdefender. The Romania-based company actually has two apps in the Play Store. The free one is Bitdefender Antivirus, not Bitdefender Mobile Security. The free version does exactly what it says:



scans your phone when you ask it to. There's also some minimal automated scanning from Auto-pilot when you download a new app—a potential attack vector for Android phones.

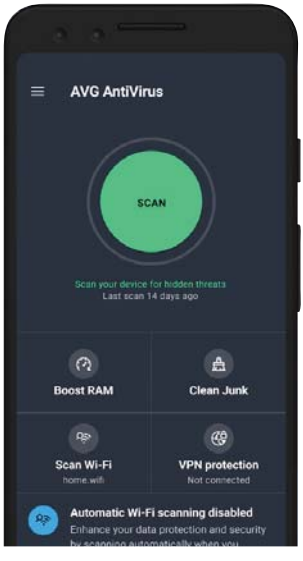
Bitdefender earned 100 percent from AV-Test (fave.co/37QsHMK) for real-time attacks and widespread malware tests for March 2022. It also had a 100 percent detection rating from AV-Comparatives' (fave.co/3MzIrE0) 2021 Mobile Security Review.

3. AVG ANTIVIRUS FREE FOR ANDROID

Price: Free from fave.co/3LmOUQv

Another top protection option is AVG Antivirus & Security for Android. It got top marks from AV-Test (fave.co/3Mmivup) with 100 percent protection for the real-time and widespread malware tests. Over at AV-Comparatives (fave.co/3MzIrE0), however, the detection rate was 99.6 percent, with one false positive. That's partially why we're putting it down here in third place. Another downside is that it uses personalized advertising to support it, while the others don't.

Despite that annoyance, however, there's a lot to like about AVG's free Android app. It can scan apps and files, clean up junk files, and scan your current Wi-Fi network. It also has malicious website protection, a "RAM booster" that kills background apps, a Wi-Fi speed test, and an anti-theft feature for tracking and securing your phone remotely. That last feature requires an AVG account.



If you prefer Avast, which owns AVG, that app is good too. It had the same protection scores as AVG and pretty much the same feature set for free.

4. SOPHOS INTERCEPT FOR MOBILE

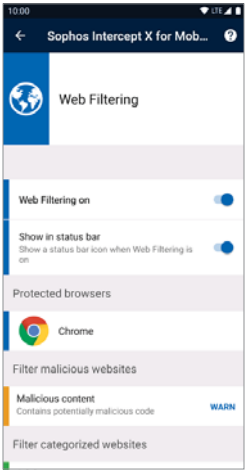
Price: Free from fave.co/39tj07F

Sophos was not analyzed on Android by A-V Comparatives, as the company opted for only a score from AV-Test (fave.co/3leaCvn). AV-Test gave it 99.8 percent in March 2022 for the real-time malware attacks. For the widespread malware test, meanwhile, Sophos earned 100 percent.

For major features, Sophos offers a lot including malware scanning for apps and files, malicious web page blocking, a link checker for protection against malicious links,

Wi-Fi network scanning, and a privacy adviser.

While it has a slightly lower score than the other apps for real-time reaction, it's still a very good service and it has a lot of nice features. Plus, it doesn't have any ads.



HOW TO CHOOSE A FREE ANTIVIRUS FOR ANDROID

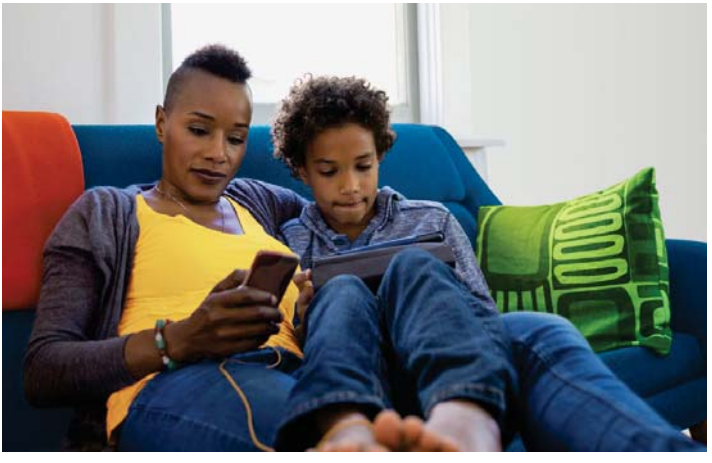
We've already touched on this briefly, but you should always get your antivirus from a well-known security company. It's also a good idea to see what third-party testing firms are saying in their reports about various Android apps.

After that, you should see if the company is using ads in their app and whether you're okay with it or not. Finally, see if it has the features you're looking for. Pretty much all the features you can expect in a free app are like the ones we highlighted here. If you're looking for active real-time scanning, for example, that is a paid option from most services.

HOW WE TESTED

For these antivirus apps we installed and ran the app for each selection, as well as consulted with third-party testing firms to see what kind of protection scores the apps received. We also filtered out any "free" apps from major antivirus vendors that were only a limited free trial since a free service and a free trial are not the same thing. A free service should be a long-term service with an option to upgrade to a better version of the app with a subscription.

There are an absolute ton of antivirus choices for Android users, but these four should be at the top of your list.



Always get your antivirus from a well-known security company.

Chrome Remote Desktop: Free, versatile remote access for Google-ites

This browser-based app supports numerous platforms, and is the only solution we know of for Chrome OS. **BY JON L. JACOBI**

Chrome Remote Desktop is the most obvious remote desktop solution for most users, and, as far as we know, the only solution for Chromebooks. It's easy to use, it covers the basics including file transfers, and it offers both fixed remote control and one-off screen sharing for those don't share your Google. It's available on any operating system that supports Chrome, including iOS and Android.

Chrome Remote Desktop has some limitations that will affect pros, but none that will significantly impact the majority of users.

INSTALLATION AND DESIGN

There are two ways to use Chrome Remote Desktop: by adding clients to your account and defining permanent PINs for anytime access, or by having helpees generate a one-time access code for a single screen-sharing (with control) session.

IMAGE: SFIO CRACHO/SHUTTERSTOCK

The first example is Remote Access in CRD-speak and requires installing clients on any computer to be controlled—a simple task. Simply log in to your Google account using Chrome (only Chrome is supported—Google isn't crazy) on the computer you want to access remotely, head to fave.co/3NaS4bg, and follow the prompts to install the viewer or client.

You'll need to define a client PIN and in some cases alter your operating system's security preferences, but that's about it. The computer will be added to your remote devices list. The obvious limitation here is that if you're helping someone remotely, you don't necessarily want them logging in to your account. That's where screen sharing (with control), aka Remote Support, comes in.

For screen sharing, all you need to do is direct the person you're helping to fave.co/3NouXdr, have them generate a code, then follow the installation instructions to add the extension to the browser. To reiterate, CRD requires Chrome.

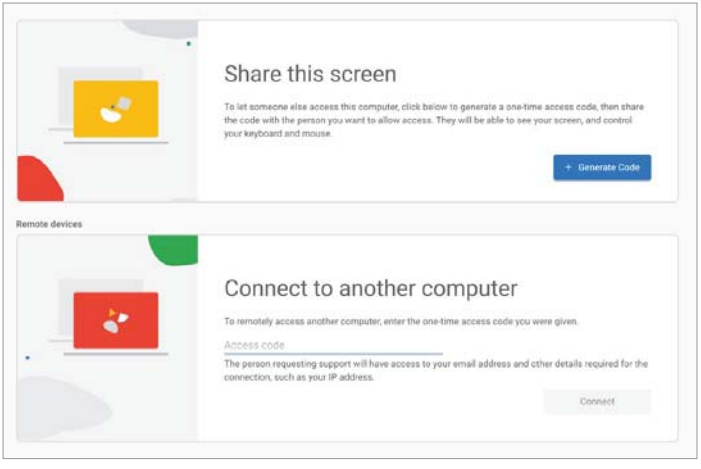
They then provide you with the code, and you can use the "Connect to another computer" function to log on and control their desktop—assuming, of course, that you've installed the Chrome extension yourself.

One thing that might affect some users is Chrome Remote Desktop's lack of support for multiple monitors. If you're doing small-scale IT, trust me, this can bite you. I used to occasionally support an entire small office of users brandishing multiple displays.

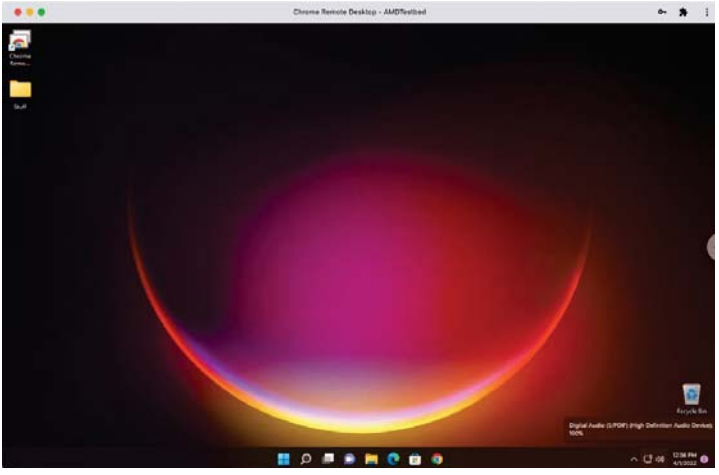
Continually asking them to drag the program to the main screen was simply not tenable. Thankfully, there are other solutions that support multiple displays such as TeamViewer (fave.co/3MzWBUw), GoToMyPC (fave.co/3LA2XSV), and so on.

PERFORMANCE

Controlling a computer over the internet was a surprisingly agile experience. Of course,



There are two parts to gaining one-off remote access to another's computer: First they must generate a code, then you must enter the access code from your end to connect.



Controlling a Windows 11 desktop from macOS. Any OS that Chrome supports is game for Chrome Remote Desktop.

I've been doing this since the days of DSL and dial-up, so everything seems fast now. Google never answered my query to confirm this, but judging by the performance on the local network, data was not flowing exclusively through Google's CDR portal but rather seeking the shortest path through the local switches.

The only issue I encountered—an exceedingly minor one—occurred after I was controlling a 5K iMac from a 1080 PC. Upon arriving back at the iMac, fonts and details were fuzzy. I had to reset the display scaling to recapture their former clarity.

This being a Google product, I'm also compelled to mention the company's privacy policy—which is basically that you have none. That's the flip side of so many "free" products, and Chrome Remote Desktop is no exception.

FAST AND FREE

Still, there's simply no getting around Chrome Remote Desktop's ease of setup and use, speed, basic feature set, and cross-platform availability. That's not to mention the fact that there are no limitations on sessions, session length, and so forth. All in all, this is good stuff from the tech giant in Mountain View (and soon San Jose), Calif.

Chrome Remote Desktop

★★★★½

PROS

- Free with Google account and Chrome browser (on any OS).
- Easy to install.
- Permanent remote access.

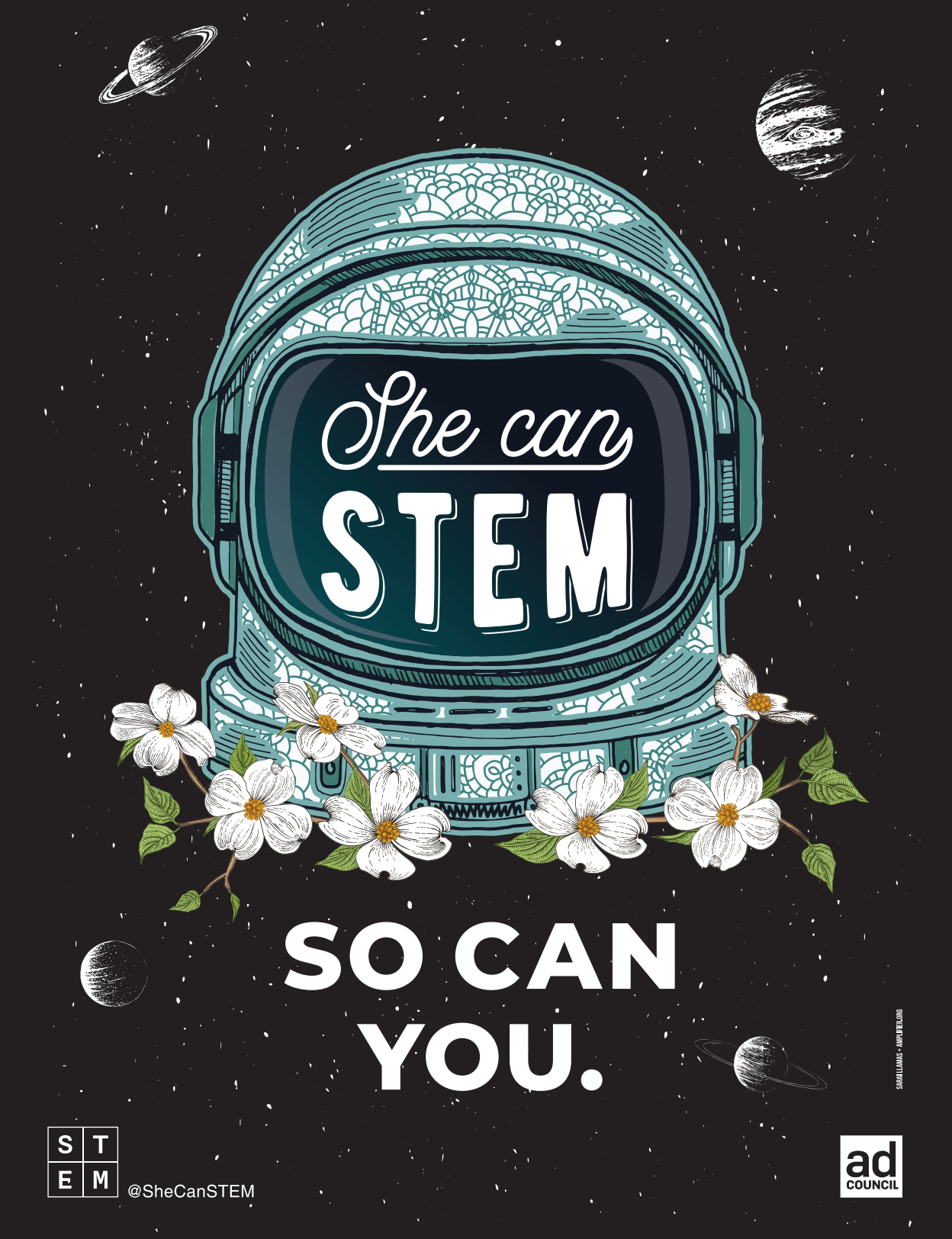
CONS

- No chat function.
- No multiple-display support.

BOTTOM LINE

Fast and free, Chrome Remote Desktop is available on any operating system that supports the Chrome browser, including, of course, Chrome OS. It supports both unattended access and one-off screen sharing, but lacks a chat function and support for multiple displays.

Free


She can
STEM
SO CAN
YOU.
S T
E M
@SheCanSTEM
ad
COUNCIL

DEEP INSIDE INTEL'S NUC:

WE VISITED INTEL'S LAB TO LEARN THE SECRETS OF TINY COMPUTING

INTEL CELEBRATES 10 MILLION NUCS—AND HAS A PLAN FOR THE NEXT 90 MILLION.

BY MATT SMITH

There's a neat symmetry to the 10th anniversary of Intel's NUC, which was first revealed to the world in 2012. In ten years the NUC group (which stands for Next Unit of Computing) has sold over 10 million of its unique miniature PCs.

If that surprises you, brace yourself: Those devices are split across a jaw-dropping 600 configurations. The scope and selection of NUC flies under the radar of even PC enthusiasts, who know NUC best for its eye-catching but relatively modest line of pint-size powerhouses.

"That's just the tip of the iceberg," said Brian McCarson, vice president and general manager of Intel's NUC group. "We're just getting warmed up."

FROM CONCEPT TO REVOLUTION

The NUC began with a simple concept. What if a desktop computer was just…smaller? Like, really small? Small enough to fit in your hand? The fact this idea no longer seems strange is testament to the NUC's success—but in 2012, it was a bold concept.

PC makers had dabbled in ultra-compact design with netbooks and other, more unusual portable machines, like Sony's Vaio P-Series subnotebooks (fave.co/3wrxDRD). Yet it wasn't clear how this could apply to the desktop.

The limitation wasn't processors, which packed ever-more power into decreasing thermal envelopes, but design. The desktop segment remained focused on boxes built

The classic 4×4 is still Intel's most iconic NUC design.

around ATX motherboards and socketed CPUs. Laptops, netbooks, and subnotebooks proved it was possible to deliver useful performance in a much smaller form factor, and a team of engineers began investigating how mobile hardware could be applied to a desktop design.

The Hades Canyon NUC (front left) marked a departure from prior designs.

Their efforts led to a design the team internally calls the 4×4. "It's 4 inches by 4 inches, on the board. That's where it all started," said Kristin Brown, commercial segment director.

The first 4×4, launched in early 2013, was born from an internal tug-of-war (fave.co/3LrxXnR). Intel's marketing department wanted it impossibly slim; the engineers wanted to balance size with performance and serviceability. The two sides came to battle packing foam stand-ins of the ideal shape. Eventually, the possibilities were whittled down to the 4×4.

For enthusiasts, the classic 4×4 remains NUC's most iconic design. It's put on some girth over the years as the NUC team added new models with quicker hardware; Core i5 and i7 models came in 2015, followed by a model with Intel Iris Pro 580 integrated graphics in 2016. Still, these were just thicker versions of the 4×4 form factor. Take a quick trip to Intel's NUC website (fave.co/3wEba2F) and you'll find the 4×4 models still hog the spotlight.

Things changed in 2018, when Intel and AMD formed an unholy alliance to integrate Radeon graphics alongside a handful of Intel mobile processors. These processors, known as the Intel 8th-Gen Core G-Series, were meant to help Intel shore up its weak graphics performance in thin powerhouses like the Dell XPS 15 2-in-1 (fave.co/3wJclVg) and HP Spectre x360.

The NUC team saw an opportunity. "When Intel went down the path of partnering with AMD, it was the first time we went, oh, this is a super interesting way to build the smallest possible gaming device," said Faisal Habib, enthusiast segment director.

This led to Hades Canyon. A successor to Skull Canyon, which featured Intel Iris Pro graphics, it packed a quad-core processor and up to 24 Radeon Vega compute units and delivered performance similar to a gaming laptop with GTX 1060 graphics (fave.co/382YWbO). It didn't look like prior NUCs, with its thicker and wider chassis and a glowing skull on the lid, but it still measured less than 9 inches wide and 6 inches deep. That's smaller than Nintendo's Wii U game console.

I purchased a Hades Canyon NUC and use it to play PC games on my TV, a task that suits it well. But Hades Canyon—as well as its successor, Phantom Canyon—are also popular with a very specific enterprise customer.

"We've seen some interesting usages for it, from an internet cafe perspective, and even an eSports hotel perspective," said Habib. "That concept is driving some of these products, because they love the fact you can put it in a hotel room and game in a small space." The Hades and Phantom Canyon NUCs also proved popular with those who need a small PC capable of driving numerous high-resolution displays.

Hades Canyon opened the door to a new generation of larger, more capable NUCs. Powerhouses like the most recent Dragon Canyon (fave.co/38BkEnu), which can deliver up to a Core i7-12900, are meant to turn heads—but they're not the only reason NUC has remained relevant for a decade.

NUC'S SECRET SUCCESS

The NUC group's success is unusual. Tech giants like Intel are notorious for spinning up wild ideas that die after a few years. Remember Intel OnCue? Or its 5G modem business (fave.co/3IqShLr)? What about the company's SSDs (fave.co/3MtIwZ5)?

PC fans might peg the NUC's success on its flashy enthusiast projects, but it's enterprise and business-to-business clients, not gamers and content creators, that drive the bulk of NUC's advancements. Developers, researchers, and academics are among NUC's most dedicated fans. A NUC might be less powerful than a full-size desktop but, for many, performance is not the sole concern.

"There was a guy I worked with who I still keep in contact with, and he was infamous for being the guy with 26 NUCs on his desk," said McCarson. "This wasn't a requirement, he wasn't asked to do that. It was just that they're so small, so compact, so efficient, so easy to plug in."

A NUC is small, sips power, generates little noise or heat, and is relatively inexpensive, all of which means developers can deploy NUCs as single-purpose machines. This approach eliminates a central point of failure and lets developers side-step changes to system software or hardware that might impact a workstation handling numerous projects at once.

The NUC group is serious about reliability and efficiency. During a tour of the group's

This NUC uses a Compute Element for less compact but more modular design.

test lab at the Hawthorne Farms campus in Hillsboro, Oregon, I was shown a series of "bento boxes" used to test dozens of NUCs at a time. Named after Marc Bento, a technical marketing engineer who designed the boxes during his internship, they can be used to rigorously test NUC samples to hunt down bugs or stability issues.

The NUC group is proud of its reputation for reliability and more than once reminded me of NUC's three-year standard warranty, a sign of confidence in an industry that often provides just one year of coverage.

This doesn't just apply to the more well-known 4×4 NUCs, either. The group has expanded to a variety of models including passively cooled and ruggedized NUCs.

Perhaps the most interesting is Intel's Compute Element, a successor to Intel's Compute Card (fave.co/3wt5YQq).

Though it no longer slots into a convenient external connector and lacks the futuristic look of the Compute Card, the Element delivers up to 12th-gen Core i9 processors in a package that's barely larger than a credit card.

"People love small compute, but in a world where we required the receiver to be exactly what we sold, it was too confined," said Brown. "They didn't want to always use the exact box we have. So we simplified it into the Compute Element, and started giving people building blocks."

This takes the modular design of Beast Canyon and Dragon Canyon to a new level. While NUC sells boards for the Compute Element, users can also design their boards to precisely fit their size and I/O requirements.

"[NUC is], for the most part, these invisible solutions all over the place. Almost every fast-food restaurant you go to has a little touch screen; if you pop open the back, you'll see a NUC in there," said McCarson.

And it's not just fast-food kiosks that could be a NUC in disguise. Intel also provides NUC hardware to OEM system

builders that need a simple, affordable way to offer a small machine.

"About 80 percent of our sales is actually as white label 'ingredients' for machine builders," said McCarson. "They love taking our board-level solutions and knowing they just have to drop their own shell on top of it."

While McCarson declined to name names, he hinted these "white label" NUCs appeal most to smaller OEMs lacking the resources to build an entire miniaturized desktop design from the ground up.

MORE POWER, MORE PROBLEMS?

It's clear that McCarson, who was promoted to his role as vice president and general manager of the group just last year, wants to take NUC to a new level. That enthusiasm will be needed, as NUC's technical challenges are likely to grow in the coming decade.

Enthusiasts know this problem too well. Top-tier hardware is growing in size and power consumption, requiring larger, more elaborate cooling systems, not to mention power supplies that deliver 1000 watts or more.

It's this trend that forced NUC's enthusiast group to rapidly expand the size of its quickest machines. The latest enthusiast NUC, Dragon Canyon (fave.co/38BkEnu), is only slightly smaller than a Mini-ITX PC case like the Lian Li Q58.

"When we started we were doing these graphics cards," said Faisal Habib, enthusiast segment director, pointing to an older Nvidia Quadro card about 6 inches long. "But then graphics cards began to be bigger, and we can't actually fit it anymore. We had to go and work with that with Beast Canyon, which became bigger, and it was great.

"But then Nvidia said, no, we're going here." Habib gestured to a massive Nvidia's RTX 3090 on the table. "And again, that doesn't work."

To some, the growth of the largest NUCs might seem a betrayal of the hardware's core mission, and I pressed McCarson on this point. He sees it another way.

NUC's Compute Element can fit into prepackaged boards or custom hardware.

"NUC is now taking on shrinking bigger and bigger boxes," said McCarson.

He admits that enthusiast NUCs are growing in size and power requirements, and this is likely to continue in the future. But he points out that larger NUCs still deliver an improvement over conventional PCs when they, too, are also growing in size and power consumption. "You can have more sustainable, have smaller, higher quality, and not trade off on performance," said McCarson. "But it takes exquisite engineering."

The ever-increasing size of PC graphics cards is a challenge for NUC's enthusiast group.

That engineering takes the form of modular design centered on a baseboard with a PCIe x16 slot. This idea, which arrived first in the Ghost Canyon NUC, works alongside Intel's Extreme Compute Elements, which connect over PCI Express. This can be found not only in enthusiast NUCs but also third-party desktop PCs, such as Razer's Tomahawk (fave.co/3FY8ls4), and cases, like the Cooler Master NC100.

"We don't necessarily care about NUC being visible if we're helping to drive innovation for our partners, or the industry, that's awesome," said Bruce Patterson, marketing communications manager. "A consumer may not know that a chassis has a NUC Element in it. They just say, oh, this has a Core i9, it's a cool-looking chassis. I'm happy."

Even a standards-based approach has risks, however, as standards change over time—and Intel has plans to alter the baseboard used for recent enthusiast NUCs.

"We expect change to come soon. There's been a lot of feedback from customers about what they want to see better," said Habib. "A lot of the conversations we are having right now are about how we can reduce the number of cables in this box, and we're wondering if we can run more of this through the baseboard."

Intel's Arc discrete graphics (fave.co/3lf4i6Q) is also on its way, though the details on how it might be implemented in the NUC remain sparse.

"We're of course working closely with the Arc team," said Patterson. The NUC team was especially coy on this point, as no one in the room wanted to steal the Arc team's thunder.

Whatever form Arc takes, it may not be a closely integrated, on-board solution. NUC's enthusiast team has looked at this option for a variety of desktop graphics cards, including those from AMD and Nvidia. In theory, this might repeat the success of Hades Canyon—but the team prefers to take a standards-based approach.

"We've explored some ideas, like taking the desktop class graphics chip and soldering it down. Maybe there's other ways of cooling it. But we don't think that's the right path," said Habib.

He points out that while this might make enthusiast NUCs slightly smaller, it's not a cheat code, and cooling a soldered desktop GPU with a TDP in the hundreds of watts would remain challenging. The flexibility of a standards-based approach, on the other hand, opens up options to turn up performance for the most demanding workloads—or stick to more efficient hardware for less onerous tasks.

TO THE NEXT 90 MILLION NUCS

Despite these hurdles, the NUC group looks toward its next decade with a sense of optimism. The lessons of the last decade have provided the group a template for designing NUCs not just as computers but as pillars of design others can buy, use, and build from.

"We want to take reference designs a step further and show not just the art of possible, but the art of possible at scale," said McCarson. "It's one thing to do a one off. It's another to do it in a million-unit quantity."

And he's serious about scale. McCarson mentioned his hopes that we'll be talking about the group shipping its 100 millionth NUC a decade from now. It's an ambitious goal, one he seems confident the NUC group's past experience has prepared it to achieve.

Intel's enthusiast NUCs are growing in size but remain smaller than the competition.


YOU MAKE MONEY.
NOW MAKE IT WORK FOR YOU.
Learn how to save for your retirement at **WeSaySaveIt.org**.
WE SAY $AVE IT
AARP
ad COUNCIL

8 WAYS WINDOWS IS BETTER TH WINDOWS

11 HAN 10

WE'VE TOLD YOU WHY YOU SHOULD HOLD OFF ON UPGRADING TO WINDOWS 11. THIS IS THE OPPOSING ARGUMENT.

BY MARK HACHMAN

Windows 11 isn't bad. Yes, we've called Windows 11 "unnecessary," (fave.co/3cdEtj3) and we still feel that the average person has no need to make the transition to an unfamiliar, restrictive operating system. But it would be unfair to say that Windows 11 hasn't taken any steps ahead, either—yes, beyond Windows 10. So we're calling them out, right here and right now.

I myself use Windows 11 on a daily basis, as part and parcel of my coverage here at PCWorld. As part of our "Windows 11 at six months" (fave.co/3rARUIb) reexamination of Windows, about the only aspect of Windows 11 that I refuse to use is the Start menu. It's simply poorly organized and offers little value.

I do think that eventually you'll upgrade your PC to Windows 11 if you haven't done so already, so this piece puts a spotlight on some of its best bits. Rest assured that this story isn't trying to list all of the features of Windows 11. Instead, these are the meaningful features that we think justify an upgrade. Our coverage of six new Windows 11 features to try first (fave.co/3Mz5IKW) and how to make Windows 11 look like Windows 10 (fave.co/3G1SpdZ) may also be of interest if you decide to take the leap.

A PRODUCTIVITY-FIRST APPROACH

There is absolutely no way that anyone would try to work on an Xbox. That means that Microsoft can design its game console for games, with an interface, Game Pass subscription service, and Auto Resume features all designed to buy, play, and resume games as quickly as possible. Let's face it: On the Xbox, the Edge browser is an afterthought (and a real pain to use, incidentally).

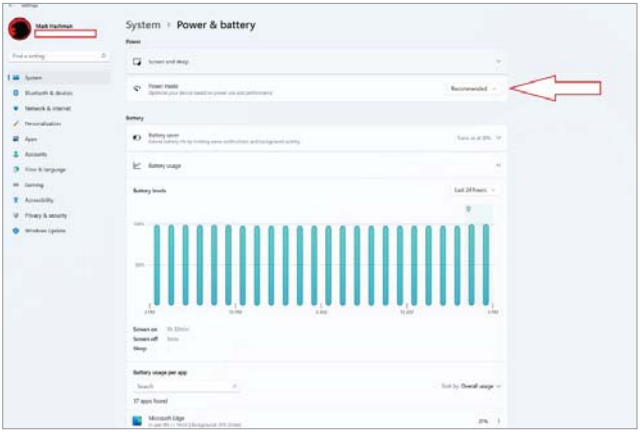
Windows itself suffers from a fundamental dichotomy: It's an operating system for work and play. Windows 10 leans more toward fun, and Windows 11 feels optimized for a work environment. Why? Microsoft CEO Satya Nadella said it best: Windows is the "socket" for Microsoft subscriptions (fave.co/3Nn7etT), and the most lucrative subscription is Microsoft 365, *née* Office. Windows 11 was therefore designed around Microsoft 365.

That's more than a little cynical, but okay. If the Start menu wasn't so useless,

The Windows 11 Taskbar.

suggesting documents to work on wouldn't feel obtrusive. Creating a rather staid row of icons along the Taskbar and Start isn't fun, but it helps you focus. I support that—after all, I argued that no one really wants to deal with distracting animated emoji (fave.co/3NIaINC) in Teams.

Microsoft's chief product officer, Panos Panay, tends to introduce new Surface devices in the context of "flow" and "focus," and the redesigned Clock app's "focus time" (fave.co/3n4ZuBp) reflect the reality that Microsoft is thinking hard about such things. As a consumer, I think it's worth pushing back against this idea of "business first, fun second," but you can't deny the earnestness of Microsoft's efforts to help you become more efficient.



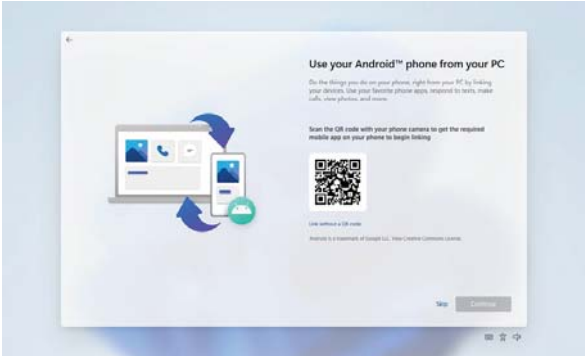
The Windows 11 Settings app hides a number of useful little informational goodies.

THE SETTINGS MENU

It's probably fair to say that most people don't buy an operating system to tinker with it under the hood. But if you do need to dive into the Settings menu for a tweak, the design of new Windows 11 Settings menu certainly makes it easy to find what you need, make the change, and get out.

Settings not only uses the standard Windows 11 sidebar navigation to jump back and forth, but a new navigation system on the top of the screen allows you to move up and down a level quite easily. Each subsection also includes its own summary screen, with its own graphical elements, so that Network & Internet shows what network you're connected to and how much data you've used at the top of the screen.

Windows also uses a number of visual elements to allow you to dive down even further, with drop-down menus, buttons, and caret menus leading deeper into the Settings menu. Most if not all of these are appropriately labeled, so that a submenu like Settings > Bluetooth & devices > Cameras tells you that you'll find connected-camera settings and default image settings the further you go. Microsoft is slowly making the legacy Control Panel obsolete.



I love Windows 11's out of the box experience. Aside from the obligation to add a Microsoft account, it's one of the most cohesive parts of Windows 11. Here, you're asked to set up your phone link (and you should).

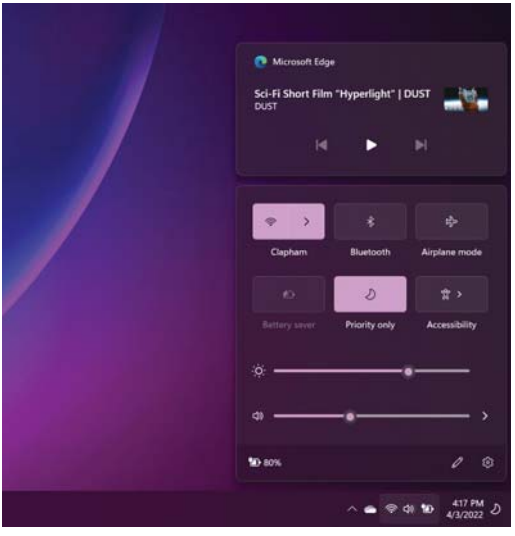
THE OUT OF THE BOX (OOBE) EXPERIENCE

Windows 11 offers a fantastic experience out of the box, with an efficient startup process that visually introduces you to the Windows 11 look and feel while walking you through what Windows is doing and what information you'll need to provide to help it on its way. It's also an easy way to instantly set up your new PC with Office apps (provided you have a Microsoft 365 subscription), and it also facilitates connecting to your Android phone via Phone Link (formerly called Your Phone).

Yes, you'll need to enter a Microsoft account to proceed, which some won't be happy about. But for anyone who's complained that Windows 11 is still something of a hodge-podge of various operating systems past, the OOBE belies that completely. If most users were polled about their attitude toward Windows 11 right after setup, my guess is that Windows 11 would have a higher approval rating than it does.

THE ACTION CENTER

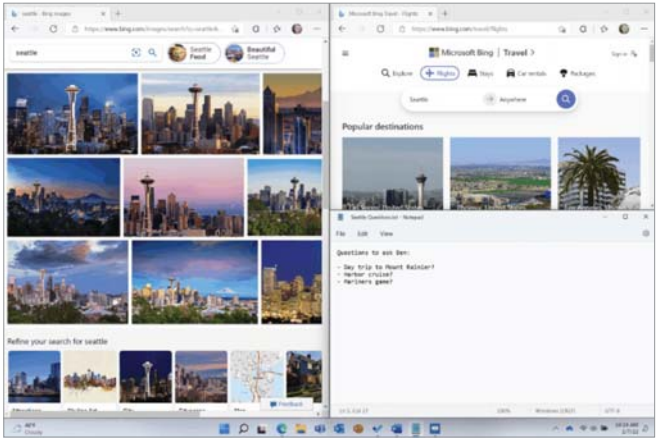
I've come around on the Action Center, the small collection of controls that lives in the bottom right corner of your primary display. I still don't like how nonintuitively the Action Center trigger is framed within Windows 11; in Windows 10, all of the corner icons are essentially one collective "button" that you can click to open the Action



The Windows 11 Action Center is compact, coherent, and unobtrusive.

Center. In Windows 11, you have to know that an icon like OneDrive is one button, the clock and date is another, and the Action Center is itself opened by clicking the volume control or battery icon.

A number of people still have quibbles with how Windows 11 represents individual controls. For example, the volume slider doesn't tell you which device is being used for audio unless you click the small caret menu to the right. You can't tweak Focus Assist without opening its corresponding Setting menu. But the Action Center itself doesn't require further, er, action except in a small variety of cases, and it's aesthetically consistent with the rest of the Windows 11 OS. It's a step forward.



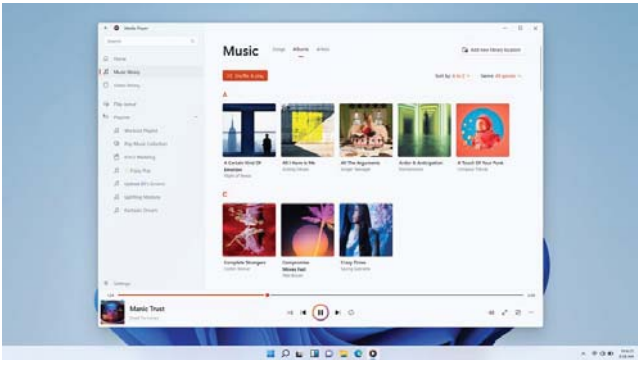
Windows 11's Snap View formatting changes depending on the display, so you may see columns that favor one side or another, rather than the equal proportions shown here. But it's still great.

SNAP VIEW

This has been a small but important improvement to Windows 11 since the beginning, especially important as (hopefully!) more and more people move to multiple large external monitors (fave.co/2Zazegw) in addition to their primary display. The improved Snap View allows you to snap your window by hovering over the traditional "full screen" icon in the upper right corner of the window, and then choosing which of a small number of templates you'd like the window to fit into. You can use the remainder of your display to house the other windows.

Let's be fair: Sites like PCWorld.com are designed to accommodate smaller displays, and there's a lot of extra white space to the left and right that can be used for ads or left blank. Snap View can be an efficient use of that space. About the only thing Microsoft didn't seem to anticipate with Snap View are ultrawide monitors, which might benefit from three or four vertical columns rather than the default two.

Windows 11 also removed Timeline (to the chagrin of some [fave.co/3BSSuxL]), which makes the whole experience cleaner.



It's not earth-shattering, but yes, the new Media Player app is cool.

THE NEW WINDOWS MEDIA PLAYER

I'm not convinced that many of the updated Windows 11 native apps (fave.co/3n4ZuBp) represent improvements, per se—just visual updates and/or reorganizations. Windows Media Player is more than that—it's a genuine step forward, at least for this specific app. With Groove Music's retirement (fave.co/3MuLnRv), Media Player has stepped in to play back audio *and* video, and there's even a long-awaited equalizer, to boot. The new Media Player is not part of Windows 10.

Yes, enthusiasts are going to ask: Is it as good as the iconic play-*everything* VLC app (fave.co/3LBk8n6)? No, it's not. But while VLC will seemingly play just about every codec under the sun, Microsoft has focused on the most common formats…well, we think. We've never found a list of file formats specifically supported by the Windows 11 Media Player app.

ANDROID APPS

Android apps on Windows 11 (fave.co/3yUjpKG) are a bit of a gimmick in that you're limited to a limited number of apps from the Amazon Appstore, at least for now. Chances are you already own an Android phone (and can load those apps on your phone) or an iPhone, meaning you might not care.

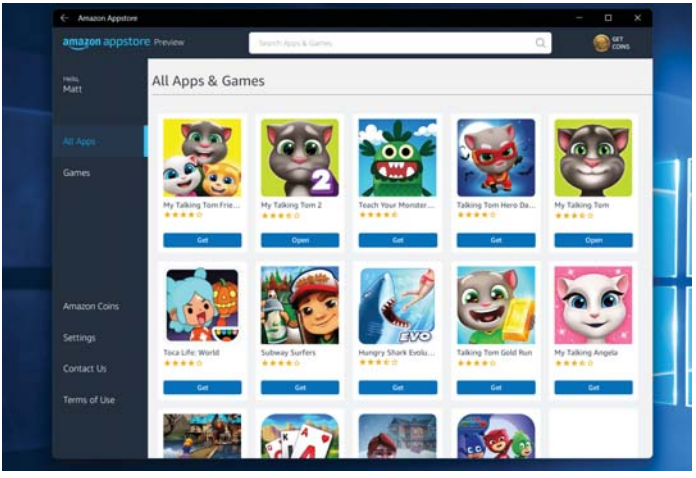
Android apps are a bit like the Linux apps (fave.co/3j8RNJe) that Microsoft enables as part of the Windows Subsystem for Linux. They have specialized purposes, which might be attractive to those who don't want to hunt down a webpage or app. But the potential is there to improve this, if Microsoft and its partners choose to. How that's managed, and what specialized advantages that might offer, however, have yet to be seen.

DIRECTSTORAGE AND AUTOHDR

We've been burned before by Windows features that either didn't deliver or simply never showed up (fave.co/3PAdHE2). But we're cautiously optimistic about DirectStorage, which could promise some extremely meaningful reductions in game load times for those with both the hardware and Windows 11. To be clear, DirectStorage is available on Windows 11, but there isn't a

single publicly released Windows game that supports it at press time.

Still, DirectStorage appears to be a relatively safe investment, in that Microsoft would be a fool not to push this as hard as it can. Windows gamers are Windows enthusiasts, and if that bloc embraces Windows 11, it could well be a tipping point for the OS—though Windows 10 will also support DirectStorage (fave.co/3DM75eO), albeit to a lesser extent. Auto HDR, a Windows 11 feature that lets older games simulate HDR visuals to great effect (sometimes) (fave.co/3MfSTPv), could also become a very enticing cherry as HDR monitors become more common (fave.co/3qP3f19).



The number of Android apps you can download is limited in Windows 11.

SOME 'NEW' FEATURES AREN'T NEW

No one asked for Windows 11. Microsoft let consumers believe that Windows 10 would be the "last Windows," and technology enthusiasts met the emergence of Windows 10X and its transition to Windows 11 with perplexed expressions. That same attitude applies to some of the changes made to Windows 11, which hearkens back to our "unnecessary" characterization. We're not going to tell you that the fixed Start menu is worth upgrading for, for example, or Teams Chat. Others, like Windows dictation, already appear in Windows 10, as does the nicely revamped Microsoft Store app. Widgets, too, is just a slightly expanded version of the News & Information feature that's on Windows 10 as well.

What we've shown you above are some of the real differences between Windows 10 and 11. We'd absolutely encourage you to take a hard look at Microsoft's newest OS if you haven't done so already. And if you're still a little nervous, don't be! Check out our story on how to roll back from Windows 11 to Windows 10 (fave.co/37YDyUO)—we'll show you what to do and how quickly you need to act.

>> How a silver lining forms

>> It starts at sea.
>> Tropical waters heat up.
>> Warm air soars skyward.
>> Cold air rushes to the void.
>> Cold air warms up.
>> Cycle repeats.
>> Faster and faster—a 50,000 foot engine of air.
>> At seventy four miles per hour it earns a name.
>> Harvey, Irma, Katrina.
>> Then landfall.
>> Roads rendered useless.
>> Buildings destroyed.
>> Families stranded.
>> But for a brief moment,
>> A silver lining appears.
>> People see neighbors instead of strangers.
>> And labels that divide are forgotten.

>> But when rains ease,
>> when clouds part,
>> silver linings need not fade.

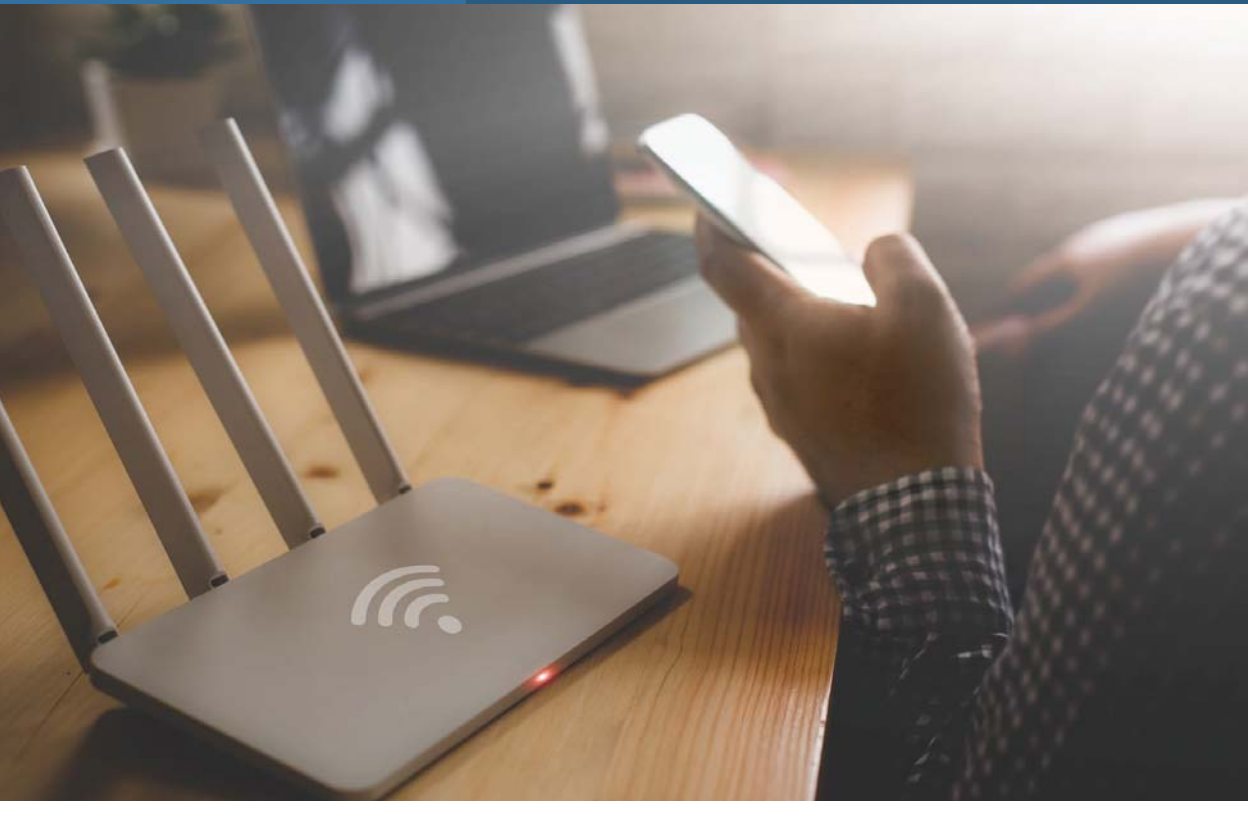
>> Let's embrace our shared humanity.
>> Let's connect with one another.
>> Let's find our love for each other.
>> Every single day.

>> Come together at lovehasnolabels.com

love has no labels

ad COUNCIL

29.7604° N, 95.3698°, W SFC 134



Wi-Fi problems? Here's how to diagnose your router issues

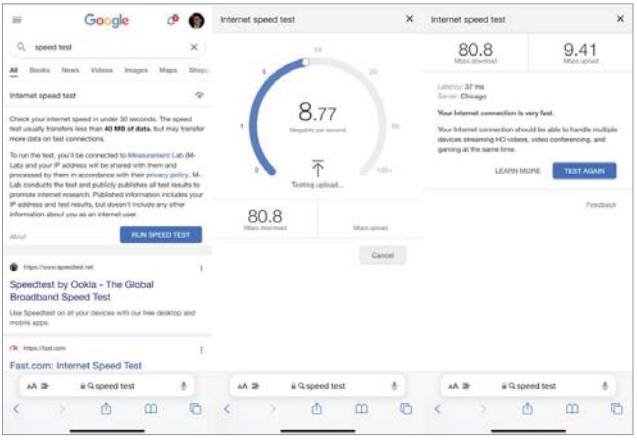
From sizing up the problem to exploring smaller fixes, you should explore various solutions before buying a whole new router. **BY JARED NEWMAN**

Whenever someone sends me a question about how to fix their Wi-Fi, I wince. It's not that I dislike helping people with their router problems. In fact, there are few geeky endeavors I find more rewarding than fixing Wi-Fi connection issues at a friend or family member's home.

But Wi-Fi has always felt more like a dark art than a science, and it's an art that's hard to conjure without being physically present. Potential points of failure are everywhere, and what works well in one home might not in another. Even the reviewers of networking gear can reach drastically different conclusions about the very same product.

IMAGE: CASEZY IDEA/SHUTTERSTOCK

Wi-Fi is fundamentally at odds, then, with my desire to answer questions with specific recommendations. The best I can do is walk you through how I diagnose Wi-Fi problems myself. That way, you can make better decisions on whether (and how) to upgrade your own gear.



Running speed tests throughout the house can help you figure out where the Wi-Fi trouble spots are.

SIZE UP THE WI-FI PROBLEM

The first step to solving Wi-Fi issues is to see if the slowdown is coming from your cable modem (which brings internet service into the home) or from the router (which distributes Wi-Fi connectivity throughout the home).

Start by plugging a computer directly into your modem with an ethernet cable and running a speed test. (The easiest way is to do a Google search for "speed test," then click the blue "Run Speed Test" button atop the search results.) A USB-to-Ethernet adapter (fave.co/38Atwtq) will be necessary for testing on computers that don't have an ethernet port, but if that's too much trouble or you don't have a proper computer at all, you can also try calling your internet provider and asking it to test your internet speed remotely.

If wired connection speeds are on par with your internet provider's advertised speeds, the next step is to start running speed tests throughout the house. Measure speeds around the area where connectivity feels slow, then work your way back to where the router is located, running multiple tests in each area as you go.

The goal here is to figure out where your connection troubles are occurring. Consistently slow speeds throughout the house may be a sign of an outdated router, while dead zones or range issues may require a more powerful router or mesh Wi-Fi system (more on that shortly).

FIND YOUR WI-FI ROUTER'S 802.11 VERSION

To figure out whether a router needs replacing, it helps to know how old it is. One way to do this to locate the router's model number—it's likely printed on the router

itself—then search the web for info about which version of Wi-Fi it supports. Here are the major Wi-Fi versions to know about:

802.11a/b/g: Extremely old and almost certainly the source of all your Wi-Fi problems.

802.11a/b/g/n (or just 802.11n): Outdated at this point and a solid candidate for replacement. Many of these routers only support a single frequency band that's slower and more congestion-prone, and "dual-band" variants have limited range on the faster 5 GHz frequency band.

802.11ac (also marketed as Wi-Fi 5): This is not the latest standard, but it's still widely available even in some high-performance routers.

802.11ax (or Wi-Fi 6): Routers using this standard started shipping in late 2020, so your router is likely quite new.

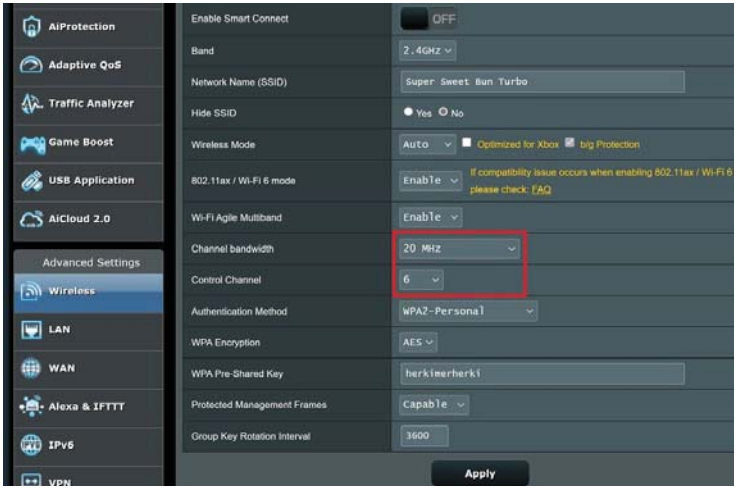
Wi-Fi 6E: Congrats, you probably just bought a new router (and maybe even spent $1,200 on it [fave.co/384decg]).

Wi-Fi versions alone aren't an indicator of quality—a cheap Wi-Fi 6 router can be worse than a high-end mesh system with Wi-Fi 5—but each successive version has introduced new features that improve connectivity, and we've generally seen a push toward better performance over time.

TRY SOME SMALLER ROUTER FIXES

Just to rehash a tip I discussed back in July (fave.co/3wsL2Jn), sometimes changing your router's channel and bandwidth settings can work wonders for reducing Wi-Fi interference, especially if you're seeing inconsistent speeds on devices that aren't too far from the router. By digging into the router's settings, you can bypass automatic channel selection and find a channel that might be less congested.

You can also try some other little tweaks, like getting your router off the ground and



Changing your Wi-Fi channel and bandwidth can make a big difference.

clearing some space around it—but I wouldn't start rearranging your room for the router's sake. Chances are the improvements will be minimal. Of course, moving your router to a more central location in the home can help, but that would likely require having the cable company come out to rewire your home internet connection.

WI-FI EXTENDERS: A LAST RESORT

Because replacing a router is a pain, a lot of folks wonder if they can just solve their problems with a Wi-Fi extender or repeater (fave.co/3wtYYD4), which take the wireless signal from a router and rebroadcast it farther away. ("Extender" sometimes refers to a device with a wired connection to the router, though I often see both of these terms used interchangeably.)

My experience with Wi-Fi extenders is hit or miss. Wireless repeaters will always degrade whatever signal they receive, so the benefits can cancel out if you're trying to address a dead zone or interference from other nearby wireless devices. The same is true with powerline adapters (fave.co/3Inj5My), which send a wired ethernet connection from your router to another part of the house through your wall outlets. Depending on how your house is wired, this approach can give you a weak connection or not work at all.

An extender can help squeeze more range out of your router, but it's not a panacea.

I don't tell people to avoid extenders outright, because they can work in some scenarios, but keep your expectations low and be prepared to return the device if it doesn't help.

PICKING A NEW WI-FI ROUTER

Once you've concluded that it's time to replace your router, then what?

A mesh Wi-Fi system (fave.co/3DXf5d0) will be the surest way to solve your Wi-Fi problems, especially in larger homes or ones with lots of dead zones. These systems let you plug in multiple access points throughout the house, creating one big network. They're better at managing connections than a router with an extender, and systems advertised as "Tri-Band" can connect each access point without congesting the rest of the network.

Such systems might not be necessary, though. If you haven't replaced your router in a while, even a new standalone router (fave.co/3IqbOfa) might be enough to power

through dead zones if they're not too far away. Standalone routers are generally cheaper than mesh systems, and some have features that mesh systems lack, such as USB storage support or a large number of ethernet ports.

A mesh Wi-Fi system will be the surest way to solve your Wi-Fi problems.

Ultimately, though, there's no way to tell for sure if a new router will work without trying it yourself. You can read all sorts of reviews—PCWorld reviews both Wi-Fi mesh systems (fave.co/3DXf5d0) and the latest Wi-Fi 6E routers (fave.co/3IqbOfa)—but even the best advice isn't one-size-fits-all. Buying a new router will always involve a leap of faith.

A NOTE ON MODEM/ROUTER COMBOS

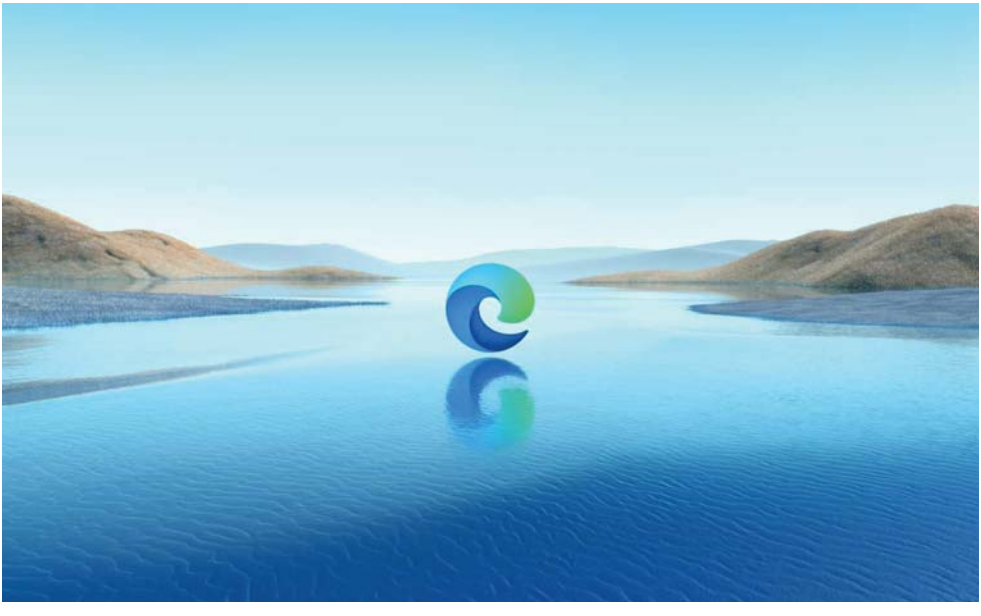
Finally, there's one more complicating factor: Although cable companies used to distribute internet modems and routers separately—the former bringing in the internet from outside the house, and the latter to distributing Wi-Fi through the home—it's increasingly common now to get both functions in one box. That makes installation easier for the cable company, but makes router replacement trickier for you.

If you have a combo box and are paying for it in rental fees, consider replacing it with two devices: a new router and a separate cable modem (fave.co/3IlkTWF). But be aware that some companies—particularly fiber-optic internet providers such as AT&T and Verizon—make replacing the modem component difficult or impossible.

If replacing the modem isn't possible or necessary, you can just disable its Wi-Fi features so they don't interfere with your new router. The instructions for doing so can vary by provider, so expect to do some Googling of "modem mode" or "bridge mode" plus the name of your internet provider.

How to Use Internet Explorer Mode in Microsoft Edge

Kick it old school. **BY MARSHALL GUNNELL**



Microsoft has been gradually edging away from Internet Explorer for years now. The company has instead been pushing the growth of its faster and more secure web browser, Microsoft Edge. In fact, Microsoft is officially retiring Internet Explorer (fave.co/3DVLdhl) on June 15, 2022.

There's no need to worry about those old sites (fave.co/3FXBhpy) that don't work well on modern browsers, though. Microsoft Edge includes a feature called Internet Explorer Mode. This feature was primarily designed for businesses that need to load internal sites without having to update or redesign them, but it also works for the average person just wanting to experience older sites that haven't been updated for modern browsers.

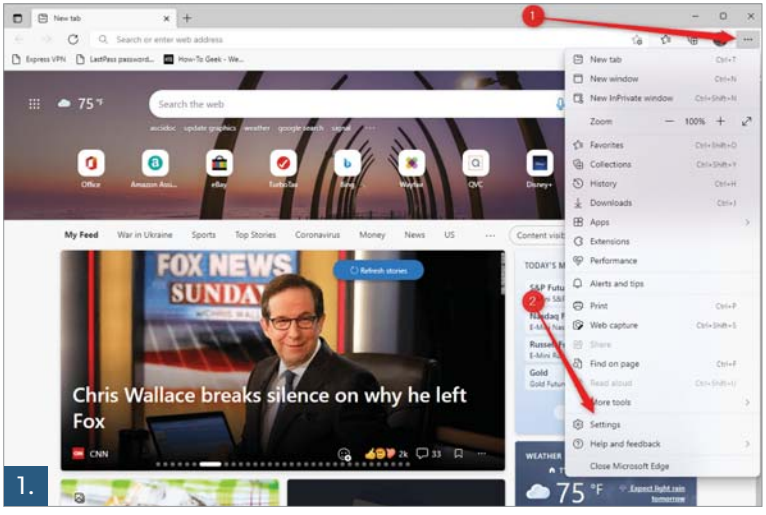
To use Internet Explorer Mode in Edge, launch Edge and click the ellipsis (…) button in the top-right corner of the window. In the

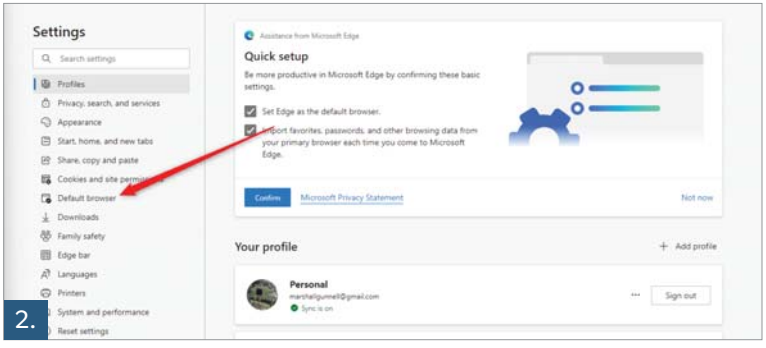
IMAGE: MICROSOFT

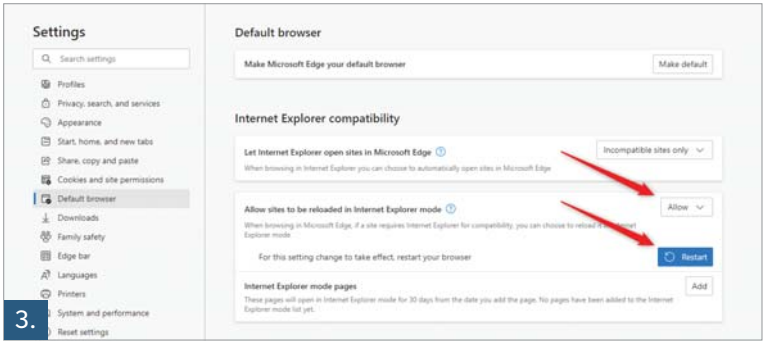
drop-down menu that appears, select Settings (**1**). Next, click "Default browser" in the left pane (**2**).

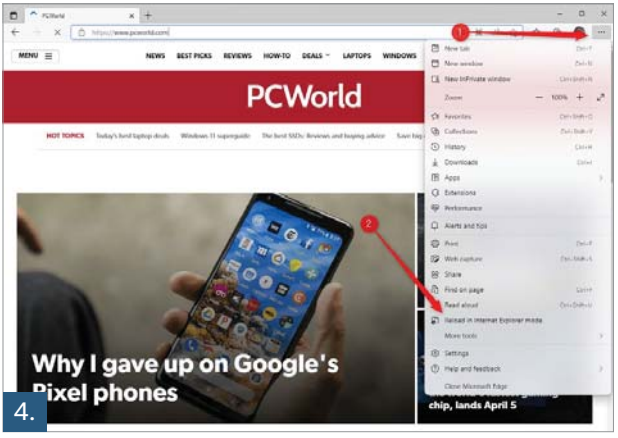
You'll now be on the Default Browser Settings screen. In the Internet Explorer Compatibility group, set the "Allow sites to be reloaded in Internet Explorer mode" option to Allow. You'll then need to restart your browser by clicking the blue Restart button for the changes to take effect (**3**).

Once the browser reloads, navigate to the site you want to view in Internet Explorer Mode. Once on the site, click the ellipsis button in the top-right corner of









4.

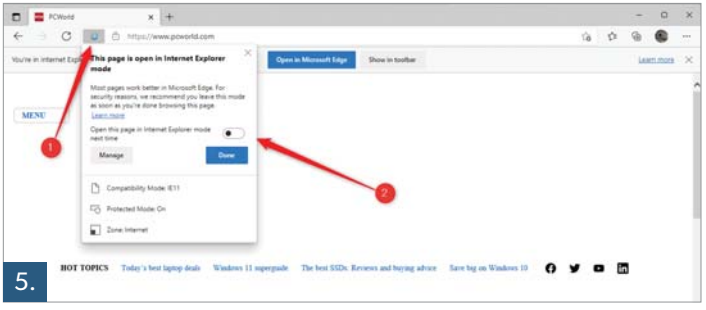
the window, and then select "Reload in Internet Explorer Mode" (**4**).

The page will now reload in Internet Explorer Mode. You'll know that you're actually using this feature if the Internet Explorer logo appears to the left of the URL in the address bar.

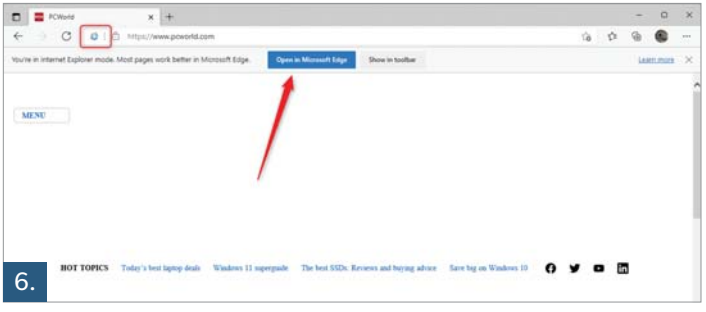
You can also tell Edge to always open this page in Internet Explorer Mode by clicking the browser icon and toggling the slider next to "Open this page in Internet Explorer mode next time" to the On position. If the slider is toggled to the right, it's enabled. If the slider is toggled to the left, it's disabled (**5**).

If you want to open the site in Microsoft Edge again, just click "Open in Microsoft Edge." (**6**)

That's all there is to it. For better performance and security, you should always browse with Microsoft Edge (fave.co/3yTWH5o) (or other modern browsers) when possible. If the site just won't work without Internet Explorer, though, now you'll know how to make it happen.



5.



6.

4 ways to stay safe on public Wi-Fi

You probably used to do these in the Before Times. **BY ALAINA YEE**

Traveling is once again becoming common these days, whether to far-distant locales for a vacation or just down to the local cafe to enjoy the ambiance. That means it's time to bring back old familiar practices, too. Like everything else we're having to relearn (how does small talk work again?), good practices security on public Wi-Fi might need a bit of a refresher.

People can snoop on what sites you access, which is a privacy issue as well as a potential security problem. Here are four quick tips that'll keep you protected while you're out and about.

BE MINDFUL ABOUT WHAT NETWORKS YOU JOIN

Your first line of defense is wisely choosing the public networks you join, especially if you're lax about your other protective measures. Anyone can scan the traffic being passed on a network—they just have to install

IMAGE: MONKEY BUSINESS IMAGES/SHUTTERSTOCK

You should be able to trust the network administrators of an airport's Wi-Fi—but not everyone else on it with you.

a program that captures data packets on their computer. Exchange unencrypted data with a website and your sensitive information goes up for grabs.

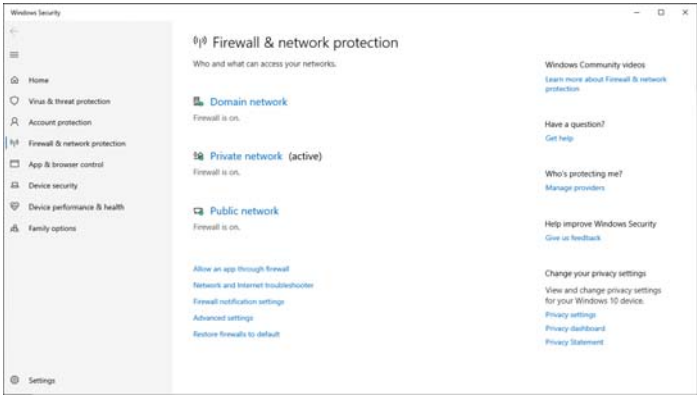
Your main goal should be avoiding open networks that are run by unknown administrators. You want to pass over obvious bad apples. Department stores, hotels, and airports are more sure bets—they don't set up their Wi-Fi for the purpose of spying on the people who use it. (At least, they don't do so for the purpose of sussing out home addresses, credit card info, national ID numbers, and the like.) Also pay attention to the spelling of network names—don't fall for imposters.

Not sure if you're on your location's official Wi-Fi? Most public Wi-Fi run by big organizations immediately ask you to agree to terms and conditions before allowing you onto the network, while savvy small businesses require a password freely shared with patrons.

But since anyone on a network can sniff its traffic, you still need other protections. That's where the remaining three tips in this article come in. And remember, any network accessible by the public counts as public Wi-Fi, even if you have to pay for access (like at hotels or airports).

MAKE SURE YOUR FIREWALL IS ON

Leaving your computer's TCP and UDP ports open is somewhat akin to leaving your home's external doors unlocked and unmonitored. To keep safe from intrusion, you want something that hides those ports from traffic requests—effectively blocking view of the doors, so no one can approach and try the doorknobs. That's what firewall software does.



Firewall set up? You're good to go.

In Windows 10 and 11, your PC should have a firewall turned on by default. But if for some reason you've been fiddling with your settings, ensure that it is still on before hopping on to public Wi-Fi. Just head to your Settings app, then type in Firewall & Network protection into the search field.

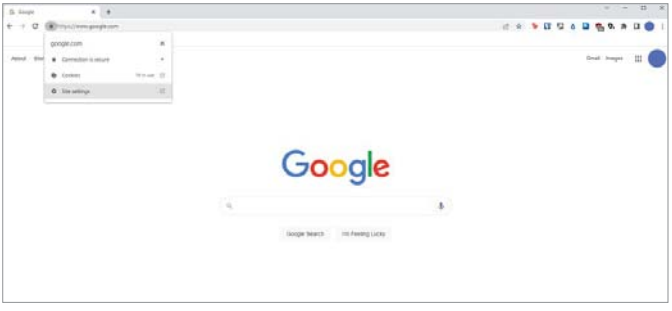
USE HTTPS EVERYWHERE

When visiting websites, make sure they're transmitting data over an encrypted connection. Today's websites should use this kind of secure connection, but some older (or outright malicious) sites won't.

Your browser should let you know when you aren't, but you can manually check as well. Look for *https* at the start of the website address.

If you instead use an unsecured HTTP connection (note the lack of an "s" in the acronym), the traffic exchanged between you and the site can be seen by anyone on your same network. That includes any sensitive info like user names, passwords, payment info, addresses, and so on. (This Cloudflare page [fave.co/3MwOPLp] explains how this works in more detail.)

Obviously, when you're on a public Wi-Fi connection, you're sharing the network with a lot of people who could see what you're up to—and without knowing who among them might have bad intentions. By conducting your browsing over a secure connection, you won't stick out as easy prey.



To see the first part of an address in Chrome, double-click it. Or you can click the padlock icon for the details. Both are shown here.

As added protection, you can install the HTTPS Everywhere (fave.co/3G3ABxk) extension from the Electronic Freedom Foundation. It's available for Chrome, Firefox (fave.co/3LuTcVT), Edge (fave.co/3Ip5HHX), and other browsers, and further minimizes unintentional use of insecure sites.

FIRE UP A VPN

As mentioned above, when you visit a secure website while on public Wi-Fi, other people on your network can't see the details of the data exchanged. However, they *can* see that you're on that site.

If you're using Google or killing time on TikTok, maybe you don't care. But step that up to checking your bank balance on your PC or phone, and suddenly the stakes rise.

Since you can't always wait until you get home to handle certain business, you can safeguard your privacy by routing your PC or smartphone's internet activity through a virtual private network (VPN). To use one, you first connect to the Wi-Fi, then to the VPN. After both those connections are established, you then proceed with your normal internet browsing. All of your traffic goes through the VPN's servers—someone monitoring network traffic will only see your computer sending and receiving data from the VPN, not the sites and services you hit up during that session.

Obviously, you must trust your VPN for this strategy to work. For that reason, most free VPNs don't past muster—they often don't guard your privacy as strictly as a paid service. Stick to vetted services, like those in our best free VPN roundup (fave.co/3wWhXFp). To get better speeds and access to more servers around the globe, you must move up to one of our recommended paid services (fave.co/3FtTTMs). Worldwide servers are important if you're traveling internationally, as you'll want local servers to lean on. Otherwise, having to route your traffic an ocean away and then back again will notably slow down your web browsing.

Using a VPN on your PC or smartphone elevates your privacy on public Wi-Fi.


YOU MAKE MONEY.
NOW MAKE IT WORK FOR YOU.
Learn how to save for your retirement at **WeSaySaveIt.org**.
WE SAY $AVE IT
AARP
ad COUNCIL

Tech Spotlight

A video showcase of the latest trends

Watch the video at youtu.be/kw9AR9cZIAk

I Tried Out 22 RPGs On The Steam Deck

The Steam Deck is an impressive handheld gaming PC, capable of running some of the latest and greatest games at playable framerates for just $400. But some genres are better suited for this device than others. Adam has been busy trying out over 20 RPGs on the Steam Deck to see just how well this hardware can run them.